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Paper 29
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UNITED STATES PATENT AND TRADEMARK OFFICE

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BEFORE THE PATENT TRIAL AND APPEAL BOARD

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ERICSSON INC. and
TELEFONAKTIEBOLAGET LM ERICSSON,
Petitioner,

v.

INTELLECTUAL VENTURES I LLC,
Patent Owner.

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Case IPR2014-00963
Patent 6,952,408 B2

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Before JOSIAH C. COCKS, WILLIAM A. CAPP, and
DAVID C. MCKONE, *Administrative Patent Judges.*

MCKONE, *Administrative Patent Judge*.

FINAL WRITTEN DECISION
35 U.S.C. § 318(a) and 37 C.F.R. § 42.73

# I. INTRODUCTION

## *A. Background*

Ericsson Inc. and Telefonaktiebolaget LM Ericsson (collectively "Petitioner") filed a Corrected Petition (Paper 6, "Pet.") to institute *inter partes* review of claims 1–16 of U.S. Patent No. 6,952,408 B2 (Ex. 1001, "the '408 patent"). Intellectual Ventures I LLC ("Patent Owner") filed a Preliminary Response (Paper 8, "Prelim. Resp."). Pursuant to 35 U.S.C. § 314, in our Decision to Institute, we instituted this proceeding as to all of the challenged claims of the '408 patent. Paper 10 ("Dec."), 26.

After the Decision to Institute, Patent Owner filed a Patent Owner Response (Paper 16, "PO Resp."), and Petitioner filed a Reply to the Patent Owner Response (Paper 18, "Reply"). An oral hearing was held on August 26, 2015. Paper 28 ("Tr.").

Petitioner relies on the testimony of Wayne Stark, Ph.D. (Ex. 1003, "Stark Decl."; Ex. 1022, "Stark Reply Decl.") in support of its contentions. Patent Owner relies on the testimony of Jonathon Wells, Ph.D. (Ex. 2007, "Wells Decl.") in support of its contentions.

We have jurisdiction under 35 U.S.C. § 6(c). This Decision is a final written decision under 35 U.S.C. § 318(a) as to the patentability of the challenged claims. Based on the record before us, Petitioner has not demonstrated, by a preponderance of the evidence, that any of the challenged claims is unpatentable.

*B. Related Matters*

Patent Owner has asserted the '408 patent against various companies in several lawsuits filed in the United States District Court for the District of Delaware. Pet. 1; Paper 5, at 1.

*C. References Relied Upon*

Petitioner relies upon the following prior art references:

Ex. 1006 US 5,592,480 Jan. 7, 1997 ("the '480 patent")

Ex. 1007 US 5,537,435 July 16, 1996 ("the '435 patent")

*Recommendation GSM 05.02, Radio Sub-system Link Control*, EUROPEAN TELECOMMUNICATIONS STANDARDS INSTITUTE, v. 3.8.0 (Dec. 1995) (Ex. 1012, "GSM 05.02")

*D. The Asserted Grounds*

We instituted this proceeding based on the following specific grounds (Dec. 26):

| Reference(s) | Basis | Claims Challenged |
|---|---|---|
| The '480 patent | § 102(b) | 1–10, 12–16 |
| The '480 patent, the '435 patent, and GSM 05.02 | § 103(a) | 1–16 |

## II. ANALYSIS

*A. The '408 Patent*

The '408 patent is directed to a method for frequency hopping in cellular wireless communication. Ex. 1001, Abstract. Frequency hopping is a modulation technique in which a transmission frequency is changed according to a schedule in order to reduce the amount of interference

experienced at particular frequencies. *Id.* at 2:23–29, 2:33–36, 11:19–24. According to the '408 patent the Groupe Spécial Mobile ("GSM") set of mobile communications standards developed by the European Telecommunications Standards Institute ("ETSI") provides for frequency hopping. *Id.* at 3:1–5. Communications between mobile stations (e.g., cellular phones) and basestations can include several logical channels time division multiplexed into recurring time slots of a single radio frequency ("RF") channel. *Id.* at 11:43–45. In frequency hopping, a mobile station maintains its time slot when hopping to a different frequency. *Id.* at 11:45–50.

A preferred embodiment of the invention of the '408 patent is illustrated in Figure 1, reproduced below:

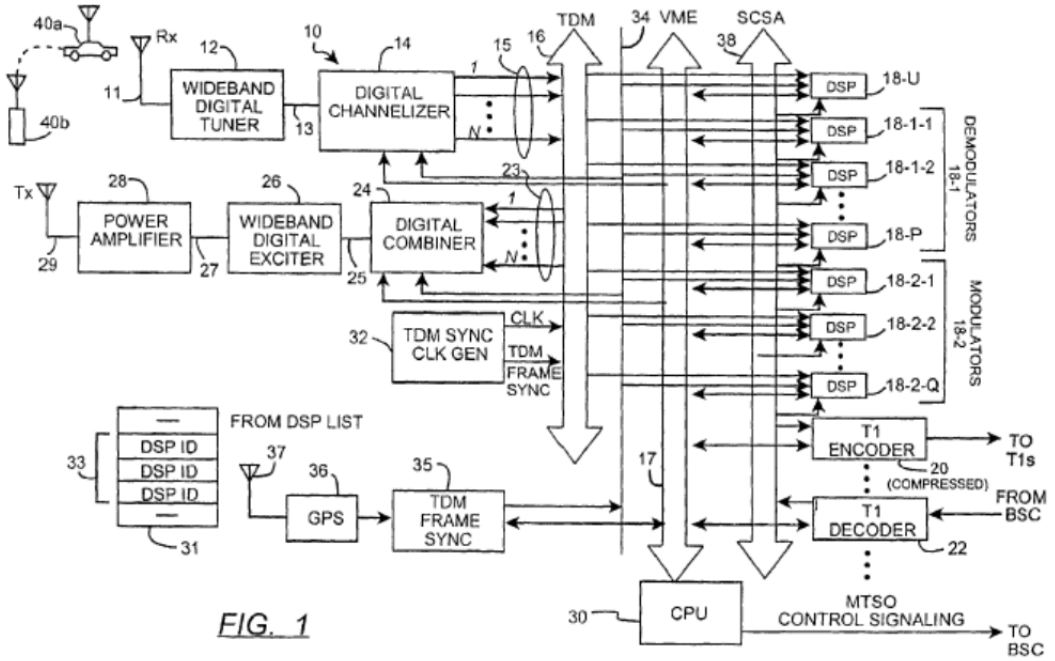


FIG. 1

Figure 1 is a block diagram of wideband digital basestation 10 in communication with mobile subscriber terminals 40a, 40b. *Id.* at 3:46–48,

4:36–38. Wideband digital tuner 12 receives a composite RF modulated signal (e.g., modulated voice or data) from a mobile subscriber terminal (e.g., 40a, 40b), down converts the signal to an intermediate frequency, and converts it from analog to digital. *Id.* at 4:53–59. Digital channelizer 14 receives the composite digital signal 13 from digital tuner 12 and separates it into a plurality of digital channel signals 15. *Id.* at 5:1–3.

The digital channel signals are provided to a plurality of digital signal processors ("DSPs") over time division multiplex ("TDM") bus 16. *Id.* at 31–34. The DSPs (e.g., 18-1-1 to 18-1-P) demodulate the digital channel signals. *Id.* at 5:31–34, 5:49–51. The TDM bus is configured to route the same recurring time slot to a particular demodulator DSP such that the DSP performs baseband processing for the same mobile station before and after a change in RF frequency. *Id.* at 12:22–24. In other words, the TDM bus routes a physical RF channel to the DSP corresponding to the correct logical channel for the mobile station.

Figure 8, reproduced below, is an example of a structure to indicate to the TDM bus how to map digital channel signals to DSPs. *Id.* at 11:50–58.

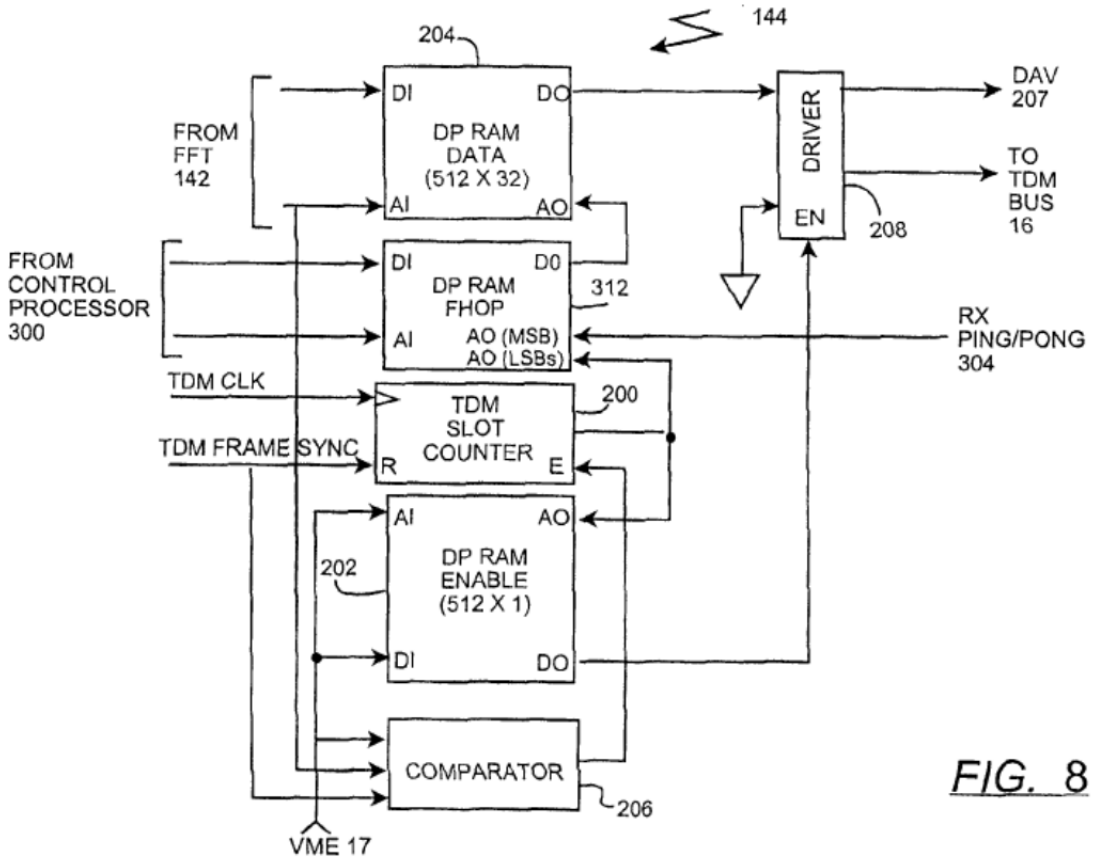


FIG. 8

Figure 8 is a block diagram of a TDM dual port ("DP") driver 144 within digital channelizer 14. *Id.* A control processor for the basestation supplies indications of current and next physical RF channel-to-logical channel mappings to frequency hop dual port random access memory ("FHOP DP-RAM") 312, which stores the current and next values in address locations that differ by the most significant address bit. *Id.* at 11:57–11. RX PING/PONG signal 304 toggles according to a hop sequence interval, causing the TDM bus to be remapped at a rate corresponding to the hop sequence interval. *Id.* at 12:15–21. The hop sequence interval can be synchronized to a timing signal from a Global Positioning System ("GPS") receiver (*see* Fig. 1, items 35–37). *Id.* at 12:31–56.

Data to be transmitted from the basestation to mobile stations are handled similarly. *Id.* at 6:44–45. With reference to Figure 1, DSPs 18-2-1 through 18-2-Q modulate the data, which are routed to digital combiner 24 via TDM bus 16. *Id.* at 6:47–56. Digital combiner 24 combines the data, which it receives in multiple RF frequencies, into a composite signal. *Id.* at 7:7–9, 8:5–7. Digital exciter 26 then generates a composite RF signal to be transmitted over an antenna to the mobile stations. *Id.* at 7:9–13.

Claim 1, reproduced below, is illustrative of the claimed subject matter:

> 1. A method for frequency hopping in a cellular communications system having multiple mobile subscribers communicating on a plurality of different physical RF channels on any time division multiplexed scheme with a basestation having a broadband transceiver, said method comprising the steps of:
>
> operating said broadband transceiver using a plurality of transceiver RF frequencies, each of which represents one of said physical RF channels; and
>
> changing from a first of said physical RF channels upon which said mobile subscribers communicate with said basestation to a second of said physical RF channels, while maintaining a same logical channel.

*B. Claim Construction*

We interpret claims of an unexpired patent using the broadest reasonable construction in light of the specification of the patent in which they appear. *See* 37 C.F.R. § 42.100(b); *In re Cuozzo Speed Techs., LLC*, 793 F.3d 1268, 1278 (Fed. Cir. 2015). Claim terms generally are given their

ordinary and customary meaning, as would be understood by one of ordinary skill in the art in the context of the entire disclosure. *See In re Translogic Tech., Inc.*, 504 F.3d 1249, 1257 (Fed. Cir. 2007).

In the Decision to Institute, in light of an agreement between the parties, we preliminarily determined that "broadband transceiver," recited in claim 1, means "a transceiver that covers a substantial portion of the bandwidth available to the wireless service provider who is operating the basestation," with the clarification that such a transceiver does not include a set of single-frequency transceivers. Dec. 10. Neither party contests this construction. On the complete record, we maintain this construction.

We further determined that no other claim term required express construction. Dec. 10. Neither party proposes a construction of any other term and we find it unnecessary to construe any other term to resolve the dispute between the parties.

*C. Anticipation by the '480 Patent*

To anticipate, a reference must "show all of the limitations of the claims arranged or combined in the same way as recited in the claims." *Net MoneyIN, Inc. v. Verisign, Inc.*, 545 F.3d 1359, 1370 (Fed. Cir. 2008); *accord In re Bond*, 910 F.2d 831, 832 (Fed. Cir. 1990). However, as Petitioner argues (Pet. 21–22), "a prior art reference must be 'considered together with the knowledge of one of ordinary skill in the pertinent art.'" *In re Paulsen*, 30 F.3d 1475, 1480 (Fed. Cir. 1994) (quoting *In re Samour*, 571 F.2d 559, 562, (CCPA 1978)).

Petitioner contends that claims 1–10 and 12–16[1] are anticipated by the '480 patent, in light of the knowledge of a person of ordinary skill in the art, as exemplified by GSM 05.02. Pet. 18–28. For the reasons given below, we disagree.

*1. Overview of the '480 Patent*

The '480 patent, also assigned to Patent Owner, describes a wideband wireless basestation. Ex. 1006, Abstract. Figure 1 of the '480 patent, reproduced below, illustrates an example:

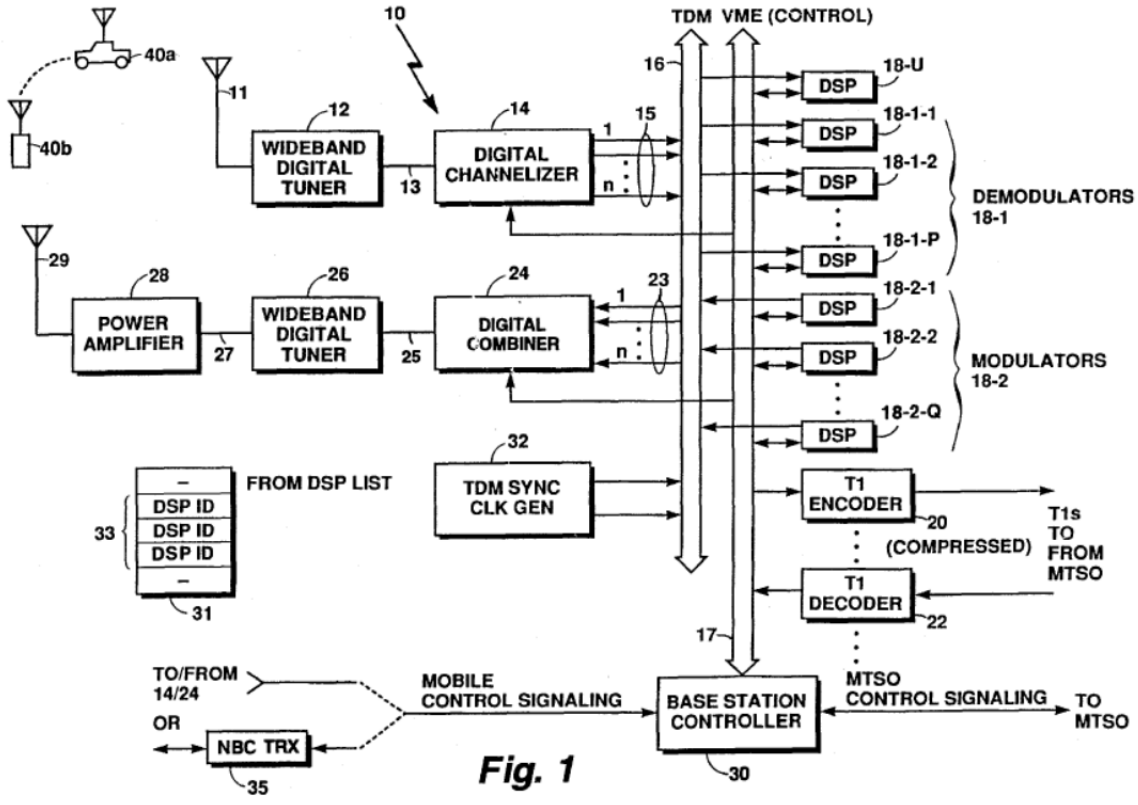


Fig. 1

[1] In our Decision to Institute, we determined that Petitioner had not shown a reasonable likelihood that it would prevail with respect to claim 11 as anticipated by the '480 patent. Dec. 15.

Figure 1 is a block diagram of a wideband digital basestation. *Id.* at 4:26–28.

The ’480 and ’408 patents are not related; however, they share significant disclosure. For example, wideband digital tuners 12, 26, digital channelizer 14, digital combiner 24, TDM bus 16, modulators 18-2, and demodulators 18-1 are described similarly to the components sharing those designations in Figure 1 of the ’408 patent, reproduced above. *Compare* Ex. 1006, 5:28–6:26, 6:60–7:35, *with* Ex. 1001, 4:60–5:56, 6:35–7:12.

Figure 3 is reproduced below:

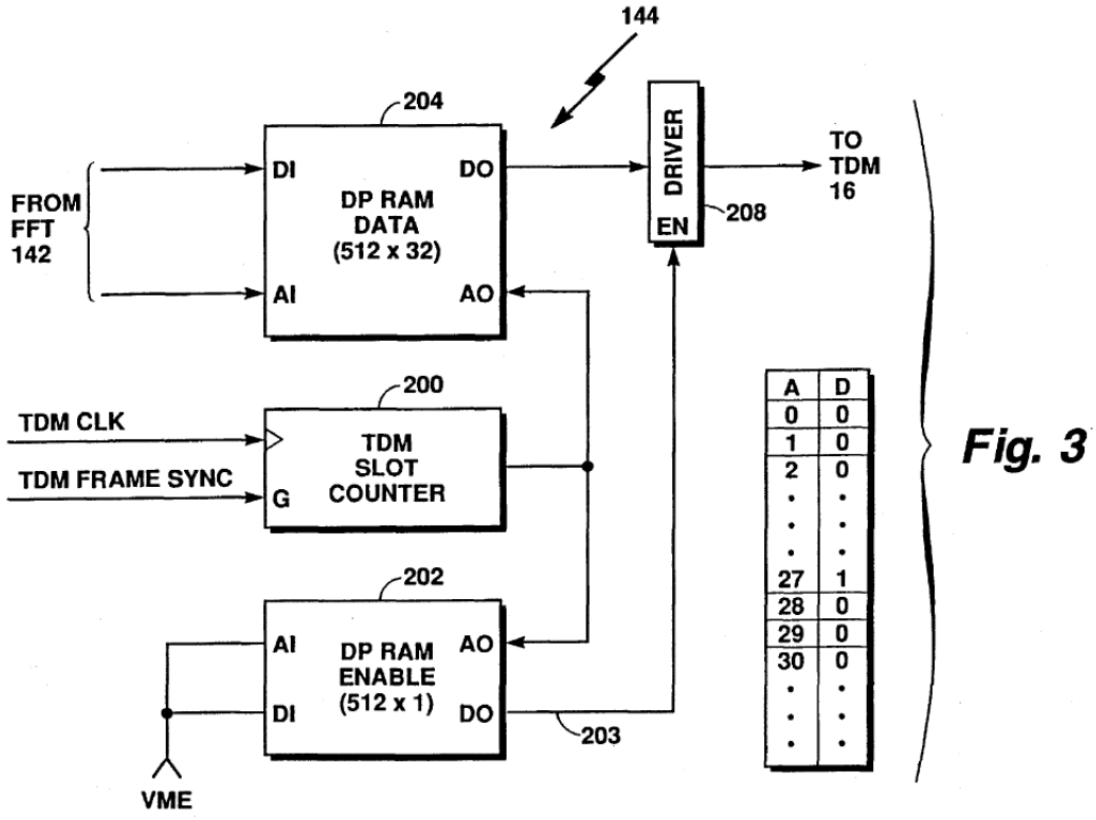


Fig. 3

Figure 3 is a block diagram of an addressable bus driver using dual port RAM. Ex. 1006, 4:33–34. Figure 3 is a detailed diagram of TDM DP driver 144, a component of digital channelizer 14 shown in Figure 1. *Id.* at 8:41–

42. In one embodiment, digital channelizer 14 uses a set of convolutional digital filters 140 and a Fast Fourier Transform ("FFT") processor 142 (both shown in Figure 2) to separate a combined signal into n individual channels. *Id.* at 5:42–56. TDM DP driver 144 operates to assert the output samples from FFT 142 in the proper time slots on TDM bus 16. *Id.* at 8:43–44.

DP-RAM Enable 202 is a memory with locations corresponding to each time slot on TDM bus 16. *Id.* at 9:54–58. During the process of setting up a new call, controller 30 writes to DP-RAM Enable 202 a mapping of "1's" and "0's" indicating whether each time slot on TDM bus 16 is active (the time slot has been assigned to TDM driver 144 and data is to be asserted at that time slot) or inactive (no data is to be asserted at that time slot). *Id.* at 9:59–63. TDM Slot Counter 200 uses a pair of signals (TDM CLK and TDM FRAME SYNC) received from synchronization circuit 32 (shown in Figure 1) to keep track of the presently active TDM slot. *Id.* at 8:60–9:4. DP-RAM Data 204 receives digital channel signal samples output by FFT 142 and stores the samples until addressed by TDM Slot Counter 200. *Id.* at 10:4–8. Using the programmed mapping and the presently active TDM slot from TDM Slot Counter 200, DP RAM Enable 202 generates enable signal 203 to driver 208 to indicate when TDM DP driver 144 may assert data from DP RAM Data 204 on TDM bus 16. *Id.* at 9:48–50.

According to the '480 patent, "[t]he particular modulation . . . used [in the described system] may be any one of a number of different wireless (air interface) standards such as . . . frequency hopping standards such as the European Groupe Speciale Mobile (GSM) . . . ." Ex. 1006, 5:9–17. As can be seen by comparing Figure 3 of the '480 patent with Figure 8 of the '408 patent, the two patents describe bus drivers with similar components.

Nevertheless, Figure 3 of the ’480 patent lacks the DP RAM FHOP 312, Comparator 206, control processor 300, and RX Ping/PONG 304 components shown in Figure 8 of the ’480 patent. As explained above, these additional components of Figure 8 are described as implementing a frequency hopping functionality. Ex. 1001, 11:19–12:24. A key dispute between the parties is whether the structure shown in Figure 3 of the ’480 patent, with appropriate programming, would implement frequency hopping, despite a lack of a specific example such as Figure 8 of the ’408 patent.

*2. Overview of GSM 05.02*

GSM 05.02 is one of the various documents defining the GSM standard. According to Dr. Stark,

> The cellular system developed, now known as GSM (Global System for Mobile Communications), was deployed in the early 1990’s by the European Telecommunications Standards Institute (“ETSI”) and is a set of protocols for second generation (2G) digital cellular networks used by mobile phones. It is the de facto global standard for mobile communications with over 90% market share and is available in over 219 countries and territories.

Ex. 1003 ¶ 20.

GSM 05.02 is a recommendation from ETSI that “defines the physical channels of the radio sub-system required to support the logical channels” and “includes a description of the logical channels and the definition of frequency hopping, TDMA frames, timeslots and bursts.” Ex. 1012, 5. Dr. Stark admits that frequency hopping is an optional part of the GSM standard. Ex. 1003 ¶ 20 (“GSM uses a combination of TDMA and optionally slow frequency-hopping with a spectrally-efficient modulation

technique known as Gaussian minimum shift keying (GMSK)."); Ex. 2001, 50:11–21.

GSM 05.02 describes an algorithm for mapping logical channels onto physical channels. Ex. 1012, 15. In particular, GSM 05.02 describes an algorithm for hopping sequence generation. *Id.* at 16 (Section 6.2.3).

*3. Claims 1–10 and 12–16*

Patent Owner frames the invention of the '408 patent, generally, as "[f]or the first time it provided a mobile broadband base station that could frequency hop." Tr. 33:5–8.

Petitioner contends that the '480 patent's basestation 10, including digital tuner 12, is a basestation having a broadband transceiver. Pet. 28–29. Petitioner cites to the '480 patent's description of down-converting a wideband signal into channel signals as a disclosure of "operating said broadband transceiver using a plurality of transceiver RF frequencies, each of which represents one of said physical RF channels," as recited in claim 1. *Id.*

Petitioner further contends that the '480 patent describes "changing from a first of said physical RF channels upon which said mobile subscribers communicate with said basestation to a second of said physical RF channels, while maintaining a same logical channel," as recited in claim 1. *Id.* at 29–30. Petitioner acknowledges that the '480 patent does not include the detailed discussion of frequency hopping presented in the '408 patent, including the discussion of the dedicated memory component depicted in Figure 8 of the '408 patent (reproduced above) used to facilitate frequency hopping. Pet. 16–17. Nevertheless, Petitioner argues that the '480 patent

states explicitly that its system implements frequency hopping and that a skilled artisan would have possessed the requisite background knowledge to understand how frequency hopping is implemented in the '480 patent. *Id.* at 17–24.

The '480 patent states that:

> More particularly, the basestation exchanges radio frequency (RF) signals with a number of mobile subscriber terminals (mobiles) 40a, 40b. The *RF* carrier signals are modulated with voice and/or data (channel) signals which are to be coupled to the public switched telephone network (PSTN) by the basestation 10. The particular modulation in use[] may be any one of a number of different wireless (air interface) standards such as the well known Advanced Mobile Phone Service (AMPS), time division multiple access (TDMA) such as IS-54B, code division multiple access (CDMA) such as IS-95, *frequency hopping standards such as the European Groupe Speciale Mobile (GSM)*, personal communication network (PCN) standards, and the like.

Ex. 1006, 5:4–17 (emphasis added). Petitioner argues that this is a statement, in the '480 patent, "that the basestation permitted frequency hopping in accordance with the GSM standard." Pet. 17.

As to the background knowledge of a skilled artisan, Petitioner's declarant, Dr. Stark, testifies that "a [person of ordinary skill in the art] would have understood that explicit reference to GSM [in Ex. 1006, 5:9–16] to include reference to the constituent part of the GSM standard that specifies frequency hopping, *i.e.*, GSM 05.02 [Ex. 1012]." Ex. 1003 ¶ 90. In light of this testimony, Petitioner argues that "[a]s evidenced by GSM 05.02, a [person of ordinary skill in the art] would understand that the GSM standard contains details about how frequency hopping works, including formula and algorithms for generating initial and subsequent frequency

hopping mappings, which could easily be programmed into the DP RAM and basestation controller disclosed in the '480 Patent." Pet. 20. Specifically, relying on Dr. Stark's testimony, Petitioner argues that GSM 05.02 discloses algorithms for "changing from a first of said physical RF channels upon which said mobile subscribers communicate with said basestation to a second of said physical channels while maintaining a same logical channel," as recited in claim 1. *Id.* 23–24 (citing Ex. 1012 §§ 5.6, 6.2, 6.2.1–6.2.3; Ex. 1003 ¶¶ 32–36, 90–97).

Petitioner contends that the existing hardware shown in Figure 3 of the '480 patent could be used for frequency hopping, specifically by using controller 30 to program appropriate RF channel mapping structures into DP RAM Enable 202 via VME bus 17. Pet. 19. The mapping structures would be programmed at appropriate intervals according to the frequency hopping algorithm provided in GSM 05.02. *Id.* at 20–21. In the Reply, Petitioner reiterates that the existing hardware shown in the '480 patent, with appropriate software changes, would support frequency hopping without any hardware changes. Reply 10. According to Petitioner,

> all that was needed to implement frequency hopping was for the basestation controller or DSPs[2] to have the GSM frequency hopping algorithm or hop sequence and then for the basestation controller or DSPs to update the hop pattern every new TDMA frame. This could be done simply by programming the basestation controller or DSPs with as little as 20 lines of code.

[2] As explained below, Petitioner did not argue in the Petition that frequency hopping could be implemented by re-programming the DSPs described in the '480 patent. Petitioner raised that argument for the first time in the Reply. Thus, Petitioner waived this argument.

*Id.* at 13 (citing Ex. 1003 ¶¶ 87–97, 99, 102–03; Ex. 1022 ¶¶ 9–10, 19, 25–44).

In response, Patent Owner argues that the '480 patent "merely states that it can support GSM, which is characterized as a frequency-hopping standard," and that this "does not mean that [the '480 patent] supports frequency hopping, one of the many features in the GSM standard." PO Resp. 9. Patent Owner makes additional arguments regarding the capability of the structure described in the '480 patent to implement frequency hopping, arguments it substantially repeats in opposing Petitioner's obviousness allegations. *Id.* at 16–27. Consideration of these arguments is not necessary to resolve the dispute over anticipation.

To be clear, Petitioner's contention is not that the '480 patent incorporates by reference GSM 05.02. *See* Reply 4 (conceding that "Petitioner made no such assertion."). Nor has Petitioner introduced evidence or argument that implementation of the algorithm disclosed in GSM 05.02 necessarily is required by (and thus inherently disclosed in) the '480 patent. Rather, Petitioner's theory is that the '480 patent expressly states that it implements the frequency hopping portion of the GSM standard and that a skilled artisan would have understood, per GSM 05.02, the appropriate algorithm that would have been programmed in the '480 patent's existing components to implement that standard. Pet. 22–23 ("A [person of ordinary skill in the art] would have understood the explicit reference in the '480 Patent to GSM to include reference to GSM 05.02 and thus that the reference discloses 'a plurality of different physical RF channels on any time division multiplexed scheme.'"; "A [person of ordinary skill in the art] would have understood the explicit reference to GSM (and, therefore GSM

05.02) to additionally disclose 'a plurality of transceiver RF frequencies, each of which represents one of said physical RF channels.'"). Thus, Petitioner's anticipation ground hinges on Petitioner's assertion that the '480 patent explicitly discloses that its system implements the frequency hopping portion of the GSM standard.

The passage from the '480 patent on which Petitioner relies (Ex. 1006, 5:4–17) describes a basestation's exchange of RF signals with mobile subscriber terminals. Specifically, the passage is directed to the modulation of voice and data channels over RF carrier signals: "The *RF carrier signals are modulated with voice and/or data (channel) signals* which are to be coupled to the public switched telephone network (PSTN) by the basestation 10." Ex. 1006, 5:6–9 (emphasis added). In that context, the '480 patent explains that "[t]he *particular modulation in use[] may be any one of a number of different wireless (air interface) standards* such as the well known Advanced Mobile Phone Service (AMPS), time division multiple access (TDMA) such as IS-54B, code division multiple access (CDMA) such as IS-95, *frequency hopping standards such as the European Groupe Speciale Mobile (GSM)*." *Id.* at 5:9–17 (emphases added). We find that this passage states, at most, that the system described in the '480 patent supports the *modulation* specified by the GSM standard.

Petitioner admitted at the hearing that frequency hopping is not a modulation scheme and that GSM specifies the same modulation scheme whether or not frequency hopping is used. Tr. 62:17–63:23. The passage of column 5, lines 9–17, of the '480 patent is consistent with the system of the '480 patent being programmed to support the modulation scheme of GSM, without supporting the optional frequency hopping functionality. While

GSM is referred to as a "frequency hopping standard[]," the frequency hopping functionality is inapposite to the modulation being discussed in the passage. Tr. 63:17–22 ("JUDGE McKONE: And you can use the same modulation regardless of whether you are using frequency hopping or not, is that right? MR. SPEARS: Exactly. Yeah, it's the same slot. It's the same framing. It's the same TDMA frames. It is all the same."). We find that the '480 patent does not state, explicitly or implicitly, that the described system implements the optional frequency hopping functionality of GSM.

We recognize that Dr. Stark testifies that "a [person of ordinary skill in the art] would have understood that explicit reference to GSM to include reference to the constituent part of the GSM standard that specifies frequency hopping, i.e., GSM 05.02, and thus a [person of ordinary skill in the art] would understand that the '480 Patent discloses this limitation as described below." Ex. 1003 ¶ 90. Dr. Stark's testimony, however, relies on his assumption that frequency hopping is a type of modulation. *Id.* As noted above, Petitioner has conceded that frequency hopping is not a type of modulation. Accordingly, we do not credit Dr. Stark's testimony on this point.

At the hearing, Petitioner argued that "there is no reason to say you are doing frequency hopping unless you are frequency hopping." Tr. 63:22–23. We are not persuaded. The '480 patent does not state that its system is "doing frequency hopping." Rather, it characterizes GSM as a "frequency hopping standard[]." While this characterization may be relevant to obviousness (discussed below), it is not a statement explicitly showing that the system of the '480 patent implements frequency hopping.

In sum, Petitioner has not shown persuasively that the '480 patent describes a system that implements frequency hopping. Accordingly, regardless of the background knowledge of a skilled artisan, Petitioner has not shown that the '480 patent "show[s] all of the limitations of the claims arranged or combined in the same way as recited in the claims." *Net MoneyIN*, 545 F.3d at 1370. Specifically, Petitioner has not shown persuasively that the '480 patent discloses "changing from a first of said physical RF channels upon which said mobile subscribers communicate with said basestation to a second of said physical RF channels, while maintaining a same logical channel," as recited in claim 1 and each of its dependents (claims 2–10 and 12–16).

On the complete record, Petitioner has not shown by a preponderance of the evidence that the '480 patent anticipates claims 1–10 and 12–16.

### *D. Obviousness Over the '480 Patent, the '435 Patent, and GSM 05.02*

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 the invention was made to a person having ordinary skill in the art to which said subject matter pertains." We resolve the question of obviousness 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 skill in the art; and (4) objective evidence of

nonobviousness, i.e., secondary considerations.[3] *Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966).

In the Petition, Petitioner contends that claims 1–16 would have been obvious over the '480 patent, the '435 patent, and GSM 05.02. Pet. 3, 35. The '435 patent also is assigned to Patent Owner. Petitioner contends that the '435 patent provides further details regarding digital channelizers and combiners in basestations, including dynamic mapping of digital channelizer outputs to DSP inputs (Pet. 36–38) and cites the '435 patent as further evidence of the obviousness of claims 3 and 4 (*id.* at 41–42). At the hearing, Petitioner clarified that it is asserting the '435 patent only against claims 3, 4, and their dependents (claims 5–16). Tr. 8:16–9:1. Accordingly, we evaluate whether claims 1 and 2 would have been obvious over the '480 patent and GSM 05.02 and whether claims 3–16 would have been obvious over the '480 patent, the '435 patent, and GSM 05.02.

Petitioner raises this ground "[t]o the Extent the Board disagrees that the frequency hopping features of GSM as described in Ground 1 [anticipation by the '480 patent] would be understood by a [person of ordinary skill in the art] from the teachings of the '480 patent." Pet. 36. Petitioner provides explicit citations to GSM 05.02 for claims 1, 2, and 4, and refers to its evidence of anticipation to show obviousness of claims 5–16. Pet. 39–42. Petitioner contends that a skilled artisan would have combined the '480 patent and GSM 05.02 because the '480 patent expressly references frequency hopping standards such as GSM. *Id.* at 38.

[3] The record does not contain any evidence of secondary considerations.

*1. Level of Skill in the Art*

Petitioner contends that a person of ordinary skill in the art would have had at least a B.S. degree in Electrical Engineering, Computer Engineering, or the like, and at least three years of additional academic or industry experience. Pet. 11 (citing Ex. 1003 (Stark Decl.) ¶ 45). Dr. Wells "generally agree[s] with Dr. Stark in paragraph 45 of his declaration." Ex. 2007 ¶ 20. We adopt the parties agreed statement of the level of skill of a person of ordinary skill in the art.

*2. Reasonable Expectation of Success*

A party challenging a patent based on obviousness must demonstrate that a skilled artisan would have had a reason to combine the teachings of prior art references and would have had a reasonable expectation of success in doing so. *See Procter & Gamble Co. v. Teva Pharm. USA, Inc.*, 566 F.3d 989, 994 (Fed. Cir. 2009). Likewise, the challenger must show that the obviousness combination would have worked for its intended purpose. *See Geo. M. Martin Co. v. Alliance Machine Sys. Int'l, Inc.*, 618 F.3d 1294, 1303 (Fed. Cir. 2010). We recognize that, "[u]nder an obviousness analysis, a reference need not work to qualify as prior art; 'it qualifies as prior art, regardless, for whatever is disclosed therein.'" *Id.* at 1302 (quoting *Amgen Inc. v. Hoechst Marion Roussel, Inc.*, 314 F.3d 1313, 1357 (Fed.Cir.2003)). Nevertheless, "prior art must teach a person of ordinary skill to make an apparatus that works for its intended purpose." *Id.* at 1303; *accord id.* ("If the Visy machine did not do so on its own, Alliance would have needed to establish that a person of ordinary skill would have nonetheless been able to make a working apparatus.").

As explained below, Petitioner has not shown that the obviousness combination it proposes would have worked for its intended purpose. For the same reasons, Petitioner has not shown that a skilled artisan would have had a reasonable expectation of success in combining the teachings of the '480 patent and GSM 05.02 in the way Petitioner proposes.

Although the parties agree as to the level of skill in the art, as discussed above, the parties disagree as to whether a skilled artisan would have had the expertise to combine the teachings of the '480 patent and GSM 05.02 to arrive at a system that implements frequency hopping. Patent Owner contends that a skilled artisan would not have been able to grasp the technical problems and challenges necessary to implement frequency hopping on the system of the '480 patent. PO Resp. 37 (citing Ex. 2007 ¶¶ 1005–06). Specifically, Patent Owner argues that a skilled artisan would lack "significant expertise in GSM protocol, TDMA, programming, synchronization, VME bus capabilities, hardware design, and real-life wireless implementation challenges" and that the changes to the '480 patent proposed by Petitioner "are not entry level endeavors, but require substantial experience or education to ensure that the desired synchronization is achieved." *Id.* at 37–38 (citing Ex. 2007 ¶ 106). Dr. Wells bases his testimony on his own experience managing engineers and concludes that system-wide re-designs require more experience than the skilled artisan postulated by Dr. Stark would have had. Ex. 2007 ¶¶ 21–22. In reply, Petitioner contends that the '480 patent would have required a modification of a mere twenty lines of software code, with no hardware changes, to implement frequency hopping. Reply 7 (citing Ex. 1022 ¶¶ 9–10).

Petitioner's obviousness analysis is sparse as to the combined teachings of the '480 patent and GSM 05.02 and is predominately dedicated to explaining Petitioner's contentions regarding the '435 patent (which admittedly is not at issue for claims 1 and 2, Tr. 8:22–9:3). Pet. 35–39. Petitioner includes several pages of claim charts that refer back to Petitioner's anticipation analysis and add quotations from GSM 05.02, but not explanatory argument. *Id.* at 39–42. In order to evaluate whether a skilled artisan reasonably would have expected success in combining the '480 patent and GSM 05.02, we look to Petitioner's anticipation analysis to understand what teachings Petitioner identifies from each reference and how Petitioner proposes combining those teachings. We note also that Patent Owner's arguments regarding whether Petitioner's combination would have worked is presented in the first instance in response to Petitioner's anticipation contentions. We thus consider Petitioner's anticipation evidence and Patent Owner's evidence in response thereto in evaluating Petitioner's obviousness contentions.

Petitioner argues that Figures 1–3 of the '480 patent and the associated text "describe how a particular RF channel at a channelizer output is mapped onto a specific time slot on the TDM bus and routed to the desired DSP for demodulation." Pet. 19 (citing Ex. 1006, 6:28–45). Specifically, Petitioner argues that controller 30 programs a mapping schedule into DP RAM Enable 202 via VME bus 17, which, according to Petitioner "provid[es] the mapping from the RF channel onto the TDM bus and to a designated DSP, during a time slot." *Id.* (citing Ex. 1006, 9:47–10:3; Ex. 1003 (Stark Decl.) ¶ 98). According to Petitioner:

> The "mapping structure" is formed by basestation control processor 30 and the TDM bus 16 acting as a cross-bar switch, with the basestation control processor 30 writing the proper configuration parameters in the DP RAM ENABLE 202 of the TDM dual-port ("DP") driver 144 and the TDM dual-port ("DP") receiver 244 (in both cases via VME bus 17).

*Id.*; *see also id.* at 24 (providing substantially the same summary of the '480 patent).

Regarding GSM 05.02, Petitioner argues that "a [person of ordinary skill in the art] would understand that the GSM standard contains details about how frequency hopping works, including formula and algorithms for generating initial and subsequent frequency hopping mappings, which could easily be programmed into the DP RAM and basestation controller disclosed in the '480 Patent." *Id.* at 20.

Regarding how these teachings would have been combined, Petitioner argues that the frequency hopping schedule of GSM 05.02 "is easily programmed into controllers, such as the 'basestation controller 30' described by the '480 Patent. The '480 Patent's basestation would 'synchronize' the 'frequency hopping schedule' to the physical RF channels by use of the TDM synchronization clock generator (32 in Fig. 1), TDM slot counter (200 in Fig. 3) and TDM CLK and TDM FRAME SYNC signals." *Id.* at 25. Dr. Stark repeats this argument in his testimony. Ex. 1003 ¶ 99; *see also* Ex. 1022 ¶ 16 ("In order to perform frequency hopping (and dehopping), the '480 Patent's basestation controller could simply provide a new mapping signal (table) to the DP RAM Enable 202 for each successive GSM TDMA frame, which as [I] describe in more detail below, is every 4.615 milliseconds.").

Thus, the theory advanced in the Petition is that the data programmed into DP RAM Enable 202 provide a mapping between particular channels and particular TDM time slots, thereby switching data associated with a particular RF channel to a DSP corresponding to a particular logical channel. According to Petitioner, by reprogramming DP RAM Enable 202, according to the frequency hopping schedule, each time there is a new frame, DP RAM Enable 202 would remap TDM bus 16 to switch time slots to different DSPs such that the same RF channel appearing in a different time slot nevertheless would be switched to the same DSP corresponding to the logical channel. *See also* Reply 13 ("As Dr. Stark explained, the '480 Patent's basestation could adjust its internal synchronization—including number of slots per frame as well as frame and slot duration—to accommodate different air interface standards. (Ex. 1003, ¶¶ 88, 99; Ex. 1022, ¶¶ 9-11, 31). This, allegedly, could accommodate frequency hopping in one of two ways.[4] First, the basestation controller could update the hopping sequence in DP RAM Enable 202 (Fig. 3) every frame. (Ex. 1022, ¶¶ 9–11, 33). These maps would then be synchronized for assertion to the TDM bus by the TDM Clk.").

Patent Owner argues that combining the teachings of the '480 patent and GSM 05.02 in the way proposed by Petitioner would not have resulted in a system that could perform frequency hopping. PO Resp. 22–27. Specifically, and in reliance on the testimony of Dr. Wells, Patent Owner argues that "the Carney '480 system cannot generate the frequency-hopping

[4] The second "way" of accommodating frequency hopping, first argued in the Reply, exceeds the scope of a proper reply and is waived, as explained below.

sequence according to the pseudo-random algorithm defined in sub-section 6.2.3 of GSM 05.02 through programming the DP RAM enable 202 alone." PO Resp. 26–27 (citing Ex. 2007 ¶ 97). According to Patent Owner, the only mapping provided by DP RAM Enable 202 is a set of 1's and 0's representing enabled time slots and the associated logical channels of the DSPs. *Id.* at 27. Patent Owner argues that "these 'mapping structures' do not allow for the 'changing from a first of said physical RF channels upon which said mobile subscribers communicate with said basestation to a second of said physical RF channels, while maintaining a same logical channel,' as recited in independent claim 1." *Id.*

We agree with Patent Owner that Petitioner has not shown that the system of the '480 patent could be modified to implement frequency hopping through re-programming of DP RAM Enable 202 alone. According to the '480 patent, the association between RF channels and DSPs (logical channels) is maintained by the locations in which the data samples from FFT 142 are stored in DP RAM Data 204. Ex. 1006, 10:4–17. The '480 patent explains that, although the samples come in frames, FFT 142 does not necessarily provide them in the same order as expected by TDM bus 16. *Id.* at 10:10–13. The samples are put into the correct order by storing them at the correct addresses in DP RAM Data 204. *Id.* at 10:15–17.

TDM Slot Counter 200 cycles through the addresses consecutively, supplying those addresses to both DP RAM Data 204 and DP RAM Enable 202. *Id.* at 9:2–4, Fig. 3. When TDM Slot Counter 200 provides an address to DP RAM Data 204, DP RAM Data 204 makes the data for the RF channel stored at that address available to driver 208. *Id.* at 10:6–8, Fig. 3. When DP RAM Enable 202 receives the same address, it provides a "1" or

"0" to driver 208, indicating that the data from DP RAM Data 204 is to be asserted (or not) on TDM bus 16 and made available to the DSP associated with the time slot. *Id.* at 9:46–10:3, Fig. 3 (table showing "A" to "D" mapping).

Petitioner and Dr. Stark do not explain persuasively how simply re-programming DP RAM Enable 202 would provide a different mapping between the data stored in DP RAM Data 204 and the DSPs. In the example of Figure 3, if DP RAM Enable 202 is programmed to provide a "0" to driver 208 rather than a "1" when it receives address 27, the data stored in DP RAM Data 204 for the RF channel stored at address 27 will not be switched to a different DSP (and logical channel). Rather, the "0" will instruct driver 108 to not apply the data at all during that time slot. Likewise, changing the mapping for address 2 from "0" to "1" does not change the DSP that will receive the data in the time slot for address 2. Rather, the "1" will instruct driver 108 to assert the data during the time slot. According to the '480 patent, all DP RAM Enable 202 stores are indications of whether time slots are active or inactive. Ex. 1006, 9:59–63. Petitioner does not point to persuasive evidence showing that DP RAM Enable 202 stores a mapping of physical RF channels to logical channels. Rather, according to the '480 patent, that mapping is determined by the addresses of DP RAM 204 at which the data are stored. *Id.* at 10:9–17.

Although Petitioner places much significance on the similarities of the disclosures of the '480 and '408 patents (Pet. 15–17), Patent Owner argues that the '480 patent's lack of the mapping structure disclosed in the '408 patent also is significant (PO Resp. 27). As explained above, Figure 8 of the '408 patent illustrates an example in which DP RAM FHOP 312, under the

control of additional processor 300 and the signal RX Ping/Pong 304, provides addresses to DP RAM Data 204. We do not consider claim 1 to be limited to the example disclosed in the '408 patent and shown in Figure 8. Nevertheless, Figure 8 provides an example of the type of detailed description that is missing from the '480 patent. Specifically, DP RAM FHOP provides a mapping that changes the order in which DP RAM Data 204 is addressed and, consequently, changes the order in which data are asserted on TDM bus 16. Ex. 1001, 12:4–14. DP RAM Enable 202 behaves the same as described in the '480 patent, simply indicating whether or not the data provided by DP RAM Data 204 should be asserted for the time slot. *Id.* at 11:59–62. The data switched to the DSP associated with that slot will correspond to a different RF channel because DP RAM FHOP 312 intercepts the address provided by TDM Slot Counter 202 and provides a different address to DP RAM Data 204. *Id.* at 12:14–24. Petitioner does not persuasively argue that the system described in the '480 patent can be provided with a similar change in mapping through programming of DP RAM Enable 202 alone.

Dr. Stark's testimony also is not supported by the description in the '480 patent. In one example, Dr. Stark testifies that:

> For the case of the receiver side (dehopping) as shown is Fig. 3, the same logical channel would "hop" onto different RF channels each successive GSM TDMA frame. This would mean that for a particular TDMA frame, a given logical channel, e.g., channel 1 on slot 1, would be at a particular RF channel such as indicated by location "27" in the table in Fig. 3. But in the next TDMA frame, the same logical channel, would be placed onto a different RF channel, e.g., location "2" in the table in Fig. 3. By the controller supplying a new mapping signal (table) every TDMA frame, the samples from the correct

> RF channel for the associated logical channel could be placed onto the TDM bus for processing by the corresponding DSP 18.

Ex. 1022 ¶ 17. This is inconsistent with the description in the '480 patent. Locations "27" and "2" in DP RAM Enable 202 merely indicate whether data can be asserted into time slots 27 and 2. Ex. 1006, 9:46–10:3. Changing the mapping in DP RAM Enable 202 to enable slot "2" and disable slot "27," without additional changes elsewhere in the system, would not result in different RF channels being switched to the same logical channel.

In this example, and the others cited above, Dr. Stark repeatedly testifies that simply re-programming DP RAM Enable 202 will change the mapping of physical RF channels and logical channels. Nevertheless, as Patent Owner argues (PO Resp. 26–27), the '480 patent does not support that testimony. Because Dr. Stark's testimony is inconsistent with the description in the '480 patent, we give his testimony little weight.[5]

Dr. Stark's testimony accompanying the Petition is undermined further by admissions he made during deposition and by Petitioner's change in position in the Reply. At deposition, Dr. Stark admitted that the '480

[5] Patent Owner argues that we should disregard Dr. Stark's testimony in its entirety because he is biased based on his "longstanding, ongoing, economic relationship with Petitioner." PO Resp. 40–42. We recognize that the expert witnesses in this case are being paid. We have considered the respective backgrounds of Dr. Stark and Dr. Wells and note that, while Dr. Stark has an established relationship with Petitioner (*id.* at 42), Dr. Wells appears to have an equally extensive history opposing Petitioner (Ex. 1007, App'x A, pp. 3–4). Given the potential for bias on the part of both experts, we evaluate their testimony by considering, *inter alia*, cross-examination and the consistency of the testimony with other evidence in the record (including the cited prior art).

patent could not be modified to perform frequency hopping through programming of DP RAM Enable 202 alone. Rather, because DP RAM Enable 202 merely indicates that a "frequency should be put on the bus for some DSP," the basestation controller must re-program some other component to place appropriate data on TDM bus 16 or re-program the DSPs to change how they take data off of TDM bus 16. Ex. 2008, 150:7–151:21:

> Q. So under your theory, the presence of a 1 indicates that frequency channel is active. It does not guarantee you who is using that channel; is that correct?
>
> A. It -- it just -- the presence of a 1 says that frequency should be put on the bus for some DSP.
>
> Q. But it doesn't tell you which DSP should get it?
>
> A. No, it doesn't tell you which DSP. This is what goes onto the bus, as opposed to what's taken off the bus.
>
> Q. And so, therefore, there's nothing in this figure that dehops or identifies who the target user is?
>
> A. Well, when the -- the -- I mean, this 1 is connected to a -- the basestation controller, which controls the table; right? . . . So the basestation controller knows which user should be using which frequency at which time, and therefore which entries in this table should be 1 and therefore the data should be put onto the bus. Similarly the controller knows which data should be taken off the bus for which DSP.
>
> Q. But that, quote, taken off for the DSP does not show up in this figure.
>
> A. This is putting onto the -- the bus. . . . There is a corresponding taken off the bus that -- . . . -- that makes sure that the appropriate DSP picks off from the bus the

> appropriate time, the appropriate frequency that was put on the bus for it.

*See also id.* at 136:1–5 ("Q. Okay. And so therefore there's no dehopping that's done by this circuit? A. Well, the dehopping is done by the overall system of connecting any frequency to any DSP."), 139:1–6 ("A. The architecture shown in Figure 3 is just one part of implementing the cross-bar switch. It's not the whole thing. So the whole thing is a cross-bar switch, and it allows any frequency to be connected to any DSP at any time."); Paper 21 (Mot. for Observations), 6.

Similar to Dr. Stark's change in position during deposition, Petitioner argues, for the first time in the Reply, that the basestation could be reprogrammed to "accommodate frequency hopping in one of two ways," including that "the DSPs could be directly programmed with the hopping sequence."). Reply 13 (citing Ex. 1022 ¶¶ 9, 19, 29, 31). Our rules, however, state that "[a]ll arguments for the relief requested in a motion must be made in the motion. A reply may only respond to arguments raised in the corresponding opposition or patent owner response." 37 C.F.R. § 42.23(b). As the Office has explained:

> While replies can help crystalize issues for decision, a reply that raises a new issue or belatedly presents evidence will not be considered and may be returned. The Board will not attempt to sort proper from improper portions of the reply. Examples of indications that a new issue has been raised in a reply include new evidence necessary to make out a *prima facie* case for the patentability or unpatentability of an original or proposed substitute claim, and new evidence that could have been presented in a prior filing.

Office Patent Trial Practice Guide, 77 Fed. Reg. 48,756, 48767 (Aug. 14, 2012). Petitioner's Reply argument is not simply a response to Patent

Owner's arguments. Patent Owner introduced evidence that Petitioner's theory failed to make a *prima facie* case of obviousness because re-programming DP RAM Enable 202 with an algorithm from GSM 05.02 would not accomplish the result testified to by Dr. Stark. PO Resp. 26–27. In Reply, Petitioner argues a new theory based on new evidence (including extensive new testimony from Dr. Stark) necessary to make its *prima facie* case. That new theory should have been brought in the Petition. Accordingly, Petitioner has waived the argument that other components of the '480 patent's system (such as the DSPs) would have been re-programmed to implement frequency hopping.

In sum, after considering the complete record, including the disclosure of the '480 patent (summarized above), Dr. Stark's testimony, and Dr. Wells' testimony, we find that the combined teachings of the '480 patent and GSM 05.02, as presented in the Petition, would not have resulted in a system capable of frequency hopping. Dr. Stark's admission that the theory presented in his testimony submitted with the Petition was, at best, incomplete, accompanied by Petitioner's introduction of new evidence and a new theory in the Reply, is additional persuasive evidence that the combination of the '480 patent and GSM 05.02 presented in the Petition would not have implemented frequency hopping.

Petitioner has not met its burden of showing that a skilled artisan would have had a reasonable expectation of success in combining the teachings of the '480 patent and GSM 05.02. Nor has Petitioner shown that its proposed combination would have worked for its intended purpose, as it would not have performed frequency hopping. Specifically, we find that Petitioner has not shown that a combination of the '480 patent and GSM

05.02 teaches both "operating said broadband transceiver using a plurality of transceiver RF frequencies, each of which represents one of said physical RF channels" and "changing from a first of said physical RF channels upon which said mobile subscribers communicate with said basestation to a second of said physical RF channels, while maintaining a same logical channel," as recited in claim 1. Thus, Petitioner has not shown, by a preponderance of the evidence, that claim 1 would have been obvious over the '480 patent and GSM 05.02.

Claims 2–16 depend from claim 1. Petitioner does not cite the '435 patent against claims 1 and 2 (Tr. 8:16–9:1) and does not contend that the '435 patent cures the deficiencies we find with respect to claim 1. Accordingly, Petitioner has not shown, by a preponderance of the evidence, that claim 2 would have been obvious over the '480 patent and GSM 05.02 or that claims 3–16 would have been obvious over the '480 patent, GSM 05.02, and the '435 patent.

## III. CONCLUSION

For the reasons given, Petitioner has not demonstrated, by a preponderance of the evidence, that any of claims 1–16 is anticipated by the '480 patent or obvious over the '480 patent, GSM 05.02, and the '435 patent.

## IV. ORDER

For the reasons given, it is

ORDERED that claims 1–16 of U.S. Patent No. 6,952,408 B2 have not been shown by a preponderance of the evidence to be unpatentable; and

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

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