

UNITED STATES PATENT AND TRADEMARK OFFICE

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BEFORE THE PATENT TRIAL AND APPEAL BOARD

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ERICSSON INC.  
NOKIA OF AMERICA CORPORATION  
Petitioners

v.

XR COMMUNICATIONS, LLC, D/B/A VIVATO TECHNOLOGIES,  
Patent Owner

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IPR2024-00613  
Patent No. 10,715,235

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**Declaration of Branimir Vojcic, D.Sc.**

I, Dr. Branimir Vojcic, declare as follows:

1. I have personal knowledge of the facts set forth herein and if called and sworn as a witness I could and would testify competently thereto.

## **1. EXPERT BACKGROUND AND QUALIFICATIONS**

2. Below is a summary of my educational background, career history, publications, and other relevant qualifications. In addition, I am attaching my *Curriculum Vitae*, which includes additional information about my qualifications and publications, as Appendix A to this declaration.

3. I am an expert in wireless technology and other areas of telecommunications, signal processing, and electrical engineering. I am presently a Professor Emeritus of Engineering and Applied Science at The George Washington University. I retired from the university in May 2015, where I was a member of the faculty since September 1, 1991. In addition, I have served as a consultant for a number of companies in the wireless communications industry in various technology areas. I have also served on numerous committees and as a reviewer and editor for several journals, conferences, and organizations.

4. I am presently President of Xplore Wireless, LLC, a small telecommunication consulting company. I was also a co-founder, Director, CEO and CTO of LN2, a startup in the telecommunication space, until 2020.

5. Appendix A is a current copy of my CV. As can be seen in Appendix A, I received my Diploma of Engineering, Master of Science, and Doctor of Science degrees in Electrical Engineering from the University of Belgrade in Yugoslavia in 1981, 1986, and 1989, respectively. The primary focus of my Doctor of Science studies was on Code Division Multiple Access (CDMA) and spread spectrum communications technologies.

6. In 1991, I joined The George Washington University as an Assistant Professor and was promoted to Associate Professor and Professor in 1997 and 2000, respectively. From 2001 to 2004, I served as the Chairman of the Electrical and Computer Engineering Department at The George Washington University. During my tenure at The George Washington University, until May 2015, I taught many different courses on communications theory and networks, wireless communications, CDMA, and I was a course director for a number of courses in communications. I have supervised students mostly in the areas of communications and coding theory, wireless communications/networks, CDMA (including IS-95, CDMA2000, WCDMA/HSDPA/HSUPA) and OFDM/LTE and have been a thesis director for a number of Doctor of Science candidates, who now have successful careers in academia, industry, and government.

7. My research in the areas I just mentioned has been supported by the communications industry and various Government agencies, such as Advanced

Research Project Agency (ARPA), National Science Foundation (NSF), and National Security Agency (NSA). Much of this research concerns communications theory, performance evaluation, modeling wireless networks, multi-user detection, adaptive antenna arrays, and ad-hoc networks.

8. I have authored or co-authored numerous journal and conference papers, contributed to various books, and co-authored a text book on CDMA, entitled “The cdma2000 System for Mobile Communications,” Prentice Hall, 2004. I also served as a co-editor of a book on wireless communications, entitled “Multiaccess, Mobility, and Teletraffic in Wireless Communications, Volume III,” Kluwer Academic Publishers, Norwell, Massachusetts, 1998. My CV includes a detailed listing of my publications.

9. I have also received awards for my work. In 1995, I received the prestigious National Science Foundation Faculty Early CAREER Development Award. The award is given annually by NSF to a select group of young professors nationwide to promote excellence in teaching and research.

10. I have served as a consultant for numerous companies in the wireless communications industry in technology areas, in the areas of 2G/3G/4G mobile technologies, Wireless LANs, new generation broadcast systems, advanced mobile satellite systems and other aspects of modern communication systems. I have also taught academic courses as well as short courses for the industry and government on

various aspects of communications in the areas of 2G, 2.5G, 3G, and 4G cellular standards, such as CDMA2000 1xRTT, CDMA2000 Evolution Data Optimized (EVDO), Wideband Code Division Multiple Access (WCDMA), and LTE.

11. I am a Senior Member of the IEEE and was an Associate Editor for IEEE Communications Letters and Journal on Communications and Networks. I served as a member of technical program committees, as a session organizer for many technical conferences and workshops, and as a reviewer of technical papers for many journals and conferences.

12. I am a co-inventor of U.S. Patent No. 6,523,147, entitled “Method and Apparatus for Forward Error Correction Coding for an AM In-Band On-Channel Digital Audio Broadcasting System,” US Patent No. 8,595,590 B1, entitled “Systems and Methods for Encoding and Decoding Check-Irregular Non-Systematic IRA Codes,” and applications, “Joint Source-Channel Decoding with Source Sequence Augmentation”, US 20140153654 A1, Jun 5, 2014, “Systems and Methods for Advanced Iterative Decoding and Channel Estimation of Concatenated Coding Systems”, US 20140153625 A1, Jun 5, 2014, “Advanced Decoding of High/Medium/Low Density Parity Check Codes”, PCT/US13/72883, and International Application Number PCT/CA01/01488, entitled “Multi-User Detector For Direct Sequence - Code Division Multiple Access (DS/CDMA) Channels.”

13. Over the last several years I have evaluated many (on the order of hundreds) patents that are essential or potentially essential to wireless standards for various clients. These evaluations typically include, for example, analyzing whether the patent claims read on the relevant standard, considering the importance of the technological inventions claimed, analyzing how such claimed inventions compare to other similar patents in the field, searching for and reviewing potential prior art, reviewing and analyzing the prosecution histories of patents relevant to potential claim construction, infringement, or other issues, reviewing and analyzing the working group documents related to the relevant standard in relation to the claimed invention, and considering whether there are available alternatives to the claimed inventions.

14. I have provided expert reports, expert depositions, and testimony over the past 10 years in numerous cases involving many aspects of wireless communications.

## **2. MATERIALS CONSIDERED**

15. In forming my opinion, I have reviewed, considered, and had access to U.S. Patent No. 10,715,235 (“235 Patent,” Ex. 1001), including its specifications and claims, as well as its prosecution histories and provisional applications. I have reviewed the Petition for IPR and the Board’s Decision to Institute in this proceeding. I have reviewed the declaration of Dr. Mark P. Mahon (“Mahon Decl.,”

Ex. 1003). I have also reviewed the Agee (Ex. 1004) and Butler (Ex. 1005) references submitted by Petitioner in this proceeding, as well as the other references that the Petitioners and Dr. Mahon rely upon. I have also reviewed the exhibits cited in Dr. Mahon's declaration, as well as the exhibits that I cite throughout my declaration. I have also reviewed Dr. Mahon's deposition testimony in this proceeding ("Mahon Dep.," Ex. 2003). I have also reviewed Patent Owner's Preliminary Response (POPR).

16. I have also relied on my professional and academic experience in the field of wireless communication. This declaration represents the opinions that I have formed to date and based on the material available to me at this time. I may consider additional documents as they become available or other documents that are necessary to form my opinions. I reserve the right to revise, supplement, or amend my opinions based on new information and on my continuing analysis in this matter.

### **3. LEVEL OF ORDINARY SKILL IN THE ART**

17. I am familiar with the concept of the person of ordinary skill in the art ("POSITA") and have reviewed Dr. Mahon's and Petitioners' views on the definition and qualifications of the POSITA for in this IPR proceeding. As Dr. Mahon states in paragraph 39 of his declaration:

In my opinion, a POSITA as of the claimed priority date of the challenged patent would have had (1) the equivalent of an undergraduate degree in Electrical Engineering or a related field; and (2) at least four years of experience in design, development, and/or testing of telecommunication systems. In a similar vein, a POSITA would also have familiarity with the wireless standards and protocols related to data transmission and network management. It is also my opinion that more education could supplement practical experience or vice versa. For example, such knowledge could be acquired [sic] by a mixture of training and work experience such as a Master's degree in Electrical Engineering with less work experience.

Ex. 1003 at 20. For purposes of this proceeding, I will adopt Dr. Mahon's definition of a POSITA. I am at least a POSITA under this definition, and I was so as of the priority date of the '235 Patent (around November 2003).

#### **4. LEGAL PRINCIPLES**

18. I am not an attorney. I offer no opinions on the law. But counsel has informed me of the following legal standards relevant to my analysis here. I have applied these standards in arriving at my conclusions.

##### **A. Burden of Proof**

19. I understand that in an *inter partes* review the petitioner has the burden of proving a proposition of unpatentability by a preponderance of the evidence.

##### **B. Claim Construction**

20. I understand that the Board will apply the "plain and ordinary meaning" standard to claim construction in this proceeding. I understand that the plain and ordinary meaning of a claim term is the meaning that the term would have to a person

of ordinary skill in the art in question at the time of the invention when read in view of the patent claims and the specification.

21. I understand that the Board does not construe claim terms unnecessary to resolving the controversy.

**C. Anticipation<sup>1</sup>**

22. It is my understanding that invalidation by “anticipation” only exists if a single alleged prior art reference discloses each and every limitation of the claim at issue, either expressly or inherently. In other words, every limitation of the claim must appear in a single prior art reference for the reference to anticipate that claim. I also understand that all limitations of the claim must be disclosed in the reference as they are arranged in the claim. I also understand that anticipation by a preponderance of the evidence requires a showing that a person could make and use the claimed invention by looking at one reference. A requirement of a claim that is missing from a prior art reference may be disclosed inherently if that missing requirement is necessarily present in the prior art. I also understand that to be considered anticipatory, the prior art reference must be enabling and must describe the patentee’s claimed invention sufficiently to have placed it in the possession of a person of ordinary skill in the field of invention.

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<sup>1</sup> I note that anticipation is not at issue in this IPR, but I nonetheless state my legal understanding of anticipation for the sake of completeness.

#### **D. Obviousness**

23. I understand that a claim of a patent may not be novel even though the invention is not identically disclosed or described in the prior art so long as the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious to a person having ordinary skill in the art in the relevant subject matter at the time the invention was made.

24. I understand that, to demonstrate obviousness, it is not sufficient for a petition to merely show that all of the elements of the claims at issue are found in separate prior art references or even scattered across different embodiments and teachings of a single reference. The petition must thus go further, to explain how a person of ordinary skill would combine specific prior art references or teachings, which combinations of elements in specific references would yield a predictable result, and how any specific combination would operate or read on the claims. Similarly, it is not sufficient to allege that the prior art *could* be combined, but rather, the petition must show *why* and *how* a person of ordinary skill *would* have combined them.

25. I understand that, to demonstrate obviousness, a petition must accurately identify and analyze the differences between the claimed invention and the prior art.

26. I understand that obviousness cannot be shown by conclusory statements, and that the petition must provide articulated reasoning with some rational underpinning to support its conclusion of obviousness.

## **5. THE '235 PATENT**

### **5.1. Overview**

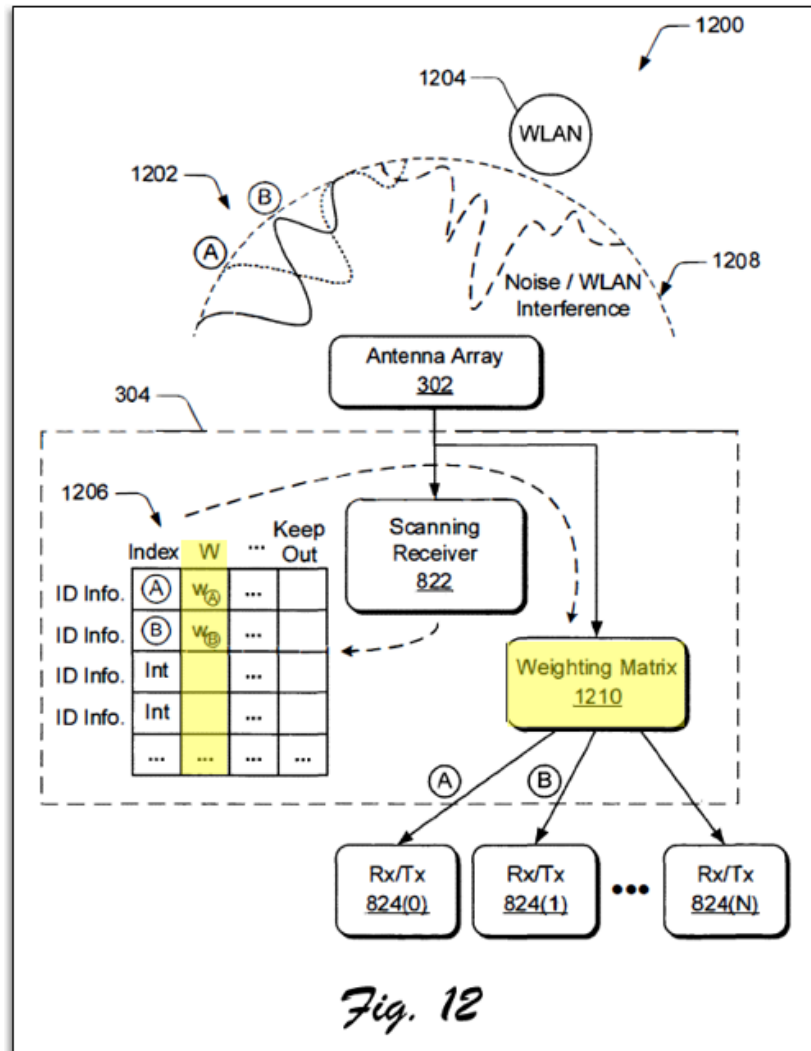
27. The '235 Patent (Ex. 1001) is entitled “Directed wireless communication” and relates to “a multi-beam directed signal system [] implemented to communicate over a wireless communication link via an antenna assembly with client devices.” '235 patent at 3:11-15. The '235 Patent discloses a wireless communications apparatus that comprises an “antenna array 302” with a plurality of “antenna elements” to emanate an array of multiple directed communication beams 214(1), 214(2),...214(N). Ex. 1001, FIGS. 2, 3. The '235 Patent teaches that the apparatus receives signal transmissions simultaneously via directed communication beams. *Id.* at 3:38-52 (“An increase in communication range is achieved by beamforming directed communication beams which simultaneously transmit directed signals and receive communication signals from different directions via receive and transmit beamforming networks.”).

28. In one embodiment, “antenna array 302 can include sixteen antenna elements...” from which “sixteen different communication beams 602(0), 602(1),...,602(15) are formed,” each of which may have beam patterns that “differ

in width, shape, number, angular coverage, azimuth, and so forth.” *Id.* at 9:12-34; 6:61-7:5 (“directed communication beams 214 of antenna array 302 can be directionally controllable”). In one embodiment, only thirteen of the beams are used for transmission and reception. *Id.* at 9:34-60.

29. The ’235 Patent apparatus receives signal transmissions via the directed communication beams from other devices or “nodes within the wireless routing network.” Ex. 1001 at 24:25-34. Further, the ’235 Patent apparatus determines signal information regarding each of the simultaneously received signals. *Id.* at 15:44-16:49, 24:25-25:30. In the Figure 12 embodiment, the “signal control and coordination logic 304 includes the scanning receiver 822 that is configured to update routing information 1206 with regard to the received signals.” *Id.* at 24:25-67. The disclosures regarding “scanning receiver 822” at columns 15-16 elaborates that the “scanning receiver 822” determines “routing and signal information which can include transmit power level information, transmit data rate information, antenna pointing direction information, weighting information, constraints information, null/zero location information, peak location information...frequency information, timing information, user and node authentication information, keep out area information, etc.” *Id.* at 15:44-16:49. Figure 12 describes how a set of weighting values is determined based on differing signal information for each received signal from each node.

30. For example, as shown in Figure 12 below, “communication and/or data transfer signals are received from sources 1202 (e.g., sources A and B).” *Id.* at 24:25-34. These signals are provided to a “signal control and coordination logic 304” which includes a “scanning receiver 822 that is configured to update routing information 1206 with regard to the received signals.” *Id.* at 24:35-25:30. More specifically, the routing information 1206 includes a routing table, and the “routing table includes stored weighting values ( $w$ ) each associated with a particular signal source 1202 (e.g., sources A and B)...[a] description of the received signal(s) can be stored in the routing table in the form of the pattern of weighting of the signal(s). In this example, a polynomial expansion in  $z$ ,  $w(z)=w_0+w_1z+w_2z^2+w_3z^3+w_4z^4+ \dots +w_iz^i$  can be utilized to establish the values of the weights ( $w_i$ ) to be applied to a weight vector.” *Id.* Figure 12 is depicted below.



## 5.2. Challenged Claims

31. The Petition challenges claims 1-5, 8-12, and 15-19 of the '235 Patent. Pet. at 29. The independent claims are claims 1, 8, and 15. The other claims are dependent claims that depend (directly or indirectly) from independent claims 1, 8, and 15. For illustrative purposes, I reproduce claims 1, 4, and 5, as well as claim 8, as follows:

| Identifier | Independent Claim 1                                                                                                                                                                             |
|------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| [1.0]      | A receiver for use in a wireless communications system, the receiver comprising: an antenna, wherein the antenna comprises a first antenna element and a second antenna element;                |
| [1.1]      | a transceiver operatively coupled to the antenna and configured to transmit and receive electromagnetic signals using the antenna;;                                                             |
| [1.2]      | a processor operatively coupled to the transceiver, the processor configured to:                                                                                                                |
| [1.3]      | receive a first signal transmission from a remote station via the first antenna element and a second signal transmission from the remote station via the second antenna element simultaneously; |
| [1.4]      | determine first signal information for the first signal transmission;                                                                                                                           |
| [1.5]      | determine second signal information for the second signal transmission, wherein the second signal information is different than the first signal information;                                   |
| [1.6]      | determine a set of weighting values based on the first signal information and the second signal information;                                                                                    |
| [1.7]      | wherein the set of weighting values is configured to be used by the transceiver to construct one or more beam-formed transmission signals;                                                      |
| [1.8]      | cause the transceiver to transmit a third signal to the remote station via the antenna, the third signal comprising content based on the set of weighting values.                               |

| Identifier | Dependent Claim 4                                                                                                                                                                                                                                    |
|------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| [4]        | The receiver as recited in claim 1, wherein the content comprises data configured to be used by the remote station to modify the placement of one or more transmission peaks and one or more transmission nulls in a subsequent signal transmission. |
| Identifier | Dependent Claim 5                                                                                                                                                                                                                                    |
| [5]        | The receiver as recited in claim 4, wherein the set of weighting values is further based on one                                                                                                                                                      |

| Identifier | Independent Claim 8                                                                                                                                                                                                                                                                                                                                                                                                |
|------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| [8.0]      | A method in a wireless communications system, the method comprising:                                                                                                                                                                                                                                                                                                                                               |
| [8.1]      | receiving a first signal transmission from a remote station via a first antenna element of an antenna and a second signal transmission from the remote station via a second antenna element of the antenna simultaneously, wherein the first signal transmission and the second signal transmission comprise electromagnetic signals comprising one or more transmission peaks and one or more transmission nulls; |
| [8.2]      | determining first signal information for the first signal transmission;                                                                                                                                                                                                                                                                                                                                            |
| [8.3]      | determining second signal information for the second signal transmission, wherein the second signal information is different than the first signal information;                                                                                                                                                                                                                                                    |
| [8.4]      | determining a set of weighting values based on the first signal information and the second signal information, wherein the set of weighting values is configured to be used by the remote station to construct one or more beam-formed transmission signals; and                                                                                                                                                   |
| [8.5]      | transmitting to the remote station a third signal comprising content based on the set of weighting values.                                                                                                                                                                                                                                                                                                         |

### **5.3. Prosecution History and Priority Date**

32. The '235 Patent issued from U.S. Pat. App. No. 15/495,539 filed April 24, 2017 claiming priority through continuation applications to U.S. Provisional Pat. App. No.60/423,660 filed on November 2, 2002. I understand that in a previous IPR, Patent Owner contended that the '235 patent is entitled to an earlier priority date, but that in this IPR, Patent Owner does not raise arguments regarding priority date or attempt to pre-date the asserted prior art. Therefore, I assume that November 2, 2002, is the priority date of the challenged claims of the '235 Patent.

## **6. CLAIM CONSTRUCTION**

33. I understand that the Board does not construe any claim terms unnecessary to resolve the parties' dispute. Petitioners<sup>2</sup> and Dr. Mahon do not propose any claim constructions, and Petitioners propose that "each claim term be given its plain and ordinary meaning." Pet. at 6. I agree that no express constructions are necessary and the claims of the '235 Patent carry their plain and ordinary meaning in view of the claim language and specification.

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<sup>2</sup> Throughout this declaration, I may refer to "the Petition," "Petitioner," "Petitioners," "Dr. Mahon," and "Mahon declaration." These references should be understood to be interchangeable. For example, references to a position/argument of Petitioners / the Petition should be understood to include the corresponding position/argument of Dr. Mahon / Mahon declaration, and vice versa.

34. I also understand that Dr. Mahon’s declaration does not contain any opinions regarding disclaimer or lexicography, as he confirmed in deposition. *See* Mahon Dep. at 16-18, 20-6 (“Q: Do you offer any opinions about ‘lexicography’ or ‘disclaimer’ in this case? A: I do not.”). I understand from lexicography means express re-definition of a term. I likewise have not seen lexicography or disclaimer of the claims of the ’235 Patent. This is based on my review of the intrinsic evidence as well as Dr. Mahon’s declaration and materials cited therein.

35. I also understand that a claim construction order has been entered in a related district court action, determining that all contested terms have their plain and ordinary meaning. Ex. 1017, *XR Comm’ns LLC v. Cisco Sys.*, No. 6:21-cv-00623-ADA, Dkt. No. 56 (W.D. Tex. Sept. 30, 2022). In particular, the court in that action adopted the following constructions relevant to the claims at issue here:

| Term                                                                                 | Court’s Final Construction                                                                                                                                                                                                           |
|--------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| “transmission nulls”<br><br>30, 32; U.S. Patent No. 10,715,235, Cls. 2, 4, 8, 12, 16 | Plain and ordinary meaning wherein the plain-and-ordinary meaning is “portions of one or more spatially distributed patterns of electromagnetic signals where transmissions of no or insignificant energy are selectively directed.” |
| “transmission peaks”<br><br>U.S. Patent No. 10,715,235, Cls. 2, 4, 8, 12, 16         | Plain-and-ordinary meaning <sup>1</sup><br><br>[ <sup>1</sup> Note not for the jury: The plain-and-ordinary meaning of “transmission peaks” includes relative maxima.]                                                               |

| Term                                                                                                                                                                                   | Court's Final Construction                                                                                                                |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------|
| <p>“third signal comprising content based on the set of weighting values”</p> <p>U.S. Patent No. 10,715,235, Cls. 1, 8 and 15</p>                                                      | <p>Plain-and-ordinary meaning wherein the plain-and-ordinary means that the “third signal” is “based on the set of weighting values.”</p> |
| <p>“the set of weighting values is configured to be used by the remote station to construct one or more beam-formed transmission signals”</p> <p>U.S. Patent No. 10,715,235, Cl. 8</p> | <p>Not indefinite. Plain-and- ordinary meaning.</p>                                                                                       |
| <p>“remote station”</p> <p>U.S. Patent No. 10,715,235, Cls. 1,4,8,9,12,15</p>                                                                                                          | <p>Plain and ordinary meaning.</p>                                                                                                        |

36. My opinions below would be the same either without claim construction or under the W.D. Tex. court's construction order.

## 7. REBUTTAL TO DR. MAHON'S OPINIONS

37. I have reviewed the Petition, expert declaration of Dr. Mahon (Ex. 1003), supporting materials to the declaration, as well as the transcript of Dr. Mahon's deposition. In my opinion, Dr. Mahon has not shown that U.S. Patent No. 7,248,841 to Agee et al. (“Agee,” Ex. 1004) alone or in combination with U.S. Patent No. 3,255,450 to Butler (“Buter,” Ex. 1005) renders obvious any challenged claim of the '235 Patent. My decision to not rebut a particular opinion in the Mahon declaration is not, and should not be interpreted as, agreement with that opinion.

Rather, I have set forth my opinions below sufficient to support my conclusion that Dr. Mahon has not shown invalidity of the challenged claims.

### **7.1. General Comments**

38. As an initial matter, I make several general comments regarding Dr. Mahon's declaration and invalidity theories presented therein. These comments provide background and context for substantive rebuttal opinions for the challenged claims below.

39. First, as mentioned in the claim construction section above, Petitioner does not propose any claim constructions, and the parties agree that terms of the '235 Patent carry their plain and ordinary meaning. I have applied the plain and ordinary meaning of the claim language, as understood by a POSITA, in providing my rebuttal validity opinions. At certain points, Dr. Mahon refers to Patent Owner's statements or alleged positions during prosecution or in other IPRs. In general, Dr. Mahon's references are inaccurate or taken out of context. It is also unclear how he is relying on prosecution or other IPRs given that his declaration and deposition make clear that he doesn't offer any opinions regarding lexicography or disclaimer. I also have not seen sufficient evidence of lexicography or disclaimer that would materially affect my rebuttal opinions.

40. Second, Dr. Mahon asserts that Agee alone renders obvious the challenged claims. Although Dr. Mahon, lists an alternative ground of Agee and

Butler, this ground is essentially the same. Dr. Mahon does not rely on any specific teachings or modifications based on the Butler patent and merely asserts that a Butler matrix would be known to a POSITA. Therefore, my rebuttal opinions focus on Agee since the crux of Dr. Mahon's opinions is single-reference obviousness. But my rebuttal opinions equally apply to the alternative ground of Agee and Butler.

41. Third, I note that for Agee, Dr. Mahon fails to sufficiently articulate an obviousness combination or modification. For example, Dr. Mahon fails to identify the differences between Agee and the challenged claims and then propose any specific modifications to Agee to arrive at the challenged claims. In deposition, Dr. Mahon confirmed that he didn't propose any modifications for Agee:

11           My question is: Do you discuss any modifications  
12 of Agee alone; for example, changes one would make to  
13 Agee to -- to render the '235 claims obvious?

14           A.       I'm not sure I understand your question.

15           Q.       Let me ask you a different way.

16           Do you -- do you discuss in your opinions any  
17 modifications or changes to Agee?

18           A.       No. My opinion is that Agee renders  
19 obvious the asserted claims based on the knowledge of a  
20 person of ordinary skill in the art at the time of the  
21 invention, and that alone is sufficient.

22           Q.       So do you believe that any changes or  
23 modifications to Agee are -- are necessary?

24           A.       Not outside of the scope of anything I've  
25 discussed in my declaration from the perspective of a

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1       person of ordinary skill in the art, and I don't recall  
2 anything right now that's coming to mind that I -- I  
3 discussed.

Mahon Dep. at 33-34.

42. Dr. Mahon also later testified to his belief that no combinations or modifications to Agee were necessary, allegedly because there was no difference between the Agee and the challenged claims:

|                |                                                       |
|----------------|-------------------------------------------------------|
| 21             | Do you see the second item that says, "The            |
| 22             | differences between the prior art and the claim under |
| 23             | consideration"?                                       |
| 24             | A. Yes, I do.                                         |
| 25             | Q. And so that would be something you have to         |
| <b>Page 35</b> |                                                       |
| 1              | consider to -- to offer your -- your obviousness      |
| 2              | opinion, right?                                       |
| 3              | A. Yes, it would.                                     |
| 4              | Q. So what are the differences between Agee           |
| 5              | and the claims of the '235 patent or Claim 1 of the   |
| 6              | '235 patent?                                          |
| 7              | A. In my analysis, there's very little                |
| 8              | daylight between the two. I can't think of anything   |
| 9              | specific in terms of differences between the Agee     |
| 10             | reference and the '235 patent.                        |

Mahon Dep. at 34-35.

43. This testimony supports my opinion that Dr. Mahon's obviousness analysis is insufficient. In my opinion there are differences between Agee and the challenged claims of the '235 Patent, as discussed below and including at least the limitations identified below. Dr. Mahon fails to appreciate those differences. And given those differences, Dr. Mahon fails to meet his burden to show obviousness by providing sufficient evidence or explanation for how or why a POSITA would modify Agee to arrive at the challenged claims.

## **7.2. Independent Claim 1**

44. In my opinion, Dr. Mahon fails to show that Agee, alone or in combination with Butler, renders obvious independent claim 1.

45. In my opinion, Dr. Mahon only presents one coherent theory for claim 1 based on Agee, alone or in combination with Butler. I now summarize that theory because it is relevant to my rebuttal opinions for other claims. The theory is Agee's disclosure related to pilot signals. Dr. Mahon argues that Agee teaches or suggests a processor that is configured to receive a first signal transmission at a first antenna element from a remote station and a second signal transmission at a second antenna element from the remote station—a pilot signal. Dr. Mahon argues that signals transmitted from Agee's remote station include a pilot signal and that these signals are simultaneously sampled at multiple antenna elements.

46. Dr. Mahon argues that the different signal strengths at different antenna elements are measured, and “[t]hese measurements are passed into the circuitry of [phase] shifters and dividers / combiners.” Mahon Decl. ¶ 342; Pet. at 14. Dr. Mahon argues that the measured signal strengths at different antenna elements correspond to the recited first signal information and second signal information. *See* Pet. 61.

47. For limitation [1.6], Dr. Mahon contends that the output data from the Butler matrix, that is, the output from processing the pilot signal information, is used to calculate weights based on the received pilot signal information—“combiner

weights.” Dr. Mahon refers to “combiner output data” as the data that is outputted by the Butler matrix after processing (that is, combining) the alleged information signals received at the antenna elements. *See, e.g.*, Mahon Dec. ¶ 324 (discussing combiner feeds and distributor feeds). The Petition states that “the received pilot data tones (‘x’) is received by the FFT-LS algorithm to calculate the weights.” The Petition argues that “[t]he ‘combiner weights W’ are used to form beams and nulls for receiving and transmitting data.” Pet. at 68; *see also* Mahon Decl. ¶¶ 549–550.

48. I understand that the Board discussed the above theory in its institution decision and found it sufficient for institution based on the preliminary record and under the reasonable unlikelihood standard. I also understand that the Board did not discuss any other theories or find them to be coherent or sufficient.

49. In my opinion, none of the other theories Dr. Mahon suggests (or purports to preserve) for claim 1 is coherent or sufficient. For example, claim 1 requires that the “first signal” and “second signal” from [1.3] being used to determine “first signal information” that is different than “second signal information” in [1.4] and [1.5] further being used to “determine a set of weighting values” in [1.6]. For limitation [1.6], the Petition’s theory requires Agee’s “pilot signal” or “pilot data tones” to serve as the claimed “signal information” used to calculate Agee’s “weights.” Pet. at 64-69.

50. The Petition presents in cursory fashion references to possible alternative mappings of “signal information” in Agee. Pet. at 62-64. In my opinion, none of these references is sufficient, for example because they do not appear as part of the Petition’s theory for limitation [1.6]. On this point, I have reviewed and agree with the arguments in Patent Owner’s Preliminary Response

51. First, the Petition identifies as possible examples of “signal information” the following: “antenna pointing direction information,” “null/zero location information,” “peak location information,” “frequency information,” and “timing information.” Pet. at 62-63. All of these are examples of signal information from the ’235 Patent itself, not from Agee or any other prior art reference. The teachings from the ’235 Patent cannot be used to render the patent itself obvious.

52. Second, the Petition states that “Agee’s 32 different OFDM tones are all separate transmissions at different frequencies and thus provide ‘frequency information.’” Pet. at 63. But the Petition does not explain how Agee “determines” such frequency information, which is insufficient to show [1.4] or [1.5]. *Id.* The Petition does not identify any element in Agee that “determines” frequency information. *Id.* There is no explanation in the Petition how “frequency information” is used to determine weighting values in limitation [1.6]. Pet. 64-69. The only reference to frequency at in limitation [1.6] is in support of the argument, introduced in limitation [1.3], that each individual tone is a separate “transmission signal,” and

that Agee performs its weight determination algorithm on a per-tone basis. Pet. at 67-68; *see id.* at 44 (contending that limitation [1.3] is met through “Agee’s use of OFDM which transmits (and receives) multiple different OFDM tones simultaneously”). The Petition’s theory is that the weighting value is determined the same way for each individual tone, but there is no contention that this involves frequency information.

53. But the Petition does not allege or explain how such “frequency information” is “used” to compute weights in limitation [1.6]. Pet. 63-69. The Petition says that Agee discloses that the “combining weights” are “applied over as broad a range of tones (frequency channels  $k$ )” but cites nothing in Agee which indicates that weights are determined based on the specific frequency  $k$ . While a weight may be determined for each frequency, the numerical value of that frequency has no impact on the determination of the weight in Agee. Agee’s alleged disclosure that weights are computed for the entire OFDM symbol comprising 32 tones does not show that the value of the frequency has any impact on the determined weights. The Petition does not clearly articulate any theory regarding frequency values and identifies no support in Agee that frequencies themselves are used in any way to calculate weights. Pet. 63-69.

54. Further, there is no suggestion or showing that Agee discloses any determination of per-tone weighting values based on the overall number of tones,

which is fixed at 32, in the Petition's own theory. And if "32" is the signal information in the Petition's theory, the Petition does not and cannot plausibly show that Agee discloses a *determination* of this value as claimed, nor how there could be a determination of "different" second signal information in [1.5] where, as here, every signal in the Petition's invalidity theory of Agee with Butler is an OFDM signal comprising the same number of tones (32 tones).

55. Third, the Petition attempts to map "signal information" as "timing information" by pointing to a "observed timing offset." Pet. at 63. There is no explanation or support for this theory. The Petition apparently references its discussion at 52-54, which does not mention any "timing information" as described in the '235 Patent and instead discusses the detection of pilot signals. And "timing information" appears nowhere else in the Petition, such as in [1.6].

56. Fourth, the Petition identifies "pseudodelays" as "node authentication information." Pet. at 63. There is no explanation or support for this apparent non sequitur, except for references that pseudodelays are "unique to each transmit note," e.g. Pet. at 52. "Node authentication information" appears nowhere else in the Petition, and "pseudodelays" are not even mentioned in connection with limitations 1.6 or 1.7.

57. Fifth, the Petition alleges that there are "peaks" in "observed pseudodelays" which are "peak location information." Pet. at 63. The Petition

contains no discussion of the supposed detection of “peaks” in Agee to support this theory, or any explanation of what information in Agee is contended to meet the limitation. Rather, the Petition merely quotes the phrases “peak location information” and “null/zero location information,” neither of which appears in Agee, and neither of which appears anywhere else in the Petition.

58. Sixth, the Petition identifies “azimuth and elevation” and “link quality statistics.” Pet. at 63: The Petition again provides no explanation why these words relate in any way to the ’235 Patent claims. “Azimuth” and “elevation” appear nowhere else in the Petition; “link quality statistics” appears in unexplained quotations, but not for limitations 1.6 or 1.7.

59. Accordingly, in my opinion the Petition presents no other invalidity theory where “first signal information” and “second signal information” in [1.4] or [1.5] used to determine the weighting values in [1.6]. The only arguably coherent theory presented is the one discussed in the institution decision based on a pilot signal transmitted from Agee’s remote station.

60. In my opinion, Dr. Mahon fails to show that Agee’s pilot signal or pilot signal theory renders obvious claim 1. On this point, I have reviewed and agree with the arguments in Patent Owner’s Preliminary Response. Although the Board found that the pilot signal theory was sufficient for institution, it did not make any findings based on a full record or under the preponderance of evidence standard. Further, the

Board did not specifically or fully address several of Patent Owner’s arguments that have merit. I summarize those arguments for further consideration by the Board.

61. For example, the Petition argues that Agee “teaches the Butler outputs collectively (‘combiner output data’) constitute a determination of different signal informations. For example, the first and second signal informations are Butler output #1 and Butler output #2.” Pet. at 64. But this argument is unsupported by any citation in Agee or what a POSITA would understand.

62. In my opinion, the Petition fails to show that “Butler output #1” or “Butler output #2” are “signal information” of [1.4] or [1.5] or that such outputs are “signal information” used to determine “weighting values” in [1.6]. In describing the Agee and Butler prior art, the Petition alleges that a Butler matrix output is the “‘combined’ signals from multiple antennas being received and aggregated.” Pet. 8. But in view of the Petition’s clear assertion that a Butler matrix output is a combined “signal,” the Petition fails to show or explain for [1.4] or [1.5] how the Butler matrix output, which is a “combined signal” (Pet. 8), is “signal information.” Pet. 64. The Petition’s argument that each output is a “determination of different signal informations resulting from multiple signals” is unsupported evidence and is contradicted by the Petition’s assertion that each Butler output is a combined “signal” which is combined from multiple signals.

63. This is shown by the Petition’s own discussion of Butler, which states that the output ports of a Butler matrix, in the context of reception, “output the ‘combined’ *signals* from multiple antennas being received and aggregated to form each reception beam.” Pet. at 8. This is further confirmed by reference to the figure from the well-known Butler reference, showing the analog components that make up the matrix. The combiners and phase shifters that form the Butler matrix perform combining and phase-shifting the various signals to produce output signals (in the context of reception) at the feed terminals.

64. A further problem of mapping “Butler outputs” as “signal information” determined by the claimed “processor” is that the Petition’s theory requires that the Butler matrix outputs are *inputs* to the claimed “processor” of [1.2]. Pet. 42 (“The DSP [processor] receives and processes the Butler matrix outputs from the antennas.”). But if the Butler matrix outputs are inputs to the DSP “processor” (as alleged for [1.2]), then the Butler matrix outputs cannot also be “signal information” that is “determined” by the “processor” as required under [1.4] and [1.5].

65. In my opinion, the Petition also fails to show that Agree determines weighting values in limitation [1.6] based on signal strength. The Petition argues that “Agee’s Butler matrix measures different signal information (signal strengths) received on each antenna even for the same signal wave due to the phase differences resulting from the antennas’ spatial separation.” Pet. at 62. In my opinion, this

argument fails to meet Petitioners’ burden to prove obviousness, for several reasons. These reasons were raised in Patent Owner’s Preliminary Response and were not specifically or fully addressed in the institution decision.

66. First, Agee does not teach anything about “signal strength” or about a Butler matrix deriving or determining “signal strength.” In my opinion, a POSITA would not understand a Butler matrix as “determining” or “measuring” signal strength. Nor does the Petition or Dr. Butler sufficiently explain this beyond asserting it. Second, the Petition fails to show a “first signal” and “second signal” from [1.3] being used to determine some “second signal strength information” which is different than “first signal strength information,” as required in [1.4] and [1.5].

67. Third, the Petition fails to show any determination of beamforming weights in [1.6] based on *any* determined signal strengths in Agee, or any determination of weights based on a *first* signal strength which is *different* than the *second* signal strength. Pet. at 61-62, 64-69. I note that there is no sufficient reference or discussion to “strength” anywhere in the [1.6] analysis. Pet. at 64-69. Further, the cited disclosures from Agee teach determinations based on the actual OFDM tones and symbols, not based on “signal strength.” *See, e.g.*, Pet. at 68 (“EX-1004, 65:24-46 (‘K is the number of tones used in a single FFT-base LS algorithm’ used to calculate ‘combiner weights.’)).

### 7.3. Dependent Claims 2–3

68. In my opinion, Dr. Mahon fails to show that Agee, alone or in combination with Butler, renders obvious dependent claims 2–3 for the same reasons as independent claim 1.

### 7.4. Dependent Claim 4

69. In my opinion, Dr. Mahon fails to show that Agee, alone or in combination with Butler, renders obvious dependent claim 4 for the same reasons as independent claim 1 and for additional reasons.

70. Claim 4 recites: “The receiver as recited in claim 1, wherein the content comprises data configured to be used by the remote station to modify the placement of one or more transmission peaks and one or more transmission nulls in a subsequent signal transmission.”

71. Here, “the content” refers back to part of limitation [1.8], “cause the transceiver to transmit a third signal to the remote station via the antenna, the third signal comprising **content** based on the set of weighting values.” The third signal comprises content, and the content comprises the “data” of claim 4.

72. As an initial matter, Dr. Mahon does not articulate or adequately explain what the alleged “third signal” (transmitted by the transceiver to the remote station via the antenna) is or how it allegedly meets the additional claim 4 requirement “wherein the content comprises data configured to be used by the

remote station to modify the placement of [transmission peaks/nulls] in a subsequent signal transmission.” The Petition and Dr. Mahon’s theory for claim 4 is not understandable. For claim 1, Dr. Mahon appears to be relying on (any) generic signal as the alleged “third signal” But for a generic signal transmitted from the receiver to the remote station, there is no showing or explanation for why or how it includes content that includes “data configured to be used by the remote station to modify the placement of [transmission peaks/nulls] in a subsequent signal transmission.”

73. Although Dr. Mahon is unclear, I assume he may argue (or attempt to argue) that the “third signal” is a pilot signal and respond on that basis. My response should not be interpreted as a concession that this argument was fairly preserved. And to the extent Petitioner attempts to make or change this argument, I reserve the right to further respond.

74. For the claim language “data configured to be used by the remote station to modify the placement of one or more transmission peaks and one or more transmission nulls in a subsequent signal transmission,” Dr. Mahon points to “the pilot signals that each Agee BS transmits to the other BSs.” Mahon Decl. ¶ 621. For this to invalidate claim 4, Dr. Mahon must show at least: (1) that the “third signal” of limitation [1.8] comprises Agee’s “pilot signals”; and (2) that Agee’s “pilot signals” are “data configured to be used by the remote station...” In my opinion, Dr. Mahon fails show either of these things, and I address them in turn.

75. ***First***, Dr. Mahon does not show that the “third signal” of limitation [1.8] comprises “pilot signals.” Dr. Mahon’s analysis of limitation [1.8] only discusses “combiner” weights, which in his theory “are used as distributor / transmit weights.” Ex. 1003, ¶ 600. In Dr. Mahon’s theory, “Agee’s output data is modified by the weights (as shown in elements [1.6]-[1.7] before it is transmitted (elements [1.4]-[1.7] above) and therefore meets this element.” This analysis says nothing about “pilot signals” being included in the “third signal.”

76. Dr. Mahon’s analysis of limitation [1.4]-[1.7] suggests that, in his theory, Agee’s pilot signal is something used to determine the claimed set of weighting values, *i.e.*, that the pilot signal is part of the first and second signal information. For example, the first real paragraph of the limitation 1.6 analysis says that “Agee uses a pilot data signal (the ‘combiner output data’) that it receives from the Butler matrix.” Mahon Decl. ¶ 538. And Dr. Mahon points to specific “usage (and calculations) of the pilot symbols received from the butler matrix... for calculating the weights for the received pilot symbol.” *Id.* ¶ 544. The rest of Dr. Mahon’s discussion of the limitation similarly confirms that the pilot signal is something used to determine the weighting values. *Id.* ¶¶ 545-572.

77. In other words, Dr. Mahon only ever opines on “pilot signals” as something received by the apparatus of claim 1, and specifically as inputs to the weight determination of limitation 1.7. He does not show that Agee discloses or

renders obvious pilot signals that are transmitted by the by the apparatus of claim 1, or that pilot signals are “output data... modified by the weights,” which is the only thing he points to as the third signal of limitation 1.8.

78. As discussed in claim 1 above, Petitioner argues that the “pilot signal” corresponds to the “first signal” and “second signal” of limitation [1.3], and also corresponds to the “first signal information” and “second signal information” of limitations [1.4] and [1.5]. This confirms my opinion that Dr. Mahon’s analysis of claim 1 maps Agee’s pilot signals to the signals that are *received* by the apparatus of claim 1, not to anything *transmitted* by the apparatus, such as the third signal of limitation 1.8.

79. Dr. Mahon’s discussion of claim 4 likewise does not show that the pilot signal is part of the third signal of limitation 1.8. Limitation 1.8 requires “the third signal comprising content based on the set of weighting values.” Dr. Mahon’s claim 4 analysis does not address this requirement at all. He says that pilot signals are “used to construct the receive weights” as discussed in elements 1.4-1.7. Ex. 1004 ¶ 622. But this sentence, as well as Dr. Mahon’s discussion of elements 1.4-1.7, is talking about the pilot signals *received* by the apparatus of claim 1 (*i.e.* the first/second signals), not any signal *transmitted* by the apparatus of claim 1 (the third signal).

80. Dr. Mahon also states that “Agee’s BS’s use the pilot signals received from other (transmitting) BS’s to calculate receive weights... those receive weights are used for transmit weights that form beam-formed transmissions that modify the placement of peaks and nulls in subsequent transmissions.” Mahon Decl. ¶ 624. This, again, refers only to pilot signals *received* by a station (first/second signals), and says nothing about a pilot signal *transmitted* by a station (third signal).

81. **Second**, Dr. Mahon fails to show that Agee’s pilot signal constitutes “data configured to be used by the remote station...” The concept of a pilot signal is generally understood by a POSITA. A pilot signal, including in context of Agee, is a tone with a predefined structure and content that is known to both the transmitter and receiver. Pilot signals are *not* data. As a POSITA would readily understand (including from introductory-level information theory) that encoding data requires and involves some amount of entropy or uncertainty in the signal, with a direct relationship between the amount of entropy and the amount of data that can be conveyed. When a signal is fixed and predefined, it contains no data. A pilot signal is fixed and predefined and contains no data.

82. The specific pilot signals described in Agee are also fixed and predefined and contain no data. Agee describes the pilot signals in figures 21 and 28. The pilot signal is determined by “one or more of the originating node, recipient node, and network or group channel organization,” and is “modified by a network

code mask.” Ex. 1004 at 58:17-21. Agee describes a specific algorithm to generate the pilot tone from these specific inputs. *Id.* at 58:16-52. This algorithm involves pseudorandom sequences, which are fixed and predefined sequences based on an input that have some of the numerical properties of a random sequence. A pseudorandom sequence does not and cannot contain more data than the input used to calculate the pseudorandom sequence. Agee explains that having pilot tones defined by the node and network identifiers “allows the network to pilot the communication through the network from origin to destination regardless of the intervening channels it takes.” *Id.* at 58:36-42.

83. Petitioner might try to argue that Agee’s pilot tones contain data because Agee uses the term “pilot data” several times. *See, e.g.*, Ex. 1004 at 32:28-31, 36:51-55, 64:52-65:22, 65:64-67, 68:5-9. But that phrase refers to the fixed, predefined sequence of tones that constitutes the pilot signal, and is used within the discussion of how to generate or interpret the pilot signal itself. For example, Agee describes a computation involving a “known segment of transmitted pilot data,” where “the pilot data transmitted over the pilot signal” is defined by a set of equations that are known by both the transmitter and receiver with no data inputs. *Id.* at 64:47-48, 64:54-65:45. This is in contrast to “the remaining *information-bearing symbols*” described in the following paragraph, which are defined to contain

“the uplink and downlink data symbols provided by prior encoding, encryption, symbol randomization, and channel reemphasis stages.” *Id.* at 65:48-57.

84. This context confirms that the pilot signals are predetermined based on “one or more of the originating node, recipient node, and network or group channel organization” (Ex. 1004 at 58:17-21) and do not contain any other data, much less “data configured to be used by the remote station to modify the placement of one or more transmission peaks and one or more transmission nulls in a subsequent signal transmission” as claimed in the ’235 Patent.

85. The pilot signal in Agee is similar to the common pilot channel (CPICH) in 3G in that it only contains predetermined bit/symbol sequence (“The CPICH is a fixed rate (30 kbps, SF=256) downlink physical channel that carries a pre-defined bit/symbol sequence.” Ex. 2004, 3GPP TS 25.211 v3.9.0 (2001-12) at 5.3.3.1). The CPICH, just as Agee’s pilot, does not carry data from a transport layer (the transport layer carries user and upper layer signaling messages) as shown below. Thus, a POSITA at the time of invention would not consider Agee’s pilot to carry any data.

## 6.1 Mapping of transport channels onto physical channels

Figure 27 summarises the mapping of transport channels onto physical channels.

| <u>Transport Channels</u> | <u>Physical Channels</u>                                                                                                                                                                                                                                                                        |
|---------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| DCH                       | Dedicated Physical Data Channel (DPDCH)<br>Dedicated Physical Control Channel (DPCCH)                                                                                                                                                                                                           |
| RACH                      | Physical Random Access Channel (PRACH)                                                                                                                                                                                                                                                          |
| CPCH                      | Physical Common Packet Channel (PCPCH)<br>Common Pilot Channel (CPICH)                                                                                                                                                                                                                          |
| BCH                       | Primary Common Control Physical Channel (P-CCPCH)                                                                                                                                                                                                                                               |
| FACH                      | Secondary Common Control Physical Channel (S-CCPCH)                                                                                                                                                                                                                                             |
| PCH                       | Synchronisation Channel (SCH)                                                                                                                                                                                                                                                                   |
| DSCH                      | Physical Downlink Shared Channel (PDSCH)<br>Acquisition Indicator Channel (AICH)<br>Access Preamble Acquisition Indicator Channel (AP-AICH)<br>Paging Indicator Channel (PICH)<br>CPCH Status Indicator Channel (CSICH)<br>Collision-Detection/Channel-Assignment Indicator Channel (CD/CA-ICH) |

Figure 27: Transport-channel to physical-channel mapping

3GPP TS 25.211 v3.9.0 (2001-12) at 6.1.

86. Dr. Mahon also states that “Agee’s BS’s use the pilot signals received from other (transmitting) BS’s to calculate receive weights. As detailed in elements 1.7-1.8 and claim 2, those receive weights are used for transmit weights that form beam-formed transmissions that modify the placement of peaks and nulls in

subsequent transmissions.” Mahon Decl. ¶ 624. Dr. Mahon does not explain the connection between his discussion of elements 1.7-1.8 and claim 2—which relate to the first and second signals and to the weight determination of claim 1—and the different limitation of claim 4, which relates to the third signal and to the placement of transmission peaks and nulls by the remote station in a subsequent transmission.

### 7.5. Dependent Claim 5

87. In my opinion, Dr. Mahon fails to show that Agee, alone or in combination with Butler, renders obvious dependent claim 5 for the same reasons as independent claim 1 and dependent claim 4, and for additional reasons.

88. Claim 5 recites: “The receiver as recited in claim 4, wherein the set of weighting values is further based on one or more of: a transmit power level, a data transmit rate, an antenna direction, quality of service data, or timing data.”

89. Here, “the set of weighting values” refers back to limitation [1.6], “determine a set of weighting values based on the first signal information and the second signal information.” Dependent claim 5 recites “*further* based on . . .” The plain meaning of this claim language is that the set of weighting values must be based on at least two things: (1) the first and second signal information (as recited in limitation [1.6]) *and also* (2) “a transmit power level, a data transmit rate, an antenna direction, quality of service data, or timing data” (as recited in claim 5).

90. Dr. Mahon fails to show this requirement of “further based on . . .” and his opinions for claim 5 are conclusory and incorrect. First, Dr. Mahon did not point to anything in Agee that would show that “a transmit power level, a data transmit rate, an antenna direction, quality of service data, or timing data” are used explicitly in weight coefficient calculations. I discuss this in my rebuttal of claim 1 above.

91. Second, Dr. Mahon’s only theory for limitation [1.6] is that “signal strength” is the alleged first signal information and the second signal information. But there is no showing in limitation [1.6] that the determination of a set of weighting values is based on anything else. To the extent that Dr. Mahon attempts to argue that transmit power level and antenna direction affect the pilot signal strength in the first and second signal information limitations, they have been already exploited for the purpose in claim 1 and could not be used for “the set of weighting values is further based.” At most, Dr. Mahon argues that the weighting values are based on one thing (signal strength), and it would be nonsensical to say that it is based on multiple things that subsumed by or indirectly related to signal strength.

92. Third, to the extent that Dr. Mahon mapped “frequency data (OFDM tones at different frequencies)” to “a data transmit rate,” that is incorrect. OFDM tones at different frequencies are not “a data transmit rate.” Further, Dr. Mahon does not point to anything in Agee that shows any of frequency data, a data transmit rate,

pseudo delay, or link quality statistics are used in the calculation or determination of weight coefficients. That is not shown or explained in claim 5 or claim 1.

93. Indeed, as discussed above for claim 1, the Petition merely states that “Agee’s 32 different OFDM tones are all separate transmissions at different frequencies and thus provide ‘frequency information.’” Pet. at 63. And there is no explanation in the Petition how “frequency information” is used to determine weighting values in limitation [1.6]. Pet. 64-69. The only reference to frequency at in limitation [1.6] is in support of the argument, introduced in limitation [1.3], that each individual tone is a separate “transmission signal,” and that Agee performs its weight determination algorithm on a per-tone basis. Pet. at 67-68; *see id.* at 44 (contending that limitation [1.3] is met through “Agee’s use of OFDM which transmits (and receives) multiple different OFDM tones simultaneously”). The Petition’s theory is that the weighting value is determined the same way for each individual tone, but there is no contention that this involves frequency information.

94. The Petition does not allege or explain how such “frequency information” is “used” to compute weights in limitation [1.6]. Pet. 63-69. The Petition says that Agee discloses that the “combining weights” are “applied over as broad a range of tones (frequency channels k)” but cites nothing in Agee which indicates that weights are determined based on the specific frequency k. While a weight may be determined for each frequency, the numerical value of that frequency

has no impact on the determination of the weight in Agee. Agee’s alleged disclosure that weights are computed for the entire OFDM symbol comprising 32 tones does not show that the value of the frequency has any impact on the determined weights. The Petition does not clearly articulate any theory regarding frequency values and identifies no support in Agee that frequencies themselves are used in any way to calculate weights. Pet. 63-69.

95. Further, the Petition mentions “signal information” as “timing information” by pointing to a “observed timing offset.” Pet. at 63. There is no explanation or support for this theory. The Petition apparently references its discussion at 52-54, which does not mention any “timing information” as described in the ’235 Patent and instead discusses the detection of pilot signals. And “timing information” appears nowhere else in the Petition, such as in [1.6].

96. Further, Petition mentions “azimuth and elevation” and “link quality statistics.” Pet. at 63: The Petition again provides no explanation why these words relate in any way to the ’235 Patent claims. “Azimuth” and “elevation” appear nowhere else in the Petition; “link quality statistics” appears in unexplained quotations, but not for limitations 1.6 or 1.7.

#### **7.6. Independent Claim 8**

97. In my opinion, Dr. Mahon fails to show that Agee, alone or in combination with Butler, renders obvious independent claim 8.

98. Claim 8 contains the same requirements of limitations [1.3]-[1.6]. Thus, for the same reasons discussed for limitations [1.3]-[1.6], Dr. Mahon fails to show obviousness of claim 8. Claim 8 also contains additional requirements, and Dr. Mahon fails to show obviousness of the additional requirements.

99. Limitation [8.4] recites: “determining a set of weighting values based on the first signal information and the second signal information, wherein the set of weighting values is configured to be used **by the remote station** to construct one or more beam-formed transmission signals.” The bolded text is different from claim 1. Claim 8 requires the weighting values to be configured for use by the remote station, not for use by the apparatus practicing the claimed method.

100. Dr. Mahon seems to suggest that limitation 8.4 should be construed to have the same meaning as limitation 1.7, that is, to require weighting values configured to be used by the apparatus practicing the claimed method, and not by the remote apparatus. *See* Ex. 1003 ¶¶ 630-641. Dr. Mahon does not explain what he believes is the correct construction of limitation 8.4.

101. In my opinion, limitation 8.4 has a plain and ordinary meaning and a POSITA reading the claim in the context of the intrinsic record would understand that the limitation is being used in its plain and ordinary sense. Specifically, it requires the weighting values to be configured to be used by the remote station to

construct one or more beam-formed transmission signals. Dr. Mahon has not shown any reason the claims should be given a different interpretation.

102. In paragraphs 632-639, Dr. Mahon argues that, based on statements in the prosecution history, “the calculation of weights by the station receiving the first and second signal information (e.g., Agee’s BS) [should be] sufficient to disclose this element.” Mahon Decl. ¶ 634; *see generally id.* ¶¶ 632-39. This is not correct. The plain meaning of the claim states that the station receiving the first and second signal information (*i.e.*, the station practicing the claimed method) performs the step of “determining a set of weighting values.” That is necessary, but not sufficient to meet the limitation. It is also necessary that the weights are configured for use by the remote station. Nothing in paragraphs 632-639 contradicts the plain language that the weights must be configured for use by the remote station.

103. Dr. Mahon fails to meet his burden to show obviousness based on the plain meaning of claim 8. Even if claim 8 does not require the data to be transmitted to be the weights themselves, it does not follow that *any* signal transmitted by the transceiver meets claim 8. But that appears to be Dr. Mahon and Petitioners’ position. And the primary (if not only support) for this position is based on inaccurate and out-of-context characterizations of the prosecution history and prior IPRs. I have reviewed the materials cited by Dr. Mahon and do not see any lexicography or disclaimer that suggests that any signal generated by the transceiver would

automatically meet claim 8. Nor does Dr. Mahon or Petitioners assert any lexicography or disclaimer here (or even propose any particular constructions).

104. Dr. Mahon presents an alternative theory “if the claims required that the data being transmitted between the nodes to be the weights themselves.” Ex. 1003 ¶ 642. That is also not the plain and ordinary meaning of the claim language, which simply requires the weights to be configured to be used by the remote station. Under this alternative theory, Dr. Mahon opines that it would be obvious for one base station to transmit “its weights” (*i.e.*, the weights determined for use by the first base station) to another base station, which “could use those weights for its own beamforming because of the reciprocal channel conditions.” *Id.* This is speculative, conclusory, and not based on any evidence. And it is still wrong, because Dr. Mahon does not show any determination of weights configured to be used by the remote station within the claimed method. Dr. Mahon is suggesting that the remote station makes its own determination based on the weights determined for use by the first base station. That is not what the claim requires.

105. Finally, Dr. Mahon opines that “because of reciprocity, the transmit weights used by Agee’s BS would be the same as the receive weights used by the remote station,” and “each of Agee’s BS’s have the capacity to employ the weight calculation.” Ex. 1003 ¶ 643. But the claim language requires the weights to be configured to be used by the remote station to ***construct one or more beam-formed***

*transmission signal.*” Dr. Mahon’s theory for claim 1 focuses on the transmit weights, which are the weights used to construct transmission signals. Even under Dr. Mahon’s theory that the transmit weights are the same as the receive weights used by a remote station, he has failed to show that the receive weights are “configured to be used by the remote station to construct one or more beam-formed transmission signals” as claimed.

106. Accordingly, Dr. Mahon fails to show Agee, alone or in combination with Butler renders obvious limitation [8.4] under its plain and ordinary meaning.

#### **7.7. Dependent Claims 9–10**

107. In my opinion, Dr. Mahon fails to show that Agee, alone or in combination with Butler, renders obvious dependent claims 9–10 for the same reasons as independent claim 8.

#### **7.8. Dependent Claim 11**

108. In my opinion, Dr. Mahon fails to show that Agee, alone or in combination with Butler, renders obvious dependent claim 11 for the same reasons as independent claim 8 and for additional reasons.

109. Claim 11 recites: “The method as recited in claim 8, wherein the set of weighting values is further based on one or more of: a transmit power level, a data transmit rate, an antenna direction, quality of service data, or timing data.”

110. Claim 11 has the same requirement as claim 5. For the reasons discussed for claim 5 above, Dr. Mahon fails to show obviousness of the additional requirement: “wherein the set of weighting values is further based on one or more of: a transmit power level, a data transmit rate, an antenna direction, quality of service data, or timing data.”

### **7.9. Dependent Claim 12**

111. In my opinion, Dr. Mahon fails to show that Agee, alone or in combination with Butler, renders obvious dependent claim 12 for the same reasons as independent claim 8 and dependent claim 11, and for additional reasons.

112. Claim 11 recites: “The method as recited in claim 11, wherein the content comprises data configured to be used by the remote station to modify the placement of one or more transmission peaks and one or more transmission nulls in a subsequent signal transmission.”

113. Claim 11 has the same requirement as claim 4. For the reasons discussed for claim 4 above, Dr. Mahon fails to show obviousness of the additional requirement: “wherein the content comprises data configured to be used by the remote station to modify the placement of one or more transmission peaks and one or more transmission nulls in a subsequent signal transmission.”

### 7.10. Independent Claim 15

114. In my opinion, Dr. Mahon fails to show that Agee, alone or in combination with Butler, renders obvious independent claim 15.

115. Claim 15 contains the same requirements of limitations [1.3]-[1.6]. Thus, for the same reasons discussed for limitations [1.3]-[1.6], Dr. Mahon fails to show obviousness of claim 15. Claim 15 also contains a similar limitation to claim 5, by reciting “the first signal transmission comprising first signal information, wherein the first signal information *comprises one or more of: a transmit power level, a data transmit rate, an antenna direction, quality of service data, or timing data*” (limitation [15.4]) and “determine a set of weighting values based on the first signal information and the second signal information” (part of limitation [1.6]). Thus, for the same reasons discussed in claim 5, Dr. Mahon fails to show obviousness of claim 15.

116. The Petition and Dr. Mahon provide no independent or sufficient analysis of claim 15. They merely cite back to limitations [1.3]-[1.6] and claim 5. And the Petition and Dr. Mahon merely assert that “‘the first signal information comprises’ multiple different recited options” and that “the signal informations are used to determine the weighting values.” Pet. at 81.

117. This fails for the reasons discussed and introduces additional problems. First, Dr. Mahon did not point to anything in Agee (for either claims 1 or 5) that

would show “a transmit power level, a data transmit rate, an antenna direction, quality of service data, or timing data” are used explicitly in weight coefficient calculations. Second, Dr. Mahon’s only theory for limitation [1.6] is that “signal strength” is **both** the alleged first signal information and the second signal information. Even as to claim 15, Dr. Mahon does not address the second signal information at all, except referring back to claim [1.6], so must be “signal strength.”

118. But there is no showing in the Petition or declaration that the determination of a set of weighting values is based two things: (1) “signal strength” as the alleged second signal information and (2) something else as the alleged first signal information. To the extent that Dr. Mahon attempts to argue that transmit power level and antenna direction affect the pilot signal strength in the first signal information limitations, Dr. Mahon has already alleged for claim 1 that the first signal information is “signal strength.” Since Dr. Mahon argued the first signal information is one thing (signal strength), it is incorrect to say that it is also multiple things that are subsumed by or indirectly related to signal strength.

119. Further, Dr. Mahon has always treated the first signal information and second signal information as the same thing (signal strength of the same signal). It is therefore inconsistent to characterize the first signal information as “signal strength” and the second signal information as something else.

120. I also disagree with any attempt by Dr. Mahon to equate “signal strength” with “a transmit power level.” A POSITA would know they are different concepts, have different values, and may be affected by different factors. I also disagree that “a transmit power level” is used by Agee in weight coefficient calculations. That is even further removed than his theory for “signal strength.” There is no sufficient showing that any processor in Agee “determines” the transmit power level at a particular antenna, and that setting weight values can be considered “based on” a transmit power level.

#### **7.11. Dependent Claim 16**

121. In my opinion, Dr. Mahon fails to show that Agee, alone or in combination with Butler, renders obvious dependent claim 16 for the same reasons as independent claim 15.

#### **7.12. Dependent Claims 17**

122. In my opinion, Dr. Mahon fails to show that Agee, alone or in combination with Butler, renders obvious dependent claim 17 for the same reasons as independent claim 15 and for additional reasons.

123. Claim 17 recites: “The apparatus as recited in claim 16, wherein the processor is configured to receive a fourth signal transmission from an interferer source, the fourth signal transmission being undesired, and the processor is

configured to store identifying information concerning the undesired interferer source and the remote station.”

124. Dr. Mahon’s analysis of Claim 17 is conclusory and incorrect. Dr. Mahon fails to show that the additional requirements of claim 7, including “the processor is configured to store identifying information concerning the undesired interferer source and the remote station” is rendered obvious. Dr. Mahon states “Agee stores “identifying information” about each node that includes, for example, the “known” pilot data for each node as well as the “pseudodelay” discussed in element 1.4-1.6 above. EX-1004, 64:43-67:28, 58:16-67, claim 53.” I disagree with this statement. Dr. Mahon also fails to show that “know” pilot data and “pseudodelay” would be considered “identifying information.” For example, there is no explanation that it is possible to specifically identify each node based on known pilot data or pseudo delay.

125. The citations from EX-1004 that Dr. Mahon used do not support his “for each node...” assertion. There is no support that identifying information concerning undesired interference sources is stored. The statement in Agee “Unauthorized pilot symbols, and symbols intended for other nodes in the network, are not so transformed and continue to appear as random noise at the recipient node (See FIGS. 38A, 38B),” does not mean that identifying information concerning interference sources is stored. EX-1004, 66:16-20. A POSITA would understand this

statement to be a consequence of the MMSE beamformer that attempts to maximize the SNIR but does not even know the direction and identity of interference sources, as it treats them as noise.

126. Dr. Mahon states “Agee’s BS stores the identifying node information for every node (not just directly connected nodes) because data might be passed through “intervening” nodes to its destination. EX-1004, 58:16-42.” Mahon at 662. This is incorrect. 1004, 58:16-42 does not support Dr. Mahon’s statement.

127. Since there is no teaching in Agee of storing identifying information concerning undesired interference sources, Dr. Mahon at 663-666 tries to explain his obviousness theory. He states that that it would be obvious to modify Agee to store identifying information about undesired interference sources (“storing “identifying information” for each node in a network would be, at most, an obvious modification to Agee, Mahon at 663”). I disagree. A POSITA would not find that obvious because the MMSE beamformer in Agee suppresses interference in a blind manner.

### **7.13. Dependent Claims 18**

128. In my opinion, Dr. Mahon fails to show that Agee, alone or in combination with Butler, renders obvious dependent claims 18 for the same reasons as independent claim 15 and dependent claim 17, and for additional reasons.

129. Claim 18 recites: “The apparatus as recited in claim 17, wherein the processor is configured to identify a further interferer signal transmission from the

interferer source, and to identify a further desired signal transmission from the remote station, wherein the processor is further configured to prevent the transceiver from transmitting a fifth signal transmission via the antenna during reception of the further desired signal transmission but to allow the transceiver to transmit a sixth signal transmission via the antenna during reception of the further interferer signal transmission.”

130. Dr. Mahon fails to show at least that the requirement that “wherein the processor is further configured to **prevent** the transceiver from transmitting a fifth signal transmission . . .” Dr. Mahon does not present any evidence or explanation showing that transmission is prevented. At most Dr. Mahon argues that the transceiver does not transmit during certain periods but makes not showing of prevention (or processor being configured to prevent).

131. Moreover, Dr. Mahon’s analysis for Claim 18 is incorrect.

132. Dr. Mahon states ”Because BS “A” has the same “transmit” slot as the BS to which no link is shown (the “interferer sources” above), the transceiver is allowed to transmit a sixth signal transmission via the antenna during reception of the further interferer signal transmission. Even though BS “A” is not shown having a link connecting it to the other black circle nodes, the antennas at BS A will still “receive” the transmitted information (even while transmitting themselves). The antennas receive the energy Declaration of Dr. Mark P. Mahon Page 279 of 286 in

the form of the radio waves regardless of whether the BS A is sampling and using that energy induced on the antenna during its transmit time slot as a result of the transmissions from the other black circle nodes.” Mahon at 675.

133. That’s incorrect and contradicts what Dr. Mahon stated at 674. In a TDD only transmit chain or the receive chain is operating in a time slot. The apparatus can’t transmit and receive simultaneously. The fact that an electromagnetic (EM) wave is impinging on the antenna does not represent receiving. Since the receive chain is disabled, when transmitting, the EM wave “seen” by the antenna will not be converted to an electric signal that passes through to receiver chain down to the baseband processing. Dr. Mahon’s statement is inconsistent to the understanding of a POSITA.

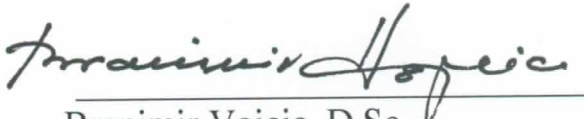
#### **7.14. Dependent Claim 19**

134. In my opinion, Dr. Mahon fails to show that Agee, alone or in combination with Butler, renders obvious dependent claim 19 for the same reasons as independent claim 15.

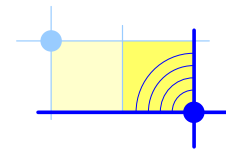
\* \* \*

I declare under penalty of perjury pursuant to the laws of the United States that the foregoing is true and correct.

Executed this 24th day of January, 2025.

  
Branimir Vojcic, D.Sc.

# Appendix A



**Branimir Vojcic**  
**CURRICULUM VITAE**

President  
Xplore Wireless LLC  
9610 Savannah Crossing Ct  
Vienna, VA 22182

Board member at LN2 DB, LLC  
Partner at Fowler Radio Group, LLC

**Education**

**Doctor of Science Degree in Electrical Engineering (1989)**

Thesis: "Performance of a class of digital transmission schemes in a fading dispersive channel with jamming", Faculty of Electrical Engineering, University of Belgrade, Yugoslavia.

**Graduate Studies in Communications (1986/1987)**

One year program, The George Washington University, Washington, DC.

**Master of Science Degree in Electrical Engineering (1986)**

Thesis: "Some possibilities of the ionospheric index of solar activity  $R_{12}$  prediction from the point of view of long term ionospheric radio wave propagation conditions prediction", Faculty of Electrical Engineering, University of Belgrade, Yugoslavia.

**Dipl. Eng Degree in Electrical Engineering (1980)**

Five year program, Faculty of Electrical Engineering, University of Belgrade, Yugoslavia.

**Experience**

**Academic Experience:**

**George Washington University (from 2000 to 2015)**, Professor in the Department of Electrical and Computer Engineering (now an Emeritus Professor)

**George Washington University (from 2001 to 2004)**, Chairman, Department of Electrical and Computer Engineering.

**George Washington University (from 1997 to 2000)**, Associate Professor in the Department of Electrical Engineering and Computer Science.

**Technology Consulting:**

CTA Incorporated (Orbital Sciences Corp.)  
Delphi Communications  
TerreStar Networks, Inc.  
Federal Communication Commission  
Hughes Network Systems  
iBiquity Digital  
LCC International  
Lucent Technologies  
Lockheed Martin  
Motorola,

**George Washington University (from 1991 to 1997)**, Assistant Professor in the Department of Electrical Engineering and Computer Science.

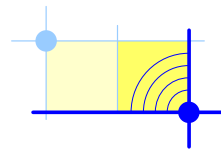
**University of Belgrade (from 1988 to 1991)**, Research Associate (part time)

**Industry and Government Experience:**

**Ministry of Defense, Yugoslavia (from 1981 to 1991)**, including leave of absence for studying), Research engineer

Novel  
Orbcom  
RKF Engineering  
Sirius Satellite  
Telecommunications Associates  
Critical Alert  
TV Answer  
XtremeSpectrum

**Business and Legal Consulting:**



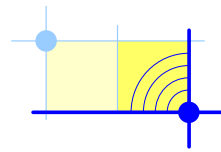
Finnegan, Henderson, Farabow, Garrett  
&Dunner LLP  
Hogan & Hartson LLP,  
KSI Inc, and Antton & Associates  
Bechtel Telecom  
Wilson, Sonsini, Goodrich, and Rosati

King & Spalding  
Ropes & Gray  
Kirkland & Ellis  
Latham & Watkins  
Dovel & Lunner  
Munger, Tolles & Olson  
Mayer Brown  
Dechert

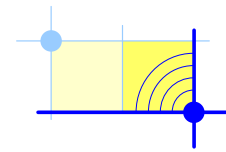
Wilmer Hale

**Expert Witness Experience:**

1. Expert for Finnegan (for Interdigital) in ITC case Interdigital vs Samsung, 2008 (testified in deposition and in trial)
2. Expert for Finnegan (for Interdigital) in ITC case Interdigital vs Nokia, 2009 (testified in deposition and in trial)
3. Expert for Finnegan (for WiAV) in WiAV versus Nokia, Motorola and Sony-Ericsson, Souther District of California, 2011 (testified in deposition, settled)
4. Expert for McCarter & English (GoldenBridge Technology Inc) in GoldenBridge Technology Inc versus Apple, District of Delaware 2013 (testified in deposition)
5. Expert for Finnegan (for SPH) in SPH vs Nokia, Motorola, Sony-Ericsson et. al., Southern District of California 2012 (testified in deposition, settled)
6. Expert for Finnegan (for Creative Kingdom) in Creative Kingdom vs Nintendo, ITC, 2012 (testified in deposition and in trial)
7. Expert for Finnegan (for Linex) in Linex vs Apple, HP, Aruba Networks, Meru Networks, Ruckus Wireless, ITC, 2012 (testified in deposition)
8. Expert for Finnegan (for HTC) in HTC vs Apple, ITC, 2012 (testified in deposition and in trial)
9. Expert for Finnegan (for Realtek) in LSI vs Realtek 2013, ITC (testified in deposition and in trial)
10. Expert for McCool, Smith & Hennigan (for GoldenBridge Technology Inc) in GBT vs Apple in 2014, Norther District of California (testified in deposition and trial)
11. Expert for Wilson Sonsini (for Interdigital) in ITC 337-TA-868 Investigations, in Interdigital vs Samsung, Huawei, Nokia and ZTE, ITC, 2014 (testified in deposition)
12. Expert for Reed & Scardino (for Mobile Telecommunications Technologies LLC) in Civil Action No. 2:12-cv-308-JRG, Eastern District of Texas, in Mobile Telecommunications Technologies LLC vs Clearwire Corporation, 2014 (testified in deposition, settled)
13. Expert for Reed & Scardino (for Mobile Telecommunications Technologies LLC) in Civil Action in Eastern District of Texas, Mobile Telecommunications Technologies LLC vs SprintNextel Corp, Samsung Telecommunications America, LLC and Apple, Inc, Case No. 2:13-cv-258-JRG-RSP, 2014 (settled).
14. Expert Witness for Wilson Sonsini (for Interdigital), in Arbitration between Interdigital Communications and Huawei, International Court of Arbitration, International Chamber of Commerce, 2015. (testified in arbitration/trial)
15. Expert Witness for Reed & Scardino (for Mobile Telecommunications Technologies LLC) in Civil Action in Eastern District of Texas, Mobile Telecommunications Technologies LLC vs T-Mobile USA, Inc., Case No. 2:13-cv-886-JRG-RSP, 2015 (settled in 2015).
16. Expert Witness for Reed & Scardino (for Mobile Telecommunications Technologies LLC) in Civil Action in Eastern District of Texas, Mobile Telecommunications Technologies LLC vs Leap Wireless International, Inc. and Cricket Communications, Inc., CIVIL ACTION NO. 2:13-CV-885-JRG-RGP (testified in deposition), 2015.
17. Expert Witness for McKool & Smith (for Ericsson) in Ericsson versus Apple ITC Investigation



- No. 337-TA-953(testified in deposition, settled before trial in 2015) .
18. Expert Witness for Munger, Tolles & Olson (for Ericsson) in Apple versus Ericsson, Case No. 3:15-cv-00154 JD in Northern District of California (settled in 2015).
  19. Expert Witness for Reed & Scardino (for Mobile Telecommunications Technologies LLC) in Civil Action in Eastern District of Texas, Mobile Telecommunications Technologies LLC vs AT&T Mobility, Inc. and Cricket Communications, Inc., Case No. 2:14-cv-00897-JRG-RSP, (testified in deposition, settled in 2016).
  20. Expert Witness for Reed & Scardino (for Mobile Telecommunications Technologies LLC) in Civil Action in Eastern District of Texas, Mobile Telecommunications Technologies LLC vs Samsung, Inc., Case No. 13-cv-259, (testified in deposition, settled in 2016).
  21. Expert for Finnegan (for LG) in LG Electronics, Inc. vs. Cellular Communications Equipment LLC, Inter Partes Review of U.S. Patents No. 8,868,060 and 8,848,556 (submitted declarations, Inter Partes Review).
  22. Technology Expert for Dechert (for Intellectual Ventures), Intellectual Ventures vs AT&T / T-Mobile in Civil Action No. 13-cv-1631-LPS (submitted technology evaluation report, deposition), in 2016.
  23. Expert Witness for Russ, August and Kabat (for SPH) in SPH America vs AT&T Mobility, Sprint Spectrum, Blackberry Limited, Huawei Technologies, ZTE, et al., in Case No. 3:13-cv-2318-CAB-KSC, Case No. 3:13-cv-2319-CAB-KSC, Case No. 3:13-cv-2320-CAB-KSC, and related cases (in 2014 submitted declaration, deposition).
  24. Expert Witness for Mayer Brown, for Internation Arbitration between LG Electronics, Inc. and Nokia, testified in arbitration, January 2017.
  25. Expert Witness for Reed & Scardino in EON Corp. vs Apple, Inc., CASE NO. 3:14-cv-05511-WHO, Northern District of California, presented a technology tutorial, settled in 2017.
  26. Expert for Hoyng Rokh Monigen, Declaration in case Phillips vs ASUS, Amsterdam, Netherlands, District Case of the Hague, no testimony January, 2017.
  27. Expert Declaration re Appln. U.S. Patent No.: RE44,507 for Sugrue Mion (SPH America), February 2017.
  28. Expert Witness for Reed & Scardino in Customedia vs Dish Network, Civil Action No. 2:16-cv-00129-JRG, Eastern District of Texas, Expert report and deposition in 2017.
  29. Expert Witness for Rus, August and Kabat (for Vivato Tech) in Vivato Technologies vs Rukus, Case No. 2:17-cv-02961-AG(JCGx), Claim Construction Declaration in 2018.
  30. Expert Witness for Mayer Brown (for Hitachi Maxell) in Hitachi Maxell vs Huawei and Hitachi Maxell vs ZTE, Case No. 5:16-cv-00179-RWS, claim construction declaration in 2017, settled.
  31. Expert Witness for Mayer Brown (for Hitachi Maxell) in Hitachi Maxell vs Huawei and Hitachi Maxell vs ZTE, Case No. 5:16-cv-00179-RWS, Expert Declaration and Supplemental Declaration in 2017 and 2018, settled.
  32. Expert Witness for Mayer Brown (for Hitachi Maxell) in Hitachi Maxell vs Huawei and Hitachi Maxell vs ZTE, Case No. 5:16-cv-00178-RWS, Expert Reports, multiple IPR declarations and depositions in 2018 and 2019, settled.
  33. Expert Witness for Mayer Brown (for Maxell) in Maxell vs ASUSTEK, Case No. 18-cv-01788-VC, claim construction declaration in 2018.
  34. Expert Witness for Wilson Sonsini (for Interdigital) in ASUS COMPUTER vs Interdigital, Case No.: 15-cv-1716 (BLF) , Expert report in 2018.
  35. Expert for Rus, August and Kabat (for Vivato) in XR Communications, dba Vivato Technologies vs Petitioners (RUCKUS WIRELESS, INC.; ARRIS SOLUTIONS, INC.; ARRIS ENTERPRISES, LLC; NETGEAR, INC.; AND BELKIN INTERNATIONAL, INC), Case IPR2018-01016 Patent No. 6,611,231. Declaration in October, 2018.
  36. Expert Declaration for Hoyng Rokh Monigen, Declaration in case Phillips vs Wiko, Amsterdam, Netherlands, District Case of the Hague, December, 2018.



37. Expert Declaration for Hoyng Rokh Monigen, Declaration in case Phillips vs ASUS, Amsterdam, January, 2019.
38. Expert for Robins Kaplan (for INVT SPE, LLC) in Apple and ZTE (USA) vs INVT, Case: IPR2018-01477, multiple IPR declarations in 2018.
39. Expert for Robins Kaplan (for INVT SPE, LLC) in HTC vs INVT, Case: IPR2018-01581, IPR declaration in 2018.
40. Expert for Robins Kaplan (for INVT SPE, LLC) in (Apple, ZTE, HTC and Samsung vs INVT) ITC Investigation No. 337-TA-1138, Expert Reports re Infringements and Validity and a claim construction declaration in 2019.
41. Expert for Feiberg Day in (for Uniloc 2017 LLC) vs Microsoft, Case No: 8-19-cv-00428-AG(JDEX), etc., Central District of California, 2019.
42. Expert for Feiberg Day in (for Uniloc 2017 LLC) vs Verizon, Case No: 2-18-cv-00513-JRG, Eastern District of Texas, 2019.
43. Expert Report, Expert for Mayer Brown in Maxel LTD v. Apple Inc, Case No.5:19-cv-00036-RWS, Eastern District of Texas, 2020.
44. Declaration to the USPTO re claim construction, Expert for Rus August and Kabat and Vivato.
45. Declarations, Expert for Di Muro in Qualcomm vs UNM Rainforest Innovations, PTAB Case No. IPR2021-00582 Patent No. 8,565,326 B2, 2021.
46. Declarations, Expert for Di Muro in Intel vs UNM Rainforest Innovations, PTAB Case No. IPR2020-01578 Patent No. 8,249,204 B2, 2021.
47. Affidavit, Expert for Wilson Sonsini, in Interdigital Technology Corporation vs Xiaomi, 2021.
48. Declaration, Expert for Mayer Brown in reexamination 90/014,632, 2021.
49. Declaration, Expert for Mayer Brown in reexamination 90/014,631, 2021.
50. Affidavit, Expert for Anand & Annand in Interdigital Technology Corporation vs Guangdong Oppo Mobile Telecommunications Corp, 2021.

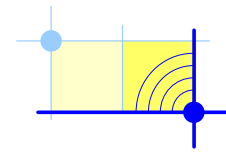
### Teaching and/or Course Director at GWU

|                                             |                                         |
|---------------------------------------------|-----------------------------------------|
| ECE12 Signals and Systems                   | ECE246 Digital Communications           |
| ECE143 Communications Engineering I         | ECE247 Communications Systems           |
| ECE144 Communications Engineering II        | ECE248 Computer Networks I              |
| ECE148 Simulation of Communications Systems | ECE249 Computer Networks II             |
| ECE203 Stochastic Processes in Engineering  | ECE253 Mobile Communications            |
| ECE219 Computational Methods in Electr.Eng. | ECE257 Multiuser Communications         |
| ECE241 Information Theory                   | ECE259 Wireless Networks                |
| ECE243 Communication Theory I               | ECE348 The Internet: Design and Implem. |
| ECE244 Communication Theory II              |                                         |

### Grants Received

#### Research

1. *Wireless Information Network for Airport Surface Traffic Automation Using GPS* (11/1/92-12/31/92), PI, Martin Marietta
2. *Wireless Information Network for Airport Surface Traffic Automation Using GPS - Network Topology and Frequency Band Considerations* (2/1/93-12/31/93), PI, Martin Marietta
3. *Spectral Shaping for Improved Capacity in Multiple Access Communications* (12/1/93-11/30/94), PI, University Facilitating Fund
4. *Research in Simulation of Communications Systems* (5/1/94-12/31/94), PI, Elanix



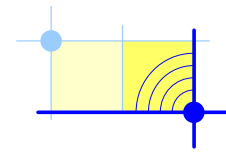
5. *Research in Multiuser Detection and Innovative Approaches in Teaching* (7/1/95-6/30/98), PI, NSF Faculty Early CAREER Development Award
6. *Integration of DBS into Digital Battlefield using Commercial LEO Systems* (10/1/95-9/30/98), PI for GWU, with Orbital Sciences Corp. (lead organization) and ALOHA Networks Inc. ARPA (GLOMO Program)
7. Research Experience for Undergraduates, Supplemental Grant from NSF (7/1/96-6/30/98)
8. *Multiuser Detection for IS-95 Air Interface* (1/1/97-12/31/97), NORTEL
9. *Multiuser Detection for Next Generation CDMA* (6/1/98-12/31/98), NORTEL
10. *Multiuser Detection for Next Generation CDMA* (6/1/99-12/31/99), NORTEL NETWORKS
11. *A Novel Packet Radio Network Architecture* (1/1/00-12/31/03), National Science Foundation
12. *Digital Signal Characterization*, (5/1/2000-4/30/2001), National Security Agency
13. *Multiuser Detection for 3G*, (6/1/2000-5/31/2001), NORTEL NETWORKS
14. *Ad-Hoc Networks*, (6/1/2000-5/31/2001), NORTEL NETWORKS
15. *Bitpipe*, (2/1/02-3/31/04), National Security Agency
16. *Routing in Ad-Hoc Networks Using CSI Information* (8/13/2002-2/12/2003), Innovative Concepts Inc
17. *Ad-Hoc Networks*, (6/1/2002-8/31/2004), NORTEL NETWORKS
18. Modeling and Simulation of Spectral and Spatial Efficiency ..., (12/15/2004-06/15/2005), US Army (with RKF Engineering)

#### Software grants/gifts

1. SPW and BOnES (CADENCE)
2. OPNET (MIL-3)
3. SystemView (ELANIX, Inc.)

#### Professional Activities

- Senior Member of IEEE.
- Past Vice Chairman, Communications Society of the Washington and Northern Virginia Chapter of IEEE.
- Past Associate Editor of the IEEE Communications Letters
- Guest Editor, Journal on Communications and Networks, Special Issue on UWB Communications
- Chair, Technical Program, IEEE Communication Theory Workshop 1996, San Destin, FL.
- Chair, Technical Program, IRSS'97, Washington, DC.
- Chair, Technical program, MMT'98, Washington, DC.
- Member, Communication Theory Committee of the IEEE Communication Society.
- Member, Technical and Organizing Committee
  - International Symposium on Spread Spectrum Systems and Techniques 1988, Belgrade, Yugoslavia.
  - IEEE Communication Theory Workshop 1993, Marathon, FL.
  - 1<sup>st</sup> International Workshop on Mobility Management, GMU, Fairfax, VA, 1994.
  - Globecom 2007
- Member, Program Committee, Workshop on Mobility Management, Paris, 1996.
- Member, Program Committee, Workshop on Mobility Management, Melbourne, 1997.
- Member, Program Committee of CTMC 1999
- Technical Program Committee for MMT'02, Rennes, France, June 2002
- Member, Technical Scientific Program Committee of the 4<sup>th</sup> IEEE Conference on Mobile and Wireless Communications Networks, Stockholm, Sep. 2002.
- Technical representative of the IEEE Communication Society to MILCOM'96, Reston, VA.
- Session Chair:
  - International Symposium on Spread Spectrum Systems and Techniques, 1988.
  - IEEE Communication Theory Workshop, 1993.
  - MILCOM'96
  - Computer Communications Workshop, 1996



- ISIT'98
- IEEE Communication Theory Workshop, 2000.
- Technical reviewer:
  - IEEE Transactions on Communications
  - IEEE Journal on Selected Areas in Communications
  - IEEE Transactions on Circuits and Systems
  - IEEE Transactions on Vehicular Technology
  - European Transactions on Telecommunications and Related Technologies
  - Wireless Personal Communications (An International Journal)
  - National Science Foundation
- Member of the Communications, Vehicular Technology and Signal Processing Societies and Information Theory Group of the IEEE.
- Member of the US Section of URSI.

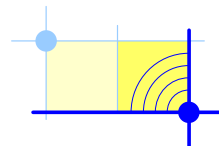
### Awards

1. Best Paper Award at ACM MSWiM'99: F. Alagooz, A. AlRustamani, D. Walters, B. Vojcic and R. Pickholtz, "On the effects of adaptive forward error correction mechanism in direct broadcast satellite networks", MSWiM'99, August 1999, Seattle, WA.
2. National Science Foundation Young Faculty Early CAREER Development Award in 1995.
3. Radio TV Belgrade (Yugoslavia) Annual Award for the Best Paper in 1990 for the paper: B.R. Vojcic and R.L. Pickholtz, "Performance of coded direct sequence spread spectrum in a fading dispersive channel with pulsed jamming", IEEE J. on Sel. Areas in Commun., vol. 8, NO. 5, pp. 934-942, 1990.

### Patents (sample)

#### B Vojcic – US Patents

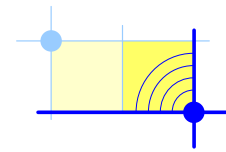
|           |    |                                                                                                           |                                                                                                                                                       |
|-----------|----|-----------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------|
| 9,455,861 | US | Systems and methods for advanced iterative decoding and channel estimation of concatenated coding systems | Utility patent relating to systems for high, medium, and low-density parity check coding.                                                             |
| 9,391,643 | US | Systems and methods for advanced iterative decoding and channel estimation of concatenated coding systems | Utility patent relating to systems for high, medium, and low-density parity check coding.                                                             |
| 9,461,863 | US | Systems and methods for advanced iterative decoding and channel estimation of concatenated coding systems | Utility patent relating to systems for high, medium, and low-density parity check coding.                                                             |
| 8,792,594 | US | Systems and methods for advanced iterative decoding and channel estimation of concatenated coding systems | Utility patent relating to methods for channel state estimation relying on forward error correction.                                                  |
| 9,838,154 | US | Systems and methods for advanced iterative decoding and channel estimation of concatenated coding systems | Utility patent relating to a system for augmenting a source message bit sequence with a synchronization sequence to facilitate better source decoding |



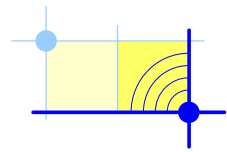
|           |    |                                                                                                           |                                                                                                                                                       |
|-----------|----|-----------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------|
| 9,191,256 | US | Systems and methods for advanced iterative decoding and channel estimation of concatenated coding systems | Utility patent relating to methods for iteratively decoding Hybrid Digital radio signals.                                                             |
| 9,698,941 | US | Systems and methods for advanced iterative decoding and channel estimation of concatenated coding systems | Utility patent relating to methods for iteratively decoding Hybrid Digital radio signals.                                                             |
| 8,595,590 | US | Systems and methods for encoding and decoding of check-irregular non-systematic IRA codes                 | Utility patent relating to systems for decoding check-irregular non-systematic irregular repeat accumulate codes.                                     |
| 8,943,383 | US | Systems and methods for encoding and decoding of check-irregular non-systematic ira codes                 | Utility patent relating to systems for encoding check-irregular non-systematic irregular repeat accumulate codes.                                     |
| 9,509,341 | US | Systems and methods for encoding and decoding of check-irregular non-systematic IRA codes                 | Utility patent relating to systems for encoding check-irregular non-systematic irregular repeat accumulate codes                                      |
| 8,948,272 | US | Joint source-channel decoding with source sequence augmentation                                           | Utility patent relating to a system for augmenting a source message bit sequence with a synchronization sequence to facilitate better source decoding |

#### B Vojcic – Foreign Patents

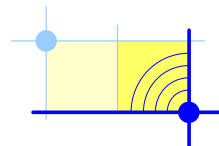
| Publication No. | Nation    | Title                                                                                                                   | Description                                                                                          |
|-----------------|-----------|-------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------|
| AU2001030786    | Australia | Method and apparatus for forward error correction coding for an am in-band on-channel digital audio broadcasting system |                                                                                                      |
| AU2002214853A   | Australia | Multi-user detector for direct sequence - code division multiple access (ds/cdma) channels                              |                                                                                                      |
| 2956304         | China     | Systems and methods for advanced iterative decoding and channel estimation of concatenated coding systems               | Utility patent relating to systems for high, medium, and low-density parity check coding.            |
| 3212039         | China     | Systems and methods for advanced iterative decoding and channel estimation of concatenated coding systems               | Utility patent relating to methods for channel state estimation relying on forward error correction. |
| CN000001478330A | China     | Multi-user detector for direct sequence-code division multiple access (DS/CDMA) channels                                |                                                                                                      |
| CN105122654 (A) | China     | Systems and methods for encoding and decoding of check-irregular non-systematic ira codes                               |                                                                                                      |



|                  |         |                                                                                                           |                                                                                                                   |
|------------------|---------|-----------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------|
| CN105122655 (A)  | China   | Systems and methods for advanced iterative decoding and channel estimation of concatenated coding systems |                                                                                                                   |
| CN105144598 (A)  | China   | Systems and methods for advanced iterative decoding and channel estimation of concatenated coding systems |                                                                                                                   |
| CN1478330        | China   | Multi-user detector for direct sequence-code division multiple access (DS/CDMA) channels                  |                                                                                                                   |
| EP1329032 (A2)   | Europe  | MULTI-USER DETECTOR FOR DIRECT SEQUENCE - CODE DIVISION MULTIPLE ACCESS (DS/CDMA) CHANNELS                |                                                                                                                   |
| EP2926460        | Europe  | SYSTEMS AND METHODS FOR ENCODING AND DECODING OF CHECK-IRREGULAR NON-SYSTEMATIC IRA CODES                 |                                                                                                                   |
| EP2926461 (A2)   | Europe  | JOINT SOURCE-CHANNEL DECODING WITH SOURCE SEQUENCE AUGMENTATION                                           |                                                                                                                   |
| EP2926462        | Europe  | Systems and methods for advanced iterative decoding and channel estimation of concatenated coding systems | Utility patent relating to systems for high, medium, and low-density parity check coding.                         |
| EP2926468        | Europe  | SYSTEMS AND METHODS FOR ADVANCED ITERATIVE DECODING AND CHANNEL ESTIMATION OF CONCATENATED CODING SYSTEMS |                                                                                                                   |
| EP3447924        | Europe  | SYSTEMS AND METHODS FOR ADVANCED ITERATIVE DECODING AND CHANNEL ESTIMATION OF CONCATENATED CODING SYSTEMS |                                                                                                                   |
| DE000060125570T2 | Germany | MEHRBENUTZERDETEKTOR FÜR DIREKTSEQUENZ-KODEMULTIPLEX-VIELFACHZUGRIFFKANÄLE                                |                                                                                                                   |
| 6096921          | Japan   | Systems and methods for advanced iterative decoding and channel estimation of concatenated coding systems | Utility patent relating to systems for high, medium, and low-density parity check coding.                         |
| 6096922          | Japan   | Systems and methods for encoding and decoding of check-irregular non-systematic IRA codes                 | Utility patent relating to systems for encoding check-irregular non-systematic irregular repeat accumulate codes. |



|                   |             |                                                                                                           |                                                                                                                   |
|-------------------|-------------|-----------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------|
| 6215955           | Japan       | Systems and methods for advanced iterative decoding and channel estimation of concatenated coding systems | Utility patent relating to methods for channel state estimation relying on forward error correction.              |
| 6396977           | Japan       | Systems and methods for advanced iterative decoding and channel estimation of concatenated coding systems | Utility patent relating to systems for high, medium, and low-density parity check coding.                         |
| JP002017077012A   | Japan       | ADVANCED ITERATIVE DECODING OF CONCATENATED CODING SYSTEM AND SYSTEM AND METHOD FOR CHANNEL EVALUATION    |                                                                                                                   |
| JP002018164288A   | Japan       | SYSTEM AND METHOD FOR ADVANCED ITERATIVE DECODING AND CHANNEL ESTIMATION OF CONCATENATED CODING SYSTEM    |                                                                                                                   |
| 10-1758737        | South Korea | Systems and methods for encoding and decoding of check-irregular non-systematic IRA codes                 | Utility patent relating to systems for encoding check-irregular non-systematic irregular repeat accumulate codes. |
| KR102015122121A   | South Korea | SYSTEMS AND METHODS FOR ENCODING AND DECODING OF CHECK-IRREGULAR NON-SYSTEMATIC IRA CODES                 |                                                                                                                   |
| KR102015123781A   | South Korea | SYSTEMS AND METHODS FOR ADVANCED ITERATIVE DECODING AND CHANNEL ESTIMATION OF CONCATENATED CODING SYSTEMS |                                                                                                                   |
| KR102015125921A   | South Korea | SYSTEMS AND METHODS FOR ADVANCED ITERATIVE DECODING AND CHANNEL ESTIMATION OF CONCATENATED CODING SYSTEMS |                                                                                                                   |
| KR102017059018A   | South Korea | SYSTEMS AND METHODS FOR ADVANCED ITERATIVE DECODING AND CHANNEL ESTIMATION OF CONCATENATED CODING SYSTEMS |                                                                                                                   |
| KR20190032635 (A) | South Korea | Systems and methods for advanced iterative decoding and channel estimation of concatenated coding systems | Utility patent relating to systems for high, medium, and low-density parity check coding.                         |
| TW511345B         | Taiwan      | Method and apparatus for forward error correction coding for an AM in-band on-channel                     |                                                                                                                   |



|                |  |                                                                                                                         |  |
|----------------|--|-------------------------------------------------------------------------------------------------------------------------|--|
|                |  | digital audio broadcasting system                                                                                       |  |
| WO2001035555   |  | METHOD AND APPARATUS FOR FORWARD ERROR CORRECTION CODING FOR AN AM IN-BAND ON-CHANNEL DIGITAL AUDIO BROADCASTING SYSTEM |  |
| WO2002033838A3 |  | MULTI-USER DETECTOR FOR DIRECT SEQUENCE - CODE DIVISION MULTIPLE ACCESS (DS/CDMA) CHANNELS                              |  |
| WO2014089087   |  | SYSTEMS AND METHODS FOR ADVANCED ITERATIVE DECODING AND CHANNEL ESTIMATION OF CONCATENATED CODING SYSTEMS               |  |
| WO2014089092   |  | SYSTEMS AND METHODS FOR ADVANCED ITERATIVE DECODING AND CHANNEL ESTIMATION OF CONCATENATED CODING SYSTEMS               |  |
| WO2014089096   |  | SYSTEMS AND METHODS FOR ADVANCED ITERATIVE DECODING AND CHANNEL ESTIMATION OF CONCATENATED CODING SYSTEMS               |  |

#### Vojcic – Pending Patent Applications

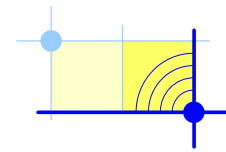
| Publication No. | Nation      | Title                                                                                                     | Description |
|-----------------|-------------|-----------------------------------------------------------------------------------------------------------|-------------|
| 10-2015-7015427 | South Korea | Systems and methods for advanced iterative decoding and channel estimation of concatenated coding systems |             |
| 1020197007897   | South Korea | SYSTEMS AND METHODS FOR ADVANCED ITERATIVE DECODING AND CHANNEL ESTIMATION OF CONCATENATED CODING SYSTEMS |             |

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##### Books:

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2. V. Vanghi, A. Damnjanovic and **B. Vojcic**, *The cdma2000 System for Mobile Communications*, Prentice Hall, 2004.

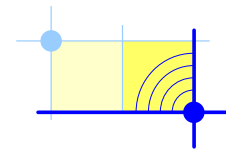
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2. R.L. Pickholtz and **B.R. Vojcic**, "CDMA for mobile LEO satellite communications", in *Code Division Multiple Access Communications*, edited by S.G. Glisic and P.A. Leppanen, Kluwer Academic Publishers, Norwell, MA, 1995.
3. F. Alagooz, A. AlRustamani, **B. Vojcic**, R. Pickholtz and D. Walters, "Adaptive resource allocation and rate control for heterogeneous traffic on DBS links", in *Multiaccess, Mobility and Teletraffic for Wireless Communications*, Vol. III, Kluwer Academic Publishers, 1998.
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5. Amina AlRustamani, **Branimir Vojcic** and Andrej Stefanov, "Greedy Detection," *Signal Processing for Wireless Communication Systems*, Kluwer Academic Publishers, Edited by: H. Vincent Poor and Lang Tong, 2002
6. D.A. Summy, **B. Vojcic** and J. Xu, "An Overview of Routing Protocols for Mobile Ad-Hoc Networks", *Ultra Wideband Wireless Communications*, John Wiley & Sons, July 2006.

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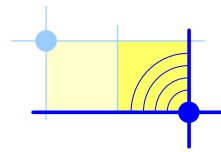
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5. **B.R. Vojcic**, R.L. Pickholtz and L.B. Milstein, "DS-CDMA outage performance over a mobile satellite channel", *European Transactions on Telecommunications and Related Technologies*, vol.6, No. 1, pp. 63-70, Jan.-Feb. 1995.
6. **B.R. Vojcic**, L.B. Milstein and R.L. Pickholtz, "Downlink DS CDMA performance over a mobile satellite channel", *IEEE Trans. on Veh. Technology*, vol. 45, No. 3, pp. 551-560, Aug. 1996.
7. V. Vanghi and **B. Vojcic**, "Multiuser detection with soft interference cancellation", *Wireless Personal Communications (An International Journal)*, Special Issue on Signal Separation and Interference Cancellation for Personal, Indoor and Mobile Radio Communications , 3: pp. 111-128, 1996.
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10. **B.R. Vojcic** and W.M. Jang, "Transmitter precoding in synchronous multiuser communications", *IEEE Transactions on Commun*. vol. 46, no. 10, pp. 1346-1355, Oct. 1998.
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12. Y. Shama, **B.R. Vojcic** and B. Vucetic, "Suboptimum soft output detection algorithms for coded multiuser", *IEEE Trans. on Communications* , Vol. 48, Oct. 2000.
13. F. Alagooz, D. Walters, A. AlRustamani, **B. Vojcic** and R. Pickholtz, "Adaptive rate control and QoS provisioning in direct broadcast satellite networks", *Wireless Networks*, Vol. 7, No. 3, pp. 269-281, May 2001.
14. A. Damnjanovic, **B. Vojcic**, "Iterative Multuser Detection/Decoding for Turbo-Coded CDMA," *IEEE Communications Letters*, Vol. 5, No. 3, February 2000.
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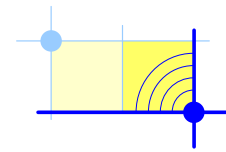
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17. A. AlRustamani and **B. Vojcic**, "A new approach to greedy multiuser detection", IEEE Transactions on Communications, Vol. 50, No. 8, pp. 1326-1336, Aug. 2002.
18. F. Alagoz, **B. Vojcic**, R. Pickholtz and A. AlRustamani, "On the Effects of Traffic Mixture in Direct Broadcast Satellites Networks" International Journal on Satellite Communications, Vol 20, No.4., July 2002, pp.293-306.
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20. A. AlRustamani, A. Stefanov and **B. Vojcic**, "Turbo-greedy decoding for systems with large number of transmit and receive antennas", IEEE Transactions on Wireless Communications, to appear 2002.
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29. M. Souryal, E. Larsson, B. Peric, B. Vojcic, Soft-Decision Metrics for Coded Orthogonal Signaling in Symmetric Alpha-Stable Noise, Signal Processing, IEEE Trans. On ASSP, Volume 56, Jan. 2008 Page(s): 266 – 273
30. J. Wu, Z. Wang, and B. Vojcic, "Partial Iterative Decoding for Binary Turbo Codes via Cross-entropy Based Symbol Selection". Vol. 57, No 12, *IEEE Transactions on Communications*, Dec., 2009.
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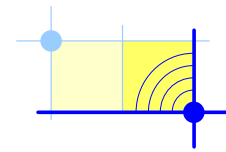
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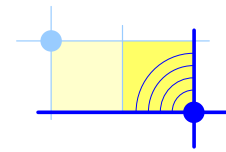
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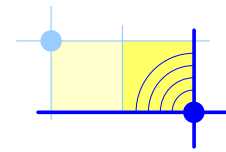
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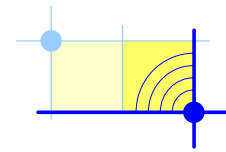
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4. **B.R. Vojcic**, R.L. Pickholtz and L.B. Milstein, "Performance of DS-CDMA with imperfect power control over a LEOS channel" (Invited Paper), Communication Theory Workshop, Marathon, Florida, 1993.
5. **B.R. Vojcic**, R.L. Pickholtz and L.B. Milstein, "CDMA sharing for mobile satellite communications", Communication Theory Workshop, Marathon, Florida, 1993.
6. **B.R. Vojcic**, "Transmitter precoding for synchronous multiuser communications", Workshop on Mobility Management, George Mason University, Fairfax, VA, Oct. 9, 1994.
7. **B.R. Vojcic**, "CDMA for low earth orbiting satellite communications", (Invited paper) Microwave Theory Workshop, Historic Electronics Museum, Baltimore, MD, Oct. 1994.
8. W.M. Jang and **B. Vojcic**, "Transmitter precoding in synchronous multiuser communications over multipath channels", Symposium on Interference Rejection and Signal Separation 1996, New Jersey Institute of Technology, Newark, March 1996.
9. **B. Vojcic**, "The role of data link layer in multiuser communications", (Invited paper), Communication Theory Workshop 1996, San Destin, April 1996.
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12. M. Honig and **B.R. Vojcic**, "Packet DS-CDMA with adaptive interference suppression and soft decoding", Information Theory Workshop, UCSD, San Diego, Feb. 1998.
13. **B.R. Vojcic** and Y. Shama, "Soft output detection for coded multiuser systems", Information Theory Workshop, UCSD, San Diego, Feb. 1998.
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24. J. Damjanovic, **B. Vojcic**, "Turbo Multiuser Detection for MIMO Rayleigh Fading Channels", Proc. of 3GIS, Athens, Greece, July 2001.
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26. **B. Vojcic**, "Multiple Access Issues for UWB Communications", Invited Talk, IEEE Communication Theory Workshop 2003, Phoenix, April 2003.
27. Jinghao Xu, B. Peric, and B. Vojcic, "Energy-aware and Link-adaptive Routing Metrics for Ultra Wideband Sensor Networks", invited paper, Networking with Ultra Wide Band and Workshop on Ultra Wide Band for Sensor Networks 2nd International Workshop, Rome, July 2005.
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3. **B.R. Vojcic**, L.B. Milstein and R.L. Pickholtz, "The effect of dual satellite diversity on the total capacity of multiple band-shared CDMA LEOS systems", Documents of Radiocommunications Study Group, USWG 8D, Washington, D.C. 1993.



4. **B.R. Vojcic**, "CDMA for mobile satellite communications", presentation given to the Communications Society of the IEEE, Washington and Northern Virginia Chapter, George Washington University, Washington, DC, Sep. 1994.
5. **B.R. Vojcic**, "DS CDMA for satellite communications", IEEE Microwave Theory Lecture Series, Maryland University, Feb. 1995.
6. **B.R. Vojcic**, "DS CDMA - a perspective", David Sarnoff Research Center, Princeton, Aug. 1995.
7. **B.R. Vojcic**, "New results in multi-stage detection", New Jersey Institute of Technology, Newark, Dec. 1995.
8. R.L. Pickholtz and **B.R. Vojcic**, "Multiuser detection in wireless communications", NORTEL, Ottawa, Canada, Aug. 1996.
9. **B. Vojcic**, "Spread ALOHA versus CDMA - A comparison" The George Washington University, Washington, DC, Oct. 1996.
10. **B. Vojcic**, "CDMA versus Spread ALOHA", George Mason University, Fairfax, VA, Oct. 1996.
11. **B.R. Vojcic**, "On coding/spreading tradeoffs in multiuser communications", UCSD, San Diego, Feb. 1998.
12. **B.R. Vojcic**, "On coding/spreading tradeoffs in multiuser communications", QUALCOM, Inc., San Diego, Feb. 1998.
13. **B.R. Vojcic**, "Multiuser detection and interference cancellation – Overview and potential", LCC, McLean, VA, May 2000.
14. **B.R. Vojcic**, "Greedy Multiuser Detection", Nortel Networks, Germantown, MD, June 2001.
15. M. Souryal, **B. Vojcic**, R. Pickholtz, "Fading is good in ad-hoc networks," Soprano Seminar, GMU, Fairfax, VA, June 15, 2001.
16. **Prof. B. Vojcic**, Prof. R. Pickholtz, Invited pannel presentation "3G - Mission Impossible?", 3GIS, Athenes, Greece, July 2001.
17. **B.R. Vojcic**, "Greedy Detection with Applications" Polytechnic Institute of New York, NY, Feb. 2002.
18. M. Souryal, **B. Vojcic**, R. Pickholtz, "Interference model for ad hoc wireless networks with M-QAM DS-CDMA signals," Soprano Seminar, GWU, Washington, DC, January 9, 2002.
19. **B.R. Vojcic**, "3G-Mission Impossible, 4G-Terra Incognita", TechExpo, GWU, Ashburn, VA, April 2002.
20. **B.R. Vojcic**, "1xEV-DO/DV: Multiuser Diversity", LCC International, , McLean, VA, Oct 2002
21. **B.R. Vojcic**, "Adaptive Multi-Hop Ad-Hoc Access technologies", Nortel Networks, Ottawa, April 2003.
22. **B.R. Vojcic**, "Probability and Stochastic Processes in Communications", Federal Communications Commission, Oct. 2005.