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Paper 74
Entered: January 24, 2017

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

TCL CORPORATION, TCL COMMUNICATION TECHNOLOGY HOLDINGS, LTD., TCT MOBILE LIMITED, TCT MOBILE INC., and TCT MOBILE (US), INC.,
Petitioner,

v.

TELEFONAKTIEBOLAGET LM ERICSSON,
Patent Owner.

Case IPR2015-01584
Case IPR2015-01600
Patent 6,029,052

Before PATRICK R. SCANLON, BARBARA A. BENOIT, and STACY B. MARGOLIES, *Administrative Patent Judges*.

BENOIT, *Administrative Patent Judge*.

DECISION
Final Written Decision
U.S.C. § 318(a) and 37 C.F.R. § 42.73

I. INTRODUCTION

These *inter partes* reviews, instituted pursuant to 35 U.S.C. § 314, challenge the patentability of certain claims of U.S. Patent No. 6,029,052 (Ex. 1001, "the '052 patent" or "the challenged patent"),[1] owned by Telefonaktiebolaget LM Ericsson ("Patent Owner"). We have jurisdiction under 35 U.S.C. § 6. This Final Written Decision is entered pursuant to 35 U.S.C. § 318(a) and 37 C.F.R. § 42.73.

For the reasons discussed herein, Petitioner has shown by a preponderance of the evidence that claims 13, 15, 16, and 18 ("the challenged claims") of the '052 patent are unpatentable. Furthermore, we deny Patent Owner's Motions to Exclude.

A. Procedural History

TCL Corporation, TCL Communication Technology Holdings, Ltd., TCT Mobile Limited, TCT Mobile Inc., and TCT Mobile (US), Inc. (collectively, "Petitioner") filed two Petitions for *inter partes* review of claims 13, 15, 16, and 18 of the '052 patent. 15 Paper 2 ("15 Pet."); 16 Paper 4 ("16 Pet."[2]). Patent Owner filed a Preliminary Response to each Petition. 15 Paper 6; 16 Paper 8. We instituted an *inter partes* review of claims 13, 15, 16, and 18 of the '052 patent as unpatentable on certain

[1] The challenged patent is Exhibit 1001 in each proceeding. Citations may be preceded by "15" to designate IPR2015-01584 or "16" to designate IPR2015-01600.

[2] For clarity, Petitioner's corrected petition in IPR2015-01600 is referred to as its Petition for IPR2015-01600.

grounds. 15 Paper 7 ("15 Institution Decision" or "15 Inst. Dec."); 16 Paper 9 ("16 Institution Decision" or "16 Inst. Dec.");

Subsequent to institution, Patent Owner filed a Patent Owner Response to the Petition in each case (15 Paper 34, "15 PO Resp."; 16 Paper 36, "16 PO Resp."), to which Petitioner filed a Reply (15 Paper 52, "15 Pet. Reply"; 16 Paper 54, "16 Pet. Reply"). In due course, and as authorized in our order (15 Paper 50; 16 Paper 52) granting Petitioner's Motion to File Supplemental Information, Patent Owner filed a Supplemental Brief (15 Paper 55, "15 PO Supp. Br."; 16 Paper 57, "16 PO Supp. Br."). In turn, Petitioner filed an Opposition (15 Paper 57, "15 Pet. Supp. Opp."; 16 Paper 59, "16 Pet. Supp. Opp.") and Patent Owner filed a Supplemental Reply (15 Paper 58, "15 PO Supp. R."; 16 Paper 60, "16 PO Supp. R.").

Patent Owner also filed a Motion to Exclude (15 Paper 61, "15 Mot. Exc."; 16 Paper 63, "16 Mot. Exc.") certain exhibits in each case, to which Petitioner filed an Opposition (15 Paper 64, "15 Opp. Exc."; 16 Paper 67, "16 Opp. Exc."). In turn, Patent Owner filed a Reply to each. 15 Paper 67 ("15 Reply Exc."); 16 Paper 69 ("16 Reply Exc.").

Patent Owner further filed observations directed to the cross-examination testimony of Behzad Razavi, Ph.D., obtained on September 7, 2016. 15 Paper 60; Ex. 2062 (Deposition Transcript); 16 Paper 62; 16 Ex. 2062 (Deposition Transcript). We have considered Patent Owner's observations and Petitioner's responses (15 Paper 65; 16 Paper 66) in rendering our decision, and have accorded the testimony

appropriate weight. *See, e.g.*, *Yorkey v. Diab*, 601 F.3d 1279, 1284 (Fed. Cir. 2010) (holding the Board has discretion to give more weight to one item of evidence over another "unless no reasonable trier of fact could have done so"); *In re Am. Acad. of Sci. Tech Ctr*., 367 F.3d 1359, 1368 (Fed. Cir. 2004) ("[T]he Board is entitled to weigh the declarations and conclude that the lack of factual corroboration warrants discounting the opinions expressed in the declarations.").

We held a consolidated hearing for the *inter partes* reviews. A transcript of the oral hearing is included in the record of each proceeding.[3] 15 Paper 72; 16 Paper 74 ("Tr.").

B. Related Matters

As required by 37 C.F.R. § 42.8(b)(2), each party identifies various judicial or administrative matters that would affect or be affected by a decision in this proceeding. 15 Pet. 1–2; 15 Paper 5 (Patent Owner's Related Matters); 16 Pet. 1–2; 16 Paper 7 (Patent Owner's Related Matters). The parties identify several lawsuits as being related to these proceedings: *TCL Communication Technology Holdings, Ltd. v. Telefonaktiebolaget LM Ericsson*, No. 8:14-cv-341 (C.D. Cal. 2014); *Ericsson Inc. v. TCL Communication Technology Holdings, Ltd.*, No. 2:15-cv-2370 (C.D. Cal.

[3] In IPR2015-01600, Petitioner filed Objections (16 Paper 72) to Patent Owner's Demonstrative Exhibits (16 Ex. 2534). In this Decision, we rely on the arguments presented properly in the parties' briefs and the evidence of record. Our decision does not rely on any information presented solely in Patent Owner's demonstrative exhibits; therefore, the objections are overruled.

2015); *Ericsson Inc. v. TCL Communication Technology Holdings, Ltd.*, No. 2:15-cv-11 (E.D. Tex. 2015); *Electronic Devices, Including Wireless Communication Devices, Tablet Computers, Media Players, and Televisions, and Components Thereof*, No. 337-TA- 952 (USITC 2015); *Ericsson Inc. v. Apple, Inc.*, No. 2:15-cv-290 (E.D. Tex. 2015). 15 Pet. 1–2; 15 Paper 5; 16 Pet. 1–2; 16 Paper 7.

C. The '052 Patent

The '052 patent is titled "Multiple-Mode Direct Conversion Receiver" and issued on February 22, 2000 from an application filed on July 1, 1997. Ex. 1001, [45], [54], [22].

1. The Written Description

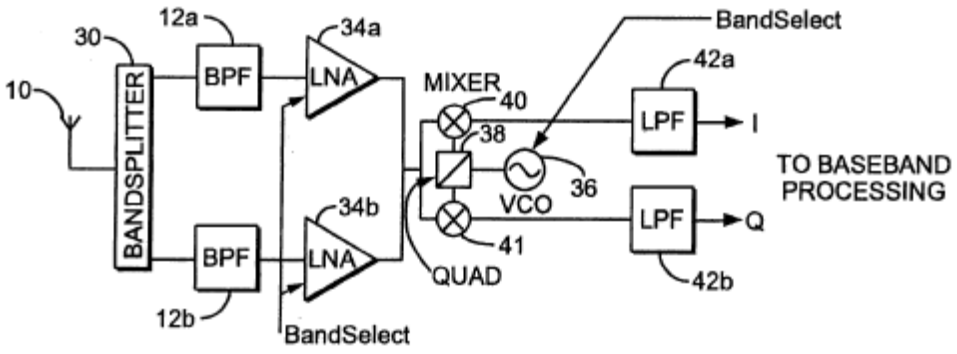
The '052 patent relates to wireless communications and addresses the general problem of consumers subscribing to wireless communication systems that operate at different "frequency bands, but use the same modulation scheme and same baseband processing scheme." *Id.* at 1:5–10, 1:15–17, 1:33–36. The '052 patent provides examples of such systems—the "well-known Global System for Mobile Communications (GSM), Personal Communication Services (PCS), and Digital Communication System (DCS) systems share such similarities." *Id.* at 1:36–40.

According to the '052 patent, although conventional superheterodyne receivers process wireless signals at multiple frequencies, such receivers often require "duplicating many receiver hardware components." *Id.* at 1:60–63. By contrast, the wireless receivers described by the '052 patent use "direct conversion," which, unlike superheterodyne receivers, do not

require converting the received wireless signal to intermediate frequencies for processing by the receiver. *Id.* at 2:7–12 (describing the wireless receiver of the invention), 1:45–60 (describing superheterodyne receivers), Fig. 1 (depicting a conventional superheterodyne receiver). The '052 patent further explains that, by using direct conversion, wireless receivers "can receive signals at multiple frequency bands without requiring significant hardware duplication" because "certain portions of the receiver circuitry are re-used." *Id.* at 2:3–7, 2:27–28. The '052 patent identifies low pass filters, mixers, quadrature generators, oscillators, and amplifiers as components that can be re-used in its multiple-mode direct conversion receiver. *Id.* at Abstract.

Figure 3, reproduced below, shows a direct conversion receiver.

FIG. 3



The direct conversion receiver depicted in Figure 3 includes antenna 10 for receiving wireless signals and bandsplitter 30 for splitting the received signals into two frequency bands. *Id.* at 2:64–3:1 (describing the direct conversion receiver in Fig. 2), 4:10–23 (describing component differences between Figs. 2 and 3). The signal is processed through one of

two circuitry branches, each with its own band pass filter (BPF 12a, BPF 12b) and low-noise amplifier (LNA 34a, LNA 34b) for filtering and amplifying the signal in the frequency band corresponding to the branch. *Id.* at 3:9–13. The branches share "a single mixing circuit, with a single voltage controlled oscillator (VCO) 36" for generating an oscillating signal "and mixers 40 and 41 . . . to mix the amplified signals generated in each frequency band." *Id.* at 4:11–14; *see id.* at 3:23–24 (describing the function of VCO 36). "The mixing circuitry generates in-phase (I) and quadrature (Q) signals which are filtered in low pass filters 42a and 42b." *Id.* at 4:14–16. The direct conversion receiver includes quadrature generator 38. *Id.* at 4:20, Fig. 3; *see id.* at 3:22–28 (explaining quadrature generator 38a separates the oscillator signal into in-phase (I) and quadrature (Q) components).

2. Illustrative Claim

Of the challenged claims, claim 13 is independent and is illustrative of the claimed subject matter.

> 13. A method for receiving a communication signal, comprising the steps of:
>
> receiving a communication signal in any one of a plurality of frequency bands, the communication signal having a bandwidth;
>
> band-pass filtering the received communication signal;
>
> amplifying the band-pass filtered signal;
>
> mixing the band-pass filtered signal with in-phase and quadrature oscillator signals to generate an in-phase and a quadrature received signal; and

low pass filtering the in-phase received signal and the quadrature received signal in a low pass in-phase filter and a low pass quadrature filter, respectively,

wherein direct conversion is used for converting all received communication signals in any one of the plurality of frequency bands.

Ex. 1001, 6:27–44.

D. Instituted Grounds of Unpatentability

We instituted *inter partes* reviews of claims 13, 15, 16, and 18 of the '052 patent based on Petitioner's asserted grounds involving the following references:[4] (i) Michael C. Lawton and John D. Waters, *The Design of Flexible Receivers for Communicating Appliances*, Vehicular Technology Conference, Mobile Technology for the Human Race, 2 IEEE 1060–64 (1996) (Ex. 1008, "Lawton"); (ii) Hans-Joachim Jentschel et al., "Multimodale Funktelefone," Ingenieur der Kommunikationstechnik 46, 33–39, May/June 1996 (Ex. 1010 (German language); Ex. 1009 (English translation), "Jentschel" or "the Jentschel article"); (iii) Japanese Patent Publication No. H5-121947, published May 18, 1993 (Ex. 1012; Ex. 1011 (English translation), "JP947"); and (iv) Japanese Patent Publication No. H5-160755, published June 25, 1993 (Ex. 1014; Ex. 1013 (English translation), "JP755").

We instituted *inter partes* reviews of claims 13, 15, 16, and 18 of the '052 patent on the following grounds:

[4] The prior art references have the same exhibit numbers in each proceeding.

Case	Reference(s)	Basis[5]	Claim(s) Challenged
IPR2015-01584	Lawton	§ 102	13, 16
IPR2015-01584	Lawton and Jentschel	§ 103	15, 18
IPR2015-01584	Jentschel and JP947	§ 103	13, 15, 16, 18
IPR2015-01600	JP947and JP755	§ 103	13, 15, 16
IPR2015-01600	JP947, JP755, and Jentschel	§ 103	18

15 Inst. Dec. 25–26; 16 Inst. Dec. 25.

II. DISCUSSION[6]

A. Whether Jentschel Is a Printed Publication under 35 U.S.C. § 102(b)

Petitioner asserts the challenged claims are unpatentable under 35 U.S.C. § 103(a) as obvious over the Jentschel article in combination with other references. 15 Pet. 31–59; 16 Pet. 52–59. In its Petitions, Petitioner asserts that the Jentschel article, which was written in the German language, is prior art to the challenged claims because it was published in the German language periodical Ingenieur der Kommunikationstechnik (English translation: Engineer of Communication Technology)[7] in June 1996, more

[5] The Leahy-Smith America Invents Act ("AIA"), Pub. L. No. 112-29, 125 Stat. 284, 287–88 (2011), revised 35 U.S.C. §§ 102 and 103, effective March 16, 2013. Because the challenged patent was filed before March 16, 2013, we refer to the pre-AIA version of §§ 102 and 103 in this decision.
[6] The discussion in this section, unless otherwise noted, addresses issues relevant to both IPR2015-01584 and IPR2015-01600.
[7] Ex. 1208, 3 (translating the periodical's name as "Engineer of Communication Technology").

than a year before the earliest filing date claimed by the challenged patent (i.e., its filing date July 1, 1997). 15 Pet. v-vi, 32; 16 Pet. v-vi, 32; Ex. 1001, [22] (filing date). Patent Owner, however, contends that the asserted invention date for the challenged claims is September 19, 1996. 15 PO Resp. 29–53; 16 PO Resp. 65; *id*. at 4, 32–65.

Patent Owner contends that Petitioner has not provided sufficient evidence to show that the Jentschel article was a publicly accessible document prior to the critical date and, therefore, has failed to provide sufficient proof that the Jentschel article is prior art to the challenged claims. *See, e.g.*, 15 PO Resp. 12–21; 16 PO Resp. 22–31.

1. Procedural Background

We begin our analysis with some procedural background to provide context for the evidence relied on by Petitioner. Among Petitioner's efforts to address Patent Owner's challenge of the Jentschel article, Petitioner submitted a declaration of a German librarian, Ms. Doris Michel, who worked at a particular German library (i.e., the Hessian State and University Library or "the Library") in 1996 and continues to work there today, as one who has knowledge of the library's record-keeping practices as of 1996 (15 Ex. 1208; 16 Ex. 1306 ("Michel Decl.")). *See* 15 Paper 50; 16 Paper 52 (Order granting Petitioner's Motion to File Supplemental Information). Ms. Michel's declaration includes an English language translation (pages 3–4) of Ms. Michel's German testimony (pages 8–9) and a certification of the translation (page 1). Michel Decl. Ms. Michel testifies that the Jentschel article was available to the public at the Library as of one to two days after

June 18, 1996. *Id.* at 4. To support Ms. Michel's testimony, her declaration discusses and includes (1) copies of the front and back of the Library's index card (called a "Kardex sheet") that records "the accession" of issues of the periodical Ingenieur der Kommunikationstechnik (Engineer of Communication Technology), [8] including the periodical volume having the Jentschel article ("periodical issue"), (2) a copy of the cover of a copy of the issue of Ingenieur der Kommunikationstechnik (Engineer of Communication Technology) from the Library, and (3) a copy of the Jentschel article from the periodical issue from the Library. Michel Decl. 5 (Kardex sheet English translation), 6 (periodical cover with English translations), 10 (German Kardex sheets), 11 (periodical cover without translations), 12–18 (the Jentschel article in German).

After Patent Owner deposed Ms. Michel (Ex. 2532,[9] "Michel Tr."), Patent Owner and Petitioner each submitted supplemental briefing on the issue of public accessibility of the Jentschel article. 15 PO Supp. Br.; 15 Pet. Supp. Opp.; 15 PO Supp. R.; 16 PO Supp. Br.; 16 Pet. Supp. Opp.; 16 PO Supp. R.

In addition, Patent Owner challenges the admissibility of Exhibits 1009 and 1010 (the Jentschel article) and Exhibits 1208 and 1306 (Michel Decl.) in its Motions to Exclude, which Petitioner opposes. 15 Mot.

[8] In general, English translation of the periodical name will be used for clarity.
[9] Ms. Michel's deposition transcript is Ex. 2532 in each proceeding.

Exc.; 15 Opp. Exc.; 15 Reply Exc.; 16 Mot. Exc.; 16 Opp. Exc.; 16 Reply Exc.

2. Printed Publication

The determination of whether a particular reference qualifies as a prior art printed publication "involves a case-by-case inquiry into the facts and circumstances surrounding the reference's disclosure to members of the public." *In re Klopfenstein*, 380 F.3d 1345, 1350 (Fed. Cir. 2004). The key inquiry is whether the reference was made "sufficiently accessible to the public interested in the art" before the critical date. *In re Cronyn*, 890 F.2d 1158, 1160 (Fed. Cir. 1989). "A reference will be considered publicly accessible if it was 'disseminated or otherwise made available to the extent that persons interested and ordinarily skilled in the subject matter or art exercising reasonable diligence, can locate it.'" *Blue Calypso, LLC v. Groupon, Inc.*, 815 F.3d 1331, 1348 (Fed. Cir. 2016) (quoting *Kyocera Wireless Corp. v. Int'l Trade Comm'n*, 545 F.3d 1340, 1350 (Fed. Cir. 2008)).

Having reviewed the parties' arguments and supporting evidence, we determine that the Jentschel article is a printed publication based on the following reasons and factual findings. First, we find that the Jentschel article was published in Issue 3 of Volume 46 (May/June 1996) of the periodical Ingenieur der Kommunikationstechnik (Engineer of Communication Technology) ("the periodical issue"). Our finding is based

on the printed material provided in Exhibit 1010[10] filed with the Petition and based on Ms. Michel's testimony. As we previously noted (15 Paper 50, 6; 16 Paper 52, 6), Exhibit 1010 facially appears to be an article appearing in a journal. The first and second pages of Exhibit 1010 are reproduced below.



Consistent with Ms. Michel's testimony, the first page of Exhibit 1010 (shown above on left) appears to be the cover of an issue of a periodical Ingenieur der Kommunikationstechnik. Ex. 1010, 1 ("cover page"); Michel Decl. 4. The second page of Exhibit 1010 (shown above on right) has the appearance of being a table of contents for the periodical issue. Ex. 1010, 2 ("the table of contents"). The table of contents identifies the Jentschel article as beginning on page 33, which is consistent with the page numbering on the Jentschel article submitted in Ex. 1010 and with Ms. Michel's testimony. *Compare* Ex. 1010, 2 (the table of contents identifying the Jentschel article beginning on page 33), *with id.* at 3 (the first page of the

[10] Exs. 1009 and 1010 are the same in both proceedings.

Jentschel article identified as page 33); Michel Decl. 4 (Ms. Michel testifying that the Jentschel article appeared on pages 33–39 of the periodical issue).

Furthermore, Ms. Michel's testimony is based on her knowledge of Library practices and "the current condition of the issue being held in the Library, that issue was "preserved intact, and, on pages 33–39, contained" the Jentschel article. Michel Decl. 4.

Second, our determination that the Jentschel article is a printed publication is based on the title of the periodical and its long history of publication. Ms. Michel testifies, based on her review of the registers and registration practices of the Library, that the periodical Ingenieur der Kommunikationstechnik (Engineer of Communication Technology) "was in the collection of the Library since Volume 13, which corresponds to the year 1963." *Id.* at 3. Moreover, Ms. Michel testifies that the German title of the periodical— Ingenieur der Kommunikationstechnik—means Engineer of Communication Technology. *Id*. Both the title of the periodical and the periodical's long history of publication, beginning more than thirty years prior to the 1996 issue being asserted in this proceeding, further support a finding that skilled artisans (Engineers of Communication Technology) interested in communication technology would be able to locate the article in one of the many copies of the periodical issue.

The testimony of Ms. Michel addresses the accessibility of the Jentschel article in a particular issue of the periodical in which the Jentschel article appears and does so in the context of a particular library. *Id.* at 3–4.

Although Ms. Michel's testimony concerns a periodical issue housed in a library, this case is distinguished from cases addressing concerns about dissertations, theses, or other research papers housed in a library because this case concerns a long-published periodical. *See Cronyn*, 890 F.2d at 1160 (concluding three undergraduate theses housed in a library were not publicly accessible because the references lacked a subject index); *In re Bayer*, 568 F.2d 1357 (CCPA 1978) (concluding a thesis housed, but not shelved nor catalogued, within a university library was not publicly accessible); *cf. In re Hall*, 781 F.2d 897, 899 (Fed. Cir. 1986) (concluding a dissertation shelved and indexed in a card catalog at a German university was publicly accessible).

Because the Jentschel article appears in the long-published Engineers of Communication Technology periodical, this case is more similar to the circumstances in *Voter Verified, Inc. v. Premier Election Solutions, Inc.*, 698 F.3d 1374, 1380 (Fed. Cir. 2012) that dealt with a well-known publication, than cases concerning research papers housed in a library. In *Voter Verified*, a particular article available only through an on-line publication that was deemed publicly accessible because the publication was well known to the community interested in the subject matter of the reference, submissions were treated as public disclosures, users could freely and easily copy the content of the on-line publication, and the on-line publication was accessible by a keyword-based search tool. Here, the periodical issue was housed in a library accessible to the public, published in a periodical that had been

published for more than thirty years, and presumably articles within an issue were treated as a public disclosure of information.

We note that Ms. Michel's testimony does not address expressly whether the periodical issue was indexed. Indexing, however, is not "a necessary condition for a reference to be publicly accessible," but is among many factors that may bear on public accessibility. *In re Lister*, 583 F.3d 1307, 1312 (Fed. Cir. 2009). Even so, Ms. Michel testifies that the copy of the periodical issue was cataloged and shelved under a particular shelf call number ("Tech Z Fe 57") and the copy of the periodical issue that Ms. Michel obtained from the Library bears such number. Michel Decl. 4, 6. This testimony and evidence supports a determination that the periodical issue in the Library was sufficiently catalogued at that particular library to provide meaningful assurance that one of ordinary skill in the art, exercising reasonable diligence, would have been able to locate this particular periodical having the Jentschel article in the Library. *See Blue Calypso*, 815 F.3d at 1348 (indicating the relevance of whether the reference housed in a library was sufficiently indexed and catalogued to a determination of public accessibility).

Patent Owner contends the Jentschel article is not a printed publication because it was not publicly accessible as of the critical date. *See* 15 PO Resp. 29–53; 15 PO Supp. Br. 1–4; 15 PO Supp. R. 2–4; 16 PO Resp. 25–31; 16 PO Supp. Br. 1–4; 16 PO Supp. R. 2–4. For the reasons discussed above, we do not agree with Patent Owner.

Based on the facts and circumstances of this case, as discussed above, we determine that the Jentschel article, which appeared in a long-published periodical directed to engineers of communication technology, a copy of which was available in a library open to the public and shelved based on a particular shelf call number, was publicly accessible and therefore is a printed publication.

3. Date of Public Accessibility

Our inquiry also involves determining whether the Jentschel article was a printed publication before September 19, 1996, the asserted invention date for the challenged claims. *See* 15 PO Resp. 29–53; 16 PO Resp. 65; *id.* at 4, 32–65. In its Petition, Petitioner contends the Jentschel article was publicly accessible as of June 30, 1996. 15 Pet. v–vi, 32; 16 Pet. v–vi, 52. Ms. Michel, employed at the Library since 1995, testifies that the periodical issue, which included the Jentschel article, "was inventoried by the Library on June 18, 1996" and "was openly accessible for use to the public after a processing time of 1–2 days under the shelf call number 'Tech Z Fe 57.'" Michel Decl. 3. According to Ms. Michel, her testimony is based on her review of the registers and the registration practices of the Library, her personal knowledge of the Library's normal registration procedure, and the current condition of the periodical issue being held in the Library. Michel Decl. 3–4.

In further support of her testimony, Ms. Michel provides "copies of the front and back of the index card ["Kardex sheet"] (proof of access), which records the accession of the issues of the requested periodical,

including the requested issue." Michel Decl. 4 (referring to Ex. 1208, 5 (English), 6 (German)) (brackets in original). Ms. Michel identifies the particular portion of the Kardex sheet that indicates the periodical issue "was inventoried on June 18, 1996." Michel Decl. 5, 6. Later, during her deposition, Ms. Michel explained that there is a "specific Kardex card for each specific periodical," such as the Engineers for Communication Technology periodical at issue in this case. Ex. 2532, 30:9–12. The Kardex sheet for the periodical Engineers of Communication Technology includes the identifier "Tech Z Fe 57," which matches a portion of the cover on the Jentschel article with the same identifier and Ms. Michel testifies that the periodical issue with the Jentschel article would have been placed on the Library shelf for the public *after* "the sticker goes on the magazine." Ex. 2532, 34:17–35:8; Michel Decl. 4; *see* Pet. Opp. Supp. Brief 2). We find the evidence of the "sticker" on the copy of the periodical issue cover (Michel Decl. 4) to further support Ms. Michel's testimony based on her knowledge of Library practices.

Based on the facts and circumstances of this case, we determine that the Jentschel article was publicly accessible prior to the invention date of the challenged patent asserted by Patent Owner (i.e., September 19, 1996). Therefore, we conclude that the Jentschel article is a printed publication and prior art to the challenged claims.

4. Patent Owner's Motion to Exclude the Jentschel Article and the Michel Declaration

Patent Owner also filed a Motion to Exclude the Jentschel article (both the certified English translation (Exhibit 1009) and the German

language article (Exhibit 1010)) and Ms. Michel's declaration testimony (Exhibits 1208 and 1306 in IPR2015-01584 and IPR2015-1600, respectively). 15 Mot. Exc.; 16 Mot. Exc. According to Patent Owner, Exhibits 1009, 1010, and the Michel Declaration are unauthenticated and, because dates included in Exhibits 1010 and the Michel Declaration are being offered for the truth of the matter asserted, the Exhibits 1009, 1010, and 1208 include inadmissible hearsay and should be excluded. 15 Mot. Exc. 1–7; 16 Mot. Exc. 1–7.

(i) The Michel Declaration and Supporting Evidence Therein

Patent Owner contends that Ms. Michel's declaration testimony and supporting evidence is not admissible as evidence of the Jentschel article public accessibility no later than June 20, 1996. 15 Mot. Exc. 3–4, 6–7; 16 Mot. Exc. 3–4, 6–7. Specifically, Patent Owner contends that date on the Kardex sheet is inadmissible (i) because it is hearsay inadmissible as evidence of the availability of the periodical issue at the Library and (ii) because it is unauthenticated because a colleague of Ms. Michel copied the original Kardex sheet. 15 Mot. Exc. 3–4; 16 Mot. Exc. 3–4.

We disagree with Patent Owner's contentions, which focus exclusively on the Kardex sheet without considering Ms. Michel's testimony concerning her personal knowledge of the Library's procedures (including the Library's use of Kardex sheets), her personal knowledge concerning the publication history of the periodical, and Ms. Michel's observations based on "the current condition of the issue as being held in the Library" (Michel Decl. 3–4). During her deposition, Ms. Michel testified that (i) her

colleague copied the Kardex sheet at her direction (Michel Tr. 30:4–12), (ii) she has personal knowledge of the common practices of the periodical department from her training in that department (*id.* at 43:24–44:2), which included placing periodicals on the Library shelves (*id.* at 9:24–10:4) and preparing Kardex sheets (*id.* at 27:25–28:5), and (iii) she gained personal knowledge supporting her declaration that she "had access to and knowledge of the registers and the registration practices of the library in 1996" and reviewed the registers and registration practices of the library" (*id.* at 25:13–26:12; Michel Decl. 3) Ms. Michel testifies the process by which a periodical would be received by the library and placed on a shelf in 1996:

> After receipt of the journal, the respective department would note, record that in the Kardex sheet with the date it was received, the periodical volume number, then it would get a stamp that showed that it was owned by the library. It received a number, display number and a signature sticker. After that it would be placed into the shelf . . . for free display.

Michel Tr. 10:14–24.

Ms. Michel also testifies that the cover of the periodical issue includes the "signature sticker" (which identifies the technical field to which the periodical issue pertains) and a "stamp" that identifies the periodical issue was owned by the Library. *Id.* at 11:3–12:7. The cover of the periodical issue provided with Ms. Michel's declaration includes what appears to be the "signature sticker" and "stamp" described by Ms. Michel. *See* Michel Decl. 8. This further supports her testimony.

Based on this testimony and evidence, we conclude that the testimony of Ms. Michel, who is a person with knowledge subject to cross-

examination, is admissible and authenticates the Kardex sheet. We also agree with Petitioner (15 Opp. Exc. 8; 16 Opp. Exc. 8) that the Kardex sheet is admissible under Federal Rule of Evidence ("FRE") 803(16)[11] as a statement in a document that is at least 20 years old and which has been authenticated by Ms. Michel. *See* Michel Decl. 5 (Kardex sheet showing volumes of the periodical dating back to February 1989). Furthermore, the Kardex sheet also falls under the exception to the rule against hearsay because the Kardex sheet meets the conditions required by FRE 803(6) as a record of a regularly conducted activity.[12]

For these reasons, we deny Patent Owner's motion to exclude the Michel Declaration and supporting evidence therein (Michel Decl.).

(ii) Exhibits 1009 and 1010

Patent Owner contends that Exhibits 1009 and 1010 are not properly authenticated and should be excluded under FRE 901. 15 Mot. Exc. 5; 16 Mot. Exc. 5. As discussed previously, Exhibit 1010 is a copy of a periodical issue that includes the Jentschel article. As such, Exhibit 1010 is

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[11] Under 37 C.F.R. § 42.62(a), the Federal Rules of Evidence generally apply to this *inter partes* review.

[12] FRE 803(6) indicates a "record of an act, event, condition, opinion, or diagnosis" is an exception if: (A) the record was made at or near the time by—or from information transmitted by—someone with knowledge; (B) the record was kept in the course of a regularly conducted activity of a business, organization, occupation, or calling, whether or not for profit; (C) making the record was a regular practice of that activity; (D) all these conditions are shown by the testimony of the custodian or another qualified witness . . . ; and (E) neither the source of information nor the method or circumstances of preparation indicate a lack of trustworthiness."

self-authenticating under FRE 902 (6) ("Printed material purporting to be a newspaper or periodical."). Moreover, Ms. Michel's declaration and deposition testimony concerning the Jentschel article that she obtained from the Library (Michel Decl. 6–9) also authenticates the Jentschel article in Ex. 1010. Other than what appear to be library stamps, the copy of the Jentschel article and cover of the periodical provided by Ms. Michel appears to be the same as the Jentschel article and periodical cover provided in Exhibit 1010. *Compare* Michel Decl. 6, 11–18, *with* Ex. 1010, 1, 3–9. We, therefore, determine that Exhibit 1010 is authenticated. Exhibit 1009 is a certified English translation of the German language document in Exhibit 1010. Ex. 1009, 14 (translation certificate). As such, we also conclude Exhibit 1009 also is authenticated.

With regard to Exhibit 1010, Patent Owner contends (i) the periodical issue cover included in Exhibit 1010 includes a date corresponding to May/June 1996 and (ii) Petitioner relies on the date as the date of publication of the Jentschel article. 15 Mot. Exc. 2; 16 Mot. Exc. 2. Therefore, according to Patent Owner, Exhibit 1010 is inadmissible hearsay. *Id.* In Opposition, Petitioner indicates it does not "need to rely" on the date on the front cover of Exhibit 1010 for the truth of the matter asserted and also argues that Exhibit 1010 qualifies as an exception to the hearsay rule under FRE 803(16) ("A statement in a document that is at least 20 years old and whose authenticity is established."). 15 Opp. Exc. 4; 16 Opp. Exc. 4. In Reply, Patent Owner contends that FRE 803(16) does not "allow the very

hearsay statements at issue to be used to overcome the underlying hearsay objections." 15 Reply Ex. 1; 16 Reply Ex. 1.

We agree that Petitioner is not relying on the date (May/June 1996) appearing on the cover periodical issue for the truth of the matter asserted—that the periodical issue was publicly accessible as of June 30, 1996. Rather, Petitioner relies on Ms. Michel's testimony. As such, the date on Exhibit 1010 (which is the only purported statement which Patent Owner contends is hearsay) is not inadmissible hearsay.

For these reasons, we deny Patent Owner's motion to exclude Exhibit 1010 and the certified English translation (Exhibit 1009) of the German language Jentschel article appearing in Exhibit 1010.

5. Patent Owner's Evidence of Conception and Diligent Reduction to Practice

Patent Owner provides evidence and arguments purportedly demonstrating that the invention was conceived at least as early as September 19, 1996 and thereafter the inventors were reasonably diligent in reducing the invention to practice during the critical period. 15 PO Resp. 29–53; 16 PO Resp. 65; *id.* at 4, 32–65. Therefore, according to Patent Owner, neither Jentschel (Ex. 1009) nor the Razavi article (Ex. 1037), which is used by Petitioner to support a motivation to combine some of the references in some asserted grounds, qualifies as prior art under 35 U.S.C. § 102(a). 15 PO Resp. 53; 16 PO Resp. 65.

Having found that Jentschel was prior art to the challenged claims as of June 20, 1996, we need not consider Patent Owner's evidence regarding a later conception date of September 19, 1996 and diligent reduction to

practice thereafter. Because we do not rely on the Razavi article (Ex. 1037) as evidence regarding reasons to combine prior art references in any asserted ground, we need not consider Patent Owner's evidence regarding conception and diligent reduction to practice.

B. Principles of Law Concerning Demonstrating Unpatentability

To prevail in challenging Patent Owner's claims, Petitioner must demonstrate by a preponderance of the evidence that the claims are unpatentable. 35 U.S.C. § 316(e); 37 C.F.R. § 42.1(d). "In an [*inter partes* review], the petitioner has the burden from the onset to show with particularity why the patent it challenges is unpatentable." *Harmonic Inc. v. Avid Tech., Inc.*, 815 F.3d 1356, 1363 (Fed. Cir. 2016) (citing 35 U.S.C. § 312(a)(3) (requiring *inter partes* review petitions to identify "with particularity . . . the evidence that supports the grounds for the challenge to each claim")). This burden never shifts to Patent Owner. *See Dynamic Drinkware, LLC v. Nat'l Graphics, Inc.*, 800 F.3d 1375, 1378 (Fed. Cir. 2015) (citing *Tech. Licensing Corp. v. Videotek, Inc.*, 545 F.3d 1316, 1326–27 (Fed. Cir. 2008)) (discussing the burden of proof in *inter partes* review). Furthermore, Petitioner cannot satisfy its burden of proving obviousness by employing "mere conclusory statements." *In re Magnum Oil Tools Int'l, Ltd.*, 829 F.3d 1364, 1380 (Fed. Cir. 2016).

Petitioner asserts certain claims of the '052 patent are unpatentable under 35 U.S.C. § 102 as anticipated by Lawton. A prior art reference will anticipate if it discloses, expressly or inherently, each and every element set forth in the claim arranged or combined in the same way as in the claim.

Blue Calypso, 815 F.3d at 1341; *Verdegaal Bros. Inc., v. Union Oil Co.*, 814 F.2d 628, 631 (Fed. Cir. 1987) ("A claim is anticipated only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior art reference."). To anticipate, a prior art reference must disclose more than "multiple, distinct teachings that the artisan might somehow combine to achieve the claimed invention." *Net MoneyIN, Inc. v. VeriSign, Inc.*, 545 F.3d 1359, 1371 (Fed. Cir. 2008); *see also In re Arkley*, 455 F.2d 586, 587 (CCPA 1972) ("The [prior art] reference must clearly and unequivocally disclose the claimed [invention] or direct those skilled in the art to the [invention] without *any* need for picking, choosing, and combining various disclosures not directly related to each other by the teachings of the cited reference."). Although the elements must be arranged or combined in the same way as in the claim, "the reference need not satisfy an *ipsissimis verbis* test," i.e., identity of terminology is not required. *In re Gleave*, 560 F.3d 1331, 1334 (Fed. Cir. 2009); *In re Bond*, 910 F.2d 831, 832 (Fed. Cir. 1990).

Petitioner also asserts that certain claims of the '052 patent are unpatentable under 35 U.S.C. § 103(a) as obvious over various combinations of references. A 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 of the invention to a person having ordinary skill in the art. *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) objective evidence of nonobviousness. *Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966). "A determination of whether a patent claim is invalid as obvious under § 103 requires consideration of all four *Graham* factors, and it is error to reach a conclusion of obviousness until all those factors are considered." *Apple v. Samsung Elecs. Co.*, 839 F.3d 1034, 1048 (Fed. Cir. 2016) (en banc) (citations omitted). "This requirement is in recognition of the fact that each of the *Graham* factors helps inform the ultimate obviousness determination." *Id.*

C. Level of Ordinary Skill

In determining whether an invention would have been obvious at the time it was made, 35 U.S.C. § 103 requires us to resolve the level of ordinary skill in the pertinent art at the time of the invention. *Graham*, 383 U.S. at 17. "The importance of resolving the level of ordinary skill in the art lies in the necessity of maintaining objectivity in the obviousness inquiry." *Ryko Mfg. Co. v. Nu-Star, Inc.*, 950 F.2d 714, 718 (Fed. Cir. 1991). The person of ordinary skill in the art is a hypothetical person who is presumed to have known the relevant art at the time of the invention. *In re GPAC, Inc.*, 57 F.3d 1573, 1579 (Fed. Cir. 1995). Factors that may be considered in determining the level of ordinary skill in the art include, but are not limited to, the types of problems encountered in the art, the sophistication of the technology, and educational level of active workers in the field. *GPAC*, 57 F.3d at 1579. In a given case, one or more factors may predominate. *Id.*

Generally, it is easier to establish obviousness under a higher level of ordinary skill in the art. *Innovention Toys, LLC v. MGA Entm't, Inc*., 637 F.3d 1314, 1323 (Fed. Cir. 2011) ("A less sophisticated level of skill generally favors a determination of nonobviousness . . . while a higher level of skill favors the reverse.").

Petitioner's declarant Dr. Razavi, Patent Owner, and Patent Owner's declarant, Vijay K. Madisetti, Ph.D., agree:

> one of ordinary skill in the art would have had either: (1) a bachelor's degree in electrical engineering, or a related field, and at least two years of experience in the design and development of radio-frequency integrated circuits and systems, or the equivalent; or (2) a graduate degree in electrical engineering, with a focus on radio-frequency integrated circuits and systems, or the equivalent, and less than two years of experience in the design and development of radio-frequency integrated circuits and systems, with the amount of experience up to two years depending on the course of study in graduate school.

15 Ex. 1201 ¶ 54; 15 PO Resp. 5 (citing Ex. 2021 ¶ 29); 15 Ex. 2021 ¶ 29; 16 Ex. 1301 ¶ 54; 16 PO Resp. 5 (citing Ex. 2022 ¶ 29); 16 Ex. 2022 ¶ 29.

Although Petitioner nominally relies on Dr. Razavi's testimony for support, Petitioner proposes a somewhat different level of ordinary skill—a person with a "Master's Degree in Electrical Engineering with coursework in communications electronics and radio systems, and at least five years' experience in designing radio-frequency ("RF") receiver circuits and systems, or equivalent." 15 Pet. 10 (citing 15 Ex. 1201 ¶ 54); 16 Pet. 11 (citing 16 Ex. 1301 ¶ 54). Petitioner does not acknowledge, much less explain adequately, the differences between its proposed level of ordinary

skill and Dr. Razavi's testimony. We agree with Patent Owner that nothing in the record suggests these alternative skill levels would lead to a different interpretation of the evidence. 15 PO Resp. 5–6; 16 PO Resp. 5–6.

Having reviewed the prior art asserted in these proceedings (*see, e.g.*, 15 Exs. 1008, 1009, 1011, 1013; 16 Exs. 1009, 1011, 1013), we determine that the level of ordinary skill proposed by Petitioner's declarant, Patent Owner, and Patent Owner's declarant is consistent with the challenged patent and the referenced prior art, and we adopt that definition of the level of ordinary skill in the art for the purposes of the analysis below. *See* 15 Ex. 1201 ¶ 54; 15 PO Resp. 5 (citing Ex. 2021 ¶ 29); 15 Ex. 2021 ¶ 29; 16 Ex. 1301 ¶ 54; 16 PO Resp. 5 (citing Ex. 2022 ¶ 29); 16 Ex. 2022 ¶ 29.

D. Claim Construction

In an *inter partes* review, the Board interprets claims in an unexpired patent using the "broadest reasonable construction in light of the specification of the patent in which [they] appear[]." 37 C.F.R. § 42.100(b); *see Cuozzo Speed Techs., LLC v. Lee*, 136 S. Ct. 2131, 2144–46 (2016) (upholding the use of broadest reasonable construction standard). Consistent with the broadest reasonable construction standard, claim terms are presumed to have their ordinary and customary meaning as understood by one of ordinary skill in the art in the context of the entire patent disclosure at the time of the invention. *In re Translogic Tech., Inc.*, 504 F.3d 1249, 1257 (Fed. Cir. 2007). An inventor may provide a meaning for a term that is different from its ordinary meaning by defining the term in the specification with "reasonable clarity, deliberateness, and precision." *In re Paulsen*,

30 F.3d 1475, 1480 (Fed. Cir. 1994). Moreover, limitations are not to be read from the specification into the claims. *In re Van Geuns*, 988 F.2d 1181, 1184 (Fed. Cir. 1993). In addition, the Board may not "construe claims during [an *inter partes* review] so broadly that its constructions are unreasonable under general claim construction principles." *Microsoft Corp. v. Proxyconn, Inc.*, 789 F.3d 1292, 1298 (Fed. Cir. 2015).

We construe the challenged claims according to these principles. Petitioner asserts the broadest reasonable construction of "receiving a communication signal in any one of a plurality of frequency bands" (which is recited in independent claim 13) is "receiving a communication signal in a frequency band selectable among multiple frequency bands." 15 Pet. 17–19; 16 Pet. 18–19. In our Decisions to Institute, we determined that no terms required express construction for those preliminary decisions. 15 Inst. Dec. 7; 16 Inst. Dec. 7. In its Response to the Petition, Patent Owner concurs that no terms require express construction for these proceedings. 15 PO Resp. 5; 16 PO Resp. 5. In its Reply, Petitioner does not address claim construction. *See generally* 15 Pet. Reply; 16 Pet. Reply. To the extent it is necessary for us to expressly construe claim terms in this decision, we do so below in the context of analyzing whether the prior art renders the claims unpatentable.

E. Summary of Prior Art References[13]

1. Summary of Lawton

Lawton is an article titled "The Design of Flexible Receivers for Communicating Appliances," which was published in an IEEE journal. Ex. 1008, 1. Lawton describes benefits of a "flexible transceiver capable of operating on different standards" for, among others, "the international traveler who requires a terminal which can support many standards and operate world-wide." Ex. 1008, Abs., 1.[14] Lawton "goes on to explore the feasibility of developing perhaps the 'ultimate goal' of a flexible receiver . . . comprising . . . an analogue to digital converter with an antenna at its input." *Id.* at Abs.; *see id.* at 2 (Section "II. Down Conversion by Subsampling"; Fig. 2). Lawton also includes "a brief summary of the relative merits of zero IF and superheterodyne receivers." *Id.* at Abs., *see id.* at 4–5 (Section "VII. Zero IF vs[.] Superheterodyne Receivers"; Fig. 9); *see also id.* Ex. 1015,[15] 15 ("A receiver with zero-IF is called a *direct-conversion* receiver.").

Figure 9, reproduced below, presents "a proposed architecture for a flexible receiver given the findings of this paper." *Id.* at 5 ("A. Proposed Architecture").

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[13] The exhibit numbers for the asserted prior art references are the same in IPR2015-01584 and IPR2015-01600.

[14] Following the practice used in the Petitions, we refer to the exhibit page numbers (1–5), rather than the article page numbers (1060–1064), of Lawton.

[15] Asad A. Abidi, *Low-Power Radio-Frequency IC's for Portable Communications*, 83 PROCEEDINGS OF THE IEEE 544–69 (1995) (Ex. 1015).

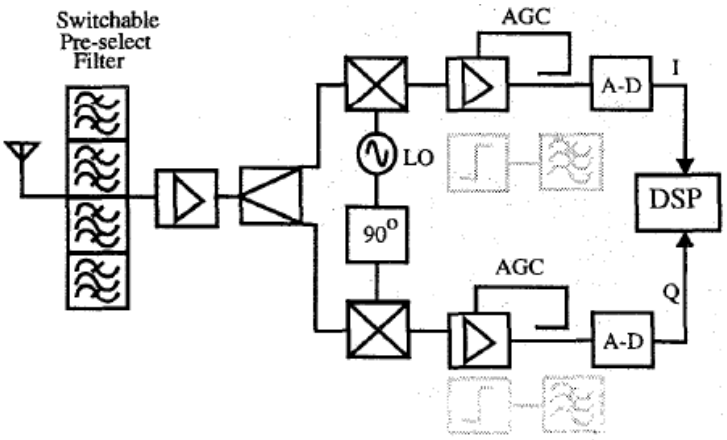


Figure 9 Proposed flexible radio architecture

Lawton's proposed flexible radio architecture depicted in Figure 9 includes "several switchable filters in order to select the appropriate band" and uses "the zero IF architecture." *Id.* Lawton indicates that "[t]he zero IF architecture was chosen . . . because it requires fewer filters with relaxed requirements," among other reasons. *Id.* Lawton acknowledges that "[t]he use of the zero IF approach does have [enumerated] technical challenges but" concludes that the benefits outweigh the technical challenges. *Id.*

Lawton also indicates the proposed architecture depicted in Figure 9 shows additional components that "could be used" for a flexible wideband FSK[16] receiver. *Id.* The additional components are shown in grey lines in Lawton's Figure 9. *Id.*

[16] FSK is a well-known abbreviation for frequency-shift keying. *See, e.g.*, Ex. 1201 ¶ 50 (citing Ex. 1015, 8).

2. Summary of Jentschel

Jentschel[17] is an article titled "Multimodal Wireless Phones" that appeared in the German language periodical Engineer of Communication Technology. Ex. 1009, 1; Michel Decl. Jentschel describes the use of various standards for cellular and wireless phones, including GSM among others. Ex. 1009, 1. Jentschel indicates that having various standards creates a problem—users must select among alternative communication networks and, to communicate through networks based on different standards, "the user would have to carry at least two different cell phones." *Id.* Jentschel describes a "multimodal" cell phone that combines standards and has a transceiver, "the operating mode of which can be switched to different standards." *Id.* at 3–4; *see generally id.* at 3–10. Jentschel also describes a "multimode direct-mixing receiver." *Id.* at 10–13.

Jentschel's Figure 2 is reproduced below.

[17] Petitioner asserts Jentschel qualifies as prior art to all of the challenged claims under 35 U.S.C. § 102(b) and 35 U.S.C. § 102(a). 15 Paper 19, 1; 16 Paper 21, 1.

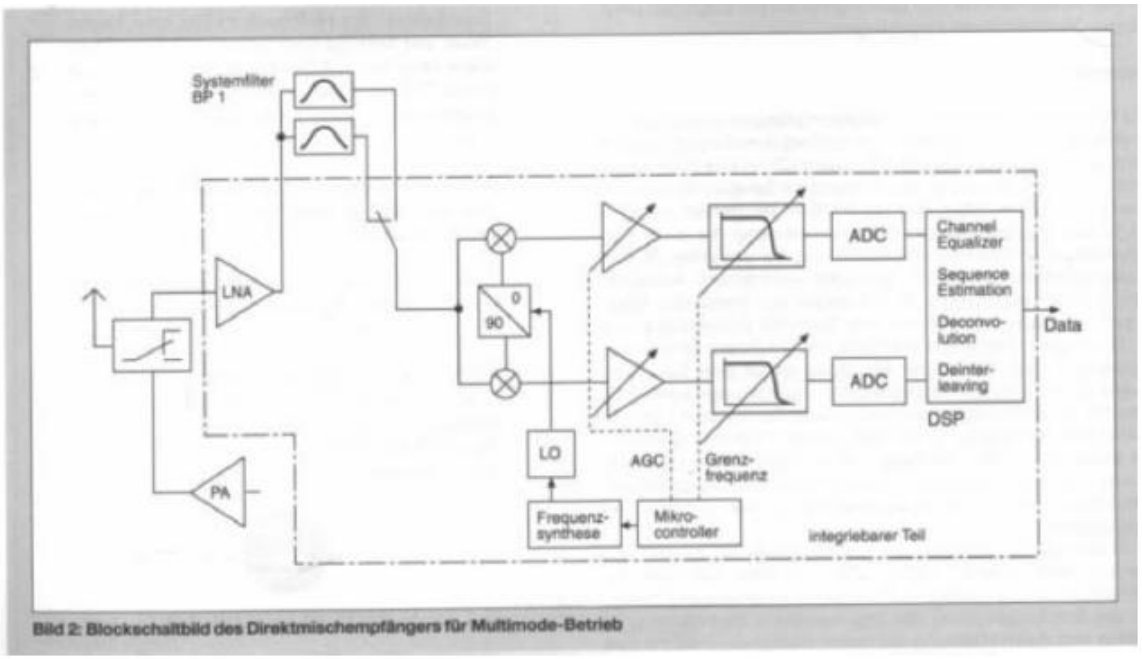


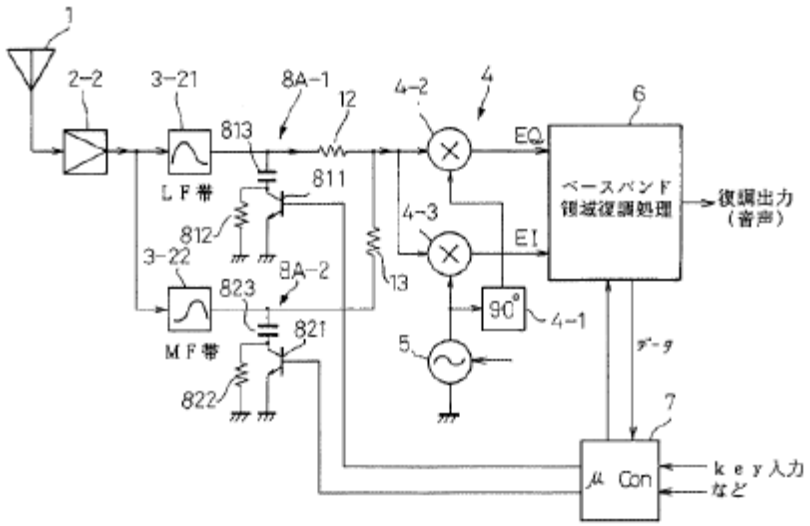
Bild 2: Blockschaltbild des Direktmischempfängers für Multimode-Betrieb

Ex. 1009, 8 (Fig. 2); *see also* Ex. 1010, 6 (Fig. 2). Jentschel's Figure 2 depicts a "block wiring diagram of a direct-mixing receiver (Direct Conversion Receiver or DCR, zero-IF receiver) used as [a] multimode receiver." *Id.* at 7. Jentschel's direct-mixing receiver converts a received "HF signal in one step (directly) to the low-frequency complex baseband signal by means of a quadrature mixer pair. . . . [T]he mixers are controlled by a complex LO [local oscillator]." Ex. 1009, 7. After quadrature mixing, the channel is selected by two low pass filters. Jentschel enumerates advantages of using a direct conversion receiver. *Id.* at 8–9.

3. Summary of JP947

JP947 is a publication of an unexamined Japanese patent application. Ex. 1011, 1. JP947 describes "a direct conversion reception system . . . that amplif[ies], separately in multiple frequency bands, the weak high-frequency signal from a multiband antenna." *Id.* at Abs. (Composition). JP947's

system applies to FM broadcasting, AM broadcasting, and "satellite broadcasting or the like." *Id.* ¶ 16. JP947's Figure 3, which is reproduced below, depicts a direct conversion system.



Id. at 10. As illustrated in JP947's Figure 3 above, an example direct conversion reception system includes "the multiband antenna 1; an AM high-frequency amplifier 2-2 that amplifies only the AM signal from the multi-band antenna 1; an FM high-frequency filter 3-1 that . . . allows only the FM signal to pass through; an AM high-frequency filter 3-2 that . . . allows only the AM signal to pass through; a mixer 4 that transforms the output signals of the FM high-frequency filter 3-1 and the AM high-frequency filter 3-2 into an orthogonal signal; [and] a local oscillator 5 for mixing the received signals with the mixer 4 and forming an orthogonal signal." *Id.* ¶ 12.

4. Summary of JP755

JP755 is a publication of an unexamined Japanese patent application. Ex. 1013, 1. JP755 describes a "direct detection receiver capable of receiving a plurality of frequency bands." Ex. 1013, Abs. The purpose of JP755's receiver is to "achieve miniaturization by reducing the number of parts." *Id.* JP755's Figure 1, which is reproduced below, depicts a direct detection receiver.

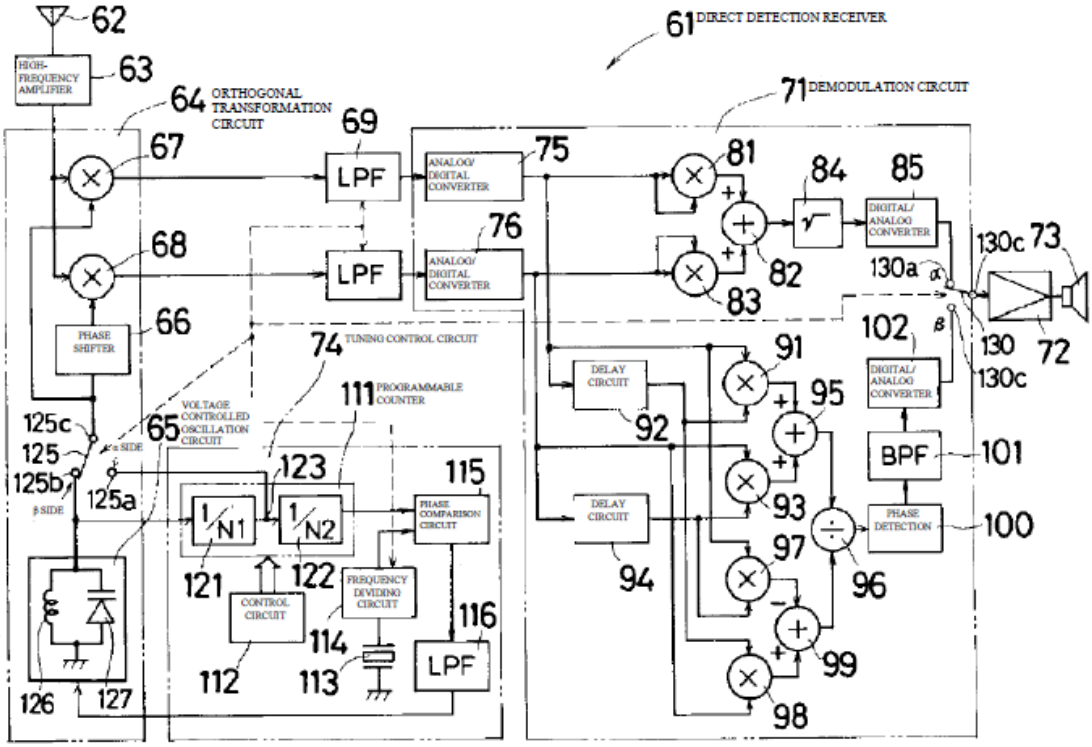


FIG. 1

Id. ¶ 18.

As illustrated in JP755's Figure 1 above, an example direct detection receiver includes antenna 62, high frequency amplification circuit 63,

orthogonal transformation circuit 64, low pass filters (LPFs) 69 and 70,[18] and demodulation circuit 71, among other components. *Id.* The orthogonal transformation circuit 64 includes "a voltage controlled oscillation circuit 65 for performing oscillation at a frequency corresponding to the output voltage from the tuning control unit circuit 74, a switching switch 125 for selectively outputting a reference signal from the voltage controlled oscillation circuit 65, a multiplier 67 for multiplying the reference signal selected by the switching switch 125 by the reception signal, a phase shifter 66 for shifting the phase of the reference signal by 90 degrees to derive a new reference signal, and a multiplier 68 for multiplying the reference signal from the phase shifter 66 by the reception signal." *Id.* ¶ 19.

III. ASSERTED GROUNDS OF UNPATENTABILITY IN IPR2015-01584[19]

In its IPR2015-01584 Petition, Petitioner contends (i) claims 13 and 16 are unpatentable under 35 U.S.C. § 102 as anticipated by Lawton (Pet. 36–47), (ii) dependent claims 15 and 18 are unpatentable under 35 U.S.C. § 103 as obvious over Lawton and Jentschel (Pet. 31–39), and (iii) all of the challenged claims are unpatentable under 35 U.S.C. § 103 as obvious over Jentschel and JP947 (Pet. 39–59). Patent Owner opposes Petitioner's contentions. PO Resp. 6–12, 54–75.

[18] LPF 70 is not identified by reference numeral in Figure 1.
[19] Citations in this section refer to papers and exhibits of record in IPR2015-01584.

A. Asserted Ground of Anticipation By Lawton

Turning first to Petitioner's asserted ground of anticipation of independent claim 13 and its dependent claim 16 by Lawton, Petitioner explains, relying on testimony of Dr. Razavi, how Lawton purportedly discloses each claim limitation. Pet. 36–47 (citing Ex. 1201). With support of testimony by Dr. Madisetti (Ex. 2021) and a prior art reference ("Mohindra"[20]), Patent Owner challenges Petitioner's contentions. PO Resp. 1–3, 6–12. In reply, Petitioner maintains its position that claims 13 and 16 are unpatentable as anticipated by Lawton. Reply 1–5.

We have reviewed the Petition, Patent Owner's Response, and Petitioner's Reply, as well as the relevant evidence discussed in those papers. For the reasons that follow, we determine that Petitioner has not shown by a preponderance of the evidence that Lawton anticipates claims 13 and 16.

1. Petitioner's Contentions

Petitioner asserts that Lawton discloses the direct conversion limitation of independent claim 13 because, among other reasons, Lawton describes a receiver that uses a zero IF architecture, which is a direct conversion receiver. *Id.* at 28–29 (citing Ex. 1008, 5; Ex. 1201 ¶ 258); *see also* Ex. 1015, 15 ("A receiver with zero-IF is called a *direct-conversion* receiver."). According to Petitioner, Lawton discloses the elements in independent claim 13 in a proposed flexible radio architecture shown in

[20] U.S. Patent No. 5,584,068 (Ex. 2008, "Mohindra").

Figure 9. Petitioner's annotations in Figure 3 of the challenged patent and Lawton's Figure 9, shown below, purportedly identify corresponding components in the figures and, thus, illustrate Petitioner's position regarding Lawton's purported disclosure of the steps recited by claim 13. Pet. 36–47.

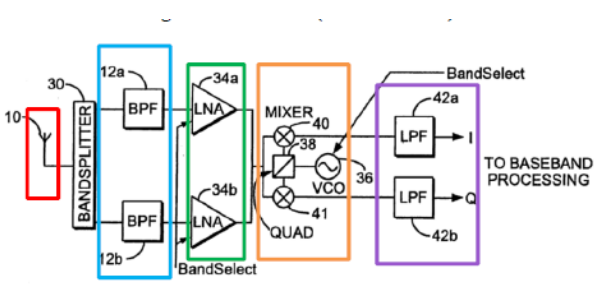


Figure 3 of the '052 Patent (demonstrative)

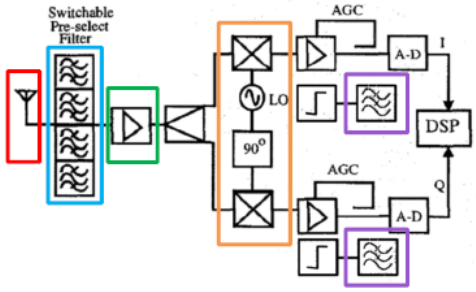


Figure 9 of Lawton (demonstrative)

Petitioner identifies, in Figure 9 shown above left, an antenna (identified with a red box) that performs the recited receiving step, band-pass filters (identified with a blue box) that perform the recited band-pass filtering step, a low-noise amplifier (identified with a green box) that perform the recited amplifying step, mixers, an oscillator, and a quadrature generator (collectively identified with an orange box) that perform the recited mixing step, and a low pass filter (identified with a purple box) that performs the recited low pass filtering. Pet. 21 (presenting annotated versions of Figure 3 of the challenged patent and Figure 9 of Lawton); *see id.* at 14 (presenting color-coded limitations of claim 13 corresponding to the colors used to annotate Figures 3 and 9), 16–29 (discussing limitations of claim 13).

Petitioner identifies facial similarities in the architectures depicted in Figure 3 in the challenged patent (shown above on left) and Lawton's Figure 9 (shown above on right) by drawing boxes around purportedly

similar components. The symbols used in the two figures to identify purportedly corresponding components, however, are not identical. For example, band pass filters 12a and 12b shown in Figure 3 do not show the same types of symbols as symbols shown in Lawton's Figure 9's switchable pre-select filter. Furthermore, Petitioner identifies a group of four symbols in Lawton's Figure 9 as a band-pass filter (identified with a blue box, as described previously) and identifies a substantially similar symbol (identified with a purple box, as described previously) as a low pass filter. These issues diminish the apparent facial similarity of components shown in Lawton's Figure 9 and Figure 3 of the challenged patent. Identity of terminology, however, is not required to show anticipation. *Gleave*, 560 F.3d at 1334; *Bond*, 910 F.2d at 832. Identifying different symbols in the figures as performing the same recited steps, however, necessitates some interpretation to show by a preponderance of the evidence that Lawton discloses each element set forth in claim 13 arranged or combined in the same way. *See Blue Calypso*, 815 F.3d at 1341.

Lawton describes the proposed architecture depicted in Figure 9 in a single paragraph:

> **A. Proposed Architecture**
>
> Figure 9 shows a proposed architecture for a flexible receiver given the findings of this paper. In this paper we have highlighted the need for RF gain and selectivity. The proposed architecture uses several switchable filters in order to select the appropriate band. The zero IF architecture was chosen for the flexible radio because it requires fewer filters with relaxed requirements and can offer flexible filtering and detection in DSP at baseband (the grey lines in figure 9 could

> be used for a flexible wideband FSK receiver). The use of the zero IF approach does have technical challenges (see above) but it is felt that these are outweighed by the benefits.

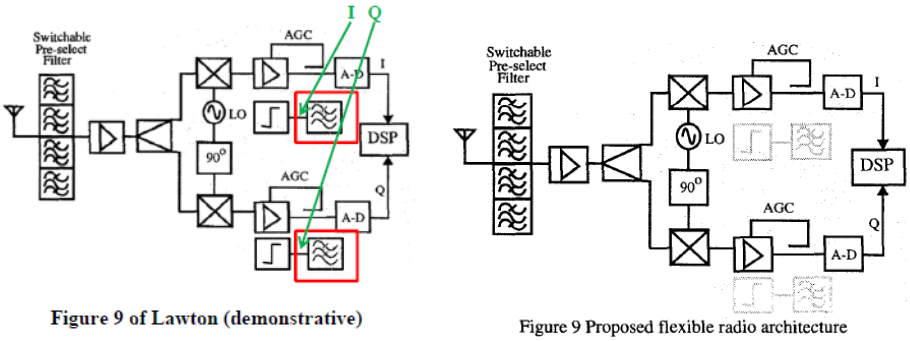
Ex. 1008, 5. Lawton's textual description of the proposed architecture shown in Figure 9 identifies the use of "the several switchable filters" to select one of multiple frequency bands, which supports Petitioner's contentions regarding the band pass filtering step recited in claim 13.

Petitioner acknowledges that "Lawton does not describe each component . . . in detail." Pet. 20 (citing Ex. 1201 ¶ 175). Petitioner contends, however, that "these components were well known in the art." *Id.* (citing Ex. 1201 ¶ 175; Ex. 1001, 1:50–63 (describing prior art components for receivers, including an antenna, a band-pass filter, an amplifier, a mixer, and an oscillator for converting a signal to a different frequency)). Petitioner relies on Dr. Razavi's testimony, including a glossary of symbols, regarding the disclosure of Lawton's proposed architecture. *Id.* at 18–31 (citing Ex. 1201); Ex. 1201 ¶¶ 55 (Glossary of Symbols), 170–88, 241–64.

2. Analysis

A central issue is whether Petitioner has met its burden to show by a preponderance of the evidence that Lawton discloses, either expressly or inherently, the recited step of "low pass filtering the in-phase received signal and the quadrature received signal in a low pass in-phase filter and a low pass quadrature filter, respectively," as arranged in claim 13. *Verdegaal Bros.*, 814 F.2d at 631. After introducing the claim limitation and repeating Dr. Razavi's conclusion that Lawton discloses the limitation, Petitioner presents another annotation of Lawton's Figure 9 (shown below on left)

purportedly identifying the in-phase and quadrature signal pathways and low pass filters that filter each of the in-phase and quadrature signals. Pet. 27 (citing Ex. 1201 ¶ 255). Lawton's Figure 9 (i.e., not annotated) also is set forth below to the right of Petitioner's annotated Figure 9.



Pet. 28; Ex. 1008, 10. Lawton's Figure 9 (above on right) depicts Petitioner's annotated "low pass filters" or "LPFs" (referenced in Petitioner's arguments) in grey. Above on the left, Petitioner annotates Lawton's Figure 9 by identifying purported in-phase and quadrature signal pathways (with green arrows) to purported filters (identified with red boxes).

Petitioner's explanation as to how Lawton discloses the recited low pass filtering is:

> While the "grey lines in figure 9 could be used for a flexible wideband FSK receiver," this FSK receiver receives communication signals in multiple frequency bands employing FSK modulations—e.g., 2 FSK POCSAG uses wideband FSK and operates in multiple frequency bands. These I and Q LPFs [in-phase and quadrature low pass filters] could also have been used in a multiband GSM/DECT receiver. Further, even if the FSK receiver is not used, Lawton teaches that its DSP low-pass filters the I and Q [in-phase and quadrature] signals.

Pet. 27–28 (citations omitted). In these three sentences, Petitioner presents alternative theories of how Lawton's apparatus shown in Figure 9 discloses the recited step of low pass filtering (Pet. 27–28). Petitioner, in its annotations of Figure 9, relies on Lawton's flexible wideband FSK receiver components as disclosing the recited low pass filtering. Petitioner alternatively relies on Lawton's DSP[21] as disclosing the recited low pass filtering. Each of Petitioner's arguments is discussed below.

a. Lawton's Flexible Wideband FSK Receiver Components

Petitioner's primary theory, as shown in Petitioner's annotation using a red box to identify components of Figure 9, relies on Lawton's I and Q signal pathways that include flexible wideband FSK receiver components. Pet. 27 ("Lawton's LPFs shown in Fig. 9 are I and Q LPFs for low-pass filtering the I and Q 'received' signals.").

Lawton does not describe the symbols identified by Petitioner as a low pass filter or as another type of filter (or component) that performs the low pass filtering required by claim 13. *See* Ex. 1008, 5, Fig. 9. Nor does Petitioner assert that Lawton does so. Petitioner relies on Lawton's express disclosure that the grey components shown in Figure 9 "could be used for a flexible wideband FSK receiver." Ex. 1008, 5.

Apparently recognizing Lawton's description of the FSK receiver does not disclose the low pass filtering as required by claim 13, Petitioner contends that the components "*could also have been used* in a multiband

[21] DSP is a well-known acronym in the art for digital signal processor.

GSM/DECT receiver." Pet. 28. Petitioner's citations shed additional light on Petitioner's position. Pet. 27. Petitioner's reasoning appears to be that, because the components shown in grey line in Lawton's Figure 9 "could be used for a flexible wideband FSK receiver," this means Lawton's "FSK receiver receives communication signals in multiple frequency bands employing FSK modulations." Pet. 27 (citing Ex. 1008, 5); *id.* at 28 (identifying one type of the grey components as "I and Q LPFs"). And, because Lawton's grey components, when used as an FSK receiver, receive communication signals in multiple frequency bands, the grey components identified by Petitioner as low pass filters "could also have been used in a multiband GSM/DECT receiver." *Id.* at 28 ("These I and Q LPFs could have been used in a multiband GSM/DECT receiver. Ex. 1201, ¶ 257."). Dr. Razavi's testimony cited by Petitioner does not provide reasoning or evidence beyond that provided by Petitioner. *Compare* Pet. 27–28, *with* Ex. 1201 ¶¶ 256–57.

Petitioner's contention that the FSK receiver components described in Lawton "could have been used" in a multiband GSM/DECT receiver is insufficient to establish an anticipatory disclosure of the recited low pass filtering. First, as noted above, Petitioner does not rely upon an express disclosure of the claimed low pass filtering to support its assertion. Petitioner does not assert, much less present sufficient reasoning and evidence to support, that Lawton necessarily includes the low pass filtering step as required for Lawton to disclose the low pass filtering step inherently. *Trintec Indus., Inc. v. Top-U.S.A. Corp.*, 295 F.3d 1292, 1295 (Fed. Cir.

2002) ("Inherent anticipation requires that the missing descriptive material is 'necessarily present,' not merely probably or possibly present, in the prior art."). Nor does Petitioner argue that one of ordinary skill in the art would "at once envisage" the use of the components of Lawton's FSK receiver in a multiband GSM/DECT receiver. *Blue Calypso*, 815 F.3d at 1334 (A prior art reference anticipates a claim, even if the reference does not expressly "spell out" all the limitations as arranged in the claim, if one of ordinary skill in the art would "at once envisage" the claimed arrangement or combination.) (quoting *Kennametal, Inc. v. Ingersoll Cutting Tool Co.*, 780 F.3d 1376, 1381 (Fed. Cir. 2015)). Rather, Petitioner argues these components "could be used" in another type of receiver (i.e., a multiband GSM/DECT receiver) than the receiver shown in Figure 9.

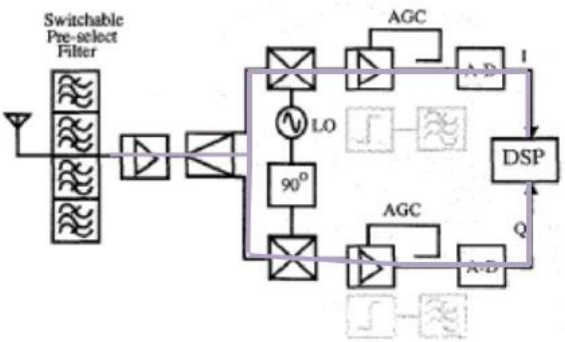
Although Lawton must be read from the perspective of one of ordinary skill in the art, Petitioner's two sentences in its Petition regarding how Lawton's flexible wideband FSK receiver could be used, as discussed above, do not show by the preponderance of the evidence that Lawton's sparsely labeled Figure 9 and short description of Figure 9 anticipates the low pass filtering required by claim 13. *Magnum Oil*, 829 F.3d at 1380 (holding that a petitioner cannot satisfy its burden of proving obviousness by employing "mere conclusory statements"); *see In re Graves*, 69 F.3d 1147, 1152 (Fed. Cir. 1995) ("A reference anticipates a claim if it discloses the claimed invention such that a skilled artisan could take its teachings in combination with his own knowledge of the particular art and be in possession of the invention."); *In re Preda*, 401 F.2d 825, 826 (CCPA 1968)

([I]t is proper to take into account not only specific teachings of the reference but also the inferences which one skilled in the art would reasonably be expected to draw therefrom.").

b. Lawton's DSP

Petitioner's alternative theory, as to how Lawton's architecture shown in Figure 9 discloses the recited step of low pass filtering, relies on a purported inherent disclosure of the DSP. According to Petitioner, "Lawton teaches that its DSP low-pass filters the I and Q signals." Pet. 28. For support of this conclusion, Petitioner cites to Lawton's indication that "baseband filtering can be done . . . in DSP" and the challenged patent's indication that low pass filters "can be integrated either as an analog or as a digital filter." *Id.* (quoting Ex. 1008, 5; Ex. 1001, 4:1–2). Dr. Razavi does not provide significant additional explanation or evidence to further support this conclusion. Ex. 1201 ¶ 257; *see* Pet. 28 (citing Ex. 1201 ¶ 257).

Patent Owner contends, with support of Dr. Madisetti, that no filtering is shown in the signal path in Lawton's Figure 9, as illustrated in Patent Owner's annotation of Lawton's Figure 9 set forth below.



PO Resp. 11 (citing Ex. 2021 ¶ 61). As shown in Figure 9 above, the signal pathway identified by Dr. Madisetti does not include the grey components identified in Petitioner's earlier argument relying on an FSK receiver. As Dr. Madisetti explains, a low pass filter is not necessarily present in a direct conversion receiver or, more specifically, in the DSP of Lawton's Figure 9. Ex. 2021 ¶ 62 (citing *id.* ¶¶ 36–42). According to Dr. Madisetti, mixer outputs could be processed in a variety of ways, including band-pass filters, high-pass filters, or no filter. Ex. 2021 ¶¶ 38–41; PO Resp. 11 (citing Ex. 2021 ¶¶ 38–41). Dr. Madisetti supports his testimony with citations to a prior art patent ("Mohindra") that discloses "[a]n embodiment of a direct conversion device . . . compris[ing] band-pass filters in the respective quadrature paths." Ex. 2021 ¶¶ 38–39 (citing Ex. 2008, 3:6–8); PO Resp. 11 – 12 (citing Ex. 2021 ¶¶ 38–39; quoting Ex. 2008, 3:6–8). In addition, Dr. Madisetti also points out that Dr. Razavi equates baseband filtering with low pass filtering. Ex. 2021 ¶ 61 (quoting Ex. 1201 ¶ 257).

In Reply, Petitioner maintains that one of ordinary skill in the art "would understand" Lawton's DSP to perform the recited low pass filtering. Pet. Reply 3. Petitioner contends that, because another figure (i.e., Figure 7) in Lawton expressly shows low-pass filters for baseband filtering and Lawton teaches that the DSP can be used to perform baseband, one of ordinary skill in the art "would understand that Lawton's DSP likewise performs baseband filtering by low-pass filtering." Pet. Reply 3 (citing Ex. 1008, 4 (Fig. 7)).

We determine Petitioner's one-sentence conclusory assertion in the Petition—"even if the FSK receiver is not used, Lawton teaches that its DSP low-pass filters the I and Q signals"—is insufficient to demonstrate Lawton's DSP expressly or inherently discloses the recited low pass filtering or one of ordinary skill in the art "would understand" Lawton to disclose Lawton's DSP performs low pass filtering.

Petitioner's reasoning and evidence indicates that Lawton's DSP *may* perform low pass filtering, which is insufficient to show a reference anticipates a claim. *See Trintec Indus.*, 295 F.3d at 1295 ("Inherent anticipation requires that the missing descriptive material is 'necessarily present,' not merely probably or possibly present, in the prior art."). Petitioner's cited evidence—that Lawton describes baseband filtering can be done in DSP—does not specify low pass filtering, but rather the broader category of "baseband filtering" (as shown by Dr. Madisetti's Mohindra prior art reference and testimony). *See* Ex. 2021 ¶¶ 38–41; Ex. 2008, 3:6–8. Petitioner's reliance on Lawton's Figure 7 purportedly to demonstrate that one of ordinary skill in the art would understand Lawton's use of the term "baseband filtering" to necessarily mean "low pass filtering" is tenuous and insufficient to demonstrate anticipation by a preponderance of evidence. Furthermore, we credit Dr. Madisetti's testimony, which finds evidentiary support in the Mohindra prior art reference, that baseband filtering could be performed by various types of bandpass filters.

3. Conclusion

For the foregoing reasons, we determine that Petitioner has not demonstrated by a preponderance of the evidence that Lawton discloses the low pass filtering recited by claim 13. Accordingly, we determine that Petitioner has not met its burden to demonstrate by a preponderance of the evidence that independent claim 13 or its dependent claim 16 are unpatentable as anticipated by Lawton. "In an [*inter partes* review], the petitioner has the burden from the onset to show with particularity why the patent it challenges is unpatentable." *Harmonic*, 815 F.3d at 1363 (citing 35 U.S.C. § 312(a)(3) (requiring *inter partes* review petitions to identify "with particularity . . . the evidence that supports the grounds for the challenge to each claim")). The Board may not "adopt arguments on behalf of petitioners that could have been, but were not, raised by the petitioner during an [*inter partes* review]." *Magnum Oil*, 829 F.3d at 1381.

We also note that each of Petitioner's three sentences set forth in the Petition regarding Lawton's purported disclosure of low pass filtering uses language more typically used in an obviousness challenge—"could be used for," "could also have been used in," and "teaches"—than language typically used in an anticipatory challenge. Pet. 27–28. As described above, Petitioner does not discuss Lawton in terms of express or inherent disclosures or how one of ordinary skill in the art would understand Lawton to "at once envisage." *See Blue Calypso*, 815 F.3d at 1341; *Trintec Indus.*, 295 F.3d at 1295.

B. Asserted Ground of Obviousness over Lawton and Jentschel

Petitioner asserts claims 15 and 18, each of which depend from independent claim 13, are unpatentable under 35 U.S.C. § 103 as obvious over Lawton and Jentschel. Pet. 31–39.

Claim 15 additionally recites "wherein the low pass in-phase filter and the low pass quadrature filter have programmable bandwidths which can be changed to accommodate communication signals of different bandwidths." Petitioner relies on its arguments that Lawton discloses low pass filtering required by independent claim 13, from which claim 15 directly depends. Pet. 35. For the reasons discussed previously, Petitioner has not demonstrated by a preponderance of the evidence that Lawton discloses low pass filtering.

Notably, Petitioner rests on its anticipation arguments made in the context of independent claim 13 and does not suggest in this asserted ground of obviousness that Lawton, under the standard of obviousness, would have conveyed to one of ordinary skill in the art the low pass filtering step recited in independent claim 13. Pet. 35. Petitioner contends that, even if Lawton does not explicitly disclose low pass filters *with programmable bandwidths* (as required in claim 15), Jentschel does so. *Id.* at 35–36. Petitioner does not contend that the combination of Jentschel and Lawton would have conveyed to one of ordinary skill in the art the low pass filtering step recited in independent claim 13. *Id.* Rather, Petitioner continues to rely explicitly on Lawton's purported disclosure of low pass filtering, with which we do not agree for reasons discussed previously. Pet. 35 ("Lawton discloses

generating I and Q LO signals in a multiband DCR and low-pass filtering I and Q (received) baseband signals.").

Claim 18 depends directly from independent claim 13 and additionally recites "further comprising the steps of generating a first oscillator signal and frequency-dividing the first oscillator signal to generate the in-phase and quadrature oscillator signals prior to the step of mixing." Petitioner does not contend that the combination of Jentschel and Lawton would have conveyed to one of ordinary skill in the art the low pass filtering step recited in independent claim 13.

In sum, Petitioner does not contend that the combination of Jentschel and Lawton would have conveyed to one of ordinary skill in the art the low pass filtering step recited in independent claim 13. Accordingly, we determine that Petitioner has not met its burden to show by a preponderance of the evidence that the subject matter of claims 15 and 18 would have been obvious over Lawton and Jentschel.

C. Asserted Ground of Obviousness over Jentschel and JP947

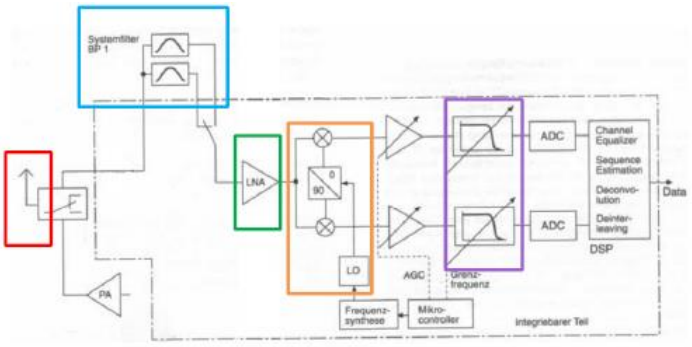
Petitioner also asserts that claims 13, 15, 16, and 18 are unpatentable under 35 U.S.C. § 103 as obvious over Jentschel and JP947. Pet. 39–59. To support its contentions, Petitioner provides explanations, with liberal use of specific citations to the asserted references, how the references would have conveyed to one of ordinary skill in the art the limitations of the challenged claims and reasons why one of ordinary skill in the art would have combined the references in the manner proposed by Petitioner. *Id*. Petitioner also relies on the declaration testimony of Dr. Razavi (Ex. 1201). *Id.*

With support of the declaration testimony of Dr. Madisetti (Ex. 2021), Patent Owner challenges Petitioner's contentions, arguing that one of ordinary skill in the art would not have combined JP947 with Jentschel and that the combination of Jentschel and JP947 fails to teach or suggest limitations recited in claims 13 and 18. PO Resp. 59–75. In reply, Petitioner maintains its position that claims 13, 15, 16, and 18 would have been obvious over the asserted references. Reply 18–26.

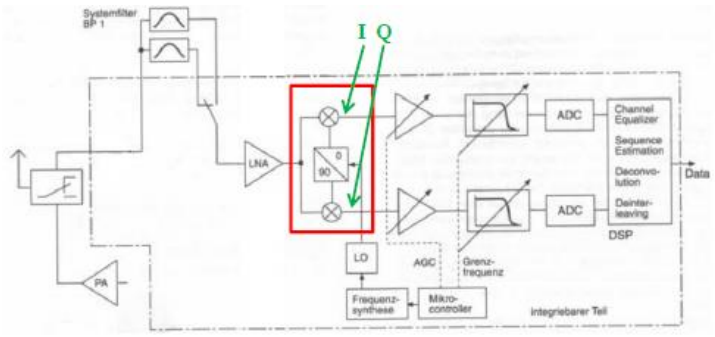
We have reviewed the Petition, the Patent Owner's Response, and Petitioner's Reply, as well as the relevant evidence discussed in those papers. For reasons that follow, we determine that Petitioner has shown by a preponderance of the evidence claims 13, 15, 16, and 18 would have been obvious over the combination of Jentschel and JP947, as set forth by Petitioner.

1. Limitations Recited in Independent Claim 13

Petitioner contends that Jentschel's Figure 2 depicts components, in a direct conversion receiver, that perform the general functions required by independent claim 13, though not in the same order as required by claim 13. Jentschel's Figure 2, as annotated by Petitioner, is set forth below. Pet. 45–54.



Id. at 50. Jentschel's Figure 2 shows an antenna symbol (identified by Petitioner's annotation of a red box), two bandpass filter symbols (identified by Petitioner's annotation of a blue box), a low-noise amplifier symbol (identified by Petitioner's annotation of a green box), a mixer for generating in-phase and quadrature oscillator signals (identified by Petitioner's annotation of an orange box), and two low-pass filters (identified by Petitioner's annotation of a purple box).[22] *Id.* Petitioner's further annotation of Jentschel's Figure 2, set forth below, identifies the in-phase and quadrature oscillator signals.



[22] Petitioner's assertions of the components depicted in Figure 2 are consistent with Dr. Razavi's glossary of symbols for an antenna, a band-pass filter, a low-noise amplifier, a mixer, a quadrature generator, and a low-pass filter. Ex. 1201 ¶ 55 (pp. 35–36).

Id. at 51. Petitioner's annotation above identifies an in-phase oscillator signal with an "I" label and quadrature oscillator signal with a "Q" label, as the respective signal output from the mixers. *Id.* at 50–52. According to Petitioner, Jentschel would have conveyed to one of ordinary skill in the art a joint antenna receiving a communication signal in any one of a plurality of frequency bands, band-pass filtering a signal, amplifying a signal, mixing a signal with in-phase and quadrature oscillator signals to generate an in-phase and a quadrature received signal, and low-pass filtering the in-phase received signal and the quadrature received signal in a low pass in-phase filter and a low pass quadrature filter, respectively. *Id.* at 45–54. Petitioner asserts that Jentschel's description of using direct conversion would have conveyed to one of ordinary skill in the art using direct conversion to convert all received communication signals in at least two of the GSM, DCS, and DECT frequency bands. *Id.* at 53.

As Petitioner acknowledges, the plain language of claim 13 requires a particular order for processing the received communication signal, which differs from that depicted in Jentschel's Figure 2. *Id.* at 48–50. Claim 13 requires band-pass filtering the received communication signal and amplifying the band-pass filtered signal, whereas Jentschel's Figure 2 depicts the received signal being amplified by the low-noise amplifier (LNA) before being processed by band-pass filters. Ex. 1001, 6:27–44; Ex. 1009, 8 (Fig. 2). Petitioner relies on JP947's express disclosure that the amplifiers and the band-pass filters shown in its Figure 3 "may switch

positions" with one another. Pet. 49 (citing Ex. 1011 ¶ 12, Fig. 3[23]). Thus, Petitioner contends, with support of Dr. Razavi's testimony, that the combination of Jentschel and JP947 would have conveyed to one of ordinary skill in the art the limitations recited in claim 13—including band-pass filtering the received communication signal, amplifying the band-pass filtered signal, and mixing the band-pass filtered signal. *Id.* at 45–54. We agree with Petitioner's analysis and adopt it as our own.

Patent Owner contends that the combination of Jentschel and JP947 does not disclose the "low-pass filtering" recited in claim 13. PO Resp. 60, 71–73. According to Patent Owner, Jentschel's direct conversion receiver "uses a high-pass filter in series with a low-pass filter" and, therefore, is a band-pass filter and so does not perform the recited low-pass filtering. *Id.* at 72; *see also* Ex. 2009, 263:16–20 (Dr. Razavi testifying that a low-pass filter followed by a high-pass filter is a band-pass filter); Ex. 2021 ¶ 138 (Dr. Madisetti testifying that "regardless of which filter comes first in series, a low-pass filter in series with a high-pass filter is a band-pass filter").

Jentschel's Figure 2 expressly depicts two low-pass filters in the respective pathways of the in-phase signal and the quadrature signal. Jentschel expressly states that "[a]fter quadrature mixing, the channel is selected by two lowpass filters which form the so-called baseband filter."

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[23] The amplifier and band-pass filter symbols shown in JP947's Figure 3 are are consistent with Dr. Razavi's glossary of symbols for a low-noise amplifier and a band-pass filter. Ex. 1201 ¶ 55 (p. 35).

Ex. 1009, 7–8. Jentschel also describes low-pass filtering in the description of the channel filter: "[t]he channel filter consists of an active lowpass (LP) in both the I and Q channel." *Id.* at 11; *see also* Ex. 1210 ¶ 50; Pet. Reply 24 (citing Ex. 1210 ¶ 50). Thus, we do not agree with Patent Owner's position that Jentschel does not disclose the recited "low pass filtering the in-phase received signal and the quadrature received signal in a low pass in-phase filter and a low pass quadrature filter, respectively" (PO Resp. 73 (quoting Ex. 2021 ¶ 139).

For these reasons, we determine that the combination of Jentschel and JP947, as set forth by Petitioner, would have conveyed to one of ordinary skill in the art the limitations recited by independent claim 13.

2. Reason to Combine Jentschel and JP947

Our inquiry, however, continues because "[a] patent composed of several elements is not proved obvious merely by demonstrating that each of its elements was, independently, known in the prior art." *KSR*, 550 U.S. at 418. Rather, "it can be important to identify a reason that would have prompted a person of ordinary skill in the relevant field to combine the elements in the way the claimed new invention does." *Id*. In other words, "there must be some articulated reasoning with some rational underpinning to support the legal conclusion of obviousness." *Id*. (quoting *In re Kahn*, 441 F.3d 977, 988 (Fed. Cir. 2006)). In addition, "[c]are must be taken to avoid hindsight reconstruction by using 'the patent in suit as a guide through the maze of prior art references, combining the right references in the right way so as to achieve the result of the claims in suit.'" *Grain Processing*

Corp. v. Am.-Maize Prods. Co., 840 F.2d 902, 907 (Fed. Cir. 1988) (quoting *Orthopedic Equip. Co. v. United States*, 702 F.2d 1005, 1012 (Fed. Cir. 1983)).

Petitioner, with support of Dr. Razavi, provides reasons why one of ordinary skill in the art purportedly would have combined Jentschel and JP947 to switch the relative positions of Jentschel's amplifier and band-pass filtering. *See, e.g.*, Pet. 42–45 (citing Ex. 1201). For the reasons that follow, we determine that Petitioner, with support of Dr. Razavi, has articulated sufficient reasoning with some rational underpinning to support the legal conclusion that the subject matter of claim 13 would have been obvious to one of ordinary skill in the art in view of the teachings of Jentschel and JP947 as combined in the manner proposed by Petitioner. *See KSR*, 550 U.S. at 418.

Our determination is supported by JP947's express disclosure that its band-pass filters can switch positions with its amplifiers, which Petitioner relies on in support of its contentions. Ex. 1011 ¶ 12; Pet. 42 (citing Ex. 1011 ¶ 12; Ex. 1201 ¶¶ 234–239); Ex. 1201 ¶ 239. Furthermore, we credit Dr. Razavi's testimony that, based on Jentschel's express disclosure that the baseband filter[24] "reduces the demands on the intermodulation suppression of all the components upstream of the baseband filter" (Ex. 1009, 9), one of ordinary skill in the art "would have recognized the opportunity to reduce the linearity demands on the amplifier by using the

[24] Jentschel refers to the bandpass filters as the "system filters." Ex. 1009, 8 (Fig. 2 label of "System filter" for bandpass filter symbols).

system filter (i.e., band-pass filter) to knock down interfering signals outside the frequency band of interest." Ex. 1201 ¶ 238; *see* Pet. 44 (discussing Ex. 1009, 9, 10; Ex. 1201 ¶ 238). *Am. Acad. of Sci. Tech Ctr.*, 367 F.3d at 1368; *Yorkey*, 601 F.3d at 1284.

We also credit Dr. Razavi's testimony that switching the order of Jentschel's bandpass filter and amplifier "would not have yielded any unpredictable results" and "one of ordinary skill in the art would have had a reasonable expectation of success" in doing so. Ex. 1201 ¶ 239; *see* Pet. 44; *KSR*, 550 U.S. at 416 ("when a patent claims a structure already known in the prior art that is altered by the mere substitution of one element for another known in the field, the combination must do more than yield a predictable result"). 37 C.F.R. § 42.65(a) ("Expert testimony that does not disclose the underlying facts or data on which the opinion is based is entitled to little or no weight."); *Am. Acad. of Sci. Tech Ctr.*, 367 F.3d at 1368; *Yorkey*, 601 F.3d at 1284. Dr. Razavi provides explanation for his conclusion—"how well known the resulting arrangement was at this time." *Id.* The prior art of record supports Dr. Razavi's contention—including the background section of the challenged patent. *See* Ex. 1001, Fig. 1 (showing bandpass filter before amplifier in a conventional superheterodyne receiver), 1:50–60 (describing Fig. 1 in the background section), 2:46–47 (describing Fig. 2 as conventional); Ex. 1008, 5 (Lawton's Fig. 9 depicting bandpass filters before amplifier).

We also credit Dr. Razavi's testimony that this modification would have been within the skill level of one of ordinary skill in the art because

Dr. Razavi supports his conclusion with reason—one of ordinary skill in the art would have understood "the system-level results of arranging typical receiver building blocks in various manners" and would have understood "the known trade-offs involved." Ex. 1201 ¶ 239; *see* Pet. 44; 37 C.F.R. § 42.65(a).

3. Patent Owner's Contentions Regarding Reasons to Combine

Patent Owner contends that one of ordinary skill in the art would not have combined JP947 with Jentschel because the references are "nonanalogous" and because the proposed combination "degrades the 'crucial' sensitivity of Jentschel's circuit design." PO Resp. 60; *see id.* at 61–71.

"References within the statutory terms of 35 U.S.C. § 102 qualify as prior art for an obviousness determination only when analogous to the claimed invention." *In re Bigio*, 381 F.3d 1320, 1325 (Fed. Cir. 2004) (finding both hair brush art and toothbrush art to be analogous to a claim to a hair brush) (citing *In re Clay*, 966 F.2d 656, 658 (Fed. Cir. 1992)). "Two separate tests define the scope of analogous prior art: (1) whether the art is from the same field of endeavor, regardless of the problem addressed and, (2) if the reference is not within the field of the inventor's endeavor, whether the reference still is reasonably pertinent to the particular problem with which the inventor is involved." *Id.* (citations omitted).

The scope of the field of endeavor is a factual determination based on the scope of the application's written description and claims. *Bigio*, 381 F.3d at 1326. The challenged patent identifies its field of invention as

"multiple-band wireless communication devices and systems incorporating direct conversion." Ex. 1001, 1:6–9. In addition, independent claim 13 is directed to a method for receiving a communication signal, the plain language of which does not limit the communication signal other than requiring the communication signal to have bandwidth. *Id.* at 6:27–44.

We determine that JP947 is analogous art to the claimed invention because the art is in the same field of endeavor as the challenged patent. JP947 describes a direct conversion reception system that receives wireless communication signals. *See, e.g.*, Ex. 1011, 1 (Abstract) (indicating the purpose of the invention is to improve the performance of a radio high-frequency stage circuit that uses a direct conversion reception system when multiple bands are received).

Similarly, we determine that Jentschel is analogous art to the claimed invention because the art is in the same field of endeavor as the challenged patent. Jentschel describes a direct conversion system that receives wireless communication signals. Ex. 1009, 4–5 (describing a multi-modal cell phone capable of receiving wireless communication signals across multiple communication standards).

As clear from Patent Owner's argument regarding nonanalogous prior art references, Patent Owner's position also is that one of ordinary skill in the art "would not have even looked to apply the teachings from an AM/FM receiver described in JP947 to a cellular receiver described in Jentschel." PO Resp. 64 (concluding "nonanalogous" argument section). This is purportedly because "JP947 performs channel selection in a fundamentally

different way than Jentschel, because JP947 uses a band-pass channel filter for AM/FM selection at RF before the mixers, rather than performing channel selection after the mixers." *Id.* at 61 (citing Ex. 2021 ¶ 94). Thus, according to Patent Owner, one of ordinary skill in the art "would have no reason to utilize architecture from an AM/FM RF channel selection receiver circuit in a cellular RF bandpass receiver circuit." *Id.* Along these lines, Patent Owner also indicates a prior art reference ("Thomas"[25]) discloses that a tunable band-pass filter was well-known for receiving AM and FM signals but was unsuitable for mobile radio receivers. *Id.* (citing Ex. 2012, 2:9–18, 2:59–65; Ex. 2021 ¶¶ 91–93).

Patent Owner's argument seems to suggest bodily incorporation of JP947's receiver with Jentschel's receiver would be required. Petitioner's combination does not rely on incorporating any components from JP947's receiver into Jentschel's receiver. Rather, Petitioner applies JP947's unambiguous teaching that the order of the bandpass filter and the amplifier may be reversed to teach or suggest reversing the order of Jentschel's bandpass filters and amplifiers. Moreover, "[i]t is well-established that a determination of obviousness based on teachings from multiple references does not require an actual, physical substitution of elements." *Mouttet*, 686 F.3d 1322, 1332 (Fed. Cir. 2012) (citing *In re Etter*, 756 F.2d 852, 859 (Fed. Cir. 1985) (en banc) ("Etter's assertions that Azure cannot be incorporated in Ambrosio are basically irrelevant, the criterion being not whether the

[25] U.S. Patent No. 5,065,452 (Ex. 2012, "Thomas").

references could be physically combined but whether the claimed inventions are rendered obvious by the teachings of the prior art as a whole.")). Furthermore, Patent Owner's assertion regarding the teaching of Thomas does not negate JP947's unambiguous teaching that the order of the bandpass filter and amplifier may be reversed. Thus, for these reasons, we do not agree with Patent Owner's position that "the teachings of JP947 are nonanalogous because Jentschel performs band selection at RF, whereas JP947 performs channel selection at RF." PO Resp. 61 (heading VIII.A.1); *id.* at 61–64.

Second, we do not agree with Patent Owner's position that the proposed combination "degrades the 'crucial' sensitivity of Jentschel's circuit design." PO Resp. 65–70. Patent Owner's contention is based on Patent Owner's premise that:

> Jentschel teaches that sensitivity is the most important aspect of performance. *See* [Ex. 1009], 6 ("Within a general multimode transceiver, the receiver is the crucial component . . . due to the high demands regarding . . . ***sensitivity*** . . .").

Id. at 65 (emphasis in original). Patent Owner's premise that "sensitivity is the most important aspect of performance" is faulty because the sentence in Jentschel on which Patent Owner ostensibly relies does not support Patent Owner's position. The full sentence in Jentschel, from which Patent Owner selectively quotes, indicates:

> Within a general multimode transceiver, the receiver is the crucial component. Among others, this is due to the high demands regarding the receiving quality (sensitivity, interference immunity), volume, weight, and price.

Ex. 1009, 6. The sentence in Jentschel, on which Patent Owner relies, indicates that the receiver is the crucial component of a general multimode transceiver. Jentschel also identifies four aspects of "high demands"—receiving quality, volume, weight, and price. Furthermore, Jentschel identifies sensitivity as only one aspect of receiving quality. We, therefore, do not agree with Patent Owner that sensitivity is "the crucial component" to Jentschel's circuit design.

4. Claims 15 and 16

Each of claims 15 and 16 depend from independent claim 13. Patent Owner presents no separate arguments regarding limitations added by these claims, but the burden remains on the Petitioner to demonstrate by a preponderance of the evidence that the claims are unpatentable. 35 U.S.C. § 326(e); 37 C.F.R. § 42.1(d).

Claim 15 additionally recites wherein the low pass in-phase filter and the low pass quadrature filter have programmable bandwidths which can be changed to accommodate communication signals of different bandwidths. Petitioner relies on Jentschel for teaching this additional feature. Pet. 54–56. Specifically, Petitioner, with support of Dr. Razavi, indicates adjustable cutoff frequencies of Jentschel's I and Q low-pass filters would have conveyed to one of ordinary skill in the art programmable bandwidths of the recited low-pass filters in claim 15. *Id.* (citing Ex. 1009, 8, 11; Ex. 1201 ¶¶ 294–96).

Claim 16 additionally recites the step of generating the in-phase and quadrature oscillator signals from an oscillator having a variable oscillation

frequency prior to the step of mixing. Petitioner relies on Jentschel for teaching this additional feature. Pet. 56–58. Specifically, Petitioner, with support of Dr. Razavi, indicates that Jentschel's expressly discloses an oscillator having a variable oscillator frequency and Jentschel's Figure 2 showing generating I and Q signals from the oscillator prior to the step of mixing. Ex. 1009, 7, Fig. 2; Ex. 1201 ¶¶ 297–300. According to Petitioner and Dr. Razavi, this would have conveyed to one of ordinary skill in the art the additional limitation recited in claim 16.

We agree with Petitioner's analysis regarding claims 15 and 16 (*see* Pet. 54–58). Thus, we determine Petitioner has shown that the combination of Jentschel and JP947 would have conveyed to one of ordinary skill in the art the limitations recited in claims 15 and 16.

5. Claim 18

Claim 18 depends from independent claim 13 and additionally recites further comprising the steps of generating a first oscillator signal and frequency-dividing the first oscillator signal to generate the in-phase and quadrature oscillator signals prior to the step of mixing. Petitioner, with support of Dr. Razavi, relies on Jentschel for teaching this limitation. Pet. 58–59 (citing Ex. 1201 ¶ 301). We agree with Petitioner that Jentschel's Figure 2 and Jentschel's text describing phase shifting would have conveyed to one of ordinary skill in the art generating in-phase and quadrature oscillator signals prior to the step of mixing. *See id.* at 58.

Regarding the frequency-dividing limitation, Petitioner relies on Jentschel's phase shifter:

> The phase shifter provides the mixer of the Q channel with an LO signal which is phase-shifted relative to the I signal. Phase shifters on the basis of conducting components have dimensions in the frequency range below 2 GHz which prevent integration. However, broadband phase shifters can be assembled by means of frequency dividers, whereby one divider each for the I and Q channel is controlled with twice the LO frequency and clocked by opposite edges. The outputs subsequently generate two signals phase-shifted by 90°.

Ex. 1009, 10. As Petitioner indicates, Jentschel describes assembling phase shifters by means of frequency dividers, whereby one divider each for the I and Q channel is controlled with twice the LO frequency and clocked by opposite edges. Pet. 58 (quoting Ex. 1009, 10).

Patent Owner contends that the combination of Jentschel and JP947 (i) does not disclose the use of frequency dividers and would defeat one of the purposes of Jentschel and (ii) Jentschel teaches away from using a frequency divider. PO Resp. 73–75. Patent Owner acknowledges Jentschel's express disclosure that "phase shifters can be assembled by means of frequency dividers" but indicates such disclosure is not sufficient because Jentschel's circuit does not use a frequency divider as a phase shifter. *Id.* at 73–74. Patent Owner indicates that "Jentschel's Fig. 2 on its own does not disclose what type of phase shifter is employed" and concludes that "Jentschel implements its in-phase and quadrature oscillator signal generation using an RC[26] phase shifter." *Id.* at 74. Patent Owner

[26] In the context of an "RC phase shifter," "RC" is a common acronym for a "resistive-capacitive."

continues, Jentschel "does not disclose use of a frequency divider with a LO signal [to control the mixer] operating at twice the desired frequency." *Id.* at 75 (citing Ex. 1009 7–8).

We do not agree with Patent Owner's premise that, under an obviousness analysis, Jentschel must disclose employing a frequency divider in its Figure 2 circuit. Unlike anticipation which requires all elements to be arranged as in the claim (*see Net MoneyIN*, 545 F.3d at 1371), "the test for obviousness is what the combined teachings of the references would have suggested to those having ordinary skill in the art." *Mouttet*, 686 F.3d at 1333 (citing *In re Keller*, 642 F.2d 413, 425 (CCPA 1981)). Importantly, Petitioner not only relies on Figure 2 but also relies on Jentschel's express indication that phase shifters can be implemented using frequency dividers. Pet. 58.

Turning to Patent Owner's argument regarding Jentschel's purported teaching away from using a frequency divider, Patent Owner contends that Jentschel "discloses frequency dividers as a potential candidate as a phase shifter" and identifies advantages and disadvantages of using them. PO Resp. 75 (citing quoting Ex. 1009, 10). Patent Owner indicates that Jentschel concludes, however, that RC elements for phase shifters are suitable. *Id.*

We accord relatively little weight to Dr. Madisetti's characterization of Jentschel's disclosure that "the high power demand is disadvantageous" as teaching "that there is no cure for the downside of frequency dividers that they consume too much power." Ex. 2021 ¶ 161. Dr. Madisetti does not

provide adequate explanation or evidence to support his conclusion, which does not necessarily follow from the Jentschel's disclosure that high power demand is "disadvantageous." 37 C.F.R. § 42.65(a) ("Expert testimony that does not disclose the underlying facts or data on which the opinion is based is entitled to little or no weight.").

We do not agree that Jentschel's discussion of advantages and disadvantages of using a frequency divider or indicating that another component is suitable rises to the level of a teaching away. A reference teaches away "when a person of ordinary skill, upon reading the reference, would be discouraged from following the path set out in the reference, or would be led in a direction divergent from the path that was taken by the applicant." *Mouttet*, 686 F.3d at 1333–34 (quoting *In re Gurley*, 27 F.3d 551, 553 (Fed. Cir. 1994)). Moreover, a "mere disclosure of more than one alternative does not amount to teaching away from one of the alternatives where the reference does not criticize, discredit, or otherwise discourage the solution." *SightSound Techs., LLC v. Apple Inc.*, 809 F.3d 1307, 1320 (Fed. Cir. 2015) (internal quotation marks omitted) (quoting *In re Fulton*, 391 F.3d 1195, 1201 (Fed. Cir. 2004)). A reference may not teach away even if a particular solution is not the preferred solution or is inferior to another solution. *Fulton*, 391 F.3d at 1200 (discussing *Gurley*, 27 F.3d at 552–53).

Thus, we agree with Dr. Razavi's testimony that, although Jentschel identifies advantages and disadvantages of using a frequency divider, Jentschel does not criticize, discredit or discourage the use of a frequency divider (Ex. 1210 ¶ 59).

For these reasons, we agree with Petitioner that the combination of Jentschel and JP947, as proposed by Petitioner, would have conveyed to one of ordinary skill in the art the limitations recited in claim 18.

6. Conclusion

Having determined that the combination of Jentschel and JP947 would have conveyed to one of ordinary skill in the art the limitations recited in claims 13, 15, 16, and 18, and having determined that Petitioner has provided sufficient articulated reasoning to support a conclusion of obviousness,[27] we determine that Petitioner has demonstrated by a preponderance of the evidence that the subject matter of claims 13, 15, 16, and 18 would have been obvious over the combination of Jentschel and JP947, as set forth by Petitioner. 35 U.S.C. § 103(a).

IV. ASSERTED GROUNDS OF UNPATENTABILITY IN IPR2015-01600[28]

In its IPR2015-01600 Petition, Petitioner contends (i) independent claim 13 and its dependent claims 15 and 16 are unpatentable under 35 U.S.C. § 103 as obvious over JP947 and JP755 and (ii) claim 18 is unpatentable under 35 U.S.C. § 103 as obvious over JP947, JP755, and Jentschel. Pet. 20–59. Patent Owner opposes Petitioner's contentions. PO Resp. 1–21, 65–76.

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[27] Patent Owner has not put forth any arguments or evidence of secondary considerations for us to consider in our obviousness analysis.
[28] Citations in this section refer to papers and exhibits of record in IPR2015-01600.

A. Asserted Ground of Obviousness over JP947 and JP755

Petitioner contends (i) independent claim 13 and its dependent claims 15 and 16 are unpatentable under 35 U.S.C. § 103 as obvious over JP947 and JP755. Pet. 20–52. To support its contentions, and relying on declaration testimony of Dr. Razavi, Petitioner provides analysis purportedly explaining how the combination would have conveyed to one of ordinary skill in the art the claim limitations recited in claims 13, 15, and 16 and provides reasons why one of ordinary skill in the art would have combined the teachings of the references. *Id.* (citing Ex. 1301). With support of the declaration of Dr. Madisetti (Ex. 2022) and additional prior art references (Mohindra and Thomas), Patent Owner challenges Petitioner's contentions. PO Resp. 1–4, 6–21. In reply, Petitioner maintains its position that claims 13, 15, and 16 would have been obvious over JP947 and JP755. Reply 1–15.

We have reviewed the Petition, Patent Owner's Response, and Petitioner's Reply, as well as the relevant evidence discussed in those papers. For reasons that follow, we determine that Petitioner has met its burden to show by a preponderance of the evidence that the subject matter of claims 13, 15, and 16 would have been obvious over JP947 and JP755.

1. Limitations Recited in Independent Claim 13

Petitioner provides, with support of Dr. Razavi, analysis purporting to show how the combination of JP947 and JP755 would have conveyed to one of ordinary skill in the art the limitations recited in claims 13, 15, and 16. Pet. 30–52. In general, Petitioner relies, with support from Dr. Razavi, on

the teachings on JP947 for many of the limitations recited in claim 13 and relies on the teaching of JP755 for the recited low-pass filtering. *Id.* at 30–46; *see id.* at 45 ("Assuming JP947 does not explicitly disclose this limitation, JP755 discloses [low pass filters] in a[n] AM/FM multiband DCR."). Petitioner includes annotated reproductions of JP947's Figure 3 and JP755's Figure 1 identifying, by color-code, components purportedly performing limitations of independent claim 13. *See, e.g.*, *id.* at 16 (presenting color-code key of limitations in claim 13); *id*. at 21, 31, 32, 35, 39, 46 (showing color-coded annotations of components in JP947's Fig. 3); *id*. at 25, 46 (showing color-coded annotations of components in JP755's Fig. 1).

Receiving a communication signal, band-pass filtering and amplifying

Petitioner relies on JP947's description of a multi-band antenna that is shared for AM and FM broadcasting for teaching the recited receiving a communication signal step. *Id.* at 30–31 (citing Ex. 1011 ¶ 12; Ex. 1301 ¶ 227). For the recited band-pass filtering step, Petitioner relies on JP947's "FM high-frequency filter 3-1 and AM high-frequency filter 3-2 are [band pass filters] that filter the received communication signal." *Id.* at 39–40. For the recited amplifying step, Petitioner further relies on JP947's AM and FM amplifiers 2-1 and 2-2 for teaching the recited amplifying the band-pass filtered signal. *Id.* at 42.

Petitioner acknowledges the order of band-pass filtering and amplifying depicted in JP947's Figure 3 does not match the required ordering of independent claim 13 because the plain language of the claim

requires the band-pass filtered signal to be amplified, while claim 13 requires the amplifying to follow the band-pass filtering.

Petitioner's position is that, although JP947's Figure 3 depicts band pass filters 3-1 and 3-2 "at the output of amplifiers 2-1 and 2-2," JP947 expressly teaches "switching the relative positions of amplifiers 2-1, 2-2 and [band pass filters] 3-1, 3-2." *Id.* at 40 (citing Ex. 1011 ¶ 12) ("FM high-frequency amplifier 2-1 and the AM high-frequency amplifier 2-2 may switch positions with the FM high-frequency filter 3-1 and the AM high-frequency filter 3-2."). Petitioner further supports its position with prior art evidence and testimony of Dr. Razavi. *Id.* at 40–41 (citing Ex. 1015,[29] 545; Ex. 1301 ¶¶ 244–46). Specifically, Petitioner contends that one of ordinary skill in the art would have reason to switch the positions of the band pass filters with the amplifiers "in order to attenuate out-of-band interferers and thus relax the linearity requirement on, and power consumption of, JP947's amplifiers" and doing so would have been a known design choice. *Id.*

We agree with Petitioner's analysis of these claim limitations and adopt it as our own.

Mixing

Regarding the recited mixing step, Petitioner contends that, "with the relative positions of the [band pass filters] and amplifiers switched per JP947's express teaching, JP947 teaches mixing the band-pass filtered signal

[29] Asad A. Abidi, *Low-Power Radio-Frequency IC's for Portable Communications*, 83 PROCEEDINGS OF THE IEEE 544–69 (1995).

as required in claim 13." *Id.* at 43. More specifically, Petitioner contends that JP947's mixer 4 includes mixers 4-3 and 4-2, phase shifter 4-1, and local oscillator 5 and contends that those components perform the mixing as required in claim 13. *Id.* at 43–45.

In opposition, Patent Owner contends that JP947 does not mix the bandpass filtered signal with in-phase and quadrature signals, as required by the claims, because of the presence of capacitor 10-2 and inductor 11-2. PO Resp. 21 (citing Ex. 2022 ¶¶ 89–91; Ex. 2009, 110:13–19, 102:21–103:4). According to Patent Owner and Dr. Madisetti, the input to mixers 4-2 and 4-3 in Figure 3 cannot be a band-pass filtered signal as required by independent claim 13 because "the signal has been either further high-pass filtered by capacitor 10-2 or further low-pass filtered by inductor 11-2." PO Resp. 21 (citing Ex. 2022 ¶¶ 89–94).

We do not agree because JP947 expressly discloses that "mixer 4 . . . transforms the output signals of the FM high-frequency filter 3-1 and the AM high-frequency filter 3-2 into an orthogonal signal." Pet. Reply 14 (citing Ex. 1011 ¶ 12). Dr. Razavi explains that this means the mixers receive the band-pass filtered signal from the FM filter 3-1 or AM filter 3-2, respectively. Ex. 1308 ¶¶ 46–49 (citing Ex. 1011 ¶ 14); Pet. Reply 14 (citing Ex. 1308 ¶ 49; Ex. 1011 ¶¶ 12, 14). Dr. Razavi continues, JP947's capacitor 10-2 and inductor 11-2 remove remaining signal output from the other frequency band not removed by the respective bandpass filter 3-1 or 3-2. Ex. 1308 ¶ 48; Pet. Reply 14 (citing Ex. 1308 ¶ 48). In other words, according to Dr. Razavi, capacitor 10-2 and inductor 11-2, respectively,

remove any remaining AM signal output from FM filter 3-2 and any remaining FM signal output from AM filter 3-2. Ex. 1308 ¶ 48; Pet. Reply 14 (citing Ex. 1308 ¶ 48). We credit Dr. Razavi's testimony which is consistent with the disclosure of JP947.

We agree with Petitioner's analysis of this claim limitation and adopt it as our own.

Low-pass filtering and direct conversion

For the recited low pass filtering step, Petitioner relies on JP755's low pass filters 69 depicted in Figure 1. *Id.* at 45–47; *see id.* at 45 ("Assuming JP947 does not explicitly disclose this limitation, JP755 discloses [low pass filters] in a[n] AM/FM multiband DCR."). According to Petitioner, one low pass filter (LPF) filters the I signal from mixer 67 and another low pass filter (LPF) filters the Q signal from mixer 68. *Id.* at 45–46 (comparing color-coded annotations of mixer components in reproductions of Figure 3 of JP947 and Figure 1 of JP755 and showing the analogous I signals and Q signals).

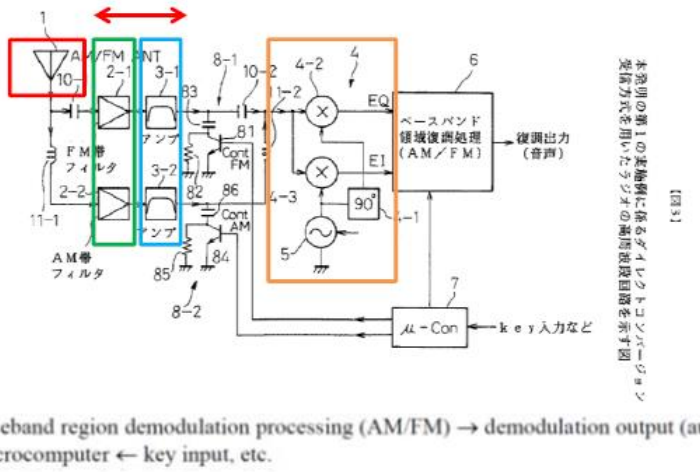
For the limitation that direct conversion be used for converting all received communication signals in any one of the plurality of frequency bands, Petitioner relies on JP947's disclosure of using direct conversion and contends that JP947's Figure 3 shows that JP947's DCR uses direct conversion for converting all signals in all frequency bands received (i.e., AM and FM in JP947) and for "downconverting" all channels in the AM and FM frequency bands. *Id.* at 48 (citing Ex. 1011, Abstract, Fig. 3). Petitioner also relies on Dr. Razavi's testimony concerning how JP947 would have

conveyed to one of ordinary skill in the art using direct conversion as required in independent claim 13. *Id.* (citing Ex. 1301 ¶¶ 262–65).

We agree with Petitioner's analysis of these claim limitations and adopt it as our own.

Summary and conclusion

Petitioner's annotation of JP947's Figure 3 is set forth below:



Pet. 24. Petitioner's annotation identifies an antenna for receiving a communication signal (in a red box), amplifying the signal (in a green box), band-pass filtering (in a blue box), and mixing the band-pass filtered signal (in an orange box). A red, double-headed arrow appears over the amplifiers and band pass filters.

For the reasons above and further reasons discussed below regarding JP947's bandpass filter in the context of reasons one of ordinary skill in the art would have combined the teaching of the references, we determine that the combination of JP947 and JP755, as set forth by Petitioner, would have

conveyed to one of ordinary skill in the art the limitations recited by independent claim 13.

2. Reason to Combine JP947 and JP755

Petitioner, with support of Dr. Razavi, provides reasons one of ordinary skill in the art would have incorporated JP755's I and Q low pass filters into JP947's direct conversion receiver, including "to remove spurious signals and attenuate out-of-band noise before digitization." *Id.* at 47; *see id.* at 26–30 (citing Ex. 1301 ¶¶ 206–11, 213–16). Petitioner also asserts one of ordinary skill in the art "would have had a reasonable expectation of success in making the modification, as the combination yields nothing more than predictable results and would have been well within" the skill level of one of ordinary skill in the art. *Id.* at 29–30 (citing *KSR*, 550 U.S. 398, 415–16 (2007) ("The combination of familiar elements according to known methods is likely to be obvious when it does no more than yield predictable results.").

3. Patent Owner's Contentions Regarding Reason to Combine

A central dispute concerns whether JP947's filters 3-1, 3-2 (shown in JP947's Figure 3) are bandpass filters that pass the signal within the entire FM band (filter 3-1) and AM band (filter 3-2), respectively, as Petitioner contends. Pet. Reply 1–10; PO Resp. 12–15. Or, as Patent Owner contends, JP947's filters 3-1, 3-2 are channel filters and, more specifically, are tunable/switchable channel filters. Pet. Reply 1; PO Resp. 12–16. For example, if JP947's filters 3-1 operates as a channel filter for FM band, then filter 3-1 selects any one of multiple FM channels within the FM band and blocks all other signals (including other FM channels within the FM band).

Pet. Reply 1; PO Resp. 12–16; *see* Pet. Reply 1. On the other hand, if JP947's filters 3-1 operates as a bandpass filter for FM band, then filter 3-1 passes the signal within the entire FM band and blocks all other signals (outside the FM band). Pet. Reply 1; PO Resp. 12–16 *see* Pet. Reply 1.

According to Patent Owner, if JP947's filters are channel filters, then it would not have been obvious to modify JP947 to include JP755's low pass filters after the mixer. PO Resp. 15 (Heading IV.D: "No reason to add the programmable low pass filter of JP755 after the mixers in JP947 because channel selection already performed"); *see* Pet. Reply 3. To support its position that JP947's filters are channel filters, Patent Owner provides technical explanations, including discussion of two prior art references (i.e., Mahindra and Thomas), regarding two types of direct conversion receivers—(i) receivers that perform channel filtering at radio frequency (RF) and (ii) receivers that perform channel filtering after converting the signal to baseband. PO Resp. 7–15. Patent Owner also relies on Dr. Madisetti's testimony that "JP947 uses a tunable/switchable bandpass channel filter for AM/FM reception." PO Resp. 14 (quoting Ex. 2022 ¶ 65). Although Patent Owner and Dr. Madisetti provide explanations and evidence as to the general state of direct conversion receiver art, neither Patent Owner nor Dr. Madisetti supports the conclusion regarding JP947 using a tunable/switchable bandpass channel filter with adequate citations to the reference itself. Instead, Patent Owner and Dr. Madisetti rely on the following single-sentence description of filters 3-1 and 3-2 of Figure 3 in JP947:

> an FM high-frequency filter 3-1 that is connected to the output of the FM high-frequency amplifier 2-1 and allows only the FM signal to pass through; an AM high-frequency filter 3-2 that is connected to the AM high-frequency amplifier 2-2 and allows only the AM signal to pass through.

PO Resp. 16 (quoting Ex. 1011 ¶ 12); *see* Ex. 2022 ¶ 74. Dr. Madisetti does not provide significant additional testimony beyond that presented by Patent Owner. *Compare* PO Resp. 16, *with* Ex. 2022 ¶ 74. From this sentence, Dr. Madisetti concludes one of ordinary skill in the art "would have understood that the 'FM signal' produced by the 'FM high-frequency filter 3-1' is a particular FM channel" and makes a corresponding conclusion regarding the AM signal. Ex. 2022 ¶ 74; PO Resp. 16 (citing Ex. 2022 ¶ 74).

Neither Patent Owner nor Dr. Madisetti provide an explanation as to why one of ordinary skill in the art would have understood the statement regarding the "FM signal" to mean a particular FM channel. *See* Ex. 2022 ¶ 74; PO Resp. 16. The text itself does not require such an interpretation. Thus, we accord Dr. Madisetti's testimony in this regard with relatively little weight because it is conclusory and not sufficiently tethered to the disclosure of JP947, on which he purportedly relies. 37 C.F.R. § 42.65(a) ("Expert testimony that does not disclose the underlying facts or data on which the opinion is based is entitled to little or no weight."); *Am. Acad. of Sci. Tech Ctr.*, 367 F.3d at 1368; *Yorkey*, 601 F.3d at 1284.

We also do not agree with Patent Owner that certain deposition testimony of Dr. Razavi—channel selection is not described in JP947 but must take place in the direct conversion receiver (Ex. 2062, 565:3–14) —

supports Patent Owner's position. PO Obs. 6–7. Rather, we note Dr. Razavi's further testimony that the oscillator in Figure 3 would have conveyed channel selection to one of ordinary skill in the art. *See* Pet. Resp. to PO Obs. 7.

In contrast to Patent Owner's argument connected to a single sentence in JP947, Petitioner supports its position that JP947's filters 3-1 and 3-2 are band-select filters with detailed explanations and liberal citations to JP947. Pet. Reply 2–11; *see* Ex. 1308 ¶¶ 10–27 (Dr. Razavi's testimony regarding the same). For example, Petitioner points out that JP947 indicates that "amplification is done separately for each frequency band." Pet. Reply 8 (quoting Ex. 1011 ¶ 14). Notably, the amplifiers in Figure 3 follow the band filters 3-1, 3-2. Thus, the disclosure that amplification is done for each frequency *band* provides support for Petitioner's position and undercuts Patent Owner's position that the band filters that operate on FM or AM signals are channel filters for a particular channel within a frequency band.

Petitioner also contends that because JP947 describes that the filter 3-1 passes "only one frequency band" and removes the signal from "the other frequency band," the filter 3-1 is a bandpass filter that passes the entire FM band, and filter 3-1 is not a channel filter that also blocks non-selected channel signals from the same frequency band. Pet. Reply 5 (citing Ex. 1011 ¶ 14).

After considering the evidence provided by each party, weighing the testimony provided by Dr. Razavi and Dr. Madisetti, and for the reasons discussed above, we find that JP947 would have conveyed to one of ordinary

skill in the art bandpass filters that pass the signal within the entire FM band (filter 3-1) and AM band (filter 3-2).

Because we do not agree with Patent Owner's premise regarding channel filtering, we do not agree with Patent Owner's contentions regarding it would not have been obvious to modify JP947 to include JP755's low pass filters after the mixer because in JP947 channel selection already is performed. PO Resp. 15–21.

4. Claims 15 and 16

Each of claims 15 and 16 depends from independent claim 13. Patent Owner presents no separate arguments regarding limitations added by these claims, but the burden remains on the Petitioner to demonstrate by a preponderance of the evidence that the claims are unpatentable. 35 U.S.C. § 326(e); 37 C.F.R. § 42.1(d).

Claim 15 additionally recites wherein the low pass in-phase filter and the low pass quadrature filter have programmable bandwidths which can be changed to accommodate communication signals of different bandwidths. Petitioner relies on JP755 for teaching this additional feature. Pet. 48–50. Specifically, with support of Dr. Razavi, Petitioner indicates adjustable cutoff frequencies of JP755's low-pass filters would have conveyed to one of ordinary skill in the art programmable bandwidths of the recited low-pass filters in claim 15. *Id.* at 49 (citing Ex. 1013 ¶¶ 2, 6, 20; Ex. 1301 ¶¶ 267–71).

Claim 16 additionally recites the step of generating the in-phase and quadrature oscillator signals from an oscillator having a variable oscillation

frequency prior to the step of mixing. Petitioner relies on the combination of JP947 and JP755 for teaching this additional feature. Pet. 50–52. Specifically, Petitioner, with support of Dr. Razavi, indicates that JP947's express disclosure of an oscillator having a variable oscillator frequency and JP947's Figure 3 showing generating I and Q signals from the oscillator prior to the step of mixing would have conveyed to one of ordinary skill in the art generating the claimed signals before mixing. Ex. 1011 ¶5; Ex. 1301 ¶¶ 273–77.

We agree with Petitioner's analysis regarding claims 15 and 16 (*see* Pet. 48–52). We, therefore, determine that the combination of JP947 and JP755 would have conveyed to one of ordinary skill in the art the limitations recited in claims 15 and 16.

5. Conclusion

Having determined that the combination of JP947 and JP755 would have conveyed to one of ordinary skill in the art the limitations recited in claims 13, 15, and 16, and having determined that Petitioner has provided sufficient articulated reasoning to support a conclusion of obviousness,[30] we determine that Petitioner has demonstrated by a preponderance of the evidence that the subject matter of claims 13, 15, and 16 would have been obvious over the combination of JP947 and JP755, as set forth by Petitioner. 35 U.S.C. § 103(a).

[30] Patent Owner has not put forth any arguments or evidence of secondary considerations for us to consider in our obviousness analysis.

B. Asserted Ground of Obviousness over JP947, JP755, and Jentschel

Petitioner contends independent claim 18 is unpatentable under 35 U.S.C. § 103 as obvious over JP947, JP755, and Jentschel. Pet. 52–59. With support of the declaration of Dr. Madisetti (Ex. 2022) and additional prior art references (Mohindra and Thomas), Patent Owner contests Petitioner's reasons one of ordinary skill in the art would have combined the teachings of the references. PO Resp. 1–5, 65–76. In reply, Petitioner maintains its position that the subject matter of claim 18 would have been obvious over JP947, JP755, and Jentschel. Reply 23–28.

1. Limitations Recited in Claim 18

Claim 18 depends from independent claim 13. Petitioner and Patent Owner rely on their respective contentions made regarding the limitations recited by independent claim 13. *See, e.g.*, PO Resp. 4, 65. For the reasons discussed previously, we have determined Petitioner demonstrated that the subject matter of independent claim 13 would have been obvious over JP947 and JP755.

Claim 18 additionally recites the steps of generating a first oscillator signal and frequency-dividing the first oscillator signal to generate the in-phase and quadrature oscillator signals prior to the step of mixing. Petitioner, with support of Dr. Razavi, relies on Jentschel as teaching this limitation. Pet. 57–58 (citing Ex. 1301 ¶¶ 278–81).

We agree with Petitioner that Jentschel's Figure 2 and text describing phase shifting would have conveyed to one of ordinary skill in the art generating in-phase and quadrature oscillator signals prior to the step of

mixing. *See id.* at 58 (citing Ex. 1009, 10 (describing the phase shifter); Ex. 1301 ¶¶ 280). Regarding the frequency-dividing limitation, Petitioner relies on Jentschel's phase shifter:

> The phase shifter provides the mixer of the Q channel with an LO signal which is phase-shifted relative to the I signal. Phase shifters on the basis of conducting components have dimensions in the frequency range below 2 GHz which prevent integration. However, broadband phase shifters can be assembled by means of frequency dividers, whereby one divider each for the I and Q channel is controlled with twice the LO frequency and clocked by opposite edges. The outputs subsequently generate two signals phase-shifted by 90°.

Ex. 1009, 10. As Petitioner indicates, Jentschel describes assembling phase shifters by means of frequency dividers, whereby one divider each for the I and Q channel is controlled with twice the LO frequency and clocked by opposite edges. Pet. 57–58 (quoting Ex. 1009, 10).

For these reasons, we determine that Petitioner has demonstrated by a preponderance of the evidence that the combination of JP947, JP755, and Jentschel would have conveyed to one of ordinary skill in the art the limitations recited in claim 18.

2. Reason to Combine Jentschel with JP947 and JP755

Petitioner, relying on Dr. Razavi's testimony, contends that one of ordinary skill in the art would have been motivated to combine Jentschel with JP947 and JP755 "for accurate, frequency independent [in-phase and quadrature local oscillator] signals with a small, integrable footprint." *Id.* at 57 (citing Ex. 1301 ¶ 279) (testifying one of ordinary skill in the art would have been motivated "to use a frequency divider in place of JP947's RC

phase shifter in order to generate accurate, frequency independent in-phase and quadrature local oscillator signals across a broad range of frequencies, while at the same time maintaining a small, highly integrable footprint").

Dr. Razavi further explains that one of ordinary skill in the art would have been motivated to do so "per Jentschel's teachings of the advantages and the disadvantages associated with RC phase shifters." Ex. 1301 ¶ 279 (citing Ex. 1009, 10; referring to Ex. 1301 ¶¶ 217–21 (in Section X.E titled "A Person of Ordinary Skill in the Art Would Have Been Motivated to Combine JP947, JP755, and Jentschel")). Dr. Razavi specifically identifies Jentschel's disclosure describing various disadvantages of an RC phase shifter and Jentschel's teaching that problems with generating in-phase and quadrature local oscillator signals using RC phase shifters can be overcome using a frequency divider. Ex. 1301 ¶ 218.

We determine Dr. Razavi testimony contending that one of ordinary skill in the art would have reason to "implement JP947's phase shifter as a frequency divider, in order to generate accurate, frequency independent I and Q [local oscillator] signals with a small, integrable footprint, while minimizing statistical variations" provides persuasive articulated reasoning with rational underpinning to support the legal conclusion of obviousness. Pet. 55 (citing Ex. 1009, 6 (indicating benefits from monolithic integration of circuit components)); Ex. 1013, Abs. ("The purpose of the invention [described in JP755] is to achieve miniaturization by reducing the number of parts of a direct detection receiver capable of receiving a plurality of frequency bands."); Ex. 1301 ¶¶ 217–18); *KSR*, 550 at 418.

3. Patent Owner Contentions Regarding Reason to Combine

Patent Owner contends,[31] relying on Dr. Madisetti's testimony, that Petitioner fails to provide the requisite articulated reasoning with some rational underpinning to support the legal conclusion of obviousness. PO Resp. 65–76 (citing Ex. 2022 ¶¶ 98, 128); *see KSR*, 500 U.S. at 418. More specifically, Patent Owner contends that (i) the benefits of Jentschel identified by Dr. Razavi do not apply to JP947's direct conversion receiver, (ii) JP947's architecture is incompatible with, and therefore, teaches away from, using a frequency divider, and (iii) Jentschel itself teaches away from the use of a frequency divider. PO Resp. 65–66; *see id.* at 65–76.

First, Patent Owner essentially contends that one of ordinary skill in the art would not have had a reason to combine the known elements in the fashion claimed by the patent at issue. *See KSR*, 550 at 418. Specifically, Patent Owner contends that the benefits of using a frequency divider to achieve "a small, integrable footprint" would not apply to the context of JP947 because (i) JP947 is concerned with improved performance, not integrating components on a chip or with miniaturization and (ii) could not

[31] As discussed above in the context of Petitioner's asserted ground of obviousness of claim 18 over JP947 and Jentschel in IPR2015-01584, we determined Petitioner met its burden, including providing persuasive articulated reasoning with rational underpinning to support the legal conclusion of obviousness. *KSR*, 550 U.S. at 418. Although at times, Patent Owner makes substantially similar arguments in this asserted ground of obviousness of claim 18 over JP947, JP755, and Jentschel, Patent Owner makes additional arguments. Furthermore, there is a different record of reasoning and evidence in this case, on which we base our determinations.

obtain such benefits because JP947 uses capacitors and coils. PO Resp. 66–67.

We do not agree with Patent Owner that the benefit of using a frequency divider in JP947's direct conversion receiver must be the same benefit as an express statement of the purpose of JP947's technology. Although "[o]ne of the ways in which a patent's subject matter can be proved obvious is by noting that there existed at the time of invention a known problem for which there was an obvious solution encompassed by the patent's claims" (*KSR*, 550 at 419–20), that is not the only way. Patent Owner's argument does not weigh against a finding of obviousness.

Moreover, as Dr. Razavi testifies, using a frequency divider in JP947's receiver would achieve the same benefit as in Jentschel: a small, integrable footprint. This weighs toward a finding of obviousness. *KSR*, 550 at 417 ("if a technique has been used to improve one device, and a person of ordinary skill in the art would recognize that it would improve similar devices in the same way, using the technique is obvious unless its actual application is beyond his or her skill.").

Patent Owner contends, with support of Dr. Madisetti, that the combination of JP947 and Jentschel would not result in the benefit identified by Dr. Razavi because JP947 uses capacitors and coils. PO Resp. 66–67 (citing Ex. 2022 ¶ 128–29). As Dr. Razavi explains, however, the identified capacitors and coils do not prevent integration of a frequency divider for how the LO phases are generated as required by claim 18. Ex. 1308 ¶ 54; Pet. Reply 24 (paraphrasing Dr. Razavi's testimony). This weighs toward a

finding of obviousness based on Petitioner's proposed reason to combine Jentschel's frequency divider with JP947's direct conversion receiver.

Second, Patent Owner contends that JP947's architecture teaches away from the use of a frequency divider. PO Resp. 65–66. More specifically, Patent Owner contends, with support of Dr. Madisetti, that JP947's architecture is incompatible with using a frequency divider. PO Resp. 67–70; Ex. 2022 ¶¶ 121–26 (describing JP947's architecture as being incompatible with a frequency divider). Patent Owner's position is based on Dr. Madisetti's description and figures regarding how one of ordinary skill in the art would combine a frequency divider in JP947's direct conversion receiver. PO Resp. 67–70. According to Patent Owner and Dr. Madisetti, such incompatibility would have discouraged the use of a frequency divider, and so teaches away. PO Resp. 70 (citing 2022 ¶ 126).

In response, Dr. Razavi disagrees that one of ordinary skill in the art would have combined the references in the manner proposed by Dr. Madisetti. Ex. 1308 ¶¶ 55–56; Pet. Reply 26. Dr. Madisetti explains one of ordinary skill in the art would have maintained the "hard wired" direct connection between an oscillator and mixer 4-3 in JP947 and connected only one of two outputs from the frequency divider to the other mixer, which would result in mixers 4-2, 4-3 receiving signals having two different frequencies, instead of in-phase and quadrature signals. PO Resp. 68–70. Dr. Razavi disagrees and contends that one of ordinary skill in the art would have understood that to have a frequency divider that provides in-phase and quadrature oscillator signals, the oscillator would be disconnected

from mixer 4-3 (in other words, not hard wired) and two outputs of the frequency divider would be applied to mixers 4-2 and 4-3, respectively. Ex. 1308 ¶¶ 55–56; Pet. Reply 26.

Weighing the testimony, we credit Dr. Razavi's testimony as to how one of ordinary skill in the art would have made a simple substitution of Jentschel's frequency divider over Dr. Madisetti's testimony that retains the hard wired connection and reflects an actual, physical substitution of elements. "It is well-established that a determination of obviousness based on teachings from multiple references does not require an actual, physical substitution of elements." *Mouttet*, 686 F.3d at 1332. Thus, we do not agree that Jentschel's frequency divider is incompatible with JP947's architecture.

Third, Patent Owner contends, relying on Dr. Madisetti's testimony, that Jentschel teaches away from using a frequency divider in JP947's receiver because such a use would defeat one of the purposes of Jentschel—low power consumption—which would discourage use of such circuitry in a direct conversion receiver. PO Resp. 71–75 (citing Ex. 2022 ¶¶ 101, 111, 117). Patent Owner further contends that one of ordinary skill in the art would be led in the direction of using phase shifters based on RC elements. *Id.* 76 (citng Ex. 2022 ¶¶ 117–19).

Patent Owner acknowledges that "Jentschel describes frequency dividers, and lists some advantages." *Id.* at 73 (citing Ex. 1009, 10; Ex. 2022 ¶ 109). Patent Owner relies on Jentschel's indication that "the high power demand [of frequency dividers] is disadvantageous" and Jentschel's indication that "[f]or acceptance of a multimode cell phone, a

highly integrated receiver solution, which features low volume, low power consumption, and low price, is of vital importance." *Id.* at 73 (citing Ex. 1009, 10, 13). Patent Owner further indicates that Jentschel concludes that RC elements for phase shifters "are suitable." *Id.* at 76 (citing Ex. 2022, ¶¶ 117–19; quoting Ex. 1009, 10) (stating "Jentschel concludes that in fact '[f]or the multimodel receiver, RC elements . . . are suitable" (emphasis omitted)).

A reference teaches away "when a person of ordinary skill, upon reading the reference, would be discouraged from following the path set out in the reference, or would be led in a direction divergent from the path that was taken by the applicant." *Mouttet*, 686 F.3d at 1333–34. Moreover, a "mere disclosure of more than one alternative does not amount to teaching away from one of the alternatives where the reference does not criticize, discredit, or otherwise discourage the solution." *SightSound Techs.*, 809 F.3d at 1320. A reference may not teach away even if a particular solution is not the preferred solution or is inferior to another solution. *Fulton*, 391 F.3d at 1200.

Applying these principles to the facts of IPR2015-01600, we determine that Jentschel's discussion of advantages and disadvantages of using a frequency divider and Jentschel's indication that another component is "suitable" does not rise to the level of teaching away from the use of frequency dividers. Nor does Jentschel's indication that "high power demand [of frequency dividers] is disadvantageous" amount to a teaching away. Accordingly, we agree with Dr. Razavi that, although Jentschel

identifies advantages and disadvantages of using a frequency divider, Jentschel does not criticize, discredit or discourage the use of a frequency divider (Ex. 1308 ¶¶ 58–65).

For these reasons, we determine that Petitioner provided sufficient articulated reasoning to support a conclusion of obviousness the combination of JP947, JP755, and Jentschel, as proposed by Petitioner.

4. Conclusion

For the foregoing reasons, we determine that Petitioner has demonstrated by a preponderance of the evidence that the subject matter of claim 18 would have been obvious over the combination of JP947, JP755, and Jentschel, as set forth by Petitioner. 35 U.S.C. § 103(a).

V. PATENT OWNER'S MOTIONS TO EXCLUDE IN IPR2015-01584 AND IPR2015-016

In its Motions to Exclude (15 Paper 61; 16 Paper 63), Patent Owner contends that Exhibits 1037 and 1050 are inadmissible hearsay and not authenticated. 15 Mot. Exc. 7–8; 16 Mot. Exc. 7–8. We have not relied on evidence contained in either of these exhibits. Thus, we need not address these issues and deny Patent Owner's Motions to Exclude Exhibits 1037 and 1050 as moot.

In addition, each of Patent Owner's Motions to Exclude also requests the exclusion of Exhibits 1056 and 1057. 15 PO Mot. Exc. 2–7; 16 PO Mot. Exc. 2–7. In response, Petitioner withdrew Exhibits 1056 and 1057. 15 Opp Exc. 1; 16 Opp Exc. 1. Accordingly, we need not address Patent Owner's

arguments to exclude Exhibits 1056 and 1057 and deny Patent Owner's Motions to Exclude Exhibits 1056 and 1057 as moot.

VI. CONCLUSION

Based on the evidence and arguments, Petitioner has demonstrated by a preponderance of the evidence that (i) the subject matter of claims 13, 15, 16, and 18 would have been obvious over Jentschel and JP947, (ii) the subject matter of claims 13, 15, and 16 would have been obvious over JP947 and JP755, and (iii) the subject matter of claim 18 would have been obvious over JP947, JP755, and Jentschel.

Petitioner, however, has *not* demonstrated that (i) claims 13 and 16 are anticipated by Lawton or (ii) the subject matter of claims 15 and 18 would have been obvious over Lawton and Jentschel.

VII. ORDER

Accordingly, it is:

ORDERED that claims 13, 15, 16, and 18 of U.S. Patent No. 6,029,052 have been shown to be unpatentable in IPR2015-01584;

FURTHER ORDERED that claims 13, 15, 16, and 18 of U.S. Patent No. 6,029,052 have been shown to be unpatentable in IPR2015-01600;

FURTHER ORDERED that Patent Owner's Motions to Exclude in IPR2015-01584 and IPR2015-01600 are denied; and

FURTHER ORDERED that, because this is a final written decision, parties to the proceedings 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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