

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

MERCEDES-BENZ USA, LLC,
Petitioner,

v.

CARUCEL INVESTMENTS, L.P.,
Patent Owner.

IPR2019-01404
Patent 7,979,023 B2

Before THOMAS L. GIANNETTI, DANIEL J. GALLIGAN, and
PAUL J. KORNICZKY, *Administrative Patent Judges*.

GALLIGAN, *Administrative Patent Judge*.

JUDGMENT
Final Written Decision
Determining All Challenged Claims Unpatentable
35 U.S.C. § 318(a)

I. INTRODUCTION

In this *inter partes* review, Mercedes-Benz USA, LLC (“Petitioner”) challenges the patentability of claims 1, 4–11, and 14–23 of U.S. Patent No. 7,979,023 B2 (“the ’023 patent,” Ex. 1001), which is assigned to Carucel Investments, L.P. (“Patent Owner”).

We have jurisdiction under 35 U.S.C. § 6. This Final Written Decision, issued pursuant to 35 U.S.C. § 318(a), addresses issues and arguments raised during the trial in this *inter partes* review. For the reasons discussed below, we determine that Petitioner has proven by a preponderance of the evidence that claims 1, 4–11, and 14–23 of the ’023 patent are unpatentable. *See* 35 U.S.C. § 316(e) (“In an *inter partes* review instituted under this chapter, the petitioner shall have the burden of proving a proposition of unpatentability by a preponderance of the evidence.”).

A. Procedural History

Petitioner requested *inter partes* review of claims 1, 4–11, and 14–23 of the ’023 patent on the following grounds:

Claims Challenged	35 U.S.C. §	References/Basis
1, 4, 5, 9, 11, 14, 15, 19	103(a) ¹	Gilhousen761, ² Adachi ³
21–23	103(a)	Gilhousen761, Adachi, Bolgiano ⁴

¹ The Leahy-Smith America Invents Act (“AIA”) included revisions to 35 U.S.C. §§ 102 and 103 that became effective after the filing of the application for the ’023 patent. Therefore, we apply the pre-AIA versions of these sections.

² Gilhousen, US 5,519,761, issued May 21, 1996 (Ex. 1005).

³ Adachi et al., US 5,652,765, issued July 29, 1997 (Ex. 1031).

⁴ Bolgiano et al., US 5,614,914, issued Mar. 25, 1997 (Ex. 1033).

Claims Challenged	35 U.S.C. §	References/Basis
1, 4, 6–11, 14, 16–22 ⁵	103(a)	Ito, ⁶ Gilhousen ⁷ , Adachi
1, 6–8, 11, 16–18	103(a)	Ito, Jakes ⁸

Paper 3 (“Pet.”), 10. Patent Owner filed a Preliminary Response. Paper 7 (“Prelim. Resp.”). With our authorization (Paper 8), Petitioner filed a Reply to the Preliminary Response (Paper 9), and Patent Owner filed a Sur-reply (Paper 11). We instituted trial on all grounds of unpatentability. Paper 12 (“Inst. Dec.”), 37.

During the trial, Patent Owner filed a Response (Paper 19, “PO Resp.”), Petitioner filed a Reply (Paper 28, “Pet. Reply”), and Patent Owner filed a Sur-reply (Paper 34, “PO Sur-reply”).

An oral hearing was held on December 2, 2020, a transcript of which appears in the record. Paper 37 (“Tr.”).

B. Related Matters

As required by 37 C.F.R. § 42.8(b)(2), the parties identify various related matters. Pet. 74–76; Paper 5, 1–2. The ’023 patent is also the subject of IPR2019-01079 and IPR2019-01103.

The ’023 patent was asserted in *Carucel Investments, LP v. Novatel Wireless, Inc.*, No. 16-cv-118 (S.D. Cal.) (“the Novatel litigation”), resulting

⁵ Claim 7 is addressed in this ground. Pet. 58–59. Therefore, we treat Petitioner’s omission of claim 7 from the table on page 10 of the Petition as a typographical error.

⁶ Ito, US 5,276,686, issued Jan. 4, 1994 (Ex. 1003).

⁷ Gilhousen et al., US 5,101,501, issued Mar. 31, 1992 (Ex. 1004).

⁸ Jakes, “A Comparison of Specific Space Diversity Techniques for Reduction of Fast Fading in UHF Mobile Radio Systems,” *IEEE Transactions on Vehicular Technology*, Vol. VT-20, No. 4, Nov. 1971 (Ex. 1032).

in a jury verdict of non-infringement. *See* Ex. 2106, 2–5 (Order denying Carucel’s motion for JMOL or new trial).

C. Real Parties in Interest

Petitioner identifies itself, Daimler AG, Daimler North America Corporation, and Mercedes-Benz U.S. International, Inc. as real parties in interest. Pet. 74. Patent Owner identifies itself as the real party in interest. Paper 5, 1.

D. The '023 Patent

The '023 patent is titled “Mobile Communication System with Moving Base Stations.” Ex. 1001, code (54). According to the patent, “[a] problem with existing mobile telephone systems is the considerable time required in handoffs. This becomes a particular problem in urban areas which are highly congested.” Ex. 1001, 1:56–58. The '023 patent addresses this problem by providing “a moving base station which is interposed between a moving mobile telephone unit and a fixed base station.” Ex. 1001, 2:66–3:2. The “movable base station moves with the traffic at a rate of speed which is comparable to the speed of the traffic and communicates with a moving mobile telephone unit via standard mobile radio transmission.” Ex. 1001, 3:3–6. The movable base station “communicates by radio signals with a plurality of fixed antennas spaced along the path of travel of the mobile base station.” Ex. 1001, 3:6–9.

This is illustrated by Figure 1 of the '023 patent, reproduced below.

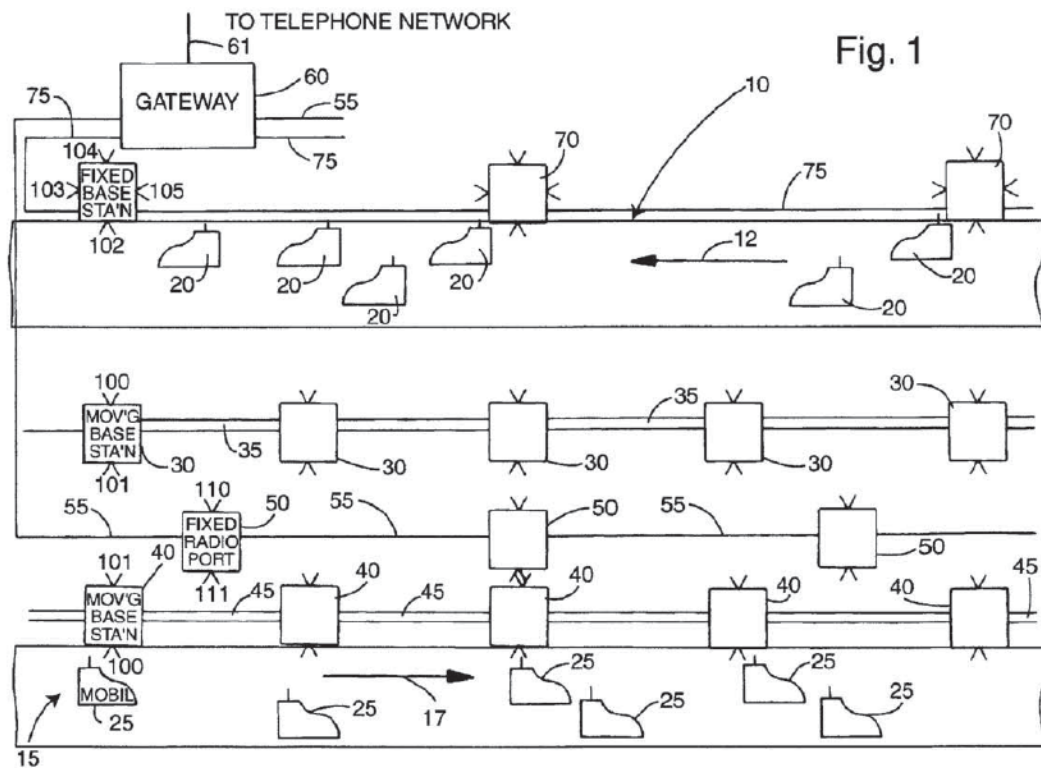


Fig. 1 is a block diagram representation of a roadway structure with fixed base stations, moving base stations, and fixed radio ports.

In Figure 1, a divided highway has mobile units 20 traveling on first roadway 10, in one direction, and mobile units 25 traveling along second roadway 15, in the opposite direction. Ex. 1001, 3:66–4:2. Moving base stations 30 are disposed along one side of roadway 10. The base stations are spaced apart by a selected distance equivalent to the diameter of the cell served by the moving base station. Ex. 1001, 4:2–6.

“[M]oving base stations 30 may be moved by means of rail 35, or other suitable conveying device, which may include an automotive vehicle traveling on the roadway, in the same direction as the traffic flow on roadway 10, as indicated by arrow 12.” Ex. 1001, 4:6–10. Similarly,

moving base stations 40 are disposed along adjacent roadway 15, moving in the direction of the traffic as indicated by arrow 17. Ex. 1001, 4:11–13.

Moving base stations 40 are moved along rail 45. Ex. 1001, 4:13–14.

In operation, base stations 30 move in the direction of the flow of the traffic at a rate of, for example, 60 miles per hour, which may be faster than some traffic and slower than other traffic. Ex. 1001, 4:39–42. The moving base stations handle telecommunications with mobile units 25, which travel at a rate of not more than 30 miles per hour faster or slower than the moving base stations. Ex. 1001, 4:42–45. Fixed base stations 70 accommodate communications with mobile units traveling at speeds of less than 30 miles per hour, including pedestrian traffic and stationary units. Ex. 1001, 4:48–51.

According to the '023 patent, the advantage of this system is reducing the number of handoffs:

The system in accordance with the invention differs from the prior art primarily in that the base stations 30, 40 are moving with the traffic and communicate with the gateway office 60 via fixed radio ports 50. Furthermore, in the examples described herein, the various call-handling functions, including handoff, are performed by the moving base station. Advantageously, *because of movement of the base station in the same direction as the traveling mobile unit, the number of handoffs is greatly reduced.*

Ex. 1001, 5:10–18 (emphasis added).

Each of the moving base stations is provided with multiple antennas. Ex. 1001, 5:20–21. Antennas 100 on moving base stations 30, 40 are used to communicate with mobile units 20, 25, whereas antennas 101 on moving base stations 30, 40 are used to communicate with fixed radio ports 50.

Ex. 1001, 5:26–29.

E. Illustrative Claims

The '023 patent has 23 claims, of which 19 (claims 1, 4–11, and 14–23) are challenged in the Petition. Of the challenged claims, claims 1 and 11 are independent and are reproduced below.

1 An apparatus configured to move relative to Earth, the apparatus comprising:

a plurality of spatially separated antennas;

a receiver configured to receive mobile device signals from a mobile device through the plurality of spatially separated antennas; and

a transmitter configured to transmit radio frequency signals corresponding to the mobile device signals to a base station.

11. An apparatus configured to move relative to Earth, the apparatus comprising:

a plurality of spatially separated antennas; and

a receiver configured to receive fixed port signals from a fixed port through the plurality of spatially separated antennas; and

a transmitter configured to transmit radio frequency signals to a mobile device corresponding to the received fixed port signals.

II. ANALYSIS

A. Level of Ordinary Skill in the Art

Petitioner contends that a person of “ordinary skill in the art would have at least a Bachelor’s degree in Electrical Engineering, Computer Science, or an equivalent area of study, and at least three years of graduate study or professional experience with wireless and/or cellular communications or similar experience.” Pet. 7–8 (citing Ex. 1008 (Declaration of Mr. Jeffrey Fischer) ¶¶ 32–33).

Patent Owner contends a person of ordinary skill in the art at or near the filing date of the earliest priority application of the '023 Patent would have had (i) a Bachelor of Science degree in electrical engineering or computer engineering or related field of study; (ii) at least two years of experience with wireless communications systems; and (iii) would also be familiar with cellular communication technology.

PO Resp. 8 (citing Ex. 2100 (Declaration of Mark R. Lanning) ¶ 60).

Further, Patent Owner contends that “[a] lack of experience can be compensated with additional education and a lack of education can be compensated with additional work experience.” PO Resp. 8.

We regard these definitions as not materially different. Both definitions, also, are consistent with the prior art before us and with the level of skill reflected in the '023 patent. *See Okajima v. Bourdeau*, 261 F.3d 1350, 1355 (Fed. Cir. 2001) (prior art itself may reflect an appropriate level of skill). As the definitions are not materially different, we adopt Patent Owner’s description, with the exception of the open-ended language “at least.” However, we would reach the same result on the ultimate question of obviousness of the '023 patent under either definition.

B. Claim Interpretation

We interpret claim terms using “the same claim construction standard that would be used to construe the claim in a civil action under 35 U.S.C. 282(b).” 37 C.F.R. § 42.100(b) (2019). In applying this claim construction standard, we are guided by the principle that the words of a claim “are generally given their ordinary and customary meaning,” as understood by a person of ordinary skill in the art in question at the time of the invention. *Phillips v. AWH Corp.*, 415 F.3d 1303, 1312–13 (Fed. Cir. 2005) (en banc) (citation omitted). “In determining the meaning of the disputed claim

limitation, we look principally to the intrinsic evidence of record, examining the claim language itself, the written description, and the prosecution history, if in evidence.” *DePuy Spine, Inc. v. Medtronic Sofamor Danek, Inc.*, 469 F.3d 1005, 1014 (Fed. Cir. 2006) (citing *Phillips*, 415 F.3d at 1312–17). There is a “heavy presumption” that a claim term carries its ordinary and customary meaning. *CCS Fitness, Inc. v. Brunswick Corp.*, 288 F.3d 1359, 1366 (Fed. Cir. 2002) (citation omitted).

The parties identify certain claims for construction, as discussed below.

1. “fixed port”

In the *Novatel* litigation, the district court construed “fixed port” to mean “a stationary device at which signals can enter or exit a communication network.” Ex. 1037 (Claim Construction Order), 12, *quoted in* Pet. 8. Patent Owner argues that this construction is “the plain and ordinary meaning of the term and is the proper construction for ‘fixed port.’” PO Resp. 10.⁹ In the ground based on Gilhousen⁷⁶¹, Adachi, and Bolgiano, Patent Owner argues that certain disclosures of Bolgiano do not teach a “fixed port” under this construction. PO Resp. 45–48. We apply the district court’s construction in our analysis of the parties’ dispute in this ground. *See* § II.E below.

⁹ Patent Owner misquotes the district court’s claim construction as saying “enter and exit” rather than “enter or exit,” as stated in the district court’s order. Ex. 1037, 12. We treat Patent Owner’s misquotation as a typographical error.

2. “*configured to*”

In the *Novatel* litigation, the district court construed “configured to,” appearing in the preambles of claims 1 and 11, as “constructed to move with the traffic at a rate of speed which is comparable to the speed of the traffic.” Ex. 1037, 13–16.¹⁰ Patent Owner contends that the preamble is limiting and urges us to adopt this construction. PO Resp. 10–12. Petitioner provides this construction from the district court in its Petition but in its Reply argues that no construction is necessary. Pet. 8; Pet. Reply 7.

Patent Owner argues for a further limitation: “An airplane does not move with traffic as it is not bound to predetermined roads.” PO Resp. 38; *see also* PO Sur-reply 24–25.

In our analysis below, we apply the district court’s construction, and we discuss the “narrower implied construction” of the term “traffic” advanced by Patent Owner in the analysis of Gilhousen761 below.¹¹

3. “*mobile device*”

Prior to our Institution Decision, neither party advanced a construction for this term, which now lies at the center of this controversy. Post-institution, Patent Owner argues that “the plain and ordinary meaning” of “mobile device” is “a device that must register with and be able to directly communicate with the cellular network.” PO Resp. 13. Patent Owner asserts that this includes the “capability to be switched back-and-

¹⁰ The phrase “configured to” appears in the bodies of claims 1 and 11 as well, but the district court’s construction focuses on the “configured to move” language of the preamble. Ex. 1037, 13–16.

¹¹ We do not express an opinion on the question of whether the preamble is limiting as that is not necessary to resolve a controversy.

forth between either a direct connection with the fixed base station or a connection with a moving base station.” PO Resp. 13–14.

To support this construction, Patent Owner relies on the ’023 patent Specification: “The ’023 Patent specification teaches that a mobile device must be capable of directly communicating with either a fixed cellular base station or a moving base station.” PO Resp. 13 (citing Ex. 1001, 4:42–51). According to Patent Owner, “the mobile unit’s capability to be switched back-and-forth between either a direct connection with the fixed base station or a connection with a moving base station is discussed repeatedly and throughout the specification.” PO Resp. 13–14 (citing Ex. 1001, 10:65–11:11). Patent Owner also cites the following discussion of the mobile unit in the ’023 patent, which describes registration:

When a mobile unit set is first powered up or first enters a service area, the mobile unit must register in the manner described earlier, by transmitting its unique address in the new service area. The address will be received by the closest moving base station 30 and transmitted via a fixed radio port and the gateway switch 60 to the telephone network. This registration procedure is required so that an incoming call for the mobile unit can be appropriately directed.

Ex. 1001, 9:62–10:2 (partially quoted at PO Resp. 14). Patent Owner also relies on testimony from its expert, Mr. Lanning. *See* PO Resp. 13–15 (citing Ex. 2100 ¶¶ 59, 66–72, 77–81).

Petitioner responds that no special construction of “mobile device” is necessary and opposes Patent Owner’s construction on a number of grounds. Pet. Reply 1–7. At the outset, Petitioner argues that Patent Owner’s proposed construction for “mobile device” cannot be the term’s ordinary meaning, as asserted by Patent Owner, because “it does not even require the ‘mobile device’ to be mobile.” Pet. Reply 2. Petitioner also asserts that

Patent Owner’s proposed construction is inconsistent with a definition Patent Owner proposed in the *Novatel* litigation: “a portable, wireless communication device for radio frequency communications with one or more other devices.” Pet. Reply 2 (quoting Ex. 1104 (Joint Claim Construction Worksheet, 1–2)).

Petitioner contends also that Patent Owner’s construction is inconsistent with the intrinsic record. Pet. Reply 3–6. Petitioner argues that the claims themselves do not require that the mobile device perform registration or communicate directly with a cellular network. Pet. Reply 3. Petitioner argues that “none of the evidence [Patent Owner] relies on shows that the mobile unit in the specification communicates with the network *directly*; all communication occurs via the fixed ports/base stations or movable base stations.” Pet. Reply 3–4 (citing Ex. 1001, 3:24–32, 9:62–10:2, 10:63–11:11). Petitioner further argues that Patent Owner’s proposed construction “is also inconsistent with the specification because it ignores other, non-cellular embodiments.” Pet. Reply 4 (citing Ex. 1001, 2:46–50, 6:48–63). Petitioner also points to statements describing “mobile units” made by the applicant during the prosecution of a closely related patent (U.S. Patent No. 7,221,904 (the ’904 patent)) that contradict Patent Owner’s narrow construction here. Pet. Reply 5 (citing Ex. 1107, 289).

Patent Owner devotes nearly half of its Sur-reply to advocating its proposed construction for “mobile device” and focuses in particular on the ’023 patent’s disclosure of operations within a cellular network. PO Sur-reply 1–15.

Having reviewed and considered the record presented, including Petitioner’s and Patent Owner’s submissions, we are not persuaded to adopt

Patent Owner's construction of "mobile device." As instructed by *Phillips*, we first look to the words of the claims. *Phillips*, 415 F.3d at 1312. We find that the language of the challenged claims does not support Patent Owner's construction. As an initial matter, the challenged patents do not claim the mobile device. Patent Owner acknowledged this during the oral argument. Tr. 52:25–53:1 (When asked if "any of [the challenged patents] claim the mobile device," Patent Owner answered "No."). Rather, the claims cover an "apparatus," i.e., a moving base station, which Patent Owner acknowledges. PO Resp. 2 ("The asserted claims of the '023 Patent cover a movable base station or apparatus configured to provide important benefits to mobile devices, such as smartphone, tablet and laptop users."); Tr. 53:3–5 (Patent Owner's counsel stating that the challenged patents "claim the moving base station"); *see also* PO Resp. 2 ("Mr. Gavrilovich invented a 'mobile base station' that significantly improved wireless communications by acting as an intermediary between cell towers and mobile devices."). Furthermore, the claims themselves do not specify a mobile device "that must register with and be able to directly communicate with the cellular network."

We find, for the reasons set forth below, that Patent Owner's contention that the mobile device must be able to communicate directly with the cellular network is not supported by the intrinsic record. In the challenged claims, it is the mobile base station that communicates directly with the fixed ports, not the mobile device. Patent Owner agrees, stating that the "movable base station is a mobile wireless device that acts as an intermediary and provides connectivity between a cellular network and one or more mobile devices." PO Resp. 3. The challenged claims describe communications passing between the moving base station (the "apparatus")

and the fixed port and between the moving base station and the mobile device. For example, claim 1 recites that the claimed apparatus (mobile base station) has “a receiver configured to receive mobile device signals from a mobile device through the plurality of spatially separated antennas” and “a transmitter configured to transmit radio frequency signals corresponding to the mobile device signals to a base station.” Claim 11 similarly recites that the claimed apparatus (mobile base station) has “a receiver configured to receive fixed port signals from a fixed port through the plurality of spatially separated antennas” and “a transmitter configured to transmit radio frequency signals to a mobile device corresponding to the received fixed port signals.” The challenged claims, therefore, do not require the mobile device to communicate directly with or register with a cellular network.

Furthermore, the challenged claims do not require the signals transmitted between the mobile device and the movable base station to be cellular signals. Patent Owner acknowledges this:

[T]he '023 Patent requires that a mobile device must register with the cellular network in order to obtain the benefits of the '023 Patent—via a moving base station—in all locations and all situations. Notably, *this requirement does not preclude a mobile device—such as a cell phone—from using a second type of radio interface that is not a standard cellular interface to communicate with the moving base station.*

PO Sur-reply 9 (emphasis added). Thus, Patent Owner agrees that the only claimed communication involving the mobile device need not be cellular.

Moreover, we find that the '023 patent Specification does not support Patent Owner's narrowing construction of “mobile device” as a device that must be able to communicate directly with a cellular network. *Cf.* PO Resp. 7–8. As stated in *Phillips*, “the specification is always highly relevant

to the claim construction analysis. Usually, it is dispositive; it is the single best guide to the meaning of a disputed term.” *Phillips*, 415 F.3d at 1315 (internal quotes and citation omitted).

First, we do not see in the Specification of the ’023 patent a clear indication supporting Patent Owner’s contention that cordless non-cellular phones should be excluded. *Cf.* PO Resp. 13 (“A mobile device is more than just a cordless phone handset.”). In the Background section, the ’023 patent describes the goal of the patent as encompassing “all applications” including cordless phones: “What is desirable is an infra structure which allows the use of such terminals *in all applications*, whether in the home or office as a *cordless phone . . .*” Ex. 1001, 2:46–50 (emphasis added). While the ’023 patent does refer to the base stations as “cell site[s]” (Ex. 1001, 4:63–65), it also describes the radio interfaces between the mobile devices and the base stations in more general terms: “For the examples herein, the radio interface between the mobile units 20, 25 and the moving base stations 30, 40 and the fixed base station 70 is a standard radio interface, well known in the art.” Ex. 1001, 6:48–51. This description is consistent with the stated goal of providing “an infra structure which allows use of . . . a cordless phone.” Ex. 1001, 2:46–50.

Patent Owner argues that the ’023 patent’s mention of a “standard radio interface” is not inconsistent with Patent Owner’s proposed construction because the ’023 patent identifies TDM/CDMA (time division multiplexed/code division multiple access) and IS-95 as radio interfaces and these are cellular interfaces. PO Sur-reply 5 (quoting Ex. 1001, 3:11–15,¹²

¹² Patent Owner cites column 3, lines 30–34, but the quoted material appears at column 3, lines 11–15 of the ’023 patent.

7:4–6). Elsewhere, however, as noted above, Patent Owner argues that the interface between the mobile device and the moving base station is not limited to “a standard cellular interface.” PO Sur-reply 9. Thus, Patent Owner’s arguments confirm that the interface between the claimed “apparatus” and the recited “mobile device” need not be cellular. Patent Owner’s attempts to require additional radio functionality of the recited “mobile device” simply find no support in the claims because the claims recite no communication with the mobile device other than the radio communication with the claimed “apparatus.”

Moreover, we find further support for our conclusion that Patent Owner’s construction is too limiting in the ’023 patent’s description of an embodiment where the mobile device is prevented from communicating directly with the fixed ports. Ex. 1001, 3:24–36); *see* Pet. Reply 3 (discussing this disclosure). In that embodiment, the power levels for the signals between the moving base station and the mobile device are chosen to “eliminat[e] any direct communication from the mobile unit to the fixed radio port.” Ex. 1001, 3:24–36.

Patent Owner argues that the ’023 patent also contains disclosure of direct communication between the mobile devices and fixed ports. PO Resp. 7–8 (citing Ex. 1001, 10:63–11:11), 13–14 (citing Ex. 1001, 4:42–51, 10:65–11); PO Sur-reply 6 (citing Ex. 1001, 11:8–13). According to Patent Owner, “[t]he ’023 Patent discloses that a mobile device can either directly communicate with the cellular network via a ‘fixed port’ (conventional base station) or it can communicate with the cellular network indirectly by communicating with a ‘moving base station’ that communicates with the ‘fixed ports.’” PO Resp. 8 (citing Ex. 1001, 10:63–11:11. We agree that the

'023 patent describes communication between a fixed base station and the mobile device in certain special situations, i.e., slow moving traffic. *See, e.g.,* Ex. 1001, 10:65–11:1 (“In congested traffic areas, a mobile unit which is stopped or slowly moving, e.g., less than 30 miles per hour, will preferably be serviced by one of the fixed base stations 70.”). But, as discussed above, the claims are directed to the “indirect[]” communication that Patent Owner identifies, where the mobile device “can communicate with the cellular network indirectly by communicating with a ‘moving base station’ that communicates with the ‘fixed ports.’” PO Resp. 8. And in that embodiment, the '023 patent discloses “eliminating any direct communication from the mobile unit to the fixed radio port,” as discussed above. Ex. 1001, 3:24–36. Thus, we find improper Patent Owner’s attempt to import various Specification descriptions of mobile device functionality into the claimed “apparatus,” i.e., the moving base station.

Phillips instructs us that the prosecution history may also be relevant in construing the claims. 415 F.3d at 1317; *see* Pet. Reply 5. During prosecution of the '904 patent, in an appeal brief to the Board, the applicant did not limit the invention to cellular devices but told the Board that radios and telephones were included: “The present invention is directed to methods and devices for providing communication services to moving mobile units *such as telephones, radio modems, or other types of radios.*” Ex. 1107, 289 (emphasis added).

Patent Owner dismisses this statement during prosecution as being “taken from the ‘summary of the invention’ portion of the appellant’s appeal brief—in which the appellant described a summary of the invention, not a definition for the term ‘mobile device.’” PO Sur-reply 10. Patent Owner

also argues that “other types of radios” include “cellular phones, cellular modems, and hybrid cellular telephone that included both analog voice and digital data capability” and, therefore, that its proposed construction is consistent with the prosecution history. We agree that these devices fall within the scope of “mobile device,” but that does not persuade us that the recited “mobile device” should be *limited* to cellular devices, especially in light of the applicant’s broad statement of the invention as relating to “radios” generally. Thus, we find that this prosecution history describing the mobile units as “telephones” and “radios” contradicts Patent Owner’s construction limiting such devices to “a device that must register with and be able to directly communicate with the cellular network.”

Patent Owner also argues that “the ’023 Patent relates to and describes as a whole improving the wireless connections of **mobile devices within cellular telephone systems** via a moving base station.” PO Sur-reply 3. In support of this argument, Patent Owner cites disclosures within the ’023 patent that discuss or relate to cellular telephone systems. PO Sur-reply 4–5 (citing Ex. 1001, 1:19–23, 1:27–32, 2:15–17, 3:30–34, 4:63–65, 7:4–6, 9:16–19). Patent Owner argues that its proposed construction is correct, therefore, because “the ’023 Patent explicitly and exclusively relates to improving the wireless connections of **mobile devices within ‘cellular telephone systems.’**” PO Sur-reply 4.

We are not persuaded by Patent Owner’s citations to the various occurrences of the term “cellular” in the ’023 patent. *Cf.* PO Sur-reply 4–5. There is no dispute that improving cellular technology is included among the goals described in the ’023 patent. Patent Owner asserts that the ’023 patent does this through a “movable base station [that] is a mobile wireless device

that acts as an intermediary and provides connectivity between a cellular network and one or more mobile devices.” PO Resp. 3. The ’023 patent’s disclosures of a cellular network in which the claimed “apparatus” operates do not justify the limiting construction for the recited “mobile device” that Patent Owner asserts. Indeed, as noted above, Patent Owner states that the connection between the “mobile device” and the moving base station is not limited to a “standard cellular interface.” PO Sur-reply 9.

Nor are we persuaded by Patent Owner’s suggestion that the Specification requires the mobile device to “register . . . with the cellular network.” PO Resp. 14–15. Such a registration requirement is not in the claims or prosecution history. Registration with a base station is mentioned in the ’023 patent Specification (*see* PO Resp. 14, PO Sur-reply 3), but the registration process described there occurs only “[w]hen a mobile unit set is first powered up or first enters a service area” and involves the mobile device transmitting its address to the moving base station, not the fixed base stations. Ex. 1001, 9:64–10:2 (“The address will be received by the closest moving base station 30 and transmitted . . . to the telephone network”). As discussed above, such transmissions between the mobile unit and the moving base station use a “standard radio interface,” which, as Patent Owner acknowledges, includes a “radio interface that is not a standard cellular interface.” *See* PO Sur-reply 9.

Patent Owner relies on “Federal Circuit precedent [that] forbids an overly broad interpretation of the claims.” PO Sur-reply 2–3 (citing *Pacing Technologies, LLC v. Garmin International, Inc.*, 778 F.3d 1021 (Fed. Cir. 2015)). In *Pacing Technologies*, the Federal Circuit found evidence of “a clear and unmistakable statement of disavowal or disclaimer” in the stated

objects of the invention, including a statement that the objects would be accomplished by the particular feature (a “repetitive motion pacing system”) to which the Court limited the claims. 778 F.3d at 1025. Here, in contrast, for the reasons discussed above, there is no corresponding “clear and unmistakable statement” limiting the scope of the mobile device to “a device that must register with and be able to directly communicate with the cellular network.” “To disavow claim scope, the specification must contain ‘expressions of manifest exclusion or restriction, representing a clear disavowal of claim scope.’” *Retractable Techs., Inc. v. Becton, Dickinson & Co.*, 653 F.3d 1296, 1306 (Fed. Cir. 2011) (quoting *Epistar v. Int’l Trade Comm’n*, 566 F.3d 1321, 1335 (Fed. Cir. 2009)); *SciMed Life Sys., Inc. v. Advanced Cardiovascular Sys., Inc.*, 242 F.3d 1337, 1341 (Fed. Cir. 2001) (“Where the specification makes clear that the invention does not include a particular feature, that feature is deemed to be outside the reach of the claims of the patent, even though the language of the claims, read without reference to the specification, might be considered broad enough to encompass the feature in question.”). As discussed above, the ’023 patent claims are directed to the mobile base station communicating with the cellular network, and the Specification describes an embodiment that prevents the mobile unit from communicating with the fixed ports. Ex. 1001, 3:24–36. The references to cellular communications in the ’023 patent cited by Patent Owner (PO Sur-reply 4–5) are merely exemplary and do not rise to the level of a clear and unmistakable disavowal. Perhaps most important, the relevant claim language deals with the interface between the claimed “apparatus” and the recited “mobile device,” which as discussed above is not limited to a cellular radio interface. See PO Sur-reply 9.

Patent Owner's discussion of *On Demand Machine Corp. v. Ingram Industries, Inc.*, 442 F.3d 1331 (Fed. Cir. 2006), is no more persuasive. See PO Sur-reply 4. As Patent Owner's quotation from *On Demand* makes clear, it is not necessary to find an explicit disavowal "when the scope of the invention is clearly stated in the specification, and is described as the advantage and distinction of the invention." 442 F.3d at 1340, *quoted in* PO Sur-reply 4. However, in our analysis above of Patent Owner's position, we find that the scope of the invention and its advantages as described in the '023 patent Specification center on the mobile base station, not the mobile device. The '023 patent Specification, therefore, does not favor Patent Owner's narrow construction of "mobile device." Thus, *On Demand's* exception to the normal requirement for an explicit disavowal is not applicable here.

In summary, we find that Patent Owner's proposed construction for "mobile device" is not supported by the claim language of the '023 patent or the intrinsic evidence, and, therefore, we do not adopt a construction that would limit "mobile device" to cellular phones or other devices "that must register with and be able to directly communicate with the cellular network" and that would exclude, for example, mobile radio devices that communicate with a cellular network via an intermediary device.

We agree with Petitioner that no construction of "mobile device" is necessary. Pet. 9; Pet. Reply 6.

4. *Remaining terms*

Patent Owner proposes to construe "automotive vehicle," which appears in claims 10 and 20, as an "automobile." PO Resp. 16–17. Patent Owner, however, makes no arguments based on this construction, and as

discussed below, Ito unquestionably discloses an “automobile.” *See* Ex. 1003, 3:17–23 (disclosing that “a mobile base device may be constituted by an automobile telephone main unit installed in a car”). Thus, we need not construe this term.

Patent Owner also proposes that the phrase “transmit radio frequency signals to a mobile device corresponding to the received fixed port signals” means “transmit radio frequency signals to a mobile device, where the radio frequency signals correspond to the received fixed port signals.” PO Resp. 13; *see* Ex. 1037, 18–20 (district court in the *Novatel* case setting forth this construction). Patent Owner does not make any arguments based on this construction, and therefore, we need not construe this phrase to resolve a controversy.

No other terms require construction. *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))).

C. Principles of Law

A patent claim is unpatentable under 35 U.S.C. § 103(a) if the 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. *KSR Int’l Co. v. Teleflex Inc.*, 550 U.S. 398, 406 (2007). The question of obviousness is resolved on the basis of 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) any secondary considerations, if in evidence.¹³ *Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966).

*D. Obviousness over Gilhousen761 and Adachi
(Claims 1, 4, 5, 9, 11, 14, 15, 19)*

Petitioner asserts that claims 1, 4, 5, 9, 11, 14, 15, and 19 of the '023 patent are unpatentable under 35 U.S.C. § 103(a) as obvious over the combined teachings of Gilhousen761 and Adachi. Pet. 18–39.

1. Gilhousen761

Gilhousen761 is a patent titled “Airborne Radiotelephone Communications System” and is directed to an airborne communication system that allows radiotelephones on a plane to communicate with a ground-based cellular system. Ex. 1005, codes (54), (57). Figure 1 of Gilhousen761 is reproduced below.

¹³ Patent Owner does not present any objective evidence of nonobviousness (i.e., secondary considerations) as to any of the challenged claims.

FIG. 1

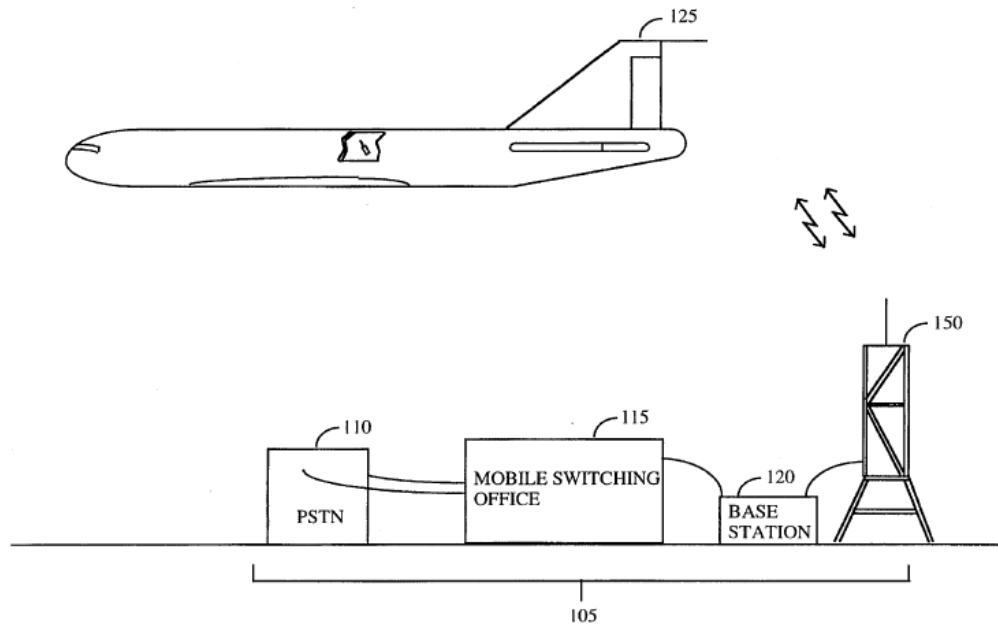


Figure 1 of Gilhousen761, reproduced above, depicts an airborne communication system having ground-based subsystem 105 and airborne-based subsystem 125. Ex. 1005, 2:16–18. As shown in Figure 1, ground-based subsystem 105 has base station 120 coupled to antenna 150 and to mobile switching center 115, which in turn is coupled to public switched telephone network (PSTN) 110. Ex. 1005, 2:27–39.

Figure 2 of Gilhousen761 is reproduced below.

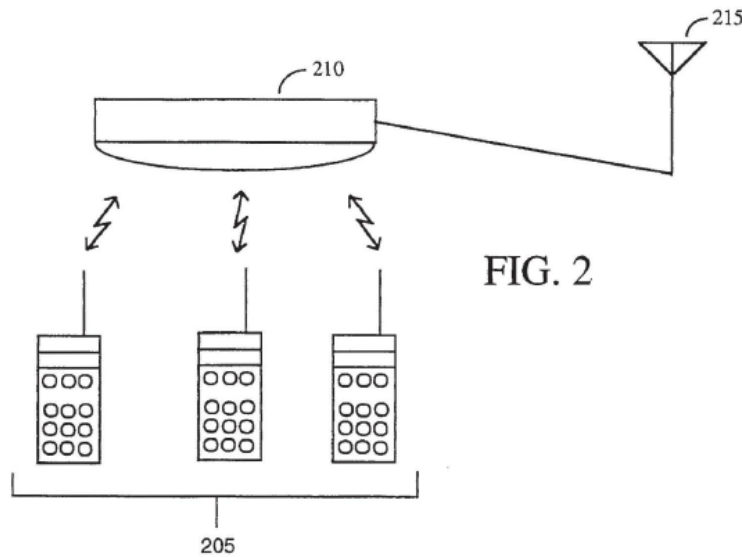


Figure 2 of Gilhousen761, reproduced above, depicts an airborne-based subsystem having Code Division Multiple Access-type (CDMA) radiotelephones 205, signal repeater 210, and antenna 215 mounted on the outside of the aircraft. Ex. 1005, 2:51–58. Repeater 210 receives signals from radiotelephones 205 within the aircraft and relays them to antenna 215, which relays the signals to the base station on the ground. Ex. 1005, 2:59–63.

2. *Adachi*

Adachi is a patent titled “Receiver and Repeater for Spread Spectrum Communications” and discloses a “repeater improving the effect of a RAKE reception.” Ex. 1031, codes (54), (57). Figure 2 of Adachi is reproduced below.

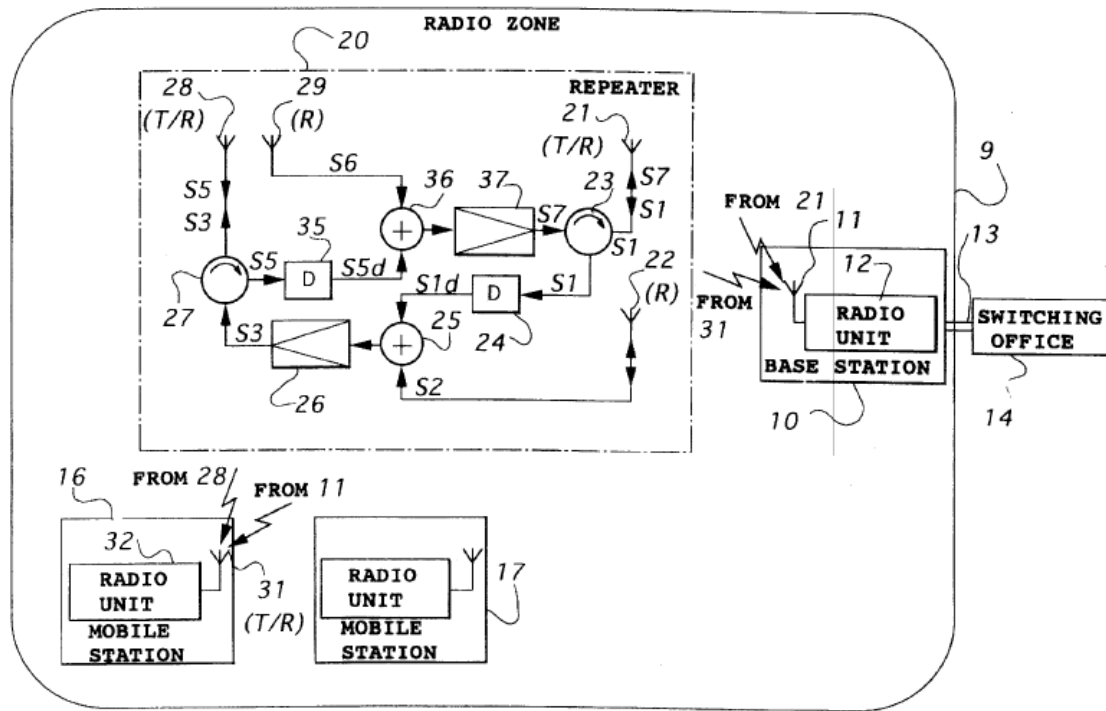


FIG. 2

Figure 2 is a block diagram showing an embodiment of a spread-spectrum communication repeater. Ex. 1031, 5:51–53. Base station 10 carries out CDMA communications with mobile stations 16 and 17. Ex. 1031, 6:5–7. Repeater 20 has two antennas 21, 22 for the base station and two antennas 28, 29 for the mobile stations 16. Ex. 1031, 6:13–16. Signals from base station 10 are received by repeater 20 by antennas 21 and 22. Ex. 1031, 6:16–18. The signals are combined, amplified, and sent to the mobile stations 16 via antenna 28. Ex. 1031, 6:26–30. Antenna 31 of the mobile station 16 receives the signal from repeater 20. Ex. 1031, 6:35–37. In the reverse direction, signals from the mobile station 16 are received at the repeater's antennas 28 and 29, and are combined, amplified, and retransmitted to base station 16. Ex. 1031, 6:49–67.

3. *Independent Claim 11*

a) *Preamble*

Claim 11 is directed to “[a]n apparatus configured to move relative to Earth.” Petitioner contends Gilhousen761’s airborne subsystem, including repeater 210, teaches an apparatus configured to move relative to Earth. Pet. 22–24 (citing Ex. 1005, 1:54–62, 2:15–18, 2:50–62, Figs. 1, 2; Ex. 1008 ¶¶ 104–106), 35 (citing Ex. 1008 ¶ 132). Petitioner argues that “during flight the aircraft (and the included airborne substation and repeater) moves at the speed of air traffic on its flight route” and, therefore, that Gilhousen761 teaches “constructed to move with the traffic at a rate of speed which is comparable to the speed of the traffic” under the district court’s construction of “configured to” in the *Novatel* litigation. Pet. 23–24 (citing Ex. 1008 ¶¶ 104–106).

Relying on the construction of “configured to” as “constructed to move with the traffic at a rate of speed which is comparable to the speed of the traffic,” Patent Owner contends this preamble limitation is not met: “An airplane does not move with traffic as it is not bound to predetermined roads.” PO Resp. 38 (citing Ex. 2100 ¶¶ 230–231). Patent Owner also argues that “traffic, as used in the ‘023 Patent . . . , is referring to ‘an automotive vehicle traveling on a roadway,’ not ‘airplane traffic.’” PO Resp. 38–39 (citing Ex. 1001, 4:8–9).

Petitioner responds that the Specification of the ’023 patent does not limit “traffic” to automotive traffic, citing the Specification’s disclosure of “pedestrian traffic.” Pet. Reply 22 (citing Ex. 1001, 2:42–43, 3:18, 4:48–51). Petitioner also cites a dictionary definition of “traffic” as “vehicles

moving on a public highway, in the air, or at sea.” Ex. 1103, *quoted in* Pet. Reply 22.

As discussed above in Section II.B.2, we apply the proposed construction of “configured to” as “constructed to move with the traffic at a rate of speed which is comparable to the speed of the traffic.” However, we see no proper basis in the language of the claims, the Specification of the ’023 patent, or its prosecution history to further limit the claims to require “predetermined roads” or to limit traffic to only automotive traffic. The ’023 patent’s references to “pedestrian traffic” (Ex. 1001, 2:43–44, 3:16–20, 4:48–51) further persuade us that Patent Owner’s proposed narrowing of the term “traffic” as requiring “predetermined roads” and being limited to automotive traffic is contrary to the intrinsic record.

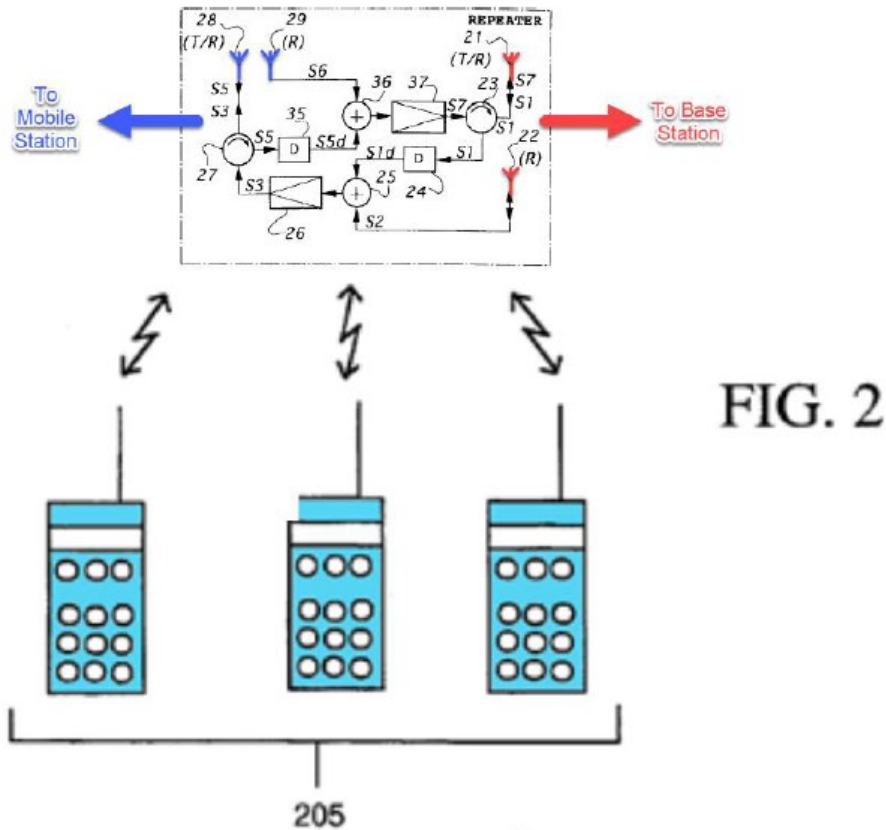
We are persuaded, and we find, that Gilhousen761’s disclosure of an airborne base station in an airplane teaches an apparatus that is constructed to move with the traffic at a rate of speed which is comparable to the speed of the traffic, specifically air traffic. *See* Ex. 1008 ¶ 106 (“[D]uring flight the aircraft (and the included airborne substation and repeater) moves at the speed of air traffic on its flight route.”); *see also* Ex. 1103, 5 (Oxford Dictionary defining “traffic” as “vehicles moving on a public highway, in the air, or at sea”).

Thus, we find that Gilhousen761 teaches the subject matter recited in the preamble (whether or not limiting) of claim 11.

b) Plurality of spatially separated antennas

Claim 11 recites that the apparatus comprises “a plurality of spatially separated antennas.” Petitioner relies on Adachi’s disclosure of a repeater in Figure 2 with multiple antennas and contends that, “[i]n the proposed

combination, Gilhousen 761's CDMA repeater is replaced by Adachi's CDMA repeater which includes multiple spatially separated antennas." Pet. 25–26 (citing Ex. 1031, code (57), 6:13–34, 6:49–54, Fig. 2; Ex. 1008 ¶¶ 107–111), 35 (citing Ex. 1008 ¶ 133). Petitioner provides the following figure illustrating the proposed combination:



The figure reproduced above illustrates Petitioner's proposed combination of Adachi's repeater with Gilhousen '761's airborne subsystem. Pet. 25.

Patent Owner does not dispute that Adachi teaches a plurality of spatially separated antennas; rather, Patent Owner argues that Petitioner has not shown sufficient reasoning to combine the references. See PO Resp. 23–28, 30–32. We address the parties' contentions as to the rationale to combine below in § II.D.3.e.

We are persuaded by Petitioner's contentions for this limitation. Referring to Figure 2, Adachi discloses that "repeater 20 has antennas 21 and 22 for the base station, and antennas 28 and 29 for mobile stations. The antennas 21 and 28 are a transmitting-receiving antenna, and the antennas 22 and 29 are a receiving antenna." Ex. 1031, 6:13–16. Figure 2 of Adachi depicts the antennas as spatially separated. Thus, we find that the combination of Gilhousen761 and Adachi teaches "a plurality of spatially separated antennas," as recited in claim 11.

c) Receiver

Claim 11 recites that the apparatus comprises "a receiver configured to receive fixed port signals from a fixed port through the plurality of spatially separated antennas." Petitioner argues that Adachi's repeater uses antennas 21 and 22 to receive signals from a base station (fixed port), which, in the proposed combination, is the ground base station 120 of Gilhousen761. Pet. 35–36 (citing Ex. 1031, 6:13–18; Ex. 1008 ¶¶ 135–137).

Patent Owner does not dispute Petitioner's contention that the combination of Gilhousen761 and Adachi teaches this subject matter, apart from its argument that Petitioner has not shown sufficient reasoning to combine the references, which we address below in § II.D.3.e.

We are persuaded by Petitioner's contentions for this limitation. Adachi discloses that "repeater 20 has antennas 21 and 22 for the base station," that antenna 21 is "a transmitting-receiving antenna," and that antenna 22 is "a receiving antenna." Ex. 1031, 6:13–16. Adachi further discloses that "[t]he electric wave transmitted from the base station 10 at a carrier frequency f_2 is received by the antennas 21 and 22." Ex. 1031, 6:16–18. We also find that Gilhousen761's ground base station 120 teaches a

“fixed port,” i.e., “a stationary device at which signals can enter or exit a communication network” (*see* § II.B.1 above (discussing claim construction for “fixed port”)), because Gilhousen761 describes ground base station 120 as a “cell site” (Ex. 1005, 2:27–30). Thus, we find that the combination of Gilhousen761 and Adachi teaches “a receiver configured to receive fixed port signals from a fixed port through the plurality of spatially separated antennas,” as recited in claim 11.

d) Transmitter

Claim 11 recites that the apparatus comprises “a transmitter configured to transmit radio frequency signals to a mobile device corresponding to the received fixed port signals.” Petitioner argues that Adachi discloses that the signals received through antennas 21 and 22 are combined and sent to the mobile devices, which in the proposed combination are Gilhousen761’s radiotelephones. Pet. 36–37 (citing Ex. 1031, 6:28–32; Ex. 1008 ¶¶ 138–141).

Patent Owner argues that “*Adachi* only discloses a stationary repeater in a communication system that is used to boost weak spread spectrum (CDMA) signals between a base station and one or more mobile stations (i.e., mobile devices).” PO Resp. 40 (citing Ex. 2100 ¶ 236). Patent Owner further argues that, because

Adachi does not disclose a moving base station, it follows that *Adachi* does not disclose that its mobile station is (i) capable of directly communicating with a moving base station; or (ii) capable of being switched back and forth between either a direct connection with the fixed base station or a connection with a moving base station.

PO Resp. 41 (citing Ex. 2100 ¶ 237).

We disagree with these arguments for several reasons. First, whether or not Adachi's repeater is "stationary" in the disclosure of Adachi, the repeater moves with the airplane of Gilhousen761 in Petitioner's proposed combination. *See* Pet. 20–21 ("In the combined Gilhousen761-Adachi system, Adachi's repeater would take the place of Gilhousen761's repeater, and communicate with Gilhousen761's airborne radiotelephones"). We address Patent Owner's arguments about the propriety of the proposed combination in the next section.

Second, Patent Owner's argument is not persuasive because it is based on Patent Owner's proposed construction for mobile device, which we do not adopt as discussed above in § II.B.3. We also find, contrary to Patent Owner's suggestion (PO Resp. 41), that there is no additional requirement that the mobile device must be "capable of being switched back-and-forth between either a direct connection with the fixed base station or a connection with a moving base station." *See* discussion above in § II.B.3 (addressing construction of "mobile device"). We see no support for this additional requirement in the language of the claims, the Specification, or the prosecution history of the '023 patent. Consequently, we do not credit Patent Owner's argument that Adachi does not have this capability. PO Resp. 41.

Third, Petitioner relies on Gilhousen761's radiotelephones to disclose the claimed "mobile device." *See* Pet. 37 ("The combined signals corresponding to the original signal received from the base station ('fixed port') are transmitted to the mobile station ('mobile device'; in the combination, Gilhousen761's radiotelephones 205).").

Patent Owner also argues that “*Gilhousen761* does not disclose a radiotelephone that registers with or is capable of directly communicating with the cellular network as required by the limitation of a ‘mobile unit’ in the context of the entire ’023 Patent.” PO Resp. 41 (citing Ex. 2100 ¶ 238; Ex. 2108-1, 37:2–6). Rather, according to Patent Owner, “*Gilhousen761*’s radiotelephone is only able to connect to a cellular network through *Gilhousen761*’s radiotelephone signal repeater or through the alternative embodiment of a base station-type unit that performs the registration function for the radiotelephone.” PO Resp. 41 (citing Ex. 1005, 2:59–63, 2:66–3:4).

These arguments are unpersuasive because they rely on Patent Owner’s proposed construction for “mobile device,” which we do not adopt as discussed above in § II.B.3. We find, instead, that *Gilhousen761*’s radiotelephone disclosure teaches a “mobile device.” *See, e.g.*, Ex. 1005, 2:33–35 (discussing channels by which the radiotelephone communicates with the base station), 2:38–39 (disclosing that the base station receives signals from and radiates signals to the radiotelephone), 2:52–55 (disclosing that the airborne “subsystem uses a CDMA-type radiotelephone (205) to communicate with a radiotelephone signal repeater (210), having an antenna, that is located in the aircraft”).

We further find that *Gilhousen761*’s radiotelephone disclosure teaches a “mobile device” even under Patent Owner’s construction. *Gilhousen761* explicitly teaches that the radiotelephones can register with a base station in a cellular network. Ex. 1005, 3:63–65 (“This enables the radiotelephones to search for the strongest pilot signal of the next cell and register with that base station.”). Patent Owner argues that “*Gilhousen761* explicitly discloses

that the registration function is actually performed by either *Gilhousen761*'s radiotelephone signal repeater or by the alternative embodiment of a base station-type unit; and not by *Gilhousen761*'s radiotelephone." PO Sur-reply 26–27. But in this sense, *Gilhousen761*'s registration is consistent with the '023 patent's registration, which is described as follows:

When a mobile unit set is first powered up or first enters a service area, the mobile unit must register in the manner described earlier, by transmitting its unique address in the new service area. *The address will be received by the closest moving base station 30* and transmitted via a fixed radio port and the gateway switch 60 to the telephone network. This registration procedure is required so that an incoming call for the mobile unit can be appropriately directed.

Ex. 1001, 9:62–10:2 (emphasis added); *see* PO Sur-reply 3 (quoting this passage in part). Thus, the '023 patent's registration procedure uses an intermediary device (the mobile base station) that is just like *Gilhousen761*'s registration process; it relays the registration using the airborne repeater.

Furthermore, *Gilhousen761* expressly discloses that the purpose of its registration is so that a call from the ground can be routed to the phone in the air: "The present invention also enables a ground telephone or radiotelephone to contact an airborne radiotelephone. Since the repeater has registered the airborne radiotelephone with the proper ground base station, the mobile switching center knows to which base station the call is to be routed." Ex. 1005, 3:48–52. Indeed, this was one of the very problems in the art that *Gilhousen761* addressed:

Aircraft radiotelephones, however, experience a number of problems. First, the aircraft based radiotelephone does not register in the ground based system. The ground based system, therefore, does not know the location of the aircraft radiotelephone. This restricts the aircraft radiotelephone to

initiating calls; it cannot receive calls since the ground system does not know where to forward calls.

Ex. 1005, 1:30–36. Patent Owner argues that this is the point of the registration requirement in the '023 patent:

In order to obtain these benefits in all locations and all situations—via the moving base station—the “mobile device” must be capable of registering with a cellular network. As Mr. Lanning explained, if the “mobile device” does not register with the cellular network, the network is unable to provide access for outgoing calls or even route any incoming calls to the “mobile device” because the network does not know its physical location.

PO Sur-reply 7 n.11 (citing Ex. 2100 ¶ 77). Thus, Gilhousen761 describes the registration procedure that Patent Owner asserts is required for the very same purpose that Patent Owner alleges it is necessary in the '023 patent.

Moreover, Gilhousen761 describes that the radiotelephones operate according to the Telecommunications Industries Association/Electronic Industries Association Interim Standard 95 (TIA/EIA/IS-95). Ex. 1005, 3:4–8. The '023 patent cites the same IS-95 standard, explaining that “[t]he interface between the mobile unit and the movable base *may* be the standard IS-95-based PCS air interface standard.” Ex. 1001, 7:4–6 (emphasis added). Patent Owner argues that this disclosure from the '023 patent demonstrates that the “mobile device” “must function in a cellular network.” PO Sur-reply 4–5 (quoting Ex. 1001, 7:4–6). Patent Owner states: “Indeed, IS-95 was the first ever CDMA-based digital cellular technology.” PO Sur-reply 5 n.7. Gilhousen761’s radiotelephones, therefore, are cellular phones that operate in a cellular network and are able to communicate directly with a cellular network. Indeed, Gilhousen761 provides the very “cellular infrastructure” that Patent Owner asserts is necessary to achieve “[t]he purpose of the invention.” PO Sur-reply 1; *see* Ex. 1005, 1:9–11 (“[T]he

present invention relates to cellular radiotelephone communications between an airplane and a ground based station.”).

For all the foregoing reasons, we find Gilhousen761 teaches that its radiotelephones are “mobile devices,” even under Patent Owner’s proposed construction.

Based on Petitioner’s persuasive arguments and evidence, and in view of the foregoing discussion, we find that the combination of Gilhousen761 and Adachi teaches “a transmitter configured to transmit radio frequency signals to a mobile device corresponding to the received fixed port signals,” as recited in claim 11. In particular, Adachi discloses that the signals received on antennas 21 and 22 are combined and that “[t]he combined signal is amplified by an amplifier 26, and is fed, as a signal S3, to the antenna 28 for mobile stations through a circulator 27 for separating transmitted and received signals, and is transmitted to the mobile stations.” Ex. 1031, 6:16–32. Thus, Adachi discloses a transmitter that transmits radio signals to mobile devices, which in the proposed combination are Gilhousen761’s radiotelephones, as discussed above.

e) Rationale for combining Gilhousen761 and Adachi

Petitioner provides a rationale for combining Gilhousen761 and Adachi. Pet. 18–22. Petitioner argues that fading is a problem in moving communication systems and that, in an aircraft system like Gilhousen761, obstacles inside the aircraft can cause interference with radio signals. Pet. 18–19 (citing Ex. 1006, 2:9–16; Ex. 1008 ¶¶ 95–96; Ex. 1035, 604; Ex. 1036, 1). Petitioner argues that “[a]ntenna diversity is one well-understood technique in the prior art to mitigate multipath fading

effects and avoid interference.” Pet. 19 (citing Ex. 1032, 1¹⁴; Ex. 1008 ¶ 96). Petitioner contends that a person of ordinary skill in the art “would have been naturally motivated to employ Adachi’s repeater and its spatially separated antennas in place of repeater 210 in Gilhousen761’s ‘repeater embodiment’ to mitigate the effects of multipath and fading.” Pet. 19 (citing Ex. 1008 ¶ 96).

Patent Owner disputes Petitioner’s rationale for combining Gilhousen761 and Adachi. PO Resp. 27, 30–32; PO Sur-reply 19–20. Patent Owner argues that Adachi’s repeater is a stationary, ground-based device that would not be compatible with Gilhousen761’s moving airplane because these systems experience different types of fading. *See* PO Resp. 30–31 (citing Ex. 2100 ¶ 183) (“*Adachi*’s repeater is designed for a stationary device and, thus, fails to disclose that its repeater can even be used on a moving device experiencing Rayleigh fading, let alone on a fast moving airborne device that experiences Rician fading.”); *see also* PO Resp. 31 (citing Ex. 2100 ¶¶ 191–192) (“Petitioner’s proposed combination improperly combines systems that are designed to receive signals based on different types of fading—i.e., Rician fading experienced by airborne systems such as *Gilhousen761*, and Rayleigh fading experienced by terrestrial (ground-based) systems, such as *Adachi*—that are not compatible with one another.”).

We do not agree with Patent Owner’s assertions here because they fail to appreciate the knowledge and ability of a person of ordinary skill in the art—a highly-trained engineer as discussed above in § II.A. For example,

¹⁴ Page 1 of Exhibit 1032 is page 81 of the IEEE publication. Petitioner cites the IEEE page numbers. We cite the exhibit page numbers.

Patent Owner's declarant, Mr. Lanning, testifies that "[t]he concept of Rayleigh fading is not even mentioned in Adachi. Therefore, Adachi is missing the required significant disclosures for processing a signal in any type of moving device or vehicle." Ex. 2100 ¶ 109. But the evidence of record shows that Rayleigh fading was a known issue at the relevant time. For example, Mr. Lanning quotes a discussion about Rayleigh fading from U.S. Patent 5,103,459 (Ex. 1006, "Gilhousen459"). Ex. 2100 ¶ 191 (quoting Ex. 1006, 1:46–2:4). Gilhousen459 explains how CDMA techniques mitigate, but do not totally eliminate, fading, and Gilhousen459 discloses that "[d]iversity is one approach for mitigating the deleterious effects of fading." Ex. 1006, 2:27–31, 2:67–68. Gilhousen459 further identifies space or path diversity as one example of a diversity technique to address problems of fading. Ex. 1006, 3:13–15; *see also* Ex. 1006, 13:61–64 (disclosing the use of "two receiver systems . . . with each having a separate antenna and analog receiver for space diversity reception"). Thus, Gilhousen459's disclosure of using multiple antennas for spatial diversity to mitigate fading actually supports Petitioner's reason to combine Adachi's spatially separated antennas with the teachings of Gilhousen761.¹⁵

Mr. Lanning's criticism of Adachi for not mentioning Rayleigh fading is particularly misplaced given the conspicuous absence of any mention of Rayleigh fading in the '023 patent itself, whose invention, according to Patent Owner, is "a movable base station or apparatus." PO Resp. 5.

¹⁵ As Patent Owner acknowledges, Petitioner's declarant "Mr. Fischer further relies on the terrestrial CDMA system of *Gilhousen459* to support Petitioner's motivation to combine arguments regarding *Gilhousen761* and *Adachi*." PO Sur-reply 19 n.28 (citing Ex. 1008 ¶ 95).

According to Mr. Lanning, the '023 patent's omission of any mention of Rayleigh fading would mean that the '023 patent "is missing the required significant disclosures for processing a signal in any type of moving device or vehicle." *See* Ex. 2100 ¶ 109. We do not share Mr. Lanning's view.

Rather, we find that a person of ordinary skill in the art at the relevant time—an engineer with two years of experience with wireless communications systems and familiarity with cellular communication technology—would have had the knowledge and capability to deal with fading issues that arise in wireless communications. As discussed above, problems with fading were known in the art at the relevant time. *See* Ex. 2100 ¶ 191 (quoting Ex. 1006, 1:46–2:4 (Gilhousen's discussion of Rician and Rayleigh fading)). Petitioner's declarant, Mr. Fischer, provides the following explanation of how multipath fading follows a Rayleigh distribution:

Mobility in the channel causes the multipath to change. The mobility can be of the transmitter, the receiver, or the objects causing the reflections. The net sum of the received signal power from the multipath signals add up in the receiver to a composite signal that will vary in amplitude and phase over time with mobility in the channel. This variation is called multipath "fading". Statistical measures show that unless mitigation techniques are used, the composite signal power at the receiver nearly follows a Rayleigh probability distribution.

Ex. 1008 ¶ 44. Thus, a stationary device can experience multipath fading based on the movement of devices to which it is communicating, which in the case of Adachi would have been mobile stations to which its repeater communicates. Ex. 1031, 6:13–16, Fig. 2, *cited in* Pet. 20 (describing Adachi's repeater communicating with mobile stations). Mr. Fischer also explains how techniques have been developed since the 1960s to mitigate

multipath fading, including antenna diversity—“us[ing] multiple antennas separated by more than a quarter of a wavelength”—and selection diversity—“process[ing] signals from multiple antennas, compar[ing] the results, and us[ing] the best one.” Ex. 1008 ¶ 46. In support of his testimony, Mr. Fischer cites a book from 1966 titled *Communication Systems and Techniques*. Ex. 1017. Chapter 10 of this book discusses several techniques that were known in 1966 for mitigating fading, including “Space (spaced antenna) diversity” and “Multipath diversity (Rake).” Ex. 1017, 5. Mr. Fischer also notes that the Rake receiver was introduced in a 1958 paper. Ex. 1008 ¶ 47 (citing Ex. 1018 (“A Communication Technique for Multipath Channels”)).

Mr. Lanning acknowledges that “a stationary receiver experiences multipath fading” but testifies that “multipath fading is much worse when the receiver is moving.” Ex. 2100 ¶ 107. Mr. Lanning testifies, therefore, that “the circuitry in a moving receiver is significantly more complex than it is for a fixed receiver and Adachi does not disclose this circuitry.” Ex. 2100 ¶ 107. The record evidence discussed above, however, shows that multipath fading was a known issue for decades prior to the relevant time, and solutions had been developed to cope with this issue. Ex. 1008 ¶¶ 44–47 (citing, *inter alia*, Exs. 1017, 1018). Thus, we do not agree that Adachi’s disclosure is deficient.

Patent Owner also criticizes Adachi for allegedly failing to disclose “the necessary circuitry and functionality” to address Rician fading. PO Resp. 27, 30–31. Mr. Lanning testifies similarly. Ex. 2100 ¶¶ 111, 183. Mr. Lanning explains that “Rician fading differs from Rayleigh fading in that obstacles do not interfere with the signals between an airborne aircraft

and the earth-based base stations like they do for terrestrial systems where many different obstacles are constantly changing the characteristics of a signal for the moving receiver.” Ex. 2100 ¶ 191. Mr. Lanning also quotes a discussion of fading from Gilhousen⁴⁵⁹. Ex. 2100 ¶ 191 (quoting Ex. 1006, 1:46–2:4). Gilhousen⁴⁵⁹ describes both Rician and Rayleigh fading as follows:

The satellite channel typically experiences fading that is characterized as Rician. Accordingly the received signal consists of a direct component summed with a multiple reflected component having Rayleigh fading statistics. The power ratio between the direct and reflected component is typically on the order of 6–10 dB, depending upon the characteristics of the mobile unit antenna and the environment about the mobile unit.

Contrasting with the satellite channel, the terrestrial channel experiences signal fading that typically consists of the Rayleigh faded component without a direct component. Thus, the terrestrial channel presents a more severe fading environment than the satellite channel in which Rician fading is the dominant fading characteristic.

Ex. 1006, 1:46–60. As with Rayleigh fading, this passage shows that Rician fading was a known issue at the relevant time and also that Rician fading was a less severe problem to address. Furthermore, Petitioner correctly points out that Rayleigh and Rician distributions are models for fading that both must be accounted for, that are not mutually exclusive, and that sometimes converge. *See* Pet. Reply 10–12 (citing Ex. 1008 ¶¶ 55–59; Ex. 2116, 184–85, 187–88; Ex. 2109, 33–34; Ex. 1006, 1:46–47, 28:48–56; Ex. 2118, 6). Indeed, as Petitioner points out, evidence submitted by Patent Owner shows that “the Ricean distribution degenerates to a Rayleigh distribution when the dominant component fades away.” Ex. 2116, 187, *quoted in* Pet. Reply 12.

Patent Owner also argues that “Petitioner’s proposed combination improperly combines systems that are designed to receive signals based on different types of fading—i.e., Rician fading experienced by airborne systems such as Gilhousen761, and Rayleigh fading experienced by terrestrial (ground-based) systems, such as Adachi—that are not compatible with one another.” PO Resp. 31 (citing Ex. 2100 ¶¶ 191–192); *see* Ex. 2100 ¶ 191 (“Petitioner’s and Mr. Fischer’s proposed combination (i.e., replacing Gilhousen761’s airborne repeater with Adachi’s stationary repeater) improperly combines systems that are designed to receive signals based on different types of fading that are not compatible with each other.”). As discussed in the preceding paragraph, Rayleigh and Rician fading are not mutually exclusive, and, therefore, we disagree with Patent Owner’s argument that the teachings of Gilhousen761 and Adachi could not have been combined for that reason. But further still, Patent Owner’s and Mr. Lanning’s positions fail to appreciate that there are two separate communication paths in Gilhousen761—the path between the ground base station and the airborne base and the path between the airborne base station and the radiotelephones on the airplane. *See* Ex. 1005, 2:59–3:4 (describing that the repeater on the airplane receives signals from the radiophones on the airplane and relays the signals to the ground base station and also receives signals from ground base station and relays the signals to the phones on the airplane). Mr. Fischer credibly testifies that, “just as buildings and other obstacles can cause multipath interference on the ground, obstacles can cause interference inside an aircraft, such as electrical equipment, large objects such as seats, and even people’s bodies.” Ex. 1008 ¶ 96 (citing Ex. 1035, 604; Ex. 1036, 1). Mr. Fischer further testifies that a person of

ordinary skill in the art “would have been naturally motivated to employ Adachi’s repeater and its multiple, spatially separated antennas in place of repeater 210 in Gilhousen761’s ‘repeater embodiment’ to mitigate the effects of multipath and fading on communications within the aircraft between the repeater and onboard radiotelephones.” Ex. 1008 ¶ 96. Thus, contrary to Patent Owner’s and Mr. Lanning’s position, the system of Gilhousen761 not only must deal with fading between the airplane and the ground base station, but also with multipath interference in the communications paths within the airplane.

Patent Owner further argues that CDMA uses power control to combat fading and that the power control used by a ground-based system, such as Gilhousen459 or Adachi, cannot operate at the speed of a jet. PO Sur-reply 19–20 (citing Ex. 2100 ¶ 187). Therefore, according to Patent Owner, a person of ordinary skill in the art “would not be motivated to replace *Gilhousen761*’s high speed airborne repeater with *Adachi*’s CDMA stationary repeater because *Adachi*’s power control method is designed for a terrestrial CDMA system that cannot support the high speeds of *Gilhousen761*.” PO Sur-reply 20 (citing Ex. 2100 ¶ 190). We disagree with this argument for several reasons.

First, Gilhousen761 already discloses a CDMA communication system. Ex. 1005, 2:19–21 (discussing ground-based CDMA system), 2:50–58 (discussing airborne-based CDMA system). Thus, we do not see how Adachi’s CDMA teachings introduce some incompatibility with Gilhousen761’s teachings when both rely on the same technology—CDMA—and that technology’s use of power control.

Second, Gilhousen761 specifically refers to U.S. Patent No. 5,289,527 (“Tiedemann”) for details on mobile unit “registration” and “hand-off.” Ex. 1005, 3:28–30, 3:59–61. Tiedemann is directed to cellular telephone registration in the context of vehicles traveling on a road (“freeway”) (Tiedemann, 3:31–46). Thus, Gilhousen761’s disclosure shows that the teachings from ground-based and air-based CDMA systems are indeed compatible.

Third, Mr. Lanning’s testimony regarding CDMA power control relies on references that are directed to combatting Rayleigh fading, not the Rician fading that would occur in the channel between the plane and the ground. Ex. 2100 ¶¶ 187–189. For example, Mr. Lanning quotes a passage from a book titled *CDMA RF System Engineering*, which states that, “[b]ecause the closed-loop power control is meant to combat fast Rayleigh fading, the mobile’s response to these power-control commands must be very fast.” Ex. 2109, 102,¹⁶ *quoted in* Ex. 2100 ¶ 188. Mr. Lanning also cites a passage from another Gilhousen patent (US 5,257,283 (“Gilhousen283”), Ex. 2112) as allegedly supporting the proposition that CDMA power control is only effective at speeds up to 50 miles per hour and certainly not for aircraft speeds. Ex. 2100 ¶¶ 189–190 (quoting Ex. 2112, 7:7–23). But Gilhousen283 is specifically addressing power control to combat fading in the terrestrial channel, i.e., Rayleigh fading. *See* Ex. 2112, 3:52–57 (describing the object of the invention as “controlling in the terrestrial channel transmitter power so as to overcome deleterious fading”), 2:64–3:6 (describing fading in the terrestrial channel as Rayleigh fading). Indeed, in

¹⁶ Mr. Lanning refers to page 89 of the book, which is page 102 of the exhibit.

the very next sentence after the passage quoted by Mr. Lanning (Ex. 2100 ¶ 189), Gilhousen²⁸³ discloses that, “[t]o account for the independence of the two Rayleigh fading paths, the mobile unit transmitter power is also controlled by the power adjustment command from the cell-site.” Ex. 2112, 7:23–26. Thus, the CDMA power control features that allegedly scuttle the proposed combination are directed to combatting Rayleigh fading in the terrestrial channel, which is not the type of fading that occurs between the aircraft and the ground base station in Gilhousen⁷⁶¹, as Mr. Lanning confirms: “[A] receiver in an airborne aircraft experiences a type of fading referred to as ‘Rician fading’ and the terrestrial (ground-based) systems experience multipath and Rayleigh fading.” Ex. 2100 ¶ 191. Thus, we do not agree with Patent Owner’s argument that these power control features render inoperable a CDMA system that transmits from an airplane to the ground at normal aircraft speeds. *See* PO Sur-reply 19–20. This is further supported by the fact that Gilhousen⁷⁶¹ expressly discloses CDMA transmissions between ground base station and the airplane. *See* Ex. 1005, 2:38–49 (describing antenna 150 on the ground radiating and receiving CDMA signals and disclosing that an upward radiating antenna can be used to form an elevated cell above the ground for the phones on the plane).

Finally, Patent Owner argues that “*Gilhousen761* further lacks the necessary design and circuitry details for both the airborne repeater and the airborne base station to even to be utilized by a [person of ordinary skill in the art] as a primary reference.” PO Resp. 31 (citing Ex. 2100 ¶ 193 (Mr. Lanning similarly testifying that “*Gilhousen761* lacks the necessary design and circuitry details for the airborne repeater to be utilized by a [person of ordinary skill in the art] as a primary reference.”)). This assertion fails to

appreciate the high level of skill in the art (*see* § II.A above), which is also reflected in the '023 patent's use of "well-known" equipment and functions, the details of which the '023 patent does not describe. *See, e.g.*, Ex. 1001, 4:28, 5:5–6, 5:23, 5:52, 5:64, 6:17, 6:28, 6:46, 6:50–51, 6:60, 9:18, 9:31, 9:60; *c.f. In re Epstein*, 32 F.3d 1559, 1568 (Fed. Cir. 1994) (comparing level of details provided in the specification and the cited prior art in the context of whether a prior art reference is enabling).

Based on the foregoing and having considered the full trial record, we are persuaded by Petitioner's contention that a person of ordinary skill in the art would have been motivated to combine the teachings of Gilhousen⁷⁶¹ and Adachi as proposed by Petitioner with a reasonable expectation of success. More particularly, as discussed in detail above, there were many known techniques to improve signal reception and mitigate fading, including using spatially separated antennas, as taught in Adachi. Ex. 1006, 2:27–31, 2:67–68, 3:13–15, 13:61–64; Ex. 1017; Ex. 1008 ¶¶ 46–48, 95–103. We find that the benefits of improved communications using multiple antennas would have motivated a person of ordinary skill in the art to make the combination, and we find that a person of ordinary skill in the art—a highly trained engineer (*see* § II.A above)—would have had a reasonable expectation of success in doing so. Ex. 1008 ¶¶ 95–103.

f) Determination of unpatentability

For the reasons discussed above, we find that the combination of Gilhousen⁷⁶¹ and Adachi teaches the subject matter recited in claim 11 and that a person of ordinary skill in the art would have been motivated to combine the teachings of these references in the manner asserted with a reasonable expectation of success. Based on the full trial record, we

conclude that Petitioner has demonstrated by a preponderance of the evidence that the subject matter recited in claim 11 would have been obvious over the combined teachings of Gilhousen761 and Adachi.

4. Independent Claim 1

Petitioner asserts that the subject matter recited in claim 1 would have been obvious based on the combined teachings of Gilhousen761 and Adachi. Pet. 18–29. Patent Owner does not separately argue claim 1. *See generally* PO Resp.

Like claim 11, claim 1 recites “[a]n apparatus configured to move relative to Earth, the apparatus comprising: a plurality of spatially separated antennas.” Petitioner’s contentions for this subject matter are the same for both claims 1 and 11. Pet. 22–26, 35. For the reasons explained above in §§ II.D.3.a–b, we find that the combination of Gilhousen761 and Adachi teaches this subject matter.

Claim 1 also recites “a receiver configured to receive mobile device signals from a mobile device through the plurality of spatially separated antennas.” This differs from claim 11’s receiver limitation, which recites receiving fixed port signals. Petitioner argues that Adachi’s repeater uses antennas 28 and 29 to receive signals from mobile devices, which, in the proposed combination, are Gilhousen761’s radiotelephones. Pet. 27–28 (citing Ex. 1031, 6:13–15, 6:49–57, 6:61–64, Fig. 2; Ex. 1008 ¶¶ 112–114).

We are persuaded by Petitioner’s contentions for the receiver limitation. Adachi discloses that “repeater 20 has . . . antennas 28 and 29 for mobile stations,” that antenna 28 is “a transmitting-receiving antenna,” and that antenna 29 is “a receiving antenna.” Ex. 1031, 6:13–16. Adachi further discloses that “data to be transmitted from the mobile station 16 . . . is

radiated from a transmitting receiving antenna 31 as an electric wave whose carrier frequency is f_1 . The electric wave is received by antennas 28 and 29 of the repeater 20 for mobile stations.” Ex. 1031, 6:49–54. Thus, we find that the combination of Gilhousen761 and Adachi teaches “a receiver configured to receive mobile device signals from a mobile device through the plurality of spatially separated antennas,” as recited in claim 1.

Claim 1 also recites “a transmitter configured to transmit radio frequency signals corresponding to the mobile device signals to a base station.” This differs from claim 11’s transmitter limitation, which recites transmitting to a mobile device. Petitioner argues that Adachi discloses that the signals received from mobile stations through antennas 28 and 29 are combined and sent to a base station and that, in the proposed combination, Gilhousen761’s ground base station 120 teaches the claimed “base station.” Pet. 28–29 (citing Ex. 1031, 6:64–7:3; Ex. 1005, 2:27–30; Ex. 1008 ¶¶ 115–118).

We are persuaded by Petitioner’s contentions for the transmitter limitation. Adachi discloses that signals received from the mobile stations are combined and that the “combined signal is amplified by an amplifier 37, fed to the antenna 21 for the base station through the circulator 23 for separating transmitted and received signals, and is radiated to the base station.” Ex. 1031, 6:53–6:67; *see also* Ex. 1005, 2:27–30 (Gilhousen761’s description of base station 120 as “a cell site”). Thus, we find that the combination of Gilhousen761 and Adachi teaches “a transmitter configured to transmit radio frequency signals corresponding to the mobile device signals to a base station,” as recited in claim 1.

We also are persuaded by Petitioner’s reasons for combining the teachings of Gilhousen761 and Adachi, as discussed above in § II.D.3.e.

Based on the full trial record, we conclude that Petitioner has demonstrated by a preponderance of the evidence that the subject matter recited in claim 1 would have been obvious over the combined teachings of Gilhousen761 and Adachi.

5. Dependent Claims 4 and 14

Claims 4 and 14 depend, respectively, from claims 1 and 11 and recite that the apparatus “further compris[es] another plurality of spatially separated antennas, the transmitter configured to transmit the radio frequency signals through the another plurality of spatially separated antennas.” Petitioner argues that, although Adachi’s first embodiment (Figure 2), on which Petitioner relies for claims 1 and 11, shows one transmitting antenna for each of the mobile stations and the base station, a person of ordinary skill in the art would have been motivated to use multiple antennas to transmit to mobile stations and to the base station based on another embodiment of Adachi. Pet. 30–33 (citing Ex. 1031, 7:24–29, 7:39–65, 8:5–14, Fig. 3A; Ex. 1008 ¶¶ 119–126); *see also* Pet. 37–38 (for claim 14, referring to contentions for claim 4). In particular, Adachi discloses using multiple transmitting antennas as follows:

Although the repeater of the first embodiment employs two receiving antennas and one transmitting antenna for each of the base station and the mobile station, it is not restricted to this arrangement. For example, a combination of three or more receiving antennas and *one or more transmitting antennas can also be used*.

Ex. 1031, 7:24–29 (emphasis added). Petitioner argues that this disclosure provides “an express motivation to use multiple antennas on each side,

capable of transmission,” and Petitioner argues that a person of ordinary skill in the art would have been motivated to use multiple transmitting antennas to reduce multipath fading and interference. Pet. 32–33 (citing Ex. 1031, 7:24–29, 8:5–14; Ex. 1008 ¶¶ 123–126).

Apart from its arguments for the independent claims, Patent Owner does not dispute Petitioner’s contentions as to these claims. *See generally* PO Resp.

We are persuaded by Petitioner’s contentions and evidence, and we conclude that the subject matter recited in claims 4 and 14 would have been obvious based on the combination of Gilhousen⁷⁶¹ and Adachi.

6. Dependent Claims 5 and 15

Claims 5 and 15 depend, respectively, from claims 4 and 14 and recite “wherein the another plurality of spatially separated antennas is configured to transmit spatially separated radio frequency beams separated in time with a predefined time delay.” Petitioner argues that the modification to use multiple transmitting antennas discussed for claims 4 and 14 teaches the subject matter of claims 5 and 15 because Adachi discloses sending one signal through a delay circuit, which a person of ordinary skill in the art would have understood to mean that the transmitted signals are “separated in time with a predefined time delay.” Pet. 33–34 (citing Ex. 1008 ¶¶ 127–130); *see also* Pet. 38–39 (for claim 15, referring to contentions for claim 5). In its disclosure of multiple transmitting antennas, Adachi discloses that the repeater transmits delayed and non-delayed signals to the mobile stations and the base station. Ex. 1031, 7:44–62.

Apart from its arguments for the independent claims, Patent Owner does not dispute Petitioner’s contentions as to these claims. *See generally* PO Resp.

We are persuaded by Petitioner’s contentions and evidence, and we conclude that the subject matter recited in claims 5 and 15 would have been obvious based on the combination of Gilhousen761 and Adachi.

7. Dependent Claims 9 and 19

Claims 9 and 19 depend, respectively, from claims 1 and 11 and recite “wherein the apparatus is conveyed by a vehicle.” Petitioner argues that Gilhousen761’s aircraft is a vehicle that carries the repeater. Pet. 34–35 (citing Ex. 1005, 1:54–61; Ex. 1029 (dictionary definition of “vehicle”); Ex. 1008 ¶ 131); *see also* Pet. 39 (for claim 19, referring to contentions for claim 9).

Patent Owner does not dispute Petitioner’s contentions for these claims, apart from its arguments as to independent claim 11, which we address above in § II.D.3. *See* PO Resp. 42 (referring to arguments for claim 11).

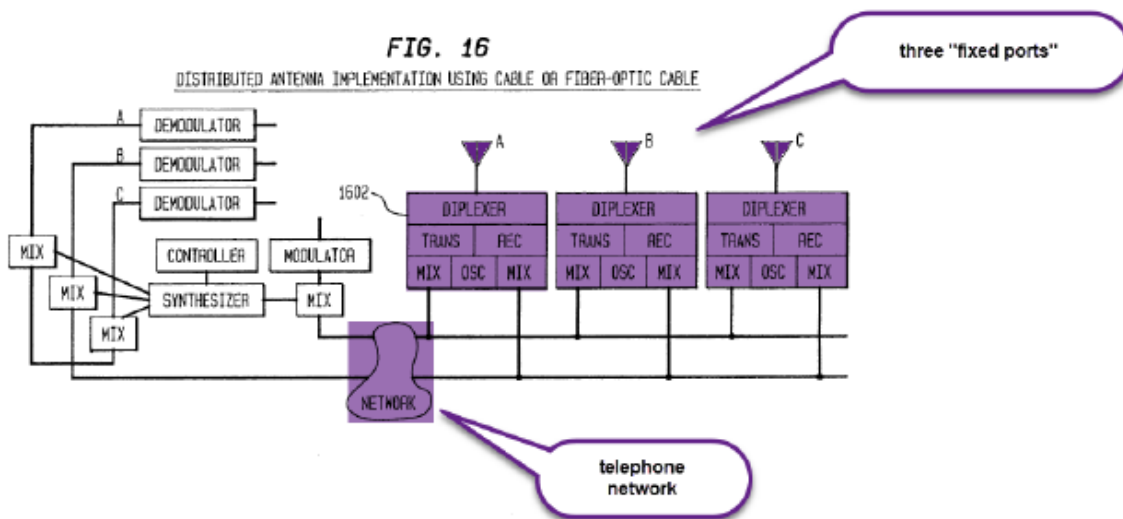
We are persuaded, and we find, that Gilhousen761’s airplane is a vehicle that carries the apparatus, and we conclude that the subject matter recited in claims 9 and 19 would have been obvious based on the combination of Gilhousen761 and Adachi.

E. Obviousness over Gilhousen761, Adachi, and Bolgiano (Claims 21–23)

Petitioner asserts that claims 21–23 of the ’023 patent are unpatentable under 35 U.S.C. § 103(a) as obvious over the combined teachings of Gilhousen761, Adachi, and Bolgiano. Pet. 39–44.

For this ground, Petitioner argues that “the Gilhousen761-Adachi combination of Ground 1 is further modified to include Bolgiano’s ability to receive and separate fixed port signals from a plurality of fixed ports that are delayed by different times.” Pet. 39. Petitioner argues that a person of ordinary skill in the art “would have been motivated to incorporate Bolgiano’s teaching of ‘triple diversity’ (spatial, frequency, and staggering signal transmissions, Ex. 1033, 8:39-42) into the fixed ports of the Gilhousen761-Adachi combination” to “reduce fading” and “ensure a high performance link.” Pet. 40–41 (citing Ex. 1033, code (57), 9:65–10:3; Ex. 1008 ¶ 151). Petitioner argues that a person of ordinary skill in the art “would have recognized that Bolgiano’s staggered reception teaching contributes to reduced fading, lowers transmission power requirements and simplifies receiver design.” Pet. 39 (citing Ex. 1033, code (57), 9:65–10:3; Ex. 1008 ¶ 148).

Claim 21 recites, “[a]n apparatus in accordance with claim 11, wherein the receiver is further configured to receive fixed port signals from a plurality of fixed ports through the plurality of spatially separated antennas.” Petitioner relies on Bolgiano to teach “a plurality of fixed ports” and provides the following annotated version of Bolgiano’s Figure 16:



In the annotated version of Bolgiano’s Figure 16 reproduced above, Petitioner identifies elements labeled 1602 as “three ‘fixed ports’” and area labeled “NETWORK” as “telephone network.” Pet. 42 (citing Ex. 1033, 15:62–64, 16:63–65, Fig. 16; Ex. 1008 ¶¶ 153–155).

Patent Owner argues that Petitioner incorrectly asserts that the area labeled “NETWORK” in Bolgiano’s Figure 16 is the telephone network and that, because this is not the telephone network, remote locations 1602 are not “stationary device[s] at which signals can enter or exit a communication network,” as construed by the district court in the *Novatel* litigation. PO Resp. 45–46; see § II.B.1 above (discussing construction for “fixed port”). In reply, Petitioner states that “[t]he Petition incorrectly labeled the ‘network’ in Figure 16 as the ‘telephone network,’ but correctly indicated that signals access the telephone network *via* that cable network, thus satisfying the construction.” Pet. Reply 26 n.11 (citing Pet. 41–42; Ex. 2108-1, 76:15–77:14, 81:15–82:2).

Based on Petitioner’s acknowledgement of a labeling error, there is no dispute that the area labeled “NETWORK” in Bolgiano’s Figure 16 does not

represent the telephone network. Patent Owner argues that “signals do not enter or exit a communication network through the blocks of *Bolgiano*’s remote locations (1602) of Figure 16” “because antennas A, B, and C (and their individual transceivers) of *Bolgiano*’s remote locations (1602) are connected to the Public Switched Network through an intermediate device (i.e., the centrally located transfer station) via a two-way cable or fiber optic cable (1402).” PO Resp. 46 (citing Ex. 2100 ¶ 250; Ex. 2108-1, 68:20–25, 71:23–72:9, 72:14–20). We disagree with Patent Owner’s argument because *Bolgiano*’s configuration of a connection through an intermediate device is consistent with the ’023 patent’s description of how a fixed port is connected to the telephone network:

Disposed between the moving base stations moving along the rails 35, 45 are a plurality of fixed radio ports 50 which are connected by means of a fiber optic ring 55 or a similar signal transmitting device to a telephone office connected to the wire line telephone network and referred to as a gateway office. The gateway office 60 forms the interface between the mobile telecommunication system and the wire line telephone network. The gateway office is a well-known equipment.

Ex. 1001, 4:21–28.¹⁷ Thus, the ’023 patent discloses that a fixed port is connected by a fiber optic connection to a gateway office, which in turn is connected to the telephone network. This configuration is the same as Patent Owner’s characterization of the prior art: “*Bolgiano*’s remote locations (1602) are connected to the Public Switched Network through an intermediate device (i.e., the centrally located transfer station) via a two-way

¹⁷ Apart from the claims, the Specification of the ’023 patent does not use the term “fixed port.” During the oral argument, Patent Owner confirmed that the claimed “fixed ports” correspond to the “fixed radio ports” in the written description of the ’023 patent. Tr. 88:10–20.

cable or fiber optic cable (1402).” PO Resp. 48 (citing Ex. 2100 ¶ 243). Thus, we find that Bolgiano’s remote locations 1602 teach fixed ports, i.e., “stationary device[s] at which signals can enter or exit a communication network.”¹⁸

Patent Owner also argues that Bolgiano does not disclose a moving base station (PO Resp. 48–50), but Petitioner relies on Gilhousen761 to teach “[a]n apparatus configured to move relative to Earth,” as recited in the preamble of claim 11 and discussed above in § II.D.1.a. Pet. 22–24, 35. Patent Owner further argues that “*Bolgiano* does not disclose any apparatus (i.e., a moving base station) comprised of a receiver that receives fixed port signals from a plurality of fixed ports through **a plurality of spatially separated antennas**.” PO Resp. 50–51 (citing Ex. 1033, Figs. 2, 3, 5, 6). Petitioner, however, relies on Bolgiano’s disclosure of three “fixed ports”—remote locations 1602 as discussed above—in combination with Adachi’s disclosure of a receiver. *See* Pet. 42 (“In the proposed combination, the Gilhousen761-Adachi system would receive signals from Bolgiano’s plurality of fixed ports.”). Bolgiano discloses that “each remote location includes a remote transceiver (transmitter, receiver, local oscillator, diplexer and antenna) at site 1602.” Ex. 1033, 16:63–65, *cited in* Pet. 42. Thus, we are persuaded, and we find, that the combination of Gilhousen761, Adachi, and Bolgiano teaches that “the receiver is further configured to receive fixed

¹⁸ Patent Owner argues that Petitioner raises a new obviousness theory in reply regarding a plurality of centralized transfer stations. PO Sur-reply 28. Because we find that Bolgiano’s remote locations 1602 teach fixed ports, as set forth in the Petition, we need not rely on any alleged new argument in the Reply. *See* Pet. 42 (“Bolgiano’s ‘fixed ports’ are blocks 1602 . . .”).

port signals from a plurality of fixed ports through the plurality of spatially separated antennas.”

Patent Owner also disputes Petitioner’s rationale to combine the references. PO Resp. 27–28, 32–33. In particular, Patent Owner argues that a person of ordinary skill in the art would not have been motivated to make the proposed combination “because of the compatibility issues that would arise when trying to modify *Gilhousen*’s fixed base station to utilize *Bolgiano*’s TDMA protocols.” PO Resp. 32 (citing Ex. 2100 ¶¶ 197–200). As Petitioner points out, however, *Bolgiano* itself discloses a system that utilizes both CDMA and TDMA: “It is desirable to provide a system of time diversity signals using time division multiple access (TDMA) in various combinations with CDMA” Ex. 1033, 2:27–30, *quoted in* Pet. Reply 14.

In its Sur-reply, Patent Owner argues that there is a “complete lack of compatibility” between CDMA and TDMA, which Patent Owner alleges is shown by the lack of “any actual cellular network, cellular standard, or cellular system that has successfully combined TDMA and CDMA.” PO Sur-reply 21–22 (citing Ex. 2100 ¶¶ 169–179, 213). According to Patent Owner, “[t]he hypothetical system in *Bolgiano* has never become a reality.” PO Resp. 22–23. Contrary to Patent Owner’s argument, there is no requirement for a reference’s disclosure to have been implemented in an actual system for that disclosure to qualify as prior art acceptable for obviousness. Indeed, the Court of Appeals for the Federal Circuit has stated that, “[e]ven if a reference discloses an inoperative device, it is prior art for all that it teaches.” *Beckman Instruments, Inc. v. LKB Produkter AB*, 892 F.2d 1547, 1551 (Fed. Cir. 1989).

Furthermore, as Petitioner points out, “[s]everal figures in Bolgiano show timing diagrams of the TDMA signals modulated using CDMA, with accompanying explanation.” Pet. Reply 14–15 (citing Ex. 1033, 3:39–67, 14:48–15:57, Figs. 10A, 10B, 11A, 11B, 17). Bolgiano explains its combined CDMA/TDMA system as follows:

[T]ime division multiplexing is used in the sense that successive time slots carry data directed to different users. Code division multiplexing is used in the sense that during each time multiplexed time slot, multiple PN code sequences permit simultaneous communication with multiple users. The result is a time division multiplexed, code division multiplexed signal.

Ex. 1033, 15:19–26. Petitioner’s declarant, Mr. Fischer, testifies that “CDMA, and any digital modulation, also can have TDM features on a macro scale” and that “TDM refers to the operation of time switching a waveform, whereas TDMA refers to an access application that relies on time switching; the former being a more generic use of the term.” Ex. 1008 ¶ 70. We credit this testimony because it is consistent with Bolgiano’s use of time division multiplexing to combine TDMA with CDMA. Furthermore, the ’023 patent itself discloses using “a time division multiplexed, direct-sequence, spread-spectrum, code-division multiple-access interface (TDM/CDMA)” as an exemplary radio interface between the moving base stations and the fixed ports. Ex. 1001, 6:51–54. We, therefore, see no merit in Patent Owner’s argument about the alleged the lack of any actual system utilizing Bolgiano’s teachings of a combined CDMA/TDMA system.

Patent Owner also argues that “Petitioner has not articulated any coherent reason why a [person of ordinary skill in the art] would have been motivated to modify *Gilhousen761*’s fixed base station with *Bolgiano*’s TDMA protocols, especially, where *Gilhousen761* lacks the necessary

design and circuitry details for the pre-existing base station to even to be utilized by a [person of ordinary skill in the art] as a primary reference.” PO Resp. 33. For the reasons explained above in § II.D.3.e, we disagree that Gilhousen761 lacks sufficient disclosure. We also disagree that Petitioner has not put forth “any coherent reason” to make the proposed combination. As discussed at the beginning of this section, Petitioner argues that a person of ordinary skill in the art “would have recognized that Bolgiano’s staggered reception teaching contributes to reduced fading, lowers transmission power requirements and simplifies receiver design.” Pet. 39 (citing Ex. 1033, code (57), 9:65–10:3; Ex. 1008 ¶ 148). This reasoning is supported by Bolgiano’s disclosure that its system “combines time and space diversity to reduce fading and simplify receiver design” and that its “triple diversity” technique “allows the transmitted power margin to be reduced by at least 10 dB for a high performance link.” Ex. 1033, code (57), 9:65–10:3). Thus, Petitioner provides a persuasive rationale, underpinned by the benefits identified by Bolgiano, for making the combination, and we find that a person of ordinary skill in the art would have been motivated to combine the teachings of Bolgiano with Gilhousen761 and Adachi with a reasonable expectation of success, as set forth by Petitioner. *See* Ex. 1008 ¶¶ 148–152; Pet. 39–41.

Claim 22 recites, “[a]n apparatus in accordance with claim 21, wherein each fixed port signal transmitted from each of the plurality of fixed ports includes common data.” Petitioner argues that Bolgiano’s disclosure of transmitting the same data packet three times from three different antennas, in combination with Gilhousen761 and Adachi, teaches this subject matter. Pet. 42–44 (citing Ex. 1033, code (57), 15:62–64, 16:9–13, 16:63–65, 17:23–27, Fig. 16; Ex. 1008 ¶¶ 156–159).

Claim 23 recites, “[a]n apparatus in accordance with claim 22, wherein transmission of each fixed port signal from each of the plurality of fixed ports is delayed by a different time and the receiver is configured to receive and separate the fixed port signals.” Petitioner argues that Bolgiano’s disclosure of transmitting and receiving a packet at three different times teaches this subject matter. Pet. 44 (citing Ex. 1033, code (57), 2:46–51; Ex. 1008 ¶¶ 160–162).

For claims 22 and 23, Patent Owner argues that Bolgiano does not teach the recited “fixed ports,” referring to its arguments for claim 21. PO Resp. 54–58. As discussed above, we disagree. Rather, we find that Bolgiano’s remote locations 1602 teach fixed ports and that Bolgiano’s disclosure of transmitting the same packet at different times teaches the additional subject matter recited in claims 22 and 23. Ex. 1033, code (57) (disclosing that a “receiver thus receives the same data packet at three different times from three different antennas”).

Based on the full trial record, we conclude that Petitioner has demonstrated by a preponderance of the evidence that the subject matter recited in claims 21–23 would have been obvious over the combined teachings of Gilhousen⁷⁶¹, Adachi, and Bolgiano.

*F. Obviousness over Ito and Jakes
(Claims 1, 6–8, 11, 16–18)*

Petitioner asserts that claims 1, 6–8, 11, and 16–18 of the ’023 patent are unpatentable under 35 U.S.C. § 103(a) as obvious over the combined teachings of Ito and Jakes. Pet. 65–73.

I. Ito

Ito is a patent titled “Mobile Radio Communication System Having Mobile Base and Portable Devices as a Mobile Station.” Ex. 1003, code (54). Figure 1 of Ito is reproduced below.

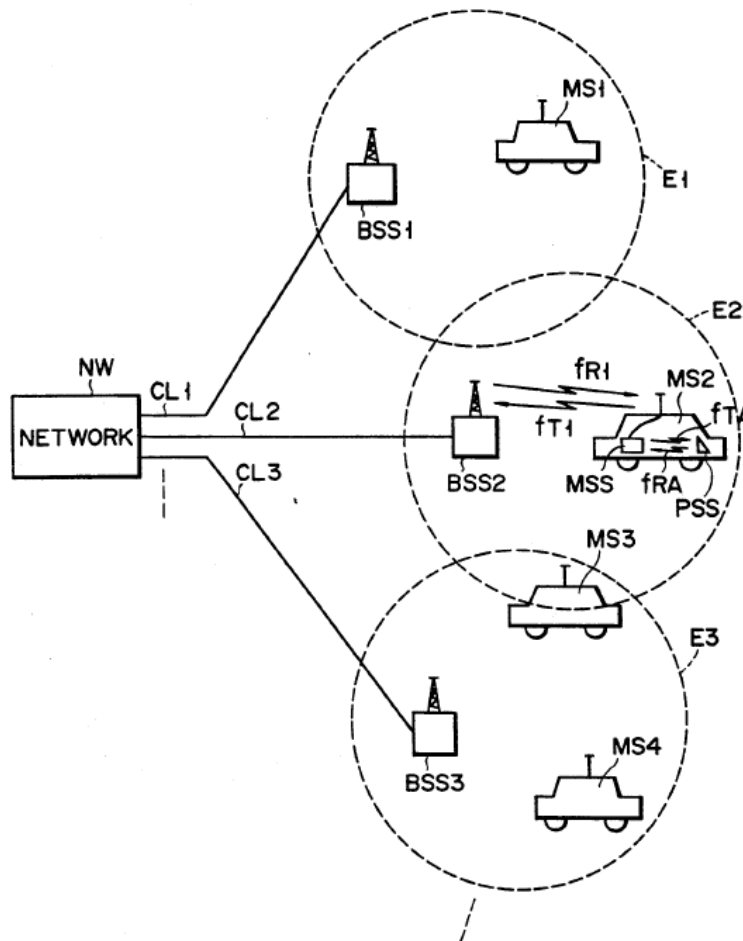


FIG. 1

Ito’s Figure 1, reproduced above, shows a car phone communication system having base stations BSS1, BSS2, and BSS3 and mobile stations MS1, MS2, MS3, and MS4. Ex. 1003, 5:31–36. Each mobile station has a mobile base device MSS and a portable device PSS. Ex. 1003, 5:39–41. The base stations are connected to telephone network NW via cables. Ex. 1003, 5:36–39.

Figure 3 of Ito is reproduced below.

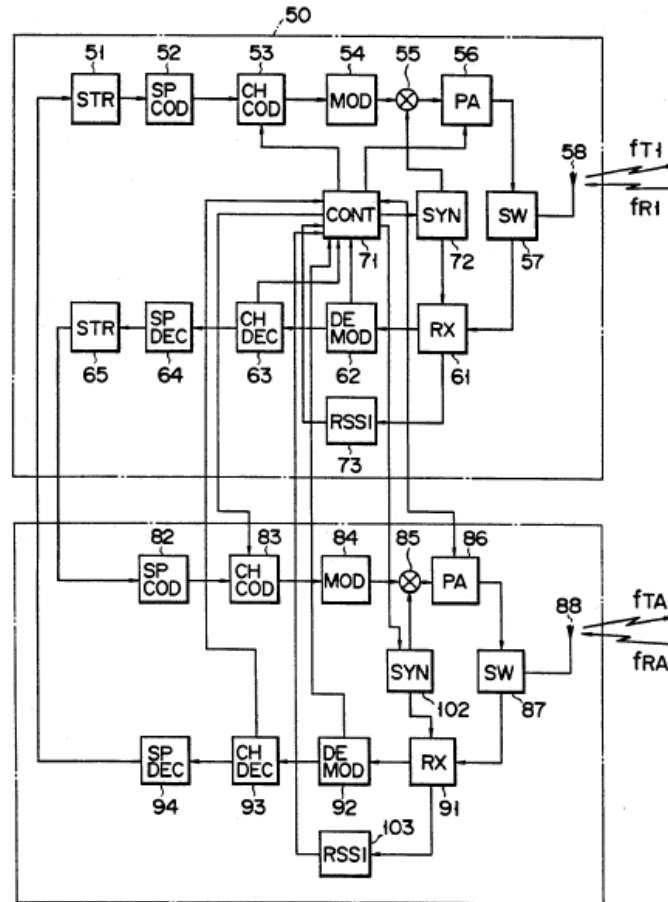


FIG. 3

Ito's Figure 3, reproduced above, is a block diagram of a mobile base device of Figure 1. Ex. 1003, 5:10–11. Ito discloses that mobile base device MSS has first transmitter-receiver unit 50 for communication with a base station BSS and a second transmitter-receiver unit 80 for communication with its portable device PSS. Ex. 1003, 7:9–17.

2. Jakes

Jakes is an IEEE paper from 1971 titled "A Comparison of Specific Space Diversity Techniques for Reduction of Fast Fading in UHF Mobile Radio Systems." Ex. 1032. As the title indicates, Jakes discusses space diversity techniques for mobile communications and discloses that using

multiple antennas can mitigate fading better than a single antenna.

Ex. 1032, 1.

Petitioner asserts that Jakes is prior art under 35 U.S.C. § 102(b) (Pet. 17), and Patent Owner does not dispute this (*see generally* PO Resp.). We are persuaded that Jakes was published more than one year before the earliest priority date for the '023 patent, and we conclude, therefore, that Jakes is prior art under 35 U.S.C. § 102(b).

3. *Independent Claim 11*

a) *Preamble*

Petitioner argues that Ito's mobile station MS comprising mobile base device MSS moves with the speed of traffic on the road as the car containing the MS moves, and, therefore, Petitioner contends Ito teaches "[a]n apparatus configured to move relative to Earth," as construed in the *Novatel* litigation. Pet. 52–53 (citing Ex. 1003, 3:17–23, 5:36–41, Fig. 1; Ex. 1008 ¶¶ 182–183), 72 (referring to discussion at Pet. 52–53). Patent Owner does not dispute this contention. *See generally* PO Resp.

We are persuaded, and we find, that Ito's disclosure of its mobile base device MSS in a car teaches "[a]n apparatus configured to move relative to Earth." *See* Ex. 1003, Fig. 1 (depicting an automobile telephone system).

b) *Plurality of spatially separated antennas*

Petitioner argues Jakes discloses "a plurality of spatially separated antennas," as recited in claim 11. Pet. 69 (citing Ex. 1032, 1, Figs. 1, 3; Ex. 1008 ¶ 221), 72 (citing Ex. 1008 ¶ 230).

Patent Owner does not dispute that Jakes teaches a plurality of spatially separated antennas; rather, Patent Owner argues that Petitioner has not shown sufficient reasoning to combine the references. *See* PO Resp. 28,

36–37. We address the parties’ contentions as to the rationale to combine below in § II.F.3.e.

We are persuaded by Petitioner’s contentions for this limitation. Figures 1 and 3 of Jakes show multiple antennas, and Jakes discloses “signals received from spatially separated antennas.” Ex. 1032, 1–3. Thus, we find that Jakes teaches “a plurality of spatially separated antennas,” as recited in claim 11.

c) Receiver

Claim 11 recites that the apparatus comprises “a receiver configured to receive fixed port signals from a fixed port through the plurality of spatially separated antennas.” Petitioner argues that Ito’s mobile base device MSS’s transmitter-receiver unit 50, which communicates with base station BSS, teaches “a receiver configured to receive fixed port signals from a fixed port,” as recited in claim 11. Pet. 61 (citing Ex. 1003, 7:9–17, 7:55–58, Fig. 3; Ex. 1008 ¶ 201), 72 (referring to discussion at Pet. 61). Petitioner relies on Jakes in combination with Ito for the recitation “through the plurality of spatially separated antennas.” Pet. 72 (citing Ex. 1008 ¶ 231).

Patent Owner does not dispute Petitioner’s contention that the combination of Ito and Jakes teaches this subject matter, apart from its argument that Petitioner has not shown sufficient reasoning to combine the references, which we address below in § II.F.3.e.

We are persuaded by Petitioner’s contentions for this limitation. Ito discloses that “mobile base device MSS . . . comprises a first transmitter-receiver unit 50” that “is used for radio communication with the base station BSS.” Ex. 1003, 7:9–17. Ito also discloses that base stations BSS “are connected to a wire telephone network NW” (Ex. 1003, 5:36–39),

and, therefore, we find that Ito's base station BSS teaches "a stationary device at which signals can enter or exit a communication network," i.e., "a fixed port." As discussed above in § II.F.3.b, Jakes discloses a plurality of spatially separated antennas, and we find, therefore, that the combination of Ito and Jakes teaches "a receiver configured to receive fixed port signals from a fixed port through the plurality of spatially separated antennas," as recited in claim 11.

d) Transmitter

Claim 11 recites that the apparatus comprises "a transmitter configured to transmit radio frequency signals to a mobile device corresponding to the received fixed port signals." Petitioner argues that Ito's "transmitter-receiver unit 80 wirelessly communicates with portable device PSS (*mobile device*), forwarding processed signals originally received from the fixed port (*signals corresponding to received fixed port signals*) to the mobile device." Pet. 61–62 (citing Ex. 1003, 7:9–17, Fig. 3; Ex. 1008 ¶ 202), 73 (referring to discussion at Pet. 61–62).

Referring back to its proposed claim construction, Patent Owner contends that the "mobile device" limitation is not met by Ito. PO Resp. 58–60, 67–68. Patent Owner states, "*Ito* does not disclose any ability of its portable device to register or directly communicate with a cellular network." PO Resp. 59 (citing Ex. 2100 ¶ 268). Patent Owner asserts Ito's "portable device is similar to a cordless phone system" and, therefore, is excluded under Patent Owner's construction of "mobile device." PO Resp. 59.

Patent Owner's argument relies on its proposed construction of "mobile device" as "a device that must register with and be able to directly communicate with the cellular network." See § II.B.3 above. Because we

have not adopted Patent Owner’s claim construction for “mobile device,” we are not persuaded by this argument.

We find that Ito’s portable device PSS teaches a “mobile device” as recited in claim 11. In particular, Ito explains that portable device PSS, which is located in a car (Fig. 1) communicates with transmitter-receiver unit 80 “by way of a . . . radio channel.” Ex. 1003, 7:9–17.

Furthermore, although Patent Owner’s claim construction discussion focuses on particular cellular functionality that allegedly must be present in the “mobile device” (*see* PO Resp. 13–15; PO Sur-reply 1–15), there is no dispute that the movable base station, not the mobile device, is the device to which the claims are directed. *See* Tr. 52:25–53:5; *see also* PO Resp. 2 (“The asserted claims of the ’023 Patent cover a movable base station or apparatus configured to provide important benefits to mobile devices, such as smartphone, tablet and laptop users.”). As discussed above in § II.B.3 (construction of “mobile device”), we agree with Patent Owner that the ’023 patent addresses improving cellular technology, but Ito does so as well. Ito explains that “[a] cellular type automobile telephone system has been known as a mobile radio communication system,” and Ito directs its invention to such a “mobile radio communication system.” Ex. 1003, 1:15–16, 5:31–33. Thus, like the ’023 patent, Ito operates within a cellular network and indeed provides a moving base station that links a portable radio device to a cellular network.

In addition, whether or not Ito’s transmitter-receiver unit 80 communicates with portable device PSS using a cellular interface is irrelevant to the claims, as Patent Owner acknowledges. In particular, Patent Owner argues that its proposed requirement that “a mobile device must

register with the cellular network in order to obtain the benefits of the '023 Patent” “does not preclude a mobile device—such as a cell phone—from using a second type of radio interface that is not a standard cellular interface to communicate with the moving base station.” PO Sur-reply 9. But this is the only communication interface with the “mobile device” that is recited in claim 11: “a transmitter configured to transmit radio frequency signals to a mobile device corresponding to the received fixed port signals.” Thus, based on Patent Owner’s arguments, claim 11 encompasses Ito’s radio interface between transmitter-receiver unit 80 and portable device PSS. *See* Ex. 1003, 7:9–17 (“[T]he second transmitter-receiver unit 80 is used for radio communication with its portable device PSS by way of a second radio channel.”).

Patent Owner also argues that Jakes does not teach a moving base station that transmits signals to a mobile device. PO Resp. 68. Petitioner, however, relies on Ito for this subject matter and relies on Jakes for teaching “a plurality of spatially separated antennas.” *See* Pet. 72–73.

Based on Petitioner’s persuasive contentions and evidence, we find that Ito teaches “a transmitter configured to transmit radio frequency signals to a mobile device corresponding to the received fixed port signals.” In particular, Ito discloses that “mobile base device MSS . . . comprises . . . a second transmitter-receiver unit 80,” which “is used for radio communication with its portable device PSS by way of a second radio channel.” Ex. 1003, 7:9–17.

e) Rationale for combining Ito and Jakes

Petitioner argues that a person of ordinary skill in the art would have been motivated to combine Jakes’s teachings of using spatially separated

antennas with the teachings of Ito because Jakes itself explains the benefit of using spatially separated antennas over a single antenna. Pet. 66–67, 69 (citing Ex. 1032, 1–2, 8–9, Figs. 1, 3, 15, 16; Ex. 1008 ¶¶ 216, 221). For example, Jakes discloses that “a signal made up of some combination of the two [antennas] would have much less severe fading properties than a signal from one antenna alone.” Ex. 1032, 1, *quoted in* Pet. 66.

Patent Owner argues that Jakes is directed to antennas for a point-to-point direct radio FM system whereas Ito is directed to FDMA/TDMA mobile base stations, and Patent Owner contends that “Petitioner has not articulated any coherent reason why a [person of ordinary skill in the art] would decide to modify *Ito* with *Jakes*, especially, where *Jakes* is not directed towards a cellular system of any type (i.e., *Jakes* does not apply to FDMA-, TDMA- or CDMA-based cellular systems).” PO Resp. 37 (citing Ex. 2100 ¶¶ 225–226). Patent Owner asserts that Petitioner does not “explain how the spatially separated antennas of Jakes’ point-to-point direct radio FM system would even be interchangeable with Ito’s FDMA/TDMA mobile base stations.” PO Resp. 37 (emphasis omitted) (citing Ex. 2100 ¶ 226); *see also* PO Sur-reply 23–24 (discussing “incompatibilities” between Jakes and Ito).

We do not agree with these arguments because they imply that obviousness requires the physical incorporation of the features of one reference into another reference, but the Federal Circuit has

consistently held . . . that “[t]he test for obviousness is not whether the features of a secondary reference may be bodily incorporated into the structure of the primary reference; nor is it that the claimed invention must be expressly suggested in any one or all of the references. Rather, the test is what the combined

teachings of the references would have suggested to those of ordinary skill in the art.”

MCM Portfolio LLC v. Hewlett-Packard Co., 812 F.3d 1284, 1294 (Fed. Cir. 2015). As discussed above, Petitioner relies on Jakes for its teachings of spatially separated antennas and the benefits thereof. *See* Pet. 65–67, 69. Among those benefits, Jakes discloses that “a signal made up of some combination of the two [antennas] would have much less severe fading properties than a signal from one antenna alone.” Ex. 1032, 1, *quoted in* Pet. 66. And, as discussed above in § II.F.3.b, Jakes discloses using “spatially separated antennas.” Ex. 1032, 1. Thus, we agree with Petitioner that Jakes itself provides an explicit motivation to combine. *See* Pet. 66–67; Ex. 1008 ¶ 216.

We also disagree with Patent Owner’s argument that a person of ordinary skill in the art would not have been motivated to make the combination because “*Jakes* is not directed towards a cellular system of any type (i.e., *Jakes* does not apply to FDMA-, TDMA- or CDMA-based cellular systems).” PO Resp. 37 (citing Ex. 2100 ¶ 225). Mr. Lanning testifies that “[t]he first generation (1G) U.S. cellular networks . . . were introduced around 1983.” Ex. 2100 ¶ 169. *Jakes* is a publication from 1971, so it is not surprising that *Jakes* does not deal with cellular systems. *Jakes*’s publication nearly 25 years before the earliest priority date for the ’023 patent underscores that using multiple antennas in radio transmissions, cellular or otherwise, would have been well within the knowledge and ability of a person of ordinary skill in the art at the relevant time, a point confirmed by the ’023 patent: “Various techniques for obtaining high antenna diversity are well known in the art and antennas employing such techniques are commercially available. Other types of antennas may be used depending on

the particular implementation.” Ex. 1001, 6:27–30; *see also* Ex. 1001, 5:21–24 (“Examples of suitable antennas for use as the antennas 100, 101, include high gain, directional antennas for use in mobile communication, and are well know[n] and commercially available.”).

Patent Owner also argues that Petitioner “fails to explain how a [person of ordinary skill in the art] would combine *Jakes*’ spatially separated antennas with *Ito*’s FDMA/TDMA system, especially, where *Jakes* is not directed towards a cellular system of any type (i.e., does not apply to FDMA-, TDMA- or CDMA-based cellular systems).” PO Resp. 28. We disagree that Petitioner’s explanation is lacking in this regard. Mr. Fischer testifies that a person of ordinary skill in the art “would have had a reasonable expectation of success in modifying *Ito*’s system to use the spatially separated antennas of *Jakes*. This functionality was well-known at the time of the ’023 patent and it would have been a routine design choice to include this feature.” Ex. 1008 ¶ 219. Mr. Fischer also cites Adachi and Bolgiano as example implementations of spatially separated antennas. Ex. 1008 ¶ 219. We credit this testimony because it is consistent with the ’023 patent’s statement that antenna diversity techniques are “well known in the art.” Ex. 1001, 6:27–29; *see Koninklijke Philips N.V. v. Google LLC*, 948 F.3d 1330, 1337 (Fed. Cir. 2020) (“[T]he inquiry into whether any ‘differences’ between the invention and the prior art would have rendered the invention obvious to a skilled artisan necessarily depends on such artisan’s knowledge.”).

Based on the foregoing, we are persuaded, and we find, that a person of ordinary skill in the art would have been motivated to combine *Jakes*’s teachings of using multiple spatially separated antennas with *Ito*’s mobile

communication system and would have had a reasonable expectation of success in doing so. *See* Pet. 65–69; Ex. 1008 ¶¶ 213–219.

f) Determination of unpatentability

For the reasons discussed above, we find that the combination of Ito and Jakes teaches the subject matter recited in claim 11 and that a person of ordinary skill in the art would have been motivated to combine the teachings of these references in the manner asserted with a reasonable expectation of success. Based on the full trial record, we conclude that Petitioner has demonstrated by a preponderance of the evidence that the subject matter recited in claim 11 would have been obvious over the combined teachings of Ito and Jakes.

4. Independent Claim 1

Petitioner asserts that the subject matter recited in claim 1 would have been obvious based on the combined teachings of Ito and Jakes. Pet. 65–70. Patent Owner does not separately argue claim 1. *See generally* PO Resp.

Like claim 11, claim 1 recites “[a]n apparatus configured to move relative to Earth.” Petitioner contends that Ito teaches this subject matter for the same reasons given for claim 11. Pet. 52–53, 69, 72. For the reasons explained above in § II.F.3.a, we find that Ito teaches this subject matter.

As with claim 11, Petitioner contends that Jakes discloses “a plurality of spatially separated antennas.” Pet. 69, 72. For the reasons explained above in § II.F.3.b, we find that Jakes teaches this subject matter.

For the limitation of claim 1 reciting “a receiver configured to receive mobile device signals from a mobile device through the plurality of spatially separated antennas,” Petitioner argues that, “[i]n the proposed combination, Ito’s modified MSS would employ a plurality of spatially separated antennas

as taught by Jakes, and accordingly, when its receiver . . . receives signals from the mobile unit (mobile device), it would do so ‘through the plurality of spatially separated antennas.’” Pet. 70 (citing Ex. 1008 ¶ 222); *see also* Pet. 54–55 (Petitioner’s contentions as to how Ito teaches claim 1’s “receiver”).

We are persuaded by Petitioner’s contentions for the receiver limitation. Ito discloses that “mobile base device MSS . . . comprises . . . a second transmitter-receiver unit 80,” which, “is used for radio communication with its portable device PSS by way of a second radio channel.” Ex. 1003, 7:9–17. Thus, Ito teaches that its mobile base device MSS has a receiver for receiving signals from its mobile device (portable device PSS), and we find that Ito in combination with Jakes’s disclosures of using spatially separated antennas teaches “a receiver configured to receive mobile device signals from a mobile device through the plurality of spatially separated antennas,” as recited in claim 1.

For the limitation of claim 1 reciting “a transmitter configured to transmit radio frequency signals corresponding to the mobile device signals to a base station,” Petitioner argues that Ito’s MSS transmitter-receiver unit 50 sends signals to base station BSS that “are processed versions of signals received from the PSS (‘mobile device’)[;] thus, they ‘correspond’ to mobile device signals.” Pet. 55–56 (citing Ex. 1003, 5:36–39, 7:9–8:11, Fig. 3; Ex. 1008 ¶¶ 187–188), 70 (referring to discussion at Pet. 55–56).

We are persuaded by Petitioner’s contentions for the transmitter limitation because Ito discloses that “mobile base device MSS . . . comprises a first transmitter-receiver unit 50” that “is used for radio communication with the base station BSS” including transmitting signals received from

portable device PSS to base station BSS. Ex. 1003, 7:9–17, Fig. 3; Ex. 1008 ¶¶ 187–188. We find, therefore, that Ito teaches “a transmitter configured to transmit radio frequency signals corresponding to the mobile device signals to a base station.”

We also are persuaded by Petitioner’s reasons for combining the teachings of Ito and Jakes, as discussed above in § II.F.3.e.

Based on the full trial record, we conclude that Petitioner has demonstrated by a preponderance of the evidence that the subject matter recited in claim 1 would have been obvious over the combined teachings of Ito and Jakes.

5. *Dependent Claim 6*

Claim 6 depends from claim 1 and recites that the apparatus “further compris[es] a controller configured to compare the received mobile device signals received through the spatially separated antennas and to select a best signal.” Petitioner argues that Ito’s control circuit 71 teaches a “controller” and that, “[i]n the proposed combination, Ito’s controller would be programmed with the functionality of Jakes’ receiver, which teaches comparing incoming signals received from spatially separated antennas and selecting the best one.” Pet. 70–71 (citing Ex. 1003, 8:15–18; Ex. 1032, 2, Fig. 1; Ex. 1008 ¶¶ 224–226).

Patent Owner does not dispute Petitioner’s contentions as to claim 6. *See generally* PO Resp.

We are persuaded by Petitioner’s contentions and evidence. In particular, Ito discloses that mobile base device MSS includes “control circuit 71,” which “has a main control section which is normally a microcomputer and executes control operations for connecting a base station

BSS and a portable device PSS.” Ex. 1003, 8:15–18, Fig. 3. Jakes discloses that “[t]he antenna signals themselves could be sampled, for example, and the best one sent to one receiver.” Ex. 1032, 2. We find, therefore, that the proposed combination of Ito and Jakes teaches “a controller configured to compare the received mobile device signals received through the spatially separated antennas and to select a best signal,” as recited in claim 6.

Based on the full trial record, we conclude that Petitioner has demonstrated by a preponderance of the evidence that the subject matter recited in claim 6 would have been obvious over the combined teachings of Ito and Jakes.

6. Dependent Claim 16

Claim 16 depends from claim 11 and recites that the apparatus “further compris[es] a controller configured to compare the received fixed port signals received through the spatially separated antennas and to select a best signal.” For this subject matter, Petitioner refers to its contentions for claim 6, arguing the following:

Claim 16 differs from claim 6 only in that the claimed controller compares fixed port signals instead of mobile device signals. Ito’s “control circuit 71” used for processing receiving fixed port signals (discussed with respect to claim 6) meets the “controller” limitation. Figure 1 of Jakes meets the selection limitation. This receiver would be programmed as described in claim 6 to select the best received signal.

Pet. 73 (citing Ex. 1008 ¶ 233).

Patent Owner argues that “*Jakes* does not disclose any apparatus (i.e., a moving base station) of any type, let alone an apparatus comprised of a controller ‘configured . . . to select a best signal’ as required by the limitation of Claim 16.” PO Resp. 69 (citing Ex. 2100 ¶ 291). Petitioner,

however, relies on Ito's control circuit 71 in mobile base device MSS to teach the control circuit. Pet. 73. Petitioner relies on Jakes for the teaching of selecting a best signal, a contention with which we agree as discussed above for claim 6. *See* Ex. 1032, 2 ("The antenna signals themselves could be sampled, for example, and the best one sent to one receiver."). Thus, Patent Owner's arguments do not address Petitioner's contentions and the combined teachings of Ito and Jakes.

We are persuaded by Petitioner's contentions that Ito's disclosure of control circuit 71 combined with Jakes's disclosure of selecting a best received signal from among several antennas teaches "a controller configured to compare the received fixed port signals received through the spatially separated antennas and to select a best signal," as recited in claim 16. Based on the full trial record, we conclude, therefore, that Petitioner has demonstrated by a preponderance of the evidence that the subject matter recited in claim 16 would have been obvious over the combined teachings of Ito and Jakes.

7. Dependent Claims 7 and 17

Claim 7 recites, "An apparatus in accordance with claim 1, further comprising a controller configured to align and combine the received mobile device signals." Claim 17 recites, "An apparatus in accordance with claim 11, further comprising a controller configured to align and combine the received radio frequency signals."

Petitioner argues that Jakes's disclosures of "cophas[ing]" and "summ[ing]" signals teach, respectively, aligning and combining signals, as recited in claims 7 and 17. Pet. 71–72 (citing Ex. 1032, 2, 7, Figs. 3, 11; Ex. 1008 ¶ 227), 73 (citing Ex. 1008 ¶ 234). Petitioner argues that, in its

proposed combination, “Ito’s controller would be programmed to align and combine the received” mobile device signals (claim 7) or radio frequency signals (claim 17). Pet. 71, 73.

Apart from its arguments for the independent claims, Patent Owner does not dispute Petitioner’s contentions as to claims 7 and 17. *See generally* PO Resp.

We are persuaded by Petitioner’s contentions and evidence. In particular, Jakes discloses summing and cophasing signals as follows: “the M signals are weighted proportionately to their individual signal voltage-to-noise power ratios and then summed. Fig. 3 shows the essentials of the method. The individual signals must be cophased before combining in contrast to selection diversity; a technique to be described later does this very simply.” Ex. 1032, 2. We are persuaded that this disclosure in combination with Ito’s disclosure of control circuit 71, discussed above for claims 6 and 16, teaches “a controller configured to align and combine the received” signals.

Based on the full trial record, we conclude that Petitioner has demonstrated by a preponderance of the evidence that the subject matter recited in claims 7 and 17 would have been obvious over the combined teachings of Ito and Jakes.

8. Dependent Claims 8 and 18

Claims 8 and 18 depend, respectively, from claims 1 and 11 and recite “the transmitter further configured to transmit the radio frequency signals within time slots of time-division multiplex channels.” Petitioner argues that “Ito uses an FDMA/TDMA technique for communications between the BSS and the MSS and between the MSS and the PSS that divides radio

frequencies into time slots. The proposed Ito-Jakes combination transmits signals using TDMA.” Pet. 72 (citing Ex. 1008 ¶ 228), 73 (citing Ex. 1008 ¶ 235); *see also* Pet. 59–60 (citing Ex. 1003, 5:47–50, 5:55–61) (discussing Ito’s use of FDMA/TDMA).

Apart from its arguments for the independent claims, Patent Owner does not dispute Petitioner’s contentions as to claims 8 and 18. *See generally* PO Resp.

We are persuaded by Petitioner’s contentions and evidence. In particular, Ito discloses using FDMA/TDMA (frequency division multiple access/time division multiple access) in which the system assigns time slots to stations for communication. Ex. 1003, 5:51–61. Patent Owner’s declarant, Mr. Lanning confirms that Ito teaches transmitting using time slots, testifying that “the heart of Ito’s invention is allocation and use of TDMA time slots for both the radio interface between the base station and the MSS and the radio interface between the MSS and PSS.” Ex. 2100 ¶ 176.

Based on the full trial record, we conclude that Petitioner has demonstrated by a preponderance of the evidence that the subject matter recited in claims 8 and 18 would have been obvious over the combined teachings of Ito and Jakes.

*G. Obviousness over Ito, Gilhousen501, and Adachi
(Claims 1, 4, 6–11, 14, 16–22)*

Petitioner asserts that claims 1, 4, 6–11, 14, and 16–22 of the ’023 patent are unpatentable under 35 U.S.C. § 103(a) as obvious over the combined teachings of Ito, Gilhousen501, and Adachi. Pet. 44–65.

1. Independent Claims 1 and 11

Petitioner contends that Ito teaches “[a]n apparatus configured to move relative to Earth,” as recited in the preambles of claims 1 and 11. Pet. 52–53 (citing Ex. 1003, 3:17–23, 5:36–41, Fig. 1; Ex. 1008 ¶¶ 182–183), 61. Patent Owner does not dispute this contention. *See generally* PO Resp. For the reasons explained above in §§ II.F.3.a and II.F.4, we find that Ito teaches this subject matter.

Referring to its contentions in the ground based on Gilhousen⁷⁶¹ and Adachi, Petitioner contends that Adachi teaches “a plurality of spatially separated antennas.” Pet. 54, 61. Patent Owner does not dispute this contention. *See generally* PO Resp. For the reasons explained above in § II.D.3.b, we find that Adachi teaches this subject matter.

For the receiver and transmitter limitations of claims 1 and 11, Petitioner relies on Ito’s receivers and transmitters that communicate with the portable device PSS and the base station BSS. Pet. 54–56, 61–62. Petitioner asserts that, “[i]n the proposed combination Ito’s system is modified to use CDMA transmission instead of FDMA transmission using Adachi’s spatially separated antennas.” Pet. 55 (citing Ex. 1008 ¶¶ 185–188).

Petitioner argues that Gilhousen⁵⁰¹ identifies several advantages of CDMA, including improved handoffs, frequency spectrum reuse, and spectral efficiency, that would have motivated a person of ordinary skill in the art to implement Ito’s FDMA/TDMA system using CDMA rather than FDMA, thus resulting in a CDMA/TDMA system. Pet. 45–48 (citing Ex. 1004, 1:15–32, 1:39–44, 1:60–2:5, 2:62–65, 3:12–15, 5:22–6:36; Ex. 1008

¶¶ 165–169).¹⁹ Referring to its contentions for the Gilhousen761-Adachi combination, Petitioner also argues that a person of ordinary skill in the art “familiar with diversity techniques in wireless communications would have naturally sought to implement Adachi into the Ito-Gilhousen501 combination since the well-known benefits of antenna diversity would have enhanced Ito-Gilhousen501 system’s ability to maintain high-quality connections between the mobile devices and base stations.” Pet. 52 (citing Ex. 1008 ¶ 181).

Patent Owner argues that the combination of Ito, Gilhousen501, and Adachi does not teach a “mobile device” under Patent Owner’s proposed construction. PO Resp. 58–61. We address this argument above in § II.F.3.d in our discussion of the ground based on Ito and Jakes, and for the reasons explained therein and in §§ II.F.3.c and II.F.4, we find that Ito’s portable device PSS teaches a “mobile device” and transmitters and receivers as recited in claims 1 and 11.

Patent Owner also disputes Petitioner’s reasoning to combine the references. PO Resp. 24–27, 33–36. Many of Patent Owner’s arguments are based on an alleged incompatibility between CDMA and TDMA. PO

¹⁹ In the Institution Decision, we noted some confusion as to whether Petitioner’s combination proposes to implement CDMA only or CDMA and TDMA in Ito. Inst. Dec. 35–36. During trial, Petitioner clarified that its proposed combination is “that a [person of ordinary skill in the art] would have been motivated to modify Ito’s FDMA/TDMA hybrid system to substitute the FDMA portion *only* for CDMA—not that a [person of ordinary skill in the art] would have substituted the FDMA/TDMA technique as a whole for CDMA.” Pet. Reply 20 (citing Pet. 55, 60). This is consistent with the position in the Petition: “In the proposed combination Ito’s system is modified to use CDMA transmission instead of FDMA transmission” Pet. 55.

Resp. 24–27, 34–35. For example, Patent Owner argues that “*Ito*’s FDMA/TDMA system is not compatible with CDMA systems—such as *Gilhousen501* and *Adachi*—because their wireless interfaces use different technology.” PO Resp. 25; *see also* PO Resp. 34 (“[A person of ordinary skill in the art] would not have been motivated to modify *Ito* as Petitioner proposes, because of the compatibility issues that would arise when trying to implement CDMA modulation techniques and CDMA signal processing of *Gilhousen501* into *Ito*’s FDMA/TDMA system.”).

For the reasons explained above in § II.E (addressing the combination of *Gilhousen761*, *Adachi*, and *Bolgiano*), we do not agree that CDMA and TDMA are incompatible. Indeed, *Bolgiano* discloses a system that uses both techniques, which shows that CDMA and TDMA are not incompatible. *See* § II.E above. Thus, because the evidence of record shows that CDMA and TDMA are not incompatible, we are not persuaded that Petitioner’s proposal to use CDMA/TDMA, rather than FDMA/TDMA, in *Ito* is improper.

We also do not agree with Patent Owner’s argument that *Ito* “teaches away from utilizing CDMA techniques.” *See* PO Resp. 26, 34. *Ito* does not even mention CDMA, let alone “criticize, discredit, or otherwise discourage” using CDMA. *See In re Fulton*, 391 F.3d 1195, 1201 (Fed. Cir. 2004).

Patent Owner also argues that a person of skill in the art would not have been motivated to combine *Adachi*’s stationary repeater with *Ito*’s mobile base stations. PO Resp. 35 (citing Ex. 2100 ¶ 214). For the reasons explained above in § II.D.3.e dealing with a similar argument about the use of *Adachi*’s stationary repeater in *Gilhousen761*’s airplane, we are not

persuaded that the fact that Adachi teaches a stationary repeater makes the combination improper.

Patent Owner also argues that Petitioner’s proposed “combination would have required much new circuitry—not disclosed in either *Gilhousen501* or *Adachi*.” PO Resp. 36 (citing Ex. 2100 ¶ 215). As with its arguments against the combination of *Gilhousen761* and *Adachi*, Patent Owner’s arguments here fail to account for the level of ordinary skill in the art—a highly trained engineer (*see* § II.A above).

We are persuaded by Petitioner’s contentions, and we find, that an ordinarily skilled artisan would have been motivated to combine the teachings of Ito, *Gilhousen501*, and *Adachi* to achieve the advantages of CDMA and spatially separated antennas asserted by Petitioner, including improved handoffs, frequency spectrum reuse, and spectral efficiency. *See* Pet. 45–48 (citing Ex. 1004, 1:15–32, 1:39–44, 1:60–2:5, 2:62–65, 3:12–15, 5:22–6:36; Ex. 1008 ¶¶ 165–169), 52 (citing Ex. 1008 ¶ 181); *see also* § II.D.3.e above (discussing benefits of *Adachi*’s multiple antennas). We also are persuaded, and we find, that a person of ordinary skill in the art would have had a reasonable expectation of success in combining the teachings of Ito, *Gilhousen501*, and *Adachi* as proposed by Petitioner. Mr. Fischer testifies that, “[w]hen designing the system described in Ito, a [person of ordinary skill in the art] would have naturally implemented known and commercially available radio communication components with the mobile base station and base station in the Ito system,” and he testifies that combining *Gilhousen501*’s CDMA teachings with Ito “would have been a routine modification.” Ex. 1008 ¶¶ 175–176. We credit this testimony because it is consistent with the ’023 patent’s description of a TDM/CDMA

radio interface as an example of a “standard radio interface” that was “well known in the art” at the relevant time. Ex. 1001, 6:48–54. Furthermore, we are persuaded that a person of ordinary skill in the art would have had a reasonable expectation of success in utilizing multiple spatially separated antennas, as taught in Adachi. Ex. 1008 ¶¶ 180–181. As discussed above in § II.F.3.e discussing the combination of Ito and Jakes, the use of multiple antennas for radio communications was well known in the art, as the ’023 patent acknowledges: “Various techniques for obtaining high antenna diversity are well known in the art and antennas employing such techniques are commercially available. Other types of antennas may be used depending on the particular implementation.” Ex. 1001, 6:27–30; *see also* Ex. 1001, 5:21–24 (“Examples of suitable antennas for use as the antennas 100, 101, include high gain, directional antennas for use in mobile communication, and are well know[n] and commercially available.”).

For the reasons explained above and in §§ II.F.3.c–d and II.F.4, we are persuaded, and we find, that the combination of Ito, Gilhousen501, and Adachi teaches the receiver and transmitter limitations of claims 1 and 11 and that a person of ordinary skill in the art would have been motivated to combine the teachings of the references with a reasonable expectation of success.

Based on the full trial record, we conclude that Petitioner has demonstrated by a preponderance of the evidence that the subject matter recited in claims 1 and 11 would have been obvious over the combined teachings of Ito, Gilhousen501, and Adachi.

2. Dependent Claims 9, 10, 19, and 20

Claims 10 and 20 are the only challenged claims that have not yet been addressed in this Decision. Claims 9 and 19 depend, respectively, from claims 1 and 11 and recite that “the apparatus is conveyed by a vehicle.” Claims 10 and 20 depend, respectively, from claims 9 and 19 and recite that “the vehicle is an automotive vehicle.” Petitioner argues that Ito’s disclosure that the mobile base device is installed in a car teaches the subject matter recited in these claims. Pet. 60–61 (citing Ex. 1003, 3:16–23; Ex. 1008 ¶ 197), 64.

Apart from its arguments for the independent claims, Patent Owner does not dispute Petitioner’s contentions as to claims 9, 10, 19, and 20. *See generally* PO Resp.

We are persuaded by Petitioner’s contentions because Ito discloses that “a mobile base device may be constituted by an automobile telephone main unit installed in a car.” Ex. 1003, 3:17–23. Based on the full trial record, we conclude that Petitioner has demonstrated by a preponderance of the evidence that the subject matter recited in claims 9, 10, 19, and 20 would have been obvious over the combined teachings of Ito, Gilhousen⁵⁰¹, and Adachi.

3. Dependent Claims 4 and 14

Claims 4 and 14 depend, respectively, from claims 1 and 11 and recite that the apparatus “further compris[es] another plurality of spatially separated antennas, the transmitter configured to transmit the radio frequency signals through the another plurality of spatially separated antennas.” Petitioner refers to its contentions for these claims in the ground based on Gilhousen⁷⁶¹ and Adachi. Pet. 56, 62.

Apart from its arguments for the independent claims, Patent Owner does not dispute Petitioner's contentions as to these claims. *See generally* PO Resp. For the reasons explained above in § II.D.5, we are persuaded that using a plurality of spatially separated antennas for transmission would have been obvious to a person of ordinary skill in the art based on the teachings of Adachi.

Based on the full trial record, we conclude that Petitioner has demonstrated by a preponderance of the evidence that the subject matter recited in claims 4 and 14 would have been obvious over the combined teachings of Ito, Gilhousen501, and Adachi.

4. Dependent Claim 6

Claim 6 depends from claim 1 and recites that the apparatus “further compris[es] a controller configured to compare the received mobile device signals received through the spatially separated antennas and to select a best signal.” Petitioner argues that Gilhousen501 teaches selecting the strongest received signal in both directions – at the cell site from the mobile device and at the mobile device from the cell site. Pet. 56–57 (citing Ex. 1004, 4:31–53, 11:59–61, 12:21–30; Ex. 1008 ¶¶ 190–191). Petitioner argues that “[t]his functionality would be incorporated into the combination such that signals received from a mobile device from a plurality of antennas would be processed using Gilhousen501's functionality.” Pet. 57.

Patent Owner does not dispute Petitioner's contentions as to claim 6. *See generally* PO Resp.

We are persuaded by Petitioner's contentions and evidence. Gilhousen501 teaches how to select the strongest signal from a mobile device as follows:

Searcher receiver 64 [at the cell site] is again used to scan the time domain about the receiver signal to ensure that the associated digital data receiver 66, and data receiver 68 if used, are tracking and processing the strongest available time domain signal. This tracking process is identical to that described with reference to the mobile unit. Searcher receiver 64 provides a signal to cell-site control processor 78 which provides control signals to digital data receivers 66 and 68 for selecting the appropriate received signal for processing.

Ex. 1004, 12:21–30, *cited in* Pet. 56–57. We find, therefore, that this disclosure of Gilhousen501, in combination with the teachings of Ito and Adachi discussed above in § II.G.1, teaches “a controller configured to compare the received mobile device signals received through the spatially separated antennas and to select a best signal,” as recited in claim 6.

Based on the full trial record, we conclude that Petitioner has demonstrated by a preponderance of the evidence that the subject matter recited in claim 6 would have been obvious over the combined teachings of Ito, Gilhousen501, and Adachi.

5. *Dependent Claim 16*

Claim 16 depends from claim 11 and recites that the apparatus “further compris[es] a controller configured to compare the received fixed port signals received through the spatially separated antennas and to select a best signal.” Referring back to its contentions for claim 6, Petitioner argues that Gilhousen501 discloses comparing the strength of signals received from cell sites. Pet. 62–63 (citing Ex. 1004, 4:31–53, 5:43–6:5, 10:12–15, 10:18–24; Ex. 1008 ¶¶ 204–205).

Patent Owner argues that Petitioner relies on the operation of Gilhousen501’s mobile unit to teach this subject matter and that “*Gilhousen501* does not disclose any apparatus (i.e., a moving base station)

of any type, let alone an apparatus comprised of a controller ‘configured . . . to select a best signal’ as required by the limitation of Claim 16.” PO Resp. 62–63 (citing Ex. 2100 ¶¶ 275–276). This argument fails to appreciate the combined teachings of the references. In particular, Petitioner relies on Ito to teach the apparatus (moving base station), and Petitioner relies on Gilhousen501 for its disclosure of selecting the strongest signal received from a fixed port, not for its disclosure of where that processing occurs. *See* Pet. 52–53, 62–63.

Patent Owner also argues that Petitioner “improperly equates” Gilhousen501’s disclosure of selecting the strongest signal with the claimed requirement of “select[ing] a best signal.” PO Resp. 64–67. Citing the testimony of Mr. Lanning, Patent Owner asserts that “determining ‘a best signal’ includes—at a minimum—an analysis of the signal quality (i.e., error rate) in addition to the signal strength when viewed in the entire context of the ’023 Patent.” PO Resp. 65–66 (citing Ex. 2100 ¶¶ 277–280; Ex. 1001, 10:13–15, 11:3–8).

We do not agree with Patent Owner’s contention that both error rate and signal strength must be considered to determine a best signal. First, the claim itself does not specify particular metrics (such as error rate) that must be evaluated by the claimed apparatus to select a “best signal.” Second, the disclosures in the ’023 patent do not define the term “best signal,” nor are they limiting disclosures. One passage states that “[t]he signal quality indication is a figure of merit *preferably* computed as a function of signal strength and signal-to-noise ratio.” Ex. 1001, 10:13–15 (emphasis added). Another passage states:

The procedures for determining whether a mobile unit is to be served by a fixed base station or a moving base station are the same procedures as described earlier herein in determining which moving base station is selected to serve a mobile unit, i.e., based on signal strength and error rate. Thus, when a call involving a mobile unit is initiated or when it is determined that a handoff should occur, the mobile unit may be handed from a moving station to a fixed station, or vice versa. Each mobile unit monitors pilot signals from fixed and moving base stations and synchronizes to the base station providing the best signal.

Ex. 1001, 11:3–13, *quoted in* PO Sur-reply 30. These passages at most set forth metrics that may be considered in determining signal quality, but they do not define the term “best signal” nor mandate that claim 16’s selection of a “best signal” be based on a consideration of both error rate and signal strength.

In its Sur-reply, Patent Owner cites the ’023 patent’s disclosure that “[t]he best data, i.e., associated with the best signal quality indication is transferred from the gateway 60 to the telephone network.” Ex. 1001, 10:32–34, *quoted in* PO Resp. 30. Although this passage shows that the “best data” are “associated with the best signal quality indication,” it does not mandate that selecting the “best signal” requires consideration of both error rate and signal strength.

We also disagree with Patent Owner’s assertion that Mr. Fischer’s testimony is an “unsupported assertion.” *See* PO Resp. 66. As Petitioner points out in reply, evidence submitted by Patent Owner shows that the best signal can be determined based on signal strength alone. Pet. Reply 31–32 (citing Ex. 2116, 312, 551; Ex. 2110, 117); *see* Ex. 2116, 312 (“While one antenna sees a signal null, one of the other antennas may see a signal peak,

and the receiver is able to select the antenna with the best signal at any time.”).

Based on the full trial record, we conclude, therefore, that Petitioner has demonstrated by a preponderance of the evidence that the subject matter recited in claim 16 would have been obvious over the combined teachings of Ito, Gilhousen501, and Adachi.

6. Dependent Claims 7 and 17

Claim 7 recites, “An apparatus in accordance with claim 1, further comprising a controller configured to align and combine the received mobile device signals.” Claim 17 recites, “An apparatus in accordance with claim 11, further comprising a controller configured to align and combine the received radio frequency signals.”

Petitioner relies on Gilhousen501’s disclosure of “diversity combiner and decoder circuitry 80,” which “includes an adder which adds the weighted 64 symbols from receiver 66 to the weighted 64 symbols from receiver 76.” Ex. 1004, 12:52–57, *cited in* Pet. 59. Petitioner asserts that a person of ordinary skill in the art “would recognize that diversity combiner and decoder circuitry 80 would also ‘adjust[] the timing of the two streams of received signals into alignment and add[] them together,’ similarly to the diversity combiner and decoder circuitry 48 in the mobile unit.” Pet. 59 (second set of brackets added by Petitioner) (quoting Ex. 1004, 10:28–31) (citing Ex. 1008 ¶ 194).

Apart from its arguments for the independent claims, Patent Owner does not dispute Petitioner’s contentions as to claims 7 and 17. *See generally* PO Resp.

We are persuaded by Petitioner’s contentions and evidence, summarized above, and, based on the full trial record, we conclude that Petitioner has demonstrated by a preponderance of the evidence that the subject matter recited in claims 7 and 17 would have been obvious over the combined teachings of Ito, Gilhousen501, and Adachi.

7. Dependent Claims 8 and 18

Claims 8 and 18 depend, respectively, from claims 1 and 11 and recite “the transmitter further configured to transmit the radio frequency signals within time slots of time-division multiplex channels.” Petitioner argues that Ito’s FDMA/TDMA technique transmits radio signals within time slots and that “[t]he proposed Ito-Gilhousen501-Adachi combination transmits CDMA signals using TDMA.” Pet. 59–60 (citing Ex. 1003, 5:47–61; Ex. 1008 ¶¶ 195–196), 63.

Apart from its arguments for the independent claims, Patent Owner does not dispute Petitioner’s contentions as to claims 8 and 18. *See generally* PO Resp.

For the reasons explained in § II.F.8, we are persuaded that Ito teaches transmitting radio frequency signals within time slots of time-division multiplex channels using TDMA. For the reasons explained above in § II.G.1, we also are persuaded that it would have been obvious to use CDMA rather than FDMA in Ito’s system, such that the combination of Ito, Gilhousen501, and Adachi teaches CDMA using TDMA.

Therefore, we are persuaded by Petitioner’s contentions and evidence, and we conclude that the subject matter recited in claims 8 and 18 would have been obvious based on the combination of Ito, Gilhousen501, and Adachi.

8. *Dependent Claim 21*

Claim 21 recites, “An apparatus in accordance with claim 11, wherein the receiver is further configured to receive fixed port signals from a plurality of fixed ports through the plurality of spatially separated antennas.” Referring to its contentions for claim 6, Petitioner argues that Ito “discloses that each base station covers a given geographic radio communication zone” and that a person of ordinary skill in the art “would have understood Ito’s control system 71 to receive signals from a plurality of fixed ports as it travels through the overlap area, for example, radio zones E2 and E3.” Pet. 64 (citing Ex. 1008 ¶ 211); *see also* Pet. 56–58 (addressing claim 6).

Apart from its arguments for independent claim 11, Patent Owner does not dispute Petitioner’s contentions as to claim 21 in this ground. *See generally* PO Resp.

We are persuaded by Petitioner’s contentions because Ito’s Figure 1, which is reproduced in § II.F.1 above, shows that mobile station 3 is in an area where zones E2 and E3 overlap. Based on the full trial record, we conclude that Petitioner has demonstrated by a preponderance of the evidence that the subject matter recited in claim 21 would have been obvious over the combined teachings of Ito, Gilhousen501, and Adachi.

9. *Dependent Claim 22*

Claim 22 recites, “An apparatus in accordance with claim 21, wherein each fixed port signal transmitted from each of the plurality of fixed ports includes common data.” Petitioner argues that Gilhousen501’s disclosure of maximal ratio combining teaches this subject matter because a person of ordinary skill in the art “would understand that maximal ratio combining necessarily requires the received data from the two signals to be the same—

indeed, maximal ratio combining in operation combines weighted values of two received signals to more faithfully reconstruct an original signal.”

Pet. 64–65 (citing Ex. 1004, 5:52–61; Ex. 1008 ¶ 212).

Apart from its arguments for independent claim 11, Patent Owner does not dispute Petitioner’s contentions as to claim 22 in this ground. *See generally* PO Resp.

We are persuaded by Petitioner’s contentions, supported by the testimony of Mr. Fischer explaining maximal ratio combining (Ex. 1008 ¶ 212), and, therefore, based on the full trial record, we conclude that Petitioner has demonstrated by a preponderance of the evidence that the subject matter recited in claim 22 would have been obvious over the combined teachings of Ito, Gilhousen501, and Adachi.

H. Constitutionality

Patent Owner contends that “adjudication of the ’023 patent violates the U.S. Constitution” and states the following: “Patent Owner challenges the constitutionality of, and the panel’s authority to adjudicate, this proceeding under *Arthrex, Inc.* *See Arthrex v. Smith & Nephew*, 941 F.3d 1320, 1338 (Fed. Cir. 2019) (noting the Board cannot offer relief to certain types of Constitutional challenges).” PO Resp. 70.

In *Arthrex*, the Federal Circuit determined that the current structure of the Board does not violate Article II of the U.S. Constitution as of the date of that precedential decision. *Arthrex*, 941 F.3d at 1338 (Fed. Cir. 2019), *cert. granted sub nom. United States v. Arthrex, Inc.*, 2020 WL 6037206 (Oct. 13, 2020); *see also Arthrex, Inc. v. Smith & Nephew, Inc.*, 953 F.3d 760, 764 (Fed. Cir. 2020) (Moore, J., concurring in denial of rehearing) (“Because the APJs were constitutionally appointed as of the implementation of the

severance, *inter partes* review decisions going forward were no longer rendered by unconstitutional panels.”).

Thus, Patent Owner’s constitutional challenge is addressed by *Arthrex*.

III. CONCLUSION

For the reasons discussed above, we determine Petitioner has proven, by a preponderance of the evidence, that the challenged claims are unpatentable, as summarized in the following table:

Claims	35 U.S.C. §	References/Basis	Claims Shown Unpatentable	Claims Not Shown Unpatentable
1, 4, 5, 9, 11, 14, 15, 19	103(a)	Gilhousen761, Adachi	1, 4, 5, 9, 11, 14, 15, 19	
21–23	103(a)	Gilhousen761, Adachi, Bolgiano	21–23	
1, 4, 6– 11, 14, 16–22	103(a)	Ito, Gilhousen501, Adachi	1, 4, 6–11, 14, 16–22	
1, 6–8, 11, 16– 18	103(a)	Ito, Jakes	1, 6–8, 11, 16–18	
Overall Outcome			1, 4–11, 14– 23	

IV. ORDER

Accordingly, it is:

ORDERED that claims 1, 4–11, and 14–23 of the '023 patent have been shown to be unpatentable; and

FURTHERED ORDERED that, because this is a Final Written Decision, parties to the proceeding seeking judicial review of the Decision must comply with the notice and service requirements of 37 C.F.R. § 90.2.

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