

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

SIEMENS MOBILITY, INC.,
GROUND TRANSPORTATION SYSTEMS USA INC.,
HUMATICS CORP., and PIPER NETWORKS, INC.,
Petitioner,

v.

METROM RAIL, LLC,
Patent Owner.

IPR2023-00468
Patent 9,043,131 B2

Before JAMES P. CALVE, HYUN J. JUNG, and NEIL T. POWELL,
Administrative Patent Judges.

CALVE, *Administrative Patent Judge.*

DECISION
Granting Institution of *Inter Partes* Review
35 U.S.C. § 314

I. BACKGROUND

Siemens Mobility, Inc., Ground Transportation Systems USA Inc., Humatics Corp., and Piper Networks, Inc. (collectively, “Petitioner”) filed a petition requesting *inter partes* review of claims 1–20 (the “challenged claims”) of U.S. Patent No. 9,043,131 B2 (“the ’131 patent”) (Ex. 1001). Paper 5, 1 (“Pet.”). Metrom Rail LLC (“Patent Owner”) timely filed a Preliminary Response. Paper 9 (“Prelim. Resp.”).

We have authority to determine whether to institute an *inter partes* review. *See* 35 U.S.C. § 314 (2018); 37 C.F.R. § 42.4(a) (2022). An *inter partes* review may not be instituted “unless . . . the information presented in the petition . . . shows that there is a reasonable likelihood that the petitioner would prevail with respect to at least 1 of the claims challenged in the petition.” 35 U.S.C. § 314(a). Upon consideration of the evidence and arguments in the record, we determine that the information presented shows a reasonable likelihood that Petitioner would prevail with respect to at least one of the challenged claims. We therefore grant institution of an *inter partes* review. *See* 37 C.F.R. § 42.108(a) (“When instituting . . . review, the Board will authorize the review to proceed on all of the challenged claims and on all grounds of unpatentability asserted for each claim.”).

A. Related Proceedings

The parties identify the following proceeding involving the ’131 patent: *Metrom Rail, LLC v. Siemens Mobility, Inc.*, Case No. 1:22-cv-00049-RGA (D. Del. filed Jan. 13, 2022). Pet. viii; Paper 7, 3. Patent Owner states, “IPR2023-00439, IPR2023-00452, IPR2023-00460 and IPR2023-00470 involve the same parties as this proceeding.” Paper 7, 3.

B. Real Parties in Interest

Petitioner identifies Siemens Mobility, Inc., Ground Transportation Systems USA Inc., Humatics Corp., Piper Networks, Inc., and Thales USA, Inc. as the real parties in interest. Pet. viii. Patent Owner identifies Metrom Rail, LLC as the sole real party in interest. Paper 7, 2.

C. The '131 patent (Ex. 1001)

The '131 patent describes collision avoidance systems (CASs) used in the railroad industry (Ex. 1001, 1:20–21) to control maintenance equipment, vehicles, railcars, hyrail vehicles, train cars, train engines, and other rail line vehicles (*id.* at 3:46–63, Figs. 1A–1C, 2). Figure 1C depicts a hyrail vehicle that operates on railroad tracks *and roads* (*id.* at 3:54) and includes a CAS (*see id.* at 3:55–63, Fig. 2 (vehicle 204)). The '131 patent's CAS technology may be used in other vehicles, applications, and industries where vehicle spacing, location, and status are important including the construction, mining, and airport (on airport tarmacs) industries. *Id.* at 29:33–41.

The CAS 300 includes four main components types of (1) transponder sensor modules (TSMs) 306, 308, (2) control electronics modules (CEMs) 310, 312, (3) user interface modules (UIMs) 314, 316, and (4) central tracking unit (CTU) 318. Ex. 1001, 6:8–13. When a group of modules such as TSM 306, CEM 310, and UIM 314 are located in or on a single vehicle 302, they are referred to collectively as a vehicle mounted module (VMM) even though individual modules and components may or may not be housed in a unitary package or enclosure. *Id.* at 6:13–19, Fig. 3.

Figure 3 of the '131 patent is reproduced below to illustrate CAS 300 in which CTU 318 is configured in discrete housing 320 to receive location, speed, and separation distance from VMMs on vehicles 302, 304.

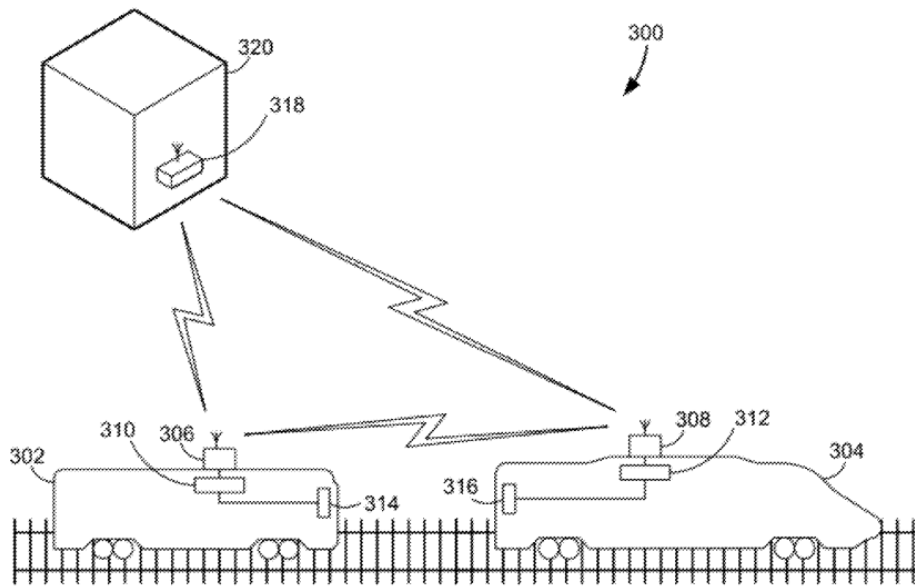


Fig. 3

Figure 3 depicts CTU 318 receiving data from VMMs (TSM 306/308, CEM 310/312, UIM 314/316) on rail vehicles 302, 304. Ex. 1001, 6:4–56. CTUs may be dispersed in VMMs as shown in Figure 4, reproduced below.

Fig. 4

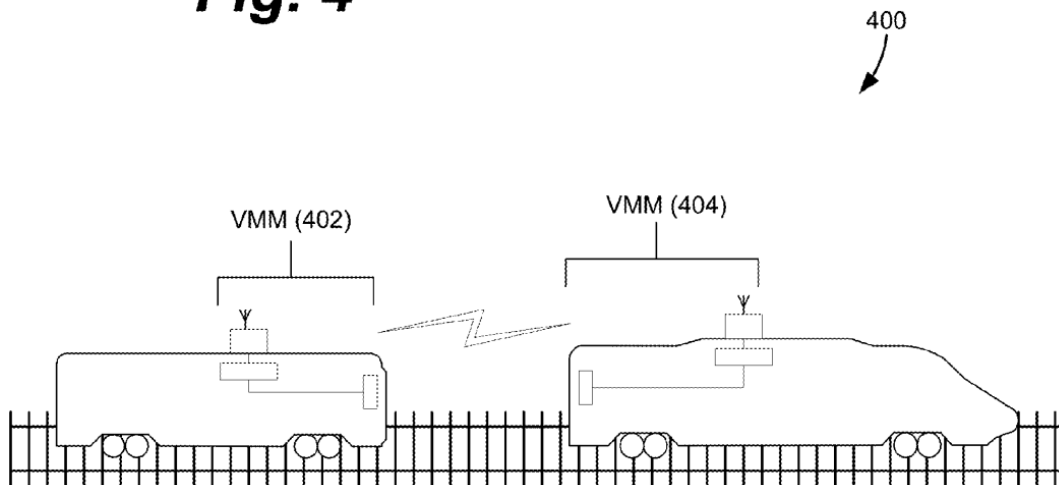


Figure 4 depicts CTUs dispersed in VMMs 402, 404 of each vehicle to track the location of other vehicles in a work gang. Ex. 1001, 6:57–7:8.

Figure 6 is reproduced below to depict the configuration of a VMM.

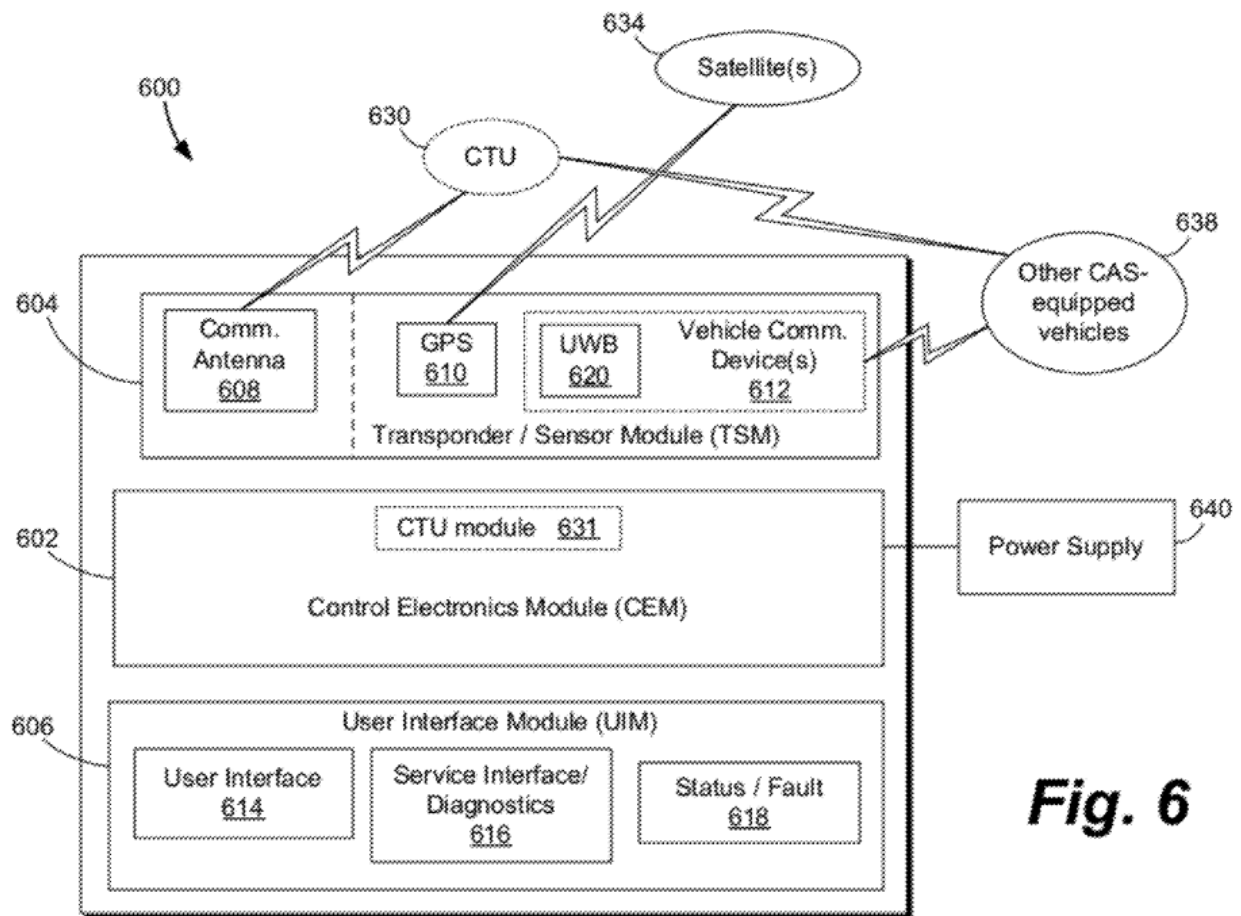


Fig. 6

Figure 6 is a block diagram of VMM 600 with CEM 602, TSM 604 and UIM 606. Ex. 1001, 7:33–50. TSM 604 includes wireless antenna 608 to send and receive data, GPS unit 610, and ultra-wideband (UWB) unit 620. *Id.* at 7:38–44. VMM 600 may transmit absolute position, relative position, and vehicle speed obtained from GPS unit 610, UWB unit 620, and/or other sensors to CTUs 631/630. *Id.* at 7:63–8:1. VMM 600 may gather absolute position data from satellites 634 using GPS unit 610. *Id.* at 8:4–7. User interface 614 may be located in a crew area/passenger cab. *Id.* at 8:51–52.

CEM 700 may use inertial measurement unit 710 with accelerometers and gyroscopes to detect changes in vehicle speed. *Id.* at 9:60–10:5, Fig. 7.

D. Challenged Claims

Petitioner challenges claims 1–20 of the '131 patent. Pet. 1–4. Claims 1 and 17 are independent. Claims 2–16 depend from claim 1. Claims 18–20 depend from claim 17. Ex. 1001, 30:44–33:31 (the '131 patent claims). Claim 1 is reproduced below with Petitioner's annotations.

[1-Pre] A collision avoidance system comprising:

[1A] a first vehicle mounted module mounted on a first rail vehicle, the first vehicle mounted module comprising:

[1B] a first transponder sensor module operable to send and receive data wirelessly, the first transponder sensor module comprising a first radio communication unit and a first antenna;

[1C] a first control electronics module comprising a first processor in communication with at least the first transponder sensor module; and

[1D] a first user interface module including a first user interface, the first user interface operable to provide rail vehicle information to a vehicle operator and to receive input from the vehicle operator;

[1E] a second vehicle mounted module mounted on a second rail vehicle, the second vehicle mounted module comprising:

[1F] a second transponder sensor module operable to send and receive data wirelessly, the second transponder sensor module comprising a second radio communication unit and a second antenna;

[1G] a second control electronics module comprising a second processor in communication with at least the second transponder sensor module; and

[1H] a second user interface module including a second user interface, the second user interface operable to provide rail vehicle information to the vehicle operator and to receive input from the vehicle operator;

[1I] wherein the first vehicle mounted module is operable to communicate with the second vehicle mounted module mounted on the second rail vehicle; and

[1J] the first vehicle mounted module and the second vehicle mounted module are operable to apply a time of flight technique to determine a separation distance between the first rail vehicle and the second rail vehicle.

Ex. 1001, 30:44–31:12; *see* Pet. 84 (Appendix of Challenged Claims).¹

E. Asserted Grounds of Unpatentability

Ground	Challenged Claim(s)	35 U.S.C. §	Reference(s)
1A	1, 11, 14	103(a) ²	Grisham ³
1B	2–4	103(a)	Grisham, Douglas ⁴
1C	5, 6	103(a)	Grisham, Richardson ⁵
1D	10	103(a)	Grisham, McDaniel ⁶
1E	12, 13	103(a)	Grisham, Breed ⁷

¹ We adopt Petitioner’s designations of claim elements. Pet. 9–76, 84–88.

² The Leahy-Smith America Invents Act (“AIA”) included revisions to 35 U.S.C. § 103 that became effective on March 16, 2013. Changes made to 35 U.S.C. § 103 in the AIA do not apply to any application for patent filed before March 16, 2013. Because the ’131 patent has an effective filing date before March 16, 2013, we refer to the pre-AIA versions of § 103.

³ US 6,759,948 B2, issued July 6, 2004 (Ex. 1006, “Grisham”).

⁴ US 8,874,359 B2, issued Oct. 28, 2014 (Ex. 1011, “Douglas”).

⁵ Richardson, P., *An outdoor UWB tracking system to improve safety of semi-autonomous vehicle operations*, 1 INT. J. ULTRA WIDEBAND COMMUNICATIONS AND SYSTEMS 3:209–221, 2010 (Ex. 1008, “Richardson”).

⁶ US 2007/0255498 A1, published Nov. 1, 2007 (Ex. 1015, “McDaniel”).

⁷ US 2010/0052945 A1, published Mar. 4, 2010 (Ex. 1014, “Breed”).

1F	15	103(a)	Grisham, Connell ⁸
2A	7–9, 17, 19	103(a)	Grisham, Nixon ⁹
2B	16	103(a)	Grisham, Nixon, Connell, McDaniel
2C	18	103(a)	Grisham, Nixon, Richardson
2D	20	103(a)	Grisham, Nixon, Richardson, Douglas
3A	1, 7, 8, 11–14, 17	103(a)	Suzuki ¹⁰ or (Suzuki, Grisham)
3B	2–6, 18, 20	103(a)	(Suzuki, Richardson) or (Suzuki, Grisham, Richardson)
3C	9, 19	103(a)	(Suzuki, Nixon) or (Suzuki, Grisham, Nixon)
3D	10	103(a)	(Suzuki, McDaniel) or (Suzuki, Grisham, McDaniel)
3E	15	103(a)	(Suzuki, Connell) or (Suzuki, Grisham, Connell)
3F	16	103(a)	(Suzuki, Nixon, Connell, McDaniel) or (Suzuki, Grisham, Nixon, Connell, McDaniel)

Petitioner relies on a Declaration of Mr. Scott Andrews. Ex. 1003.
Patent Owner does not provide a declaration in support of its contentions.

⁸ US 2009/0255329 A1, published Oct. 15, 2009 (Ex. 1012, “Connell”).

⁹ WO 03/009254 A1, published Jan. 30, 2003 (Ex. 1016, “Nixon”).

¹⁰ EP 1 785 744 A1, published May 16, 2007 (Ex. 1005, “Suzuki”).

II. DISCUSSION

A. Level of Ordinary Skill in the Art

Petitioner asserts that a person of ordinary skill in the art “would have had a background in wireless electronics, including at least a bachelor’s degree in electrical engineering or a related field, and would have at least two years of experience with using such electronics for control systems applications such as collision-avoidance systems or positioning systems.” Pet. 7 (citing Ex. 1003 ¶¶ 23–28).

Patent Owner contends that Petitioner’s definition of a person of ordinary skill in the art (“POSITA”) should reflect that positioning systems are for rail-line vehicles and railway systems (Prelim. Resp. 3–5) as follows:

POSITAs would have had a background in wireless electronics, including at least a bachelor’s degree in electrical engineering or a related field, and would have at least two years of experience with using such electronics for control systems applications such as railway collision-avoidance systems or railway positioning systems.

Prelim. Resp. 5.

The ’131 patent provides some guidance on this issue. Specifically, the ’131 patent explains to the skilled artisan that

Although the present disclosure describes a collision avoidance system that may be applied to a work gang of railroad vehicles, the technology and the concepts described herein may be utilized in other vehicles, applications and/or industries, for example, in industries where spacing, location and status is important. Some industries that may utilize the concepts described herein are (1) the construction industry, (2) the mining industry, (3) the airport industry, specifically on airport tarmacs.

Ex. 1001, 29:33–41.

This disclosure indicates the '131 patent's CAS technologies can be used with other vehicles and systems. This technology uses UWB and GPS sensors to determine vehicle location, speed, and separation distance for collision avoidance as discussed above. Ex. 1001, 3:31–4:60, 6:4–8:13.

Although vehicle mounted modules are mounted on “a rail vehicle,” separation distances are determined by time of flight technique with a radio unit (claims 1, 17) or GPS (claims 7, 8, 17, 19), CTUs track VMMs or CTUs (claims 2–4, 20), auxiliary transponder sensor module and auxiliary/second antenna (claims 5, 6, 18), GPS and radio units to receive information (claims 7, 8, 19) to determine whether to issue warnings (claims 8, 9, 16, 19) by separation criteria and thresholds (claims 8–10), ground speed detection (claim 11), inertial measurement unit (claims 12, 13), stopping distance (claim 15), and center frequencies (claim 14, 19). Ex. 1001, 30:44–33:31.

The claimed CAS and features measure distances between objects that are “rail vehicles” and issue warnings without claiming any implementation that is particular to railroad technologies, practices, or problems.

The asserted prior art indicates vehicle and train collision avoidance systems both use radio and GPS sensor technologies to determine locations, speeds, and separation distances to avoid collisions by warning operators. Ex. 1005 ¶¶ 13–42 (using GPS to determine position and in-vehicle radar for separation distance for warning if less than a predetermined distance), 55–63 (using UWB radio to manage a car platoon); Ex. 1006, 18:53–24:36 (using impulse radio units as transceivers on rail vehicles, trains, railroad poles, and passenger vehicles to measure separation distances and warn operators), Figs. 11–22; Ex. 1016, 3–8 (using UWB and GPS sensors to warn vehicle operators of nearby trains, airplanes, boats, ships, snowmobiles, and ATVs).

The '131 patent also discloses that known CASs for trains use GPS.

Previous systems for preventing collisions of rail line vehicles have typically utilized a single sensor, for example a GPS or radar-based sensor, to monitor the approximate location of rail mounted vehicles [but] [a] shortcoming of single sensor systems, such as ones that depend on GPS sensors, is that the rail vehicles being monitored often enter into “blackout” areas (for example, around buildings, in the mountains, canyons, around sharp curves or in tunnels) where the single sensor may be unable to accurately determine the vehicle’s location.

Ex. 1001, 2:60–3:2. The problem of GPS blackout areas affects railroad, automotive, and other vehicles that traverse such areas.

Garcia¹¹ is cited to distinguish car and train CASs. Prelim. Resp. 5. Garcia states that Car-2-Car systems use GPS with *multihop networks* that may not work on railways that lack sufficient traffic to support multihops. Ex. 2001, 4. Yet, multihop networks are not claimed in the '131 patent.

The '131 patent describes “a rail vehicle” including *hyrail trucks* that travel on roads and tracks. See Ex. 1001, 3:46–58, Figs. 1C, 2 (vehicle 204). *Specific spacing* must “be maintained between vehicles when traveling to/ from work sites and when working at a work site.” *Id.* at 1:41–55; see *id.* at 3:46–63, Fig. 2; Ex. 1003 ¶ 217; Ex. 1012, 209–210; Ex. 1005, Figs. 1A, 17.

For purposes of our decision, we adopt Petitioner’s proposed level of skill in the art. See *Best Med. Int’l, Inc. v. Elekta Inc.*, 46 F.4th 1346, 1353 (Fed. Cir. 2022) (listing factors to assess the level of skill in the art as types of prior art problems and solutions, sophistication of technology, speed of innovations, and education level of the inventor and workers in the field).

¹¹ Garcia, C., *Comparison of Collision Avoidance Systems and Applicability to Rail Transport*, 10.1109/ITST.2007.4295927, July 2007 (Ex. 2001).

B. Qualifications of Mr. Andrews

Patent Owner also argues that “Mr. Andrews has no experience in collision avoidance systems for rail-line vehicles” and therefore “cannot appreciate the *differences* between collision avoidance systems for railway systems, *i.e.*, the 131 patent, and roadway systems.” Prelim. Resp. 5, 6. Patent Owner asserts that Mr. Andrews is not a skilled artisan, and his “opinions should be discounted and accorded no weight.” *Id.* at 6.

As discussed above, the ’131 patent itself indicates that its collision avoidance system, which is configured for trains *and hyrail* vehicles, can be applied in other industries, vehicles, and applications to control vehicles. Ex. 1001, 29:33–41 (mining, construction, airports). This disclosure is consistent with the prior art’s use of such technologies for trains, vehicles, trucks, planes, boats, ships, snowmobiles, and ATVs. Ex. 1016, 6; Ex. 1001, 3:46–63, Figs. 1C (hyrail vehicle), 2 (vehicle 204); Ex. 1005 ¶¶ 2–9, 55–59; Ex. 1006, 18:53–24:28, Figs. 9–22; Ex. 1008, Abstract, 209–213, Figs. 1–7.

Mr. Andrews’ more than twenty years of experience with wireless technologies and transportation collision avoidance systems qualifies him as more than a person of ordinary skill in the art under both parties’ definitions, and Mr. Andrews’ supervision of skilled artisans has familiarized him with their level of skill. Ex. 1003 ¶ 28. Any lack of railway experience affects the weight we may give to his testimony. As discussed below, his testimony is consistent with the asserted prior art and the ’131 patent. As claimed, the CAS technology is simple enough that expert testimony is helpful, but not essential, to our understanding of the references and issues. *See Wyers v. Master Lock Co.*, 616 F.3d 1231, 1242 (Fed. Cir. 2010); *Perfect Web Techs., Inc. v. InfoUSA, Inc.*, 587 F.3d 1324, 1329 (Fed. Cir. 2009).

C. Claim Interpretation

We interpret claims using the same claim construction standard that would be used to construe the claims in a civil action held under 35 U.S.C. 282(b). 37 C.F.R. § 42.100(b). Under this standard, we construe claims “in accordance with the ordinary and customary meaning of such claim as understood by one of ordinary skill in the art and the prosecution history pertaining to the patent.” *Id.* We construe the claims only to the extent necessary to determine whether to institute *inter partes* review. *See Nidec Motor Corp. v. Zhongshan Broad Ocean Motor Co.*, 868 F.3d 1013, 1017 (Fed. Cir. 2017) (“[W]e need only construe terms ‘that are in controversy, and only to the extent necessary to resolve the controversy.’”) (quoting *Vivid Techs., Inc. v. Am. Sci. & Eng’g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999)).

Petitioner asserts that no express claim constructions are needed for this proceeding. Pet. 8. Patent Owner does not propose claim constructions for any terms but “does not waive its right to propose constructions for one or more claim terms at a later time.” Prelim. Resp. 3.

D. Prosecution History of the ’131 patent

In the initial review of the application filed on April 15, 2014, the Examiner determined, “[c]laims 1–20 are considered allowable, since when reading the claims in light of the specification, as per MPEP § 2111.01, none of the references of record, either individually or in combination, disclose the specific arrangement of elements in the same combination specified in independent claims nos. 1 and 17, specifically including” the limitations of claims 1 and 17. Ex. 1002, 146–148 (Non-Final Office Action, mailed Dec. 2, 2014, Allowed Claims) (“The examiner’s search failed to find this combination of features, nor was it obvious in light of the prior art.”).

E. Principles of Law

A patent claim is unpatentable under 35 U.S.C. § 103 if differences between the claimed subject matter and the prior art are such that the subject matter, as a whole, would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. 35 U.S.C. § 103; *KSR Int’l Co. v. Teleflex Inc.*, 550 U.S. 398, 406 (2007). “[I]f a technique has been used to improve one device, and a person of ordinary skill in the art would recognize that it would improve similar devices in the same way, using the technique is obvious unless its actual application is beyond his or her skill.” *KSR*, 550 U.S. at 417.

The question of obviousness is resolved based on underlying factual determinations including: (1) the scope and content of the prior art; (2) any differences between the claimed subject matter and the prior art; (3) the level of ordinary skill in the art; and (4) when in evidence, objective evidence of non-obviousness. *Graham v. John Deere Co. of Kan. City*, 383 U.S. 1, 17–18 (1966). Neither party submits evidence of secondary considerations.

F. Ground 1A: Alleged Obviousness Over Grisham

Petitioner asserts that claims 1, 11, and 14 are unpatentable under § 103(a) over Grisham. Pet. 1, 3, 9–20.

1. Grisham (Ex. 1006)

Grisham describes a railroad collision avoidance system 900f that can equip two locomotives 1102, 2102 with transmitting and receiving impulse radio units 902, 904 that transmit impulse radio signals 910 to alert operators of each vehicle of the presence of the other vehicle. Ex. 1006, 23:33–24:29.

Figure 21 is reproduced below to illustrate this arrangement.

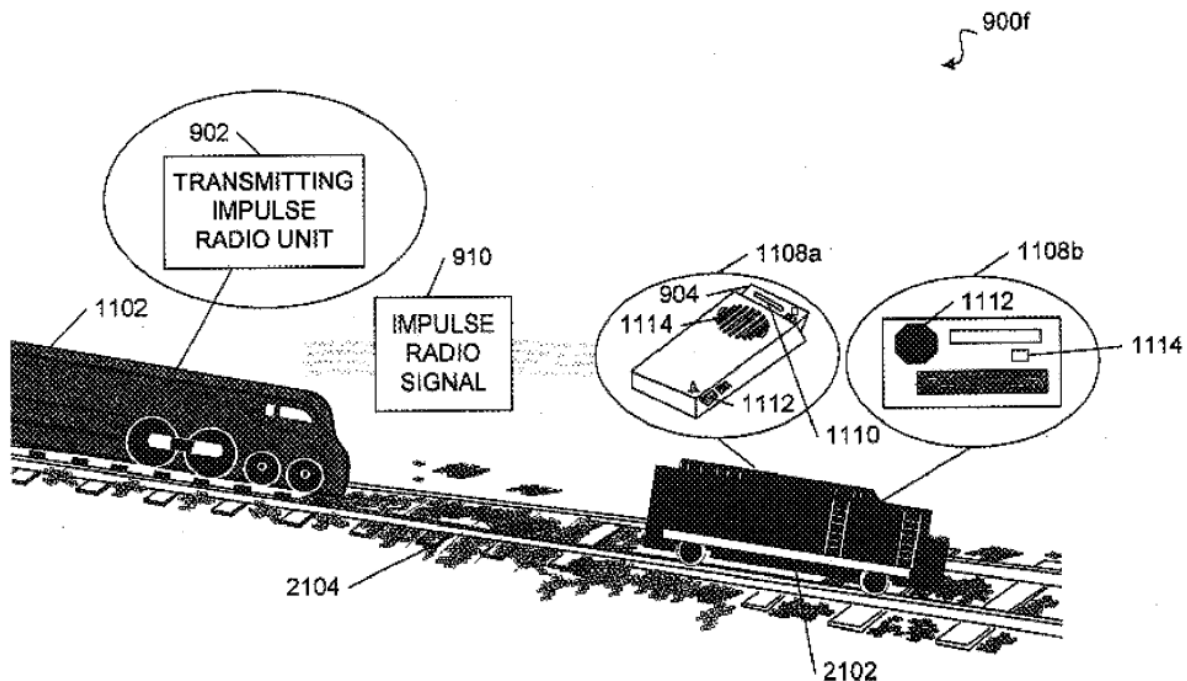


FIG. 21

Figure 21 depicts warning system 900f with transmitting impulse radio unit 902 coupled to locomotive 1102 to send radio signals 910 to receiving impulse radio unit 904 on second locomotive 2102 to alert persons there of the direction, distance, and/or speed of first locomotive 1102, and both locomotives 1102, 2102 may contain the same equipment so each may be notified of the presence and speed of the other via an after-market display 1108a or in-dash display 1108b. Ex. 1006, 23:33–24:29.

2. Independent Claim 1

Regarding element [1-Pre], Petitioner contends that Grisham discloses a railroad collision avoidance system for preventing train accidents. Pet. 10 (citing Ex. 1006, title, 2:16–31, 24:46; Ex. 1003 ¶¶ 100–104). This contention, which Patent Owner does not contest at this stage, is supported sufficiently by evidence of record.

Grisham's field of invention is "a railroad collision avoidance system and method for preventing train accidents." Ex. 1006, 1:8–10; *id.* at 2:16–19 (the invention is a railroad collision avoidance system that warns people when a locomotive is in their vicinity).

Regarding elements [1A]/[1E], Petitioner asserts that Grisham mounts radio units 902, 904 on each locomotive 1102, 2102 (rail vehicles), and each unit includes components recited in elements [1B]–[1D]/[1F]–[1H] to form a vehicle mounted module. Pet. 11–12 (citing Ex. 1006, 23:33–38, Figs. 21, 22; Ex. 1003 ¶¶ 105–117), 14–15 (citing Ex. 1006, 23:33–40, Figs. 21, 22; Ex. 1003 ¶ 118). These contentions, which Patent Owner does not contest at this stage, are supported sufficiently by record evidence. Grisham couples a transmitting impulse radio unit 902 and receiving impulse radio unit 904 to each locomotive 1102, 2102 to alert operators of the presence and speed of the other locomotive. Ex. 1006, 23:33–24:28, Figs. 21, 22.

Regarding elements [1B]/[1F], Petitioner asserts that Grisham uses transmitting impulse radio unit 902 and receiving impulse radio unit 904 to send and receive signals and the radio units 902, 904 may be combined into a transceiver impulse radio unit mounted on each locomotive 1102, 2102 to send and receive data wirelessly thereby achieving substantial economy over separate transmit/receive impulse radios and forming a "transponder sensor module." Pet. 12–13 (citing Ex. 1006, 16:39–49, 16:59–60, 17:44–46, 23:33–47, Figs. 6, 7; Ex. 1003 ¶¶ 107–110), 15 (citing element [1B]; Ex. 1003 ¶ 119). Petitioner asserts that skilled artisans would understand that Grisham's impulse radio in each transceiver unit and its antenna are a first and second radio communication unit and a first and second antenna as claimed. Pet. 13 (citing Ex. 1003 ¶¶ 107–110), 15 (citing Ex. 1003 ¶ 119).

Patent Owner argues that Petitioner mischaracterizes Grisham because radio unit 902 on rail vehicle 1102 is a “transmitting impulse radio unit” that is operable *only to send* an impulse radio signal wirelessly rather than send and receive data wirelessly as claimed. Prelim. Resp. 11–12. Patent Owner argues that radio unit 904 on rail vehicle 2102 is a “receiving impulse radio unit” that is operable *only to receive* an impulse radio signal wirelessly and cannot send *and* receive data wirelessly as claimed. *Id.*

Patent Owner also argues that Grisham does not teach or suggest that transmitting impulse radio unit 902 and receiving impulse radio unit 904 are or can be combined into a single module to send and receive wireless data as the Petition alleges, and the Petition offers no motivation to combine the two radio units into a single module, no support from Mr. Andrews, its expert, and no showing of a reasonable expectation of success. *Id.* at 12–13.

Grisham describes an “Exemplary Transceiver Implementation” that comprises a “Transmitter” *and* a “Receiver.” Ex. 1006, 16:14–17:43. “In a *transceiver embodiment*, substantial economy can be achieved by sharing part or all of several of the functions of the transmitter 602 and receiver 702” and shared functions include “time base 718, precision timing generator 714, code source 722, [and] *antenna 704.*” *Id.* at 17:44–48 (emphasis added).

No motivation is needed to combine transmitter 602 and receiver 702 to form a transceiver because Grisham teaches a *transceiver embodiment* as Petitioner asserts. *See* Ex. 1006, 16:14–17:48; Pet. 12–13 (citing Ex. 1006, 17:44–46; Ex. 1003 ¶ 108 (citing Ex. 1006, 17:44–48)). Figure 21 mounts transmitting impulse radio unit 902 and receiving impulse radio unit 904 on each locomotive 1102, 2102 to function as transceivers that send and receive radio signals. *See* Ex. 1006, 23:33–24:29, 16:14–17:48.

Grisham describes mounting transmitting impulse radio unit 902 on locomotive 1102 to transmit impulse radio signal 910 to receiving impulse radio unit 904 on locomotive 2102 (Ex. 1006, 23:33–63) and states that “[i]t should be understood that the first locomotive 1102 can contain the same equipment as the second locomotive 2102 . . . and as such could be notified of the presence and speed of an oncoming second locomotive 2102” (*id.* at 24:24–29). Each locomotive 1102, 2102 has transmitting *and* receiving impulse radio units that function as transceivers to send and receive data as impulse radio signals 910 to notify operators on each locomotive of the presence and speed of the other locomotive to achieve substantial economy.

Mr. Andrews testifies that Grisham combines transmitter 602 and receiver 702 into transceiver units that transmit and receive as a transponder. Ex. 1003 ¶¶ 107–110 (embodiments transmit and receive as transceivers).

Regarding elements [1C]/[1G], Petitioner asserts that Grisham teaches a control electronics module as controller 1110 in each transponder sensor module of elements [1B]/[1F], and skilled artisans would have understood that controller 1110 includes a processor or would have been motivated to include one to process data it receives, and controller 1110 (and processor) communicate with receiving impulse unit 904 in each transponder sensor module to communicate with other radio units via impulse radio signal 910. Pet. 13 (citing Ex. 1006, 23:64–24:24, Fig. 22; Ex. 1003 ¶¶ 111–114), 16 (citing element [1C]; Ex. 1003 ¶ 120). This contention, which Patent Owner does not contest at this stage, is supported sufficiently by evidence of record. Receiving impulse unit 904 and controller 1110 in each transponder sensor module receive impulse radio signals 910 that controller 1110 processes to measure distances between locomotives 1102, 2102. Ex. 1006, 23:66–24:8.

Regarding elements [1D]/[1H], Petitioner contends that Grisham's receiving impulse unit 904 may be incorporated in, or coupled to, an after-market display 1108a or an in-dash display, which provides a user interface module that displays direction, distance, and speed of an oncoming train to an operator *and* receives operator input to communicate with a person on another train, and such displays receive user input to adjust display settings. Pet. 13–14 (citing Ex. 1006, 23:52–66, Fig. 21; Ex. 1003 ¶¶ 115–117), 16.

Patent Owner argues that Grisham discloses an after-market display or an in-dash display, and the Petition does not contend that either is operable “to receive input from the vehicle operator” as claimed. Prelim. Resp. 13. Patent Owner argues that Petitioner asserts that a skilled artisan would have understood it was conventional for displays including aftermarket displays to receive user input such as adjustments to the display's settings and cites its expert, Mr. Andrews, who repeats this conclusory assertion without citing any additional supporting evidence or technical reasoning. *Id.* at 13–14.

Petitioner has provided sufficient evidence that Grisham's receiving impulse radio unit 904 includes a user interface module and after-market or in-dash display 1108a, 1108b that alerts operators of locomotive 1102/2102 of the presence of an approaching locomotive 2102/1102 with the direction, distance, and/or speed of the locomotive. Ex. 1006, 23:33–24:29; *see* Pet. 14 (citing Ex. 1006, 23:52–66, Fig. 21); Ex. 1003 ¶ 116 (quoting Ex. 1006, 23:52–66 and its description of displays 1108a, 1108b that show direction, distance, and/or speed of an oncoming locomotive 1102).

Display 1108 also receives input from an operator to communicate with a person on another locomotive via impulse radio signals. Ex. 1006, 19:51–54, 23:1–4, 23:60–63 (cited in Pet. 14 and Ex. 1003 ¶ 116).

Patent Owner does not dispute that Grisham’s display receives input of operators to communicate with operators on other trains. Prelim. Resp. 13–14; Pet. 14, 16; Ex. 1003 ¶ 116. The ’131 patent describes interfaces that allow operators to send messages to other vehicles. Ex. 1001, 18:50–60.

Mr. Andrews testifies that such “after-market” displays are known to receive user input to adjust display settings. Ex. 1003 ¶ 117. Mr. Andrews supports his opinion with Grisham’s disclosure that after-market displays allow operators to communicate with operators of other vehicles so the user interface receives user inputs. *Id.* ¶¶ 116 (citing Ex. 1006, 23:52–66), 117.

Regarding element [1I], Petitioner asserts that impulse radio unit 902 mounted on a first train continually transmits a radio signal to impulse radio unit 904 on another train. Pet. 16–18 (citing elements [1A], [1B]; Ex. 1006, 22:45–49, 23:36–49, 24:25–29, Figs. 19, 21; Ex. 1003 ¶¶ 122–124). These contentions, which Patent Owner does not contest, are supported sufficiently by evidence of record. Impulse transceivers on different trains communicate with one another. Ex. 1006, 16:14–17:48, 18:53–24:29, Figs. 21, 22.

Regarding element [1J], Petitioner contends that Grisham’s radio-unit controllers use time position measurements to measure a propagation delay and determine a link distance between impulse radio units and locomotives, and the time of flight (TOF) technique incorporates Richards (US 6,133,876, Ex. 1013) and its pulse sequences between two transceivers to measure total TOF difference using two signal pulses. Pet. 18–19 (citing Ex. 1006, 14:56–62, 24:18–24, Figs. 21, 22; Ex. 1013, 2:31–46; Ex. 1003 ¶¶ 125–127). This contention, which Patent Owner does not contest, is supported sufficiently by evidence of record. On this record, we find Petitioner has established a reasonable likelihood that claim 1 is unpatentable over Grisham.

3. *Claims 11 and 14*

Regarding claims 11 and 14, Petitioner asserts that Grisham discloses vehicle-mounted radio units with controllers and ultra-wideband units that communicate with each other to determine the speed of a rail vehicle and can be mounted on a control box or railroad pole (claim 11) and the radio units use “a desired center frequency” by altering the waveform significantly for a given application, which skilled artisans would understand to mean the radio units are designed to transmit and receive ultrawide-band signals of varying center frequencies (claim 14). Pet. 19–20 (citing discussion for elements [1B], [1C], and [1E] in Ground 1A for claim 11; Ex. 1006, 14:56–62, 18:60–19:4, 23:64–24:24; Ex. 1013, 2:31–46; Ex. 1003 ¶¶ 125–130).

Patent Owner argues that a ground speed detection module is part of the CAS mounted on first and second vehicle mounted modules rather than a control box or a railroad pole. Prelim. Resp. 14–16. Yet, radio transceivers mounted on trains 1102, 2102 provide ground speed detection as Petitioner contends. Pet. 19; Ex. 1006, 23:33–24:29. Such ground speed detection can be placed in *a control box, railroad pole, vehicle, or train*. Ex. 1006, 18:53–24:29, Figs. 9–22. Impulse radio signals 910 are received by radio unit 904 and processed to determine a link distance between unit 904 and a train and distances are updated to determine the train’s speed, which is displayed with its distance and direction. *Id.* at 23:64–24:24; *see* Pet. 13–14; Ex. 1003 ¶¶ 115–117 (citing Ex. 1006, 23:52–66). Mr. Andrews relies on Grisham’s description of determining locomotive speed by radio unit 904, which may be mounted on second locomotive 2102, by receiving signals to determine distance from propagation delay and updating the distance to determine the train’s presence and speed. Ex. 1003 ¶ 129 (citing Ex. 1006, 24:19–24).

Patent Owner attacks Petitioner’s contentions for claim 14 as being just two sentences with a citation to Mr. Andrews’ Declaration, whose analysis of the prior art is not reflected in the Petition. Prelim. Resp. 17–18.

Grisham’s UWB units use an impulse radio waveform that “attempts to approach one cycle of radio frequency (RF) energy *at a desired center frequency*” and “this waveform may be altered significantly in practice for a given application.” Ex. 1006, 4:61–5:12 (emphasis added) (cited in Pet. 20 and Ex. 1003 ¶ 132). Altering waveforms for a given application to be one cycle of RF energy at a desired center frequency varies the center frequency of the waveform. Ex. 1006, 4:61–5:2 (cited in Pet. 17 and Ex. 1003 ¶ 132).

Patent Owner argues that the ’131 patent describes varying center frequencies as transmitting “multiple pulses/signals with different center frequencies at different times” (Prelim. Resp. 18 (citing Ex. 1001, 16:22–24)) but in Grisham “the center frequency is set at calibration to the desired center frequency” (*id.* (citing Ex. 1006, 16:25–26)). Yet, claim 14 recites a radio communication unit “is operable to transmit and receive signals with varying center frequencies.” Ex. 1001, 32:20–22. Patent Owner admits that Grisham’s radio unit is operable to transmit and receive signals with varying center frequencies by calibrating it at a desired center frequency. Grisham further alters impulse radio waveforms “significantly in practice for a given application” to approach one cycle of RF energy at a desired center frequency as discussed. Ex. 1006, 4:61–5:12; *see id.* at 5:1–2 (“waveforms having very broad, or wide, spectral bandwidth approximate a Gaussian shape to a useful degree.”); *see id.* 5:60–6:35, 7:50–57, Figs. 1A–1F.

On this record, we find that Petitioner has established a reasonable likelihood that claims 11 and 14 are unpatentable over Grisham.

G. Ground 1B: Alleged Obviousness Over Grisham and Douglas

Petitioner asserts the unpatentability of claims 2–4 under § 103(a) over Grisham and Douglas. *See* Pet. 2–3, 20–23.

1. Douglas (Ex. 1011)

Douglas’ collision avoidance system equips trains with apparatus 20 (transceiver and processor) to enable them to communicate with each other over a wireless network and with apparatus 32 at station 30. Ex. 1011, 1:9–10, 3:1–30. Each train broadcasts a signal with a unique identification of the train and the track on which the train is moving using the transceivers so a receiving apparatus 20 can identify the train transmitting the signal with its direction of motion and respective track. *Id.* at 3:30–47, Figs. 1, 1b.

2. Claims 2–4

Regarding claim 2, Petitioner asserts that Douglas locates apparatus 32 at train station 30 to receive information transmitted by trains such as the track a train is moving on and broadcasts locations of trains within a certain range by a list of links for a train to traverse and direction of motion and path of a train. Pet. 20–21 (citing Ex. 1011, 3:18–23, 3:31–47, 4:23–49, 6:25–31, 7:10–12; Ex. 1003 ¶¶ 135–138). Petitioner asserts that skilled artisans would understand that station-based apparatus 32 tracks the location of the trains by repeatedly updating their paths. *Id.* at 21. Petitioner asserts that skilled artisans would have been motivated to combine Douglas’ apparatus with Grisham’s train-to-train embodiment to use existing railway and train-control infrastructure to identify conflicts between paths of trains and potential collisions before trains enter the range where Grisham’s train-to-train communication is effective. *Id.* (citing Ex. 1003 ¶ 139).

Patent Owner argues that the Petition recognizes that neither Grisham nor Douglas discloses a central tracking unit that tracks a *location* of a vehicle mounted module by asserting that skilled artisans would understand that Douglas' station-based apparatus tracks locations of trains by repeatedly updating the trains' paths via a list of links to travel and direction of travel of a train on a track. Prelim. Resp. 20–21. Patent Owner asserts that neither the Petition nor Mr. Andrews explains why this is so or provides additional supporting evidence. *Id.* at 21. Patent Owner argues that the Petition also fails to address a reasonable expectation of success in combining Grisham's embodiment with Douglas' system so that a location of the first and second vehicle mounted modules can be tracked based on a list of links and the direction of motion and paths of trains. *Id.* at 21–22.

The '131 patent describes central tracking unit (CTU) 318 accepting information such as location, speed, and separation distance from vehicle mounted modules (VMMs) in vehicles of a work gang. “[T]he CTU may analyze absolute and relative positioning data and speed data from vehicles in the work gang.” Ex. 1001, 6:36–38. No technical implementation details are provided. *See id.* at 4:26–30, 5:48–59, 6:4–7:8; 28:16–23, Fig. 3.

Douglas describes apparatus 32 located at station 30 communicating with apparatuses 20 located on trains to receive information over a wireless network from trains 12–18 (Ex. 1011, 3:18–30) including identification of each train, identification of the track on which each train is moving, and a direction of motion of each train (*id.* at 3:30–47) and to process this data to provide each train with a list of rail links and tracks each train will travel, the direction of movement of each train, and other trains *located in* the zone of station 30 (*id.* at 4:32–53, 7:10–12). *See* Pet. 20–21 (citations therein).

Douglas thus tracks the locations of trains along specific tracks 22–28 relative to links 23–27 that connect specific tracks to allow a specific train to switch tracks at a particular location and within the zone of station 30. This tracking of each train 12–18 and mounted apparatus 20 tracks its location as recited in claim 2. Petitioner and Mr. Andrews rely on teachings of Douglas that apparatuses 20 on each train broadcast their ID, track ID, and direction of motion location information so apparatus 32 at station 30 can broadcast a list of links that each train will traverse with a direction of motion and list of trains within a zone (location) of station 30. Ex. 1011, 3:1–4:60, 6:63–7:23, Fig. 1; Pet. 20–21 (and citations); Ex. 1003 ¶¶ 135–139 (and citations).

“The reasonable expectation of success requirement refers to the likelihood of success in combining references to meet the limitations of the claimed invention.” *Intelligent Bio-Sys., Inc. v. Illumina Cambridge Ltd.*, 821 F.3d 1359, 1367 (Fed. Cir. 2016) (“[F]ailure to consider the appropriate scope of the . . . patent’s *claimed invention* in evaluating the reasonable expectation of success . . . constitutes a legal error that [is] review[ed] without deference.”) (citation omitted). The expectation of success need only be reasonable rather than absolute. *Pfizer, Inc. v. Apotex, Inc.*, 480 F.3d 1348, 1364 (Fed. Cir. 2007) (“[C]ase law is clear that obviousness cannot be avoided simply by a showing of some degree of unpredictability in the art so long as there was a reasonable probability of success.”).

Here, the ’131 patent and Douglas evidence a level of predictability in the art to implement a CAS with a central tracking unit that communicates with first and second VMMs to track the locations of the VMMs. On this record, we find that Petitioner has established a reasonable likelihood that claim 2 is unpatentable over Grisham and Douglas.

Regarding claim 3 and 4, Petitioner contends that Douglas discloses that a central tracking unit at a station *or* in apparatus 20 on each train 12–18 generates a state table of links for each train to travel between tracks and a direction of travel of each train on a track (claim 3), and the central tracking unit 32 at station 30 is in a discrete housing as shown in Figures 1 and 1b (claim 4). Pet. 22–23 (citing Ex. 1011, 3:1–30, 7:12–19; Ex. 1003 ¶¶ 140–144). These contentions, which Patent Owner does not contest at this stage, are supported sufficiently by evidence of record.

On this record, we find that Petitioner has established a reasonable likelihood that claims 3 and 4 are unpatentable over Grisham and Douglas.

H. Ground 1C: Alleged Obviousness Over Grisham and Richardson

Petitioner asserts the unpatentability of claims 5 and 6 under § 103(a) over Grisham and Richardson. *See* Pet. 2–3, 24–28.

1. Richardson (Ex. 1008)

Richardson describes a UWB positioning system that improves safety by positioning coordinate radios at each corner of a vehicle to provide more accurate position measurements between vehicles in a convoy. Ex. 1008, 209–210, 212–214, Figs. 1, 2, 6, 7. The system controller selects two radios to be requesters and two radios to be responders in order to minimize the dilution of precision (DOP) that can result based on the respective angles and orientations of both vehicles and the location of the positioning radios that are selected to measure position. *Id.* at 213 (configuring coordinate radio pairs to define eight zones), Fig. 6 (depicting eight zones for distance measurement), 7 (illustrating bilateration for position measurement).

2. *Claims 5 and 6*

Petitioner asserts that Richardson uses four UWB transceivers with an offset distance of r_b as “auxiliary transponder sensor module” and auxiliary antenna as recited in claims 5 and 6 to improve location measurements and collision avoidance. Pet. 25–28. Petitioner asserts that skilled artisans would understand that Grisham’s ability to calculate distances based on the location of a single impulse radio module on long trains would not avoid collisions at other points on the train that may be a mile away so that such artisans would have been motivated to supplement Grisham’s system with Richardson’s use of multiple UWB transceivers with their own antennas that are offset (r_b) from another unit to account for the train’s length, improve location measurements, and avoid collisions to include using Richardson’s user interface to calibrate ranging of the modules for a train. *Id.* at 26–28 (citing Ex. 1008, 211, 213, 214, Figs. 6, 7; Ex. 1003 ¶¶ 145–152).

Patent Owner argues that Petitioner fails to explain how Richardson’s system that improves navigation and safety for semi-autonomous systems could “account for the length of a train” of over a mile when Richardson’s system is designed for use between 2 and 40 meters. Prelim. Resp. 23–26. Patent Owner asserts that Petitioner’s motivation is conclusory and relies on Mr. Andrews’ Declaration that provides a series of unsupported conclusions that are entitled to little or no weight, and the Petition does not address whether a skilled artisan would have had a reasonable expectation of success in combining Grisham’s train-to-train communication system with Richardson’s system for semi-autonomous construction and agricultural vehicles. *Id.* at 24–26.

The '131 patent describes an embodiment in which vehicle 900 uses multiple offset transponder sensor modules (TSMs) 902, 904, and a sensor included in TSM 904 is placed near an end of the vehicle to calibrate itself to determine the location of the vehicle's end and other vehicles. Ex. 1001, 11:64–12:16. A vehicle operator can specify the vehicle's length from the mounted TSMs so the components can compute the distance between their mounting locations and the ends of the vehicle. *Id.* at 11:64–12:57, Fig. 9. This system may calibrate for vehicle length and mounting locations. *Id.* TSMs may be mounted at a vehicle's front and rear ends. *Id.* at 12:40–42.

Richardson mounts four UWB radios on corners of each vehicle of a convoy to measure distances between adjacent vehicles by defining positions of adjacent vehicles. Ex. 1008, 212–213. “[T]he four coordinate radios are spaced so as to limit DOP [dilution of precision] and eight zones are defined using radio pairings as shown in Figure 6 to balance the effects of DOP between zones.” *Id.* at 213. “At each position update, the controller on the following truck selects two radios to be requesters and two radios to be responders based on minimization of DOP.” *Id.* The more accurate position measurements improve safety (and reduce collisions). *Id.* Abstract.

Petitioner proposes to apply this technique in Grisham for similar benefits of better measurements between a train (front and rear ends) and nearby vehicles to avoid collisions as Richardson teaches. Pet. 26; *see KSR*, 550 U.S. at 417; Ex. 1003 ¶¶ 147–148; Ex. 1008, 209–214. Richardson's disclosure evidences a high degree of predictability in this art to support a reasonable expectation of success in the combination. On this record, we find that Petitioner has established a reasonable likelihood that claims 5 and 6 are unpatentable over Grisham and Richardson.

I. Ground 1D: Alleged Obviousness Over Grisham and McDaniel

Petitioner asserts the unpatentability of claim 10 under § 103(a) over Grisham and McDaniel. *See* Pet. 2–3, 29–30.

1. McDaniel (Ex. 1015)

McDaniel discloses a collision avoidance system that determines threshold warning distances and minimum distances to avoid collisions adaptively based on the velocities of vehicles. Ex. 1015 ¶¶ 1, 38, 39.

2. Claim 10

Petitioner contends that McDaniel uses a controller to set a minimum threshold warning distance required by host machine 110 to avoid a collision based on velocities of host machine 110 and target object 130, and skilled artisans would have added this feature to a vehicle mounted module to avoid collisions more accurately and effectively using speeds of approaching trains to avoid nuisance alerts where Grisham already collects speed and distance data. Pet. 29–30 (citing Ex. 1015 ¶¶ 38, 39; Ex. 1003 ¶¶ 153–156).

Patent Owner argues that Petitioner fails to explain how the adaptive threshold feature would work in Grisham’s collision avoidance system when McDaniel determines a threshold distance based on velocity and inclination angle of a target and host machine and reaction time due to environmental conditions without distinguishing target objects that are a true threat from those that are merely a nuisance such as nearby trains on a separate track. Prelim. Resp. 27–28. Patent Owner argues that Petitioner fails to explain whether a skilled artisan would have had a reasonable expectation of success in arriving at the claimed invention when McDaniel’s adaptive threshold feature is not designed for use in trains. *Id.* at 28–29.

On this record, Petitioner has made a sufficient showing that a skilled artisan would have been motivated to add McDaniel's adaptive threshold feature to Grisham to improve the ability of Grisham's CAS to distinguish trains that present a threat of collision from those that do not by considering the approaching speeds of trains. Pet. 29–30; *see KSR*, 550 U.S. at 417.

McDaniel's adaptive threshold warning system would enhance the CAS of Grisham to avoid nuisance alerts to operators of the safe approach or close proximity of other trains “given the number of trains that can safely be positioned within feet of each other in, for example, a train yard.” Pet. 29–30. McDaniel modifies vehicle separation thresholds based on the speed of a first vehicle and the speed of a second vehicle as claimed. Ex. 1015 ¶¶ 16, 39. Claim 10 does not require a system to distinguish target objects that are a true threat from those that are a nuisance such as trains that are nearby but on a separate and distinct track as Patent Owner argues. Prelim. Resp. 28. Such argument is not commensurate with the scope of the claim and not relevant to a reasonable expectation of success inquiry. *See Intelligent Bio-Sys.*, 821 F.3d at 1367. Petitioner asserts that McDaniel improves Grisham by identifying rail vehicles approaching at speeds that are unsafe. Pet. 30. McDaniel determines relative velocities of vehicles to assess a closing rate and whether a target object is approaching, retreating, or moving in a direction orthogonal to a host machine 110, and Mr. Andrews testifies that calculating threshold warning distances with velocities would alert operators when stopping distances are inadequate and may be implemented routinely in Grisham. Ex. 1003 ¶¶ 153–156 (quoting Ex. 1015 ¶¶ 38, 39). On this record, we find that Petitioner has established a reasonable likelihood that claim 10 is unpatentable over Grisham and McDaniel.

J. Ground 1E: Alleged Obviousness Over Grisham and Breed

Petitioner asserts the unpatentability of claims 12 and 13 under § 103(a) over Grisham and Breed. Pet. 2–3, 30–32.

3. Breed (Ex. 1014)

Breed’s safety system uses an inertial measurement unit (IMU) with accelerometers and gyroscopes to measure acceleration and angular rate and changes thereto to improve location tracking and velocity measurements of vehicles to reduce a risk of collision. Ex. 1014 ¶¶ 13, 93, 109, 205, 567.

4. Claims 12 and 13

Regarding claims 12 and 13, Petitioner contends that Breed uses an IMU in a vehicle location system, and the IMU contains accelerometers that measure vehicle acceleration in latitude, longitude, and vertical directions and the changes in speed are sent to a processor. Pet. 30–32 (citing Ex. 1014 ¶¶ 93, 205, 225, 567; Ex. 1003 ¶¶ 157–165; Ex. 1006, 2:16–31, 24:46).

Petitioner contends that skilled artisans would have been motivated to consider the speed and acceleration detection system of Breed to supplement Grisham’s UWB-based system to ensure that position data and calculations regarding the potential for collision are as exact as possible by knowing a train’s location to avoid collisions. Pet. 31. Petitioner asserts that skilled artisans would have been motivated to modify Grisham in view of Breed to couple an IMU with its accelerometers and gyroscopes to provide accurate speed and acceleration data beyond the working range of UWB to assist in avoiding collisions by the vehicle-to-vehicle communications as Grisham desires by improving speed and acceleration measurements. *Id.* at 31–32 (citing Ex. 1014 ¶ 93; Ex. 1006, 2:16–31, 24:46; Ex. 1003 ¶¶ 161–165).

Patent Owner argues that Breed does not disclose an IMU “operable to detect changes in the speed of the first rail vehicle” as recited in claim 12. Prelim. Resp. 29. Patent Owner asserts that Breed does not teach or suggest an IMU “operable to detect changes in the speed,” and Mr. Andrews’ declaration provides only conclusory motivation assertions. *Id.* at 29–33.

The ’131 patent discloses control electronics module (CEM) 700 with inertial measurement unit 710 and accelerometers and/or gyroscopes that can detect *changes in the speed* of a traveling vehicle such as sudden changes in speed to indicate a vehicle is involved in a collision. Ex. 1001, 9:60–10:15. Microwave radars and laser devices measure ground speed. *Id.* at 9:2–9, 20:15–21:6. The ’131 patent distinguishes devices that measure *changes in speed* from devices that measure speed as does Breed. Ex. 1001, 9:2–4, 9:60–10:15, 20:19–21:21, Fig. 7 (706, 710, 752, 754); *see* Ex. 1014 ¶ 93.

Breed discloses a vehicle-to-vehicle communication system with an IMU that includes accelerometers to provide a vehicle’s acceleration and gyroscopes to measure angular rates or velocities. Ex. 1014 ¶¶ 13, 93, 567.

Acceleration is “the rate of change of velocity with respect to time.” Merriam-Webster.com at “<http://www.merriam-webster.com/dictionary/acceleration>” (accessed May 12, 2023). Ex. 3001. By detecting vehicle acceleration, Breed’s IMU is “operable to detect changes in the speed of a . . . vehicle” as claimed and Breed’s system may be used with automobiles, trucks, *railroad cars*, ships, and airplanes. Ex. 1014 ¶ 88; *see* Ex. 1003 ¶ 160 (Breed teaches accelerometers that measure “vehicle acceleration in the latitude, longitude, and vertical directions”) (citing Ex. 1014 ¶ 567), ¶ 162 (skilled artisans understand “tracking changes in speed or acceleration is important for knowing a train’s location and avoiding collisions”).

Mr. Andrews testifies that using Breed's IMU with Grisham's UWB-based system would improve positioning and location determination by measuring vehicle speed independently and tracking changes in speed and acceleration to know a train's location, avoid collisions and obstacles, and fill gaps when satellites are out of view for train safety (by redundancy) and preventing collisions. Ex. 1003 ¶¶ 159–163. His testimony is supported by record evidence that communicating vehicle position and velocity data can reduce a risk of collision. Ex. 1014 ¶ 211 (dead reckoning fills gaps when satellites are out of view); Ex. 1006, 2:16–31; Ex. 1003 ¶ 163.

On this record, we find that Petitioner has established a reasonable likelihood that claims 12 and 13 is unpatentable over Grisham and Breed.

K. Ground 1F: Alleged Obviousness Over Grisham and Connell

Petitioner asserts the unpatentability of claim 15 under § 103(a) over Grisham and Connell. *See* Pet. 2, 29–30.

1. Connell (Ex. 1012)

Connell's control system 20 is operable to determine dynamically brake shoe effectiveness data 22 that provides sufficient information used to determine the ability of a braking arrangement to retard a train to a specified level, whether a speed level or a complete stop, based on braking data 14 in brake database 12 and train data 18 in train database 16. Ex. 1012 ¶ 26. Once the desired brake shoe effectiveness data 22 is determined, the control and operational parameters of the train are determined or set such as speed limits, maximum speed limit, braking curve distance required for the train to stop completely, and stopping distance. *Id.* ¶ 28.

2. *Claim 15*

Petitioner asserts that Connell calibrates the distance required for a train TR to stop completely by dynamically determining the brake shoe effectiveness as the train travels, and skilled artisans would understand this teaching to mean the distance between a first location when the brakes are engaged and a second location when the vehicle comes to a complete stop as claimed. Pet. 33–34 (citing Ex. 1012 ¶¶ 25, 26, 28; Ex. 1003 ¶¶ 166–171).

Patent Owner argues that Grisham and Connell lack “the first vehicle mounted module [that] is operable to execute a stopping distance calibration feature that measures a stopping distance under existing conditions” as claimed. Prelim. Resp. 33–34. Patent Owner argues that Mr. Andrews does not support the Petitioner’s statement that Connell discloses “the distance required for the train TR to completely stop is calibrated by dynamically determining brake shoe effectiveness as the train travels” but testifies that a skilled artisan would have determined or calibrated appropriate stopping distances by physically testing the rail vehicles under different conditions and adopting the appropriate calibration under existing conditions. *Id.* at 34.

Mr. Andrews testifies that Connell’s vehicle mounted module can execute a stopping distance calibration feature that measures a stopping distance under existing conditions as control system 20 using brake database 12 and train database 16 to dynamically determine brake shoe effectiveness data 22 and the ability of the braking to retard the train to a specified level, e.g., a speed level *or a complete stop* and control operational parameters such as *a braking curve, which is the distance required for the train TR to completely stop*. Ex. 1003 ¶¶ 166–169 (citing Ex. 1012 ¶¶ 25, 26, 28); *see also* Pet. 33–34 (citing Ex. 1012 ¶¶ 25, 26, 28; Ex. 1003 ¶¶ 166–171).

Connell’s calibration feature dynamically determines brake shoe effectiveness data 22 “to determine the ability of the braking arrangement BA to retard the train TR to a specified level, whether a speed level *or a complete stop*.” Ex. 1012 ¶ 26 (emphasis added). Additional calibration features use the determined brake shoe effectiveness to calibrate operational parameters such as “a braking curve, i.e., the distance required for the train TR to completely stop” and “a stopping distance.” *Id.* ¶ 28.

On this record, we find that Petitioner has established a reasonable likelihood that claim 15 is unpatentable over Grisham and Connell.

L. Ground 2A: Alleged Obviousness Over Grisham and Nixon

Petitioner asserts the unpatentability of claims 7–9, 17, and 19 under § 103(a) over Grisham and Nixon. Pet. 1–3, 34–40.

1. Nixon (Ex. 1016)

Nixon’s collision avoidance system uses trail alert transceiver 100 to transmit identification codes to trail alert transceivers on other vehicles and output sound/light alert signals based on a range and speed estimated from received signals to indicate relative distance (e.g., faster beeping as a target moves closer) of an approaching vehicle. Ex. 1016, 1, 5–6.

The trail alert equipment can be applied to any kind of vehicle such as a train, airplane, boat, ship, snowmobile, and ATV. Ex. 1016, 6. The trail alert equipment can determine positions of targets by processing outputs of a vehicle location system such as GPS receivers that receive GPS signals from other trail alert equipment and determine their own position while displaying a hostile target’s position based on range estimation and displaying their own position as determined by the GPS receiver. *Id.* at 6–7.

2. *Claims 7–9*

Regarding claim 7, Petitioner asserts that Nixon uses a GPS receiver to receive GPS signals to determine the receiver's position and communicate that position to collision avoidance equipment, and vehicles like trains can be equipped with GPS receivers to determine their absolute location. Pet. 35 (citing Ex. 1016, 6–7; Ex. 1003 ¶¶ 172–175). Petitioner asserts that skilled artisans would have been motivated to supplement Grisham's UWB-based collision avoidance system with Nixon's GPS units because UWB accuracy is range-limited due to low transmission power that reduces its usefulness in stopping long trains. *Id.* Petitioner also asserts that skilled artisans would have been motivated to supplement data of Grisham's UWB-based system with heading, acceleration, and heading for collision-avoidance, and a GPS system complements a UWB system by being effective at larger distances and tracking train travel paths. *Id.* at 36–37 (citing Ex. 1003 ¶¶ 176–179).

Patent Owner argues that claim 7 is not unpatentable at least because it depends from claim 1. Prelim. Resp. 35. Patent Owner also asserts that Petitioner's assertions regarding the motivations of skilled artisans rely only on Mr. Andrews' Declaration, which parrots what is in the Petition without any support for conclusory assertions regarding what skilled artisans would have understood. Prelim. Resp. 35–37. Patent Owner argues that neither the Petition nor Mr. Andrews explains whether a skilled artisan would have had a reasonable expectation of success in combining Grisham and Nixon to arrive at the claimed invention and Mr. Andrews states only that "UWB and GPS provide positioning data, so it would have been readily apparent to a POSITA how to implement GPS into the radio units from Grisham." *Id.* at 37 (citing Ex. 1003 ¶ 179).

According to the '131 patent, prior art collision-avoidance systems used GPS and radar-based sensors to monitor rail vehicle locations except when the systems enter “blackout” areas in buildings, mountains, canyons, and tunnels GPS cannot determine a vehicle’s location accurately. Ex. 1001, 2:60–3:3. The claimed collision avoidance system introduces redundancy of multiple types of sensors with different accuracies at different distances. *Id.* at 3:64–4:9. A vehicle mounted module (VMM) 600 may transmit absolute position, relative position, speed, and other vehicle data to CTU 630 using GPS unit 610, UWB unit 620, or other sensors. *Id.* at 7:52–8:7. VMM 600 may obtain absolute position using GPS unit 610. *Id.* at 7:63–8:7. A UWB unit may work with a GPS unit. *Id.* at 11:24–27, 13:33–15:31.

Petitioner and Mr. Andrews contend that Nixon’s collision avoidance system uses GPS to determine the absolute position of moving vehicles such as trains and provide alerts based on the proximity of vehicles to one another by beeping faster as a target moves closer, and they cite teachings in Nixon. Pet. 34–35 (citing Ex. 1016, 5–7; Ex. 1003 ¶¶ 92–93 (citing Ex. 1016, 5–7), 172–175 (citing Ex. 1016, 6–7), 176–179 (citing Ex. 1037, 4:66–5:5)).

Mr. Andrews contends that skilled artisans would augment Grisham’s UWB-based system with Nixon’s GPS because UWB has low transmission power and would benefit from using GPS to measure the absolute position and heading of vehicles. Ex. 1003 ¶¶ 61 (citing Ex. 1025 ¶ 3), 176–179. Mr. Andrews testifies that GPS’s accuracy can vary by several meters, but UWB precisely measures range and refines the accuracy of GPS to prevent collisions at all distances, and GPS offsets shortfalls of UWB, and UWB overcomes limitations on GPS such as tunnels, urban areas, or low satellite visibility. *Id.* ¶¶ 175–179 (citing Ex. 1016, 6; Ex. 1037); *see id.* ¶¶ 61–70.

On this record, we find Mr. Andrews’ testimony supported by record evidence sufficiently and, in turn, supporting Petitioner’s contentions. Any lack of support goes to the weight to be given to Mr. Andrews’ testimony.

Mr. Andrews testifies that Grisham discloses a UWB-based collision avoidance system, and Nixon’s GPS based collision avoidance system uses GPS position data “so it would have been readily apparent to a POSITA how to implement GPS into the radio units from Grisham.” Ex. 1003 ¶¶ 174–179 (citing Ex 1016, 6–7). The level of detail in Grisham, Nixon, and the ’131 patent for using UWB and GPS in collision avoidance systems to determine locations and distances between vehicles indicates the technologies are well developed and predictable enough to implement together with a reasonable expectation of success to use a GPS unit in a VMM to receive satellite data as recited in claim 7. *See Intelligent Bio-Sys.*, 821 F.3d at 1367. Nixon uses GPS and UWB in a collision avoidance system. Ex. 1016, 2–3, 5–14; *see* Pet. 34–37; Ex. 1003 ¶¶ 173–175 (citing Ex. 1016, 6–7). On this record, we find that Petitioner has established a reasonable likelihood that claim 7 is unpatentable over Grisham and Nixon.

Regarding claims 8 and 9, Petitioner asserts that Nixon and Grisham issue alarms to alert an operator to oncoming trains in the vicinity, and the warnings can be variable in sight or sound (e.g., beeping faster) as a target is moving closer or approaching rapidly in Nixon, and it would have been obvious to combine the teachings to distinguish collision alarms from other alarms. Pet. 37–39 (citing Ex. 1006, 23:57–60, 23:57–58, Fig. 21; Ex. 1016, 5–6; Ex. 1003 ¶¶ 180–187). These contentions, which Patent Owner does not contest at this stage, are supported sufficiently by evidence of record. *See* Ex. 1016, 5–6; Ex. 1006, 19:40–54.

On this record, we find that Petitioner has established a reasonable likelihood that claims 8 and 9 are unpatentable over Grisham and Nixon.

3. Independent Claim 17

Petitioner contends that elements [17-Pre], [17A], and [17B] track to elements [1-Pre], [1A], [1B], and [1F] and are disclosed by Grisham for the same reasons provided for claim 1 in Ground 1A. Pet. 39.

Regarding elements [17C]–[17G], Petitioner contends that Grisham uses radio units to transmit and receive impulse radio signals wirelessly to provide direction, speed, and separation distance data for each rail vehicle with a single antenna 704 (element [17C], a GPS system to determine an absolute position of a rail vehicle with Nixon as for claim 7 (element [17D], and elements [17E]–[17G] for the same reasons as elements [1C]–[1F] in Ground 1A. Pet. 39–40 (citing Ex. 1006, 16:39–41, 16:59–60, 17:44–48, 23:42–47, Figs. 6, 7, 22; Ex. 1003 ¶¶ 192–197).

Patent Owner argues that Grisham does not disclose the elements of claim 17 for many of the same reasons as argued for claim 1 in Ground 1A and claims 7–9 of this ground by failing to identify a motivation to combine Grisham and Nixon or reasonable expectation of success. Prelim. Resp. 38.

As discussed for claim 7 above, Petitioner asserts that skilled artisans would have been motivated to combine Nixon with Grisham to supplement the range of Grisham’s UWB-based CAS with a complementary technology of Nixon’s GPS. Pet. 35–37 (citing Ex. 1003 ¶¶ 172–179). Nixon describes the use of UWB and GPS in a collision avoidance system. Ex. 1016, 5–14. On this record, we find Petitioner has established a reasonable likelihood that claim 17 is unpatentable over Grisham and Nixon.

4. *Claim 19*

Petitioner contends that the limitations of claim 19 track to claims 8 and 9 and are satisfied for the same reasons provided for claims 8 and 9 in Ground 2A. Pet. 40 (citing Ex. 1003 ¶ 198). Patent Owner argues that claim 19 is not unpatentable for the same reasons as claim 17 from which it depends. Prelim. Resp. 38.

On this record, we find that Petitioner has established a reasonable likelihood that claim 19 is unpatentable over Grisham and Nixon.

M. Ground 2B: Alleged Obviousness Over Grisham, Connell, Nixon, and McDaniel

Petitioner asserts the unpatentability of claim 16 under § 103(a) over Grisham, Connell, Nixon, and McDaniel. Pet. 2–3, 41.

Petitioner contends that claim 16 contains limitations that track the limitations of claims 9 and 10 and are satisfied for the reasons provided for claim 9 in Ground 2A and for claim 10 in Ground 1D. Pet. 41. Petitioner contends that a skilled artisan would have been motivated to incorporate McDaniel's adaptive threshold warning system and Connell's stopping distance calibration feature for vehicle collision avoidance into Grisham's CAS to accurately and effectively avoid collisions when rail vehicles are approaching at different speeds or braking conditions and to avoid nuisance alerts to operators of the safe approach or close proximity of other trains and the urgency of the warning. *Id.* (citing Ex. 1003 ¶¶ 199–201).

Patent Owner argues that claim 16 is not unpatentable based on its dependency from claims 1 and 15. Prelim. Resp. 38. On this record, we find that Petitioner has established a reasonable likelihood that claim 16 is unpatentable over Grisham, Connell, Nixon, and McDaniel.

N. Ground 2C: Alleged Obviousness Over Grisham, Nixon, and Richardson

Petitioner asserts the unpatentability of claim 18 under § 103(a) over Grisham, Nixon, and Richardson. Pet. 2–3, 42–43. Petitioner contends that skilled artisans would have been motivated to combine Grisham’s UWB-based CAS with Nixon’s longer-range GPS and use Richardson’s auxiliary transponder sensor module and offset for better location measurements and improved collision avoidance. *Id.* at 42–43 (citing contentions for claims 7 and 9 in Ground 2A and claim 5 in Ground 1C; Ex. 1003 ¶¶ 202–207).

Patent Owner argues that Petitioner has not shown a motivation to combine the references with reasonable expectations of success for the reasons provided for Ground 2A and 1C, respectively. Prelim. Resp. 39.

For reasons discussed above for those claims and grounds, on this record, we find that Petitioner has established a reasonable likelihood that claim 18 is unpatentable over Grisham, Nixon, and Richardson.

O. Ground 2D: Alleged Obviousness Over Grisham, Nixon, Richardson, and Douglas

Petitioner asserts the unpatentability of claim 20 under § 103(a) over Grisham, Nixon, Richardson, and Douglas. Pet. 2–3, 43. Petitioner asserts that the limitations of claim 20 (first and second central tracking unit (CTU) components on each vehicle) track to claims 2 and 3 and are satisfied for the same reasons as those claims in Ground 1B. Pet. 43. Petitioner asserts that trains communicate their positions to each other through CTU components, and a skilled artisan would have been motivated to use CTUs on the trains of Douglas to communicate with each other and provide critical up-to-date information to operators. *Id.* (citing Ex. 1011, 7:12–19; Ex. 1003 ¶ 208).

Patent Owner argues that claim 20 is not unpatentable for the same reasons as claim 17 from which it depends and for the same reasons that claims 2 and 3 are not unpatentable. Prelim. Resp. 39–40.

On this record, Petitioner has made a sufficient showing that a skilled artisan would have been motivated to add Douglas’s CTU components to vehicle mounted modules on each train to provide location and other information to avoid collisions. *See KSR*, 550 U.S. at 417. On this record, we find that Petitioner has established a reasonable likelihood that claim 20 is unpatentable over Grisham, Nixon, Richardson, and Douglas.

P. Ground 3A: Alleged Obviousness Over Suzuki or (Suzuki and Grisham)

Petitioner asserts the unpatentability of claims 1, 7, 8, 11–14, and 17 under § 103(a) over Suzuki alone or in combination with Grisham. *See Pet.* 2–3, 44–67.

1. Suzuki (Ex. 1005)

Suzuki discloses a collision avoidance system that uses UWB devices for communication and radar/ranging functions. Ex. 1005 ¶ 57. The system measures distances to an obstacle or a front vehicle using a radar function and issues a hazard warning to the driver if the distance is a predetermined amount or less. *Id.* ¶¶ 8, 18, 28, 37, 57.

2. Motivation to Modify and/or Combine Suzuki and Grisham

Petitioner contends that skilled artisans would understand Suzuki’s teachings to apply to all ground vehicles such as dual-mode rail vehicles that are motor vehicles that operate on tracks and road and also would have been obvious to apply on rail vehicles in view of Grisham’s teachings to employ a CAS on rail vehicles and cars. *See Pet.* 45–46 (citing Ex. 1003 ¶¶ 220–225).

3. *Claim 1*

Regarding element [1-Pre], Petitioner contends that Suzuki teaches a collision-avoidance system. Pet. 46 (citing Ex. 1005, code (57), ¶ 8; Ex. 1003 ¶¶ 227–229). This contention, which Patent Owner does not contest at this stage, is supported sufficiently by evidence of record. Suzuki discloses a UWB device with communication and radar functions to measure distances between cars and, based on that distance, issue a warning to a driver or carry out a pre-crash operation. Ex. 1005, code (57), ¶¶ 8, 18, 28.

Regarding element [1A], Petitioner contends that Suzuki discloses in-vehicle radar 110 in various configurations with a radar and user interface to warn drivers and mounted as a vehicle mounted module with units discussed for elements [1B]–[1D]. Pet. 47–49 (citing Ex. 1005 ¶¶ 35, 36, Figs. 1B, 3, 8; Ex. 1003 ¶¶ 214–219).

a. Unpatentability Over Suzuki Alone

Petitioner asserts that skilled artisans would understand teachings of Suzuki apply to all ground vehicles, including rail vehicles because Suzuki refers generally to “vehicles” throughout its disclosure and only sometimes specifies that vehicles are “cars,” and skilled artisans would understand that some railroad work vehicles are dual-mode work vehicles, road-rail vehicles, or hi-rail trucks that “are essentially motor vehicles or cars with the ability to operate on tracks and road.” Pet. 46, 49 (citing Ex. 1003 ¶¶ 220–225).

Mr. Andrews testifies that skilled artisans would understand that these teachings apply to all vehicles including dual-mode rail vehicles that operate on tracks and roads, would avoid collisions of rail and road vehicles, and could be applied to rail vehicles with minimal changes because they have fewer degrees of freedom of movement than cars. Ex. 1003 ¶¶ 216–219.

Patent Owner argues that Suzuki measures short separation distances of vehicles that are close together but the '131 patent “recognizes, to avoid crashes between rail vehicles, the devices must be capable of measuring separation distances where the rail vehicles are far apart.” Prelim. Resp. 40–41 (citing Ex. 1001, 23:32–38). Patent Owner argues that a skilled artisan would recognize that Suzuki would not be able to measure longer separation distance and would not have a reasonable expectation of success of arriving at a collision avoidance system for rail vehicles recited in claim 1. *Id.* at 41.

According to the '131 patent, its collision avoidance system (CAS) provides techniques and solutions for a wide variety of railway vehicles such as maintenance vehicles, railcars, hyrail cars, train cars, and engines such as illustrated in Figures 1A–1C. Ex. 1001, 3:46–63. Figure 1C depicts a hyrail vehicle that can operate on railroad tracks and roads. *Id.* at 3:54. The CAS may combine sensors to detect vehicles that are far away or inches away. *Id.* at 4:2–9. A GPS unit and UWB offer distance measurements of different ranges and precision. *Id.* at 17:10–30. The VMM equipment may sense the closest targets in the front and back. *Id.* at 22:12–18. A host vehicle may be 50 feet behind a target vehicle. *Id.* at 23:11–28. Separation distances can be 40 feet and 100 feet. *Id.* at 23:33–47. The '131 patent's CAS may be used in other vehicles, applications, and industries including construction, mining, and airport (on airport tarmacs) industries. *Id.* at 29:33–41.

Claim 1 does not require a particular separation distance or sensor with a particular capability to sense or detect a particular distance range. Patent Owner's arguments in this regard are not commensurate with the scope of claim 1. Prelim. Resp. 40–41. Suzuki also uses cognitive radio to expand its coverage. *See* Ex. 1005 ¶¶ 40–49, Figs. 9–11.

Petitioner has provided sufficient evidence at this stage to support a determination that a skilled artisan would have considered Suzuki's CAS to be applicable to railroad vehicles including hyrail vehicles that operate on roads and railroad tracks as the '131 patent discloses. Ex. 1001, 3:46–63, Fig. 1C; Ex. 1003 ¶ 217. Mr. Andrews testifies that Suzuki's system can be applied to rail vehicles with a reasonable expectation of success as such rail vehicles present simpler technical problems and fewer degrees of freedom than vehicles that operate on roads. Ex. 1003 ¶¶ 218–219. Mr. Andrews also provides persuasive testimony at this stage that a skilled artisan would consider Suzuki's system for use in rail vehicles because the mounting would require less complexity than monitoring cars. *Id.* ¶ 219.

b. Unpatentability Over Suzuki and Grisham

Petitioner also contends, “using Suzuki's collision-avoidance system on rail vehicles would have been obvious to POSITAs in view of Grisham.” Pet. 46 (citing Ex. 1003 ¶¶ 220–225), 49–51 (same). Petitioner asserts that Grisham's collision avoidance system uses UWB communications and displays to provide user alerts and inputs for rail vehicles that travel on tracks, trains, and conventional cars so that skilled artisans would have been motivated to apply Suzuki's collision-avoidance system to rail vehicles and to mount modules and other components on rail vehicles with a reasonable expectation of success because both references address the same problem of vehicular collision avoidance in substantially the same way for vehicles such as cars (Suzuki) and cars, work vehicles, and trains (Grisham). *Id.* at 49–51 (citing contentions for elements [1A]–[1D] in Ground 1A; Ex. 1006, 19:20–20:14, 22:42–23:32, Figs. 11, 19; Ex. 1003 ¶¶ 221–225).

Petitioner contends that Grisham teaches how to use its rail system in a car and the benefits of a collision avoidance system with UWB sensors in rail vehicles so it would have been a trivial modification for skilled artisans to apply the vehicle mounted modules of Suzuki to rail vehicles as taught by Grisham where Grisham teaches the interoperability and compatibility of providing collision avoidance between cars and rail vehicles as taught by Grisham's car-train embodiment. Pet. 49–51 (citing Ex. 1003 ¶¶ 221–225).

Patent Owner argues that Mr. Andrews' Declaration is not supported by evidence such as his conclusion that skilled artisans would understand from reading Grisham that rail systems and car systems would provide the greatest benefit when they are compatible with each other. Prelim. Resp. 41 (citing Ex. 1003 ¶¶ 223–225). Patent Owner asserts that Mr. Andrews' testimony does not provide substantial evidence and disregards differences between car and train collision avoidance systems such as the fewer degrees of freedom of movement of rail vehicles compared to cars and does not explain why a skilled artisan would be motivated to replace Grisham's train-based system with Suzuki's car-based system. *Id.* at 41–42.

Petitioner and Mr. Andrews rely on Grisham's teachings of collision-avoidance systems that use UWB communications and displays for alerts and user inputs for rail vehicles, dual mode hi-rail vehicles, trains, and cars to prevent collisions between rail vehicles and cars. Pet. 46, 49–51 (citing contentions for elements [1A]–[1D] in Ground 1A; Ex. 1006, 19:20–20:14, 22:42–23:32, Figs. 11, 19); Ex. 1003 ¶¶ 221–225 (citing Ex. 1006, 22:28–30, 23:33–40, Figs. 11, 12, 19, 21; Ex. 1036). Petitioner and Mr. Andrews thus cite record evidence and provide technical reasoning to support their contentions that skilled artisans would have combined Suzuki and Grisham.

Figures 11 and 12 of Grisham describe a collision avoidance process for vehicle 1104 at railroad crossing 1106 to receive impulse radio signal 910 from transmitting impulse radio unit 902 on a locomotive 1102 that is approaching railroad crossing 1106 at receiving impulse radio unit 904 on vehicle 1104 to alert the vehicle operator of a potentially dangerous situation of the presence of locomotive 1102. Ex. 1006, 19:20–54, Figs. 11, 12.

Grisham’s teaching of the combinability and interoperability of UWB units for trains, rail vehicles, and cars provides a rational underpinning for a skilled artisan to apply Suzuki’s teachings to rail vehicles for similar benefits with a reasonable expectation of success. Ex. 1006, 18:52–24:44. Grisham provides a road map for doing so. *See* Ex. 1003 ¶¶ 221–225.

c. Remaining elements of claim 1

Regarding element [1B]/[1F], Petitioner asserts that Suzuki teaches an in-vehicle UWB radar device 110 that sends, via antenna 121A, radar waves and data with vehicle location and ID information and receives radar waves and data via antenna 121B and the antennas can be shared as antenna 121C. Pet. 51–53 (citing Ex. 1005, code (57), ¶¶ 14, 15, 20, 27, Figs. 1B, 2, 3, 8; Ex. 1003 ¶¶ 226–229), 56. These contentions, which Patent Owner does not contest at this stage, are supported sufficiently by evidence of record.

Regarding element [1C]/[1G], Petitioner asserts that Suzuki’s control part 123 is part of radar device 110 that sends commands to the transceivers and processes information from front- and rear-mounted devices in integral unit 310 and skilled artisans would understand the information processing to be done by a processor. Pet. 54 (citing Ex. 1005 ¶¶ 14, 35, 36, Figs. 1B, 3, 8; Ex. 1003 ¶ 230), 57. These contentions, which Patent Owner does not contest at this stage, are supported sufficiently by evidence of record.

Regarding elements [1D]/[1H], Petitioner contends that Suzuki has a display that is operable to provide vehicle information as a warning to a driver when the distance between two vehicles is less than a predetermined value or as an alarm display or alarm tone when a short time to crash is calculated, and it would have been obvious for the display to receive input from an operator to mute the alarm or adjust the volume and to provide rail-vehicle information just as readily as vehicle information because cars and rail vehicles face the same problem of avoiding collisions, and applying a warning/alarm for cars to rail vehicles would not require any substantial modifications. Pet. 53–55 (citing element [1A], Ground 3A; Ex. 1005 ¶¶ 8, 18, 28, 37; Ex. 1003 ¶¶ 231–237; Ex. 1001, 18:18–20), 57.

Petitioner contends in the alternative that Suzuki and Grisham render this element obvious through Grisham’s teaching of a user interface module with a display that provides information and receives input from an operator to communicate with other operators, and skilled artisans would have been motivated to combine Suzuki’s collision avoidance system with warnings and alarms with Grisham’s display to provide rail vehicle information and to receive operator input to mute the alarm and adjust the volume with a reasonable expectation of success. Pet. 55 (citing element [1D] in Ground 1A; element [1A] in ground 3A; Ex. 1003 ¶¶ 236–237), 57.

Patent Owner argues that Petitioner contends that it would have been obvious that the warning and alarm displays and navigation system disclosed in Suzuki would receive input from the driver such as muting the alarm and adjusting the volume and the Petitioner relies on Mr. Andrews to support its contention, but Mr. Andrews repeats, verbatim, the conclusory assertion for which it is offered to support. Prelim. Resp. 42–43.

Mr. Andrews testifies that it would have been obvious for a warning and alarm display and navigation system to receive driver input to mute and adjust alarms and volumes, and such Automotive Navigation Systems 312 of Suzuki were known to allow operators to input a destination into the system for guidance. Ex. 1003 ¶ 234.

Patent Owner argues that Grisham does not disclose this element and Petitioner's assertion cannot render this element obvious. Prelim. Resp. 44.

Petitioner cites element [1D] of Ground 1A to support its contentions that Suzuki and Grisham render obvious a display that receives user input in element [1D] of Ground 3A. Pet. 55, 57. Element [1D] of Ground 1A relies on Grisham to teach a display that displays direction, distance, and speed of an oncoming train to a vehicle operator (Ex. 1006, 23:52–66) and allows the operator to communicate with operators on another train (*id.* at 23:60–62). Pet. 13–14 (citing Ex. 1006, 23:52–66 to disclose element [1D] of Ground 1A). These teachings support Petitioner's contentions for Ground 3A.

Regarding elements [1E]/[1J], Petitioner asserts that Suzuki's UWB unit sends signals with location data or vehicle ID to a UWB unit on another vehicle and measures distance to the other vehicle if it detects its own ID in a received radar transmission to measure distance by TOF. Petitioner asserts it would be obvious to mount Suzuki's radar units on rail vehicles to warn operators of other trains, determine separation distance, and avoid collisions. Pet. 55–56 (citing element [1A], Ground 3A; Ex. 1005 ¶¶ 8, 15, 16, 55, Figs. 17; Ex. 1006, 22:45–60, 23:36–52, Figs. 19–22; Ex. 1003 ¶¶ 214–225), 58–59 (citing element [1A], Ground 3A; Ex. 1005 ¶¶ 4, 32; Ex. 1003 ¶¶ 244–247). These contentions, which Patent Owner does not contest, are supported sufficiently by evidence of record.

Suzuki combines vehicle-to-vehicle communication with UWB radar to measure distances to objects around a vehicle. Ex. 1005 ¶¶ 7, 8, 14, 16, 27, 45, 51–57. Grisham mounts communication modules on rail vehicles to transmit their position and distance to other vehicles and alert operators of dangers. Ex. 1006, 22:33–60, Figs. 19–22; Pet. 55. On this record, we find that Petitioner has established a reasonable likelihood that claim 1 is unpatentable over Suzuki alone or in combination with Grisham.

4. Claims 7, 8, 11–14, 17

Petitioner provides contentions with citations to record evidence and Mr. Andrews’ testimony that Suzuki discloses a GPS system (claim 7), a warning signal when vehicle separation criteria are violated (claim 8), a ground speed detection module (claim 11), first inertial measurement unit (claim 12) comprising an accelerometer/gyroscope (claim 13), varying center frequencies (claim 14), and a rail vehicle module (claim 17). Pet. 59–68 (citing Ex. 1003 ¶¶ 248–278). These contentions, which Patent Owner does not contest, are supported sufficiently by record evidence. On this record, we find that Petitioner has established a reasonable likelihood that claims 7, 8, 11–14, and 17 are unpatentable over Suzuki alone or in combination with Grisham.

Q. Ground 3B: Alleged Obviousness Over Suzuki and Richardson or Over Suzuki, Grisham, and Richardson

Petitioner asserts the unpatentability of claims 2–6, 18, and 20 under § 103(a) over Suzuki and Richardson or Suzuki, Grisham, and Richardson. Pet. 2–5, 68–74 (citing Ex. 1003 ¶¶ 283–300). These contentions, most of which Patent Owner does not oppose at this stage, are supported sufficiently by evidence of record. Prelim. Resp. 44.

Patent Owner argues that neither Suzuki nor Richardson relates to a CAS for rail vehicles, and a skilled artisan would not combine Suzuki with Richardson for use in rail vehicles or have a reasonable expectation of arriving at a collision avoidance system for rail vehicles, and Petitioner and Mr. Andrews do not explain why a skilled artisan would want to improve collision avoidance systems of Suzuki and Grisham. Prelim. Resp. 44–45.

Petitioner contends that a skilled artisan would have been motivated to combine teachings of Suzuki with Richardson or Richardson and Grisham, all of which disclose vehicle-proximity detection systems, to improve safety and prevent collisions for a *platoon of vehicles* in Suzuki where Richardson mounts four UWB radios on each vehicle of *a convoy* as central tracking units to monitor locations of, and distances between, several vehicles with a reasonable expectation of success. Pet. 68–71 (citing Ex. 1005 ¶¶ 55, 56, Fig. 17; Ex. 1008, Abstract, 209–210, 212, Figs. 1, 2; Ex. 1003 ¶¶ 283–292).

Mr. Andrews testifies that Suzuki controls a platoon of vehicles with in-vehicle radar devices, and Richardson describes a control system for a convoy of vehicles using a central controller to manage four radios on each truck to track vehicles in front and behind and this ranging and detection would improve safety and control of Suzuki’s platoon by monitoring vehicle locations and distances between vehicles uniformly. Ex. 1003 ¶¶ 283–292 (citing Ex. 1005 ¶¶ 55, 56; Ex. 1008, 210, 212, Figs. 1, 2).

Richardson describes dilution of precision problems that can occur in measuring distances between vehicles in convoys with multiple radios due to geometry and minimizes these issues by defining eight zones for coordinate radio pairs. Ex. 1008, 212–213, Figs. 6, 7; *see KSR*, 550 U.S. at 417. Such a CTU arrangement would improve Suzuki’s control over a vehicle platoon.

On this record, we find that Petitioner has established a reasonable likelihood that claims 2–6, 18, and 20 are unpatentable over Suzuki and Richardson or over Suzuki, Grisham, and Richardson.

R. Ground 3C: Alleged Obviousness Over Suzuki and Nixon or Over Suzuki, Grisham, and Nixon

Petitioner asserts unpatentability of claims 9 and 19 under § 103(a) over Suzuki and Nixon or Suzuki, Grisham, and Nixon. Pet. 2–3, 74–75. Petitioner asserts that Suzuki and Grisham teach or suggest alerts based on vehicle separation distances, and Nixon uses a progressive warning signal that would have been obvious to combine with Suzuki and/or Grisham to improve their alarms and prevent collisions with a reasonable expectation of success in claim 9. Pet. 74–75 (citing elements [1D], [24F], and [24G] of Ground 3A; claim 9, Ground 2A; Ex. 1003 ¶¶ 304–309). Petitioner cites its contentions for claim 8, Ground 3A for claim 19 and its reasons for claim 9, Ground 3C. Pet. 75.

Patent Owner argues that Petitioner failed to provide a motivation to combine Nixon and Grisham or a reasonable expectation of success, and Mr. Andrews’ declaration is full of conclusory statements. Prelim. Resp. 44–46. Yet, Petitioner asserts Nixon’s progressive warning feature would improve the alarms in Suzuki and/or Suzuki and Grisham to alert a vehicle operator progressively as a collision risk increases with a reasonable expectation of success, and Mr. Andrews relies on teachings of Nixon to support the contentions. Pet. 74–75 (citing Ex. 1003 ¶¶ 304–309); Ex. 1003 ¶¶ 304–309 (citing Ex. 1016, 5–6). On this record, we find that Petitioner has established a reasonable likelihood that claims 9 and 19 are unpatentable over Suzuki and Nixon or over Suzuki, Grisham, and Nixon.

S. Ground 3D: Alleged Obviousness Over Suzuki and McDaniel or Over Suzuki, Grisham, and McDaniel

Petitioner asserts the unpatentability of claim 10 under § 103(a) over Suzuki and McDaniel or Suzuki, Grisham, and McDaniel. Pet. 2–4, 75–76. Petitioner relies on its contentions for claim 10, Ground 1D that McDaniel discloses an adaptive threshold warning distance based on velocities of host and target vehicles to avoid collisions between vehicles at varying speeds and conditions. Pet. 75–76 (citing Ex. 1003 ¶¶ 355, 356).

Patent Owner argues that Petitioner failed to provide a motivation to combine Suzuki with McDaniel, and with Grisham with a reasonable expectation of success. Prelim. Resp. 46–47.

Yet, Petitioner has contended that this feature would improve the CAS systems of Suzuki and Grisham in varying conditions to avoid collisions when rail vehicles approach at different speeds and avoid nuisance alerts to the operator of the safe approach or close proximity of other trains. Pet. 29–30 (citing Ex. 1015 ¶¶ 38, 39; Ex. 1003 ¶¶ 153–156 for Ground 1D), 75–76 (citing Ex. 1003 ¶¶ 314–317 for Ground 3D).

Mr. Andrews testifies that this feature would improve the accuracy of avoiding collisions when rail vehicles approach at different speeds to avoid nuisance alerts to the operator of the safe approach or close proximity of other trains. *See* Ex. 1003 ¶¶ 314–317 (citing Ex. 1015 ¶ 39; Ex. 1003 ¶¶ 147, 148).

On this record, we find that Petitioner has established a reasonable likelihood that claim 10 is unpatentable over Suzuki and McDaniel or over Suzuki, Grisham, and McDaniel.

T. Ground 3E: Alleged Obviousness Over Suzuki and Connell or Suzuki, Grisham, and Connell

Petitioner asserts the unpatentability of claim 15 under § 103(a) over Suzuki and Connell or Suzuki, Grisham, and Connell. Pet. 2, 4, 76.

Petitioner relies on its contentions for claim 15, Ground 1F including the reasons provided therein to incorporate Connell's stopping-distance calibration into the CAS of Suzuki to avoid collisions between vehicles at varying conditions. Pet. 76 (citing Ex. 1003 ¶¶ 318–319).

Patent Owner argues that Petitioner failed to establish that a skilled artisan would have been motivated to combine Connell with Suzuki. Prelim. Resp. 47. Petitioner relies on Mr. Andrews who testifies that skilled artisans would know that varying driving conditions and speeds produce different stopping distances and would have been motivated to apply the stopping distance calibration algorithm of Connell to improve overall safety of the CAS of Suzuki for the same reasons discussed for Grisham. Ex. 1003 ¶ 319.

On this record, we find that Petitioner has established a reasonable likelihood that claim 15 is unpatentable over Suzuki and Connell or over Suzuki, Grisham, and Connell.

U. Ground 3F: Alleged Obviousness Over Suzuki, Nixon, McDaniel, and Connell or Over Suzuki, Grisham, Nixon, and McDaniel, Connell

Petitioner asserts the unpatentability of claim 16 under § 103 over Suzuki, Nixon, Connell, and McDaniel, or Suzuki, Grisham, Nixon, Connell, and McDaniel. Pet. 76 (citing contentions for claim 9, Grounds 2A, 3C and claim 10, Grounds 1D, 3D). Patent Owner argues that the Petition failed to establish that a skilled artisan would be motivated to make the asserted combinations. Prelim. Resp. 47–48.

Yet, Nixon provides a progressive warning to alert a person to an impending collision as Petitioner contends. Pet. 38–39 (claim 9, Ground 2A) (cited in Pet. 76); Ex. 1016, 5–6.

On this record, we find that Petitioner has established a reasonable likelihood that claim 16 is unpatentable over Suzuki, Nixon, Connell, and McDaniel, or over Suzuki, Grisham, Nixon, Connell, and McDaniel.

III. CONCLUSION

For the reasons discussed above, we are persuaded that Petitioner has demonstrated a reasonable likelihood of prevailing in establishing that at least one of claims 1–20 of the '131 patent is unpatentable.

IV. ORDER

In consideration of the foregoing, it is hereby:

ORDERED that *inter partes* review of the '131 patent is hereby instituted as to claims 1–20 on all grounds set forth in the Petition; and

FURTHER ORDERED that pursuant to 35 U.S.C. § 314(c) and 37 C.F.R. § 42.4, notice is hereby given of the institution of a trial on the grounds of unpatentability authorized above; the trial commences on the entry date of this decision.

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