

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

ONEPLUS TECHNOLOGY (SHENZHEN) CO., LTD.,
Petitioners,

v.

PANTECH CORPORATION,
Patent Owner

IPR2025-00762

U.S. Patent No. 10,863,573

**DECLARATION OF DR. PAUL MIN
IN SUPPORT OF PATENT OWNER'S RESPONSE TO PETITION
FOR *INTER PARTES* REVIEW OF U.S. PATENT NO. 10,863,573**

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PATENT OWNER'S EXHIBIT LIST

Exhibit Number	Description
2001	Second Amended Docket Control Order, <i>Pantech Corporation and Pantech Wireless, LLC v. OnePlus Technology (Shenzhen) Co., Ltd.</i> , No. 5:24-CV-00038-RWS-JBB (E.D. Tex.) (Dkt. 58) (May 13, 2025)
2002	United States District Courts – National Judicial Caseload Profile
2003	Pantech Corporation's July 9, 2021 Notice Letter to OnePlus Technology Co., Ltd.
2004	Third Amended Docket Control Order, <i>Pantech Corporation and Pantech Wireless, LLC v. OnePlus Technology (Shenzhen) Co., Ltd.</i> , No. 5:24-CV-00038-RWS-JBB (E.D. Tex.) (Dkt. 86) (July 17, 2025)
2005	Order Modifying Dates in Docket Control Order, <i>Pantech Corporation and Pantech Wireless, LLC v. OnePlus Technology (Shenzhen) Co., Ltd.</i> , No. 5:24-CV-00038-RWS-JBB (E.D. Tex.) (Dkt. 85) (July 17, 2025)
2006	Jury Verdict, <i>Pantech Corp. v. OnePlus Technology (Shenzhen) Co., Ltd.</i> , No. 5:22-cv-00069-RWS (E.D. Tex.) (Dkt. 259) (April 1, 2024)
2007	Final Judgment, <i>Pantech Corp. v. OnePlus Technology (Shenzhen) Co., Ltd.</i> , No. 5:22-cv-00069-RWS (E.D. Tex.) (Dkt. 499) (Jan. 23, 2025)
2008	Kiri Gupta & Urska Petrovcic, <i>Evidence of Systematic "Patent Holdout"</i> , 38 Berkeley Tech. L. J. (2023)
2009	Richard A. Epstein & Kayvan B. Noroozi, <i>Why Incentives for "Patent Holdout" Threaten to Dismantle FRAND, and Why It Matters</i> , 32 Berkeley Tech. L.J. 1381 (2017)
2010	Kalyan Dasgupta & David J. Teece, <i>Protecting Innovation in the Mobile Wireless Ecosystem: Understanding & Addressing "Hold-Out"</i> , 38 Berkeley Tech. L.J. 313 (2023)

2011	Claim Construction Order from <i>Pantech Corp. et al. v. OnePlus Tech. (Shenzhen) Co., Ltd.</i> , No. 5:24-cv-00038-RWS-JBB (E.D. Tex.)
2012	Declaration of Dr. Paul Min in Support of Patent Owner's Response
2013	Transcript of December 18, 2025 Deposition of Dr. Titus Lo
2014	Certified English translation of KR-10-2013-0053408
2015	U.S. Patent Application Publication No. 2016/0113058

LISTING OF CHALLENGED CLAIMS

Claim	Claim Text
1[pre]	A method for user equipment receiving multi-flow data with respect to one evolved packet system (EPS) bearer through a macro base station (macro eNB) and a small base station (small eNB) serving a single cell in a wireless communication system supporting dual connectivity, the method comprising:
1[a]	receiving packet data convergence protocol (PDCP) packet data units (PDUs) through the macro base station and the small base station;
1[b]	obtaining PDCP service data units (SDUs) corresponding to the PDCP PDUs; and
1[c]	receiving from the macro base station information related to an in-sequence timer for the PDCP SDUs through a radio resource control (RRC) message,
1[d]	wherein the PDCP SDUs are indicated by a predefined PDCP sequence number (SN),
1[e]	wherein the RRC message includes a PDCP-configuration information element (IE), and
1[f]	the PDCP-configuration IE includes a field indicating a value of the in-sequence timer.
2	The method of claim 1, further comprising: confirming the respective PDCP SNs of the obtained PDCP SDUs and performing in sequence delivery of the PDCP SDUs to an

	upper layer from a PDCP entity according to the PDCP SN.
3[a]	The method of claim 2, further comprising: confirming whether there is a PDCP SDU of PDCP SN #n-1 which is missed notwithstanding obtaining a PDCP SDU of PDCP SN #n; and
3[b]	driving the in-sequence timer with respect to the PDCP SDU of PDCP SN #n when there is the PDCP SDU of PDCP SN #n-1 which is missed.
4[a]	The method of claim 3, wherein before the in-sequence timer for the PDCP SDU of PDCP SN #n has expired, when the PDCP SDU of PDCP SN #n-1 is obtained,
4[b]	the PDCP SDU of PDCP SN #n-1 and the PDCP SDU of PDCP SN #n are delivered to the upper layer according to the order of the PDCP SN.
5	The method of claim 2, wherein when the in-sequence timer for the PDCP SDU of PDCP SN #n has expired, the PDCP SDU of PDCP SN #n is delivered to the upper layer of the PDCP entity even though there is no PDCP SDU of PDCP SN #n-1.
8[pre]	A user equipment (UE) for receiving multi-flow data with respect to one evolved packet system (EPS) bearer through a macro base station (macro eNB) and a small base station (small eNB) serving a single cell in a wireless communication system supporting dual connectivity, the UE comprising:
8[a]	a receiving unit receiving packet data convergence protocol

	(PDCP) packet data units (PDUs) through the macro base station and the small base station and
8[b]	receiving from the macro base station information related to in-sequence timer for the PDCP SDUs through a radio resource control (RRC) message; and
8[c]	a processor obtaining PDCP service data units (SDUs) corresponding to the PDCP PDUs,
8[d]	wherein the PDCP SDUs are indicated by a predefined PDCP sequence number (SN),
8[e]	wherein the RRC message includes a PDCP-configuration information element (IE), and
8[f]	the processor determines the value of in-sequence timer based on the PDCP-configuration IE.
9[a]	The UE of claim 8, wherein the processor confirms the processor confirms the respective PDCP SNs of the obtained PDCP SDUs and
9[b]	performs in-sequence delivery of the PDCP SDUs to an upper layer from a PDCP entity according to the PDCP SN.
10[a]	The UE of claim 9, wherein the processor confirms whether there is a PDCP SDU of PDCP SN #n-1 which is missed notwithstanding obtaining a PDCP SDU of PDCP SN #n; and
10[b]	drives the in-sequence timer with respect to the PDCP SDU of PDCP SN #n when there is the PDCP SDU of PDCP SN #n-1 which is missed.

11	The UE of claim 10, wherein the processor delivers, when the in-sequence timer for the PDCP SDU of PDCP SN #n has expired, the PDCP SDU of PDCP SN #n to the upper layer of the PDCP entity even though there is no PDCP SDU of PDCP SN #n-1.
12	The UE of claim 10, wherein the processor delivers, before the in-sequence timer for the PDCP SDU of PDCP SN #n has expired, when the PDCP SDU of PDCP SN #n-1 is obtained, the PDCP SDU of PDCP SN #n-1 and the PDCP SDU of PDCP SN #n to the upper layer according to the order of the PDCP SN.

I. INTRODUCTION

1. My name is Dr. Paul Min. I have been asked by Patent Owner, Pantech Corporation (“Pantech”), to provide my opinion as to the patentability of claims 1-5 and 8-12 (“Challenged Claims”) of U.S. Patent No. 10,863,573 (“’573 Patent”) (EX1001). I have also been asked to provide my understanding of the claim construction and level of ordinary skill in the art related to this patent, as well as to explain the relevant technical background related to this patent.

2. Depending on new information learned during this proceeding, or positions taken throughout this IPR by Petitioner or its expert, 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.

3. If called upon to do so, I am prepared to testify regarding my opinions expressed here.

II. BACKGROUND AND QUALIFICATIONS

4. I am an expert in the field of high-speed telecommunications and computing, and the development of electronic devices and software systems and for the related applications. I am currently a Senior Professor in the Department of Electrical and Systems Engineering at Washington University in Saint Louis.

5. I received a B.S. degree in Electrical Engineering in 1982, an M.S. degree in Electrical Engineering in 1984, and a Ph.D. degree in Electrical

Engineering in 1987 from the University of Michigan in Ann Arbor. I received several academic honors, including my B.S. degree with honors, a best graduate student award and a best teaching assistant award during my M.S. study, and a best paper award from a major international conference for reporting results from my Ph.D. thesis.

6. After receiving my Ph.D., I worked at Bellcore in New Jersey from August 1987 until August 1990. At Bellcore, I was responsible for evolving the public switched telephone network (PSTN) into a multi-services voice and data network that incorporated packet switches, optical technologies, and wireless technologies. I received an Outstanding Achievement Award for my contributions to Bellcore in 1989.

7. In September 1990, I joined the faculty at Washington University in St. Louis. Upon arriving at Washington University, I developed a communication and computer curricula in the School of Engineering and Applied Science. I regularly teach undergraduate and graduate courses. In July 1996, I was promoted to an Associate Professor of Electrical Engineering with tenure. I am currently a Senior Professor of Electrical and Systems Engineering at Washington University. I have served as the Chair of the Graduate Curriculum (2000–2002) and the Chair of the Undergraduate Curriculum (2011–2014) for the Department of Electrical and

Systems Engineering.

8. At Washington University, I have conducted research in communication, computing, and related electronic hardware and software. My research group has pioneered a new paradigm for computing and communication systems that can alleviate the speed and performance mismatch against optical technology. I have received several grants from U.S. Federal Agencies, including the National Science Foundation (NSF), the Defense Advanced Research Project Agency (DARPA), and the Air Force Office of Scientific Research (AFOSR), and numerous contracts from companies and organizations around the world.

9. In addition, my research group at Washington University has significantly contributed to development of future generations of wireless technology. We developed methods that enable coordinated transmission and reception of wireless signals among multiple base stations. Previously, radio signals from multiple base stations were considered as interference. Leveraging our research, a cluster of base stations can work together as a single resource enhancing the quality of radio signals across extremely noisy wireless channels.

10. I developed and implemented a number of semiconductor integrated circuit chips. These integrated circuit chips include switch fabrics, processors, high speed interfaces, protocol transposers, controllers, content search engines, look up

table processors, and memory cells and arrays.

11. I have researched a variety of technologies for the packet switches and routers including packet scheduler, traffic shaper, traffic policing, buffer management, and interposer. In addition, I have researched and implemented various look-up table configurations for fast packet processing, which is particularly applicable to the Multi Protocol Label Switching or MPLS. Moreover, since mid 1990s, I have been researching and developing various security technologies such as the deep packet inspection, content searching and matching, regular expression processing, etc.

12. As a faculty member at Washington University, I have taught a number of courses in electronics, communication, and computing at both the undergraduate and graduate levels. For example, I have taught Electronics (Washington University ESE 232), Communication Theory (Washington University ESE 471), Transmission and Multiplexing (Washington University ESE 571), and Signaling and Control of Communication Networks (Washington University ESE 572).

13. I have directly supervised numerous graduate students, a number of whom received a doctoral degree under my guidance. A number of doctoral theses that I have supervised relate specifically to the aforementioned-communication and computing technologies related to this proceeding. My students and I have published

a number of peer-reviewed articles in these topics.

14. In addition to my responsibilities as a university faculty member, I have founded two companies. In May 1997, I founded MinMax Technologies, Inc., a fabless semiconductor company that developed switch fabric integrated circuit chips for the Internet. In March 1999, I founded Erlang Technology, Inc., a fabless semiconductor company that focused on the design and development of integrated circuit chips and software for the Internet. One of Erlang's products received a best product of the year award in 2004 from a major trade journal for the electronics industry.

15. Outside my own start-up companies, I have also served in various technology and business advisor roles for other companies and organizations around the world. I was the main technical author for one of two winning proposals to the Korean government for CDMA wireless service licenses (1996). I was responsible for designing a commercial scale IS-95 CDMA cellular network, which I understand to be one of the earliest such networks deployed in the world. I worked with numerous engineers and scientists around the world to implement this commercial-scale cellular network before IS-95 CDMA was widely accepted. This provided me with extensive insight into various components of commercial-scale communication technology used today. I have also been involved in a semiconductor company that

specializes in semiconductor memories, such as flash EEPROMs, as a board member and as a technical advisor (2007–2011).

16. I am a named inventor on eleven U.S. patents. I have authored and co-authored numerous technical papers and memoranda, many of which have appeared in various peer-reviewed international journals and conferences. I have given more than 100 seminars and invited talks around the world. I have organized several international conferences and served as an international journal editor.

17. I am a member of, and have been actively involved in, a number of professional organizations. I have served as the Chair of the St. Louis Section of the IEEE, which has more than 3,000 members (2014), and a member of the Eta Kappa Nu Honor Society for electrical engineers. I have also been an Ambassador of the McDonnell International Scholars Academy (2007–2013).

18. I was a member of the Presidential Business Advisors Committee (to President George W. Bush) and was named 2002 Businessman of the Year by the Wall Street Journal for the State of Missouri, for my entrepreneurial efforts.

19. I have received multiple awards for my publications and contributions to technical communication systems. In 1988, I received the Best Paper Award at 18th ISATA Award of Technical Excellence in Florence, Italy. I was also a Rockwell Fellow at the University of Michigan in Ann Arbor in 1988 and 1989. I received a

Research Initiation Award in 1993 from the Defense Advance Research Project Agency (DARPA). I received the Best Paper Award at MOBILITY 2011 in Barcelona, Spain. In my nearly 40 years of professional experience, I have acquired significant knowledge about telecommunications, computer, and electronics industry standards and standard setting organizations such as ANSI, IEEE, ITU, IETF, and 3GPP.

20. Additional details of my education and work experience, awards and honors, and publications that may be relevant to the opinions I have formed are set forth in my curriculum vitae. *See* Appendix A.

III. UNDERSTANDING OF LEGAL STANDARDS

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

22. 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.

A. Claim Construction

23. 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.

24. 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.

25. 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.

26. 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.

B. Presumption of Validity

27. I understand that all patents enjoy a presumption of validity. In other words, patents are presumed to have been correctly issued by the United States Patent and Trademark Office after undergoing a rigorous examination process that often lasts for years.

28. For this reason, I understand that Petitioner's burden to show invalidity of the '573 Patents' claims is a high one. Specifically, I am informed that the burden for proving a patent claim is invalid is by the "preponderance of the evidence."

C. Obviousness

29. I understand that a patent claim can be invalid under 35 U.S.C. § 103 if the claimed subject matter would have been "obvious" to a person of ordinary skill in the art as of the priority date of the patent based upon one or more prior art references. I understand that an obviousness analysis should consider each of the following so-called "*Graham* factors": (1) the scope and content of the prior art; (2) the differences between the claims and the prior art; (3) the level of ordinary skill in the pertinent art; and (4) secondary considerations, if any (such as unexpected results, commercial success, long felt but unsolved needs, failure of others, copying by others, licensing, and skepticism of experts).

30. I understand that a conclusion of obviousness may be based upon either a single prior art reference or a combination of prior art references, particularly if

the combination of elements does no more than yield predictable results. However, I understand that merely demonstrating that each of the claim elements was, independently, known in the prior art does not prove that a patent composed of several claim elements is obvious.

31. Moreover, I understand that it can be important to identify a reason that would have prompted a person of ordinary skill in the relevant field to combine the elements in a way the claimed new invention does.

32. I further understand that, to determine obviousness, courts look to the interrelated teachings of multiple patents or other prior art references, the effects of demands known to the design community or present in the marketplace, and the background knowledge possessed by a person having ordinary skill in the art.

33. I also understand that, in determining whether a combination of prior art references renders a claim obvious, it may be helpful to consider whether there is some teaching, suggestion, or motivation to combine the references and a reasonable expectation of success in doing so. I understand, however, that the teaching, suggestion, or motivation to combine inquiry is not required and may not be relied upon in lieu of the obviousness analysis outlined above.

34. I understand that the following exemplary rationales may lead to a conclusion of obviousness: the combination of prior art elements according to

known methods to yield predictable results; the substitution of one known element for another to obtain predictable results; and the use of known techniques to improve similar devices in the same way.

35. However, a claim is not obvious if the improvement is more than the predictable use of prior art elements according to their established functions. Similarly, a claim is not obvious if the application of a known technique is beyond the level of ordinary skill in the art.

36. Further, when the prior art teaches away from combining certain known elements, discovery of successful means of combining them is not obvious. I understand that similar subject matter may not be sufficient motivation for a person of skill in the art to combine references if the references have conflicting elements.

37. I understand that, in order to be used in an obviousness combination, a prior art reference must be “analogous.” I understand that a prior art reference may be analogous if it is in the same field of endeavor as the other references with which it is combined, or if the reference is reasonably pertinent to the solving the problems the inventors of the patent-at-issue sought to solve.

38. I understand that obviousness of a patent claim cannot properly be established through hindsight, and that elements from different prior art references, or different embodiments of a single prior art reference, cannot be selected to create

the claimed invention using the invention itself as a roadmap. I understand that the claimed invention as a whole must be compared to the prior art as a whole, and courts must avoid aggregating pieces of prior art through hindsight that would not have been combined absent the inventor's insight.

39. I understand that obviousness is not established by simply combining previously known elements from the prior art. A patent composed of several elements is not proved obvious merely by demonstrating that each of its elements was, independently, known in the prior art. An invention is unpatentable as obvious if the differences between the patented subject matter and the prior art would have been obvious at the time of invention to a person of ordinary skill in the art.

40. I understand that obviousness of a patent cannot properly be established by mere conclusory statements. Instead, there must be some articulated reasoning with some rational underpinning to support the legal conclusion of obviousness. When an expert opines that all the elements of a claim disparately exist in the prior art, the expert should provide the rationale to combine the disparate references. A reason for combining disparate prior art references is a critical component of an obviousness analysis. The obviousness analysis should be made explicit and needs to provide an articulated reasoning with some rational underpinning to identify the reason that would have prompted a person of ordinary skill in the relevant field to

combine the elements in the way the claimed new invention does.

41. I also understand that inventions in most, if not all, instances rely upon building blocks long since uncovered, and claimed discoveries almost of necessity will be combinations of what, in some sense, is already known. This is another reason why merely pointing to the elements being known in the art in separate locations is not the end of the obviousness inquiry.

42. I understand that technical experts may testify to matters like the level of skill in the art at the time of the invention and what a skilled artisan might find obvious in light of the prior art without addressing objective indicia of non-obviousness. However, where an expert purports to testify not just to certain factual components underlying the obviousness inquiry, but to the ultimate question of obviousness, the expert must consider all factors relevant to that ultimate question, including all objective evidence of nonobviousness.

D. Secondary Considerations

43. I understand that one of the so-called *Graham* factors that must be considered in determining obviousness is the existence of any secondary considerations, which tend to show that a patent claim is not obvious. Such secondary considerations of nonobviousness of a patent include: (1) long-felt and unmet need in the art that was satisfied by the claimed invention of the patent; (2)

failure of others to achieve the results of the claimed invention; (3) commercial success or lack thereof of the products and processes covered by the claimed invention; (4) deliberate copying of the claimed invention by others in the field; (5) taking of licenses under the patent by others; (6) whether the claimed invention was contrary to the accepted wisdom of the prior art; (7) expression of disbelief or skepticism by those skilled in the art upon learning of the claimed invention; (8) unexpected results achieved by the claimed invention; (9) praise of the claimed invention by others skilled in the art; and (10) lack of contemporaneous and independent invention by others.

44. I understand that each of these considerations may form an independent basis for nonobviousness of a patent. I also understand that the fact that another person simultaneously and independently created the same invention claimed in an asserted patent can serve as an indication that the invention was obvious.

45. I also have been informed by counsel that there must be a nexus between any such secondary considerations and the claimed invention.

IV. MATERIALS CONSIDERED

46. I considered the following materials at the time I formed my opinions set forth herein. Among those materials are the '573 Patent (EX1001); the file history of the '573 Patent (EX1002); the Petition (Paper 2) and all accompanying exhibits,

including Dr. Titus Lo's declaration (EX1003); the Institution Decision (Paper 10); all other papers and exhibits filed in this IPR; the deposition transcript of Petitioner's expert, Dr. Titus Lo (EX2013); and other materials that I specifically cite to and mention throughout my declaration.

47. In addition to these materials, I also relied upon my extensive experience and expertise in electrical engineering and telecommunications technology as discussed above. In forming my opinions, I have also taken into account the knowledge and background principles that a person of ordinary skill in the art would be familiar with, as well as my experience and training in the field of art.

V. OVERVIEW OF THE '573 PATENT

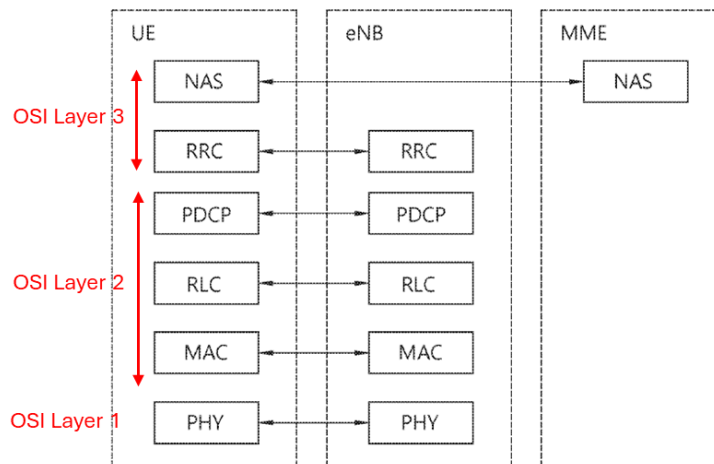
A. Background

48. The '573 Patent, titled "Method And Apparatus For Sequential Forwarding Considering Multi-Flow In Dual Connectivity System," issued from U.S. Application No. 15/935,626, which was filed on March 26, 2018. *See* EX1001.

49. From my review, the '573 Patent describes and claims in-sequence delivery apparatuses and methods for multi-flow in a wireless communication system supporting dual connectivity. EX1001 at 1:21-25. It is well recognized in telecommunications that demands vary by location and time of day. For example, demands on communications can be generated in a specific area such as a hotspot in

a cell. Due to signal demand and concentration, the receiving sensitivity of radio waves “may deteriorate in a specific area such as a cell edge or a coverage hole.” EX1001 at 1:29-32. To help with increased demand within a macro cell, a heterogeneous network (HetNet) may be formed. A HetNet is formed in which “the macro cell is a cell having large coverage and the small cells such as the femto cell and the pico cell are cells having small coverage.” *Id.* at 40-42. Certain small cells, such as a pico cell, a femto cell, a micro cell, a remote radio head (RRH), a relay, a repeater, and the like are “installed in a macro cell for the purpose of enabling communication in areas such as the hot spot, the cell edge, and the coverage hole.” *Id.* at 32-38. In the HetNet, the coverages of multiple macro cells and small cells overlap with each other. *See id.* at 45-47. The ’573 Patent is directed to solving problems whereby a packet data convergence protocol (PDCP) entity cannot sequentially acquire the PDCP service data units (SDUs). EX1001 at 2:34-3:21. PDCP is part of the Data Link Layer, which is layer 2 of the Open Systems Interconnect (“OSI”) architecture. In the context of the ’573 Patent, (as shown in annotated version of FIG. 3 of the ’573 Patent below,) PDCP lies above the radio link control (“RLC”) layer and below the radio resource control (“RRC”) layer. The main role of the PDCP layer is the preparation of the user and control data to be transported by the RLC layer and below.

FIG. 3



EX1001, FIG. 3 (Annotations added.)

50. As shown in annotated FIG. 3 above, the PDCP layer at the UE communicates with the PDCP layer at the eNB as in a peer-to-peer relationship. That is to say that the PDCP packet transmitted by the UE is understood by the PDCP layer of the eNB, and vice versa. The PDCP packet transmitted by the UE has the header and the payload, and the eNB receiving the PDCP packet transmitted from the UE processes the packet header to retrieve the instructions as to how to process the payload in the PDCP packet. In this regard, the PDCP packet as a whole, which contains the header and the payload is called the protocol data unit (or the PDU) and the payload contained with the PDCP packet is called the service data unit (or the

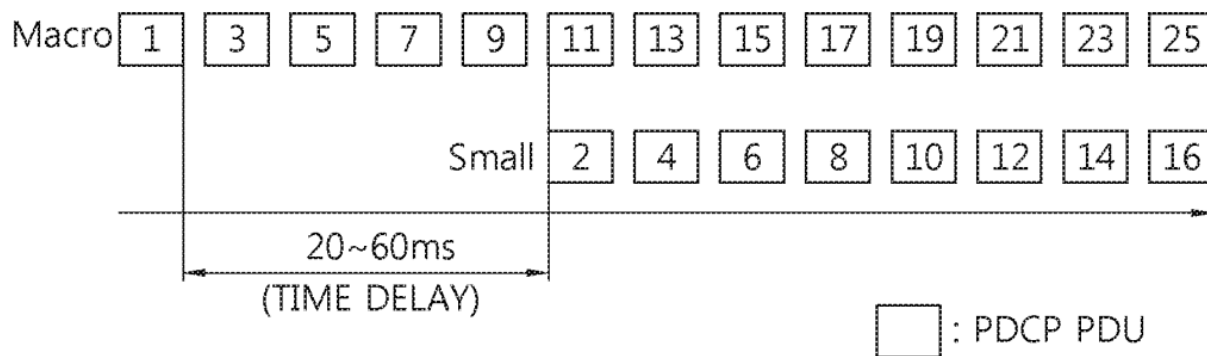
SDU). The PDU contains the header and the payload, of which the header portion is processed by the receiving PDCP layer to extract the instructions as to how to handle the payload. From the receiving PDCP layer's view, the payload in the PDU, i.e., the SDU, is just data and is not processed by the PDCP layer.

51. The receiving device (e.g., UE) can use the sequence number of PDCP PDUs to reorder the PDCP PDUs as necessary. This method, however, does not account for situations where multiple PDCP entities transmit packets belonging to the same information (e.g., video stream). In this case, each of the multiple PDCP entities would have their separate PDU sequences, and the receiving device, *e.g.*, UE, cannot reorder based on the sequence numbers of the received PDCP PDUs. Instead, in-sequence communications (including reordering) of SDUs are performed based on the sequence numbers for the PDCP SDUs, which individually may be transported via the PDCP PDUs from different one of the multiple PDCP entities. Therefore, the sequence of SDUs is based on the sequence number of the SDUs, not based on received PDCP PDUs.

52. Dual connectivity is a wireless communication concept where user equipment (UE) transmits and receives services from two or more serving cells, which may belong to different base stations. EX1001 at 1:50-60. The inventors of the '573 Patent recognized that existing protocols for reordering PDUs received by

the UE were “insufficient for dual connectivity.” *Id.* at 1:65-2:30. For example, “the RLC entity for the small base station and the RLC entity for the macro base station are distinguished to receive the respective RLC SDUs and acquire the PDCP SDU and deliver the acquired PDCP SDU to the upper layer and in this case, the PDCP entity cannot sequentially acquire the PDCP SDUs.” *Id.* at 2:21-27. As the ’573 Patent explains, “in the case of the UE using the multi-flows, a new method for sequential delivery of the PDCP SDUs to the upper layer in the PDCP entity is required.” *Id.* at 2:27-30.

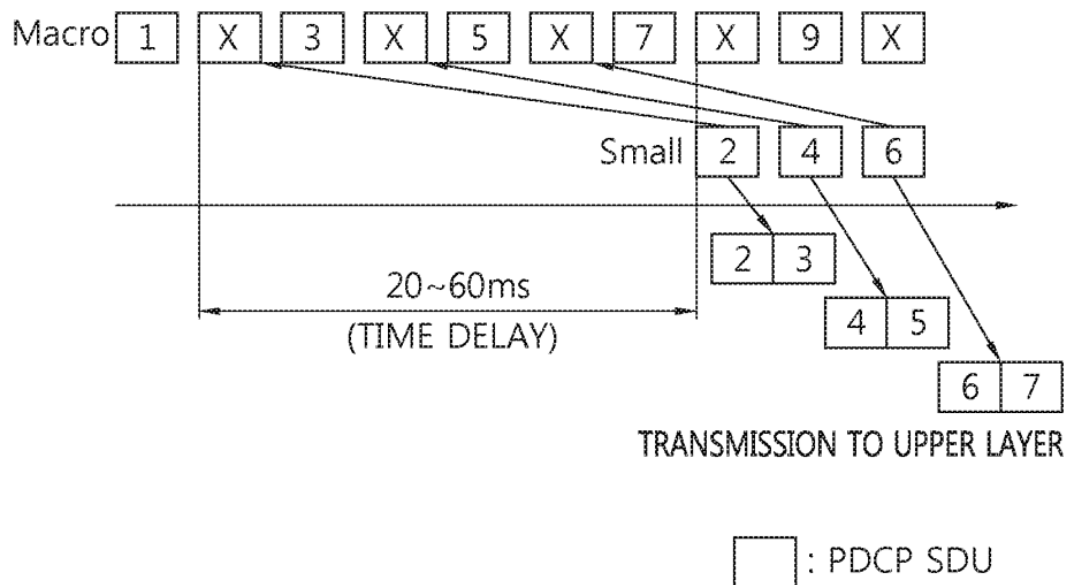
53. One example of a PDCP PDU receiving timing in a PDCP entity of UE is shown in FIG. 12 of the ’573 Patent. FIG. 12 (and its associated description) show “a time when a PDCP PDU transmitted through a macro base station and a PDCP PDU transmitted through a small base station reach a PDCP entity of UE.” EX1001 at 12:30-34.



EX1001, FIG. 12.

54. The '573 Patent explains that sequential transmission may be more advantageous in terms of the overall capability of the network when the packet is transmitted to the upper layer at a predetermined radio protocol end, even though the delay time is added. EX1001 at 14:10-14.

55. The '573 Patent provides another example in FIG. 13:



EX1001, FIG. 13.

56. Here, sequential upper layer transmission is performed “depending on the PDCP sequence number (SN) in the PDCP entity of the UE.” EX1001 at 14:15-17. The '573 Patent explains that this example in FIG. 13 provides that PDCP SDUs having odd numbered PDCP SNs are received by the UE through the macro base

station and PDCP SDUs having even numbered PDCP SNs are received via the small base station. *Id.* at 14:17-21.

57. In contrast to the existing solutions at the time of the '573 invention, the use of "in-sequence timer" at the UE accounts for the delay caused by the use of the transmission path through the small base station. With this invention of the '573 Patent, any received PDCP SDU with a missing PDCP SDU with a smaller sequence number ("SN") is not transmitted to the upper layer until the in-sequence timer expires. In this way, it becomes more probable that the upper layer (e.g., TCP) receives the PDCP SDU in-sequence, thereby reducing the possibility of flow control to be triggered by the receiving TCP layer. The flow control often causes the reduction of the transmission window and consequently the bandwidth of the TCP connection. The inventors of the '573 Patent recognized that the "in-sequence timer," which is easily implemented at the UE, could provide out-sized benefits in the capacity and latency. In contrast, solely relying on the discard timer implemented at the transmitting base station could cause excessive retransmission and consequently waste of bandwidth.

B. Prosecution History of the '573 Patent

58. It is my understanding that U.S. Patent Application No. 15/935,626, which ultimately issued as the '573 Patent on December 8, 2020, was filed on March

26, 2018. The '573 Patent claims foreign priority to Korean Patent Application No. KR-10-2013-0053408, filed on May 10, 2013.

59. I have reviewed the prosecution history of the '573 Patent (identified as EX1002). From my review, the Examiner considered analogous references but ultimately found the invention patentable. *See* EX1002 at 12-20. As can be seen in the prosecution history, the Examiner rejected the initial claim set based on U.S. Patent Application Publication No. 2015/0215827 ("Zhang") and U.S. Patent Application Publication No. 2010/0046448 ("Peisa"), but Zhang was not prior art and therefore this rejection was withdrawn by the Examiner. EX1002 at 140 and 156-175. The Examiner then rejected the claim set based on U.S. Patent Application Publication No. 2012/0182971 ("Ohta") and U.S. Patent Application Publication No. 2010/0304733 ("Yi"). EX1002 at 138-144. The Applicant made multiple arguments in response, including explaining to the Examiner that Ohta and Yi both failed to disclose the claimed in-sequence timer. For example, as the Applicant successfully argued, Yi disclosed a "discard timer" but not an in-sequence timer. EX1002 at 138-144 and 127-129.

60. Finding this argument persuasive, the Examiner searched the prior art again and found U.S. Patent Application Publication No. 2015/0373559 ("Hong"), which was combined with Ohta and Yi to reject the claims. *Id.* at 108-114. As can

be seen in the response to this office action, claim 1 was amended and claims 2-12 were added, and the Applicant asserted that Hong does not disclose the in-sequence timer required by claim 1 but instead discloses a distinct “activation/deactivation timer.” EX1002 at 36-43. The Examiner was persuaded and allowed the application.

61. The Patent Office issued a Notice of Allowance on July 24, 2020, which stated that the cited references “fail[] to disclose or render obvious the received in-sequence timer for the PDCP SDUs and how the in-sequence timer is delivered as claimed.” EX1002 at 12-20.

C. Summary of Cited References

62. Based on the Institution Decision (“ID”) (Paper 10), it is my understanding that the Board instituted this IPR for claims 1-5 and 8-12 of the ’573 Patent based on three grounds of alleged unpatentability. *See* ID at 2. The instituted grounds are the following:

Ground	Challenged Claims	Basis	Reference
1	1-5 and 8-12	§ 103	Koskinen
2	1-5 and 8-12	§ 103	Koskinen in view of Sammour
3	1-5 and 8-12	§ 103	Deenoo in view of Sammour

1. Koskinen (EX1005)

63. U.S. Patent Application Publication No. 2014/0301362 (“Koskinen”) was published on October 9, 2012. Koskinen describes a method of implementing

timers and/or forwarding status reports for “in-sequence delivery of protocol data units received in parallel from several lower-layer acknowledged-mode protocol entities.” EX1005 at Abstract. Koskinen also describes “observing a gap in a sequence of protocol data units received from a plurality of lower-layer protocol entities providing data transfer [and] starting a timer upon the gap observation [and] preventing the gap from blocking delivery of service data units to a higher layer, when the timer expires.” EX1005 at ¶18. Koskinen then discloses to “detect[] a forwarding-status report” and “immediately proceed[] with data delivery to higher layer, containing the gaps because of the lack of forwarding at handover.” EX1005 at Abstract.

2. Sammour (EX1006)

64. U.S. Patent Application Publication No. 2009/0149189 (“Sammour”) was published on June 11, 2009. From my review, Sammour describes “supporting configuration and control of the radio link control (RLC) and packet data control protocol (PDCP) sub-layers by defining and using radio resource control (RRC) parameters and procedures.” EX1006 at ¶15. According to Sammour, “[t]he eNB utilizes a PDCP In sequence delivery IE to indicate to the WTRU that the WTRU PDCP entity is required to provide in-sequence delivery (i.e. reordering),” and then “[t]he eNB uses a PDCP Reordering Stop Mode IE to indicate to the WTRU that the

WTRU PDCP entity whether it should use the timer mechanism (e.g. Flush Timer) to stop reordering following handover, or whether it should use stop reordering after all stored PDCP SDUs have been delivered to upper layers.” *Id.* at ¶¶ 146-149.

3. Deenoo (EX1007)

65. U.S. Patent Application Publication No. 2016/0021581 (“Deenoo”) was published on January 21, 2016. Deenoo describes providing “enhancements” to small cell eNBs and their use with macro eNBs. EX1007 at Abstract. Deenoo states that small-cell enhancements may be used in dual-connectivity scenarios. EX1007 at ¶22. Deenoo also discloses using PDCP re-ordering that includes “starting a reordering timer, for example perhaps when an out of sequence packet may be received from any one of RLC entities.” EX1007 at ¶211. As mentioned, Deenoo also implements status reporting in which a “PDCP status report may be transmitted, for example to trigger retransmission... if the time to expiry for the reordering timer may be more than a configured report threshold.” EX1007 at ¶211. Deenoo teaches that PDUs may be queued or advanced, and/or the re-ordering timer may be canceled when the time until expiration of a reordering timer is “less than a configured report threshold.” *Id.*

VI. PRIORITY OF THE ’573 PATENT

66. In my opinion, the ’573 Patent is entitled to the priority date of the

Korean patent application to which it claims priority. It is my understanding that the '573 Patent claims priority to U.S. Application No. 14/890,407 (filed on May 9, 2014 and published as U.S. Patent Application Publication No. 2016/0113058), which in turn claims priority to Korean Patent Application No. KR-10-2013-0053408 (filed on May 10, 2013).

67. Based on my review of the documents filed in this proceeding, it is my understanding that Petitioner has not specifically argued that the '573 Patent is not entitled to its priority claims. Thus, I reserve the right to supplement or otherwise respond to any future new arguments made by Petitioner or its expert related to the priority of the '573 Patent. Regardless, I have reviewed U.S. Patent Application Publication No. 2016/0113058 (EX2015) and a certified English translation of KR-10-2013-0053408 (EX2014). Based on my review, it is my opinion that support for claims 1-5 and 8-12 of the '573 Patent can be found in both U.S. Patent Application Publication No. 2016/0113058 (EX2015) and KR-10-2013-0053408.

68. Regarding limitation [1.pre] ("A method for user equipment receiving multi-flow data with respect to one evolved packet system (EPS) bearer through a macro base station (macro eNB) and a small base station (small eNB) serving a single cell in a wireless communication system supporting dual connectivity, the method comprising:"), exemplary support for the '573 Patent's priority claim can be

found at EX2015 at ¶¶ 13-15, 99-125, Figs. 12-14 and EX2014 at ¶¶ 10-11, 81-108, Figs. 12-14. For example, EX2015 at ¶¶ 99-125 and EX2014 at ¶¶ 81-108 describe the substantively similar Figures 12-14 of each application, and describe “an example of a PDCP PDU receiving timing in a PDCP entity of UE,” such as “a case in which odd numbers among PDCP sequence numbers (SNs) are transmitted through the macro base station and even numbers are transmitted through the small base station.” EX2015 at ¶ 99; EX2014 at ¶ 81 (same). Thus, these exemplary disclosures set forth a method for user equipment receiving multi-flow data with respect to one evolved packet system (EPS) bearer through a macro base station (macro eNB) and a small base station (small eNB) in a wireless communication system supporting dual connectivity.

69. Regarding limitation [1.a] (“receiving packet data convergence protocol (PDCP) packet data units (PDUs) through the macro base station and the small base station;”), exemplary support for the ’573 Patent’s priority claim can be found at EX2015 at ¶¶ 13-15, 100-101, 106-111, Figs. 12-13 and EX2014 at ¶¶ 10-11, 82-83, 88-93, Figs. 12-13. For example, EX2015 at ¶¶ 100-101 and EX2014 at 82-83 describe the “receiving time of the PDCP PDCU transmitted through the macro base station in the UE and a receiving time of the PDCP PDCU transmitted through the small base station in the UE.” EX2015 at ¶ 100; EX2014 at ¶ 82 (same).

Further details of the reception of packet data convergence protocol (PDCP) packet data units (PDUs) through the macro base station and the small base station are set forth at EX2015 at ¶¶ 100-101, 106-111, Figs. 12-13 and EX2014 at 82-83, 88-93, Figs. 12-13. Thus, these exemplary disclosures set forth receiving packet data convergence protocol (PDCP) packet data units (PDUs) through the macro base station and the small base station.

70. Regarding limitation [1.b] (“obtaining PDCP service data units (SDUs) corresponding to the PDCP PDUs; and”), exemplary support for the ’573 Patent’s priority claim can be found at EX2015 at ¶¶ 13-15, 102, Fig. 13 and EX2014 at ¶¶ 10-11, 84, Fig. 13. For example, EX2015 at ¶ 102 and Fig. 13 and EX2014 at 84, Fig. 13 describe that the “PDCP entity of the UE deciphers and header compresses the received PDCP PDCU and transmits the PDCP SDU to the upper layer.” EX2015 at ¶ 102; EX2014 at ¶ 84 (“The PDCP entity of the UE performs deciphering and header decompression on the received PDCP PDU and transmits the PDCP SDU to the upper layer.”). Thus, these exemplary disclosures set forth obtaining PDCP service data units (SDUs) corresponding to the PDCP PDUs.

71. Regarding limitation [1.c] (“receiving from the macro base station information related to an in-sequence timer for the PDCP SDUs through a radio resource control (RRC) message,”), exemplary support for the ’573 Patent’s priority

claim can be found at EX2015 at ¶¶ 13-15, 118-120, 130, 135 and EX2014 at ¶¶ 10-11, 100-103, 113, 118. For example, EX2015 at ¶ 119 and EX2014 at ¶ 101 describe that “the in-sequence timer may be transmitted from the macro base station to the UE through the RRC message.” EX2015 at ¶ 119; EX2014 at ¶ 101 (same). Further details of receiving from the macro base station information related to an in-sequence timer for the PDCP SDUs through a radio resource control (RRC) message are set forth at EX2015 at ¶¶ 120, 130, and 135 and EX2014 at 102, 103, 113 and 118. Thus, these exemplary disclosures set forth receiving from the macro base station information related to an in-sequence timer for the PDCP SDUs through a radio resource control (RRC) message.

72. Regarding limitation [1.d] (“wherein the PDCP SDUs are indicated by a predefined PDCP sequence number (SN)”), exemplary support for the ’573 Patent’s priority claim can be found at EX2015 at ¶¶ 13-15, 109-114, Fig. 14 and EX2014 at ¶¶ 10-11, 91-96, Fig. 14. For example, EX2015 at ¶ 109 and EX2014 at ¶ 91 describe that “The PDCP sequence number (SN) of the PDCP SDU corresponding to the PDP PDU received in the PDCP entity is confirmed.” EX2015 at ¶ 109; EX2014 at ¶ 91 (same). Thus, these exemplary disclosures set forth that the PDCP SDUs are indicated by a predefined PDCP sequence number (SN).

73. Regarding limitation [1.e] (“wherein the RRC message includes a

PDCP-configuration information element (IE), and”), exemplary support for the ’573 Patent’s priority claim can be found at EX2015 at ¶¶ 13-15, 118-120, 130, 135 and EX2014 at ¶¶ 10-11, 100-103, 113, 118. For example, EX2015 at ¶ 119 and EX2014 at ¶ 101 describe that “the in-sequence timer may be included in a PDCP configuration which is an RRC information element as the following syntax.” Further details of the RRC information element is provided in EX2015 at ¶ 120 and EX2014 at ¶ 102-103. Thus, these exemplary disclosures set forth that the RRC message includes a PDCP-configuration information element (IE).

74. Regarding limitation [1.f] (“the PDCP-configuration IE includes a field indicating a value of the in-sequence timer”), exemplary support for the ’573 Patent’s priority claim can be found at EX2015 at ¶¶ 13-15, 118-120, 130, 135 and EX2014 at ¶¶ 10-11, 100-103, 113, 118. For example, EX2015 at ¶ 120 and EX2014 at ¶ 102-103 describe that “the PDCP configuration information element includes an inseqTimer field. The inseqTimer field indicates an in-sequence timer value.” EX2015 at ¶ 120; EX2014 at ¶ 102-103. Thus, these exemplary disclosures set forth that the PDCP-configuration IE includes a field indicating a value of the in-sequence timer.

75. Regarding limitation [2] (“The method of claim 1, further comprising: confirming the respective PDCP SNs of the obtained PDCP SDUs and performing

in sequence delivery of the PDCP SDUs to an upper layer from a PDCP entity according to the PDCP SN.”), exemplary support for the ’573 Patent’s priority claim can be found at EX2015 at ¶¶ 10, 13-15, 98, 102, 108-111, 124-125, 139, Figs. 13-14 and EX2014 at ¶¶ 7, 10-11, 80, 84, 90-94, 97, 107-108, 122, Figs. 13-14. For example, EX2015 at ¶¶ 109-111 and EX2014 at ¶¶ 91-94 describe that “The PDCP sequence number (SN) of the PDCP SDU corresponding to the PDP PDU received in the PDCP entity is confirmed” and that if the PDCP PDU for all relevant PDCP SDUs are received, “the corresponding PDCP SDUs are sequentially transmitted to the upper layer.” Thus, these exemplary disclosures set forth confirming the respective PDCP SNs of the obtained PDCP SDUs and performing in sequence delivery of the PDCP SDUs to an upper layer from a PDCP entity according to the PDCP SN.

76. Regarding limitation [3.a] (“The method of claim 2, further comprising: confirming whether there is a PDCP SDU of PDCP SN #n-1 which is missed notwithstanding obtaining a PDCP SDU of PDCP SN #n; and”), exemplary support for the ’573 Patent’s priority claim can be found at EX2015 at ¶¶ 13-15, 109, 120-125 and EX2014 at ¶¶ 10-11, 91, 103-108. For example, EX2015 at ¶ 109 and EX2014 at 91 describe that “The PDCP sequence number (SN) of the PDCP SDU corresponding to the PDP PDU received in the PDCP entity is confirmed and if the

PDCP SN of the PDCP SDU is not sequential (that is, when the SN prior to the PDCP SN of the PDCP SDU is missed), an in-sequence timer for the PDCP SDU is driven.” Thus, these exemplary disclosures set forth confirming whether there is a PDCP SDU of PDCP SN #n-1 which is missed notwithstanding obtaining a PDCP SDU of PDCP SN #n.

77. Regarding limitation [3.b] (“driving the in-sequence timer with respect to the PDCP SDU of PDCP SN #n when there is the PDCP SDU of PDCP SN #n-1 which is missed”), exemplary support for the ’573 Patent’s priority claim can be found at EX2015 at ¶¶ 13-15, 109, 120-125 and EX2014 at ¶¶ 10-11, 91, 103-108. For example, EX2015 at ¶ 109 and EX2014 at 91 describe that “The PDCP sequence number (SN) of the PDCP SDU corresponding to the PDP PDU received in the PDCP entity is confirmed and if the PDCP SN of the PDCP SDU is not sequential (that is, when the SN prior to the PDCP SN of the PDCP SDU is missed), an in-sequence timer for the PDCP SDU is driven.” Thus, these exemplary disclosures set forth driving the in-sequence timer with respect to the PDCP SDU of PDCP SN #n when there is the PDCP SDU of PDCP SN #n-1 which is missed.

78. Regarding limitation [4] (“The method of claim 3, wherein before the in-sequence timer for the PDCP SDU of PDCP SN #n has expired, when the PDCP SDU of PDCP SN #n-1 is obtained, the PDCP SDU of PDCP SN #n-1 and the

PDCP SDU of PDCP SN #n are delivered to the upper layer according to the order of the PDCP SN.”), exemplary support for the ’573 Patent’s priority claim can be found at EX2015 at ¶¶ 13-15, 111, 115-117, 124 and EX2014 at ¶¶ 10-11, 93, 97-99, 107. For example, EX2015 at ¶ 111 and EX2014 at ¶ 93 describe that “While the in-sequence timer for the PDCP SDU is running, when the PDCP PDU corresponding to the PDCP SDU for the PDCP SN prior to (that is, missed from) the PDCP SN of the PDCP SDU is received, and as a result, the PDCP SDUs may be sequentially transmitted, the in-sequence timer has expired and the corresponding PDCP SDUs are sequentially transmitted to the upper layer.” Thus, these exemplary disclosures set forth that before the in-sequence timer for the PDCP SDU of PDCP SN #n has expired, when the PDCP SDU of PDCP SN #n-1 is obtained, the PDCP SDU of PDCP SN #n-1 and the PDCP SDU of PDCP SN #n are delivered to the upper layer according to the order of the PDCP SN.

79. Regarding limitation [5] (“The method of claim 2, wherein when the in-sequence timer for the PDCP SDU of PDCP SN #n has expired, the PDCP SDU of PDCP SN #n is delivered to the upper layer of the PDCP entity even though there is no PDCP SDU of PDCP SN #n-1.”), exemplary support for the ’573 Patent’s priority claim can be found at EX2015 at ¶¶ 13-15, 110-111, 125 and EX2014 at ¶¶ 10-11, 92-93, 108. For example, EX2015 at ¶ 110 and EX2014 at ¶ 92 describe that

“When the in-sequence timer for the PDCP SDU has expired [which means that no PDCP SDU of PDCP SN # $n-1$ has been received], the PDCP SDU is transmitted to the upper layer. The reason is that when the PDCP PDU corresponding to the PDCP SDU for the PDCP SN which is missed is not received by the PDCP entity of the UE until the in-sequence timer has expired, the corresponding PDCP SDU is removed by the elapse of the discard timer at the transmission side of the PDCP entity of the macro base station.” Thus, these exemplary disclosures set forth that when the in-sequence timer for the PDCP SDU of PDCP SN # n has expired, the PDCP SDU of PDCP SN # n is delivered to the upper layer of the PDCP entity even though there is no PDCP SDU of PDCP SN # $n-1$.

80. Regarding limitation [8.pre] (“A user equipment (UE) for receiving multi-flow data with respect to one evolved packet system (EPS) bearer through a macro base station (macro eNB) and a small base station (small eNB) serving a single cell in a wireless communication system supporting dual connectivity, the UE comprising:”), exemplary support for the ’573 Patent’s priority claim can be found at EX2015 at ¶¶ 13-15, 99-125, Figs. 12-15 and EX2014 at ¶¶ 10-11, 81-108, Figs. 12-15. For example, EX2015 at ¶¶ 99-125 and EX2014 at ¶¶ 81-108 describe the substantively similar Figures 12-14 of each application, and describe “an example of a PDCP PDU receiving timing in a PDCP entity of UE,” such as “a case in which

odd numbers among PDCP sequence numbers (SNs) are transmitted through the macro base station and even numbers are transmitted through the small base station.” EX2015 at ¶ 99; EX2014 at ¶ 81 (same). Thus, these exemplary disclosures set forth user equipment (UE) for receiving multi-flow data with respect to one evolved packet system (EPS) bearer through a macro base station (macro eNB) and a small base station (small eNB) serving a single cell in a wireless communication system supporting dual connectivity.

81. Regarding limitation [8.a] (“a receiving unit receiving packet data convergence protocol (PDCP) packet data units (PDUs) through the macro base station and the small base station and”), exemplary support for the ’573 Patent’s priority claim can be found at EX2015 at ¶¶ 13-15, 100-101, 106-111, Figs. 12-13, 15 and EX2014 at ¶¶ 10-11, 82-83, 88-93, Figs. 12-13, 15. For example, EX2015 at ¶¶ 100-101 and EX2014 at 82-83 describe the “receiving time of the PDCP PDCU transmitted through the macro base station in the UE and a receiving time of the PDCP PDCU transmitted through the small base station in the UE.” EX2015 at ¶ 100; EX2014 at ¶ 82 (same). Further details of the reception of packet data convergence protocol (PDCP) packet data units (PDUs) through the macro base station and the small base station are set forth at EX2015 at ¶¶ 100-101, 106-111, Figs. 12-13 and EX2014 at 82-83, 88-93, Figs. 12-13. Thus, these exemplary

disclosures set forth a receiving unit receiving packet data convergence protocol (PDCP) packet data units (PDUs) through the macro base station and the small base station.

82. Regarding limitation [8.b] (“receiving from the macro base station information related to in-sequence timer for the PDCP SDUs through a radio resource control (RRC) message; and”), exemplary support for the ’573 Patent’s priority claim can be found at EX2015 at ¶¶ 13-15, 118-120, 130, 135 and EX2014 at ¶¶ 10-11, 100-103, 113, 118. For example, EX2015 at ¶ 119 and EX2014 at ¶ 101 describe that “the in-sequence timer may be transmitted from the macro base station to the UE through the RRC message.” EX2015 at ¶ 119; EX2014 at ¶ 101 (same). Further details of receiving from the macro base station information related to an in-sequence timer for the PDCP SDUs through a radio resource control (RRC) message are set forth at EX2015 at ¶¶ 120, 130, and 135 and EX2014 at 102, 103, 113 and 118. Thus, these exemplary disclosures set forth receiving from the macro base station information related to in-sequence timer for the PDCP SDUs through a radio resource control (RRC) message.

83. Regarding limitation [8.c] (“a processor obtaining PDCP service data units (SDUs) corresponding to the PDCP PDUs”), exemplary support for the ’573 Patent’s priority claim can be found at EX2015 at ¶¶ 13-15, 102, Figs. 13, 15 and

EX2014 at ¶¶ 10-11, 84, Figs. 13, 15. For example, EX2015 at ¶ 102 and Fig. 13 and EX2014 at 84, Fig. 13 describe that the “PDCP entity of the UE deciphers and header compresses the received PDCP PDCU and transmits the PDCP SDU to the upper layer.” EX2015 at ¶ 102; EX2014 at ¶ 84 (same). Thus, these exemplary disclosures set forth a processor obtaining PDCP service data units (SDUs) corresponding to the PDCP PDUs.

84. Regarding limitation [8.d] (“wherein the PDCP SDUs are indicated by a predefined PDCP sequence number (SN),”), exemplary support for the ’573 Patent’s priority claim can be found at EX2015 at ¶¶ 13-15, 109-114, Fig. 14 and EX2014 at ¶¶ 10-11, 91-96, Fig. 14. For example, EX2015 at ¶ 109 and EX2014 at ¶ 91 describe that “The PDCP sequence number (SN) of the PDCP SDU corresponding to the PDP PDU received in the PDCP entity is confirmed.” EX2015 at ¶ 109; EX2014 at ¶ 91 (same). Thus, these exemplary disclosures set forth that the PDCP SDUs are indicated by a predefined PDCP sequence number (SN).

85. Regarding limitation [8.e] (“wherein the RRC message includes a PDCP-configuration information element (IE), and”), exemplary support for the ’573 Patent’s priority claim can be found at EX2015 at ¶¶ 13-15, 118-120, 130, 135 and EX2014 at ¶¶ 10-11, 100-103, 113, 118. For example, EX2015 at ¶ 119 and EX2014 at ¶ 101 describe that “the in-sequence timer may be included in a PDCP

configuration which is an RRC information element as the following syntax.” Further details of the RRC information element is provided in EX2015 at ¶ 120 and EX2014 at ¶ 102-103. Thus, these exemplary disclosures set forth that the RRC message includes a PDCP-configuration information element (IE).

86. Regarding limitation [8.f] (“the processor determines the value of in-sequence timer based on the PDCP-configuration IE”), exemplary support for the ’573 Patent’s priority claim can be found at EX2015 at ¶¶ 13-15, 118-120, 130, 135 and EX2014 at ¶¶ 10-11, 100-103, 113, 118. For example, EX2015 at ¶ 120 and EX2014 at ¶ 102-103 describe that “the PDCP configuration information element includes an inseqTimer field. The inseqTimer field indicates an in-sequence timer value. The inseqTimer field is driven when the PDCP SDU corresponding to the PDCP PDU received by the PDCP entity is not sequentially formed in the order of the PDCP SN.” EX2015 at ¶ 120; EX2014 at ¶ 102-103. Driving the inseqTimer field means that the UE determines the value of in-sequence timer based on the PDCP-configuration IE. Thus, these exemplary disclosures set forth that the processor determines the value of in-sequence timer based on the PDCP-configuration IE.

87. Regarding limitation [9] (“The UE of claim 8, wherein the processor confirms the processor confirms the respective PDCP SNs of the obtained PDCP

SDUs and performs in-sequence delivery of the PDCP SDUs to an upper layer from a PDCP entity according to the PDCP SN.”), exemplary support for the ’573 Patent’s priority claim can be found at EX2015 at ¶¶ 10, 13-15, 98, 102, 108-111, 124-125, 139, Figs. 13-14 and EX2014 at ¶¶ 7, 10-11, 80, 84, 90-94, 97, 107-108, 122, Figs. 13-14. For example, EX2015 at ¶¶ 109-111 and EX2014 at ¶¶ 91-94 describe that “The PDCP sequence number (SN) of the PDCP SDU corresponding to the PDP PDU received in the PDCP entity is confirmed” and that if the PDCP PDU for all relevant PDCP SDUs are received, “the corresponding PDCP SDUs are sequentially transmitted to the upper layer.” Thus, these exemplary disclosures set forth that the processor confirms the processor confirms the respective PDCP SNs of the obtained PDCP SDUs and performs in-sequence delivery of the PDCP SDUs to an upper layer from a PDCP entity according to the PDCP SN.

88. Regarding limitation [10.a] (“The UE of claim 9, wherein the processor confirms whether there is a PDCP SDU of PDCP SN #n-1 which is missed notwithstanding obtaining a PDCP SDU of PDCP SN #n; and”), exemplary support for the ’573 Patent’s priority claim can be found at EX2015 at ¶¶ 13-15, 109, 120-125 and EX2014 at ¶¶ 10-11, 91, 103-108. For example, EX2015 at ¶ 109 and EX2014 at 91 describe that “The PDCP sequence number (SN) of the PDCP SDU corresponding to the PDP PDU received in the PDCP entity is confirmed and if the

PDCP SN of the PDCP SDU is not sequential (that is, when the SN prior to the PDCP SN of the PDCP SDU is missed), an in-sequence timer for the PDCP SDU is driven.” Thus, these exemplary disclosures set forth that the processor confirms whether there is a PDCP SDU of PDCP SN # $n-1$ which is missed notwithstanding obtaining a PDCP SDU of PDCP SN # n .

89. Regarding limitation [10.b] (“drives the in-sequence timer with respect to the PDCP SDU of PDCP SN # n when there is the PDCP SDU of PDCP SN # $n-1$ which is missed”), exemplary support for the '573 Patent's priority claim can be found at EX2015 at ¶¶ 13-15, 109, 120-125 and EX2014 at ¶¶ 10-11, 91, 103-108. For example, EX2015 at ¶ 109 and EX2014 at 91 describe that “The PDCP sequence number (SN) of the PDCP SDU corresponding to the PDP PDU received in the PDCP entity is confirmed and if the PDCP SN of the PDCP SDU is not sequential (that is, when the SN prior to the PDCP SN of the PDCP SDU is missed), an in-sequence timer for the PDCP SDU is driven.” Thus, these exemplary disclosures set forth that the processor drives the in-sequence timer with respect to the PDCP SDU of PDCP SN # n when there is the PDCP SDU of PDCP SN # $n-1$ which is missed.

90. Regarding limitation [11] (“The UE of claim 10, wherein the processor delivers, when the in-sequence timer for the PDCP SDU of PDCP SN # n has expired, the PDCP SDU of PDCP SN # n to the upper layer of the PDCP entity even though

there is no PDCP SDU of PDCP SN # $n-1$.”), exemplary support for the ’573 Patent’s priority claim can be found at EX2015 at ¶¶ 13-15, 110-111, 125 and EX2014 at ¶¶ 10-11, 92-93, 108. For example, EX2015 at ¶ 110 and EX2014 at ¶ 92 describe that “When the in-sequence timer for the PDCP SDU has expired [which means that no PDCP SDU of PDCP SN # $n-1$ has been received], the PDCP SDU is transmitted to the upper layer. The reason is that when the PDCP PDU corresponding to the PDCP SDU for the PDCP SN which is missed is not received by the PDCP entity of the UE until the in-sequence timer has expired, the corresponding PDCP SDU is removed by the elapse of the discard timer at the transmission side of the PDCP entity of the macro base station.” Thus, these exemplary disclosures set forth that the processor delivers, when the in-sequence timer for the PDCP SDU of PDCP SN # n has expired, the PDCP SDU of PDCP SN # n to the upper layer of the PDCP entity even though there is no PDCP SDU of PDCP SN # $n-1$.

91. Regarding limitation [12] (“The UE of claim 10, wherein the processor delivers, before the in-sequence timer for the PDCP SDU of PDCP SN # n has expired, when the PDCP SDU of PDCP SN # $n-1$ is obtained, the PDCP SDU of PDCP SN # $n-1$ and the PDCP SDU of PDCP SN # n to the upper layer according to the order of the PDCP SN.”), exemplary support for the ’573 Patent’s priority claim can be found at EX2015 at ¶¶ 13-15, 111, 115-117, 124 and EX2014 at ¶¶ 10-11,

93, 97-99, 107. For example, EX2015 at ¶ 111 and EX2014 at ¶ 93 describe that “While the in-sequence timer for the PDCP SDU is running, when the PDCP PDU corresponding to the PDCP SDU for the PDCP SN prior to (that is, missed from) the PDCP SN of the PDCP SDU is received, and as a result, the PDCP SDUs may be sequentially transmitted, the in-sequence timer has expired and the corresponding PDCP SDUs are sequentially transmitted to the upper layer.” Thus, these exemplary disclosures set forth that the processor delivers, before the in-sequence timer for the PDCP SDU of PDCP SN #n has expired, when the PDCP SDU of PDCP SN #n-1 is obtained, the PDCP SDU of PDCP SN #n-1 and the PDCP SDU of PDCP SN #n to the upper layer according to the order of the PDCP SN.

VII. LEVEL OF ORDINARY SKILL

92. Based on my review of the Petition, it is my understanding that Petitioner and Dr. Lo propose that a person of ordinary skill in the art (POSITA) would have had “a bachelor’s degree in electrical engineering, computer engineering, computer science, or a related field and at least two years of practical experience with design or development of telecommunication and/or wireless communications systems, or the equivalent.” Pet. at 7; EX1003 at ¶19-21.

93. While I do not necessarily agree with this definition of a POSITA, I certainly qualify as a POSITA under this definition.

VIII. CLAIM CONSTRUCTION

A. “an in-sequence timer”

94. It is my understanding that the Institution Decision (Paper 10) requested that the Patent Owner address the meaning of the claimed “in-sequence timer” because it appeared to be in dispute. From my review of the Institution Decision (*e.g.*, page 13), it appears to equate or at least imply that the claimed in-sequence timer and a t-Reordering timer are the same. However, this is not strictly correct in the context of its implementation in the ’573 Patent.

95. To start, the purpose of the t-Reordering timer is to detect any missing PDCP SDU. For example, when a PDCP packet is traversing through various segments of the EPS bearer path (*e.g.*, from P-GW to S-GW, from S-GW to eNB, from eNB to UE), the PDCP packet may lose the framing signals. Then, the receiving end of the packet is not able to detect the boundary of the PDCP packet and consequently, the PDCP packet is not received. The t-Reordering timer is triggered when a PDCP packet is received non-consecutively in their sequence numbers. The t-Reordering timer works in conjunction with the timer that triggers the retransmission, possibly at the higher layer, such as the TCP layer. The 3GPP standard allows very large values for the t-Reordering timer, which allows the roundtrip delay between the transmitting device and the receiving device. In contrast, the in-sequence time taught by the ’573 Patent is implemented specific to

the difference between the latencies in the slow path (e.g., via the small base station and the fast path (e.g., large base station). The in-sequence timer does not address the case of packet loss, which is the main purpose of the t-Reordering timer. Instead, the packet loss is addressed by the retransmission performed at the TCP layer.

96. Moreover, in 3GPP, reordering may be performed at various stages depending on the implementation and the demands of the specific configuration and is separate from the claimed in-sequence timer. The claimed in-sequence timer is implemented in the '573 Patent differently than the t-Reordering timer, such as specified in 3GPP. Indeed, PDU or SDU reordering could occur before, during, or after the period of the in-sequence timer depending on its implementation.

97. In my opinion, in the context of the '573 patent, an “in-sequence timer” is a timer that begins upon the detection of an out-of-sequence SDU and lasts for a period of time.

98. The '573 Patent provides multiple helpful descriptions that are consistent with this definition. For example, the '573 Patent at 13:43-55 states:

The PDCP sequence number (SN) of the PDCP SDU corresponding to the PDP PDU received in the PDCP entity is confirmed and if the PDCP SN of the PDCP SDU is not sequential (that is, when the SN prior to the PDCP SN of the PDCP SDU is missed), an in-sequence timer for the PDCP SDU is driven... When the in-sequence timer for the PDCP SDU has expired, the PDCP SDU is transmitted to the upper layer.

99. The '573 Patent also provides helpful and consistent disclosures at 13:56-14:2 and 15:51-65. Thus, it is my opinion that the '573 Patent is consistent with my understanding of the claimed “in-sequence timer” as a timer that begins upon the detection of an out-of-sequence SDU and lasts for a period of time.

100. In fact, it is my understanding that Dr. Lo *agrees* with me that the claimed in-sequence timer is a timer that begins upon the detection of an out-of-sequence SDU. *See* EX2013 at 64:17-22.

101. The use of the “in-sequence timer” in the claims would be understood by a POSITA to be consistent with its plain and ordinary meaning, which is a timer that begins upon the detection of an out-of-sequence SDU and lasts for a period of time. It is my opinion that the '573 Patent uses the term in this same manner. For example, the '573 Patent specifies the usage of an “in-sequence timer for the PDCP SDUs” in at least independent claims 1 and 8. The dependent claims are similar – for example, claims 3 and 10 further define the beginning of the in-sequence timer and claims 4, 5, 11, and 12 recite what the UE does prior to expiration of the timer or upon expiration of the in-sequence timer.

IX. NONE OF THE CHALLENGED CLAIMS ARE RENDERED OBVIOUS BY THE REFERENCES CITED IN THE PETITION

102. In my opinion, Petitioner has failed to show by a preponderance of the evidence that any of Grounds 1-3 renders obvious claims 1-5 and 8-12. From my

review of the references relied upon by Petitioner, Koskinen, Deenoo, and Sammour fail to establish obviousness of several aspects of the claims, including, for example, at least (i) receiving from the macro base station information related to an in-sequence timer for the PDCP SDUs through a radio resource control (RRC) message, (ii) the PDCP-configuration IE includes a field indicating a value of the in-sequence timer, and (iii) determining the value of in-sequence timer based on the PDCP-configuration IE.

A. Ground 1: Koskinen Fails to Render Obvious Claims 1-5 and 8-12

103. In my opinion, Petitioner has failed to provide a showing that any of claims 1-5 and 8-12 are obvious based on Koskinen by a preponderance of the evidence, as I will explain below.

1. Koskinen Fails to Render Obvious Claim Elements 1[c] and 8[b]

104. Claim Element 1[c] recites “receiving from the macro base station information related to an in-sequence timer for the PDCP SDUs through a radio resource control (RRC) message.”

105. Claim Element 8[b] recites “receiving from the macro base station information related to in-sequence timer for the PDCP SDUs through a radio resource control (RRC) message.”

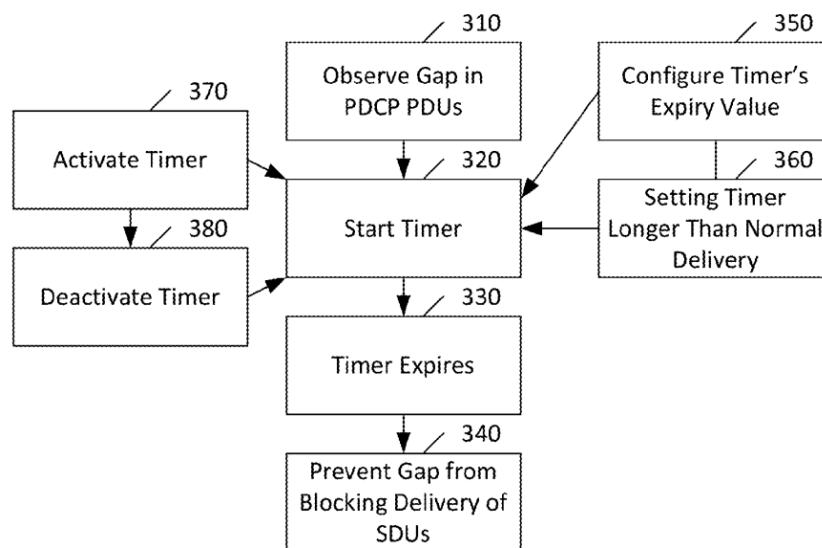
106. Based on my review of Koskinen and applying the knowledge of a

POSITA, the Petition fails to establish that Koskinen would have rendered obvious these claim elements.

107. The Petition appears to misunderstand or misinterpret the teachings of Koskinen. I believe it would be helpful to start with an explanation of Koskinen. Koskinen describes “in-sequence delivery of protocol data units received in parallel from several lower-layer acknowledged-mode protocol entities may benefit from reordering timers and/or forwarding status reports.” EX1005 at ¶ 2. Koskinen describes that a gap is observed in a sequence of PDUs “received from a plurality of lower-layer protocol entities providing data transfer” and then a timer is started “upon the gap observation.” *Id.* at ¶ 18. Koskinen also teaches that when this timer expires or is stopped, the gap should be prevented from “blocking delivery of” SDUs to a higher layer. *Id.*

108. Koskinen describes providing a method “for the PDCP entity at the user equipment to deduce when not to expect reception gaps to be filled.” EX1005 at ¶ 36. This is because, as Koskinen’s paragraph 35 states, “if the PDCP at the user equipment always waits for reception gaps to be filled before delivery of data to higher layer, then at a handover without forwarding the bearer may go into deadlock, because the gaps created by packets that were not forwarded will never be received.” EX1005 at ¶ 35.

109. The Petition relies on the reordering timer of Koskinen. Starting at paragraph 37, Koskinen states that “certain embodiments utilize a timer, such as a reordering timer, as shown in FIG. 2.” I provide a copy of Koskinen’s FIG. 2 below, which shows the implementation of the timer:



EX1005, FIG. 2.

110. Koskinen’s paragraphs 38-40 provide additional explanation of the timer and FIG. 2. Koskinen’s paragraph 38 states “a timer, such as a reordering timer, can be started at 320 whenever a gap in the received protocol data units is observed at 310, such as by observing a gap in a sequence of protocol data units.” EX1005 at ¶ 38. Once the timer expires (at 330), the gap in the sequence of PDUs is prevented from blocking delivery of SDUs to a higher layer. *Id.*

111. Koskinen describes configuring the expiration value of the timer “by

radio resource control (RRC) at 350, and can be set at 360 long enough so that the timer does not expire during normal delivery delay of protocol data units sent by the eNB to the user equipment via a small-cell node, for example, including all possible HARQ and ARQ retransmissions at MAC and RLC level therein, respectively.” *Id.* at ¶ 39. Koskinen does **not** explain what precisely “long enough” means and, in my opinion, it would be ambiguous to a POSITA. Petitioners expert, Dr. Lo testified that there may be multiple “considerations” in determining how long “long enough” might be and this determination would “depend[] on the system design...” EX2013 at 86:19-88:15. In particular, the statement by Koskinen regarding “all possible HARQ and ARQ retransmissions at MAC and RLC level therein” suggest that Koskinen’s timer is **not** the “in-sequence timer” taught by the ’573 Patent, which is specifically focused on the difference in the latencies between the fast path (e.g., from the large base station to the UE) and the slow path (e.g., from the small base station to the UE). *See* EX1005 at ¶ 39.

112. Whatever the length of the timer, a delay will be caused. To address the delay due to the “gaps,” Koskinen describes the network sending “a forwarding-status report” to the UE to “explicitly tell the user equipment (after handover)” which PDU SNs it should expect to receive or not expect to receive. EX1005 at ¶ 40.

113. Therefore, it is my opinion that Koskinen does not teach “a timer that

begins upon the detection of an out-of-sequence SDU and lasts for a period of time.” As I explain, Koskinen teaches a reordering timer, which is not an in-sequence timer, that starts “whenever a gap in the received protocol data units is observed at 310, such as by observing a gap in a sequence of protocol data units.” EX1005 at ¶ 38. There is a literal difference between Koskinen’s reordering timer “observing a gap in a sequence of protocol data units,” which accounts for “all possible HARQ and ARQ retransmissions at MAC and RLC level therein,” and the claimed in-sequence timer that detects “an out-of-sequence SDU” due to the difference in the latencies between the fast path (e.g., from the large base station to the UE) and the slow path (e.g., from the small base station to the UE).

114. As mentioned, Petitioner and Dr. Lo appear to misunderstand or misinterpret Koskinen and its teachings related to the reordering timer. The Petition states “Koskinen describes re-purposing the timer operating at the RLC level to be used at the PDCP layer (“in-sequence timer”).” Pet. at 18-19. Koskinen’s description to “repurpose” RLC state variables for PDCP acknowledged-mode (AM) data transfer does not teach to convert its reordering timer into the claimed in-sequence timer for PDCP SDUs. Koskinen describes a layer-specific RLC “t-Reordering” timer, which is used for reordering PDUs. It is not an in-sequence timer for PDCP SDUs.

115. When explaining the use of the timer as described by Koskinen, Petitioner's expert, Dr Lo, testified that Koskinen teaches that "you can just repurpose the timer at RRC into the PDCP layer. And the RRC timer operation has already defined or specified in the standard for RRC layer. So you can just repurpose it." EX2013 at 96:22-97:2. However, Koskinen does not teach it's timer for use at the RRC layer. It appears that Dr. Lo may have meant to refer to the RLC layer, instead of an "RRC layer," in which case Dr. Lo still does not explain **how** a POSITA would know how to take Koskinen's RLC timer, which has been repurposed for the PDCP layer, and then somehow further reconfigure it to be the claimed in-sequence timer for PDCP SDUs. In my opinion, this would be ambiguous at best, and more likely, this simply would not have occurred to a POSITA (much less been obvious) when reading the disclosure of Koskinen.

116. In my opinion, a POSITA would not read Koskinen to teach to reconfigure its RLC-based reordering timer to be an in-sequence timer for PDCP SDUs. At most, Koskinen teaches that PDCP could repurpose RLC state variables, but this does not teach a POSITA the claimed PDCP in-sequence timer as a timer for a received PDCP SDU and sets a time period for receiving a missed PDCP SDU having a sequence number that is previous in sequence number to the received PDCP SDU. From my review of Koskinen, the Petition, and Dr. Lo's declaration, the

Petitioner is relying on hindsight to stretch the teachings of Koskinen to arrive at the claimed in-sequence timer. It is my understanding that this hindsight reasoning is not permitted and cannot be a basis for finding a claim obvious.

117. As mentioned, I also reviewed the prosecution history of the '573 Patent. The prosecution history does not change my opinions, and in fact supports my opinion that the Challenged Claims are not obvious based on the teachings of Koskinen. During prosecution, the Applicant distinguished various types of timers in the prior art. The Examiner agreed with the Applicant and allowed the patent application. EX1002 at 42 (“cell activation/deactivation timer” of Hong); *id.* at 128 (“discard timer” of Yi). The same applies here – Koskinen’s reordering timer is not an in-sequence timer for PDCP SDUs, even when repurposed from RLC-UM data transfer to RCL-AM data transfer. EX1005 at ¶37.

118. Therefore, it is my opinion that Petitioner fails to prove by a preponderance of the evidence that Claim Elements 1[c] and 8[b] would have been obvious based on a POSITA’s understanding of Koskinen.

2. Koskinen Fails to Render Obvious Claim Elements 1[e] & 1[f] and 8[e] & 8[f]

119. Claim Element 1[e] (and similarly Claim Element 8[e]) recites “wherein the RRC message includes a PDCP-configuration information element (IE)” and Claim Element 1[f] (and similarly Claim Element 8[f]) recites “the PDCP-

configuration IE includes a field indicating a value of the in-sequence timer.” Claim Elements 1[e] and 1[f] (and similarly Claim Elements 8[e] and 8[f]) are related to each other and therefore I will discuss them together. However, I understand that they are separate elements of the claims and are independently novel and nonobvious over Koskinen.

120. Koskinen describes that expiration of the reordering timer “can be configured by radio resource control (RRC) at 350.” EX1005 at ¶39. The Petition states “[b]ecause the UE includes a PDCP layer and is configured by RRC, POSITAs would have recognized and found obvious the RRC included a PDCP configuration information element.” Pet. at 22 (citing EX1003 at ¶¶147-148). The Petition agrees that “[Koskinen] does not explicitly describe a configuration IE field for the in-sequence timer...” but relies on Dr. Lo that “this limitation would have been obvious based on Koskinen’s teachings.” Pet. at 23-24 (citing EX1003 at ¶¶150-154). I disagree with Dr. Lo.

121. Koskinen only generally discusses the use of RRC, which is a wide-ranging concept applied in many aspects of 3GPP telecommunications. While it is correct that RRC uses information elements (“IEs”) to communicate information / parameters, this does not mean that simply using RRC equates to the UE receives from the macro eNB an RRC message including a PDCP-configuration IE, which

includes a field indicating a value of the in-sequence timer for a received PDCP SDU that sets a time period for receiving a missed PDCP SDU having a sequence number that is previous in sequence number to the received PDCP SDU. Petitioner and Dr. Lo overly stretch the teachings of Koskinen; a POSITA would not have understood Koskinen to teach the claimed “RRC message includes a PDCP-configuration information element (IE)” that “includes a field indicating a value of the in-sequence timer, as recited in independent claims 1 and 8.

122. In my opinion, Koskinen fails to render obvious the claimed in-sequence timer because repurposing RLC state variables for PDCP acknowledged-mode (AM) data transfer does not teach a POSITA to create the claimed in-sequence timer for PDCP SDUs. Nothing in Koskinen teaches reconfiguring the RLC-based t-reordering timer for PDUs to instead be a PDCP-based in-sequence timer for a received PDCP SDU that sets a time period for receiving a missed PDCP SDU having a sequence number that is previous in sequence number to the received PDCP SDU. *See supra*, §IX(A)(1). Therefore, Koskinen fails to teach a POSITA the claimed RRC message that includes a PDCP-configuration IE with a field indicating a value of the in-sequence timer.

123. Further, the 3GPP technical specifications (*e.g.*, 3GPP TS 36.331 (EX1014) and 3GPP TS 36.322 (EX1013)) discussed in the Petition and by Dr. Lo

also do not teach a POSITA to somehow transform Koskinen's t-reordering timer into the claimed PDCP-configuration IE including a field indicating a value of the in-sequence timer. Koskinen discloses repurposing of a t-reordering timer for RLC-UM to be for RLC-AM data transfer, but there is no disclosure that a PDCP-configuration IE is provided to the UE via RRC to indicate a value for the t-reordering timer. EX1005 at ¶ 37. Looking at each of the 3GPP technical specifications cited, 3GPP TS 36.331 describes an IE for RLC-Config to "specify the RLC configuration of SRBs [signaling radio bearers] and DRBs [data radio bearers]," which includes a "T-Reordering" field. EX1014 at 219. Next, 3GPP TS 36.322 describes unacknowledgement mode (UM) and acknowledgement mode (AM) data transfer procedures for RLC layer entities, including the use of a t-reordering timer. EX1013 at 13-17.

124. However, none of these teachings are the claimed in-sequence timer. Koskinen, 3GPP TS 36.322, and 3GPP TS 36.331 teach similar timers (t-reordering timers) used for the RLC layer, and not an in-sequence timer for the PDCP layer and its related IE, as recited in claims 1 and 8. It would be clear to a POSITA that there is a disconnect between Koskinen's teaching of "repurpose[ing]" an RLC-UM timer and its variables for AM data transfer and the claimed PDCP-based in-sequence timer for a received PDCP SDU that sets a time period for receiving a missed PDCP

SDU having a sequence number that is previous in sequence number to the received PDCP SDU. A POSITA would not have arrived at the claimed in-sequence timer from the teachings of Koskinen and/or 3GPP TS 36.322 and 3GPP TS 36.331. In my opinion, the Petition and Dr. Lo rely on hindsight, and when considered without hindsight, Claim Elements 1[e], 1[f], 8[e], and 8[f] would not have been obvious to a POSITA.

125. Therefore, for at least the foregoing reasons, Claim Elements 1[e], 1[f], 8[e], and 8[f] would have been rendered obvious based on Koskinen, contrary to the assertions of the Petition and Dr. Lo.

3. Koskinen Fails to Render Obvious Claims 2 and 9

126. In my opinion, the Petition and Dr. Lo fail to show by a preponderance of the evidence that either claim 2 or 9 would have been rendered obvious based on Koskinen.

127. Claims 2 and 9 depend from claims 1 and 8, respectively, and therefore include all of the limitations that Koskinen fails to teach with regard to the independent claims, as detailed above.

4. Koskinen Fails to Render Obvious Claims 3 and 10

128. In my opinion, the Petition and Dr. Lo fail to show by a preponderance of the evidence that either claim 3 or 10 would have been rendered obvious based on Koskinen.

129. Claims 3 and 10 depend from claims 2 and 9 (and ultimately claims 1 and 8), respectively, and therefore include all of the limitations that Koskinen fails to teach with regard to the independent claims, as detailed above.

130. As similarly explained already for Claim Elements 1[c] and 8[a], Koskinen does not teach “confirming whether there is a PDCP SDU of PDCP SN #n-1 which is missed notwithstanding obtaining a PDCP SDU of PDCP SN #n; and driving the in-sequence timer with respect to the PDCP SDU of PDCP SN #n when there is the PDCP SDU of PDCP SN #n-1 which is missed.”

131. Nothing in Koskinen would be recognized by a POSITA as teaching “confirming” that a PDCP SDU has been missed. Koskinen also does not teach that the reordering timer is a timer “with respect to the PDCP SDU of PDCP SN #n when there is the PDCP SDU of PDCP SN #n-1 which is missed.” At most, Koskinen merely discloses “a timer, such as a reordering timer, can be started at 320 whenever a gap in the received protocol data units is observed at 310, such as by observing a gap in a sequence of protocol data units.” EX1005 at ¶ 38.

132. Koskinen does not teach to “confirm” the gap and does not teach the reordering timer is for a PDCP SN #n when there is a PDCP SN #n-1 that is missed, which are required by claims 3 and 10.

5. Koskinen Fails to Render Obvious Claims 4 and 12

133. In my opinion, the Petition and Dr. Lo fail to show by a preponderance of the evidence that either claim 4 or 12 would have been rendered obvious based on Koskinen.

134. Claims 4 and 12 depend from claims 3 and 10 (and ultimately claims 1 and 8), respectively, and include all of the limitations that Koskinen fails to teach for those claims.

135. In particular, Koskinen fails to teach delivering PDCP SDUs “to the upper layer according to the order of the PDCP SN” when “the PDCP SDU of PDCP SN # $n-1$ is obtained” prior to expiration of the “in-sequence timer for the PDCP SDU of PDCP SN # n .” This is recited in both claims 4 and 12 and are not taught to a POSITA by Koskinen. The reordering timer in Koskinen teaches what happens when it expires, but it does not teach what happens when the timer does not expire. Koskinen does not teach what happens when PDUs are received out of order prior to the expiration of the reordering timer.

136. The Petition asserts “POSITAs would have recognized, at least in certain circumstances, the UE receives the missing PDCP PDU [] because the eNB has indicated the PDU was sent and the timer would not expire before it is received” and “[d]elivering consecutive PDCP PDUs without gaps is further disclosed in

‘embodiments in which both a timer and a forwarding-status report are included.’”

Pet. at 30-31. However, this does not teach a POSITA the elements of claim 4 or 12.

137. For example, paragraph 45 of Koskinen it is clear that Koskinen merely teaches regarding “just one example embodiment”—and in this paragraph, reception of out-of-sequence SDUs is not disclosed, nor is any transmission prior to the expiration of Koskinen’s reordering timer.

138. In my opinion, Koskinen neither discloses nor renders obvious either of these aspects, and thus does not render obvious claims 4 or 12. Instead, these claim elements teach reordering and delivery of received SDUs prior to the expiration of the in-sequence timer.

139. Therefore, the Petition fails to prove by a preponderance of the evidence that either claim 4 or 12 would have been rendered obvious based on Koskinen.

6. Koskinen Fails to Render Obvious Claims 5 and 11

140. In my opinion, the Petition and Dr. Lo fail to show by a preponderance of the evidence that either claim 5 or 11 would have been rendered obvious based on Koskinen.

141. Claims 5 and 11 depend from claims 2 and 10 (and ultimately claims 1 and 8), respectively, and therefore include all of the limitations that Koskinen fails

to teach with regard to the independent claims, as detailed above.

B. Ground 2: The Combination of Koskinen and Sammour Does Not Render Obvious Claims 1-5 and 8-12

142. In my opinion, the addition of Sammour to the teachings of Koskinen does nothing to resolve the deficiencies of Koskinen explained above.

143. Based on my review of the Petition, Dr. Lo and Petitioner use Sammour for only one missing piece of the claims. The Petition states “POSITAs would have been motivated to extend Koskinen to incorporate Sammour’s ‘flush timer’ in Koskinen’s RRC.” Pet. at 39-43. Curiously, it appears that Dr. Lo may not even support the Petition’s position. During his deposition, Dr. Lo testified that he has no opinion on what the flush timer does: “I don’t have any opinion on what the flush timer, okay? Here it’s not -- the point is not what the timer does. To me it’s not important here.” EX2013 at 102:6-9.

144. I disagree. The combination of Koskinen and Sammour would not have been obvious to achieve the claimed elements. Even if Koskinen and Sammour were combined, the resulting combination does not teach each claim element of the Challenged Claims, as explained herein.

145. Even considering the “flush timer” disclosures of Sammour alongside the teachings of Koskinen, it is my opinion that a POSITA would not have found the claimed invention to be obvious. For example, Koskinen suggests that reordering

“timer's expiry value can be configured by radio resource control (RRC) at 350, and can be set at 360 long enough so that the timer does not expire during normal delivery delay of protocol data units sent by the eNB to the user equipment via a small-cell node, for example, including all possible HARQ and ARQ retransmissions at MAC and RLC level therein, respectively.” EX1005 at ¶ 39.

146. But Sammour's “flush timer IE” does not disclose how to do this, and thus would not be obvious to combine with Koskinen. The “flush timer” of Sammour indicates whether to “stop reordering following handover,” and therefore is a handover-specific disclosure, which a POSITA would not look at to configure the “reordering timer” of Koskinen. Moreover, as the “flush timer” of Sammour is specific to the handover scenario, it is triggered at the beginning of the handover, not triggered by the skipping over any PDCP PDU(s) not received in sequence.

TABLE 8A

Name	Semantics description
SN Length (or SN Size)	Indicates the length of the SN (e.g. 12 bits or 7 bits)

EX1006, Table 8A.

147. As shown in Table 8A of Sammour (reproduced above), the sequence number for the PDCP is for the PDU as the information element described in Table

8A is used by the PDCP entity in generating PDCP PDUs. In addition, as the flush timer is used exactly once per RB during the handover, the flush timer would stop the reordering of PDCP PDUs received from the previous radio bearer (RB) for good.

148. Sammour also does not disclose that the “PDCP Flush Timer IE” might indicate a time “long enough so that the timer does not expire during normal delivery delay of protocol data units sent by the eNB to the user equipment,” as Koskinen seeks to accomplish with its reordering timer.

149. Therefore, for at least the foregoing reasons, including the reasons discussed above for Koskinen alone, it is my opinion that the alleged combination of Koskinen and Sammour fails to render obvious any of the Challenged Claims, contrary to the assertions of the Petition and Dr. Lo.

C. Ground 3: The Combination of Deenoo and Sammour Fails to Render Obvious Claims 1-5 and 8-12

150. In my opinion, the Petition and Dr. Lo have failed to show that any of claims 1-5 and 8-12 are obvious based on Deenoo and Sammour by a preponderance of the evidence, as I will explain below.

1. Petitioner Fails to Establish That Deenoo is Prior Art to the '573 Patent

151. As I explained above, the '573 Patent is entitled to its claimed priority date of May 10, 2013. In my analysis, Deenoo is not entitled to a priority date prior

to May 10, 2013.

152. From my review, the Institution Decision agreed that the PCT application to which Deenoo claims priority was filed on January 17, 2014. ID at 20. The Petitioner cites to various portions of Deenoo's provisional applications (U.S. Provisional Applications 61/753,867 filed January 17, 2013 and 61/811,233 filed April 12, 2013) to attempt to show support. However, it is my opinion that these provisional applications lack support for Deenoo.

153. For example, at least paragraph 211 and Figure 8 of Deenoo are not present or otherwise described in the priority applications. These portions of Deenoo are extensively cited in the Petition (pages 44, 55, 56, 60, 62, and 64) and by Dr. Lo in his declaration (¶¶205, 231, 233, 247, 251, and 260).

154. It is my understanding that Petitioner argued that "Figure 8 and paragraph 211 of Deenoo are based on and describe the sequence of events described in paragraphs 208-210 of Deenoo." Paper 13 at 15. However, paragraph 211 and Figure 8 of Deenoo teach more than paragraphs 208-210, and therefore support from the provisional applications is lacking. For example, paragraph 211 of Deenoo states that "[o]ne or more, or all, queued PDUs and/or advancing the PDCP receive window and/or canceling the re-ordering timer may be done, for example perhaps if the time to expiry for the reordering timer may be less than a configured report

threshold.” This is not described in paragraphs 208-210 of Deenoo.

155. Therefore, in my opinion, a POSITA would have recognized that the provisional applications to which Deenoo claims priority do not support the Deenoo patent, and thus Deenoo is not entitled to their priority date.

2. Petitioner Fails to Establish Any Motivation to Combine Deenoo and Sammour

156. It is my understanding that Petitioner and Dr. Lo asserts that a POSITA “would have been motivated to extend Deenoo to incorporate Sammour’s ‘flush timer’ configuration in Deenoo’s RRC.” Pet. at 45 (citing EX1003 at ¶¶206-212). Petitioner contends, without support from the references themselves, that “POSITAs would have been motivated to incorporate Sammour’s new PDCP reordering IEs in Deenoo to reliably configure Deenoo’s reordering timer when small cells are present with the macro cell and both sending data to the UE.” Pet. at 46 (citing EX1003 at ¶210). In my opinion, the combination of Deenoo and Sammour would not have been obvious to a POSITA, and instead is a result of impermissible hindsight reconstruction by Petitioner, as I will explain below.

157. To start, Sammour’s “flush timer IE,” when combined with the teachings of Deenoo would not render obvious the claimed invention. Looking first at Deenoo, Deenoo describes PDCP re-ordering that may include starting a reordering timer when an out of sequence packet is received from an RLC entity.

EX1007 at ¶211. Deenoo states that “[a] PDCP status report may be transmitted, for example to trigger retransmission, perhaps in some embodiments if the time to expiry for the reordering timer may be more than a configured report threshold.” *Id.* Deenoo further states “queued PDUs and/or advancing the PDCP receive window and/or canceling the re-ordering timer may be done, for example perhaps if the time to expiry for the reordering timer may be less than a configured report threshold.” *Id.*

158. But nowhere in Deenoo does it teach an in-sequence timer for the PDCP SDUs in which the UE receives, via an RRC message, a PDCP-configuration information element (IE) indicating a value of the in-sequence timer via an RRC message, as required by the claims of the '573 Patent.

159. In my opinion, a POSITA would not combine Sammour's teachings into Deenoo for these claim elements, unless applying hindsight, which is improper.

160. Contrary to the Petition's assertion, Sammour does not disclose how its flush timer IE and new PDCP reordering IEs could “reliably configure Deenoo's reordering timer when small cells are present with the macro cell and both sending data to the UE”. Pet. at 46. A POSITA would understand Sammour's flush timer to teach that it indicates whether to “stop reordering following handover.” Meaning, a POSITA would understand that Sammour is teaching that its flush timer is

specifically used for handover.

161. On the other hand, the reordering timer of Deenoo is used with multiple RLC entities receiving PDCP PDUs from the same PDCP entity. In reordering previously skipped over PDCP PDUs, Deenoo reordering timer must consider any PDCP PDUs received by different RLC entities, which complicates the handover mechanism disclosed in Sammour. Sammour is silent about having more than one RLC entity receiving PDCP PDUs from the same PDCP entity. As the handover mechanism itself is very complex, and it is highly unlikely that multiple RLCs can be established at the target Node B. Moreover, there is no explicit disclosure in Deenoo regarding use of sequence numbers associated with the PDCP SDU. Therefore, in my opinion, a POSITA would not look to configure the “reordering timer” of Deenoo in the event of small cells and the macro cell both sending data to the UE according to any disclosure in Sammour, nor would a POSITA reconfigure Deenoo’s reordering timer based on Sammour because Sammour does not teach how to configure an expiration of Deenoo’s timer.

162. Therefore, a POSITA would not have found it obvious to apply to dissimilar teachings of Sammour to the teachings of Deenoo and arrive at the claimed elements, except through hindsight, which is prevalent throughout the Petition’s and Dr. Lo’s positions.

3. Deenoo and Sammour Fails to Render Obvious Claim Elements 1[c] and 8[b]

163. Claim Element 1[c] recites “receiving from the macro base station information related to an in-sequence timer for the PDCP SDUs through a radio resource control (RRC) message.”

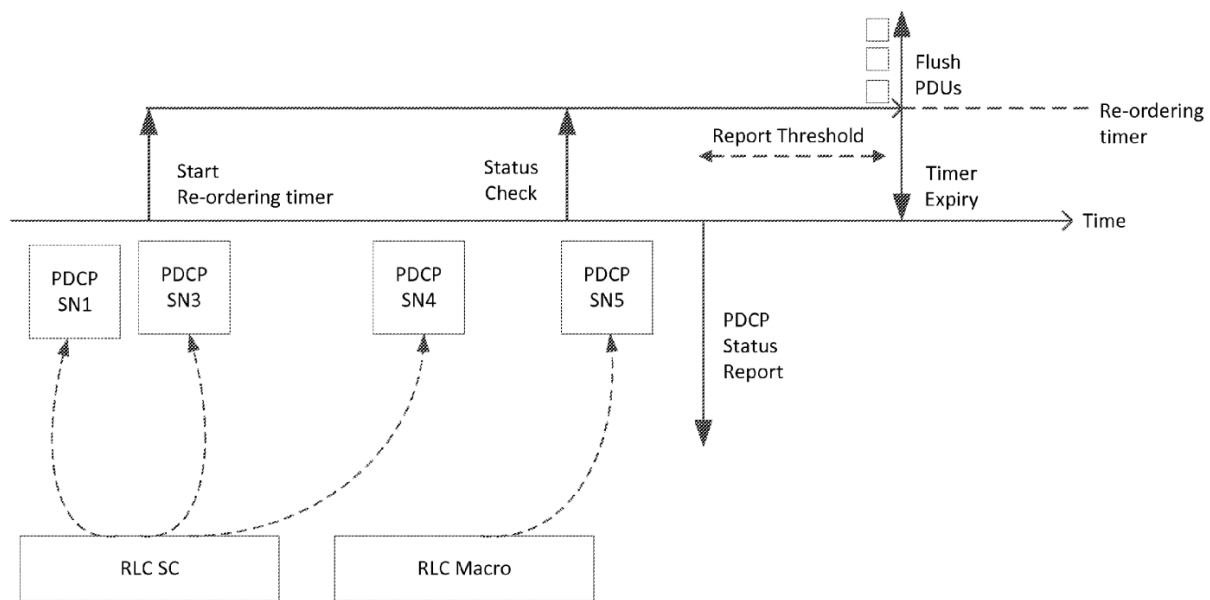
164. Claim Element 8[b] recites “receiving from the macro base station information related to in-sequence timer for the PDCP SDUs through a radio resource control (RRC) message.”

165. In my opinion, the Petition fails to establish that the alleged combination of Deenoo and Sammour would have rendered obvious these limitations.

166. It is helpful to start with an explanation of Deenoo. Deenoo describes PDCP re-ordering during a handover or re-establishment. EX1007 at ¶205. During handover, “the source RLC (in source SCeNB) may forward the queued UL RLC SDUs (e.g. potentially out-of-order) to macro PDCP,” which “buffer[s] these PDCP PDUs” until macro PDCP receives “in order transmission from the UE in the target SCeNB.” EX1007 at ¶205. The macro PDCP generates “a PDCP status report that may reflect the up-to-date status of the PDCP receiver in the macro [PDCP].” EX1007 at ¶205. During downlink, the UE RLC forwards “buffered DL RLC SDUs to the UE PDCP,” which “buffer[s] them until it may receive the transmission from

target SCeNB.” EX1007 at ¶206.

167. Petitioner relies on a re-ordering timer implemented in a re-ordering algorithm to purportedly render obvious the claimed in-sequence timer. A representative series of triggers for status and related actions for the reordering timer are shown in FIG. 8 of Deenoo:



EX1007, FIG. 8.

168. From my review of the Petition, it appears that the Petitioner realizes their issue that there is little to no support for their usage of Deenoo’s re-ordering timer because they only discuss it in a single conclusory sentence. Specifically, the Petition states “POSITAs would have found obvious the RRC message to the UE in RRC CONNECTED mode would be used to set the duration of the reordering timer

because the RRC message ‘configure[s] the measurement parameters/events/triggers for the UE.’” Pet. at 54 (citing EX1003 at ¶228; Deenoo at ¶143). Similarly, it is my understanding from Dr. Lo’s deposition that he relies only on two quoted portions of Deenoo: (1) “the macro cell may ‘send an RRC Connection reconfiguration to the UE with macro and/or the small cell configuration,’” and (2) “[m]acro eNB may configure the measurement parameters/events/triggers for the UE in an RRC CONNECTED mode.” See EX1003, ¶227; EX2013 at 108:17-109:23 (“essentially these two statements by Deenoo basically have all the information[] for a POSITA to go on and set up the timer information.”). But I can find no explanation of how a POSITA would make the connection between these teachings of Deenoo to the claimed “receiving from the macro base station information related to an in-sequence timer for the PDCP SDUs through a radio resource control (RRC) message.” Petitioner’s and Dr. Lo’s are unsupported and lack the necessary teachings to inform a POSITA how to achieve the claimed in-sequence timer from the teachings of Deenoo.

169. To correct these issues, it appears that the Petition then looks to Sammour’s flush timer IE to teach this claim element. However, as I already explained, a POSITA would have not found it obvious to combine Deenoo and Sammour in the manner asserted by Petitioner to achieve the claimed elements.

170. Sammour provides merely a broad description of a “Reordering Stop Mode IE.” Paragraph 146 of Sammour states that this mode “indicate[s] to the WTRU that the WTRU PDCP entity whether it should use the timer mechanism (e.g. Flush Timer) to stop reordering following handover, or whether it should use stop reordering after all stored PDCP SDUs have been delivered to upper layers.” EX1006 at ¶146. Sammour also briefly describes a “Flush Timer IE” that “indicate[s] to the WTRU the value of the flush timer that the WTRU should use to stop reordering for this RB.” *Id.* at ¶152.

171. Deenoo’s re-ordering timer and Sammour’s flush timer do not teach “a timer that begins upon the detection of an out-of-sequence SDU and lasts for a period of time,” which is the proper construction for the claimed in-sequence timer. Instead, Deenoo discloses a “re-ordering timer” that starts “as soon as out of sequence PDCP Data PDU SN>N (from say RLC1/RLC2) is received,” and Sammour describes a “flush timer IE” that is used in a Reordering Stop Mode” to stop reordering “following handover” or “after all stored PDCP SDUs have been delivered to upper layers.” EX1007 at ¶¶208-211; EX1006 at ¶¶149, 152. Because neither Sammour nor Deenoo explicitly teach the use of sequence numbers for the PDCP SDU, neither of these teachings, even if combined, render obvious an in-sequence timer for the PDCP SDUs, in which the timer begins upon the detection of an out-of-sequence

SDU and lasts for a period of time. Petitioner relies entirely on impermissible hindsight reconstruction of the claimed in-sequence timer.

172. Similar to my discussion above regarding Koskinen, my review of the prosecution history of the '573 Patent further supports my opinion. Again, the Applicant distinguished other forms of timers to achieve allowance of the patent application. The re-ordering timer of Deenoo and flush timer of Sammour are no different because they are not an in-sequence timer for PDCP SDUs based upon the detection of an out-of-sequence SDU.

173. It is my opinion that the Petition fails to show by a preponderance of the evidence that Claim Elements 1[c] and 8[b] would have been rendered obvious based on the alleged combination of Deenoo and Sammour.

4. Deenoo and Sammour Fails to Render Obvious Claim Elements 1[e] & 1[f] and 8[e] & 8[f]

174. Claim Element 1[e] (and similarly Claim Element 8[e]) recites “wherein the RRC message includes a PDCP-configuration information element (IE).”

175. Claim Element 1[f] (and similarly Claim Element 8[f]) recites “the PDCP-configuration IE includes a field indicating a value of the in-sequence timer.”

176. In my opinion, the Petition and Dr. Lo’s declaration fail to establish by the preponderance of the evidence that the alleged combination of Deenoo and

Sammour would have rendered obvious these limitations.

177. As described above, neither Sammour nor Deenoo explicitly teach the use of sequence numbers for the PDCP SDUs. Because of this lack of disclosure and teaching in Deenoo and Sammour, it appears that the Petition and Dr. Lo are forced to rely on the rather broad teachings of RRC and its use for communicating RRC parameters, including IEs, to leap to the conclusion that Deenoo and Sammour render obvious the specific requirements recited in claim 1; namely, the UE receives from the macro eNB an RRC message including a PDCP-configuration IE, which includes a field indicating a value of the in-sequence timer for a received PDCP SDU that sets a time period for receiving a missed PDCP SDU having a sequence number that is previous in sequence number to the received PDCP SDU.

178. Deenoo and Sammour fail to render obvious the claimed in-sequence timer because Deenoo's re-ordering timer and Sammour's flush timer do not teach a timer that begins upon the detection of an out-of-sequence SDU and lasts for a period of time. Therefore, in my opinion, Deenoo and Sammour fail to render obvious that an in-sequence timer, for which an RRC message is received by the UE that includes a PDCP-configuration IE with a field indicating a value of the in-sequence timer, as recited in Claim Elements 1[e], 1[f], 8[e], and 8[f].

179. In addition, Deenoo states that "the Macro eNB may configure the

measurement parameters/events/triggers for the UE in an RRC CONNECTED mode [and] [t]he UE may send the measurement report when the configured reporting criterion is satisfied.” EX1007 at ¶143. This simply describes to a POSITA that some unspecified information may be configured for the UE by the eNB via RRC messaging, which is a well-known concept in 3GPP that lacks any of the specific detail recited in the claims for configuring an in-sequence timer for the PDCP SDUs.

180. Sammour is similar in its lack of teachings. Sammour describes a general description of a “Reordering Stop Mode IE” that indicates “to the WTRU that the WTRU PDCP entity whether it should use the timer mechanism (e.g. Flush Timer)” and a “Flush Timer IE” that indicates “to the WTRU the value of the flush timer that the WTRU should use to stop reordering for this RB.” *Id.* at ¶¶148-152. Both of which may be provided in RRC messages. *Id.* at ¶¶148-153.

181. However, neither Deenoo nor Sammour teaches a POSITA to implement a PDCP-based in-sequence timer for a received PDCP SDU that sets a time period (signaled via a PDCP-configuration IE) for receiving a missed PDCP SDU having a sequence number that is previous in sequence number to the received PDCP SDU. Again, as explained above, neither Deenoo nor Sammour teaches the use of sequence numbers for the PDCP SDUs.

182. It is therefore my opinion that Deenoo and Sammour fail to render

obvious that the RRC message includes a PDCP-configuration IE with a field indicating a value of the in-sequence timer, as recited in Claim Elements 1[e], 1[f], 8[e], and 8[f], except through improper hindsight reasoning.

5. Deenoo and Sammour Fails to Render Obvious Claims 2 and 9

183. In my opinion, the Petition and Dr. Lo fail to show by a preponderance of the evidence that either claim 2 or 9 would have been rendered obvious based on Deenoo and Sammour.

184. Claims 2 and 9 depend from claims 1 and 8, respectively, and therefore include all of the limitations that the combination of Deenoo and Sammour fails to teach with regard to the independent claims, as detailed above.

6. Deenoo and Sammour Fails to Render Obvious Claims 3 and 10

185. In my opinion, the Petition and Dr. Lo fail to show by a preponderance of the evidence that either claim 3 or 10 would have been rendered obvious based on Deenoo and Sammour.

186. Claims 3 and 10 depend from claims 2 and 9 (and ultimately claims 1 and 8), respectively, and therefore include all of the limitations that the alleged combination of Deenoo and Sammour fails to teach with regard to those claims.

187. In addition, Deenoo and Sammour fail to render obvious the specifically claimed “confirming whether there is a PDCP SDU of PDCP SN #n-1

which is missed notwithstanding obtaining a PDCP SDU of PDCP SN #n; and driving the in-sequence timer with respect to the PDCP SDU of PDCP SN #n when there is the PDCP SDU of PDCP SN #n-1 which is missed.” Deenoo and Sammour do not teach “confirming” that a PDCP SDU has been missed. Further, Deenoo and Sammour fail to teach that either the reordering or flush timer is a timer “with respect to the PDCP SDU of PDCP SN #n when there is the PDCP SDU of PDCP SN #n-1 which is missed.” This is because the flush timer of Sammour and the reordering timer of Deenoo are triggered by any single missing PDCP PDU. Then, as long as this PDCP PDU remains missing, the flush timer of Sammour and the reordering timer of Deenoo stay active, whether or not any additional PDCP PDU(s) becoming missing before these timers expire. For example, after missing PDCP PDU #3, PDCP PDUs #4-20 and #22-30 are received, with missing PDCP PDU #21, before the timers expire. When the PDCP PDU #22 is received, even though PDCP PDU #21 is missing, the timers would not be retriggered and continue until the predetermined duration of time.

188. Therefore, in my opinion, the Petition fails to show by a preponderance of the evidence that either claim 3 or 10 would have been rendered obvious based on the alleged combination of Deenoo and Sammour.

7. Deenoo and Sammour Fails to Render Obvious Claims 4 and 12

189. In my opinion, the Petition and Dr. Lo fail to show by a preponderance of the evidence that either claim 4 or 12 would have been rendered obvious based on Deenoo and Sammour.

190. Claims 4 and 12 depend from claims 3 and 10 (and ultimately claims 1 and 8), respectively, and therefore include all of the limitations that the alleged combination of Deenoo and Sammour fails to teach with regard to those claims.

191. Further, Deenoo and Sammour do not disclose any functionality of delivering PDCP SDUs to the upper layer “according to the order of the PDCP SN” when “the PDCP SDU of PDCP SN # $n-1$ is obtained” prior to expiration of the “in-sequence timer for the PDCP SDU of PDCP SN # n ,” as required by claims 4 and 12. These claim elements concern both reordering received SDUs and delivery of them prior to the expiration of the in-sequence timer. Deenoo and Sammour are both silent as to what may or may not occur when PDUs are received out of order prior to the expiration of the reordering timer.

192. Therefore, in my opinion, the Petition fails to show by a preponderance of the evidence that either claim 4 or 12 would have been rendered obvious based on the alleged combination of Deenoo and Sammour.

8. Deenoo and Sammour Fails to Render Obvious Claims 5 and 11

193. In my opinion, Petitioner fails to show by a preponderance of the evidence that either claim 5 or 11 would have been rendered obvious based on Deenoo and Sammour for at least the above-mentioned reasons.

194. Claims 5 and 11 depend from claims 2 and 10 (and ultimately claims 1 and 8), respectively, and therefore include all of the limitations that the alleged combination of Deenoo and Sammour fails to teach with regard to those claims.

X. CONCLUSION

195. For at least the foregoing reasons, it is my opinion that the Petitioner and Dr. Lo have failed to show by a preponderance of the evidence that any of the Challenged Claims are unpatentable.

196. 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.

197. 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: January 7, 2026


Paul Min, Ph.D.

APPENDIX A

Paul S. Min, Ph.D.
Washington University in Saint Louis
(Webpage : <https://engineering.wustl.edu/faculty/Paul-Min.html>)

psm@wustl.edu
+1 (314) 853-6200 (phone)

Campus Box 1223
Academy Building Room 218A
St. Louis, MO 63130

Education

<u>Year</u>	<u>College or University</u>	<u>Degree</u>
1987	The University of Michigan	Ph.D. in Electrical Engineering
1984	The University of Michigan	M.S. in Electrical Engineering
1982	The University of Michigan	B.S. in Electrical Engineering

Professional Experience

From: 1990
To: Present
Organization: Washington University, St. Louis

Summary:

2015 - Senior Professor - Department of Electrical Systems Engineering

2011 – 2014 Chair – Undergraduate Curriculum, Department of Electrical and Systems Engineering

2000 – 2002 Chair – Graduate Curriculum, Department of Electrical and Systems Engineering

2002 - 2014 Associate Professor - Department of Electrical and Systems Engineering

1997 - 2008 On leave from full-time duty at Washington University – as Presidents of MinMax Technologies and Erlang Technology.)

1996 - 2002 Associate Professor - Department of Electrical Engineering

1996 Promoted with Tenure

1990 - 1996 Assistant Professor - Department of Electrical Engineering

- Teaching Experience
- “Transmission System and Multiplexing,” Washington University, ESE 571
 - “Electrical Laboratory I,” Washington University, EE 250.
 - “Communication Theory,” Washington University, ESE 471.
 - “Reliability and Quality Control,” Washington University, ESE 405/505
 - “Signaling and Control of Communications Networks,” Washington University, ESE 572.
 - “Introduction to Electronic Circuits,” Washington University, ESE232
 - “Queueing Systems and Discrete Stochastic Processes,” Washington University, EE 536 / CS 567.
 - “Digital Computer,” Washington University, EE 260M / CS 260.
 - “Data Networks,” Washington University, EE 530.
 - “Electrical Circuit Analysis,” Washington University, ESE 230.
 - “Computer/Communications System Analysis I,” Washington University, EE 557/ CS 557.
 - “Computer/Communications System Analysis II,” Washington University, EE558 / CS 558.
 - “Digital Systems Laboratory,” Washington University, EE 455 / CS 455.

From: 1999
To: 2008
Organization: Erlang Technology, Inc., St. Louis, Missouri
Title: Founder and President
Summary: Up to 70 employees, \$40M in total capital raised from 5 VCs and 3 Corporations
Received “Product of Year” Award from Analog Zone Magazine in 2004

From: 1997
To: 1999
Organization: MinMax Technologies, Inc., St. Louis, Missouri
Title: Founder and President
Summary: Fabless semiconductor company, designing high performance switching ASICs

From: September 1987
To: August 1990
Organization: Bellcore, New Jersey
Title: Member of Technical Staff
Summary: Member of New Network Architecture Development Group

From: 1983
To: 1987

Organization: Department of Electrical Engineering, The University of Michigan
Title: Graduate Instructor
Summary: Instructor for senior level Electrical Engineering Laboratory Class. Received a Best “Best Graduate Instructor Award” from the Department of Electrical Engineering

Professional Affiliations, Achievements & Awards

- Technical Program Committee, COMCAS 2021, Tel Aviv, November 2021.
- Technical Program Committee, COMCAS 2019, Tel Aviv, November 2019.
- Technical Program Committee, COMCAS 2017, Tel Aviv, November 2017.
- Technical Program Committee, COMCAS 2015, Tel Aviv, October 2015.
- Past-Chair, Saint Louis Section of the Institute of Electrical and Electronics Engineers (IEEE), 2015.
- Member of Executive Committee, Saint Louis Section of the IEEE, 2010-2015.
- Chair, Saint Louis Section of the IEEE, 2014.
- Technical Program Committee, COMCAS 2013, Tel Aviv, October 2013.
- Vice Chair, Saint Louis Section of the IEEE, 2013
- Treasurer, Saint Louis Section of the IEEE, 2012.
- The Best Paper Award at MOBILITY 2011, October 2011, Barcelona, Spain.
- Counselor, Student Chapter of the Year, the Institute of Electrical and Electronics Engineers, 2011.
- Award of Appreciation, Saint Louis Section of the Institute of Electrical and Electronics Engineers, 2011, for contribution to various activities of the Saint Louis Section the Institute of Electrical and Electronics Engineers.
- Secretary, Saint Louis Section of the IEEE, 2010.
- Counselor, Student Chapter of the Year, the Institute of Electrical and Electronics Engineers, 2010.
- Wall Street Journal Businessmen of Year, 2003.
- American Men and Women of Science, listed in 1997.
- Member, Eta Kappa Nu (Honor Society for Electrical Engineers), inducted in 1992
- Outstanding Achievement Award, Bellcore, 1990.
- 18th ISATA Award of Technical Excellence, the best paper award at ISATA 1988.
- Rockwell Fellow, Rockwell International, 1985, 1986.
- Outstanding Graduate Student Award, the University of Michigan, 1985.
- Outstanding Teaching Award, the University of Michigan, 1984, 1986.
- Member of Honor's College, the University of Michigan, 1979, 1980.

- Honor's Convocation, the University of Michigan, 1979.
- Outstanding Freshman Award, the University of Michigan, 1979.
- Woodhaven Rotary Club Scholarship, Woodhaven Rotary Club, 1978.
- Second Place Winner, the State of Michigan Mathematics Prize Competition, 1977.
- International Program Committee, *IASTED International Conference on Communications, Internet and Information Technology (CIIT 2005)*, Cambridge, Massachusetts from October 31-November 2, 2005.
- International Program Committee, *IASTED International Conference on Communications 2003*, Scottsdale, Arizona, 2003.
- International Program Committee, *Wireless and Optical Communications 2003*, Banff, Canada, 2003.
- International Program Committee, Session Chair, *Wireless and Optical Communications 2002*, Banff, Canada, 2002.
- Invited participant, *NSF Workshop on Enhancing International Cooperation in CS/CE Research and Education*, Portland, 1997.
- Session Chair, *the 1993 Conference on Information Sciences and Systems*, Baltimore, March 1997.
- Member, Board of Editors, *Journal of Network and Systems Management*, 1996-1998.
- Program Committee, *International Symposium on Integrated Network Management*, San Diego, 1997.
- Guest Editor, *Journal of Network and Systems Management, Special Issue on Routing in Broadband Networks*, December 1995 and June 1996.
- Invited participant, *ARPA Workshop on Survivability of Large Scale Systems*, Washington D.C., 1996.
- Special Event Organizer, *International Symposium on Integrated Network Management*, Santa Barbara, 1995.
- Organizing Committee, *International Symposium on Integrated Network Management*, Santa Barbara, 1995.
- Local Arrangements Chair, *IEEE Information Theory Workshop on Information Theory Multiple Access and Queueing*, St. Louis, 1995.
- Chair, *Communications Chapter, St. Louis Section of the IEEE*, 1995.
- Participant, *IEEE Information Theory Workshop on Information Theory, Multiple Access and Queueing*, St. Louis, 1995.
- Participant, *ARPA/AFOSR Non-Linear Optics and Communication Workshop*, Denver, 1994.
- Participant, *CNRI Giga Bit Network Workshop*, Washington D.C., 1993.
- Participant, *IFIP/IEEE International Workshop on Distributed Systems*, New Jersey, 1993.
- Program Committee, *International Conference on Computer Communications and Networks*, San Diego, 1992.
- Session Chair, *ISMM International Conference*, New Orleans, 1990.
- Senior Member, *IEEE*.

- Member, *IEEE Committee on Network Operations and Management*.
- Member, *IEEE Committee on Computer Communications*.
- Registered Specialist, *Hong Kong Research Grant Council*.
- Reviewer, *IEEE Transactions on Communications*.
- Reviewer, *IEEE Transactions on Networking*.
- Reviewer, *IEEE Journal on Selected Areas in Communications*.
- Reviewer, *Journal of Network and Systems Management*.
- Reviewer, *Telecommunication Systems*.
- Reviewer, *Computers and Electrical Engineering*.
- Reviewer, *ETRI Journal*.
- Reviewer, *IEEE Transactions on Automatic Control*.
- Reviewer, *IEEE Communications*.
- Book Reviewer, *Prentice Hall*.
- Book Reviewer, *Morgan Kaufmann Publishers, Inc.*
- Book Reviewer, *Irwin Publishing Co.*

University Activities:

- Undergraduate Studies Committee, School of Engineering and Applied Science (2012 – Present)
- Faculty Advisor for IEEE Student Chapter (2009 – Present)
- Ambassador for McDonnell International Scholar Academy (2007 – 2013)
- Web Development Committee (2006 – 2008)
- University Judicial Board (1998 - 2000)
- Resource Generation Committee (1994 - 1995)
- Top 20 Committee (1992 - 1995)
- Telecommunications Committee, Chair (1991 - 1997)
- Library Planning Committee (1991 - 1992)
- Computer Engineering Committee (1990 - 1996)
- Communications Curriculum Committee (1990 - 1992)
- Resources Committee (1990 - 1992)

Patents

<u>Patent No.</u>	<u>Date</u>	<u>Title</u>
10,623,323	04/14/20	Network Devices and a Method for Signature Pattern Detection
10,284,476	05/07/19	Hierarchical Pattern Matching Devices and Methods

7,110,411	09/19/06	Method of and Apparatus for WFQ Scheduling Using a Plurality of Scheduling Queues to Provide Fairness, High Scalability, and Low Computational Complexity
7,106,738	09/12/06	Method of and Apparatus for High Speed Packet Switching Using Train Packet Queuing and Providing High Scalability
6,859,455	02/22/05	Method of and Apparatus for Building and Using Multi-Dimensional Index Trees for Multi-Dimensional Data Objects
6,614,789	09/02/03	Method of and Apparatus for Matching Strings of Different Lengths
6,359,885	3/19/02	Multi-Channel Packet Switching Apparatus Having Traffic Flow Controlling and Checking Functions
6,128,292	10/03/00	Packet Switching Apparatus with Multi-Channel and Multi-Cast Switching Functions and Packet Switching System Using the Same
5,788,161	12/13/98	Network Designer for Communication Networks
5,526,352	06/11/95	Integrable Low Complexity Multi-Channel Switch
5,440,549	08/08/95	Nonblocking Multi-Channel Switching with Multicasting Capability

Publications

- Yu, Qixiang, Luo, Z., and Min, P.S., “Intrusion Detection in Wireless Sensor Networks for Destructive Intruders.” Proceedings of the APSIPA 2015 conference. December 16-19, 2015.
- Hung, C.P., and Min, P.S., “Simple Web Application Framework.” Submitted for publication in the IEEE Transactions on Cloud Computing.
- Luo, Z., and Min, P.S., “Parallel Implementation of Energy-Based Target Localization Methods in Wireless Sensor Networks.” Proceeding of the 2014 IEEE SOUTHEASTCON.
- Yu, Q., Luo, Z., and Min, P.S., “Intrusion Detection in Wireless Sensor Networks for Destructive Intruder.” Proceeding of 2014 International Conference on Smart Computing (SMARTCOMP 2014).
- Luo, Z., and Min, P.S., “Survey of Target Localization Methods in Wireless Sensor Networks,” 19th IEEE International Conference on Networks (ICON 2013), Singapore, December 11-13, 2013.
- Hung, C.P., and Min, P.S., “Deriving and Visualizing the Lower Bounds of Information Gain for Prefetch Systems,” 19th IEEE International Conference On Networks (ICON 2013), Singapore, December 11-13, 2013.
- Hung, C.P., and Min, P.S., “Access LUT without CAM - Improved Pearson Hashing for Collision Reduction,” 19th IEEE International Conference On Networks (ICON 2013), Singapore, December 11-13, 2013.
- Luo, Z and Min, P.S., “Target Localization in Wireless Sensor Networks for Industrial Control with Selected Sensors.” International Journal of Distributed Sensor Networks, Volume 2013 (2013), Article ID 304631.
- Hung, C.P., and Min, P.S. “Performance Evaluation of Distributed Mobile Application Virtualization Services,” International Journal on Advances in Internet Technology, Vol. 5, no. 3&4, 2012, pp. 65-83.

- Hung, C.P. and Min, P.S., “Performance evaluation of distributed application virtualization services using the UMTS mobility model,” *MOBILITY 2011 The First International Conference on Mobile Services, Resources, and Users*, 23-29 Oct. 2011.
- Hung, C.P. and Min, P.S., “Service Area Optimization For Application Virtualization Using UMTS Mobility Model,” *International Conference on Internet Computing*, pp. 128-134, Las Vegas, July 18-21, 2011.
- Hung, C.P. and Min, P.S., “Application Virtualization Using UMTS Mobility Model,” *ICOMP'11*, September, 2011.
- Hung, C.P. and Min, P.S., “Infrastructure Arrangement for Application Virtualization Service,” the 9th International Information and Telecommunication Technologies Symposium, Vol.1, pp. 78-85, Rio de Janeiro, December 2010.
- Hung, C.P. and Min, P.S., “Probabilistic Approach to Network-Based Virtual Computing,” the 9th International Information and Telecommunication Technologies Symposium, Vol.1, pp. 117-124, Rio de Janeiro, December 2010.
- Shiravi, A. and Min, P. S., “On the Latency Bound of Proportional Nested-DRR with Credit Adjusting,” *2007 Workshop on High Performance Switching and Routing HPSR 2007*, July 2007.
- Shiravi, A. and Min, P. S., “LOOFA-PB: A Modified LOOFA Scheduler for Variable-Length Packet Switching,” *2007 IEEE International Conference on Communications (ICC 2007)*, Glasgow, June 2007.
- Shiravi, A., Kim, Y. G., and Min, P. S., “Congestion Prediction of Self-Similar Network through Parameter Estimation,” *Proceedings of 2006 IEEE/IFIP Network Operations & Management Symposium*, April 2006, Vancouver.
- Shiravi, A., Kim, Y. G., and Min, P. S., “Traffic Dispatching Algorithm in Three-Stage Switch,” *Proceedings of 5th International Conference on Networking*, April 2006, Mauritius.
- Shiravi, A., Kim, Y. G., and Min, P. S., “Proportional Nested Deficit Round Robin with Credit Adjusting,” *Proceedings of 2nd Int’l Conf. on Quality of Service in Heterogeneous Wired/Wireless Networks (QShine 2005)*, Orlando, August 2005.
- Shiravi, A., Kim, Y. G., and Min, P. S., “Proportional Nested Deficit Round Robin: Improving the Latency of Packet Scheduler with an $O(1)$ Complexity,” *Proceedings of International Workshop on Advanced Architectures and Algorithms for Internet Delivery and Applications (AAA-IDEA 2005)*, Orlando, June 2005
- Kim, Y. G., Shiravi, A., and Min, P. S., “Prediction-Based Routing through Least Cost Delay Constraint,” *Proceedings of IEEE IPDPS 2004*, Santa Fe, April 2004.
- Kim, Y. G. and Min, P. S., “On the Prediction of Average Queuing Delay with Self-Similar Traffic,” *Proceedings of IEEE GLOBECOM 2003*, San Francisco, December 2003.
- Hu, C., Saidi, H., Yan, P. Y., and Min, P.S., “A Protocol Independent Policer And Shaper Using Virtual Scheduling Algorithm,” *Proceedings of ICCAS 2002*.

- Hu, C., Saidi, H., and Min, P.S., "DB_WFQ: An Efficient Fair Queueing Using Binary Counter," *Proceeding of Coins 2002*.
- Yoon, U. and Min, P.S., "Performance Analysis of Radio Link Control Mechanism in W-CDMA System", IEEE VTC'01 Fall, October 2001, New Jersey
- Akl, B., Hegde, M.V., Naraghi-Pour, M., and Min, P.S., "Multi-Cell CDMA Network Design," *IEEE Transaction on Vehicular Technology*, Volume 50, No. 3, pp. 711-722, May 2001.
- Yoon, U., Park, S., Min, P.S., "Performance Analysis of Multiple Rejects ARQ at RLC (Radio Link Control) for Packet Data Service in W-CDMA System," *IEEE Globecom*, November 2000, San Francisco.
- Yoon, U., Park, S., Min, P.S., "Performance Analysis of Multiple Rejects ARQ for RLC (Radio Link Control) in the Third Generation Wireless Communication," *WCNC*, September 2000, Chicago.
- Yoon, U., Park, S., Min, P.S., "Network Architecture and Wireless Data Service Protocol based on Mobile IP toward the Third Generation Wireless Communication," *3G Wireless*, June 2000, San Francisco, pp. 211-215
- R.G. Akl, M.V. Hegde, M. Naraghi-Pour, P.S. Min, "Multi-Cell CDMA Network Design," *IEEE International Conference on Communications*, June 2000.
- R.G. Akl, M.V. Hegde, M. Naraghi-Pour, P.S. Min, "CDMA Network Design to Meet Non-uniform User Demand," *International Teletraffic Congress*, March 2000.
- R.G. Akl, M.V. Hegde, M. Naraghi-Pour, P.S. Min, "CDMA Network Design," *IEEE Transactions on Vehicular Technology*.
- R.G. Akl, M.V. Hegde, M. Naraghi-Pour, P.S. Min, "Cell Placement in a CDMA Network," *IEEE Wireless Communications and Networking Conference*, September 1999, Volume 2, pp. 903-907.
- R.G. Akl, M.V. Hegde, P.S. Min, "Effects of Call Arrival Rate and Mobility on Network Throughput in Multi-Cell CDMA," *IEEE International Conference on Communications*, June 1999, Volume 3, pp. 1763-1767.
- Hegde, M.V., Schmid, O.A., Saidi, H., and Min, P.S., "Real-Time Adaptive Bandwidth Allocation for High-Speed ATM Switches," accepted, *International Conference on Communications*, June 1999.
- Akl, B.G., Hegde, M.V., and Min, P.S., "Effects of Mobility on Network Throughput in Multicell CDMA Networks," accepted, *International Conference on Communications*, June 1999.
- Akl, B.G., Hegde, M.V., Min, P.S., and Naraghi-Pour, M., "Flexible Allocation of Capacity in Multi-Cell CDMA Networks," accepted, *Vehicular Technology Conference*, June 1999.
- R.G. Akl, M.V. Hegde, M. Naraghi-Pour, P.S. Min, "Flexible Allocation of Capacity in Multi-Cell CDMA Networks," *IEEE Vehicular Technology Conference*, May 1999, Volume 2, pp. 1643-1647.

- Oh, M.S., and Min, P.S., "Reliability Analysis for One-Turn and Deflection Crossbar Architectures and Distributed Fault Recovery Scheme," *Proceedings of GLOBECOM 97*, Phoenix, November 1997.
- Kim, K.B., Yan, P.Y., Kim, K.S., Schmid, O., and Min, P.S., "A Growable ATM Switch with Embedded Multi-Channel Multicasting Property," *Proceedings of GLOBECOM 97*, pp. 222-226, Phoenix, November 1997.
- Kim, K.B., Yan, P.Y., Kim, K.S., Schmid, O., and Min, P.S., "MASCON: A Single IC Solution to ATM Multi-Channel Switching with Embedded Multicasting," *Proceedings of ISS 97*, pp. 451-458, Toronto, September 1997.
- Maunder, A.S., and Min, P.S., "Investigation of Rate Control in Routing Policies for B-ISDN Networks," *Proceedings of the 15th International Teletraffic Congress*, Washington D.C., June 1997.
- Yan, P.Y., Kim, K.B., Kim, K.S., and Min, P.S., "A Large Scale ATM Switch System Using Multi-Channel Switching Paradigm," *Proceedings of ATM Workshop*, Lisbon, Portugal, May 1997.
- Yan, P.Y., Kim, K.S., Min, P.S., and Hegde, M.V., "Multi-Channel Deflection Crossbar (MCDC): A VLSI Optimized Architecture for Multi-Channel ATM Switching," *Proceedings of IEEE INFOCOM 97*, Kobe, Japan, April 1997.
- Maunder, A., Rayes, A., and Min, P.S., "Analysis and Rate Controlling Link: Leaky Bucket with Finite Servers," *Proceedings of the 1997 Conference on Information Sciences and Systems*, Baltimore, March 1997.
- Shin, S.W., Min, P.S., and Kim, J.H., "Real Time Traffic Management System at Korean Mobile Telecom," *Proceedings of 19th Annual Pacific Telecommunications Conference*, pp. 113-121, Honolulu, Hawaii, January 1997.
- Min, P.S., Hegde, M.V., Chandra, A., and Maunder, A.S., "Analysis of Banyan Based Copy Networks with Internal Buffering," *Journal of High Speed Networks*, Volume 5, No. 3, pp. 259-275 November 1996.
- Vargas, C., Hegde, M.V., Naraghi-Pour, M., and Min, P.S., "Shadow Prices for Least Loaded Routing and Aggregated Least Busy Alternate Routing," *IEEE Transactions on Networking*, Volume 4, No. 5, pp. 796-807, October 1996.
- Shin, S.W., Kwon, S.M., and Min, P.S., "Capacity Analysis of CDMA with Nonuniform Cell Loading and Sizes," *Proceedings of the 34th Annual Allerton Conference*, October 1996.
- Hegde, M.V., Min, P.S., and Sohraby, K., "Note from Guest Editors," *Journal of Network and Systems Management*, Volume 4, No. 2, pp. 101-102, June 1996.
- Rayes, A. and Min, P.S., "Application of Shadow Price in Capacity Expansion of State Dependent Routing," *Journal of Network Systems Management*, Volume 4, No. 1, pp. 71-93, March 1996.
- Min, P.S., "PCS Revolution in the United States," *Electronics News*, No. 2277, January 22, 1996. Translated and published in Korean.

- Hegde, M.V., Min, P.S., and Sohraby, K., "Guest Editorial," *Journal of Network and Systems Management*, Volume 3, No. 4, pp. 347-349, December 1995.
- Min, P.S., Hegde, M.V., Saidi, H., and Chandra, A., "Nonblocking Copy Networks in Multi-Channel Switching," *IEEE Transactions on Networking*, Volume 3, No. 6, pp. 857-871, December 1995.
- Rayes, A. and Min, P.S., "Capacity Expansion of Least Busy Alternate Routing with Shadow Price," *Proceedings of GLOBECOM 95*, Singapore, November 1995.
- Min, P.S., Hegde, M.V., Chandra, A., and Maunder, A., "Throughput and Delay for Copy Networks with Internal Buffers," *Proceedings of the 33rd Annual Allerton Conference*, October 1995.
- Min, P.S., Hegde, M.V., Saidi, H., and Chandra, A., "Fanout Splitting in Nonblocking Copy Networks with Shared Buffering," *Proceedings of the 33rd Annual Allerton Conference*, October 1995.
- Min, P.S., Hegde, M.V., and Rayes, A., "Estimation of Exogenous Traffic Based on Link Measurements in Circuit-Switched Networks," *IEEE Transactions on Communications*, Volume 43, No. 8, pp. 2381-2390, August 1995.
- Maunder, A., Rayes, A., and Min, P.S., "Analysis of Routing Policies in Broadband Networks." Invited paper. *Canadian Journal of Electrical and Computer Engineering*, Special Issue on Planning and Designing of Broadband Networks, Volume 20, No. 3, pp. 125-136, July 1995.
- Min, P.S., Hegde, M.V., Saidi, H., and Chandra, A., "Architecture and Performance of Nonblocking Copy Networks with Multi-Channel Switching," *Proceedings of APCC 95*, pp. 531-535, Osaka, Japan, June 1995.
- Saidi, H., Min, P.S., and Hegde, M.V., "A New Structural Property of Statistical Data Fork," *IEEE Transactions on Networking*, Volume 3, No. 3, pp. 289-298, June 1995.
- Min, P.S., Saidi, H., and Hegde, M.V., "A Nonblocking Architecture for Broadband Multi-Channel Switching," *IEEE Transactions on Networking*, Volume 3, No. 2, pp. 181-198, April 1995.
- Min, P.S., Hegde, M.V., Saidi, H., and Chandra, A., "Multi-Channel Copy Networks: Architecture, Performance Model, Fairness, and Cell Sequencing," *Proceedings of IEEE INFOCOM 95*, pp. 931-938, Boston, April 1995.
- Min, P.S., Hegde, M.V., and Chandra, A., "Analysis of Packet Movements in Internally Buffered Copy Networks," *Third ORSA Telecommunications Conference*, p. 141, Boca Raton, Florida, March 1995.
- Maunder, A. and Min, P.S., "Routing for Multi-Rate Traffic with Multiple Qualities of Service," *Proceedings of the Third International Conference on Computer Communications and Networks*, pp. 104-108, San Francisco, September 1994.
- Saidi, H. and Min, P.S., "Performance Benefits of Multi-Channel Switching," *Proceedings of the 32nd Annual Allerton Conference*, pp. 583-592, September 1994.
- Min, P.S., "Book Review: 'Telecommunications Network Management into the 21st Century'," *IEEE Communications*, Volume 32, No. 7, pp. 5-8, July 1994.

- Saidi, H., Min, P.S., and Hegde, M.V., "Guaranteed Cell Sequence in Nonblocking Multi-Channel Switching," *Proceedings of IEEE INFOCOM 94*, Toronto, pp. 1420-1427, June 1994.
- Min, P.S., Hegde, M.V., Saidi, H., and Chandra, A., "Shared Buffering in Nonblocking Copy Networks," *Proceedings of the 1994 IEEE International Symposium on Information Theory*, Norway, p. 406, June 1994.
- Min, P.S., Hegde, M.V., and Rayes, A., "Real Time Traffic Estimation in Circuit-Switched Networks," *Proceedings of the 14th International Teletraffic Congress*, France, pp. 1175-1184, June 1994.
- Hegde, M.V., Min, P.S., and Rayes, A., "State Dependent Routing: Traffic Dynamics and Performance Benefits," *Journal of Network and Systems Management*, Volume 2, No. 2, pp. 125-149, June 1994.
- Saidi, H., Min, P.S., and Hegde, M.V., "Control of Packet Flow in Statistical Data Forks," *Proceedings of the 1994 International Conference on Communications*, New Orleans, pp. 415-419, May 1994.
- Saidi, H., Min, P.S., and Hegde, M.V., "Nonblocking Multi-Channel Switching in ATM Networks," *Proceedings of the 1994 International Conference on Communications*, New Orleans, pp. 701-705, May 1994.
- Maunder, A. and Min, P.S., "Analysis and Development of Routing Schemes for Multi-Rate, Multi-Point Traffic," *Proceedings of the 1994 Conference on Information Sciences and Systems*, Princeton, pp. 1041-1046, March 1994.
- Min, P.S., Hegde, M.V., and Chandra A., "Internal Buffering in Banyan-Based Copy Networks," *Proceedings of the 1994 Conference on Information Sciences and Systems*, Princeton, pp. 209-214, March 1994.
- Rayes, A. and Min, P.S., "Capacity Expansion in State Dependent Routing Schemes," *Proceedings of the 1994 Conference on Information Sciences and Systems*, Princeton, pp. 237-241, March 1994.
- Vargas, C., Hegde, M.V., Naraghi-Pour, M., and Min, P.S., "Shadow Prices for State Dependent Routing," *Proceedings of the 1994 Conference on Information Sciences and Systems*, Princeton, pp. 243-248, March 1994.
- Saidi, H., Min, P.S., and Hegde, M.V., "Non-Blocking Multi-Channel Switching." Invited paper. *Proceedings of the 31st Annual Allerton Conference*, pp. 335-344, September 1993.
- Min, P.S., Hegde, M.V., and Rayes, A., "Model Based Estimation of Exogenous Traffic," *Proceedings of the 1993 Conference on Information Sciences and Systems*, Baltimore, pp. 126-131, March 1993.
- Hegde, M.V., Min, P.S., and Rayes, A., "Performance Analysis of State Dependent Routing," *Proceedings of the 1993 Conference on Information Sciences and Systems*, pp. 695-700, Baltimore, March 1993.
- Hegde, M.V. and Min, P.S., "Telephone Networks," *Magill Survey of Science Applied Science*, Salem Press, pp. 2624-2630, 1992.

- Saidi, H., Min, P.S., and Hegde, M.V., "Assignment of 2^k Trunk Groups in Multi-Channel Switches Using Generalized Binary Addresses," *Proceedings of the 30th Annual Allerton Conference*, pp. 652-661, September 1992.
- Hegde, M.V. and Min, P.S., "Performance Analysis of State Dependent Routing." Invited paper. *Second ORSA Telecommunications Conference*, Boca Raton, Florida, February 1992.
- Rizzoni, R. and Min, P.S., "Detection of Sensor Failures in Automotive Engines," *IEEE Transactions on Vehicular Technology*, Volume 40, No. 2, pp. 487-500, May 1991.
- Min, P.S. and Hegde, M.V., "End-to-End Planning Models for Optimal Evolution of Telecommunications Network," *Proceedings of IEEE INFOCOM 90*, San Francisco, pp. 200-206, June 1990.
- Min, P.S., "Validation of Controller Inputs in Electronically Controlled Engines." Invited paper. *Proceedings of the 1990 American Control Conference*, pp.2887-2890, San Diego, May 1990.
- Min, P.S. and Youn, C., "Generic Equipment Models (GEM) for Consistent Planning of Telecommunications Networks," *Proceedings of the 1990 ISMM International Conference*, New Orleans, pp. 190-194, March 1990.
- Min, P.S., "Robust Application of Beard-Jones Detection Filter," *Advances in Computing and Control*, Springer-Verlag, Volume 130, pp. 162-173, 1989.
- Min, P.S. and Ribbens, W.B., "A Vector Space Solution to Incipient Sensor Failure Detection," *IEEE Transactions on Vehicular Technology*, Volume 38, No.3, pp. 148-158, August 1989.
- Min, P.S., "Robust Application of Beard-Jones Detection Filter," *Proceedings of the 1989 American Control Conference*, Pittsburgh, pp. 859-864, June 1989.
- Rizzoni, G. and Min, P.S., "Real Time Detection Filters for the On-board Diagnosis of Incipient Failures," *Proceedings of the 1989 International Symposium on Allied Technology and Automation*, pp. 1445-1466, Paper No. 89131, Florence, Italy, June 1989.
- Min, P.S., "Diagnosis of On-Board Sensors in Internal Combustion (IC) Engines," *Proceedings of the 1989 American Control Conference*, Pittsburgh, pp. 1065-1070, June 1989.
- Min, P.S., "Detection of Incipient Sensor Failures in Internal Combustion Engines," *Proceedings of the 1988 International Symposium on Allied Technology and Automation*, Paper No. 88038, Florence, Italy, June 1988.

Testimony Provided or Expected to Provide as Expert Witness

Matter: Patent Infringement for Cellular Networks
Law Firm: Arnold and Porter Kaye Scholer LLP

Case Name: Truesight Communications LLC v. Samsung Electronics Co., Ltd., et al., No. 2:23-CV-00643-JRG (E.D. Tex.)
Testifying Expert for Samsung.
Completed in July 2025.
(Expert reports submitted and deposited.)

Matter: Inter Parte Reexamination for Cable Network
Law Firm: Marshall, Gerstein & Bourn LLP
Case Name: Patent reexamination in front of the U.S.P.T.O.
Testifying Expert for Charter Communications, Inc.
Retained in June 2024.
(Expert reports submitted and deposited.)

Matter: Inter Parte Reexamination for Transmission Networks
Law Firm: Haynes and Boone, LLP
Case Name: Patent reexamination in front of the U.S.P.T.O.
Testifying Expert for Cisco Systems, Inc.
Retained in April 2025.
(Expert reports submitted.)

Matter: Patent Infringement for Network Communication
Law Firm: Quinn Emanuel Urquhart & Sullivan LLP
Case Name: Cloud Byte, LLC v. Dell, Inc. and Dell Technologies, Inc., Case No. 2:24-cv-00637-JRG (E.D. Tex.)
Testifying Expert for Cloud Byte, LLP.
Retained in December 2024.
(Expert reports submitted.)

Matter: Inter Parte Reexamination for Air to Ground Communication
Law Firm: Quinn Emanuel Urquhart & Sullivan LLP
Case Name: Patent reexamination in front of the U.S.P.T.O.
Testifying Expert for GoGo, Inc.
Retained in April 2025.
(Expert reports submitted.)

Matter: Inter Parte Reexamination for Communication Networks
Law Firm: Willkie Farr & Gallagher LLP
Case Name: Patent reexamination in front of the U.S.P.T.O.
Testifying Expert for Lenovo Group Limited.
Retained in July 2024.
(Expert reports submitted.)

Matter: Patent Infringement for Network Communication
Law Firm: Quinn Emanuel Urquhart & Sullivan LLP
Case Name: Collision Communications, Inc. v. Samsung Electronics Co., Ltd., and Samsung Electronics America, Inc., Case No. 2:23-cv-00587 (U.S.D.C. ED. Tx)

Testifying Expert for Samsung.
Retained in March 2024.
(Expert reports submitted.)

Matter: Inter Parte Reexamination for Communication Network
Law Firm: Baker Botts LLP
Case Name: Patent reexamination in front of the U.S.P.T.O.
Testifying Expert for Arista Networks, Inc.
Retained in July 2024.
(Expert reports submitted.)

Matter: Patent Infringement for Cellular Communication
Law Firm: Fish & Richardson, P.C.
Case Name: In the Matter of Certain Cellular Base Station Communication Equipment,
Components Thereof, and Products Containing Same, ITC Investigation No. 337-
TA-1388
Testifying Expert for Lenovo.
Completed in September 2024.
(Expert reports submitted, deposed, and testified in the hearing.)

Matter: Patent Infringement for Wireless Local Area Networks
Law Firm: Quinn Emanuel Urquhart & Sullivan LLP
Case Name: Certain Audio Players and Components thereof (II). U.S.I.T.C. Inv. No. 337-TA-
1330.
Testifying Expert for Google Inc.
Completed in June 2023.
(Expert reports submitted, deposed, and testified in the hearing.)

Matter: Patent Infringement for Cellular Communication
Law Firm: Willkie Farr & Gallagher/Covington Burling/Fish & Richardson
Case Name: IPR against the validity of U.S. Patent No. 7,746,798
Testifying Expert for Lenovo.
Retained in August 2024.
(IPR declaration submitted.)

Matter: Patent Infringement for Wireless Communications
Law Firm: Alston & Bird
Case Name: Atlas Global Technologies LLC v. ASUSTek Computers Inc. USDC WD TX
Civil Action No. 6:21-cv-820
Testifying Expert for ASUSTek
Completed in November 2023
(Expert report submitted.)

Matter: Patent Infringement for Wireless Communications
Law Firm: Perkins Coie

Case Name: Bell Northern Research, LLC v. HMD AMERICA, INC. et al., Case No.: 1:22-cv-22706-SCOLA/GOODMAN (S.D. Fla.)
Testifying Expert for HMD
Completed in December 2023
(Expert report submitted. Deposed.)

Matter: Patent Infringement for Wireless Communications
Law Firm: LAW OFFICES S. J. CHRISTINE YANG
Case Name: Atlas Global Technologies LLC v. ZyXEL Communications Corp. et al., U.S.D.C., W.D.T.X., Waco Div., Case No. 6:22-cv-00355 Atlas Global Technologies LLC v. D-Link Corp. U.S.D.C., W.D.T.X., Waco Div., Case No. 6:22-cv-00520
Testifying Expert for ZyXel
Retained in March 2023.
(Expert report submitted.)

Matter: Patent Infringement for Wireless Communications
Law Firm: Finnegan, Henderson, Farabow, Garrett & Dunner, LLP
Case Name: Bell Northern Research v. MeidaTek Inc.
Testifying Expert for MediaTek Inc.
Retained in August 2023.

Matter: Patent Infringement for Home Security System
Law Firm: Foley and Lardner LLP
Case Name: Alarm.com v. Vivint, Inc., AAA Arbitration Case. No. 01-22-0004-5525 and U.S.D.C. Case No. 2:23-cv-00004-JRG-RSP (E.D. Tex.),
Testifying Expert for Vivint, Inc.
Completed in 2023.

Matter: Patent Infringement for Wireless Communications and Electronics
Law Firm: Perkins Coie
Case Name: Bell Northern Research, LLC v. HMD AMERICA, INC. et al., Case No.: 1:22-cv-22706-SCOLA/GOODMAN (S.D. Fla.)
Testifying Expert for HMD
Completed in December 2023.

Matter: Patent Infringement for Network Switches
Law Firm: Charhon Callahan Robson & Garza, PLLC
Case Name: Sable Networks, Inc. and Sable IP, LLC v. CloudFlare, Inc. U.S.D.C. WD Tx Case No. 6:21-cv-261
Testifying Expert for CloudFlare, Inc.
Completed in January 2024.
(Expert report submitted and deposed.)

Matter: Patent Infringement for Network Security
Law Firm: Fish and Richardson

Case Name: Finjan LLC v. Palo Alto Networks, Inc. – Case No. 4:14-cv-04908-PJH. USDC ND CA, Oakland Division.
Testifying Expert for Finjan LLC.
Retained in September 2022.
(Expert report submitted and deposed.)

Matter: Patent Infringement for Network Management
Law Firm: Irell & Manella LLP
Case Name: SNMP Research, Inc. & SNMP Research International, Inc. v. Broadcom Inc., Brocade Communications Systems LLC, & Extreme Networks, Inc. U.S.D.C. E.D. Tennessee at Knoxville Case No. 3:20-CV-451
Testifying Expert for SNMP Research.
Retained in May 2022.

Matter: Inter Parte Reexamination for Wireless Communications
Law Firm: Finnegan, Henderson, Farabow, Garrett & Dunner, LLP
Case Name: Patent reexamination in front of the U.S.P.T.O.
Testifying Expert for MediaTek
Retained in March 2023.

Matter: Patent Infringement for Network Switching
Law Firm: Baker Botts
Case Name: Corrigent Corp. v. Arista Networks, Inc., Case No. 1:22-cv-00497-UNA. USDC Delaware
Testifying Expert for Arista
Retained in October 2022.

Matter: Patent Infringement for Mobile Devices
Law Firm: Fish and Richardson
Case Name: GComm v. Samsung, U.S.D.C. ED. TX. Case No.:2:22-cv-0078-JRG
Testifying Expert for Samsung
Completed in January 2024.

Matter: Patent Infringement for Wireless Networks
Law Firm: McKool Smith
Case Name: Certain Mobile Telephones, Tablet Computers with Cellular Connectivity, and Smart Watches with Cellular Connectivity, Components Thereof, and Products Containing Same. U.S.I.T.C. Inv. No. 337-TA-1299
Testifying Expert for Ericsson
Completed in July 2022.
(Expert report submitted and deposed.)

Matter: Patent Infringement for Semiconductor Manufacturing
Law Firm: Kramer Levin
Case Name: Oasis Tooling, Inc. v. Siemens Indus. Software, Inc., 1:22-cv-151 (D. Del.), Oasis Tooling, Inc. v. GlobalFoundries U.S. Inc., 1:22-cv-312 (D. Del.)

Testifying Expert for Oasis Tooling
Retained in June 2022.
(Expert reports submitted.)

Matter: Patent Infringement for Optical Networks
Law Firm: Duane Morris
Case Name: NextGen Innovations, LLC v. Infinera Corporation. U.S.D.C. ED. TX (Marshall)
Case No. 2:22-cv-00306-JRG-RSP / IPR
Testifying Expert for Infinera
Retained in April 2023.

Matter: Patent Infringement for Wireless Devices
Law Firm: King and Spalding LLP
Case Name: Intellectual Ventures, et. al. v. General Motors Company and General Company
Motors, LLC, Case No. 6:21-CV-1088 pending in the Western District of Texas,
Waco Division
Testifying Expert for General Motors
Completed in January 2023.
(Expert report submitted.)

Matter: Patent Infringement for Wireless Devices
Law Firm: Sterne Kessler
Case Name: Neo Wireless LLC v. Volkswagen Group of America, Inc. and Volkswagen
Group of America Chattanooga Operations, LLC and related matters
Testifying Expert for Volkswagen
Completed in September 2023.
(Expert report submitted and deposited. IPR declarations submitted)

Matter: Patent Infringement for Wireless Networks
Law Firm: Covington & Burling LLP
Case Name: XR Communications, LLC v. D-Link Systems, Inc., No. 8:17-cv-00596
(Consolidated) (C.D. Cal.)
Testifying Expert for Hewlett Packard Enterprise
Completed
(Expert report submitted and deposited.)

Matter: Patent Infringement for USB Charging System
Law Firm: Orrick, Herrington & Sutcliffe LLP
Case Name: Fundamental Innovation Systems International LLC v. TCT Mobile (US), TCT
Mobile (US) Holdings, Inc., et al. U.S.D.C. Delaware No. 20-552-RGA-CJB
Testifying Expert for TCL
Completed in June 2022.
(Expert report submitted and deposited.)

Matter: Inter Parte Reexamination for Wireless Communications
Law Firm: Alston & Bird

Case Name: Patent reexamination in front of the U.S.P.T.O.
Testifying Expert for Nokia
Retained in May 2022.
(Expert report submitted.)

Matter: Patent Infringement for Network Management System
Law Firm: Morgan, Lewis & Bockius, LLP
Case Name: Certain Routers, Access Points, Controllers, Network Management Devices,
Other Networking Products, and Hardware and Software Components Thereof,
U.S.I.T.C. Inv. No. 337-TA-1227
Testifying Expert for Hewlett Packard, Netgear, and CommScope
Completed in August 2021.
(Expert report submitted, deposed, and testified during trial.)

Matter: Contract Dispute
Law Firm: Orrick, Herrington & Sutcliffe LLP
Case Name: Allied Telesis, Inc., et al vs. Micron Technology, Inc., Santa Clara County
Case No: 2015-1-CV-282977
Testifying Expert for Micron
Retained in 2021. Deposed in October 2021.
Completed in 2022

Matter: Patent Infringement for Security Systems
Law Firm: Forley and Lardner LLP
Case Name: Certain Residential Premises Security Monitoring and Automation Control
Panels, and Components Thereof (ITC Inv. No. 337-TA-1273) and ADT LLC et
al v. Vivint, Inc., Case No. 6:21-cv-00687 (W.D. Tex.)
Testifying Expert for Vivint, Inc.
Completed in April 2022.
(Expert report submitted, deposed, and testified during trial.)

Matter: Inter Parte Reexamination for Internet Communications
Law Firm: Perkins Coie
Case Name: Patent reexamination in front of the U.S.P.T.O.
Testifying Expert for Twitter
Retained in June 2020.
(Expert report submitted.)

Law Firm: Fisher Broyles
Case Name: Vaxcel International Co., Ltd. v. Heathco LLC, U.S.D.C. Delaware No. 20-224-
LPS
Testifying Expert for Vaxcel
Retained in February 2021.
(Expert report submitted and deposed.)

Matter: Patent Infringement for Network Communication System

Law Firm: Charhon Callahan Robson & Garza, PLLC
Case Name: Sable Networks, Inc. and Sable IP, LLC, v. ClouFlare, Inc. U.S.D.C. WDTX,
Civil Action No. 6:21-cv-261
Testifying Expert for CloudFlare, Inc.,
Completed in January 2024.

Matter: Patent Infringement for Mobile Wireless Device
Law Firm: Pearl Cohen
Case Name: In the Matter Of Certain UMTS And LTE Cellular Communications Modules
And Products Containing The Same, U.S.I.T.C. Inv. No. 337-TA-1240
Testifying Expert for Telit Wireless Communication, Quectel, and Thales
Completed in March 2023.
(Expert reports submitted and deposited.)

Matter: Transactional Taxes for Internet Application
Law Firm: Ryan Rapp & Underwood, PLC
Case Name: ADP, LLC v. Arizona Department of Revenue (TX2018-000246),
Testifying Expert for ADP, LLC.
Completed in June 2020.
(Expert report submitted.)

Matter: Trade Secret Misappropriation in Digital Electronics
Law Firm: Goodwin Proctor LLP
Case Name: Guzik Technical Enterprises versus Keysight Technologies, Inc. Superior Court
of the State of California for the County of Santa Clara, Case No.: 19CV355879
Testifying Expert for Keysight Technologies, Inc.
Retained in August 2020.

Matter: Patent Infringement for Fiber Optic Devices
Law Firm: Cooley
Case Name: Certain High-Density Fiber Optic Equipment and Components Thereof,
U.S.I.T.C. Inv. No. 337-TA-1194
Testifying Expert for AFL Communications, Panduit, FS.Com, Wirewerk, and
Siemon
Completed in October 2020.
(Expert reports submitted, deposited, and testified during trial.)

Matter: Patent Infringement for Optical Transport Networks
Law Firm: Venerble
Case Name: Huawei Technologies Co. Ltd v Verizon Communications, Inc., et. al., 2:20-cv-
0030
Testifying Expert for Verizon.
Retained in March 2020.
(IPR declarations submitted.)

Matter: Patent Infringement for Lighting System

Law Firm: Fisher Broyles
Case Name: Vaxcel International Co., Ltd., v. Jasco Products Company, LLC., (Case No. USDC Western District of Oklahoma, 5:19-CV-00154-JD)
Testifying Expert for Vaxcel.
Retained in August 2020.

Matter: Patent Infringement for Wireless Communication
Law Firm: McDermott Will & Emery
Case Name: Bell Northern Research LLC v. ZTE. (Case No. 3:18-cv-01786 - S.D. Cal)
Testifying Expert for ZTE.
Retained in July 2019.
(IPR declarations submitted.)

Matter: Patent Infringement for Wireless Communication
Law Firm: Jones Day
Case Name: Bell Northern Research LLC v. Kyocera Corp. (Case No. 3:18-cv-1785 - S.D. Cal)
Testifying Expert for Kyocera.
Completed in May 2019.
(Claim construction declaration submitted, and deposed.)

Matter: Patent Infringement for Electronic Payment Systems
Law Firm: Paul Hastings
Case Name: ID Tech Corp. v. Samsung Electronics Co., Ltd., et al. (Case No. No. 8:17-cv-1748-DOC-JDE (C.D. Cal))
Testifying Expert for Samsung.
Retained in January 2019.
(Expert reports submitted, and deposed.)

Matter: Patent Infringement for Internet Switching
Law Firm: Maynard Cooper
Case Name: Parity Networks, LLC v. Juniper Networks, Inc., Case No. 6:17-CV-00495-RWS-KNM (U.S.D.C.E.D. Tx.)
Testifying Expert for Juniper.
Retained in April 2018.
(IPR declarations submitted.)

Matter: Patent Infringement for Internet Switching
Law Firm: Morgan Lewis
Case Name: Parity Networks, LLC v. Hewlett Packard Enterprise Company, Case No. 6:17-CV-00682 (U.S.D.C.E.D. Tx.)
Testifying Expert for Hewlett Packard Enterprise Company.
Retained in September 2018.
(IPR declarations submitted.)

Matter: Inter Parte Reexamination for Covered Business Method

Law Firm: Reed Smith LLP

Case Name: NASDAQ v. Miami International
Expert for Miami International.
Retained in February 2018.
(Expert declarations submitted, and deposed.)

Matter: Patent Infringement for Mobile Devices

Law Firm: Quinn Emanuel

Case Name: Qualcomm v. Apple, Case No. 3:17-cv-00108-GPC-MDD (U.S.D.C.S.D. Cal.)
Testifying Expert for Qualcomm.
Completed in April 2019.
(Expert reports submitted, and deposed.)

Matter: Patent Infringement for Communication Devices

Law Firm: Venable

Case Name: Sycamore IP Holdings LLC v. Verizon Communications Inc, Case No. 2:16-cv-591-JRG-RSP (U.S.D.C. E.D. Texas)
Testifying Expert for Verizon and Level 3.
Completed in September 2017.
(Expert reports submitted, and deposed.)

Matter: Patent Infringement for Mobile Devices

Law Firm: Alston Bird

Case Name: Huawei Technologies Co. Ltd. V. Nokia Solutions and Networks, Case No. 2:16-cv-0056-JRG-RSP (U.S.D.C. E.D. Texas)
Testifying Expert for Nokia.
Completed in December 2017.
(Expert reports submitted.)

Matter: Patent Infringement for Mobile Devices

Law Firm: Quinn Emanuel

Case Name: Huawei Technologies Co. Ltd. V. Samsung Electronics C. Ltd, Case No. 3:16-cv-02787 (U.S.D.C. N.D. Cal)
Testifying Expert for Samsung.
Completed in March 2019.
(Expert reports submitted, and deposed.)

Matter: Arbitration for Licensing

Law Firm: Alston Bird

Case Name: Nokia v. LG Electronics, International Chamber of Commerce Arb. No. 21326
Testifying Expert for Nokia.
Completed in October 2016.
(Expert reports submitted.)

Matter: Patent Infringement for Mobile Devices

Law Firm: Ropes and Gray
Case Name: Godo Kaisha IP Bridge 1 v. TCL Communication Technology Holdings, Case No. 15-634-SLR-SRF (U.S.D.C.S.D. Delaware.)
Testifying Expert for IP Bridge.
Completed in October 2018.
(Expert reports submitted, and deposed.)

Matter: Patent Infringement for Mobile Devices
Law Firm: Paul Hastings
Case Name: Odyssey Wireless, Inc., v. Samsung Electronics Co., Ltd., et al, Case No. 3:15-cv-1738-H-RBB (U.S.D.C.S.D. Cal.)
Testifying Expert for Samsung.
Completed in October 2016.
(Expert reports submitted.)

Matter: Patent Infringement for Mobile Devices
Law Firm: Greenberg Traurig
Case Name: Mobile Telecommunications Technologies LLC v. Amazon.com, Inc., 2:13-cv-883-JRG-RSP (U.S.D.C. E.D. Texas)
Testifying Expert for Amazon.
Completed in April 2015.
(Expert reports submitted, and deposed.)

Matter: Patent Infringement for Mobile Devices
Law Firm: Mayer Brown
Case Name: Mobile Telecommunications Technologies LLC v. LG Electronics Mobilecomm U.S.A., Inc., 2:13-cv-947-JRG-RSP (U.S.D.C. E.D. Texas)
Testifying Expert for LG Electronics Mobilecomm.
Completed in February 2016.
(Expert reports submitted, and deposed.)

Matter: Patent Infringement for Semiconductor Devices
Law Firm: Mayer Brown
Case Name: Inter Parte Reexamination for U.S. Patent Nos. 6,895,520 and 6,899,332
Expert for LG Electronics.
Completed in February 2016.
(Expert declaration submitted, and deposed.)

Matter: Patent Infringement in Vehicular Electronics
Law Firm: Gardner, Linn, Burkhardt & Flory, L.L.P
Case Name: *Magna Electronics Inc. v. TRW Automotive Holdings Corp. et al.*, Civil Action No. 1:12-cv-00654 (Western District of Michigan), and relating to the action styled *Magna Electronics Inc. v. TRW Automotive Holdings Corp. et al.*, Civil Action No. 1:13-cv-00324 (Western District of Michigan).
Testifying Expert for Magna Electronics
Completed in February 2016.

(Expert reports submitted, and deposed.)

Matter: Patent Infringement in Electronic Circuits
Law Firm: Ropes and Gray
Case Name: Certain Devices Containing Non-Volatile Memory and Products Containing the Same (USITC Inv. Nos. 337-TA-922)
Testifying Expert for Spansion Inc.
Completed in February 2015.
(Expert reports submitted.)

Matter: Trade Secret Misappropriation in Software Method for Cable Television Advertisement
Law Firm: Brownstein Hyatt Farber Schreck
Case Name: Cross MediaWorks v. EMT Holdings, USDC Southern District of New York, Case No. 1:14-cv-00561-VSB
Testifying Expert for Cross MediaWorks.
Completed in April 2015.
(Testified during injunction hearing.)

Matter: Patent Infringement in Vehicular Electronics
Law Firm: Steptoe and Johnson
Case Name: Certain Vision-Based river Assistance System Cameras and Components Thereof (USITC Inv. Nos. 337-TA-899 and 907)
Testifying Expert for Magna Electronics
Completed in February 2015.
(Expert reports submitted, deposed, and testified during trial.)

Matter: Patent Infringement for Vehicular System
Law Firm: Susman Godfrey
Case Name: Eagle Harbor Holdings, LLC, and Mediustech, LLC, v. Ford Motor Company, 3:11-cv-05503-BHS (U.S.D.C. Western District of Washington at Tacoma)
Testifying Expert for Mediustech.
Completed in March 2015.
(Expert reports submitted, deposed, and testified during trial.)

Matter: Patent Infringement for Communication Networks
Law Firm: Davis Polk & Wardwell LLP
Case Name: Sprint Communications Company L.P., v. Comcast Cable Communications, LLC, Comcast IP Phone, LLC, and Comcast Phone of Kansas, LLC. 2:11-cv-02684-KHV-DJW (U.S.D.C. Kansas)
Testifying Expert for Comcast.
Retained in March 2012.
(Expert reports submitted, and deposed.)

Matter: Patent Infringement for Communication Networks
Law Firm: Quinn Emanuel

Case Name: France Telecom S.A. v. Marvell Semiconductor, Inc., 12-Civ-4986 (S.D.N.Y.)
Testifying Expert for Marvell.
Completed in September 2014.
(Expert reports submitted, deposed, and testified during trial.)

Matter: Wireless Image Distribution
Law Firm: Jones Day
Case Name: *Inter Partes* Review of U.S. Patent No. 8,437,797
Expert for Google Inc.
Completed in November 2014.
(Expert declaration submitted.)

Matter: Nonvolatile Semiconductor Memories
Law Firm: Jones Day
Case Name: *Inter Partes* Review of U.S. Patent Nos. 8,301,833 and 8,516,187
Expert for SanDisk.
Completed in May 2014.
(Expert declaration submitted.)

Matter: Communication Protocols for Wireless Device
Law Firm: Dorsey & Whitney, LLP
Case Name: Certain Point-To-Point Network Communication Devices and Products
Containing Same (USITC Inv. No. 337-TA-892)
Testifying Expert for Toshiba
Completed in May 2014.
(Expert reports submitted, and deposed.)

Matter: Patent Infringement for Wireless Networks
Law Firm: Ropes and Gray
Case Name: In the Matter of Certain Wireless Devices With 3G and/or 4G Capabilities and
Components Thereof (USITC Inv. No. 337-TA-868) InterDigital Comms., Inc. v.
Huawei Techs. Co., Ltd., No. 13-00008 (D. Del., filed January 2, 2013),
InterDigital Comms., Inc. v. ZTE Corp., No. 13-00009 (D. Del., filed January 2,
2013), InterDigital Comms., Inc. v. Nokia Corp., No. 1:13-cv-00010 (D. Del.,
filed January 2, 2013), InterDigital Comms., Inc. v. Samsung Elec. Co., Ltd., No.
13-00011 (D. Del., filed January 2, 2013)
Testifying Expert for Joint Defense Group.
Completed in February 2014.
(Expert reports submitted, deposed, and testified during trials.)

Matter: Patent Infringement for Mobile Communication
Law Firm: Finnegan, Henderson, Farabow, Garrett & Dunner, L.L.P.
Case Name: Certain Digital Media Devices, Including Televisions, Blu-Ray Disc Players,
Home Theater Systems, Tablets and Mobile Phones, Components Thereof and
Associated Software (USITC Inv. No. 337-TA-882)
Testifying Expert for LG Electronics, Inc.

Completed in February 2014.
(Expert reports submitted, deposed, and testified during trial.)

Matter: Patent Infringement for Wireless Networks
Law Firm: Vinson & Elkins LLP
Case Name: Wi-LAN USA, Inc. and Wi-LAN, Inc. v. Telefonaktiebolaget LM Ericsson and Ericsson, Inc. (USDC: Southern District of FL - Case #1: 12-cv-23569), Wi-LAN USA, Inc. and Wi-LAN, Inc. v. Alcatel-Lucent USA, Inc. (USDC: Southern District of FL - Case #1: 12-cv-23568-Altonaga/Simonton)
Testifying Expert for Wi-LAN.
Completed in May 2015.
(Expert reports submitted, and deposed.)

Matter: Patent Infringement for Data Storage
Law Firm: Ropes and Gray, Weil Gotshal
Case Name: Summit Data Systems, LLC v. EMC Corporation., et al. 1:10-cv-00749-GMS (U.S.D.C. Delaware)
Testifying Expert for EMC Corporation and Netapp, Inc.
Completed in December 2012.
(Expert reports submitted, and deposed.)

Matter: Patent Infringement for Wireless Mobile Device
Law Firm: Ashurst Australia
Case Name: Samsung v. Apple, Australian Federal Court Proceeding No. NSD 1243 of 2011
Testifying Expert for Samsung Electronics.
Completed in December 2012.
(Expert reports submitted, deposed, and testified during trial.)

Matter: Patent Infringement for Wireless Mobile Devices
Law Firm: Quinn Emanuel
Case Name: Apple Inc. v. Samsung Electronics Co., Ltd., et al., 4:11-cv-01846-LHK (N.D. Cal.) and Samsung Electronics Co., Ltd., et al. v. Apple Inc., 4:11-cv-02079 (N.D. Cal.)
Testifying Expert for Samsung Electronics.
Completed in July 2012.
(Expert reports submitted, and deposed.)

Matter: Patent Infringement for Wireless Mobile Device
Law Firm: Quinn Emanuel
Case Name: Certain Electronic Devices, Including Wireless Communication Devices, Portable Music And Data Processing Devices, And Tablet Computer, U.S.I.T.C. Inv. No. 337-TA-794
Testifying Expert for Samsung Electronics.
Completed in June 2012.
(Expert reports submitted, deposed, and testified during trial.)

Matter: Patent Infringement for Portable Storage Device
Law Firm: White and Case
Case Name: CERTAIN UNIVERSAL SERIAL BUS (“USB”) PORTABLE STORAGE DEVICES, INCLUDING USB FLASH DRIVES AND COMPONENTS THEREOF, US International Trade Commission Investigation No. 337-TA-788
Testifying Expert Witness for Trek
Completed in May 2012.
(Expert reports submitted, and deposed.)

Matter: Copyright Infringement for Petroleum Processing Software
Law Firm: Osha Liang LLP
Case Name: Aspen Technology, Inc. v. Tekin A. Kunt and M3 Technology, Inc., Case Number: H-10-1127, US District Court, Texas, Houston Division.
Testifying Expert for M3 Technology, Inc.
Completed in May 2012.
(Expert reports submitted, deposed, and testified during trial.)

Matter: Trade Secret Misappropriation for DC-DC converter
Law Firm: Covington & Burling, Haynes Boone
Case Name: Certain DC—DC Controllers and Products Containing Same, US International Trade Commission Investigation No. 337-TA-698
Testifying Expert for UPI.
Completed in March 2012.
(Expert reports submitted, deposed, and testified during trial.)

Matter: Patent Infringement for Parallel Processor
Law Firm: Orrick, Herrington, & Sutcliffe. Kirkland and Ellis.
Case Name: BIAx Corporation v. Nvidia and Sony Civil Action No. 09-cv-01257-PAB-MEH
Testifying Expert for Nvidia and Sony
Completed in March 2012.
(Expert reports submitted, and deposed.)

Matter: Patent Infringement for Call Center Technology
Law Firms: Duffy, Sweeney, and Scott. Foley Lardner.
Case Name: Ronald Katz Technology Licensing v. Citizens Financial Group 7-ML-1816-C RGK (FFM)
Testifying Expert Witness for Citizens Financial Group.
Completed in 2011.
(Expert reports submitted, and deposed.)

Matter: Patent Infringement for Storage Area Network
Law Firm: DLA Piper
Case Name: Network Appliance, Inc., v. Sun Microsystems, Inc., Case Number: C-07-06053 EDL, US District Court, Northern District of California, San Francisco Division.
Testifying Expert for Sun Microsystems, Inc.
Completed in 2010.

(Expert reports submitted, and deposed.)

Matter: Patent Infringement for Flat Panel Display Controller
Law Firm: Jones Day
Case Name: Certain Video Displays, Components Thereof, and Products Containing Same, US International Trade Commission Investigation No. 337-TA-687
Testifying Expert for Vizio, Inc.
Completed in 2010.
(Expert reports submitted, deposed, and testified during trial.)

Matter: Patent Infringement for Call Center Technology
Law Firms: Foley Lardner
Case Name: Ronald Katz Technology Licensing v. US Bank 7-ML-1816-C RGK (FFM)
Testifying Expert Witness for US Bank
Completed in May 2009.
(Expert reports submitted, and deposed.)

Matter: Patent Infringement for USB to VGA Converter
Law Firm: Wang Hartmann, Gibbs, & Cauley, P.C.
Case Name: Displaylink Corporation v. Magic Control Technology Corporation, Case No. 5:07-CV-01998-RMW, US District Court, Northern District of California, San Francisco Division.
Testifying Expert for Magic Control Technology Corporation
Completed in 2009.
(Expert reports submitted, and deposed.)

Matter: Patent Infringement for Flash Memory
Law Firm: Jones Day and Wilson Sansini
Case Name: Certain Flash Memory Controllers, Drives, Memory Card, and Media Players and Products Containing Same. US International Trade Commission Investigation No. 337-TA-619
Testifying Expert for SanDisk Corporation.
Completed in 2008.
(Expert reports submitted, deposed, and testified during trial.)

Matter: Patent Infringement for Semiconductor Packaging
Law Firm: Jones Day
Case Name: Certain Semiconductor Chips with Minimized Chip Package Size and Products Containing the Same. US International Trade Commission Investigation No. 337-TA-605
Testifying Expert for Freescale Semiconductor
Completed in 2008.
(Expert reports submitted, deposed, and testified during trial.)

Matter: Patent Infringement for Automatic Switching System
Law Firms: Jones Day, and Heller Ehrman, LLP.

Case Name: ATEN International Co., Ltd and ATEN Technology, Inc. v. Belkin Corporation, Belkin Logistics, Inc. and Emine Technology Co., Ltd. US International Trade Commission Investigation No. Ltd 337-TA-589
Testifying Expert for Belkin Corporation, Belkin Logistics, Inc., and Emine Technology Co., Ltd.
Completed in 2007.
(Expert reports submitted, deposed, and testified during trial.)

Matter: Patent Infringement for Dual Mode Communication
Law Firm: Wilmer Cutler Pickering Hale and Dorr, LLP
Case Name: Broadcom Corporation v. Qualcomm Incorporated SACV05-467-JVS (RNBx)
Testifying Expert Witness for Broadcom Corporation
Completed in 2007.
(Expert reports submitted, deposed, and testified during trial.)