IN THE UNITED STATES DISTRICT COURT
FOR THE EASTERN DISTRICT OF TEXAS
TEXARKANA DIVISION

PANTECH CORPORATION and PANTECH WIRELESS, LLC Plaintiffs, v. LG ELECTRONICS INC. and LG ELECTRONICS U.S.A., INC., Defendant.	Case No. 5:22-cv-00113-RWS **JURY TRIAL DEMANDED**

CLAIM CONSTRUCTION EXPERT REPORT OF PETER RYSAVY CONCERNING U.S. PATENT NO. 9,854,545

I hereby declare under the penalty of perjury under the laws of the United States of America that the opinions set forth herein are true and accurate to the best of my knowledge, information, and belief.

Dated: June 23, 2023

Peter Rysavy

LG Elecs. Ex. 1021
LG Elecs. v. Pantech Corp.
IPR2023-01270 Page 1

TABLE OF CONTENTS

I. INTRODUCTION ..... - 1 -

II. BACKGROUND AND QUALIFICATIONS ..... - 1 -

III. UNDERSTANDING OF LEGAL STANDARDS ..... - 4 -

IV. MATERIALS CONSIDERED ..... - 5 -

V. OVERVIEW OF THE '545 PATENT ..... - 6 -

VI. LEVEL OF ORDINARY SKILL IN THE ART ..... - 8 -

VII. CLAIM CONSTRUCTION OPINIONS ..... - 8 -

VIII. RESERVATION OF RIGHTS ..... - 19 -

I. INTRODUCTION

1. My name is Peter Rysavy. I have been asked by Plaintiffs in this lawsuit (Pantech Corporation and Pantech Wireless LLC) (collectively, "Pantech") to provide my opinion as to the proper construction of certain claim of U.S. Patent No. 9,8545,545 (the "'545 patent"). I have also been asked to provide my understanding of the level of ordinary skill in the art related to these patents, as well as to explain the relevant technical background related to these patents.

2. Although I am being compensated at my usual consulting rate of $500 per hour for my time reviewing materials and preparing this declaration, my opinions expressed here are my own. My compensation is in no way dependent on the outcome of this case or upon the Court accepting my opinions, and I have no other financial interest in this matter or the parties thereto.

3. Depending on new information learned during discovery, or positions taken throughout the case by Defendants LG Electronics Inc. and LG Electronics U.S.A., Inc. (collectively, "LGE") or their experts, I may edit, add to, or otherwise refine the topics and expected testimony described here. I reserve the right to supplement my opinions based on new information.

4. If called upon to do so, I am prepared to testify before the Court regarding my opinions expressed here. In such a situation, I may rely on live demonstrations, demonstratives, exhibits, or other visual aids to assist in presenting my testimony.

II. BACKGROUND AND QUALIFICATIONS

5. My qualifications to testify about the '545 Patent and the relevant technology, along with a list of all my publications within at least the past ten years and a list of the matters in which I have testified (either at trial or by deposition), are set forth in my curriculum vitae ("CV"), which

I have attached here as Appendix A. I will briefly summarize my qualifications to render opinions regarding this technology in the following paragraphs.

6. I graduated with BSEE and MSEE degrees from Stanford University in 1979, with my master's degree emphasizing communications technologies.

7. From 1988 to 1993, I was vice president of engineering and technology at Traveling Software (later renamed LapLink), at which projects included LapLink, LapLink Wireless, and connectivity solutions for a wide variety of computing platforms. During this period, I was responsible for evaluating wireless communications technologies for use with the LapLink file transfer and synchronization product families. I also managed the development of a short-range wireless modem called LapLink Wireless that replaced a serial-data cable connection between computers. Prior to Traveling Software, I spent seven years at Fluke Corporation, where I worked on data-acquisition products and touch-screen technology.

8. I am now the president of the consulting firm Rysavy Research LLC and have worked as a consultant in the field of networking systems and wireless technology since 1993. As a consultant I specialize in wireless systems, including the wireline networking systems that support them. My work includes working with networking protocols at all layers of the protocol stack, including the TCP/IP family of protocols. One of my clients in 1994 was McCaw Cellular (which later became AT&T Wireless), the leading U.S. cellular company at the time. I did multiple projects for McCaw Cellular, helping me develop my expertise in networking technologies.

9. Beginning in 1994, I began teaching public courses, including courses that I taught at Portland State University, the University of California at Los Angeles, at conferences, and through my own organization. These courses included content about cellular networks, Wi-Fi and other wireless local area networks, Bluetooth, paging, and mobile-application architectures.

10. Past projects have included reports on the evolution of networking technologies, evaluation of wireless technologies, strategic consultations, system design, articles, courses and webcasts, network performance measurement, test reports, and involvement in multiple patent litigation cases. I have analyzed and reported on telephony- and video-communications architectures, for example using the IP Multimedia Subsystem (IMS) and Wi-Fi Calling. My past and current clients include more than one hundred organizations.

11. I have written more than one hundred and ninety articles, reports, and papers, and have taught more than forty public courses and webcasts, on networking technologies. I have also performed technical evaluations of many networking technologies.

12. From 2000 to 2016, as part of my consulting practice, I was the executive director of the Portable Computer and Communications Association (PCCA), which was formally incorporated in May of 1993, then operated as the Wireless Technology Association. The PCCA's mission was to promote the interoperability of wireless-data systems, and its initial work was to develop specifications for interfaces between computers and wireless modems. The PCCA/WTA held workshops and conferences that addressed 2G (GSM/GPRS/EDGE), 3G (WCDMA/HSPA), 4G (LTE), and 5G wireless technologies.

13. I have extensive experience with standards and specifications in the wireless industry, including analyzing standards and specifications documents associated with dozens of projects, and being the executive director of the Portable Computer and Communications Association (PCCA) for sixteen years, an organization that developed wireless interoperability specifications, one of which became adopted by the TIA/EIA as the TIA/EIA-678 standard.

14. In the more than twenty-five years of my consulting career, I have studied or worked with nearly every major wireless technology related to cellular networks and wireless

local-area networks, as well as the wireline networks associated with them. Specifically, I have worked in depth with 1G, 2G, 3G, 4G, and 5G wireless technologies. This includes my reports (for example, see https://rysavyresearch.files.wordpress.com/2020/09/2020-09-global-5g-rise-of-a-transformational-technology.pdf), articles, client work, work as an expert in patent litigation, and presentations (for example see https://rysavyresearch.files.wordpress.com/2020/09/2020-10-interop-5g-available-and-improving.pdf).

15. My CV contains further details on my background, work experience, clients, publications, and cases in which I have given testimony.

III. UNDERSTANDING OF LEGAL STANDARDS

16. I am not a lawyer and am not offering any opinions regarding legal matters. However, the legal principles relevant to my opinion herein have been explained to me by Pantech's counsel. In this section, I summarize these legal principles as they have been explained to me.

17. I reserve the right to change or formulate new opinions in the event there is a change in the law concerning my opinions provided in this report.

18. I understand that the claim construction exercise begins with the language of the claims themselves, and that the general rule is that claim terms are given their plain and ordinary meaning to a person of ordinary skill in the art, in view of the specification of the patent, at the time of the invention. I also understand that the intrinsic evidence (*i.e.*, the claims, the written description including the figures, and prosecution history) are the primary sources used in interpreting claim language.

19. I understand that if disputed claim language is clear on its face, the intrinsic evidence should be consulted to determine whether some deviation from the ordinary meaning of the claim language is warranted.

20. When the disputed claim language is not clear on its face, I understand that the intrinsic evidence should be used to resolve, if possible, any lack of clarity. I also understand that the specification is the best evidence of what the patentee intended the term to mean when there is no clear meaning of a claim term, and that the prosecution history may also shed light on the meaning of ambiguous terms. However, I understand that it is improper to import limitations from the specification into a patent claim through claim construction.

21. I have been informed that sometimes the ordinary meaning of claim language as understood by a person of ordinary skill in the art may be readily apparent even to lay persons. I understand that claim construction in such cases involves little more than the application of the widely accepted meaning of commonly understood words.

22. I further understand that a patentee may act as his own lexicographer by giving a definition for a particular claim term. I understand that, in order for this principle to apply, the patentee must clearly set forth a definition and clearly express an intent to define that term. Simply disclosing a single embodiment is not sufficient

IV. MATERIALS CONSIDERED

23. I considered the following materials at the time I formed my opinions presented herein. I have considered the ’545 Patent and its file history. I have also considered each of the parties’ claim construction positions and the extrinsic evidence set forth by the parties, which I cite to as applicable within my report.

24. I have also relied upon my extensive experience in the fields of the ’545 Patent, as set forth above.

V. OVERVIEW OF THE ’545 PATENT

25. The ’545 Patent is entitled “Apparatus and Method for Establishing Uplink Synchronization in a Wireless Communication System.” As explained in the ’545 Patent’s specification, “synchronization between a user equipment (UE) and an evolved node B (eNB) is an important issue in a wireless communication system since transmission/reception of information between the UE and the eNB may not be performed without synchronization.” ’545 Patent at 1:29-33; *see also id.* at 1:42-43 (“synchronization is a factor that has a great effect on an efficiency of a network”). However, prior to the ’545 Patent, effective synchronization had yet to be achieved in wireless communication systems using more than one component carrier (CC). *Id.* at 1:34-39. There was thus a “desire for a scheme for effective synchronization” in such a system, because a “[c]urrent wireless communication system needs to satisfy a user demand through a plurality of CCs, unlike a conventional wireless communication system that supports a single component carrier (CC) or a single service band.” *Id.* at 1:34-42.

26. The ’545 Patent addresses this need by disclosing systems and methods for establishing uplink synchronization in a wireless communication system supporting one or more uplink CCs. For example, embodiments of the invention do so through the use of uplink timing groups and Timing Advanced (TA) values for CCs included in such timing groups. As one example of how the ’545 patent achieves this synchronization, independent claim 2 recites “[a] method for establishing an uplink (UL) synchronization by a User Equipment (UE)” comprising receiving a Radio Resource Control (RRC) signaling including a UL timing group information set, configuring one or more UL timing groups based on the UL timing group information set, transmitting a

random access preamble through one or more UL CCs "being set as a delegate CC in the respective UL timing group," receiving a random access response including a Timing Advanced value "for UL CCs in the respective timing group," and applying each Timing Advanced value "to CCs in the respective UL timing group."

27. The '545 Patent teaches that "[t]he UE may be an inclusive concept indicating a user terminal utilized in a wireless communication, including a UE in Wideband Code Division Multiple Access (WCDMA), Long Term Evolution (LTE), High Speed Packet Access (HSPA), and the like, and a mobile station (MS), a user terminal (UT), a subscriber station (SS), a wireless device and the like in Global System for Mobile Communications (GSM)." '545 Patent at 3:64-4:4. In addition, in the '545 Patent, "[t]he eNB or a cell may refer to a fixed station where communication with the UE is performed, and may also be referred to as a Node-B, a base transceiver system (BTS), an access point, and the like." '545 Patent at 4:5-8; *see also id.* at 4:9-14 ("The eNB or the cell may be construed as an inclusive concept indicating a portion of an area covered by a radio network controller (RNC) in WCDMA, and the like, and the concept may include various cell coverage areas, such as a megacell, macrocell, a microcell, a picocell, a femtocell, and the like."). In other words, "[i]n the specifications, the UE and the eNB are used as two inclusive transceiving subjects to embody the technology and technical concepts described in the specifications, and may not be limited to a predetermined term or word." *Id.* at 4:15-18.

28. The '545 Patent also explains that the "eNB may calculate a TA value for each CC group (each delegate CC) based on the received RAP [random access preamble] signal." '545 Patent at 13:60-62. For example, the eNB may "generate information associated with synchronization based on the received RAP," such as a RAR message including TA information and UL grant information, which the eNB may transmit to the UE. *Id.* at 23:42-50. The TA

information included in such a message may include a TA value for each UL timing group, which "may be transmitted through one or more delegate CCs, simultaneously or at separated time." *Id.* at 23:56-24:2.

29. Figure 1 illustrates an exemplary wireless communication system that uses a plurality of CCs according to an embodiment of the '545 Patent. '545 Patent at Fig. 1; *id*. at 4:46-48.

VI. LEVEL OF ORDINARY SKILL IN THE ART

30. In my opinion, at the time of the '545 Patent, a person of ordinary skill in the art would have a bachelor's degree in electrical engineering, or equivalent training, and approximately two years of experience working in the field of wireless networking.

VII. CLAIM CONSTRUCTION OPINIONS

A. "eNB" / "evolved NodeB (eNB)" (claims 2, 3)

31. I understand that the parties have proposed the following constructions for this term:

Term and Applicable Claims	Pantech Proposed Construction	LGE Proposed Construction
"eNB" / "evolved NodeB (eNB)" (claims 2, 3)	base station	Plain and ordinary meaning

32. I have reviewed each of the proposed constructions and considered them in view of the claims, specification (including the figures), and prosecution history of the '545 Patent, as well as the extrinsic evidence identified by both Pantech and LGE.

33. It is my opinion that this term should be construed as "base station," as proposed by Pantech. Pantech's construction is consistent with the patentee's description of the term "eNB"

in the claims and specification of the ’545 Patent, which, in my opinion, set forth a clear intent by the patentee to define the term “eNB” as a base station.

34. For example, at the outset of the detailed description, the patentee states:

> The eNB or a cell may refer to a fixed station where communication with the UE is performed, and may also be referred to as a Node-B, a base transceiver system (BTS), an access point, and the like.
>
> The eNB or the cell may be construed as an inclusive concept indicating a portion of an area covered by a radio network controller (RNC) in WCDMA, and the like, and the concept may include various cell coverage areas, such as a megacell, macrocell, a microcell, a picocell, a femtocell, and the like.

’545 Patent at 4:5-14.

35. A person of ordinary skill in the art would understand from these statements that the patentee is using the term “eNB” to refer to a base station, and is not limiting the term to a specific type of wireless technology or cellular network. For example, a person of ordinary skill in the art would understand that, while base stations in a 4G cellular network are often referred to as “eNBs” (short for “evolved Node-B”), a person of ordinary skill in the art would also understand that a “Node-B” commonly refers to a base station in a 3G cellular network, and a “base transceiver system (BTS)” commonly refers to base stations in 2G (i.e., GSM) cellular networks. A person of ordinary skill in the art would also understand that an “access point” is a generic term that could refer to a base station in a number of different cellular technologies, and is not limited to a 2G, 3G, or 4G network. Thus, a person of ordinary skill in the art would understand that, by stating that the eNB “may also be referred to as a Node-B, a base transceiver system (BTS) an access point, and

the like," '545 Patent at 4:7-8, the patentee was defining eNB to apply inside as well as outside the 4G context, and to refer generally to a base station.[1]

36. This construction is further supported by the statement in the specification that "[t]he eNB or the cell may be construed as an inclusive concept indicating a portion of an area covered by a radio network controller (RNC) in WCDMA, and the like." '545 Patent at 4:9-11. WCDMA (Wide-Band Code-Division Multiple Access) is a 3G cellular technology, and RNCs are components of 3G networks that interface with and control Node-Bs. Thus, by stating that the eNB may be covered by a RNC in a WCDMA network, a person of ordinary skill in the art would further understand that the patentee was defining eNB more broadly than a 4G evolved Node B.

37. Moreover, the patentee expressly states: "Hereinafter, a user terminal may be referred to as a UE and a base station may be referred to as an eNB." '545 Patent at 8:19-20. A person of ordinary skill in the art would understand that to be a definitional statement by the patentee defining "eNB" as a base station. That is especially so in light of the disclosures in the '545 Patent equating an eNB with 2G and 3G base stations, and referring to an eNB as an "access point," which, as discussed above, a person of ordinary skill in the art would also understand to show the patentee's clear intent to define "eNB" broadly as a base station, rather than an intent to limit that term to only base stations used in a particular cellular technology.[2]

[1] The '545 patent describes the UE (user equipment) in similarly broad terms: "The UE may be an inclusive concept indicating a user terminal utilized in a wireless communication, including a UE in Wideband Code Division Multiple Access (WCDMA), Long Term Evolution (LTE), High Speed Packet Access (HSPA), and the like, and a mobile station (MS), a user terminal (UT), a subscriber station (SS), a wireless device and the like in Global System for Mobile Communications (GSM)." '545 Patent at 3:64-4:4.

[2] That the definitional statements in the specification use the term "may" does not alter my opinion that those statements reflect a clear intent by the patentee to define "enB" as a base station. As explained herein, the specification consistently uses the term "enB" in accordance with those definitions, and nothing in its language would suggest to a person of ordinary skill in the art that the patentee intended to use the term "eNB" in any other way.

38. Moreover, nothing in the language of claims 2 and 3 demonstrates any intent by the patentee to use the terms "evolved NodeB" and "eNB" differently than how those terms are defined in the specification.

39. Accordingly, it is my opinion that Pantech's proposed construction of "base station" accurately reflects the manner in which the patentee defined the term "eNB" in the '545 Patent.

B. "wherein each TA value . . ." (claims 2, 3)

Term and Applicable Claims	**Pantech Proposed Construction**	**LGE Proposed Construction**
"wherein each TA value is transmitted from the eNB for the respective UL timing group based on the transmitted RAP associated with a delegate CC of the respective UL timing group" (claims 2, 3)	Plain and ordinary meaning	wherein each TA value is transmitted from the eNB for the respective UL timing group in response to the transmitted RAP through its delegate CC of the respective UL timing group

40. I have reviewed each of the proposed constructions and considered them in view of the claims, specification (including the figures), and prosecution history of the '545 Patent, as well as the extrinsic evidence identified by both Pantech and LGE.

41. It is my opinion that a person of ordinary skill in the art would understand the plain an ordinary meaning of this term and that no construction is necessary. For example, at least the following portions of the specification demonstrate that this claim term should be given its plain meaning, and show that the '545 Patent does not assign a specific meaning to this claim term.[3]

> To perform transmission and reception of data with an eNB **390**, a UE **380** may need to obtain a UL synchronization. To obtain the

[3] I note that this claim term does include "eNB," which I address as a separate claim term above.

> UL synchronization, the UE **380** may proceed with a process of receiving information required for synchronization, from the eNB **390**. FIG. 3 shows a random access procedure for receiving information required for synchronization. The random access procedure may be applicable when a UE is newly coupled to a network through a handover and the like.

'545 Patent at 6:49-57.

> The UE **380** may randomly select a preamble signature so as to generate a random access preamble (RAP). Subsequently, the UE **380** may transmit the selected preamble to the eNB **390** (step S**310**). The process of selecting the preamble signature may be contention-based selection or contention-free selection. In this example, the eNB may inform the UE of a previously reserved RAP, and the UE may transmit, to the eNB **390**, a preamble selected based on received information (step S**310**).

'545 Patent at 6:62-7:3.

> The eNB 390 may perform random access response (RAR) with respect to the preamble received from the UE 380. In this example, the eNB 390 may transmit an RAR message through a physical downlink shared channel (PDSCH).
>
> Information transmitted through the RAR message may include, for example, identification information of the UE preamble received by the eNB, an identifier (ID) of the eNB, a temporary cell radio network temporary identifier (C-RNTI), information associated with a time slot where the preamble is received, TA information, and the like. Timing information for a UL synchronization may be received through the RAR message and thus, the UE 380 may perform the UL synchronization with the eNB 390. The UE 380 may perform a scheduled transmission that transmits data at a scheduled time determined based on the TA information received in step S320 (step S330).

'545 Patent at 7:12-29.

> Therefore, the UE or the eNB may select a delegate CC in each group. In this example, the UE or the eNB may select the delegate CC by selecting an SCell including the delegate CC. In this example, the delegate CC or the SCell may be selected based on the conditions c-i) through c-v), from among CCs that are capable of obtaining a TA value to be used for obtaining a UL synchronization. That is, one of the c-i) through c-v) may be selected as a delegate CC.

. . .

> After completing steps S432 and S434 for setting a UL timing group and a corresponding delegate CC, to obtain a UL synchronization, the UE 480 may set an RAP through a delegate CC of each group, and may transmit the set preamble by selecting one of the resources defined in SI of each CC (step S440).

'545 Patent at 12:45-64.

> The eNB 490 may calculate a TA value for each group with respect to each CC group (each delegate CC) based on the received RAP signal. The eNB 490 may transmit, to the UE 480, UL grant information and a TA value of a UL timing group (a delegate CC) through an RAR message (step S450). The TA value may be an example of UL synchronization information required when the UE adjusts a UL transmission time.

'545 Patent at 13:60-67.

> For example, the eNB 590 may calculate a TA value based on the UL timing group set in step S508, and may transmit the calculated TA value. Also, the eNB 590 may transmit the RAR message through a predetermined CC, and may transmit the RAR message through all CCs in the corresponding UL timing group.

'545 Patent at 15:8-13; *see also id.*at 15:1-7.

> As described in FIG. 6, the UE 680 may receive a set UL timing group from the eNB 690, and may perform a random access procedure based on a representative value of a corresponding group. Subsequently, the UE 680 may receive a TA value of the timing group based on a preamble associated with the random access procedure, and may adjust a UL timing for obtaining synchronization.

'545 Patent at 16:48-54.

> Subsequently, the eNB may transmit an RAR message with respect to the received preamble. In this example, the eNB may transmit UL grant information for the UE and TA information for each UL timing group along with the RAR message (step S750).
>
> The TA value may be an example of UL synchronization information required when the UE adjusts a UL transmission time. Also, the TA information for each UL timing group may be transmitted through a plurality of delegate CCs, simultaneously or

> at separated time. Here, the TA information for each UL timing group may be transmitted in a form of a table including a TA value corresponding to a group index.

'545 Patent at 17:44-56.

> Accordingly, the UE may transmit the RAP through all UL CCs configured based on information included in the RAP resource information response message (step S994). When the RAP resource information does not exist in the RAP resource information response message received from the eNB, a time that is closest to the time when the RAP needs to be transmitted may be selected so that the RAP may be simultaneously transmitted through all the UL CCs. In this example, the same RAP may be selected from all the CCs and may be simultaneously transmitted.
>
> Subsequently, the UL timing group information may be received from the eNB through a PCC. That is, the eNB may determine RAPs transmitted from the UE, may determine that the UE requests configuration of a UL timing group, may calculate a TA value based on the preambles received through the RAPs, and may generate the UL timing group of the UE based on the calculated TA. The UL timing group information of the generated UL timing group may be transmitted to the UE.

'545 Patent at 21:21-39.

> The transceiving unit 1050 may receive, from the UE, the synchronization request message requesting synchronization, for example, a message including an RAP. That is, the RAP transmitted through the delegate CC determined by the UE for the UL timing group may be determined, and a TA value for each UL timing group may be transmitted. The synchronization request message may be received through at least one delegate CC, simultaneously or sequentially at separated time.

'545 Patent at 23:30-38.

> The controller 1010 may control the transceiving unit 1050 to generate information associated with synchronization based on the received RAP, for example, a message including UL grant information, TA information associated with the synchronization, and the like, and to transmit the generated information to the UE. In this example, the message including the TA information may include an RAR message . . . .

> Here, the controller 1010 may generate TA information for each UL timing group in a form of a table including a TA value corresponding to a group index, in a form of a TA value including a unit error for each timing group. The error for each timing group may have a size of an integer-multiple of a predetermined unit value, or may be specified in detail. Also, the controller 1010 may control the transceiving unit 1050 to transmit the TA information for each UL timing group as an indicator indicating a TA based on a predetermined rule. The TA value may be an example of the UL synchronization information required when the UE adjusts a UL transmission time, and the synchronization information for the UL timing group may be transmitted through one or more delegate CCs, simultaneously or at separated time.

'545 Patent at 23:43-24:2.

42. Reading all of these exemplary disclosures in the '545 Patent, a person of ordinary skill in the art would have understood that the specification uses the plain and ordinary meaning of the words in this claim term. For example, a person of ordinary skill in the art would understand that the claim term's use of "RAP" (or "random access preamble") and "TA value" is consistent with the plain and ordinary meaning of those terms, as is reflected by the description of the random access procedure in the specification and the extrinsic evidence identified by Pantech. *See, e.g.* '545 Patent at 6:49-7:3, 7:12-29; 3GPP TS 36.300 v9.1.0, Section 10.1.5 (Random Access Procedure), 3GPP TS 36.321 v9.1.0, Sections 6.1.5 (MAC PDU (Random Access Response)) and 6.2.3 (MAC Payload for Random Access Response). Moreover, a person of ordinary skill in the art would understand that the '545 Patent does not assign a specific definition to any of the remaining words in this claim term (with the exception of "eNB," which I address as a separate claim term).

43. I have also reviewed and considered the construction proposed by LGE. I disagree with LGE's attempts to rewrite the plain language of the claim term. I note that LGE does not dispute the plain meaning of the first portion of this claim term: "wherein each TA value is

transmitted from the eNB for the respective UL timing group." I thus focus my discussion on LGE's attempt to rewrite "based on the transmitted RAP associated with a delegate CC of the respective UL timing group" as "in response to the transmitted RAP through its delegate CC of the respective UL timing group."

44. To start, I disagree with LGE's proposal to rewrite "based on" as "in response to." The specification discloses in a number of places that the TA value is "based on" the transmitted RAP. *See, e.g.*, '545 Patent at 13:60-67; *id.* at 15:8-13; *id.* at 21:31-39. Indeed, the specification discloses that the eNB calculates a TA value "based on" information included in the RAP transmitted by the UE, and includes that TA value in a RAR (random access response) message it transmits to the UE. *See, e.g.*, '545 Patent at 13:60-67; *id.* at 15:8-13; *id.* at 21:31-39; *id.* at 23:43-24:2. A person of ordinary skill in the art would thus not read the specification to support LGE's attempted rewriting of "based on" as "in response to." I also note that the extrinsic evidence identified by LGE states that the step of "the network transmitting a timing advance command" is "based on the timing estimate" in the RAP step. *See* LGE_0095971.

45. LGE's position is also at odds with the claims of the '545 Patent. For example, claims 2 and 3 each use the words "based on" twice. In the first instance, those claims recite "configur[ing/e] one or more UL timing groups based on the UL timing group information set." '545 Patent at Claims 2, 3. It is my understanding that LGE agrees that the plain and ordinary meaning of "based on" applies to that limitation. The disputed term appears later in the claim. For that term only, LGE takes the position that "based on" means "in response to." My review of the intrinsic and extrinsic record reveals no basis on which a person of ordinary skill in the art would conclude that the patentee intended to assign two different meanings to the words "based on" within the same claim.

46. I also disagree with LGE's attempt to rewrite "associated with a delegate CC of the respective UL timing group" as "through its delegate CC of the respective UL timing group." To start, LGE's use of "its" improperly limits this term to a singular delegate CC. Claims 2 and 3 recite that the RAP is transmitted "through one or more UL CCs," and that "each of the one or more UL CCs transmitting an RAP being set as a delegate CC in the respective UL timing group." *See* '545 Patent at Claims 2, 3. The language of the disputed claim term—"a delegate CC of the respective UL timing group"—is consistent with that additional claim language reciting that the RAP may be transmitted through "one or more UL CCs" that are "set as a delegate CC in the respective UL timing group." LGE's proposed langauge—"its delegate CC of the resepctive UL timing group"—is not.

47. Moreover, the specification discloses that the eNB may transmit a RAR including a TA value through more than one CC of a UL timing group. *See, e.g.* '545 Patent at 15:8-13 ("Also, the eNB 590 may transmit the RAR message through a predetermined CC, and may transmit the RAR message through all CCs in the corresponding UL timing group."); '545 Patent at 17:51-53 ("Also, the TA information for each UL timing group may be transmitted through a plurality of delegate CCs, simultaneously or at separated time."); '545 Patent at 23:65-24:2 ("The TA value may be an example of the UL synchronization information required when the UE adjusts a UL transmission time, and the synchronization information for the UL timing group may be transmitted through one or more delegate CCs, simultaneously or at separated time."). A person of ordinary skill in the art would understand the claim language to be consistent with those disclosures, as it does not require that the TA value be transmitted through any particular delegate CC; the TA value must simply be transmitted "based on the transmitted RAP associated with a delegate CC of the respective UL timing group." LGE's proposal, meanwhile, would require that

the TA value be transmitted from the eNB through a single delegate CC. A person of ordinary skill in the art would not read the claim to be so limited in the light of the plain language of the claim and these disclosures in the specification.

48. LGE's "through its" language would also introduce ambiguity into the claim to a person of ordinary skill in the art. LGE's proposed construction recites that each TA value is transmitted "from the eNB for the respective UL timing group in response to the transmitted RAP through ***its*** delegate CC of the respective UL timing group." (emphasis added). LGE's proposal does not clearly convey to a person of ordinary skill in the art which delegate CC the RAP is transmitted through. In LGE's construction, it is unclear what "its" refers to—i.e., it is not clear to what the delegate CC belongs. If "its" is intended to refer to the transmitted RAP—i.e., that "its delegate CC" is the delegate CC of the transmitted RAP—such a construction would contradict the remainder of the term, which states that the delegate CC is a delegate CC "of the respective UL timing group." In other words, under this interpretation of LGE's construction, the claim would effectively recite that the TA value is transmitted "through the delegate CC of the transmitted RAP of the respective UL timing group." Because the claim recites that the RAP may be transmitted "through ***one or more*** UL CCs, each of the ***one or more*** UL CCs being set as a delegate CC in the respective UL timing group," LGE's construction does not convey to a person skilled in the art which of those delegate CCs is "its" delegate CC. On the other hand, if "its" is intended to refer to the respective UL timing group, then the "of the respective UL timing group" claim language would be rendered redundant. And, LGE's construction still would not convey which of the one or more delegate CCs in the respective UL timing group is "its delegate CC of the respective UL timing group." I therefore do not agree that either reading reflects the plain and ordinary meaning of the claim to a person of ordinary skill in the art.

49. Based on the foregoing, it is my opinion that the disputed "wherein each TA value . . ." term should be given its plain and ordinary meaning as proposed by Pantech.

VIII. RESERVATION OF RIGHTS

50. In addition to the opinions and evidence expressed herein, I reserve the right to rebut any arguments made or evidence presented in response to this report. I also reserve the right to supplement this report based on further investigation or analysis.

APPENDIX A

Peter Rysavy – Curriculum Vitae

PO Box 680, Hood River, OR 97031, USA
+1-541-386-7475, public.temp1@rysavy.com, http://www.rysavy.com

Peter Rysavy is an expert in data networking, wireless technology, and mobile computing

Contents

1. EDUCATION 1
2. WORK EXPERIENCE 1
3. PATENTS 4
4. TESTIFYING AND CONSULTING EXPERIENCE IN LITIGATION 4
5. PUBLIC SPEAKING 8
6. PUBLISHED ARTICLES AND REPORTS 8
7. WIRELESS COURSES 18

1. Education

BSEE, MSEE Electrical Engineering, Stanford University, 1979.

2. Work Experience

Rysavy Research. 1993 to Present: President

Peter Rysavy is president of Rysavy Research LLC, a consulting firm that has specialized in data networking, wireless technology, and mobile computing since 1993. Projects have included testifying in multiple venues, evaluation of data network capabilities, reports on wireless technology evolution, network performance measurement, test reports, spectrum analysis for broadband services, strategic consultations, system design, articles, courses, and webcasts.

Peter Rysavy has expertise in all aspects of data networking, internet technologies, TCP/IP, fiber, DOCSIS, voice communications, IP Multimedia Subsystem (IMS), IEEE 802.11 (Wi-Fi), wireless hotspots, mesh networks, metro and municipal Wi-Fi, paging technology, 2G, 3G, 4G, 5G (Release 15, Release 16, Release 17, Release 18), IMT-Advanced, IMT-2020, Global System for Mobile Communications (GSM), General Packet Radio Service (GPRS), Enhanced Data Rates for GSM Evolution (EDGE), Universal Mobile Telecommunications System (UMTS), Code Division Multiple Access (CDMA), Wideband CDMA (WCDMA), High Speed Downlink Packet Access (HSDPA), High Speed Uplink Packet Access (HSUPA), High Speed Packet Access (HSPA), HSPA+, Long Term Evolution (LTE), LTE-Advanced, LTE-Advanced Pro, LTE-Licensed Assisted Access (LAA), LTE-U, CDMA2000, CDMA2000 1XRTT, Evolved Data Optimized (EV-DO), Bluetooth, WiMAX, IEEE 802.16 (IEEE 802.16e, IEEE 802.16m), wireless security, smartphones, smartphone operating systems, Mobile IP, Evolved Packet System (EPS), Evolved Packet Core (EPC), machine-to-machine communications (M2M), Internet of Things (IoT), remote monitoring and control systems, location-based services, e-mail, wireless e-mail, browsers, mobile browsers, media gateways, orthogonal frequency division multiplexing (OFDM),

orthogonal frequency division multiple access (OFDMA), voice over IP (VoIP), mobile video, wireless spectrum, spectrum sharing, spectral efficiency, capacity analysis, and mobile computing architectures.

Patent Litigation

Peter Rysavy has worked in numerous cases, both as testifying and consulting expert. He has trial experience, reports, and depositions. See section 4 for details**.**

Analysis

Rysavy Research analyzes wireless technologies for capability, compatibility, interoperability, and intellectual-property considerations.

Training

Rysavy Research conducts wireless-technology training, both publicly and privately.

Testing and Reports

Rysavy Research tests, evaluates, and reports on all major wireless technologies.

Application Development and Deployment

Rysavy Research works with companies to define architectures, select vendors, perform pilots, and to deploy wireless systems and applications.

Clients from 1993 to present include:

5G Americas, ADT, AlphaSights, AltaVista, Anchorage Partners, Antenna Software, Apple, Arris, AT&T, AT&T Wireless, Aventail, Black Lowe & Graham, Bluetooth SIG, Broadbeam, Canopy Spectrum, Cingular Wireless, City of Seattle, CMP Media, Compression Laboratories, Coinstar, Comverse Network Systems, Cravath Swaine & Moore, Cricket Wireless, Crosslink Capital, Customer Focused Strategies, Datacomm Research, CTIA – The Wireless Association, Data Communications Magazine, Datacomm Research, Delco Electronics, Epicenter, Epicron, Ericsson, Fish and Richardson, Fitbit, Fluke, Foley Lardner, Fossil, GE, Gerson Lehrman Group, Gibson Dunn, Good, Google, GSMA, GuidePoint, Haynes & Boones, Hillman Company, Hobnob, Holland & Knight, Huawei, Hughes Network Systems, IMS Expert Services, Informa, Information Week, Intel, IT World, iWindsurf, Juniper Networks, Keker & Van Nest, King & Spalding, Kirkland & Ellis, Klarquist Sparkman, Mayer Brown, MCCI, McGuire Woods, Medtronic Physio-Control, Microsoft, Mobile Computing Promotion Consortium (MCPC), Mobile Future, Moffatt Thomas, Motorola, NetMotion Wireless, Network Magazine, Network Computing Magazine, New York State Wireless Association, Nokia, Norcom Networks, Novatel Wireless, OmniSky, Pacific Commware, Park & Associates, Perkins Coie, Portable Computer and Communications Association (PCCA), Portland State University, Powell and Gilbert, Research in Motion (RIM), Park and Associates, Quality in Motion, RKM Holdings, Rogers Communications, RPX, Ruckus Wireless, Sanyo, SkyGo, Sprint, Stratos Product Development Group, Superconductor Technologies, Symbian, T-Mobile, TCI, Teklicon, Tektronix, Teledyne Electronic Technologies, Third Bridge, Traveling Software

(LapLink), United Business Media, University of British Columbia, UCLA, US Department of Defense, Verizon Wireless, Wells Fargo, White & Case, Whitworth Analytics, WiMAX Forum, Wireless Data Forum, Wireless Technology Association, WRQ, Xerox Palo Alto Research Center, and Xircom.

Wireless Technology Association. 2000 to 2016: Executive Director.

Managed all the logistics of a non-profit industry organization that that evaluated wireless technologies, investigated mobile communications architectures, and promoted wireless-data interoperability. Organized and moderated more than fifty industry workshops.

Traveling Software (LapLink), Bothell, WA, USA. 1992 to 1993: Vice President of Technology.

Researched and evaluated key technologies. Developed Traveling Software's wireless communications strategy for local area and wide area connections. Helped define overall product and technology directions. Prototyped new technologies. Collaborated with technology partners. Developed license agreements for sale and purchase of technology. Participated in strategic sales efforts. Frequently traveled around the US and Asia. Spoke at conferences. Attended and monitored standards efforts. Managed patent applications and patent issues.

Traveling Software (LapLink), Bothell, WA, USA. 1988 to 1992: Vice President, Research and Development.

Developed Traveling Software's Research and Development department. Recruited over thirty professionals, including managers, design engineers, quality assurance engineers and technical writers. Under my management, we implemented: documented design and quality assurance procedures; a version control system; complete archiving with off-site storage; regular performance appraisals; a bonus plan; and well defined career paths. This R&D organization successfully brought in house all strategic technology and also released numerous successful software products for the retail PC market, including LapLink, LapLink Mac, DOS Connect for the HP 95LX, Organizer Link for the Sharp Wizard, and PC Link for the Casio BOSS.

Fluke Corporation, Everett, WA, USA. 1979 to 1981 and 1983 to 1988: Program Manager, Project Manager, Design Engineer.

As program manager, managed marketing group to determine target markets, sales channels, positioning and promotion in support of Fluke's operator interface business. As project manager, managed development of an entire family of communications-oriented touch terminals. Fluke introduced the first member, the 1020 Touch Control Screen in May, 1986. Directed software (C code for 68000 family processor), digital hardware (surface mount, semi-custom IC's, computer aided engineering), package design (injection molded plastic parts, steel chassis), and manuals (in English, French, German and Japanese.) Coordinated many groups: design, manufacturing, purchasing, component engineering, and marketing. As design engineer from 1979 to 1981, designed hardware and firmware for various systems, including: RS-232 communications; IEEE-488 communications; RS-485 multi-drop communications; thermal printer interface; cartridge drive interface; vacuum display driver and keypad driver.

Other Work Experience:

Time Office Computers, Australia, 1981 to 1983: Ethernet networking, random-access memory, power supply hardware development.

Stanford University, USA, 1976-1979: software consulting services for university/industry collaborations.

Additional information:

Available at https://rysavy.com/.

3. Patents

Peter Rysavy is the co-inventor of US4929935A, Apparatus for aligning raster scanned image to touch panel, filed May 2, 1986.

Peter Rysavy is the co-inventor of US4941845 A, Data transfer cable, filed June 7, 1989.

4. Testifying and Consulting Experience in Litigation

Summary

Forty-nine engagements in cases as a testifying expert.

Forty-seven engagements in patent cases as a testifying expert.

Court testimony as testifying expert in patent-litigation trial for Apple.

Ten patent-related depositions as testifying expert.

One breach-of-contract litigation deposition as testifying expert.

Thirty-three expert declarations for Inter Partes Review covering twenty patents.

Seven expert reports on non-infringement covering fifteen patents.

Eight expert reports on invalidity covering ten patents.

Three declarations related to claim construction.

Fifteen patent cases as consulting expert.

Three expert reports on non-patent matters.

Training in testifying and patents, 2020. (Seak: *How to be an Effective Expert Witness. How to Excel and Succeed as an Expert Witness in Patent Cases: Special Techniques*.)

Current Patent Cases as Testifying Expert (most recent on top)

Two cases. Details available upon request.

Prior Patent Cases as Testifying Expert (most recent on top)

Testifying expert for Alarm.com. Inter Partes Review. U.S. Patent No. 9,349,262. *Case No. IPR2022-00728.* Firm: Cravath, Swaine & Moore. Declaration filed March 18, 2022.

Testifying expert for Alarm.com. Inter Partes Review. U.S. Patent No. 7,956,739. *Case No. IPR2022-00714.* Firm: Cravath, Swaine & Moore. Declaration filed March 15, 2022.

Testifying expert for T-Mobile. Inter Partes Review. U.S. Patent No. 9,918,196. Firm: *Case No. IPR2022-00669.* Firm: McGuire Woods. Declaration filed March 4, 2022.

Testifying expert for ADT. Inter Partes Review. U.S. Patent No. 9,349,262. *Case No. IPR2022-00612.* Firm: Cravath, Swaine & Moore. Declaration filed February 7, 2022.

Testifying expert for Amazon. Inter Partes Review. U.S. Patent 10,791,442. *Case No. IPR2022-00260*. Firm: Perkins Coie. Declaration filed December 10, 2021.

Testifying expert for Fossil. Non-infringement, U.S. Patent Nos. 8,738,794; 8,892,752; and 9,749,847. *Case No. 4:17-CV-05933-YGR.* Firm: Fish & Richardson. Expert report on non-infringement October 29, 2021.

Testifying expert for ADT. Inter Partes Review. U.S. Patent No. 7,956,739. *Case no. IPR2021-01374.* Firm: Cravath, Swaine & Moore. Declaration filed August 6, 2021. Deposed April 26, 2022.

Testifying expert for Huawei. Inter Partes Review. U.S. Patent 6,704,304. *Case no. IPR2021-01012.* Firm: Fish & Richardson. Declaration filed May 26, 2021.

Testifying expert for Huawei. Inter Partes Review. U.S. Patent 7,460,658. *Case no. IPR2021-00691.* Firm: Fish & Richardson. Declaration filed April 6, 2021.

Testifying expert for T-Mobile. Claim construction. U.S. Patent 6,922,728. *Case No. 2:20-cv-281-JRG.* Firm: Gibson Dunn. Declaration filed March 15, 2021. Deposed March 31, 2021.

Testifying expert for Huawei. Inter Partes Review. U.S. Patent 8,429,480. *Case no. IPR2021-00229.* Firm: Fish & Richardson. Declaration filed November 30, 2020.

Testifying expert for Huawei. Inter Partes Review. U.S. Patent 7,515,546. *Case no. IPR2021-00225*. Firm: Fish & Richardson. Declaration filed November 30, 2020.

Testifying expert for Huawei. Inter Partes Review. U.S. Patent 7,508,755. *Case no. PR2021-00224.* Firm: Fish & Richardson. Declaration filed November 30, 2020.

Testifying expert for Ericsson. Inter Partes Review. U.S. Patent No. 7,016,676. *Case no. IPR2020-00376.* Firm: Haynes and Boone, LLP. Declaration of December 22, 2019.

Testifying expert for Microsoft. Inter Partes Review. U.S. Patent No. 6,664,891. *Case no. IPR2019-01188.* Firm: Klarquist Sparkman. Declaration filed June 11, 2019. Second declaration filed May 25, 2020. Patent Trial and Appeal Board ruled challenged claims unpatentable, November 4, 2020.

Testifying expert for Microsoft. Inter Partes Review. U.S. Patent No. 7,016,676. *Case no. IPR2019-01116.* Firm: Klarquist Sparkman. Declaration filed May 29, 2019. Second declaration filed May 19, 2020. Patent Trial and Appeal Board ruled challenged claims unpatentable, October 26, 2020.

Testifying expert for Microsoft. Inter Partes Review. U.S. Patent No. 6,993,049. *Case no. IPR2019-01026.* Firm: Klarquist Sparkman. Declaration filed May 6, 2019. Second declaration filed May 19, 2020.

Testifying expert for RPX. Inter Partes Review. U.S. Patent 7,245,917. *Cases no. IPR2018-01387, IPR2018-01388.* Firm: Klarquist Sparkman. Declaration filed July 13, 2018. Declaration for opposition to motion to amend filed August 8, 2019.

Testifying expert for Verizon. Non-infringement, U.S. Patent No. 9,642,024. *Traxcell v. Verizon. Case no. 2:17-cv-00721-RWS-RSP.* Firm: Holland & Knight. Expert report on non-infringement July 17, 2019. Deposed August 9, 2019. Motion for summary judgement granted September 18, 2019.

Testifying expert for Fossil. Non-infringement and invalidity, U.S. Patent No. 6,490,443. *Freeny v. Fossil, case no. 2:18-cv-00049.* Firm: Fish & Richardson. Expert report on non-infringement, May 13, 2019. Expert report on invalidity April 22, 2019. Deposed May 21, 2019. Parties settled.

Testifying expert for Fossil. Inter Partes Review. U.S. Patent 6,490,443. *Case no. IPR2019-00755.* Firm: Fish & Richardson. Declaration filed April 1, 2019.

Testifying expert for Microsoft. Inter Partes Review. U.S. Patent 9,531,657. *Case no. IPR2017-01411.* Firm: Klarquist Sparkman. Declaration filed May 8, 2017. On November 28, 2018, the Patent Trial and Appeal Board ruled all claims to be unpatentable.

Testifying expert for Arris. Non-infringement and invalidity (one patent), U.S. Patent No. RE45,126. *Sony v. Arris, ITC No. 337-TA-1049.* Firm: Fish & Richardson. Expert report on non-infringement, October 13, 2017. Expert report on invalidity September 27, 2017. Case settled in December 2017.

Testifying expert for Microsoft. Inter Partes Review. U.S. Patent 8,848,892. *Case no. IPR2017-01052.* Firm: Klarquist Sparkman. Declaration filed March 9, 2017. Deposed November 30, 2017. On September 19, 2018, the Patent Trial and Appeal Board ruled all claims to be unpatentable.

Testifying expert for Apple. Non-infringement and invalidity. U.S. Patent 6,321,092. *Unwired Planet v. Apple, Case No. 13-cv-04134.* Firm: Gibson Dunn. Expert reports on non-infringement and invalidity, March 7, 2017.

Testifying expert for Google, Inter Partes Review.

> U.S. Patent 5,809,428. *Case nos. IPR2017-00529, IPR2017-00530, and IPR2017-00559*. Three declarations filed December 30, 2016. Firm: Fish & Richardson. Parties settled as of May 2017 and IPR proceedings terminated.
>
> U.S. Patent 5,754,946. *Case nos. IPR2017-00536 and IPR2017-00537*. Two declarations filed December 29, 2016. Firm: Fish & Richardson. Parties settled as of May 2017 and IPR proceedings terminated.
>
> U.S. Patent 5,894,506. *Case nos. IPR2017-00532, IPR2017-00533, IPR2017-00534, and IPR2017-00535*. Four declarations filed December 28, 2016. Firm: Fish & Richardson. Parties settled as of May 2017 and IPR proceedings terminated.

Testifying expert for T-Mobile, non-infringement. U.S. Patent Nos. RE41,490, RE43,306, 5,790,793, 7,450,957, and 8,078,200. *Intellectual Ventures v. T-Mobile US*, case no. 1:13-cv-01632-LPS. Firm: Gibson Dunn. Expert report May 26, 2016. Deposed September 20, 2016. Parties settled.

Testifying expert for RPX, Inter Partes Review.

U.S. Patents 8,135,342 and 8,879,987. *Case nos. IPR2016-01052, IPR2016-01053, and IPR2016-01054*. Declaration filed May 17, 2016. Firm: Klarquist Sparkman. January 2017, all IPRs were instituted on a majority of the claims in the petitions, and patent owner ultimately canceled all instituted claims.

U.S. Patents 8,135,342 and 8,879,987. *Case nos. IPR2016-00985 and IPR2016-00989*. Declaration filed April 30, 2016. Firm: Klarquist Sparkman. January 2017, both IPRs were instituted on a majority of the claims in the petitions, and patent owner ultimately canceled all instituted claims.

Testifying expert for Microsoft, invalidity and non-infringement. U.S. Patents 6,346,047 and 6,684,062. *Eleven Engineering Inc. et al. v. Microsoft Corporation et al., Case No. 09-903-LPS (D. Del.).* Firm: Fish & Richardson. Plaintiff conceded to non-infringement based on claim construction July 2016 prior to report submission.

Testifying expert for LG Electronics, non-infringement. U.S. Patent 8,055,820. *Cellular Communication Equipment LLC v. LG Electronics, Inc., et al., Case no. 6:13-cv-00508 (EDTX)*. Firm: Mayer Brown. Case settled July 2016 prior to report submission.

Testifying expert for Amazon, Barnes & Noble, MediaTek, Nokia, Samsung, Texas Instruments, invalidity. U.S. Patent No. 5,487,069. *CSIRO v. MediaTek et al., Case No. 6:12-cv-578-LED-KNM*. Firms: Covington & Burling, O'Melveny & Myers, Quinn Emanuel Urquhart & Sullivan, White & Case. Report on invalidity December 19, 2014. Deposed March 6, 2015. Case settled July 2015.

Testifying expert for Apple, non-infringement (three patents) and invalidity (two patents). U.S. Patent Nos. 6,317,831, 6,647,260, and 6,532,446. *Unwired Planet v. Apple, case No. 13-cv-04134.* Firm: Gibson Dunn. Expert report on non-infringement January 12, 2015. Expert report on invalidity December 3, 2014; rebuttal-reply report on invalidity January 26, 2015. Deposed February 13, 2015. Case settled in April 2017.

Testifying expert for Apple, invalidity. U.S. Patent Nos. 7,555,267, 7,570,954, and 7,792,492. *GPNE v. Apple*, *case no. 12-CV-02885-LHK*. Firm: Fish & Richardson. Report on invalidity January 4, 2014. Deposed February 20, 2014. Testified in court October 17 and October 20, 2014. Jury verdict of non-infringement on all three patents.

Testifying expert for HTC, invalidity (one patent), in *Nokia v. HTC, ITC Investigation No. 337-TA-847*. Firm: White & Case. Report 2013. Patent withdrawn from dispute.

Other Patent-Litigation Testimony

Claim-construction declaration for Microsoft in *Eleven Engineering Inc. et al. v. Microsoft Corporation et al., No. 09-903-LPS (D. Del.)*, January 28, 2016. Case details above.

Claim-construction declaration for Apple in *Unwired Planet v. Apple*, April 7, 2014. Case details above.

Declaration *"In re Patent Application of Han-Jin JOH, 11/266,114."* Docket No. P2481US00, April 18, 2012. Firm: H.C. Park & Associates, PLC.

Declarations for Front Row Technologies in *Inter Partes Reexam. 95/001,565*, April 4, 2011; *95/001,568*, March 7, 2011; *95/001,566*, March 4, 2011. Firm: Black, Lowe & Graham PLLC.

Non-Patent Litigation Testimony

Testifying expert for Instant Checkmate, *Robert Fischer and Stephanie Lukis individually and on behalf of all others similarly situated v. Instant Checkmate LLC,* Civil action 1:19-cv-04892 (N.D. Ill.). Firm: Jenner & Block. Report September 17, 2021.

Testifying expert for Sprint, *Truckstop.net vs. Sprint Communicatio*ns, Case No. CV-04-561-S-BLW. Firm: Moffatt Thomas. Report March 31, 2006, supplemental report September 28, 2006. Deposed May 3, 2007. Worked on case 2005 to 2010.

Consulting Expert History

Twenty cases.

Law firms include: Axinn, Veltrop & Harkrider; Finnegan, Henderson, Farabow, Garrett & Dunner; Foley & Lardner; HC Park & Associates; Holland & Knight, Keker & Van Nest; King & Spalding; Kirkland & Ellis; Klarquist Sparkman; Maynard, Coper & Gale; Powell Gilbert; Simpson Thacher & Bartlett.

Clients include: Amazon, Apple, Huawei, Lenovo, Motorola, Nokia, Pantech, Research in Motion (RIM), Samsung, Sanyo, SkyTel (Verizon), Starent, Thales, and T-Mobile.

5. Public Speaking

Peter Rysavy has spoken at more than 60 public events, such as conferences, as a keynote presenter, moderator, and panelist. See https://rysavy.com/speaking/ for details.

6. Published Articles and Reports

The more-than-190 articles, reports, and white papers by Peter Rysavy, listed from most recent to oldest, include the following:

1. "5G Mid-Band Spectrum: The Benefits of Full Power, Wide Channels, and Exclusive Licensing," December 2022. Report published by CTIA.
2. "Lessons Learned from the CBRS Spectrum Experiment," April 2022. Article for Fierce Wireless.
3. "3G Shutdowns Should Not Be Delayed," February 2022. Article for Fierce Wireless.
4. "Rational Decisions Needed on C-band and Altimeters," November 2021. Article for Fierce Wireless.
5. "The Folly of Attempting to Future-proof Broadband," June 2021. Article for Light Reading.
6. "No Magic Spectrum Sharing Solutions," April 2021. Article for Fierce Wireless.
7. "5G Mid-Band Spectrum Deployment," February 2021. Rysavy Research Report.
8. "DoD's proposed 5G spectrum sharing fraught with problems," October 2020. Article for Fierce Wireless.

9. "Global 5G: Rise of a Transformational Technology," September 2020. Report published by 5G Americas.
10. "Latest Tech Aims to Solve Riddle for Rural Broadband," August 2020. Article for Fierce Wireless.
11. "6 GHz Should Be Allocated for Both Licensed and Unlicensed Applications," March 2020. Article for Light Reading.
12. "Virtualization Will Transform the Wireless Industry," December 2019. Article for Fierce Wireless.
13. "Global 5G: Implications of a Transformational Technology," September 2019. Report published by 5G Americas.
14. "How Title II Net Neutrality Undermines 5G," June 2019. Report published by Rysavy Research.
15. "How the 'Save the Internet' Act Breaks 5G," May 2019. Article for Bloomberg Law.
16. "Bad Idea of Nationalized 5G Network Put to Rest," April 2019. Article for Fierce Wireless.
17. "Untangling C-band for a New Broadband Future," January 2019. Article for Fierce Wireless.
18. "Broadband Disruption: How 5G Will Reshape the Competitive Landscape—Second Edition," November 2018. Report published by Datacomm Research.
19. "LTE to 5G: The Global Impact of Wireless Innovation," August 2018. Report published by 5G Americas.
20. "Mid-Band Spectrum for 5G Needed Now," August 2018. Article published by Fierce Wireless.
21. "Small Cells – Suddenly Essential," March 2018. Article published by RCR Wireless.
22. "How 5G Will Solve Rural Broadband," January 2018. Article published by Fierce Wireless.
23. "The Power of Wireless Broadband," November 2017. Report published by Rysavy Research.
24. "Broadband Disruption: How 5G Will Reshape the Competitive Landscape," August 2017. Report published by Datacomm Research.
25. "Why 5G Will Be a Game Changer," August 2017. Article published by Fierce Wireless.
26. "LTE to 5G: Cellular and Broadband Innovation," August 2017. Report published by 5G Americas.
27. Declaration of Peter Rysavy. Exhibit to CTIA Comments to Federal Communications Commission, WC Docket No. 17-108, Restoring Internet Freedom. 2017.
28. "How "Title II" Net Neutrality Undermines 5G," April 2017. Report published by Rysavy Research.

29. "Accelerating Innovation in Unlicensed Spectrum," November 2016. Article published by Fierce Wireless.
30. "IoT &5G: Wait or Move?" October 2016. Report published by Informa.
31. "Mobile Broadband Transformation," August 2016. Report published by 5G Americas.
32. "Threading the Spectrum Needle - Can LTE and Wi-Fi Coexist?" February 2016. Article published by Fierce Wireless.
33. "5G – Promises and Pitfalls," November 2015. Article published by RCR Wireless News.
34. "LTE and 5G Innovation: Igniting Mobile Broadband," August 2015. Report published by 4G Americas.
35. "Latest FCC Auction Shatters Spectrum Myths," January 2015. Article published by Gigaom.
36. "LTE Congestion Management - Enabling Innovation and Improving the Consumer Experience," January 2015. Report published by Mobile Future.
37. "Mobile Broadband Networks Should Not Be Hampered by Net Neutrality Constraints," September 2014. Article published by Fierce Wireless.
38. "How Wireless is Different - Considerations for the Open Internet Rulemaking," September 2014. Report for Mobile Future.
39. "Beyond LTE: Enabling the Mobile Broadband Explosion," August 2014. Report published by 4G Americas.
40. "Will LTE in Unlicensed Spectrum Unlock a Vast Store of Mobile Broadband Capacity?" June 2014. Article published by MIMO World.
41. "How will 5G compare to fiber, cable or DSL?" May 2014. Article published by Fierce Wireless.
42. "It's Time for a Rational Perspective on Wi-Fi," April 2014. Article published by Gigaom.
43. "Complexities of Spectrum Sharing - How to Move Forward," April 2014. Report published by Mobile Future.
44. "Canadian 700 MHz Auction: Analysis of Results." April 2014. Analysis of auction that concluded February 2014 in Canada.
45. "Challenges and Considerations in Defining Spectrum Efficiency," March 2014. Article for Proceedings of the IEEE.
46. "The High and Wide Future of Radio," March 2014. Column for Fierce Wireless.
47. "Uncertain Government Spectrum Policies Have Far-Reaching Consequences," November, 2013. Article for Bloomberg BNA Insights.
48. "Who Owns the Internet of Things?", September 2013. Column for Fierce Wireless co-authored with Chris Rezendes.

49. "Mobile Broadband Explosion - The 3GPP Wireless Evolution," August 2013. Report for 4G Americas.
50. "Learn How Technology Will Turn Less Desirable Airwaves into 'Beachfront' Spectrum," June 2013. Article for Gigaom.
51. "Efficiency of Spectrum Use," May 2013. Article for Fierce Wireless.
52. "2013 Mobile Commerce Survey," May 2013. Report for Information Week.
53. "Trends in Enterprise Cellular Network Data Usage," March 2013. Market research and report done in conjunction with NetMotion Wireless."
54. "White Spaces Networks Are Not "Super" Nor Even Wi-Fi," March 2013. Article for Gigaom.
55. "Mobile Commerce: State of the Market," February 2013. Coauthored report for Information Week.
56. "Vehicles and Mobility Are Converging but Fragmentation, Lack of Standards May Hinder Progress," February 2013. Column for Fierce Wireless.
57. "4G: Carriers, IT Pros Square Off," December 2012. Report for Information Week.
58. "Spectrum – All Options Essential, Including Incentive Auctions," December 2012. Blog for HighTech Forum.
59. "Spectrum Sharing with LTE is Conceivable But Not Trivial," November 2012. Column for Fierce Wireless.
60. "4G World: The Need For More Spectrum," October 2012. Column for Information Week.
61. "Spectrum Sharing Opens a Potential Attack Route," October 2012. Article for Giagaom.
62. "No Silver Bullets for FCC, NTIA Spectrum Challenge," September 2012. Article for Bloomberg BNA.
63. "Mobile Broadband Explosion – The 3GPP Wireless Evolution," September 2012. Report for 4G Americas.
64. "Spectrum Sharing – The Promise and The Reality," July 2012. Report for Mobile Future.
65. "Mobile Network Design and Deployment: How Incumbent Operators Plan for Technology Upgrades and Related Spectrum Needs," June 2012. Rysavy Research report.
66. "LTE: Huge Technology, Huge Challenges," March 2012. Report for Information Week.
67. "Wireless Spectrum Doomsday Looms," January, 2012. Column for InformationWeek.
68. "Unleashing the Wireless Power of Long-Term Evolution: Spectrum, and Lots of It," December 2011. Article for Bureau of National Affairs (BNA).
69. "Convergence of 3G/4G and Wi-Fi, October 2011. Report for InformationWeek.

70. "Comments on Citi 'Wireless Supply and Demand'," October 2011. Analysis and report.

71. "Mobile Broadband Explosion. 3GPP Broadband Evolution to IMT-Advanced (4G)," September 2011. Detailed report for 4G Americas.

72. "Public Safety Spectrum," July 2011. Analysis and report.

73. "Efficient Use of Spectrum," May, 2011. Report sponsored by CTIA, filed with the FCC.

74. "The Spectrum Imperative: Mobile Broadband Spectrum and its Impacts for U.S. Consumers and the Economy. An Engineering Analysis," March 2011. Report sponsored by Mobile Future.

75. "Application Mobilization: A Rapidly Changing Landscape," January 2011. Report published by Information Week.

76. "Smartphone Efficiency Report," January 2011. Rysavy Research report.

77. "Innovation Enabled by Mobile Wireless Network Management," Report sponsored by Mobile Future, filed with the FCC October, 2010.

78. "Strategic Use of Wi-Fi in Mobile Broadband Networks," October 2010, Rysavy Research white paper.

79. "Transition to 4G – 3GPP Broadband Evolution to IMT-Advanced," September 2010. Rysavy Research report for 4G Americas.

80. "Spectrum Shortfall Consequences," April 2010. Analysis written for CTIA and filed with the FCC.

81. "Beyond Smartphones," February, 2010. Article published by Information Week.

82. "Mobile Broadband Capacity Constraints And the Need for Optimization," February 2010. Rysavy Research report.

83. "The 2.6 GHz Spectrum Band - Unique Opportunity to Realize Global Mobile Broadband," December 2009. Report published by GSMA with Peter Rysavy providing the technology analysis on how best to manage the 2.6 GHz band.

84. "Net Neutrality Regulatory Proposals: Operational and Engineering Implications for Wireless Networks and the Consumers They Serve." Report sponsored by Mobile Future, filed with the FCC January, 2010.

85. "The Mobile Web Imperative," December 2010. Article published by Information Week.

86. "Air Pressure: Why IT Must Sort Out App Mobilization Challenges," October, 2009. Analytics report published by Information Week.

87. "Spectrum Crisis?" October, 2009. Article published by Information Week.

88. "HSPA to LTE-Advanced. 3GPP Broadband Evolution to IMT-Advanced (4G)" September 2009. Detailed report published by 3G Americas.

89. "3G Safeguards: Incomplete, Getting Better," May 2009. Article published by Information Week.

90. "Mobile Broadband Spectrum Demand," December 2008. Report commissioned by CTIA, released at CTIA Wireless March, 2009.

91. "Femtocells Suit Up For Work," January 2009. Article published by Information Week.

92. "Wireless E-Mail Efficiency Assessment," January 2009. Test report.

93. "HSUPA Gets Uploads Almost Up To Download Speeds," September 2008. Article published by Information Week.

94. "EDGE, HSPA and LTE - Broadband Innovation," September 2008. White paper, published by 3G Americas.

95. "Code of the Road," August 2008. Article published by Information Week.

96. "Global Mobile," May 2008. Article published by Information Week.

97. "GPS Performance," March 2008. Test report.

98. "Mobile Application Development Quick Start Guide," March 2008. White paper, published by AT&T.

99. "Harnessing Mobile Middleware", December 2008. White paper published by AT&T.

100. "Security Requirements for Wireless Networking," December 2007. White paper.

101. "Mobile Application Development Best Practices," September 2007. Peter Rysavy co-wrote this white paper, published by AT&T.

102. "EDGE, HSPA, LTE: The Mobile Broadband Advantage", September 2007, White Paper for 3G Americas

103. "Handheld Computing Evolution", June 13, 2007, Network Computing Mobile Observer

104. "Reach Me if You Can", article on wireless application deployment, May 2007, Network Computing Magazine

105. "Global Mobile", May 23, 2007, Network Computing Mobile Observer

106. "Wireless Networks, Wired Bottlenecks", May 2, 2007, Network Computing Mobile Observer

107. "Breaking the Gray Flannel Ceiling", article on mobile IM, April 2007, Network Computing Magazine

108. "QoS and VoIP With 3G: Not an Easy Marriage", Apr 11, 2007, Network Computing Mobile Observer

109. "Mobile Linux Puzzle - Coming Together." March 2007, Network Computing Magazine.

110. "Learning from Bluetooth", Mar 21, 2007, Network Computing Mobile Observer

111. "Disconnect!", Feb 28, 2007, Network Computing Mobile Observer

112. "EV-DO Rev A: Upping the Ante", Feb 7, 2007, Network Computing Mobile Observer

113. "IEEE 802.11n for the Enterprise—Not a Trivial Upgrade", Jan 17, 2007, Network Computing Mobile Observer

114. "Google Embraces Mobile", Dec 20, 2006, Network Computing Mobile Observer

115. "Using VPNs with Wireless Networks", Nov 29, 2006, Network Computing Mobile Observer

116. "Evolved EDGE and the Future of TDMA", Oct 18, 2006, Network Computing Mobile Observer

117. "Wireless E-Mail Efficiency Assessment." Oct 13, 2006. White paper that presents the results of a detailed engineering assessment to compare network efficiency of RIM Blackberry versus Microsoft Direct Push.

118. "Mobile Broadband: EDGE, HSPA & LTE", Sep 2006. White paper published by 3G Americas.

119. "Mobile Computing Policy and De-Perimeterization", Sep 27, 2006, Network Computing Mobile Observer

120. "Trials and Tribulations in Assessing Wireless Network Performance", Sep 6, 2006, Network Computing Mobile Observer

121. "Time to Decide", article on wireless networking, Aug 31, 2006, Network Computing Cover Story

122. "Sprint Nextel, WiMAX and the Mobile Broadband Conundrum", Aug 16, 2006, Network Computing Mobile Observer

123. "Wide-Area Wireless—The Next Five Years", Jul 26, 2006, Network Computing Mobile Observer

124. "Anatomy of a Well-Designed Wireless Application", Jul 5, 2006, Network Computing Mobile Observer

125. "Wireless Network Assessment, EVDO and WiFi Hotspots." A detailed test report on the relative performance of CDMA2000 EVDO and WiFi hotspots. March 21, 2006.

126. "Using Your Cell Phone as a Modem", Jun 14, 2006, Network Computing Mobile Observer

127. "Convergence Update: IMS and UMA", May 24, 2006, Network Computing Mobile Observer

128. "Mobile Broadband - Trying to Catch a Fast-Moving Target", May 3, 2006, Network Computing Mobile Observer

129. "Integrated Voice/Data in 3G", Apr 12, 2006, Network Computing Mobile Observer

130. "Mobile Middleware in the Broadband Era", Mar 22, 2006, Network Computing Mobile Observer

131. "Figuring Out Metro Wi-Fi", Mar 1, 2006, Network Computing Mobile Observer

132. "Sprint Nextel's Jump to the Future", Feb 8, 2006, Network Computing Mobile Observer

133. "The Smartphone Conundrum", Jan 18, 2006, Network Computing Mobile Observer

134. "Municipal and Mesh Wi-Fi", Dec 21, 2005, column, Network Computing Mobile Observer

135. "Linksys WRT54G -- Not What It Used to Be", Nov 30, 2005, column, Network Computing Mobile Observer

136. "Confusion About 4G", Nov 9, 2005, column, Network Computing Mobile Observer

137. "Strong Capabilities, Difficult Decisions", Oct 27, 2005, article, Network Computing Magazine

138. "Hard Numbers and Experts' Insights on Migration to Evolved 3G and 4G Wireless Technology", Oct, 2005, updated public report, published by Datacomm Research

139. "Wireless Data Pricing--One Hundred Times Less Expensive and Still Not Satisfied", Oct 19, 2005, column, Network Computing Mobile Observer

140. "Secure Mobile Access Using SSL VPNs", Oct 2005, white paper, published by Aventail

141. "Embedded Wireless WAN", Sep 28, 2005, column, Network Computing Mobile Observer

142. "Redefining the Endpoint--Wireless Broadband Routers", Sep 7, 2005, column, Network Computing Mobile Observer

143. "Data Capabilities: GPRS to HSDPA and Beyond", Sep 2005, white paper, published by 3G Americas

144. "High Speed Downlink Packet Access (HSDPA)", Aug 17, 2005, column, Network Computing Mobile Observer

145. "The Uneven Uptake of Wireless Data", Jul 21, 2005, column, Network Computing Mobile Observer

146. "Where is WiMAX?", Jul 6, 2005, column, Network Computing Mobile Observer

147. "Mobile Broadband and the Multi-Network Path to 4G", Jul 2005, article, WiMAX Business and Technology Strategies

148. "Freed Up or Tied Down", Jul 21, 2005, article, Network Computing Magazine

149. "Wireless E-Mail for the Masses, Jun 15, 2005, column, Network Computing Mobile Observer

150. "Parallel Mobile Universes", May 25, 2005, column, Network Computing Mobile Observer

151. "Beyond the Airlink- IP Multimedia Subsystem", May 4, 2005, column, Network Computing Mobile Observer

152. "Secure Wireless Networking Using SSL VPNs", May 2005, white paper, published by Aventail

153. "3 Sides to 3G", Apr 13, 2005, column, Network Computing Mobile Observer

154. "Hard Numbers and Experts' Insights on Migration to Evolved 3G and 4G Wireless Technology", Feb, 2005, public report, published by Datacomm Research

155. "Forever Evolving", Oct 14, 2004, article, Network Computing Magazine

156. "Data Capabilities: GPRS to HSDPA", Sep 2004, white paper, published by 3G Americas

157. "Brush up on Bluetooth", Jun 24, 2004, article, Network Computing Magazine

158. "Policing the Airwaves", May 7, 2004, article, Secure Enterprise Magazine

159. "Device Drivers (Smartphones and Wireless PDAs)", Apr 15, 2004, article, Network Computing Magazine

160. "Making the Smart Choice (Smartphone and Wireless PDA Platform Review), Apr 15, 2004, article, Network Computing Magazine

161. "Wireless Instant Messaging: Propelling SMS and Desktop IM to the Next Level", Oct 27, 2003, public report, published by Datacomm Research

162. Common Goals, Unique Strengths – Survey of Hotspot Operators, May 15, 2003, article, Network Computing Magazine

163. "Data Capabilities for GSM Evolution to UMTS", Nov 19, 2002, white paper, published by 3G Americas.

164. "Wireless Nirvana", Oct 21, 2002, article, Network Computing Magazine

165. "Voice Capacity Enhancements for GSM Evolution to UMTS", Jul 18, 2002, white paper, published by 3G Americas.

166. "Networking Standards and Wireless Networks", 2002, white paper, published by NetMotion Wireless

167. "Public Wireless LANs: Challenges, Opportunities and Strategies", Jul 9, 2001, public report, published by Datacomm Research

168. "Break Free With Wireless LANs", Oct 29, 2001, article, Network Computing Magazine

169. "MMDS Struggles to Find a Foothold", Oct 29, 2001, article, Network Computing Magazine

170. "Can MWIF Unify Cellular Protocols?", May 2001, column, M-Business Magazine

171. "M-Wallets: Not Ready Yet", Apr 2001, column, M-Business Magazine

172. "AT&T's GSM Move Could Ignite U.S. Market", Mar 2001, column, M-Business Magazine, March 2001

173. "Lessons From I-Mode", Feb 2001, column, M-Business Magazine

174. "E-Commerce Unleashed", Jan 22, 2001, article, Network Computing Magazine

175. "Mobile-Commerce ASPs Do the Legwork", Jan 22, 2001, article, Network Computing Magazine.

176. "Big Step to Mobile Payments", Jan 2001, column, M-Business Magazine.

177. "Emerging Technology: Clear Signals for General Packet Radio Service", Dec 2000, article, Network Magazine.

178. "WAP: Untangling the Wireless Standard", Nov 2000, article, Network Computing Magazine

179. "The Road to a Wireless Future", Oct 30, 2000, article, Network Computing Magazine

180. "Wireless Wonders (HiperLAN and Bluetooth) Coming Your Way", May 2000, article, Network Magazine.

181. "Managing Mobile Code", Aug 23, 1999, online manual, Network Computing Magazine.

182. "The Evolution of Cellular Data: On the Road to 3G", 1999, article published by Intel "On The Road To PCS", February 15, 1996, article, Network Computing Magazine.

183. "Wireless IP - A Case Study", Apr 30, 1999, article, PCS Data Today online journal

184. "Broadband Wireless: Now Playing in Select Locations", Oct 7, 1999, article, Data Communications Magazine

185. "Satellite Services: Don't Join the Space Race", Sep 21, 1999, column, Data Communications Magazine

186. "Making the Case for Fixed Wireless Technology", Jul 1999, column, Data Communications Magazine

187. "Wireless IP: Ready to Lift Off?", Mar 1999, column, Data Communications Magazine.

188. "Planning and Implementing Wireless LANS", 1999, online manual, Network Computing Magazine.

189. "Wireless Broadband and Other Fixed-Wireless Systems", 1998, online manual, Network Computing Magazine.

190. "General Packet Radio Service (GPRS)", September 30, 1998, GSM Data Today online journal.

191. "Wide-Area Wireless Computing", 1997, online manual, Network Computing Magazine.

192. "Internet-To-Go, Now With Mobile IP", November 1, 1997, article, Network Computing Magazine.

193. "Making The Call With Two-Way Paging", January 15, 1997, article, Network Computing Magazine.

194. "Cellular Data Communications Made Easy", July 1, 1997, article, Network Computing Magazine.

195. "Wireless Data Made To Order", March 15, 1996, article, Network Computing Magazine.

196. "TCP/IP: The Best Protocol for Remote Computing", public white paper, WRQ. 1996.

197. "Message Middleware In A Wireless Environment", April 15, 1996, article, Network Computing Magazine.

198. "On The Road To PCS", Feb 15, 1996, article, Network Computing Magazine

199. "The ABCs of PCS," Nov 7, 1994, article, Network World.

7. **Wireless Courses**

The following lists the public courses that Rysavy Research has taught. These are listed in the order of most recent to oldest. Rysavy Research has also privately taught on wireless technology at AT&T, Bluetooth SIG, Cingular Wireless, Cricket Communications, Intel, Medtronic, Microsoft, NetMotion Wireless, RIM, Tektronix, Teledyne, T-Mobile, and the U.S. Department of Defense.

1. Interop Conference, Las Vegas, May 2013. "Wireless Everywhere: LTE and Beyond," 1 hour course.
2. Bellevue, WA, April 2013. "4G: Deep Technology Insights," full-day course.
3. Interop Conference, Las Vegas, May 2012. "LTE Update," one-hour course.
4. Bellevue, WA, April 2012. "Mobile Broadband Explosion," full-day course.
5. Redmond, WA, December 2010. "Mobile Broadband - Technology Evolution and Strategic Considerations," full-day course.
6. Portland, OR, November 2010. "Mobile Broadband - Technology Evolution and Strategic Considerations," full-day course.
7. AT&T Developer Program, March 2010, "Guidelines for Delivering Streaming Services on AT&T's Wireless Network," one-hour webcast.
8. Bellevue, WA, Oct 2009. "Mobile Broadband - Entering the 4G Decade," 1.5-hour session at IEEE Wireless Workshop.
9. Bellevue, WA, Apr 2009. Portland, OR, May 2009. "Mobile Broadband Innovation - 3G to 4G Evolution and Impacts," full-day course.

10. 3G Americas, Dec 2008, "EDGE, HSPA, LTE - Broadband Innovation," one-hour webcast.
11. AT&T Developer Program, August 2008, "Broadband Innovation - Applications for New Broadband Networks," one-hour webcast.
12. AT&T Developer Program, June 2008, "Emerging Mobile Application Architectures," one-hour webcast.
13. AT&T Developer Program, March 2008, "Understanding Mobile Application Development Environments: Open Platforms, Tools, Capabilities, Developer Strategies," one-hour webcast.
14. AT&T Developer Program, Dec 2007, "Harnessing Mobile Middleware - Architectures, Functions and Integration," one-hour webcast.
15. AT&T Developer Program, Sep 2007, "Best Practices for Mobile Application Development - Strategies, Considerations, and Techniques for Optimal Development," one-hour webcast.
16. AT&T Developer Program, Apr 2007, "How Enterprises Can Get Ready for IP Multimedia Subsystem (IMS): IMS Strategies and Application Development Approaches," one-hour webcast.
17. Bellevue, WA, May 2006, "Evolution of Mobile Broadband", full-day course.
18. Portland State University, Apr 2006, "Wireless Technology Advances: Wi-Fi, 3G, WiMAX, Mobile Broadband", full-day course.
19. Portland State University, Sep 2005, "3G, Evolved 3G, 4G and WiMAX", full-day course.
20. Bellevue, WA, April 2005, "Wireless Technology Advances", full-day course.
21. CTIA Wireless Data University, Mar 2005, "Wi-Fi and WiMAX in Detail", half-day course.
22. Portland State University, Jan 2005, "Wi-Fi Technology - Evolution and Integration", full-day course.
23. CTIA Wireless Data University, Oct 2004, Wi-Fi - Technology, Evolution, Adoption and Hotspots, Added Section: WiMAX", half-day course.
24. Portland State University, Jun 2004, "3G, WiMAX and other Wide-Area Broadband Wireless Networks", full-day course.
25. CTIA Wireless Data University, Mar 2004, "Wi-Fi - Technology, Evolution, Adoption and Hotspots", half-day course.
26. Portland State University, Nov 2003, "Wi-Fi - Evolution, Adoption and Hotspots", full-day course.
27. CTIA Wireless Data University, Oct 2003, "Wi-Fi Technology - Evolution, Adoption and Hotspots", half-day course.
28. IEEE Wireless LAN Conference, 2002, "Wireless LAN Business and Marketing Issues", one-hour presentation.

29. Portland State University, 2002, "WLANs, 3G Cellular and Beyond", two-day course.
30. Portland State University, 2001, "Next Generation Cellular Data", full-day course.
31. CMP Web 2001, "The Wireless Web in Detail", full-day course.
32. IEEE Chapter Evening Presentation, 2001, "Wireless Networking Advances - Setting Reasonable Expectations", two-hour presentation.
33. UCLA, 2001, "Wireless Data Systems", full-day course.
34. CMP Web 2000, "Wireless Data Networks", full-day course.
35. UCLA, 2000, "Wireless Data Systems", two-day course.
36. UCLA, 1999, "New Third Generation Cellular, Digital PCS and Broadband Mobile Data - What Will Dominate?", four-day course co-taught with C. R. Baugh Ph.D.
37. Portable Design Conference, 1999, "Wireless Data Integration", full-day course.
38. Northcon, 1998, "Wireless Data Networking Advances", full-day course.
39. UCLA, 1998, "Technologies for Wireless Competitive Markets: Cellular, PCS and Wireless Data", four-day course co-taught with C. R. Baugh Ph.D.
40. UCLA, 1997, "Cellular, PCS and Wireless Data Technology", four-day course co-taught with C. R. Baugh Ph.D.
41. UCLA, 1996, "Wireless Voice And Data Communications (Personal Communications Services, Digital Cellular, and Wireless Data)", four-day course co-taught with C. R. Baugh Ph.D.
42. UCLA, 1995, "Wireless Voice and Data Communications (Personal Communications Services, Digital Cellular, and Wireless Data)", four-day course co-taught with C. R. Baugh Ph.D.
43. UCLA, 1994, "Wireless Voice and Data Communications (Personal Communications Services, Digital Cellular, and Wireless Data)", four-day course co-taught with C. R. Baugh Ph.D.

CV Version of June 12, 2023