

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

APPLE INC.,
Petitioner,

v.

SPEIR TECHNOLOGIES LTD.,
Patent Owner

IPR2023-00151
Patent No. 7,110,779

PATENT OWNER'S RESPONSE

Table of Contents

I.	Introduction.....	1
II.	Burden of Proof.....	3
III.	The Prior Art References <i>McCrady</i> , <i>Raphaeli</i> , and <i>Rofheart</i>	4
	A. The Teaching of <i>McCrady</i>	4
	1. <i>McCrady</i> 's General Approach to Range Estimation.....	6
	2. <i>McCrady</i> 's Processing Delays	8
	3. <i>McCrady</i> 's Time of Arrival Estimation	11
	4. Low Resolution Mode and High Resolution Mode	13
	B. The Teaching of <i>Raphaeli</i>	16
	C. The Teaching of <i>Rofheart</i>	23
IV.	Level of Ordinary Skill in the Art.....	27
V.	Claim Construction	29
	A. The Board Should Construe “Estimating a Range ...” to Be Based Upon a “Plurality of Determined Propagation Delays”.....	29
VI.	Grounds 1, 2 and 3 Fail Because the Petition Fails to Motivate its Combination of <i>McCrady</i> with <i>Raphaeli</i>	31
VII.	Ground 4 Fails Because the Petition Fails to Motivate its Combination of <i>Rofheart</i> with <i>Raphaeli</i>	38
	A. The Petition's Rationale to Consider <i>Raphaeli</i> 's Average Calculations in View of <i>Rofheart</i> is Unsupported.....	39
	B. The Petition Identifies No Benefit for its Proposed Combination.....	43
	C. A POSITA Would Have Further Avoided the Petition's Proposed Combination Because the Effects of that Combination Would Be Contrary to <i>Rofheart</i> 's Design Goals.	46

D. The Petition's Combination is Supported Only by Hindsight.	50
VIII. Conclusion	52

Table of Authorities

Cases

<i>Apple, Inc. v. Realtime Data LLC</i> , IPR2016-01737, 2018 WL 1326656 (PTAB Mar. 13, 2018).....	45
<i>DePuy Spine, Inc. v. Medtronic Sofamor Danek, Inc.</i> , 567 F.3d 1314 (Fed. Cir. 2009).....	36, 50
<i>Duo Sec. Inc. v. Strikeforce Techs., Inc.</i> , IPR2017-01041, 2017 WL 4677235 (PTAB Oct. 16, 2017)	45
<i>Dynamic Drinkware, LLC v. Nat'l Graphics, Inc.</i> , 800 F.3d 1375 (Fed. Cir. 2015).....	4
<i>Ex Parte Brillowska-Dabrowska</i> , Appeal No. 2016-006485, 2016 WL 4525004 (PTAB Aug. 24, 2016)	45
<i>Ex Parte Debates</i> , Appeal No. 2020-006536, 2022 WL 263587 (PTAB Jan. 27, 2022).....	44
<i>Ex Parte Masashi Hayakawa</i> , Appeal No. 2020-006550, 2021 WL 6133976 (PTAB Dec. 27, 2021).....	52
<i>Ex Parte Shigetoshi Ito & Daisuke Hanaoka</i> , Appeal No. 2010-003391, 2012 WL 3041144 (BPAI July 23, 2012)	49, 53
<i>Google LLC f/k/a Google Inc. v. Singular Computing LLC</i> , IPR2021-00155, Paper 62 (PTAB May 23, 2022)	50
<i>Harmonic Inc. v. Avid Tech., Inc.</i> , 815 F.3d 1356 (Fed. Cir. 2016).....	3
<i>In re Gordon</i> , 733 F.2d 900 (Fed. Cir. 1984).....	36, 50
<i>In re Kahn</i> , 441 F.3d 977 (Fed. Cir. 2014).....	35

<i>In re Magnum Oil Tools Int'l, Ltd.</i> , 829 F.3d 1364 (Fed. Cir. 2016).....	4
<i>In re Mouttet</i> , 686 F.3d 1322 (Fed. Cir. 2012).....	51
<i>In re NTP, Inc.</i> , 654 F.3d 1279 (Fed. Cir. 2011).....	51
<i>Johns Manville Corp. v. Knauf Insulation, Inc.</i> , IPR2018-00827, 2018 WL 5098902 (PTAB Oct. 16, 2018)	40, 46
<i>KSR Int'l Co. v. Teleflex Inc.</i> , 550 U.S. 398 (2014)	35, 44, 52
<i>Meiresonne v. Google, Inc.</i> , 849 F.3d 1379, 1382 (Fed. Cir. 2017).....	50
<i>Nidec Motor Corp. v. Zhongshan Broad Ocean Motor Co.</i> , 868 F.3d 1013 (Fed. Cir. 2017).....	29
<i>Personal Web Techs., LLC v. Apple, Inc.</i> , 848 F.3d 987 (Fed. Cir. 2017).....	45
<i>Regents of the Univ. of Minn. v. AGA Med. Corp.</i> , 717 F.3d 929 (Fed. Cir. 2013).....	30
<i>SciMed Life Sys. Inc. v. Adv. Cardiovascular Sys., Inc.</i> , 242 F.3d 1337 (Fed. Cir. 2001).....	30
<i>Syntex (U.S.A.) LLC v. Apotex, Inc.</i> , 407 F.3d 1371 (Fed. Cir. 2005).....	50
<i>Trivascular, Inc. v. Samuels</i> , 812 F.3d 1056 (Fed. Cir. 2016).....	49
<i>U.S. Surgical Corp. v. Ethicon, Inc.</i> , 103 F.3d 1554 (Fed. Cir. 1997).....	29

<i>Verizon Servs. Corp. v. Vonage Holdings Corp.</i> , 503 F.3d 1295 (Fed. Cir. 2014)	30
<i>Vivid Techs., Inc. v. Am. Sci. & Eng'g, Inc.</i> , 200 F.3d 795 (Fed. Cir. 1999)	29
<i>Winner Int'l Royalty Corp. v. Wang</i> , 202 F.3d 1340 (Fed. Cir. 2000)	47
<u>Statutes</u>	
35 U.S.C. § 316(e)	4

Exhibits

Exhibit No.	Description
2001	Clerks Notice Resetting Case Management Conference Following Reassignment, <i>Speir Technologies Limited v. Apple Inc.</i> , No. 5:23-cv-00095-EJD, Dkt. No. 79 (N.D. Cal. Jan. 27, 2023)
2002	Docket Sheet, <i>Speir Technologies Limited v. Apple Inc.</i> , No. 5:23-cv-00095-EJD (N.D. Cal. Mar. 20, 2023)
2003	Defendant's Amended Preliminary Invalidity Contentions, <i>Speir Technologies Limited v. Apple Inc.</i> , No. 6:22-cv-00077-ADA (W.D. Tex. Oct. 26, 2022)
2004	Declaration of John F. Petrusic In Support of Motion <i>Pro Hac Vice</i>
2005	July 31, 2023 Deposition Transcript of Zhi Ding, Ph.D.
2006	Declaration of Dr. Mark P. Mahon in Support of Patent Owner's Response.
2007	<i>Curriculum Vitae</i> of Mark P. Mahon, Ph.D.
2008	Excerpts of <i>Adaptive Signal Processing</i> , Widrow and Stearns
2009	Excerpts of <i>Wireless Communications Principles & Practices</i> , Rappaport
2010	Excerpts of <i>Digital Communications Over Fading Channels, A Unified Approach to Performance Analysis</i> , Simon and Alouini
2011	Excerpts of <i>Digital Communications</i> , Fourth Edition, Proakis,
2012	Excerpts of <i>Digital Modulation Techniques</i> , Xiong
2013	Excerpts of <i>Signal Processing for Intelligent Sensor Systems</i> , Swanson

I. Introduction

The Petition challenges the claims of U.S. Patent No. 7,11,779 (“the ’779 Patent”) under five grounds of unpatentability:

- Ground 1. Claims 1, 2, 8-10, 12-13, 18-19, 22-24, 26-28, 32, and 34 are obvious over U.S. Patent No. 6,453,168 (“*McCrady*,” Ex. 1005) in view of U.S. Patent 7,511,604 (“*Raphaeli*,” Ex. 1006).
- Ground 2. Claims 1, 3-6, 10-11, 13-17, 20-21, 24-25, and 29-33 are obvious over *McCrady* in view of *Raphaeli* and U.S. Patent No. 7,058,414 (“*Rofheart*,” Ex. 1009).
- Ground 3. Claims 6-7, 17, 21, and 31 are obvious over *McCrady* in view of *Raphaeli* and U.S. Patent No. 6,070,079 (“*Kuwahara*,” Ex. 1007).
- Ground 4. Claims 1–6, and 8-34 are obvious over *Rofheart* in view of *Raphaeli* and U.S. Patent Publication 2005/0130634 to Godfrey (“*Godfrey*,” Ex. 1028).

All of the claims of the ’779 Patent recite the limitation of “estimating a range ...based upon ... a plurality of determined propagation delays.” Ex. 1001, 11:13-15 (for claims 1-12); 12:21-23 (for claims 13-17); 12:65-67 (for claims 18-26); and 14:11-13 (for claims 27-34). With respect to this limitation, Petitioner asserts that

the limitation is (i) obvious over *McCrady* in view of *Raphaeli* (Grounds 1, 2 and 3); and (ii) obvious over *Rofheart* in view of *Raphaeli* (Ground 4).

The challenge based on the proposed combination of *McCrady* and *Raphaeli* fails. The Petition's theory relies on the assertion that a POSITA would have been motivated to modify *McCrady*'s estimation of range based upon the time of arrival at the master radio of one of M reply messages from the reference radio and use *Raphaeli*'s "averaging" of arrival times of a set of collected pulses. In doing so, the Petition generically asserts that *McCrady*'s system would benefit from the supposed increased accuracy afforded by *Raphaeli*'s "averaging" technique. But the Petition fails to provide any allegation that a POSITA would have recognized any issues with respect to the accuracy of *McCrady*'s unmodified system or that a POSITA would have recognized any benefit from making the modification. In fact, a POSITA would understand that the proposed combination would prove unpredictable to the operation of *McCrady*'s system, which is specifically designed to provide range estimates in an environment with severe multipath interference. For this reason, the Petition cannot show any challenged claim in Grounds 1, 2, and 3 to be unpatentable.

The challenge based on the proposed combination of *Rofheart* and *Raphaeli* also fails. The Petition's theory relies on the assertion that a POSITA would have been motivated to modify *Rofheart*'s estimation of range based upon a determined "propagation delay" from a single ranging message to employ multiple ranging

messages to determine multiple corresponding “propagation delays,” to which *Raphaeli*’s “averaging” technique would be applied. In doing so, the Petition generically asserts that *Rofheart*’s system would benefit from the supposed increased accuracy afforded by *Raphaeli*’s “averaging” technique. But the Petition fails to provide any allegation that a POSITA would have recognized any issues with respect to the accuracy of *Rofheart*’s unmodified system or that a POSITA would have recognized any benefit from making the modification. In fact, a POSITA would understand that the proposed combination would be **detrimental** to *Rofheart*, because it contradicts *Rofheart*’s stated goal of minimizing the transmit time allocated to the range messaging. A POSITA would thus **not** have been motivated to make the proposed combination. At most, the Petition establishes that a POSITA **could** have made its proposed modification to *Rofheart*, not that a POSITA **would have been motivated** to do so, as required. For this reason, the Petition cannot show any challenged claim in Ground 4 to be unpatentable.

For the above reasons, and as explained in further detail below, the Petition fails to establish that any challenged claims are unpatentable.

II. Burden of Proof

“In an [*inter partes* review], the petitioner has the burden from the onset to show with particularity why the patent it challenges is unpatentable.” *Harmonic Inc. v. Avid Tech., Inc.*, 815 F.3d 1356, 1363 (Fed. Cir. 2016) (citing 35 U.S.C. §

312(a)(3) (requiring *inter partes* review petitions to identify “with particularity ... the evidence that supports the grounds for the challenge to each claim”)). This burden of persuasion never shifts to Patent Owner. *See Dynamic Drinkware, LLC v. Nat’l Graphics, Inc.*, 800 F.3d 1375, 1378 (Fed. Cir. 2015) (discussing the burden of proof in *inter partes* review). Furthermore, the petitioner cannot satisfy its burden of proving obviousness by employing “mere conclusory statements.” *In re Magnum Oil Tools Int’l, Ltd.*, 829 F.3d 1364, 1380 (Fed. Cir. 2016). “The petitioner must instead articulate specific reasoning, based on evidence of record, to support the legal conclusion of obviousness.” *Id.* To prevail in an *inter partes* review, Petitioner must show by a preponderance of the evidence that a patent is invalid. 35 U.S.C. § 316(e).

III. The Prior Art References *McCrady*, *Raphaeli*, and *Rofheart*

A. The Teaching of *McCrady*

U.S. Patent No. 6,453,168 to *McCrady* (“*McCrady*”) generally relates to a system for the determination of a geographical position for a mobile communication device. *See* Ex. 1005, 3:54-57 (“It is an object of the present invention to rapidly, reliably and accurately determine the three-dimensional position of a mobile communication device in a variety of environments, including urban areas and inside buildings where multipath interference can be great.”). *McCrady* further notes that the mobile communication device is useful for “military personnel and equipment,

emergency personnel and equipment, valuable items, vehicles, mobile telephones, children and prisoners.” *Id.*, 3:63-65; *see also id.*, 17:14-21 (“The system ... can also be used to locate and track non-military personnel and resources located both indoors or outdoors, including but not limited to: police engaged in tactical operations; firefighters located near or within a burning building; medical personnel and equipment in a medical facility or en route to an emergency scene; and personnel involved in search and rescue operations.”).

With respect to the potential for multipath interference in “urban areas” and “inside buildings,” *McCrady*’s goal is to “to minimize the effects of interference caused by multipath signal propagation in a position location system, thereby providing highly accurate three-dimensional position estimates even under severe multipath conditions.” *Id.*, 3:66-4:3. To that end, *McCrady* describes separating “multipath interference from direct path signals to accurately determine the time of arrival of the direct path signal to accurately determine range.” *Id.*, 4:14-17. By doing so, “[t]he system ... is capable of determining position location to an accuracy of less than one meter in a severe multipath environment.” *Id.*, 4:49-51. Because of the dynamic uses of the mobile devices, *McCrady* looks to “provide[] accurate, reliable three-dimensional position location of a handheld or portable, spread spectrum communication device within milliseconds without interruption of voice or data communications.” *Id.*, 4:44-48.

1. *McCrady's* General Approach to Range Estimation

McCrady describes a mobile communication device that will estimate the range from the device to multiple, fixed reference radios with known positions. Ex. 1005, 7:21-30. Based on the range estimates and the known positions of the fixed reference radios, standard triangulation techniques can be used to estimate the position of the mobile communication device. *Id.* The mobile communication device relies on sending ranging messages to the reference radios and receiving replies thereto. “To provide high accuracy range estimates, the time of arrival of the ranging messages are precisely estimated. By performing internal delay calibration, errors caused by difficult-to-predict internal transmitter and receiver delay variations can be minimized.” *Id.*, 5:9-13.

Generally, *McCrady's* system “employs a two-way, round-trip ranging message scheme in which the time of arrive of the ranging messages is accurately determined to yield accurate range estimates used to calculate the position of a mobile radio via trilateration. A master or target mobile radio transmits outbound ranging messages to plural reference radios which respond by transmitting reply ranging messages that indicate the location of the reference radio and the message turn around time (i.e., the time between reception of the outbound ranging message and transmission of the reply ranging message). Upon reception of the reply ranging message, the master radio determines the signal propagation time, and hence range,

by subtracting the turn around time and internal processing delays from the elapsed time between transmission of the outbound ranging message and the time of arrival of the reply message.” *Id.*, 4:53-5:1. While the reference radios are expected to be fixed at known positions, *id.*, 6:57-60, another mobile radio can be used as one of the reference radios if signal strength from one of the fixed reference radios is too weak, *id.*, 16:38-47.

For range estimation with each reference radio, the mobile communication device (the “master” or “target” radio) initiates the general process of:

1. First, “the ranging message sequence begins with the master radio transmitting an initial outbound ranging message RTS-T to a particular reference radio (the process is repeated with each reference radio in sequence).” *Id.*, 8:5-7.
2. Second, “[t]he reference radio receives the RTS-T message after a delay proportional to the range from the master radio, and determines the time of arrival of the RTS-T message.” *Id.*, 8:8-10.
3. Third, “the reference radio transmits a reply ranging message (TOA Msg.) to the master radio. The TOA message packet indicates the turn around time at the reference radio, i.e., the time between arrival of the RTS-T message and transmission of the corresponding TOA message.” *Id.*, 8:11-15.
4. Finally, “[t]he master radio determines the time of arrival of the TOA message and derives the range to the reference radio from knowledge of the round trip delay time and the turn around time.” *Id.*, 8:15-18.

“By precisely knowing the time of transmission of the outbound ranging message, the far-end turn around time at the reference radio (supplied to the master radio in the reply ranging message), the time of arrival of the reply ranging message,

and internal transmission/reception processing delays, the master radio can precisely determine the two-way signal propagation time between itself and each reference radio.” *Id.*, 8:65-9:5. More specifically:

“[T]he two-way or round-trip propagation time (T_{RT}) is the time of arrival (TOA) of the reply message minus the time of transmission (TT) of the outbound message minus the duration of the turn around time (ΔT_{TA}) and internal processing delays within the master radio ΔT_{ID} (the internal processing delays of the reference radio are incorporated into the turn around time ΔT_{TA}).

$$T_{RT} = TOA - TT - \Delta T_{TA} - \Delta T_{ID} \quad (1)$$

Id., 9:5-13.

The time of transmission (TT) and the reply time of arrival (TOA) are known by the master radio. *Id.*, 9:31-35. Furthermore, “the accounting for the internal processing delays can be considered part of accurately determining the time of arrival TOA and the time of transmission TT ; thus, the round-trip signal propagation time T_{RT} can more generally be described as the difference between a) the elapsed time between the time of transmission of the outbound ranging message and the time of arrival of the reply ranging message and b) the turn around time ΔT_{TA} .” *Id.*, 9:14:22.

2. *McCrary's Processing Delays*

The detailed range estimation process from a master radio to a reference radio begins when “the master radio initiates the TOA ranging process by performing an internal delay calibration using a loop back through pad 40 to determine internal

delays ($T_{mt}+T_{mr}$) in the master radio for correction purposes. Multiple trials, for example ten, are performed and averaged to reduce the variance of the delay estimate. The delay T_{mt} is the master radio transmitter delay.” Ex. 1005, 10:44-50. “The delay T_{mr} is the master radio receiver delay.” *Id.*, 10:55-56.

“Once the delay calibration is completed, the master radio begins the TOA ranging message sequence by transmitting the RTS-T outbound ranging message to the reference radio.” *Id.*, 10:60-62. “The reference radio receives the RTS-T [and] performs an internal delay calibration using a loop back through pad 54 to determine the reference radio internal delay ($T_{rt}+T_{rr}$), curve fits to refine the turnaround delay ... and forms the TOA Message [including] results of the delay calibration, and turnaround delay refinement from curve fitting.” *Id.*, 10:64-11:5. Similar to the master radio, “[t]he delay T_{rr} is the reference radio receiver delay,” *id.*, 11:5-6, and “[t]he delay T_{rt} is the reference radio transmitter delay,” *id.*, 11:9. “The TOA Message is transmitted back to the master radio which computes the final one-way TOA, range, and relative position.” *Id.*, 11:12-14.

“[T]he internal processing delay of the master radio ΔT_{ID} seen in equation (1) is determined from the master radio transmitter and receiver delays T_{mt} and T_{mr} determined from the calibration process and the estimated antenna delay T_a .” *Id.*, 11:24-28. The “antenna delay T_a ... is a constant preloaded into the radios ... and determined by measuring the delay through a large sample of antennas and cabling,

over a range of operating temperatures, and calculating the mean and standard deviation of the measured values.” *Id.*, 11:15-22. “Similarly, the estimate of the duration of the turn around time TT includes the reference radio transmitter and receiver delays T_{rt} and T_{rr} determined from the calibration process and the estimated antenna delay T_a .” *Id.*, 11:28-31.

“[T]he master radio calibration process can be performed just prior to starting the timer measuring the duration of the round trip message time, and the reference radio calibration can be performed during the turn around time at the reference radio.” *Id.*, 11:47-51. “By accurately estimating and subtracting out the time attributable to processing delays, the signal propagation time (and hence the range) can be more accurately determined,” *id.*, 11:36-39, and “is ***one of the keys to getting repeatable accuracy***,” *id.*, 11:41-42 (emphasis added). In equation (1) ($T_{RT} = TOA - TT - \Delta T_{TA} - \Delta T_{ID}$), ΔT_{ID} is the internal processing delay of the master radio and consists of three additive components: (1) T_{mt} , the master radio transmitter delay; (2) T_{mr} , the master radio receiver delay; and (3) T_a of the master radio antenna. Also in equation (1), ΔT_{TA} is the internal processing delay of the reference radio and consists of four additive components: (1) the time of reply message from the reference radio minus the time of arrival (TOA) of the RTS message at the reference radio; (2) T_{rr} , the reference radio receiver delay; (3) T_{rt} , the reference radio transmitter delay; and (4) T_a of the reference radio antenna.

3. *McCrady's Time of Arrival Estimation*

The “precise estimation of the time of arrival of the outbound ranging message at the reference radio” is another aspect of *McCrady* that is necessary for “accurately determining the range between the master radio and the reference radios.” Ex. 1005, 11:59-62. To accomplish a “precise estimate,” “the timing of the leading edge of a synchronization sequence of the ranging message is accurately determined by assessing and avoiding multipath interference which can degrade the accuracy of the time of arrival estimate.” *Id.*, 11:64-12:1. For this purpose, *McCrady* discloses two-stage signal acquisition processing. The first-stage “employs digital matched filtering and Barker code correlation to detect the transmitted communication acquisition waveform and to derive the required timing information.” *Id.*, 12:16-19. The digital matched filter “de-spreads each of the [RTS message communication acquisition sequence] symbols and provides a peak response when aligned with each symbol.” *Id.*, 12:28-29. “A differential detector 74 compares the phase of the received signal between two successive symbol intervals,” *id.*, 12:35-36:

More specifically, differential detector 74 includes a complex delay unit 76 which delays the output of DMF 72 by a symbol interval, a complex conjugate unit 78 which forms the complex conjugate of the delayed signal, and a comparator 80 which receives the output of DMF 72 and the delayed complex conjugate of the output of DMF 72 and produces the differential detector output. The decision variable is proportional to the phase difference between these two complex numbers, which, for BPSK, can be extracted from the real part of the differential detector output (see block 82).

The real portion of the differential detector output is quantized in quantizer 84 and supplied to a symbol sequence correlator 86, such as a Barker code correlator. The output of the Barker code correlator is compared to a detection threshold 88. If the detection threshold is exceeded, a communication detection is declared.

Id., 12:37-53.

“[D]etection of the communication acquisition sequence triggers a second stage in which a longer acquisition symbol is processed with a longer matched filter (i.e., TOA synchronization processing).” *Id.*, 13:8-12. “Matched filtering is performed on the 4096 chip TOA synchronization sequence using a digital matched filter (N=4096). After performing a magnitude function (block 94), the ***filtered TOA synchronization sequence is applied to a pulse width evaluator 96 which determines the severity of the multipath interference between the master radio and the reference radio at the frequency of the ranging message.***” *Id.*, 13:26-32 (emphasis added). More specifically, the pulse width evaluator “moves the pulse shape replica through the profile of the output of the matched filter 92 and performs a least-mean-square error fit to achieve a rough curve fitting between the replica pulse shape and the matched filter output to identify the timing of the direct path signal and subsequent multipath signals.” *Id.*, 13:36-42.

Multipath interference “is a problem in which the transmitted information takes more than one path to the receiver, thus producing interference and echoes in the received signal.” Ex. 2008, *Adaptive Signal Processing*, Widrow and Stearns, p.

200. *McCrady* determines the degree of multipath interference based on the chip width between the direct path signal and the multipath “copies.” *Id.*, 13:57-64; *see also id.*, 5:20-27. Based on the severity of the multipath interference, *McCrady*’s “TOA processor is capable of providing two selectable levels of accuracy; a one meter accuracy and a three meter accuracy (the accuracy refers to the resultant range estimate).” *Id.*, 13:50-53. “[I]f the pulse width evaluator determines that the multipath interference is separated from the direct path signal by more than a predetermined number of chip widths, the multipath interference is classified as insubstantial in terms of impacting the TOA estimate.” *Id.*, 13:57-61; *see also id.*, 13:61-67 (describing “insubstantial” multipath interference as judge by more than three chip widths, or optionally, one chip width).

4. Low Resolution Mode and High Resolution Mode

“When the multipath interference is judged by the pulse width evaluator 96 to be insubstantial, the TOA estimate is obtained via a curve fitting algorithm using the leading edge samples plus two samples after the peak.” Ex. 1005, 14:1-4. For *McCrady*, this result is of high accuracy (accuracy within one meter) regardless of the accuracy mode that has been selected. *See id.*, 14:6-8. The time of arrival estimate is made at the reference radio on the received RTS message “to accurately determine” turnaround delay ΔT_{TA} of equation (1) by subtracting TOA from reply message time and adding T_{rr} , T_{rt} , and T_a of the reference radio. Subsequently, the

master radio will employ the same process to estimate the time of arrival at the master of the reply message from the reference (TOA in equation (1)). *See id.*, 14:11-15. The master radio can then “accurately determine the round trip propagation time.” *Id.* “The resulting range estimate, together with the TOA accuracy estimate (e.g., one meter or three meters) is supplied to a navigation Kalman filter (not shown) which tracks the location solution of the master radio.” *Id.*, 14:15-18.

When the multipath interference is judged to be substantial, “the processing differs, depending on whether a high accuracy (e.g., one meter) TOA mode or a lower accuracy (e.g., three meter) TOA mode has been selected.” *Id.*, 14:24-27. “If a lower accuracy (e.g., three meters) mode has been selected, a leading edge curve fit 100 is implemented to estimate the TOA.” *Id.*, 14:27-29. The lower accuracy of the time of arrival estimate is passed on to the tracking Kalman filter, along with an “alert ... to reduce the associated filter gain [of the Kalman filter].” *Id.*, 14:31-34.

“[I]f the multipath interference is classified as substantial and the high accuracy (e.g., one meter) mode has been selected, the TOA processor implements a process employing frequency diversity to identify an optimal transmission frequency that minimizes multipath interference.” *Id.*, 14:35-40. Either the master radio or the reference radio can “declare the need” for the frequency diversity process. *Id.*, 14:40-53. In the frequency diversity process, “a rapid succession of M

different frequency signals or multiple “pings” are transmitted between the radios in search of an optimal frequency.” *Id.*, 14:53-56.

After the first exchange between the master radio and the reference radio, “the next M-1 TRS-T/TOA message exchanges are transmitted, using different carrier frequencies for each exchange,” and “can use shortened packets.” *Id.*, 15:15-19. “[T]he TOA processor processes the communication acquisition sequence and the TOA synchronization sequence of each of the M ranging messages in the same manner as the initial ranging message.” *Id.*, 15:24-27. ***From the results of the pulse width evaluation for each of the M ranging messages, the TOA at the master radio may be estimated for the frequency having the best multipath discrimination. See id.***, 15:34-40. “Specifically, the data is searched to find the frequency where the optimal pulsewidth occurs at the carrier phase with the shortest path delay. The resulting TOA measurement is processed in the aforementioned manner to accurately determine the range between the master radio and the reference radio, and the range estimate and TOA accuracy estimate are supplied to the navigation Kalman filter to update the master radio's position.” *Id.*, 15:40-47.

“The master radio determines its own position from the measured range to each of the reference radios via a trilateration technique which can be for example, a conventional trilateration technique. Once the master radio's position has been determined, the master radio can convey this information to other radios or to a

controller or coordinator performing tracking and/or mapping of the master radio and perhaps other associated mobile radios.” *Id.*, 16:17-24.

B. The Teaching of *Raphaeli*

U.S. Patent Application No. 7,511,604 to Raphaeli (“*Raphaeli*”) relates to a RFID system and the determination of distance from a reader to one or more tags based on the round trip delay of signals sent from the reader to the tags and reply signals sent from the tags to the reader. Ex. 1006, 1:11-15. “In order to determine whether one or more tags 4 are in a specific range from reader 2, and optionally the identity of one or more tags 4, reader 2 transmits a wide band broadcast interrogation signal.” *Id.*, 8:44-47. The wide band signal is “of a bandwidth of about 50 MHz, or even about 100 MHz In an exemplary embodiment of the invention, the transmitted signals are in the 2.4 GHz band.” *Id.*, 17:7-10; *see also id.*, 13:25-44.

The “wide band broadcast interrogation signal 20 features a sequence of pulses 22 separated by a fixed interval, for example 10 microseconds.” *Id.*, 9:6-8; *see also id.*, 13:18-21 (“Optionally, the no-energy periods between pulses of a signal are of a same predetermined duration, such that after tuning onto a first pulse of the signal, the receiver knows the timing of the rest of the pulses of the signal.”). As shown in Fig. 2, reproduced below, “pulses 22 of wide band broadcast interrogation signal 20 are optionally organized in three intervals: a preamble portion 24, a data portion 26, and a response period portion 28.” *Id.*, 9:15-18.

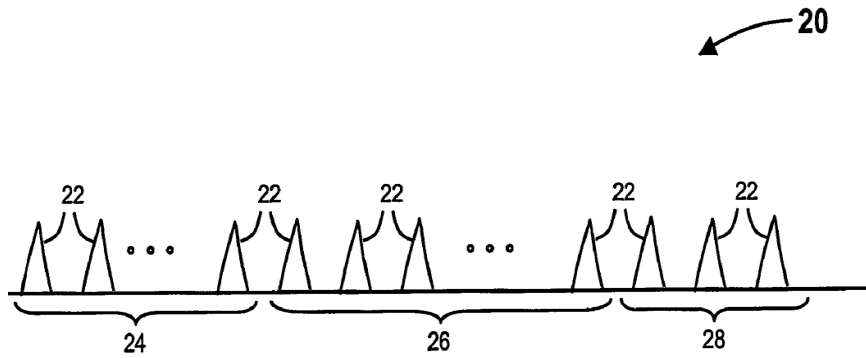


FIG. 2

Id., Fig. 2.

“Preamble portion 24 is optionally used to alert tags 4 of the command. In an exemplary embodiment of the present invention, the number of pulses 22 in preamble portion 24 is such that tag 4 will be activated and receive at least one of pulses 22 of preamble portion 24, regardless of the relative timing of reader 2 and tag 4.” *Id.*, 9:22-27. The “data portion 26 of wide band broadcast interrogation signal 20 features one or more of the following fields: a delimiter field, for identifying the beginning of the message (for example, 16 bits), a reader ID field (for example, 48 bits), a command field (for example, 8 bits), a cyclic redundancy check (CRC) field (for example, 16 bits), and/or an error correction code (ECC) parity field (for example, 16 bits).” *Id.*, 9:34-41.

“Pulses 22 of response period portion 28 are optionally used by tags 4 to synchronize their response signals, as described hereinafter. Pulses 22 of data

portion 26 are optionally modulated with specifics of the wide band broadcast interrogation signal 20, while pulses 22 of preamble portion 24 and response period portion 28 are not modulated, or modulated with a sequence known to the tags. In an alternative exemplary embodiment of the present invention, pulses 22 are modulated by changing their transmission time. For example, a '1' bit may be modulated on to a pulse 22 by 5 ns delaying the transmission of a pulse, and a '0' bit may be modulated by transmitting a pulse 5 ns in advance." *Id.*, 9:58-10:2. In other words, the pulses of the response period portion will be offset from the fixed interval of the response portion as a means to differentiate 1's and 0's in what would otherwise be identical pulses. *Raphaeli* further describes this operation with respect to the tag transmit circuitry illustrated in Fig. 4, reproduced below.

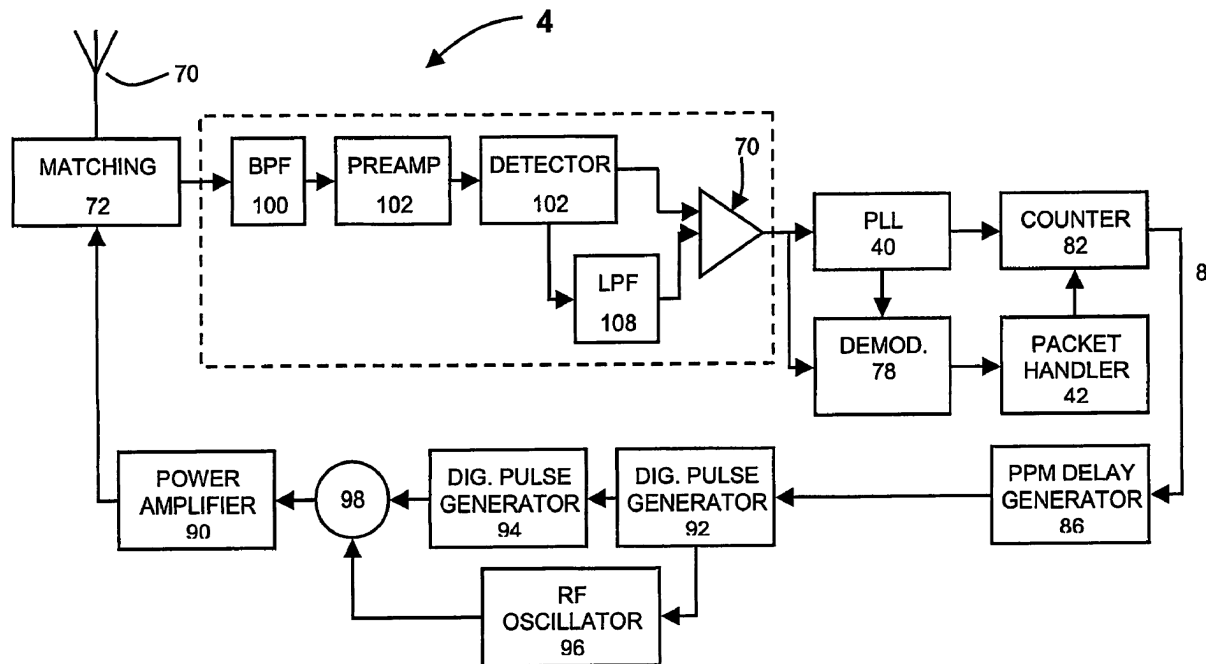


FIG. 4

Id., Fig. 4.

“In an exemplary embodiment of the present invention, in which the data content of the wide band response signal is modulated by changing the timing of its pulses, a pulse position modulation (PPM) delay generator 86 receives the trigger signal on line 84 and the data content of the wide band response signal abitat a time. For each received trigger, delay generator 86 alters the timing of the trigger according to the value of the data bit currently provided, and passes the altered trigger to a pulse generator 88 which generates a respective pulse.” *Id.*, 14:49-58.

“Optionally, pulse position modulation (PPM) delay generator 86 adds an additional constant delay to allow for backward modulation (for example, 5 ns). Alternatively, a time modulation which does not require backward timing is used, for example, addition of 0 ns for 0 and 10 ns for 1.” *Id.*, 15:1-5.

The “wide band response signal includes one or more of the following fields: a tag 4 ID (identification) field (for example, 48 bits); a reader ID field enabling a reader 2 to know whether the wide band response is his; a random delay field (for example, 8 bits), a CRC field (for example, 16 bits) and/or a parity field (for example, 32 bits).” *Id.*, 14:5-10.

“Pulse generator 88 optionally comprises a digital pulse generator 92, which generates a short digital pulse, for example: 10 ns logic ‘1’. The short pulse is optionally provided to a shaping filter 94 which smoothes the pulse for transmission, as is known in the art. Shaping filter 94 optionally makes the pulse in the bandwidth suitable for transmission in the required band.” *Id.*, 15:64-16:3. “The shape of the pulse may be simple, such as Gaussian shape for example.” *Id.*, 13:29-31. “[A]n RF oscillator 96 and a mixer 98 modulate the shaped pulse from shaping filter 94. It is noted that the shaped pulse has a duration longer than the short digital pulse, for example, of about 50 ns.” *Id.*, 16:6-10.

“[B]efore tag 4 begins to transmit modulated pulses of the wide band response signal in synchronization with the response period of the broadcast, tag 4 transmits,

at the beginning of the response period, several (for example, 10) non-modulated pulses or modulated pulses with a sequence identical to all tags and known to the reader, during a second synchronization period of the PLL of tag 4. The object of this second synchronization period is to increase the lock accuracy of the PLL. These non-modulated pulses optionally inform reader 2 of the forthcoming wide band response signal.” *Id.*, 16:18-27. “[F]or each wide band response signal, a random delay is selected, to prevent collisions with wide band response signals of other tags 4. A counter 82 optionally adds the random delay period to the trigger signal from pulse detector 74, so as to provide the trigger signal on line 84.” *Id.*, 15:30-35.

“Reader 2 is detecting at least one response sequence included in that at least one wide band response signal received by reader 2, counting the approximate number of distinguishable responses to that wide band broadcast interrogation signal, and analyzing the wide band response signals transmitted by the authorized tags in order to determine the round trip delay (RTD).” *Id.*, 16:61-67. “[T]he round trip delay is determined by subtracting a predetermined correction factor from the measured time between the transmission of the wide band broadcast interrogation signal 20 and receiving the wide band response signals. The predetermined correction factor optionally compensates for a known delay of tags 4 between receiving the wide band broadcast interrogation signal 20 and transmitting the wide band response signal and/or for the operation time of reader 2.” *Id.*, 17:11-19.

“Alternatively or additionally to reducing the predetermined correction factor, in these embodiments, reader 104 subtracts the length of the random delay period from the measured time between the transmission of the wide band broadcast interrogation signal 20 and receiving the wide band response signals.” *Id.*, 17:35-41.

At the reader, baseband digital samples of the received signals are provided to DSP 40. *See id.*, 18:30-37. The “collection of pulses belonging to a single tag 4 is examined to determine that it includes at least a predetermined number of received pulses ... that allows reconstructing the data content of the wide band response signal using error correction methods.” *Id.*, 19:2-7. The DSP 40 also calculates “an average time delay for collected pulse groups including at least the predetermined number of pulses.” *Id.*, 19:11-13. The average time delay gives the reader the ability to differentiate the time-shifted pulses from the tag and discern 1’s and 0’s. *See id.*, 19:13-15 (“***Using the average time delay, DSP 40 Is extracting the modulated data*** from the collected pulse groups.”) (emphasis added). The timing of the pulses can also be corrected to remove the error introduced by the pulse time-shift introduced at the tag. *See id.*, 19:15-19 (“The timing of the pulses are optionally corrected according to their modulation ... for example by adding or subtracting 5 ns according to the bit carried by the pulse group.”). “Thereafter, a second, more accurate, average is optionally calculated.” *Id.*, 19:19-20. “[T]he random delay purposely

added by the transmitting tag 4 is determined from the demodulated data and subtracted from the average delay, so as to receive the delay which is due to the traveling distance.” *Id.*, 19:41-45.

C. The Teaching of *Rofheart*

U.S. Patent No. 7,058,414 to Rofheart (“*Rofheart*”) relates to a system for enabling or blocking communications between a local device and multiple remote devices using an ultra-wide band (UWB) signal in a relatively size-constrained environment such as in a conference room, or near a kiosk in a retail store. Ex. 1009, 2:29-48. The local device and the remote devices can come in the form of mobile telephones, laptop computers, personal digital assistants (PDAs), or fixed devices such as a retail store kiosk. *Id.*, 17:25-30.

As part of the enabling or blocking of communications *Rofheart*'s local device transmits distance-determining messages to the remote devices and receives responses therefrom via UWB links to determine if the remote devices are within a given range and should be allowed to communicate to and through the local device:

The present invention provides a method for enabling device functions based on distance information. More specifically, the present invention provides a simplified method for enabling communications between a local wireless device and a remote wireless device based on the distance between the wireless devices. In order to provide Such a distance based system that is practically usable, the wireless devices must be able to discriminate distances at fine intervals; or stated another way, the wireless device must have accurate range resolution.

Id., 16:37-46.

The present inventors have recognized that using an ultra wide band system, range resolutions can be accomplished that have practical significance in distinguishing between remote wireless devices. For example, an ultra wide bandwidth system having 3 GHz of bandwidth has a range resolution of 1 meters. Even greater bandwidth systems can accomplish resolutions on the order of centimeters. Thus, as realized by the present inventors, a local UWB device can compute a unique distance to remote UWB devices as long as the actual distance from the local device to each remote device differs on the order of centimeters which is a common scenario for current uses of wireless devices such as PDAs.

Id., 17:1-12.

The wireless network 300 includes a local device 301 linked to a first remote device 302, a second remote device 303 and N number of additional remote devices 300N via UWB links 312, 313, and 315N respectively.

Id., 17:18-22.

[I]n this embodiment, the MAC protocol provides the capability for local device 301 to establish unique and independent UWB links 312, 313, and 315N with remote devices 302, 303, and 300N respectively ...

Id., 18:20-24.

The local device determines the amount of time between the transmission of the distance-determining message to the remote device and the reception of the reply message from the remote device and from that time determines the distance to the remote device:

After unique links 312, 313, and 300N are established, the local device 301 determines a distance to each linked remote device and communicates with each linked remote device based on the distances determined as shown in step 403. In determining the distance, local device 301 exchanges information with remote devices 302, 303, and 300N via their respective unique links. Each distance determined by the

local device 301 is associated with a remote device as will be discussed in describing FIG. 8.

Id., 18:26-34.

Based on the determined distance, accurate on the order of centimeters, between the local device and the remote device, the local device either (1) enables communications with the remote device if the determined distance is within the range limit or (2) blocks communications with the remote device if the determined distance is outside of the range limit. The process is repeated regularly to update the remote devices that may have communications enabled or blocked:

In communicating with the remote devices 302-300N based on the distances determined, the local device 301 makes use of the range resolution of the UWB signal as discussed above. Because the range resolution is on the order of centimeters, the probability of having remote devices at equal distances is very low and the local device 301 can differentiate between remote devices 302 through 300N based on the distance determined for each device. Thus, different communications can be made with each remote device depending on the distance to the remote devices.

For example, the local device may automatically enable data communications with devices that are located within a predefined range at any given time while all remote devices outside the predefined range will be blocked from data communications with the local device as will be described with respect to FIG. 6.

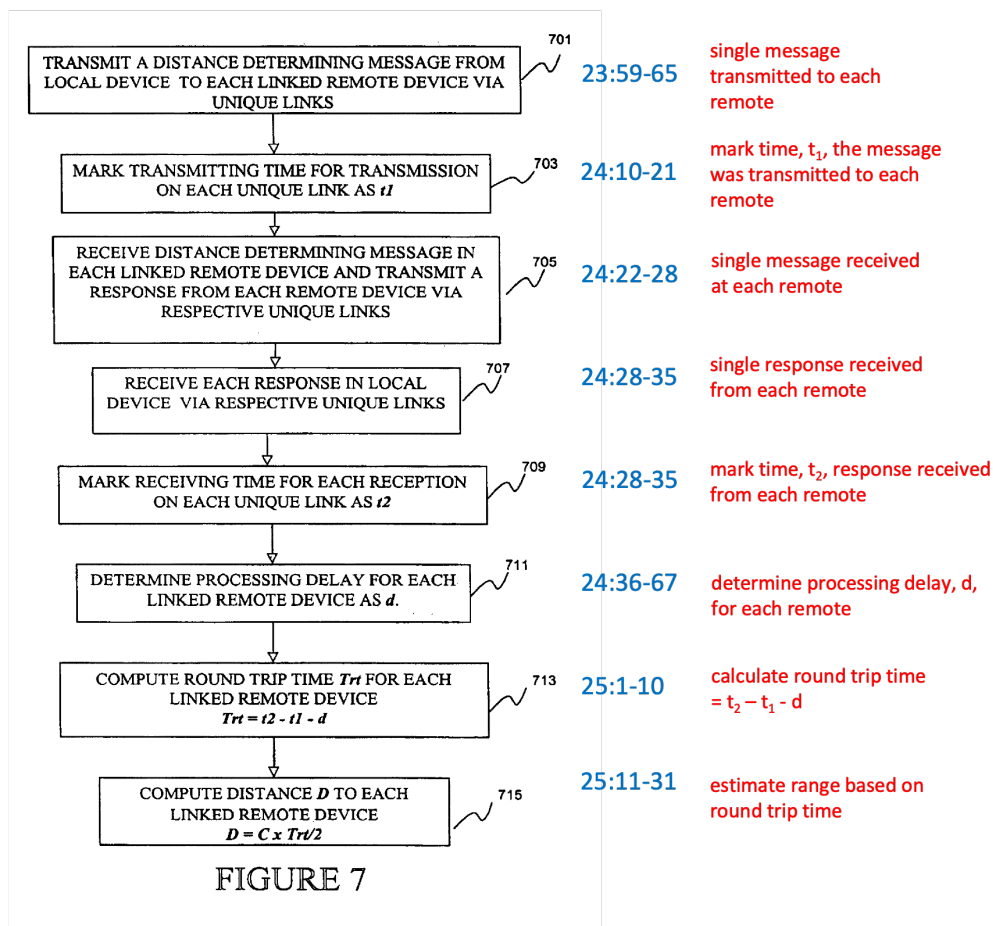
Id., 18:34-50; *see also id.*, 21:23-23:3, Fig. 6.

Thus, according to the embodiment of the present invention shown in FIG. 6, a local device automatically enables and blocks data communications with remote devices based on the remote device's distance from the local device thereby providing a dynamic network in which communications with remote devices may be received without the

need for the user of the local device to select from among a list of remote devices based on private information about the remote device.

Id., 23:50-58.

Rofheart's local device determines the distance based on a **single** transmission of the distance-determining message to the remote device and the corresponding reply message:



Id., Fig. 7 (annotated); see also *id.*, 23:59-25:31.

With a fixed amount of transmit time resources, *Rofheart* seeks to maximize the allocation of transmit time on the UWB links 312, 313, and 315N for enabled

communications between the local device 301 and the remote devices 302, 303, and 300N. Accordingly, *Rofheart* seeks to minimize the allocation of transmit time to the transmission of distance determining messages and the corresponding responses on the UWB links 312, 313, and 315N.

Each unique link 312, 313, and 315N is a low level communications link that is allocated a minimal amount of transmit time available to the local device 301. The amount of transmit time allocated may vary but is preferably an amount that is sufficient for the local device 301 to maintain awareness of the presence of the remote devices 302 through 300N and to determine and update distance to each linked remote device.

Id., 21:15-22.

In a preferred embodiment, however, communications are blocked and enabled at the MAC level in the local device 301. In this embodiment, the local device 301 allocates a minimal amount of available transmit time to unique links associated with blocked remote devices, and a relatively large amount of transmit time to unique links associated with enabled remote devices.

Id., 22:19-25.

The minimal transmit time allocated to each unique link associated with a remote device that has not satisfied the authentication criteria is preferably an amount sufficient to transmit a simple distance determining message so that the local device 301 can update the distance information for blocked remote devices as discussed above.

Id., 22:25-31.

IV. Level of Ordinary Skill in the Art

The Petition asserts that for “this IPR, a person of ordinary skill in the art (“POSITA”) would have had a Bachelor’s degree in electrical engineering, computer

engineering, computer science, or a related field, and 2-3 years of experience in design or development of wireless communication systems/networks including ranging/positioning systems, or the equivalent. Additional graduate education could substitute for professional experience, or significant experience in the field could substitute for formal education.” Petition at 4-5, Ex. 1003 at ¶ 20-22. Patent Owner generally agrees with this assessment except for the inclusion of degrees in computer engineering and computer science because candidates for those degrees will not typically encounter the wireless technologies, including signal propagation and processing, at issue in the '779 Patent and prior art references in this case. Ex. 2006, *Declaration of Dr. Mark P. Mahon in Support of Patent Owner's Response*, ¶ 30.¹

Patent Owner therefore proposes a modified definition: A person of ordinary skill in the art would have had a Bachelor's degree in electrical engineering, or a related field, and 2-3 years of experience in design or development of wireless communication systems/networks including ranging/positioning systems, or the equivalent. Additional graduate education could substitute for professional experience, or significant experience in the field could substitute for formal education. *Id.*

¹ See also Ex. 2007, *Curriculum Vitae* of Mark P. Mahon, Ph.D.

V. Claim Construction

Claim terms that are in dispute and for which resolution of such dispute is “necessary to resolve the controversy” must be construed. *Vivid Techs., Inc. v. Am. Sci. & Eng'g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999); *U.S. Surgical Corp. v. Ethicon, Inc.*, 103 F.3d 1554, 1568 (Fed. Cir. 1997). This threshold for construing claim terms is applicable in IPR proceedings. *Nidec Motor Corp. v. Zhongshan Broad Ocean Motor Co.*, 868 F.3d 1013, 1017 (Fed. Cir. 2017).

A. The Board Should Construe “Estimating a Range ...” to Be Based Upon a “Plurality of Determined Propagation Delays”

In the Board's Decision Granting Institution, the Board did not construe any terms because neither party had, to that point, proposed an explicit construction of any claim term. For the sake of clarity, with respect to “estimating a range ...based upon ... a plurality of determined propagation delays” as required by all challenged claims of the '779 Patent, Patent Owner respectfully requests that the Board recognize that “estimating a range ...based upon ... a plurality of determined propagation delays” requires the range to the target device be estimated not solely based upon a single determined propagation delay, but rather upon a plurality of determined propagation delays. This construction is consistent with the plain and ordinary meaning of the limitation, as reinforced by the specification.

The plain language of these limitations, including limitation [1.d.iii] for claims 1-12), limitation [13.d.iii] for claims 13-17, limitation [18.g] for claims 18-

26, and limitation [27.e] for claims 27-34, dictates that a **single** range (“a range”) must be calculated using a **plurality** of determined propagation delays (“based upon a plurality of determined propagation delays”). The specification supports this meaning. For example, the specification states that “[i]n accordance with the present invention, the controller 42 advantageously estimates the range to the target device 34 not solely based upon a single measured propagation delay, but rather upon a plurality thereof.” Ex. 1001, 7:46-49.

The specification's recitation that, “in accordance with the present invention,” a single range estimation must be based on a plurality of propagation delays, “is strong evidence that the claims should not be read to encompass [an] opposite” reading. *SciMed Life Sys. Inc. v. Adv. Cardiovascular Sys., Inc.*, 242 F.3d 1337, 1343 (Fed. Cir. 2001); *see also Regents of the Univ. of Minn. v. AGA Med. Corp.*, 717 F.3d 929, 936 (Fed. Cir. 2013); *Verizon Servs. Corp. v. Vonage Holdings Corp.*, 503 F.3d 1295, 1308 (Fed. Cir. 2014) (“When a patent thus describes the features of the ‘present invention’ as a whole, this description limits the scope of the invention.”). Consistent with the specification, all of the claims of the '779 Patent recite “estimating a range ...based upon ... a plurality of determined propagation delays.” Ex. 1001, 11:13-15 (for claims 1-12); 12:21-23 (for claims 13-17); 12:65-67 (for claims 18-26); and 14:11-13 (for claims 27-34).

VI. Grounds 1, 2 and 3 Fail Because the Petition Fails to Motivate its Combination of *McCrady* with *Raphaeli*

Grounds 1, 2, and 3 of the Petition propose a combination of *McCrady* with *Raphaeli*, *inter alia*, to allege invalidity of all challenged claims. In particular, the proposed combination addresses *McCrady*'s failure to teach the estimation of a single range based upon a plurality of determined propagation delays. Petitioner contends that a POSITA would be motivated to incorporate *Raphaeli*'s teachings about averaging propagation delays into *McCrady*'s system under two combination theories. Under the first theory, a "POSITA would have calculated the individual propagation delays (delay estimates) from the 'M' ranging message exchanges on various frequencies, and then averaged those delays as taught by *Raphaeli*." Petition at 8-9. Under Petitioner's second theory, "[t]he POSITA would have contemplated the alternative approach of conducting multiple of *McCrady*'s ranging message exchanges on a single frequency, determining corresponding delays, and averaging those delays as taught by *Raphaeli*." *Id.* at 9. Both theories fail because a POSITA would not be motivated to combine *Raphaeli*'s "averaging technique" with *McCrady*'s system.

McCrady's system is directed to a position location system that can effectively operate in a severe multipath interference environment. *See* Ex. 1005, 1:9-17; 3:54-58; 3:66-4:3; 6:20-27; Ex. 2006, ¶¶ 33-35. When a severe multipath environment is detected and a high accuracy mode for range resolution is selected, *McCrady* turns

to “frequency diversity to identify an optimal transmission frequency that minimizes multipath interference.” *Id.*, 14:35-40. Ex. 2006, ¶¶ 36-39. Through frequency diversity and the other accuracy enhancing measures it takes, for example with respect to internal delay estimates, McCrady can rapidly and effectively reduce the impacts of multipath interference on its range estimate calculations. *Id.*, ¶ 36.

Multipath “is a problem in which the transmitted information takes more than one path to the receiver, thus producing interference and echoes in the received signal” which in turn leads to time-dispersion of the received signal. Ex. 2006, ¶ 40; Ex. 2008, *Adaptive Signal Processing*, Widrow and Stearns, at pg. 200. As Dr. Mahon explains, multipath interference affects the time response of the channel and can vary significantly over time due to the changing time and frequency characteristics of the channel. Ex. 2006, ¶ 41. Multipath interference is also called “small-scale fading” and can produce several negative effects on the received signal. These negative effects include (i) rapid changes in signal strength over a short time period; (ii) frequency distortions due to Doppler shifts across separate multipath signals; and (iii) “copies” or echoes of the transmitted signal arriving at the receiver at different times due to the multiple propagation paths between the transmitter and receiver. *Id.*, ¶ 42; Ex. 2009, *Wireless Communications Principles & Practices*, Rappaport, at pg. 139. Sometimes the “copies” of the transmitted signal can arrive at the receiver significantly separated in time from each other. Ex. 2006, ¶ 42. Other

times, the overlap in time of the “copies” can have a cancelling effect on each other, resulting in rapid changes in signal strength, at certain times. *Id.*

Multipath interference can result from (i) the reflection and scattering of the electromagnetic propagation due to physical obstructions, such as in *McCrady's* urban and inside of buildings environments; (ii) relative motion of the transmitter and receiver causing short term variations in frequency, or Doppler shifts; and (iii) distortions based on the relationship of the signal bandwidth and the channel bandwidth, e.g., where the channel bandwidth is less than the signal bandwidth. *Id.*, ¶¶ 43-44; Ex. 2010, *Digital Communications Over Fading Channels, A Unified Approach to Performance Analysis*, Simon and Alouini, at pp. 15 – 28; Ex. 2011, *Digital Communications*, Proakis, at pp. 810–820; Ex. 2009, at pp. 140-141, 167.

To improve receiving quality in the face of severe multipath fading, there are several options, including equalization, frequency diversity, and channel coding for error correction. Ex. 2006, ¶ 45; Ex. 2009, at pg. 299. Frequency diversity can involve transmitting the same signal over multiple carrier frequencies with the expectation that one of the carriers will perform more robustly. Ex. 2006, ¶ 46; Ex. 2011, at pg. 821; Ex. 2009, at pg. 335; Ex. 2012, *Digital Modulation Techniques*, Xiong, at pg. 562. Frequency diversity can also involve transmitting a single signal having a bandwidth much greater than the coherence bandwidth of the channel, such that multipath components can be resolved through a rake receiver and combined to

“average out” the multipath interference. Ex. 2006, ¶ 47; Ex. 2011, at pp. 821–822; Ex. 1009, 11:66-12:27. The former method is applied by *McCrady* to achieve higher accuracy in severe multipath interference conditions by finding the optimal carrier frequency where the multipath effects are minimized, *i.e.*, to find the optimal multipath condition. Ex. 2006, ¶¶ 48-50.

Turning back to *McCrady*, when either the master radio or reference radio determines that multipath interference is substantial enough, the radio may declare the need for frequency diversity to select the single optimum instance/frequency with the best multipath, *i.e.*, least substantial, response. Ex. 1005, 15:14-47. In its first combination theory, Petitioner suggests that more than one of the “propagation delay” results of *McCrady*’s frequency diversity process could be averaged to produce a range estimation. Petition at 8-9. As Dr. Mahon explains, this amounts to combining the results of the ranging determination at the optimal frequency with a ranging determination at a non-optimal frequency and will necessarily yield something less accurate than the optimal result. Ex. 2006, ¶ 51. Even if there are multiple optimal results, the averaging of those results will yield no better than the single best result. *Id.* While increased accuracy is frequently desired, *McCrady*, by applying a Kalman filter to the position tracking estimates, already takes into consideration the fact that severe multipath interference will limit the attainable

degree of accuracy. Ex. 2006, ¶ 52; Ex. 2013, *Signal Processing for Intelligent Sensor Systems*, Swanson, at pp. 277 – 292; Ex. 2011, at pp. 683-688.

To a POSITA, the expected result on accuracy of the proposed combination of *Raphaeli's* “averaging technique” with *McCrady's* frequency diversity process will be neutral at best and highly likely negative. It will never be positive. A POSITA would therefore not have a reasonable expectation of success from the combination because a POSITA would understand the combination to yield an expected result that is *contrary to the intended purpose of increased accuracy*. Ex. 2006, ¶¶ 53-55. Furthermore, the proposed combination would entail increased complexity and result in time delays. *Id.*, ¶ 56. A frequency diversity approach that involves averaging, *i.e.*, the approach that involves transmitting a single signal would also entail increased complexity and would only estimate a single propagation delay. *Id.*, ¶ 57. Consequently, a POSITA would be motivated not to make the combination.

There must be an apparent reason for one of ordinary skill in the art to combine known elements in the fashion claimed by the patent at issue. The analysis should be explicit. *See KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 418 (2014), citing *In re Kahn*, 441 F.3d 977, 988 (Fed. Cir. 2014). A conclusion of obviousness requires a reasonable expectation of success. “When there is a design need or market pressure to solve a problem and there are a finite number of identified, predictable

solutions, a person of ordinary skill has good reason to pursue the known options within his or her technical grasp. *If this leads to the anticipated success*, it is likely the product not of innovation but of ordinary skill and common sense. In that instance the fact that a combination was obvious to try might show that it was obvious under § 103.” *KSR*, 550 U.S. 398, 421 (emphasis added). “Although predictability is a touchstone of obviousness, the ‘predictable result’ discussed in *KSR* refers not only to the expectation that prior art elements are capable of being physically combined, *but also that the combination would have worked for its intended purpose.*” *DePuy Spine, Inc. v. Medtronic Sofamor Danek, Inc.*, 567 F.3d 1314, 1326 (Fed. Cir. 2009) (emphasis added).

In the present circumstances, the proposed combination of *Raphaeli*’s “averaging technique” with *McCrady*’s frequency diversity process would not have worked for the intended purpose of increased accuracy. To a POSITA, there would not be a reasonable expectation of success in making the proposed combination and the combination would not have yielded a predictable result. *See In re Gordon*, 733 F.2d 900, 902 (Fed. Cir. 1984) (finding no reason to modify a prior art device where the modification would render the device “inoperable for its intended purpose”). A POSITA would not be motivated to make the proposed combination. The Petition fails to establish that the claims of the ’779 Patent would be obvious over *McCrady* in view of *Raphaeli* under the first combination theory.

Petitioner's second combination theory, that a POSITA would perform an additional range estimation, either at a single default frequency or at *McCrady's* "optimal frequency" similarly fails.² Due to the time-varying nature of the effects of multipath interference, the response of the channel may change significantly from transmission to transmission (i.e., from one transmission of the ranging reply to a subsequent repeated transmission of the same ranging reply message). Ex. 2006, ¶¶ 40-45, 59-65; Ex. 2008, Fig. 9.5; Ex. 2011, at pg. 801; Ex. 2009, at pg. 167, 168. This is especially true in *McCrady's* severe multipath environment where the master radio is in use by military, police, firefighters or emergency rescue personnel and is thus continuously moving in a setting with a strong indication towards reflection and scattering, i.e., an "urban area" or "inside buildings." Ex. 2006, ¶ 44 (identifying reflection, refraction, and scattering occurring in the channel and relative motion of the transmitter and receiver as elements of the channel that may be responsible for small-scale fading effects). The proposed combination will, at best, yield a neutral result, but will more likely introduce larger estimation errors into the range estimation process and, hence, result in decreased accuracy. *Id.*, ¶¶ 65-67.

² Notably, the Petition only references multiple range estimations at a single frequency, but does not raise the possibility of taking multiple range estimations at the "optimal frequency" determined in *McCrady's* frequency diversity process. *See, e.g.*, Petition at 9-10.

Consequently, the proposed combination of *Raphaeli*'s "averaging technique" with *McCradly* under the Petition's second theory would not have worked for the intended purpose of increased accuracy. To a POSITA, there would not be a reasonable expectation of success in making the proposed combination and the combination would not have yielded a predictable result. A POSITA would not be motivated to make the proposed combination. Like the first combination theory, the Petition fails to establish that the claims of the '779 Patent would be obvious over *McCradly* in view of *Raphaeli* under the second combination theory.

VII. Ground 4 Fails Because the Petition Fails to Motivate its Combination of *Rofheart* with *Raphaeli*

Ground 4 of the Petition proposes a combination of *Rofheart* with *Raphaeli*, *inter alia*, to allege invalidity of challenged claims 1-6 and 8-34. In particular, the proposed combination addresses *Rofheart*'s failure to teach the estimation of a single range based upon a plurality of determined propagation delays. *See* Petition at 54-55 ("A POSITA motivated to incorporate an averaging technique, such as described by *Raphaeli*, would have appreciated the need for *Rofheart*'s system to conduct multiple ranging message exchanges and calculate multiple corresponding propagation delays. ... ") In other words, the POSITA would have contemplated conducting multiple of *Rofheart*'s ranging message exchanges, determining corresponding delays, and averaging those delays as taught by *Raphaeli*.").

As discussed below, the Petition fails to show that a POSITA would have found it obvious to use *Raphaeli*'s "averaging technique" for estimation of a single range with *Rofheart*'s range determination system.

A. The Petition's Rationale to Consider *Raphaeli*'s Average Calculations in View of *Rofheart* is Unsupported.

Petitioner asserts that:

- "A POSITA looking to improve Rofheart's system would have been familiar with references such as *Raphaeli* because both describe distance determination of wireless devices. Further, as discussed above, both describe message exchanges and measuring the round-trip delay. Also, both employ wireless technology such as ultra wide band (UWB). It is therefore no surprise that a POSITA would have been motivated to pursue the Rofheart-Raphaeli-Godfrey combination for multiple reasons. Petition at 55 (citations omitted).
- "[A] POSITA would have expected *Raphaeli*'s teaching on averaging multiple propagation delays to predictably improve a similar system like Rofheart's by enhancing the precision of the estimated range ... *Raphaeli*'s express disclosure on this precision advantage would have reinforced the POSITA's understanding." *Id.* (citations omitted).
- "[E]ven without *Raphaeli*'s observation of improved precision, a POSITA would have recognized that unknown/random error(s) exists in the individual propagation delay estimates described by Rofheart/*Raphaeli* due to channel noises, interferences, measurement errors, etc. Thus, the POSITA would have sought to employ known methods for the purpose of obtaining a more precise representation of the delay estimate." *Id.* at 56 (citations omitted).
- "[A] POSITA would have been motivated to incorporate *Raphaeli*'s averaging technique based on an understanding that the concomitant accuracy and precision benefits of this approach would be particularly advantageous in Rofheart's system. For example, Rofheart describes embodiments where accuracy and precision are of paramount importance because the ability of a remote device to transact with the

local device depends on the relative distance between the two.” *Id.* at 56-57 (citations omitted).

None of the Petitioner's cited reasons factually or legally support the obviousness contention with respect to the combination of *Rofheart* and *Raphaeli*. First, Petitioner's identification of *Rofheart* and *Raphaeli* as being on the “common subject of determining the distance to a wireless device” is essentially asserting that a POSITA would be motivated to combine *Rofheart* and *Raphaeli* because they are analogous prior art. But it is well settled that this does not factor into determining whether a POSITA would have a motivation to combine the references. “Analogous art is merely a threshold inquiry as to whether a reference can be considered in an obviousness analysis. Demonstrating that a reference is analogous art or relevant to the field of endeavor of the challenged patent is not sufficient to establish that one of ordinary skill would have had reason to combine its teachings with other prior art in the manner set forth in the claim.” *Johns Manville Corp. v. Knauf Insulation, Inc.*, IPR2018-00827, 2018 WL 5098902, at *4 (PTAB Oct. 16, 2018) (citing *Securus Techs., Inc. v. Global Tel*Link Corp.*, 701 F. App'x 971, 977 (Fed. Cir. 2017)).

Next, Petitioner alleges that a “POSITA would have expected *Raphaeli*'s teaching on averaging multiple propagation delays to predictably improve a similar system like *Rofheart*'s by enhancing the precision of the estimated range *Raphaeli*'s express disclosure on this precision advantage would have reinforced the POSITA's understanding.” Petition at 55 (citations omitted). Petitioner's assertions are

unfounded and fail to show that a POSITA would have a motivation to combine *Rofheart* and *Raphaeli*.

As an initial matter, Petitioner appears to misunderstand *Raphaeli*'s averaging technique. As set forth in Section III.B, *supra*, because *Raphaeli*'s tag introduces timing discrepancies to effectuate data modulation, *Raphaeli*'s averaging technique is necessary to establish timing to discern the 1s and 0s coming from the tag. Furthermore, Petitioner presents no detail or analysis with respect to the accuracy of *Rofheart*'s range determining system. That is unsurprising because a POSITA, reading the descriptions of the system and goals of *Rofheart*, would recognize that *Rofheart* has already implemented accuracy that significantly *exceeds* the needs of the system. As such, a POSITA would not be motivated to look to *Raphaeli* to improve the accuracy of *Rofheart*'s system.

Rofheart's system "provides a **simplified** method for enabling communications between a local wireless device and a remote wireless device based on the distance between the wireless devices." Ex. 1009, 16:39-42 (emphasis added). A "local device automatically enables and blocks data communications with remote devices based on the remote device's distance from the local device thereby providing a dynamic network." *Id.*, 23:51-54. The remote devices, as well as the local device, could be mobile telephones, laptop computers, personal digital assistants (PDAs), or fixed devices such as a retail store kiosk. *Id.*, 17:25-30.

Rofheart gives examples of the environments the system is designed for, including conference rooms and retail stores. *Id.*, 2:29-48. The remote devices contemplated by *Rofheart*, such as mobile telephones, laptops, PDAs, retail kiosks, etc., are either stationary or slow moving in these environments.

Rofheart also teaches that the accuracy of a single UWB-signal-based range estimate is sufficient. *See id.*, 18:37-42 (“Because the range resolution is on the order of centimeters, the probability of having remote devices at equal distances is very low and the local device 301 can differentiate between remote devices 302 through 300N based on the distance determined for each device.”); *see also id.*, 17:7-12 (“[A]s realized by the present inventors, a local UWB device can compute a unique distance to remote UWB devices as long as the actual distance from the local device to each remote device differs on the order of centimeters which is a common scenario for current uses of wireless devices such as PDAs.”). Although *Rofheart* states that “an ultra wide bandwidth system having 3 GHz of bandwidth has a range resolution of 1 meters,” a POSITA would understand that range resolution to be 0.1 meters. Ex. 2006, ¶ 69.

Indeed, *Rofheart* provides no indication of why accuracy better than centimeters would be contemplated. *See id.*, 19:13-16 (“[I]t should be clear to one of ordinary skill in the art that virtually any function of the local device 301 may be accomplished based on distance information obtained in accordance with the present

invention.”). Nor would a POSITA, reading *Rofheart*, need to contemplate enhanced accuracy, because *Rofheart* provides the details of the components and operation of a system that already has more than adequate accuracy. Ex. 2006, ¶ 69 (explaining *Rofheart* range resolution of less than 4 inches), ¶ 70 (explaining that any increase in range estimation accuracy to be on the order of fractions of an inch). Petitioner has not identified any reason why a POSITA, contemplating the teachings of *Rofheart*'s system, would be motivated to look to other references to improve the accuracy of *Rofheart*'s range determinations.

B. The Petition Identifies No Benefit for its Proposed Combination.

Petitioner also urges that using the “concomitant accuracy and precision benefits of this approach would be particularly advantageous in *Rofheart*'s system. For example, *Rofheart* describes embodiments where accuracy and precision are of paramount importance because the ability of a remote device to transact with the local device depends on the relative distance between the two.” Petition at 56-57 (citations omitted). This is a merely conclusory statement as to purported benefits from the combination. Neither the Petition nor Dr. Ding discuss in any detail (i) the sufficiency of accuracy of *Rofheart*'s system in its unmodified form (“on the order of centimeters,” Ex. 1009, 17:7-12; Ex. 2006, ¶ 69); (ii) what potential “errors” *Rofheart*'s system faces in its unmodified form; (iii) how those potential “errors” impact the performance of *Rofheart*'s system in its unmodified form in light of

Rofheart's already high degree of accuracy (Ex. 2006, ¶ 70); (iv) the degree to which the potential “errors” would be reduced if *Rofheart's* system were modified as suggested (*Id.*); and, *most importantly*, (v) how and why *Rofheart's* system would ***benefit, let alone overcome the drawbacks***, from the proposed combination (*Id.*, ¶¶ 70-72). Petitioner's explanation as to the purported benefit is inadequate. Taken to its logical conclusion, Petitioner's argument would allow a POSITA to find any modification to *Rofheart* that improves accuracy, even in the slightest without regard to drawbacks, to be beneficial. This is inconsistent with the law of obviousness.

The absence of evidence for any specific benefit from the combination of *Rofheart* and *Raphaeli* is strong evidence against obviousness. As the Court explained in *KSR*:

Although common sense directs one to look with care at a patent application that claims as innovation the combination of two known devices according to their established functions, *it can be important to identify a **reason** that would have prompted a person of ordinary skill in the relevant field to combine the elements in the way the claimed new invention does.* This is so because inventions in most, if not all, instances rely upon building blocks long since uncovered, and claimed discoveries almost of necessity will be combinations of what, in some sense, is already known.

KSR, 550 U.S. 398, 418–19; *see also id.* at 424 (“The proper question to have asked was whether a [POSITA] ... would have seen a ***benefit*** to upgrading Asano with a sensor.”); *Ex Parte Debates*, Appeal No. 2020-006536, 2022 WL 263587, at *4

(PTAB Jan. 27, 2022) (reversing examiner's obviousness rejection because it was "too general and [was] not tailored to explaining why one skilled in the art would have seen the *benefit* of modifying Lerner's electronic device and tag reading method to include the specific overlay features of Detlefsen"); *Duo Sec. Inc. v. Strikeforce Techs., Inc.*, IPR2017-01041, 2017 WL 4677235, at *9 (PTAB Oct. 16, 2017) (finding no motivation to combine where "Petitioner *never identifies or explains adequately any benefit or improvement* gained by adding Falk, and specifically, Falk's relevant message, to the proposed combination of Feigen and Bulfer" (emphasis added)); *Ex Parte Brillowska-Dabrowska*, Appeal No. 2016-006485, 2016 WL 4525004, at *4 (PTAB Aug. 24, 2016) (reversing rejection based on a combination of references where it was "unclear why" the combination "would be particularly useful").

The Petition's failure to show that a POSITA *would have been motivated* to make its proposed combination is shown by the Petition's failure to articulate in detail how *Rofheart* would benefit from the enhanced accuracy that the proposed combination allegedly provides—much less consider any supposed benefits and weigh them *against the significant drawbacks* to the combination that a POSITA would have recognized. Ex. 2006, ¶¶ 69-72; see *Johns-Manville Corp.*, 2018 WL 5098902, at *6 ("An unsupported statement that combining the teachings of the two references would have been 'well within the skill of a POSA,' because the results of

reacting a reducing sugar with an amine reactant 'were well-known and predictable' does not meet Petitioner's burden.").

In summary, the Petition fails to compare the performance of *Rofheart's* range determining system in its unmodified form with the Petitioner's proposed addition of *Raphaeli's* averaging technique. Nor does the Petition adequately identify any affirmative reason a POSITA would have had to make the proposed modification. Furthermore, as explained below, the Petition's proposed modification not only lacks benefits, but also includes drawbacks that contradict *Rofheart's* design goals, causing a POSITA to avoid making that combination. Ex. 2006, ¶¶ 69-72.

C. A POSITA Would Have Further Avoided the Petition's Proposed Combination Because the Effects of that Combination Would Be Contrary to *Rofheart's* Design Goals.

As discussed above, the Petition provides no articulation or explanation of the alleged benefit of modifying *Rofheart's* range estimation to be based upon a plurality of determined propagation delays. However, even if the Petition *had* made such a showing, the inquiry would not end there, because obviousness cannot be established based solely on an allegation of benefits. Instead, the countervailing drawbacks or losses from pursuing a proposed modification must be evaluated to determine whether the proposed modification is "on balance, desirable." *Winner Int'l Royalty Corp. v. Wang*, 202 F.3d 1340, 1349 (Fed. Cir. 2000) ("Trade-offs often concern what is feasible, not what is, on balance, desirable. Motivation to combine requires

the latter.”). Accordingly, “the benefits, both lost and gained, should be weighed against one another.” *Id.* at 1349 n.8.

Neither Petitioner nor Dr. Ding discuss the potential drawbacks to *Rofheart* from the proposed modification, but a POSITA would have recognized drawbacks in the form of lost transmit time. *Rofheart* notes that the local device 301 has transmit time, or data transmission resource, limitations, *see* Ex. 1009, 19:59-62, and proposes that “[e]ach unique link 312, 313, and 315N is a low level communications link that is ***allocated a minimal amount of transmit time available to the local device 301*** ... [and] is preferably an amount that is sufficient for the local device 301 to maintain awareness of the presence of the remote devices 302 through 300N and to determine and update distance to each linked remote device,” *id.*, 21:15-22 (emphasis added). *See also id.*, 22:21-25 (“[T]he local device 301 ***allocates a minimal amount of available transmit time*** to unique links associated with blocked remote devices, and a relatively large amount of transmit time to unique links associated with enabled remote devices.”) (emphasis added); 22:25-30 (“[t]he minimal transmit time allocated to each unique link associated with a remote device that has not satisfied the authentication criteria is preferably an amount sufficient to transmit a simple distance determining message so that the local device 301 can update the distance information for blocked remote devices”).

Rofheart sets a clear goal of maximizing the allocation of transmit time on the UWB links 312, 313, and 315N for enabled communications between the local device 301 and the remote devices 302 through 300N. To do so, *Rofheart* also sets a clear goal of *minimizing the allocation of transmit time to the transmission of distance determining messages* and the corresponding responses on the UWB links 312, 313, and 315N. Ex. 2006, ¶ 71. Petitioner proposes modifying *Rofheart* to include a second “propagation delay” calculation. To accomplish this modification, an additional distance determining message, along with a corresponding response, must be transmitted.

To support transmission of the additional messages and responses to the remote devices 302 through 300N in the same amount of time, *Rofheart* system would have to *double* the allocation of transmit time on the UWB links 312, 313, and 315N. Ex. 2006, ¶ 71. This runs contrary to *Rofheart*'s goal of minimizing the allocation of transmit time to the transmission of distance determining messages and the corresponding responses. *Id.* A POSITA would be *discouraged* from making this modification absent some countervailing benefit that a POSITA would view as trumping the loss of transmit time on the UWB links for enabled communications between the local device and the remote devices. Petitioner's conclusory assertion that a POSITA would recognize a benefit from increased accuracy as a result of the combination is insufficient to be considered such a countervailing benefit. *Id.*, ¶ 72.

These drawbacks of the Petition's proposed combination (which the Petition fails to address) are strong evidence of non-obviousness. *See Ex Parte Shigetoshi Ito & Daisuke Hanaoka*, Appeal No. 2010-003391, 2012 WL 3041144, at *4 (BPAI July 23, 2012) (“[T]he Examiner relied on impermissible hindsight.... Since Harding strives to increase cooling, one skilled in the art would have been discouraged from modifying Harding's device with Ootsuka's nonconductive, thermally insulating, cap.”); *see also Trivascular, Inc. v. Samuels*, 812 F.3d 1056, 1068 (Fed. Cir. 2016) (finding no motivation to modify the prior art where doing so “would destroy the basic objective” of the prior art); *In re Gordon*, 733 F.2d at 902 (finding no reason to modify a prior art device where the modification would render the device “inoperable for its intended purpose”); *Google LLC f/k/a Google Inc. v. Singular Computing LLC*, IPR2021-00155, Paper 62, at 74 (PTAB May 23, 2022) (“Petitioner's asserted combination ... would ... defeat[] MacMillan's stated objective of achieving a highly parallel SIMD computer architecture at lower system cost”) (internal quotations omitted).

Furthermore, “[u]nder the proper legal standard, a reference will teach away when it suggests that the developments flowing from its disclosures are unlikely to produce the objective of the applicant's invention.” *Syntex (U.S.A.) LLC v. Apotex, Inc.*, 407 F.3d 1371, 1380 (Fed. Cir. 2005) (citing *In re Gurley*, 27 F.3d 551, 553 (Fed. Cir. 1994)). Teaching away requires a reference to “criticize, discredit, or

otherwise discourage investigation into the claimed invention.” *Meiresonne v. Google, Inc.*, 849 F.3d 1379, 1382 (Fed. Cir. 2017). A reference teaches away “when a person of ordinary skill, upon reading the reference, would be discouraged from following the path set out in the reference, or would be led in a direction divergent from the path that was taken.” *DePuy Spine*, 567 F.3d at 1327.

By discouraging the use of anything beyond a minimal allocation of transmit time, *Rofheart* teaches away from using more than one ranging message to determine the distance of a remote device between the local device 301 and the remote devices 302 through 300N over UWB links 312, 313, and 315N. As a result of such teaching away, the possibility of rendering a claim obvious based on the combination of *Rofheart* with *Raphaeli* is negated. See *In re Mouttet*, 686 F.3d 1322, 1333 (Fed. Cir. 2012). Consequently, Petitioner's proposed combination of *Rofheart* with *Raphaeli* cannot render the challenged claims of the '779 Patent obvious.

D. The Petition's Combination is Supported Only by Hindsight.

Petitioner does not compare the overall performance of *Rofheart's* system in its unmodified form to the overall performance with the proposed modification from *Raphaeli*, such that a POSITA, when considering the benefits and drawbacks, would find it prudent to make the modification to *Rofheart*. The Petition necessarily arrives at its proposed combination through the impermissible use of hindsight. The Petition's hindsight-motivated approach should be rejected. See *In re NTP, Inc.*, 654

F.3d 1279, 1299 (Fed. Cir. 2011) (“Care must be taken to avoid hindsight reconstruction by using ‘the patent in suit as a guide through the maze of prior art references, combining the right references in the right way so as to achieve the result of the claims in suit.’”) (quoting *Grain Processing Corp. v. American–Maize Prods. Co.*, 840 F.2d 902, 907 (Fed. Cir. 1988)).

In *NTP*, the Federal Circuit reviewed the Board’s rejection of certain claims of a patent application and acknowledged that all claim elements were disclosed separately in the prior art. *Id.* (noting that “the Board’s findings regarding the content of the references are supported by substantial evidence”). Nevertheless, the court reversed the Board’s rejections because the Board “improperly relied on hindsight reasoning to piece together elements to arrive at the claimed invention.” *Id.* The court criticized the Board for “carv[ing] out” a claim limitation from one reference for combination with applicant’s admitted prior art (“AAPA”), explaining: “This type of piecemeal analysis is precisely the kind of hindsight that the Board must not engage in.” *Id.*

The Petition improperly engages in exactly this type of “piecemeal analysis” by carving out a particular feature of *Raphaeli* for use in *Rofheart*—the use of an “averaging technique” applied to multiple determined propagation delays in the estimation of a single range—while failing to compare the goals and operation of *Rofheart* both with and without that feature. Absent any articulated, rational

explanation as to why a POSITA would have been motivated to arrive at the challenged claims, the Petition can only arrive at its conclusion of obviousness with the benefit of improper hindsight. *See Ex Parte Masashi Hayakawa*, Appeal No. 2020-006550, 2021 WL 6133976, at *4 (PTAB Dec. 27, 2021) (“Without any explanation as to how or why the references would be combined to arrive at the claimed invention, we are left with only hindsight bias that *KSR* warns against.”). And the impropriety of the Petition’s hindsight-motivated approach is further underscored because, as discussed above, a POSITA would have been discouraged from making the proposed combination in view of the combination’s drawbacks. *See Ex Parte Shigetoshi Ito & Daisuke Hanaoka*, 2012 WL 3041144, at *4 (“[T]he Examiner relied on impermissible hindsight.... Since Harding strives to increase cooling, one skilled in the art would have been discouraged from modifying Harding’s device with Ootsuka’s nonconductive, thermally insulating, cap.”).

In sum, the Petition’s hindsight-guided approach to obviousness should be rejected. *See NTP*, 654 F.3d at 1299.

VIII. Conclusion

As set forth above, a POSITA would ***not*** have been motivated to combine *Raphaeli*’s “averaging technique” with *McCrady* because of the negative effect on *McCrady*’s range estimation process. For this reason, the Petition cannot show any challenged claims to be unpatentable under Grounds 1, 2 or 3.

With respect to the proposed combination of *Rofheart* and *Raphaeli*, the Petition fails to either adequately explain any benefit that a POSITA would recognize from the proposed combination or analyze the drawbacks of the proposed combination—drawbacks that run contrary to *Rofheart*'s stated goal of minimizing the transmit time allocated to range messaging. A POSITA would thus *not* have been motivated to make the proposed combination. For this reason, the Petition cannot show any challenged claim in Ground 4 to be unpatentable.

For all of the reasons above, Patent Owner respectfully requests that all challenged claims be found not unpatentable.

Respectfully submitted,

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Lead counsel for Patent Owner

Date: August 28, 2023

CERTIFICATION REGARDING WORD COUNT

Pursuant to 37 C.F.R. § 42.24(d), Patent Owner certifies that there are 12,305 words in the paper excluding the portions exempted under 37 C.F.R. § 42.24(a)(1).

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CERTIFICATE OF SERVICE (37 C.F.R. § 42.6(e))

The undersigned hereby certifies that the above document was served on August 28, 2023, by filing this document through the Patent Trial and Appeal Case Tracking System as well as delivering a copy via electronic mail upon the following attorneys of record for the Petitioner:

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