

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

ERICSSON INC. and
TELEFONAKTIEBOLAGET LM ERICSSON,
Petitioner,

v.

INTELLECTUAL VENTURES I LLC,
Patent Owner.

Case IPR2014-00921
Patent 6,023,783

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

COCKS, *Administrative Patent Judge*.

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

I. INTRODUCTION

Ericsson Inc. and Telefonaktiebolaget LM Ericsson (“Ericsson”), filed a Petition (Paper 1, “Pet.”) requesting *inter partes* review of claims 1–5, 23, 24, 38–42, 60, and 61 of U.S. Patent No. 6,023,783 (“the ’783 patent”). We issued a Decision to institute an *inter partes* review of claims 23, 24, 60, and 61 of the ’783 patent on the following grounds: (1) claims 23, 24, 60, and 61 as unpatentable under 35 U.S.C. § 103 as unpatentable over Robertson¹ and Ungerboeck²; (2) claims 23 and 60 as anticipated under 35 U.S.C. § 102 by Palicot³; (3) claims 23 and 60 as unpatentable under 35 U.S.C. § 103 over Palicot; and (4) claims 24 and 61 as unpatentable under 35 U.S.C. § 103 over Palicot and Ungerboeck. Paper 8 (“Inst. Dec.”).⁴

After institution of trial, Intellectual Ventures I LLC (“Intellectual Ventures”) filed a Patent Owner’s Response (Paper 26, “PO Resp.”), to which Ericsson replied (Paper 28, “Pet. Reply”). Ericsson also filed a Motion to Exclude portions of Exhibit 2006 (Paper 34), to which Intellectual Ventures filed an Opposition (Paper 36).

¹ Patrick Robertson et al., *A Comparison of Optimal and Sub-Optimal MAP Decoding Algorithms Operating in the Log Domain*, PROCEEDINGS of IEEE INTERNATIONAL CONFERENCE ON COMMUNICATIONS 1009–13 (June 1995). (“Robertson”) (Ex. 1012).

² Gottfried Ungerboeck, *Trellis-Coded Modulation with Redundant Signal Sets Part 1: Introduction*, 25 IEEE COMMUNICATIONS MAGAZINE NO. 2 5–11 (Feb. 1987). (“Ungerboeck”) (Ex. 1007).

³ J. Palicot & J. Veillard, *Possible Coding and Modulation Approaches to Improve Service Availability for Digital HDTV Satellite Broadcasting at 22 GHz*, 39 IEEE TRANSACTIONS ON CONSUMER ELECTRONICS NO. 3 660–67 (Aug. 1993). (“Palicot”) (Ex. 1008).

⁴ We did not institute trial on any grounds directed to claims 1–5 and 38–42.

Oral argument was conducted on August 26, 2015. A transcript of that argument has been made of record. Paper 42.

We have jurisdiction under 35 U.S.C. § 318(a). After considering the evidence and arguments of both parties, and for the reasons set forth below, we determine that Ericsson has met its burden of showing, by a preponderance of the evidence, that claims 23, 24, 60, and 61 of the '783 patent are unpatentable.

A. Related Matters

Intellectual Ventures has asserted the '783 patent against various companies in the following lawsuits filed in the United States District Court for the District of Delaware:

Intellectual Ventures I LLC et al. v. AT & T Mobility LLC et al.,
No. 1:13-cv-01668-LPS (D. Del.), filed October 7, 2013;

Intellectual Ventures I LLC et al. v. Leap Wireless International Inc. et al., No. 1:13-cv-01669-LPS (D. Del.), filed October 7, 2013;

Intellectual Ventures I LLC et al. v. Nextel Operations Inc. et al.,
No. 1:13-cv-01670-LPS (D. Del.), filed October 7, 2013;

Intellectual Ventures I LLC et al. v. T-Mobile USA Inc. et al.,
No. 1:13-cv- 01671-LPS (D. Del.), filed October 7, 2013; and

Intellectual Ventures I LLC et al. v. United States Cellular Corp.,
No. 1:13- cv-01672-LPS (D. Del.), filed October 7, 2013.

Pet. 1; Paper 5, 1.

B. The '783 Patent (Ex. 1001)

The '783 patent is titled "Hybrid Concatenated Codes and Iterative Decoding," and is expressed as relating to "error correcting codes."

Ex. 1001, 1:12. In that respect, the “Related Art” is described as being concerned with “[t]urbo codes,” which are “binary error-correcting codes built from the parallel concatenation of two recursive systematic convolutional codes and using a feedback decoder.” *Id.* at 1:14–17. The patent characterizes its disclosed invention as “encompass[ing] several improved turbo code apparatuses and methods.” *Id.* at 1:66–67.

By way of explanation, the ’783 patent presents the following figure, which is represented as “Prior Art”:

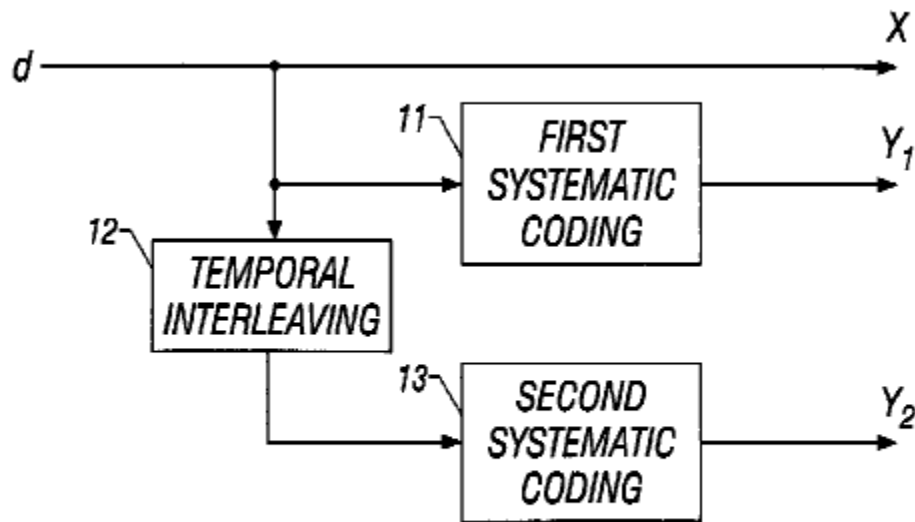


FIG. 1
(Prior Art)

Figure 1 is a block diagram of a prior art turbo code encoder. *Id.* at 2:48.

As shown in the above-noted figure:

Each source data element *d* to be coded is coupled to a first systematic coding module 11 and, through a temporal interleaving module 12, to a second systematic coding module 13. The coding modules 11 and 13 may be of any known systematic type, such as convolutional coders, that take into account at least one of the preceding source data elements in order to code the source data element *d*.

Id. at 1:27–34.

The '783 patent further explains that “an important aspect of prior art turbo code encoders is that they transmit a data element X equal to input source data element d .” *Id.* at 1:53–55.

Figure 5 of the '783 patent is reproduced below and depicts an embodiment according to the invention of that patent:

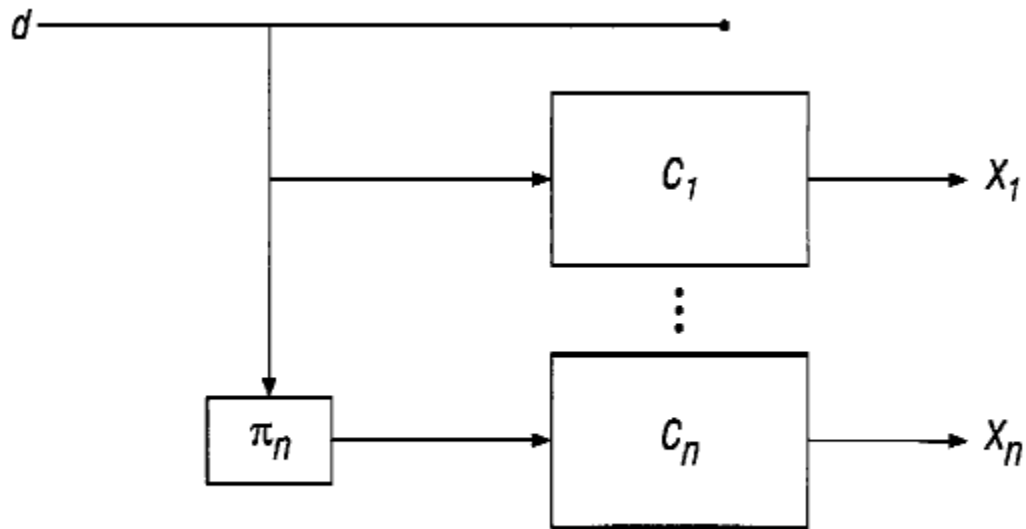


FIG. 5

The figure above illustrates a diagram of a turbo encoder that includes similar features to those of the prior art. The '783 patent describes that “encoded parity elements X_n ,” i.e., encoded data, are transmitted from coding modules C , with at least one interleaver π_n . *Id.* at 13:59–66. According to the '783 patent, the invention disclosed therein is distinguished from the prior art because the turbo encoder structure of the patent “outputs *only* encoded parity elements X_n from the coding modules C —the original data source elements d are not transmitted or stored.” *Id.* (emphasis added).

C. Illustrative Claims

Claims 23 and 60 are independent claims. Those claims are illustrative of the subject matter at issue, and are reproduced below:

23. A system for error-correction coding of a source of original digital data elements, comprising:

(a) a first systematic convolutional encoder, coupled to the source of original digital data elements, for generating a first series of coded output elements derived from the original digital data elements;

(b) at least one interleaver, each coupled to the source of original digital data elements, for modifying the order of the original digital data elements to generate respective interleaved elements;

(c) at least one next systematic convolutional encoder, each coupled to respective interleaved elements, each for generating a corresponding next series of coded output elements derived from the respective interleaved elements, each next series of coded output elements being in parallel with the first series of coded output elements; and

(d) a multilevel modulator, directly coupled to the original digital data elements and to the coded output elements of each systematic convolutional encoder, for generating an output modulated signal representative of at least some of such original digital data elements and coded output elements.

60. A method for error-correction coding of a source of original digital data elements, comprising the steps of:

(a) generating a first series of systematic convolutional encoded output elements derived from a source of original digital data elements;

(b) modifying the order of the original digital data elements to generate at least one set of interleaved elements;

(c) generating at least one next series of systematic convolutional encoded output elements derived from at least one set of interleaved elements, each next series of systematic convolutional encoded output elements being in parallel with the first series of systematic convolutional encoded output elements; and

(d) generating an output multilevel modulated signal directly from and representative of at least some of such original digital data elements and systematic convolutional encoded output elements.

Ex. 1001, 26:3–26; 31:21–38.

II. ANALYSIS

A. Claim Construction

The Board construes claims of an unexpired patent by applying the broadest reasonable interpretation in light of the Specification. *See* 37 C.F.R. § 42.100(b); *see also In re Cuozzo Speed Techs., LLC*, 793 F.3d 1268, 1278 (Fed. Cir. 2015) (“We conclude that Congress implicitly approved the broadest reasonable interpretation standard in enacting the AIA.”). Claim terms also 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). Nevertheless, a “claim term will not receive its ordinary meaning if the patentee acted as his own lexicographer and clearly set forth a definition of the disputed claim term in either the specification or prosecution history.” *CCS Fitness, Inc. v. Brunswick Corp.*, 288 F.3d 1359, 1366 (Fed. Cir. 2002).

In our Decision instituting trial, we determined that no terms of the claims of the '783 patent should be given any special meaning, and, thus, concluded that all terms should take on their broadest reasonable meaning as would be understood by one of ordinary skill in the art in light of the Specification. Inst. Dec. 9. We made explicit that meaning for the terms/phrases: (1) “systematic convolutional encoder,” (2) “coded output elements”; and (3) “directly coupled”/“signal directly from.” *Id.* at 9–13. Neither party contests our preliminary constructions for “systematic convolutional encoder” or “coded output elements,” and we do not discern a reason to revisit those constructions. For general reference, the constructions of those terms set forth in the Decision instituting trial are reproduced below:

Claim Term	Construction
“systematic convolutional encoder”	“an encoder that may output both encoded data and also original data (or its equivalent).” Inst. Dec. 11.
“coded output elements”	“any data that is derived from data received and processed by a coder or encoder.” <i>Id.</i> at 12.

In connection with this Final Written Decision, we discern that there is disagreement between the parties as to the proper construction of the term “directly coupled”/“signal directly from.” In our preliminary assessment of the meaning of the term, we concluded that components that are “directly” coupled to one another, or which receive signals “directly” from one another, excludes the presence of an interleaver between those components,

but does not prohibit any and all intervening structures, such as a switch. *Id.* at 13. In reaching that conclusion, we took into account disclosure in the '783 patent including that components were understood directly connected to one another despite being separated by a structure recognizable as a switch. *Id.* at 12–13.

Intellectual Ventures proposes a meaning for “directly coupled”/“signal directly from” of “coupled in a manner such that the order and content of the elements are unmodified.” PO Resp. 10. To that end, Intellectual Ventures urges the following:

The well-established ordinary meaning of the term “coupled” allows indirect attachment of components.[footnote omitted] Adding the modifier “direct” to “coupling” means the phrase cannot be construed to allow functionally indirect attachments where the elements would be modified or reordered. To be a direct coupling, the intervening structure, which may include a switch, must pass the elements unmodified and in the order they were received. Otherwise, the coupling is indirect.

Id. at 11–12.

Ericsson disagrees with Intellectual Ventures’s construction as being too “narrow.” Pet. Reply 2. Instead, Ericsson contends that “the Board’s initial construction is correct.” *Id.*

We observe that Intellectual Ventures points to little content of the record supporting its proposed construction of the relevant terms. In that regard, Intellectual Ventures’s proposed support for the meaning of “directly coupled”/“signal directly from,” as precluding reorganization of data elements, appears to arise mainly from statements made by the Examiner during prosecution of the underlying patent application that became the '783 patent. More specifically, Intellectual Ventures states the following:

During prosecution, the Examiner stated that the “order rearranging” functionality of Le Goff does not “diminish its coupling function.” (Ex. 1021, p. 3) Claims 23 and 60 were subsequently amended to include the terms “directly coupled” and “directly from,” respectively, to overcome the rejection (Ex. 1023, p. 2). This supports Patent Owner’s position that “order rearranging” is precluded from a direct coupling. Thus, the functionality of the intervening structure, not the complexity asserted by Petitioners, is the key issue.

PO Resp. 15.

Intellectual Ventures does not explain adequately why a generic reference by the Examiner to “order rearranging” as not “diminish[ing]” a “coupling function” serves to impart a meaning to “directly coupled” or “directly from” that excludes any type of reordering of data between components so coupled. Moreover, we observe that the unabbreviated statement made by the Examiner is: “The process of order rearranging performed by Le Goff’s *interleaver* is not considered to diminish its coupling function.” Ex. 1021, 3 (emphasis added). Thus, the Examiner’s statement was made with respect to a particular “interleaver” component, and was not offered in a general context in connection with all components that may be viewed as reordering data in some respect. Simply put, the Examiner’s statement does not provide a suitable underlying basis for the construction of “directly coupled”/“signal directly from” that is now offered by Intellectual Ventures. Neither does the statement support Intellectual Ventures’s view that it is a modification of data through *any* reordering that somehow establishes the dichotomy between coupling understood as direct versus indirect.

Intellectual Ventures also generally points to paragraph 42 of the Declaration testimony of its declarant Dr. Leonard Cimini, urging that the

testimony provides support for the following statement: “Since multiplexing rearranges elements from a parallel format to a serial format, and puncturing actively deletes elements, neither of these functions can be part of a direct coupling.” PO Resp. 15. That noted testimony, however, does not provide elucidation as to why a skilled artisan would consider only whether data content is reordered in assessing whether one component is directly coupled, or receives a signal directly from, another component.

It is clear from the record evidence before us that, in the context of the ’783 patent, a connection between two components is not one that is considered properly as “direct” if there is an interleaver between those components. We understand that an “interleaver” is a structure that provides extensive reordering of data. For instance, record evidence characterizes a particular interleaver as a “pseudorandom block scrambler” that reads out data “in a specified permuted order.” Ex. 1009, 29. Indeed, the ’783 patent itself characterizes an interleaver as a “pseudo-random block scrambler” that operates to output data “in a specified (fixed) random order.” Ex. 1001, 5:57–61. In that respect, it is further understood from the ’783 patent that there are extensive considerations that go into the design of interleavers and the effect that a given interleaver has on the configuration, order, and characteristics of data. *See id.* at 9:53–13:54. Thus, the operations of an interleaver appear to constitute complex data reordering schemes where the “pseudorandom” scrambling of data is, at least in some cases, the desired goal.

As noted above, in the context of an *inter partes* review, the Board construes claim terms based on their broadest reasonable construction that is consistent with the underlying specification. Here, with that guidance in

mind, we do not discern that Intellectual Ventures's position that the claim terms in question should be construed narrowly to prohibit any intervening structure that performs any type of operation that may be regarded as manipulating data or changing the order of data in some aspect, regardless of the nature or extent of the data reordering. To that end, while the reordering operations provided by an interleaver are not encompassed by "directly" connecting elements, we are not satisfied that Intellectual Ventures has provided a suitable evidentiary basis for its position that any intervening data reordering, of any kind, is the benchmark for evaluating whether structures are directly connected to one another. It also is clear from the Specification of the '783 patent, and as we observed in our Decision instituting trial (Inst. Dec. 12–13), that a direct connection does not prohibit some intervening structures, such as the intervening presence of a switch.

In considering the totality of the record before us, we do not discern that there is cause to deviate from the construction we initially adopted for "directly coupled"/"signal directly from" as a part of the Decision to institute trial. Accordingly, for purposes of this Final Written Decision, we maintain the understanding that components that are "directly" coupled to one another, or which receive signals "directly" from one another, excludes the presence of an interleaver between those components, but does not prohibit any and all intervening structures, such as a switch.

B. Obviousness over Robertson and Ungerboeck

1. Overview of Robertson (Ex. 1012)

Robertson is an article titled “A Comparison of Optimal and Sub-Optimal MAP Decoding Algorithms Operating in the Log Domain.”

Ex. 1012, 1009. Robertson contemplates studying of “the behaviour of the (Max-)Log-MAP algorithm applied to the decoding of convolutional codes (and in particular recursive systematic convolutional (RSC) codes).” *Id.*

Robertson’s Figure 1 is reproduced below:

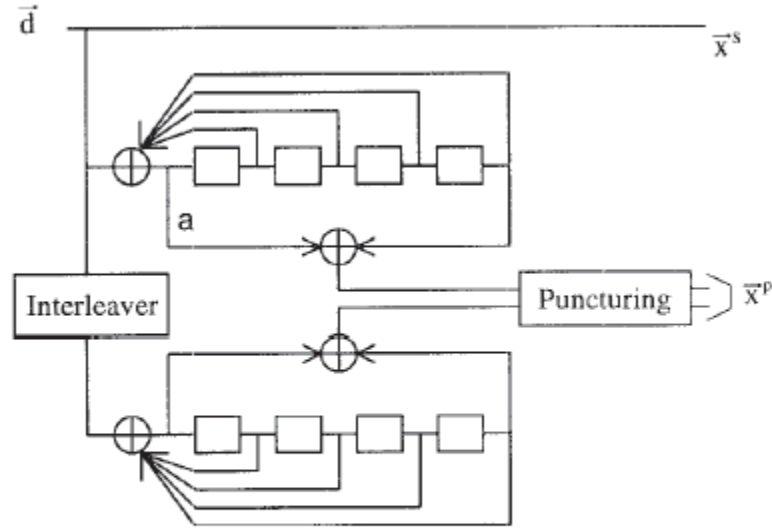


Figure 1: Two identical recursive systematic convolutional encoders employed in a Turbo coding scheme.

As shown in the Figure above, data sequence $\vec{d}$ may be directed to recursive systematic convolutional encoders (unnumbered) whose output may be punctured by a “Puncturing” component before being modulated and then transmitted over a channel. *Id.* at 1009–10.

2. Overview of Ungerboeck (Ex. 1007)

Ungerboeck is a series of two articles titled “Trellis-Coded Modulation with Redundant Signal Sets” including “Part I: Introduction” (Ex. 1007, 5), and “Part II: State of the Art” (*id.* at 12). The first “Introduction” portion describes its content as follows:

Simple four-state trellis-coded modulation (TCM) schemes improve the robustness of digital transmission against additive noise by 3 dB without reducing data rate or requiring more bandwidth than conventional uncoded modulation schemes. With more complex schemes, coding gains up to 6 dB can be achieved. This article describes how TCM works

Id. at 5.

The second “State of the Art” portion sets forth the following:

This article is intended to bring the reader up to the state of the art in trellis-coded modulation. The general principles that have proven useful in code design are explained. The important effects of carrier-phase offset and phase invariance are discussed. Finally, recent work in trellis-coded modulation with multi-dimensional signal sets is described

Id. at 12.

Ungerboeck characterizes “multilevel (amplitude and/or phase) modulation systems” as “conventional” (*id.* at 6), and describes the use of a particular “8-PSK” modulation system (*id.*).

3. Level of Ordinary Skill in the Art

Factors that may be considered in determining level of ordinary skill in the art include: (1) the educational level of the inventor; (2) type of problems encountered in the art; (3) prior art solutions to those problems; (4) rapidity with which innovations are made; (5) sophistication of the technology; and (6) educational level of active workers in the field.

Environmental Designs, Ltd. v. Union Oil Co. of California, 713 F.2d 693, 696 (Fed. Cir. 1983). There is evidence in the record before us that reflects the knowledge level of a person with ordinary skill in the art. In particular, each of Ericsson's declarants, Mr. Mark Lanning (Ex. 1003) and Dr. Zixiqang Xiong (Ex. 1032), as well as Intellectual Ventures's declarant, Dr. Leonard Cimini (Ex. 2006), provides testimony in that respect.

Mr. Lanning testifies the following:

38. It is my opinion that a person of ordinary skill in the field of the '783 Patent would have at least a Bachelors or Masters level college degree in Electrical Engineering, Computer Science, Computer Engineering or equivalent training and experience. This person would also have at least three to five years of academic or industrial experience in the field of communication systems, such as wireless cellular communication systems and networks. Such a person would be familiar with turbo codes and the functionality provided by turbo encoders, decoders, interleavers, multiplexers and demultiplexers, and modulators.

Ex. 1003 ¶ 38.

Similarly, Dr. Xiong testifies the following:

22. Based on the disclosure of the '783 patent, one of ordinary skill in the art would have at least a Bachelors or Masters level college degree in Electrical Engineering, Computer Science, Computer Engineering or equivalent training and experience. This person would also have at least three to five years of academic or industrial experience in the field of communication systems, such as wireless cellular communication systems and networks. Such a person would be familiar with turbo codes and the functionality provided by turbo encoders, decoders, interleavers, multiplexers and demultiplexers, and modulators.

Ex. 1032 ¶ 22.

Dr. Cimini testifies the following:

24. Based on the disclosure of the '783 patent, one of ordinary skill in the art would have a Master's degree in Electrical Engineering, Computer Science, or an equivalent field as well as at least 3–5 years of academic or industry experience in communications systems, or comparable industry experience.

25. My definition of level of ordinary skill in the art is higher than Mr. Lanning's definition in that Mr. Lanning only requires a Bachelor's Degree or equivalent. (Lanning Decl., ¶ 38.) However, in my experience working with undergraduate and graduate students, someone with only a Bachelor's Degree would not have the mathematical foundation to evaluate design choices for error correction algorithms. This opinion is supported by the fact that Divsalar, Robertson, Ungerboeck, Palicot, and Pollara all have Ph.D.'s (See Exs. 2001, 2009, 2010, 2011, and 2012) and all of the references applied in this *inter partes* review proceeding are research papers. In my opinion, an individual with only a Bachelor's Degree would generally not be able to parse the mathematics underlying Robertson or Ungerboeck, for example.

Ex. 2006 ¶¶ 24, 25.

Thus, the declarants are largely in agreement as to the level of ordinary skill in the art, but for a slight difference of opinion as to the extent of education. While Mr. Lanning and Dr. Xiong take the view that a person of ordinary skill “would have at least a Bachelors or Masters level college degree in Electrical Engineering, Computer Science, Computer Engineering or equivalent training and experience,” Dr. Cimini opines that only a Bachelor's degree would be insufficient. Dr. Cimini advanced that opinion on the theory that one with only a Bachelor's degree would lack an appropriate “mathematical foundation.”

On the record before us, it is not apparent that the possession of a Master's degree as compared with possession of a Bachelor's degree

establishes a dividing line between a person who is of ordinary skill in the art, and a person who is not. Dr. Cimini does not explain persuasively why a person with a Bachelor's degree in the noted areas, coupled for instance, with the noted "academic or industry experience" would lack the requisite "mathematical foundation." To that end, we are cognizant of the level of ordinary skill to which all declarants have testified, but do not understand the record as establishing that a Master's degree, to the exclusion of other equivalent experience, is a strict requirement of a skilled artisan in the pertinent field.

4. Discussion – Robertson and Ungerboeck

Ericsson contends that each of claims 23, 24, 60, and 61 are unpatentable as obvious over Robertson and Ungerboeck. Obviousness is a question of law based on underlying factual findings: (1) the scope and content of the prior art; (2) the differences between the claims and the prior art; (3) the level of ordinary skill in the art; and (4) objective indicia, or secondary considerations, of non-obviousness. *See Graham v. John Deere Co. of Kansas City*, 383 U.S. 1, 17–18 (1966). Here, however, neither party introduced evidence on secondary considerations of non-obviousness. Accordingly, we focus our attention on the first three *Graham* factors. Intellectual Ventures argues the claims in two groupings: (1) claims 23 and 60; and (2) claims 24 and 61.

a. Claims 23 and 60

As noted above, claim 23 is directed to a "system for error-correction coding of a source of original digital data elements," and claim 60 constitutes a corresponding method. As set forth in its Petition, Ericsson

contends that Robertson discloses all the features of claims 23 and 60 (Pet. 49–54) with the exception of those features directed to “multilevel modulation” (*id.* at 53). In that regard, Ericsson contends that Robertson is directed to “binary modulation” rather than “multilevel modulation,” but points to Ungerboeck as disclosing multilevel modulation. *Id.* Referencing the declaration testimony of Mr. Mark Lanning (Ex. 1003), Ericsson contends the following:

As noted by Mr. Lanning, it would have been obvious to one of ordinary skill in the art to combine *Robertson* and *Ungerboeck* to replace the binary modulation in *Robertson*’s coding system with multilevel modulation taught by *Ungerboeck* because it would yield the predictable result—that more data bits correspond to a modulated symbol, thereby enhancing bandwidth efficiency.

Id. at 53–54.

To that end, we understand that Ericsson proposes, and Mr. Lanning testifies (Ex. 1003 ¶ 230), that one of ordinary skill in the art would have had reason to substitute Ungerboeck’s multilevel 8-PSK modulator for Robertson’s binary modulator so as to enhance bandwidth efficiency.

With regard to the claim requirement that the multilevel modulator is “directly coupled . . . to the coded output elements of each systematic convolutional encoder” (claim 23) and the modulated signal is generated “directly from” the systematic convolutional encoded output elements (claim 60), Ericsson relies on disclosure in Robertson. In particular, Ericsson notes that although Robertson discloses a puncturing component associated with its encoders, the broadest reasonable interpretation does not exclude the presence of a puncturing component in forming a “directly” connected relationship. Pet. 53. Ericsson also reasons that, as attested to by

Mr. Lanning, a person of ordinary skill in the art would have understood that “puncturing is optional and could be omitted.” *Id.* at 52–53 (citing Ex. 1003 ¶ 222). Ericsson reasons that the absence of a puncturing component also establishes that the coder and modulator are directly connected. *Id.*

Intellectual Ventures contends that the substitution of a multilevel modulator for the binary modulator of Robertson would necessitate the inclusion of a multiplexer between Robertson’s turbo coder and the multilevel modulator. PO Resp. 20–25. As such, and based on its proposed interpretation of the “directly coupled”/“signal directly from” features of claims 23 and 60, Intellectual Ventures contends that the presence of a multiplexer precludes a conclusion that those claims would have been obvious over Robertson and Ungerboeck. *Id.*

In response, Ericsson disputes that a multiplexer would be necessary in the manner offered by Intellectual Ventures. Pet. Reply 1–2. Alternatively, Ericsson maintains that even if such a multiplexer was present, the “directly coupled”/“signal directly from” requirements of the claims would, nevertheless, be satisfied. *Id.* at 2–3.

Thus, at its core, there are two main bases of disagreement between the parties. First, whether a multiplexer would be required as a part of the Robertson and Ungerboeck combination. Second, even if a multiplexer is present between a coder component and a modulator component, whether such circumstance would preclude a determination that those components are directly coupled to one another.

With respect to the first point of disagreement noted above, Intellectual Ventures relies on its declarant, Dr. Leonard Cimini, (PO Resp. 23–25) who testifies that in Robertson, a multiplexer is “necessary” (Ex.

2006 ¶ 50), and that a multiplexer would also be a part of the Robertson and Ungerboeck combination (*id.* at ¶ 51). On cross-examination, Ericsson’s own declarant, Mr. Lanning, when queried by Intellectual Ventures’s counsel, testified that a multiplexer would be present. Specifically, the following exchange appears in the record in connection with questions as to the Robertson and Ungerboeck combination:

Q. So would there be circuitry, then, necessarily between the memory and the modulator to alternate between memory locations? . . .

A. Again, we’re working on just a hypothetical question. It could be as simple as hardware circuitry and a memory function that just selects in a cyclic fashion each input to the memory. It would -- which I would look at or view as a logical multiplexing function.

Ex. 2008, 123:5–16.

Thus, Mr. Lanning also takes the view that a component performing a “multiplexing function” would be present upon combining the noted references. Although Ericsson disputes that a multiplexer would be required as a part of the Robertson and Ungerboeck combination, Ericsson simply offers statements of counsel without recourse to record evidence. Pet. Reply 2–3. Argument of counsel, however, cannot take the place of evidence lacking in the record. *See Estee Lauder Inc. v. L’Oreal, S.A.*, 129 F.3d 588, 595 (Fed. Cir. 1997).

On the record before, us we do not discern that there is a suitable evidentiary basis for concluding that the proposed combination of Robertson and Ungerboeck would provide for the omission of a multiplexer disposed between a turbo coder and a multilevel modulator. Accordingly, we find that such a multiplexer would be present.

The inquiry now before us is whether the presence of a multiplexer, in the manner discussed above, provokes a determination that the turbo coder and multilevel modulator are not directly coupled to one another.

Intellectual Ventures takes the view that the multiplexer reorders or modifies data content, and, thus, the presence of the multiplexer means the turbo coder and multilevel modulator arising from the combination of Robertson and Ungerboeck would not be directly coupled to one another. Intellectual Ventures bases that view on its interpretation of “directly coupled”/“signal directly from” as excluding an intervening component that modifies or changes the order of data. *See, e.g.*, PO Resp. 23. Pointing to the testimony of Dr. Cimini (Ex. 1003 ¶ 42), Intellectual Ventures contends that a multiplexer reorders data content such that its presence between a coder and modulator means those components are not directly coupled. PO Resp. 12–16.

As discussed above, we do not adopt the construction of “directly coupled”/“signal directly from” proposed by Intellectual Ventures. As is now undisputed, the construction of those terms does not prohibit the intervening presence of a switch between components so coupled. In our Decision instituting trial, we postulated that a multiplexer “is essentially analogous to a switch.” Inst. Dec. 19. During the course of the trial, the record has developed further as to the operation and functioning of a multiplexer. As discussed above, a multiplexer is a component that transitions multiple parallel inputs of data into a single output recognized as serial. In that respect, the following is a description from an on-line source designated “Electronics Tutorials” describing Multiplexers:

The *multiplexer*, shortened to “MUX” or “MPX”, is a combinational logic circuit designated to switch one of several input lines through to a single common output line by the application of a control signal. Multiplexers operate like very fast acting multiple position rotary switches connecting or controlling multiple input lines called “channels” one at a time to the output.^{5]}

The “Electronics Tutorials” reference further summarizes its description of multiplexers stating that they “are switching circuits that just switch or route signals through themselves.” *Id.* Thus, one of ordinary skill in the art would understand that multiplexers are a type of switch, e.g., a “rotary switch[,]” that simply operates to relay multiple input lines into a single output line. To the extent that such operation amounts to some reordering of the data from the parallel lines to the single serial line, we do not discern why a multiplexer would not be understood generally as a structure analogous to a switch that simply functions to handle multiple parallel inputs. In that respect, the presence of a multiplexer between a coder and modulator is not distinct from the presence of a switch between those components, so as to establish an indirect coupling rather than a direct coupling. As such, Intellectual Ventures’s assertion to that effect is incorrect.

Furthermore, even were we to adopt the construction of “directly coupled”/“signal directly from” offered by Intellectual Ventures, we are cognizant of the testimony of Ericsson’s declarant, Dr. Zixiqang Xiong, offered in reply to Intellectual Ventures’s Patent Owner’s Response. Dr. Xiong provides detailed testimony explaining why “parallel-to-serial”

⁵ Description of “The Multiplexer” from http://www.electronics-tutorials.ws/combinational/comb_2.html (last accessed November 24, 2015).

conversion multiplexing does not change the content or the order of the encoder output elements.” Ex. 1032 ¶¶ 24–26 (quotation from ¶ 24).

Although Intellectual Ventures’s declarant, Dr. Cimini, generally states that multiplexers, in the context of “bits” of data, “modify the order of the bits, changing the bits from a parallel to a serial format,” (Ex. 2006 ¶ 50), Dr. Cimini does not offer adequate explanation for that testimony. On the record before us, we credit Dr. Xiong’s detailed countervailing testimony.

With the foregoing discussion in mind, and in considering the totality of the record now before us, we are persuaded that Ericsson has shown, by a preponderance of the evidence, that claims 23 and 60 are unpatentable over Robertson and Ungerboeck.

b. Claims 24 and 61

Claim 24 depends from claim 23, and claim 61 depends from claim 60. Claim 24 adds: “wherein the multilevel modulator generates a trellis code modulation.” Similarly, claim 61 adds: “wherein the multilevel modulation is trellis code modulation.” In its Petition, Ericsson relies on Ungerboeck as disclosing the use of trellis code modulation. Pet. 53–54. Citing to Mr. Lanning’s testimony, Ericsson also reasons that it would have been obvious for a skilled artisan “to use the known trellis code modulation taught by Ungerboeck as an implementation of multilevel modulation because trellis code modulation as well-known to be an improved modulation scheme.” *Id.* at 54 (citing Ex. 1003 ¶ 236).

Intellectual Ventures takes the position that there would have been no reason to combine Ungerboeck’s teachings concerning trellis code modulation with Robertson’s system. In that respect, Intellectual Ventures contends that “[s]imply substituting a multilevel modulator with

Ungerboeck's TCM produces an absurd result of re-coding the output of the turbo encoder with an inferior code." PO Resp. 27 (citing Ex. 2006 ¶ 58).

There is no dispute that trellis code modulation was known in the art prior to the '783 patent. Indeed, the record is replete with references to such modulation. Although Intellectual Ventures contends, and Dr. Cimini testifies, that such modulation is associated with "inferior code," neither Intellectual Ventures nor Dr. Cimini adequately explain how they reach the conclusion that trellis code modulation is recognized as something inferior. Indeed, contrary to those views, Ericsson's expert, Mr. Lanning, testifies that "trellis code modulation was well known to be an effective modulation scheme for 'achievement of significant coding gains over conventional uncoded multilevel modulation without compromising bandwidth efficiency." Ex. 1003 ¶ 236 (quoting Ex. 1007 (Ungerboeck), 5, ¶ 1). Intellectual Ventures does not address those noted benefits attributed to trellis code modulation in Ungerboeck.

Furthermore, even if trellis code modulation is a modulation scheme that is inferior in some respect to other modulation schemes, the inquiry here is one grounded in obviousness. In considering obviousness, there is no requirement that the product of a combination of teachings must be optimal or better than other known structures or techniques. *See In re Fulton*, 391 F.3d 1195, 1200 (Fed. Cir. 2004) ("[C]ase law does not require that a particular combination must be the preferred, or the most desirable, combination described in the prior art in order to provide the motivation for the current invention.") Here, it is not apparent why a person of ordinary skill in the art, who is also a person of ordinary creativity, *see KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 421 (2007), would have failed to appreciate

that trellis code modulation is a viable modulation scheme, even if its application in some systems or settings would be regarded as “inferior.”

We are cognizant that Intellectual Ventures also contends that there is a dichotomy between turbo coding, such as that disclosed in Robertson, and trellis code modulation, such as that disclosed in Ungerboeck. *See* PO Resp. 27–30. In particular, Intellectual Ventures urges that combining the teachings of Robertson and Ungerboeck results in “double-coding” that is “nonsensical” and “renders Robertson unsatisfactory for its intended purpose—turbo coding.” *Id.* at 28–30. Ericsson, on the other hand, responds that its proposed combination involves the combination of Robertson’s turbo coder and Ungerboeck’s modulator, and does not require the addition of Ungerboeck’s coder so as to arrive at the result characterized by Intellectual Ventures as “absurd.” Pet. Reply 15–16.

We have considered the record before us, and conclude that there is a sufficient basis justifying the argument that Ericsson makes. To that end, it is not apparent that a skilled artisan would view a particular coder, i.e., a turbo coder, as unavailable for combination in connection with a particular modulation scheme, i.e., trellis code modulation. Although we have considered Intellectual Ventures’ arguments to the contrary, we find that, to the extent that some modification would be necessary in combining such component or features, such modification would be within the skill of a person of ordinary skill and creativity in the art. We also observe that Ericsson’s declarant, Dr. Xiong, describes how one of ordinary skill in the art would implement teachings directed to a turbo coder with those directed to a trellis code modulation. Ex. 1032 ¶¶ 30–35. We credit that testimony.

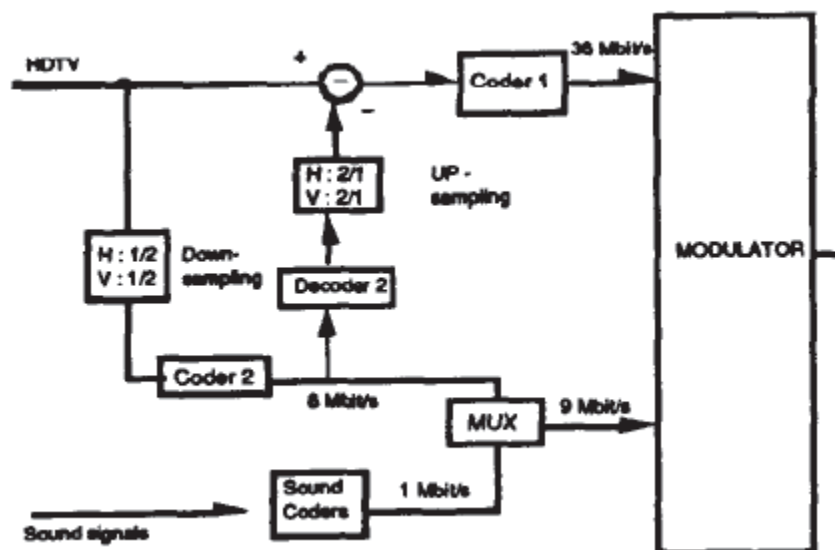
We have considered Intellectual Ventures's arguments, but are not persuaded that they patentably distinguish claims 24 and 61 from the content of the prior art. In light of the record at hand, we are persuaded that Ericsson has shown by a preponderance of the evidence that claims 24 and 61 would have been obvious in view of the teachings of Robertson and Ungerboeck.

C. Grounds of Unpatentability Based on Palicot

Ericsson also contends that (1) claims 23 and 60 as anticipated by Palicot; (2) claims 23 and 60 as obvious over Palicot; and (3) Claims 24 and 61 as obvious over Palicot and Ungerboeck.

1. Overview of Palicot (Ex. 1008)

Palicot is an article describing coding and modulation approaches in connection with HDTV satellite broadcasting. Ex. 1008, 660. A portion of Palicot's Figure 4 is reproduced below:



The segment of Figure 4 reproduced above depicts a conceptual block diagram showing a portion of a coding scheme set forth in Palicot. In particular, Palicot explains the following:

At the transmission side, the HDTV signal is down sampled and a compatible 625 lines picture is obtained which is applied to encoder 2. The residual component (difference between HDTV input and locally decoded output of encoder 2) is coded by encoder 1. This scheme allows to reduce the transmitted data rate or to increase the portion of data rate allocated to the picture component in the multiplex.

Ex. 1008, 662.

The above-noted paragraph describes two encoders as a part of the transmission side of a coding scheme, “encoder 1” and “encoder 2.”⁶ HDTV signal is applied to encoder 2, which, as shown in Figure 4, passes through a multiplexer (component “MUX” in the figure) before being passed to a modulator. The “residual component” of the HDTV signal is coded by encoder 1 and then passed to the modulator.

2. Anticipation By Palicot

Ericsson contends that claims 23 and 60 are unpatentable under 35 U.S.C. § 102 as anticipated by Palicot. Anticipation requires that every element in a claim must be found in a single prior art reference, and arranged as recited in the claims. *See Karsten Mfg. Corp. v. Cleveland Golf Co.*, 242 F.3d 1376, 1383 (Fed. Cir. 2001).

Ericsson initially laid out in its Petition where it understood all the features required by claims 23 and 60 may be found in Palicot. *See* Pet. 54–58. In that regard, the crux of the panel’s determination whether to institute

⁶ We understand that, as depicted in Figure 4, the encoders are identified as “Coder 1” and “Coder 2.”

trial was premised on the interpretation of “directly coupled”/“signal directly from” as not precluding the presence of a multiplexer arranged between Palicot’s encoder 2 and its modulator. As it did in its Preliminary Response, Intellectual Ventures again takes the view that, in light of the meaning for the above-noted terms that it now advocates in its Patent Owner Response, that Palicot does not anticipate either of claims 23 or 60. In particular, Intellectual Ventures argues that the intervening presence of a multiplexer between encoder 2 and the modulator precludes a determination that the modulator directly receives coded output elements from that encoder. *See* PO Resp. 30–31. Intellectual Ventures, thus, contends that Palicot does not disclose the “directly coupled” and “signal directly from” aspects of claims 23 and 60.

In our Decision instituting trial in this proceeding, we concluded, in light of the record that was before us including the Specification of the ’783 patent, that components directly connected to one another do not preclude the presence of some intervening structure, such as a switch. Inst. Dec. 12–13. Neither party disagrees with that conclusion. *See* PO Resp. 11–12 (“[t]o be a direct coupling, the intervening structure . . . may include a switch.”); *see also* Pet. Reply 11–12 (urging confirmation of “the Board’s initial construction provided in the Institution Decision.”)

As is conveyed in the evidentiary record before us, a multiplexer is understood as a component that converts the format of data from one that is recognized as parallel to one that is recognized as serial. *See* Ex. 2006 ¶ 50; Ex. 1032 ¶ 23. Indeed, there was and is no dispute in that respect. Where dispute emerged as a part of the parties’ briefings to the Board was in the question of whether the multiplexer’s function is one that modifies the order

and content of the data. According to Intellectual Ventures, “Palicot’s multiplexer modifies the order of the elements output from coder 2,” and removes Palicot as an anticipatory reference of claims 23 and 60 in view of the meaning of “directly” coupling or “directly” receiving signals advocated by Intellectual Ventures. PO Resp. 30–31.

As noted above, we do not agree with the construction of “directly coupled”/“signal directly from” that is advocated by Intellectual Ventures. We, however, observe that in reply to Intellectual Ventures’s Patent Owner Response, Ericsson now presents two alternative theories of how Palicot anticipates claims 23 and 60. First, Ericsson contends that the Board should simply “confirm[]” its initial construction of “directly coupled”/“signal directly from” and conclude that Palicot anticipates claims 23 and 60 for the reasons that were presented in the Decision instituting trial. Pet. Reply 20. Alternatively, Ericsson urges that the reference to “coder 2” in its Petition as constituting one of the systematic convolutional coders required by claims 23 and 60 was in error. In that respect, Ericsson now contends the following:

Petitioners correctly pointed to the turbo coder in Table 1, which for the Example 2 (System B), described in the right-side column of the table, confirms that it is referring to the turbo coder and modulator represented by the “Modulator” box¹⁴ in the Figure 4 block diagram on the prior page. But Petitioners mistakenly referred to the turbo coder as being represented by “Coder 2” in the Figure 4 block diagram, which incorrectly places the turbo coder outside the “Modulator” box. Patent Owner pounced on this error because it also mistakenly assumes that there is a multiplexer between the turbo coder and the multilevel (QPSK) modulator, as shown in Figure 4 as the “MUX” box located between the source “Coder 2” and the “Modulator” box.

¹⁴ The information in Table 1 for the turbo coder confirms that it is inside the Figure 4 “Modulator” box by specifying that the bit rate before the turbo code channel coding is 9 Mbit/s, which matches the 9 Mbit/s input to the “Modulator” box in Figure 4 for the low bit rate component after the MUX. And further confirmed by the 36 Mbit/s bit rate before channel coding for the high bit rate component that matches the 36 Mbit/s input to the “Modulator” box in Figure 4. Coder 1 and Coder 2 are source coders, not channel coders. The turbo coder is a channel coder, not a source coder. Patent Owner highlights the distinction between source coders (data compression) and channel coders (*e.g.*, turbo coders) at page 4 of its Response. The Error Control Coding textbook submitted by Patent Owner (Ex. 2013, Lin at 1-2), provides further explanation of the distinctions.

Pet. Reply 21–22.

Thus, Ericsson now contends that it “mistakenly” referenced Palicot’s “Coder 2” as a part of its Petition, and characterizes that Coder 2 as a “source coder[]” rather than a “channel coder[].” Evidently, Ericsson represents that claims 23 and 60 of the ’783 patent require a coder or encoder that is a channel encoder, and that Palicot’s Coder 2 is not such an encoder. Instead, now according to Ericsson, the coder required by the claims is satisfied by a turbo coder that is present “inside the ‘Modulator’ box in the Figure 4 block diagram,” and that the turbo coder is directly coupled to a multilevel modulator also within that Modulator box.

Pet. Reply 22–23.

Ericsson does not explain how its first theory as to the anticipation of claims 23 and 60 can be reconciled with its second, alternative theory now

advanced in its Reply. To that end, if the Petition's reliance on "Coder 2" was in error, Ericsson does not articulate how or why it is appropriate for this panel to conclude that a proposed ground relying on that coder as a component accounting for the encoder of claims 23 and 60 can be correct. Indeed, if Ericsson's reference to "Coder 2" is in error, it would not be appropriate to conclude that its anticipation ground relying on that Coder 2 and its relationship to the Modulator is justified.

Moreover, with respect to Ericsson's alternative ground, as noted above, anticipation requires that every element in a claim must be found in a single prior art reference, and arranged as recited in the claims. As shown in the portion of Palicot's Figure 4 reproduce *supra*, the Modulator is depicted simply as a rectangular box with no illustrated detail of the contents, or the arrangement therein, of the box. That the Modulator may include a turbo coder does not, itself, present a suitable basis for ascertaining how Palicot contemplates the relationship of a turbo coder and a multilevel modulator within the Modulator "box." On the record before, Ericsson has not shown an adequate evidentiary basis for concluding that any turbo coder and multilevel modulator present in Palicot are necessarily arranged in the manner that is required by claims 23 and 60. Yet, such a conclusion would be necessary in order to determine that claims 23 and 60 are anticipated by Palicot.

For the foregoing reasons, and on the record presented here, Ericsson has not shown a sufficient basis for concluding, by a preponderance of the evidence, that claims 23 and 60 are anticipated by Palicot.

3. Obviousness Based on Palicot

Ericsson contends that claims 23 and 60 are unpatentable as obvious, over Palicot. Ericsson also proposes that claims 24 and 61 are unpatentable over Palicot and Ungerboeck.

a. Claims 23 and 60

The fundamental question of the patentability of claims 23 and 60 under 35 U.S.C. § 103 based on Palicot is whether a skilled artisan would have appreciated that a turbo coder and a multilevel modulator may be connected in a manner recognizable as establishing a “direct” connection between those components. To that end, there is no dispute that Palicot discloses a turbo coder and a multilevel modulator. Intellectual Ventures stakes its case for the patentability of claims 23 and 60 over Palicot on the theory that the connection between any turbo code and multilevel modulator in Palicot requires the intervening presence of a multiplexer, which precludes a determination that those components are directly coupled. PO Resp. 31–34.

As discussed above in connection with the ground of unpatentability based on Robertson and Ungerboeck, we determine that the presence of a multiplexer between a coder and a modulator does not preclude those components from being viewed as directly connected to one another. Thus, we conclude that one of ordinary skill in the art would have appreciated that Palicot’s turbo coder and multilevel modulator may be configured in the “directly coupled”/ “signal directly from” manner required by claims 23 and 60 despite the presence of a multiplexer between them. To that end, while we are not satisfied Ericsson has presented a suitable basis for establishing anticipation of claims 23 and 60 by Palicot, we, nevertheless, conclude that

under the more expansive obviousness inquiry, claims 23 and 60 are not patentable over the teachings of Palicot, as they would be understood by a person of ordinary skill in the art.

Accordingly, in considering the record now before us, including Ericsson's Petition and Reply, and Intellectual Ventures's Patent Owner Response we are persuaded that Ericsson has shown by a preponderance of the evidence that claims 23 and 60 are unpatentable under 35 U.S.C. § 103 in light of the teachings of Palicot.

b. Claims 24 and 61

As noted above, claims 24 and 61 add to claims 23 and 60 features directed to a trellis code modulation. As it did with respect to the grounds based on Robertson, Ericsson relies on the teachings of Ungerboeck to account for that added feature. Intellectual Ventures presents essentially the same argument vis-à-vis the Palicot and Ungerboeck combination as it did for the Robertson and Ungerboeck combination. For the same reasons discussed above, we find Ericsson's evidence persuasive and are not persuaded by Intellectual Ventures's arguments.

Accordingly, on the present record, we conclude that Ericsson has shown, by a preponderance of the evidence that claims 24 and 61 are unpatentable over Palicot and Ungerboeck.

D. Ericsson's Motion to Exclude

Ericsson has filed a Motion to Exclude paragraphs 51, 53, 55, 57–60, 66, 67, and 70–73 from the Declaration of Intellectual Ventures's declarant, Dr. Cimini (Ex. 2006). Paper 34, 1. The underlying controversy centers on

Dr. Cimini's Declaration and deposition testimony concerning a printed publication referred to as Robertson CMS (Ex. 1025).⁷

Here, we do not discern that it is necessary to consider the substantive merit of Ericsson's Motion to Exclude. In that regard, to the extent that we have considered or relied upon the pertinent paragraphs of Dr. Cimini's Declaration, we have resolved the underlying issue in Ericsson's favor.

Accordingly, Ericsson's Motion to Exclude is *dismissed as moot*.

III. CONCLUSION

We determine that Ericsson has shown by a preponderance of the evidence that: (1) claims 23, 24, 60, and 61 are unpatentable under 35 U.S.C. § 103 over Robertson and Ungerboeck; (2) claims 23 and 60 are unpatentable under 35 U.S.C. § 103 over Palicot; and (3) claims 24 and 61 are unpatentable under 35 U.S.C. § 103 over Palicot and Ungerboeck. We determine that Ericsson has not shown that claims 23 and 60 are anticipated under 35 U.S.C. § 102 by Palicot.

IV. ORDERS

After due consideration of the record before us, it is
ORDERED that claims 23, 24, 60, and 61 are held
unpatentable;

FURTHER ORDERED that Ericsson's Motion to Exclude
(Paper 34) is *dismissed as moot*; and

⁷ P. Robertson and T. Würz, *Coded Modulation Scheme Employing Turbo Codes*, 31 ELECTRONICS LETTERS, No. 18, at 1546–47, Aug. 31, 1995.

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

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