

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

T-Mobile USA, Inc., AT&T Services, Inc., Cellco Partnership d/b/a Verizon
Wireless, Nokia of America Corporation, Ericsson Inc.
Petitioners

v.

Wireless Alliance, LLC
Patent Owner

Case IPR2024-00608
Patent 9,565,662

**DECLARATION OF JOSEPH CAMP IN SUPPORT OF
PETITION FOR INTER PARTES REVIEW OF
UNITED STATES PATENT NO. 9,565,662**

TABLE OF CONTENTS

I.	INTRODUCTION	1
II.	BACKGROUND AND QUALIFICATIONS.....	2
III.	MATERIALS REVIEWED.....	4
IV.	LEGAL STANDARDS.....	5
	A. Obviousness.....	6
	B. Written Description	11
	C. Claim Construction.....	12
V.	PERSON OF ORDINARY SKILL IN THE ART AT THE TIME OF THE ALLEGED INVENTION	12
VI.	TECHNICAL BACKGROUND.....	14
	A. Carrier Aggregation.....	14
	B. HARQ Procedure	17
	C. Use of HARQ with Carrier Aggregation	19
VII.	THE '662 PATENT	23
	A. Description of the '662 Patent's Specification.....	23
	B. The '662 Patent's Prosecution History	26
	C. Interpretation of the '662 Challenged Claims.....	27
VIII.	THE CHALLENGED PATENTS ARE NOT ENTITLED TO THEIR PURPORTED PRIORITY DATE	28
	A. Legal Standards	29
	B. The '880 Application Does Not Show the Inventor Was in Possession of the "based on a predetermined time" Limitation	29

IX.	SUMMARY OF THE PRIOR ART	31
A.	U.S. Patent App. Pub. No. 2011/0026495 to Lee et al. (“Lee”) (Ex. 1005).....	31
B.	U.S. Patent App. Pub. No. 2011/0103326 to Kim et al. (“Kim”) (Ex. 1006).....	38
1.	Overview	38
2.	Kim is prior art as of its priority date.....	43
(i)	The Kim provisional applications provide written description for Kim Claim 1	43
(ii)	The Kim provisional applications describe the subject matter relied upon as prior art in this petition	47
C.	Motivation to Combine	48
X.	GROUND 1: LEE IN VIEW OF KIM OBVIOUS CLAIMS 1-4	51
A.	Independent Claim 1	51
	[1.p] A carrier management method of a base station for use in a carrier aggregation environment, comprising:.....	51
	[1.a] transmitting a deactivation message for a secondary carrier to a terminal;	53
	[1.b] changing the secondary carrier to a deactivation state based on a predetermined time from the transmission of the deactivation message; and.....	56
	[1.c] stopping downlink (DL) data transmission of the secondary carrier and initializing uplink (UL) and DL buffers associated with the secondary carrier after transmitting the deactivation message.	61
(i)	Stopping downlink (DL) data transmission of the secondary carrier ... after transmitting the deactivation message	62

(ii)	Initializing uplink and downlink buffers associated with the secondary carrier after transmitting the deactivation message	64
B.	Dependent Claim 2	68
[2]	The carrier management method of claim 1, wherein the predetermined time is a value predefined to make state information that is managed by the base station consistent with state information that is managed by the terminal for the secondary carrier.	68
C.	Dependent Claim 3	71
[3]	The carrier management method of claim 1, further comprising: receiving a reception success message for the deactivation message from the terminal after transmitting the deactivation message, wherein the changing of the secondary carrier to the deactivation state includes changing, by the base station, the secondary carrier to the deactivation state after a predetermined time from an arrival time of the reception success message.	71
D.	Dependent Claim 4	74
[4]	The carrier management method of claim 1, further comprising: immediately stopping, by the base station, data transmission and retransmission using the secondary carrier immediately after transmitting the deactivation message.	74
XI.	CONCLUSION	76
XII.	'662 PATENT CLAIM LISTING	78

I. INTRODUCTION

1. My name is Dr. Joseph Camp. I am the Department Chair *ad interim* and Professor of Electrical and Computer Engineering at the Southern Methodist University.

2. I have been retained by T-Mobile USA, Inc., AT&T Services, Inc., Cellco Partnership d/b/a Verizon Wireless, Nokia of America Corporation, and Ericsson, Inc. (“Petitioners”) as an independent expert consultant in this proceeding before the United States Patent and Trademark Office (“PTO”) against Cobblestone Wireless, LLC (“Patent Owner”) regarding U.S. Patent No. 9,565,662 (“the ’662 Patent”)¹ (Ex. 1001).² I have been asked to submit this Declaration on behalf of Petitioners.

3. I have been asked to consider whether certain references disclose or render obvious the features recited in Claims 1-4 (collectively, the “Challenged Claims”) of the ’662 Patent. My opinions are set forth below. Based on my

¹ Concurrently, I have also submitted a similar declaration regarding U.S. Patent No. 9,144,106, which is the parent of the ’662 Patent and has similar claims. *See* IPR2024-00607 (Ex. 1009).

² Where appropriate, I refer to exhibits that I understand are to be attached to the petition for *Inter Partes* Review of the ’662 patent.

experience and expertise, it is my opinion that the prior art renders obvious all limitations of the Challenged Claims, as I discuss in detail below.

4. I am being compensated at a rate of \$750 per hour for my work in this proceeding. My compensation is in no way contingent on the nature of my findings, the presentation of my findings in testimony, or the outcome of this or any other proceeding. I have no other interest in this proceeding.

5. All of my opinions stated in this Declaration are based on my own personal knowledge and professional judgment. I am over 18 years of age and, if I am called upon to do so, I would be competent to testify as to the matters set forth in this Declaration.

II. BACKGROUND AND QUALIFICATIONS

6. My background and expertise that qualify me as an expert are described in detail in my *Curriculum Vitae* attached as **Attachment A**, which further includes an accurate list of all publications authored by me in the previous 10 years and a list of all cases in which I testified as an expert at trial or by deposition during the previous 4 years. Below I have summarized those qualifications, as well as any other background and expertise relevant to the technical issues in this case:

7. My educational background includes a B.S. with honors in Electrical and Computer Engineering (ECE) from UT-Austin in 2003, an M.S. in ECE from Rice University in 2006, and a Ph.D. in ECE from Rice University in 2009. My

master's thesis focused on a novel multi-tier architecture for deploying a mesh network in which multiple frequency bands were aggregated to provide Internet access to over 4000 users in an underserved community in Houston. My Ph.D. dissertation focused on addressing observed performance problems in the deployed mesh network based on stretching the existing wireless standards to serve a large area in a multihop/mesh topology with multiple frequency bands. The main performance issues identified pertained to HARQ-type signaling that reduced the effective throughput of in-field wireless links. For my Ph.D. dissertation, I was honored to receive the Ralph Budd Award for Best Engineering Thesis at Rice University.

8. In the summer of 2009, I was hired as an Assistant Professor at SMU in the Electrical and Computer Engineering Department. I received the NSF Faculty Early Career Development Program (CAREER) award in 2012. In 2014, I was additionally honored to receive the Golden Mustang Teaching Award, which is given to one pre-tenured faculty per year. In 2016, I received tenure and promotion to Associate Professor. In 2021, I received promotion to Professor and the Gerald J. Ford Research Fellowship, and was promoted to ECE Department Chair, *ad interim*, in November of 2022, where I still serve in that capacity.

9. Over my career, I have published over 80 peer reviewed conference and journal papers, most of which are affiliated with IEEE, and received over \$6M in federally funded grants.

III. MATERIALS REVIEWED

10. The opinions contained in this Declaration are based on the documents I reviewed, my professional judgment, as well as my education, experience, and knowledge.

11. In forming my opinions expressed in this Declaration, I also reviewed the following materials and information:

Exhibit No.	Description
1001	U.S. Patent No. 9,565,662 (“’662 Patent”)
1002	U.S. Patent No. 9,144,106 (“’106 Patent”)
1003	Prosecution History for U.S. Patent 9,565,662
1004	Prosecution History for U.S. Patent 9,144,106
1005	U.S. Patent Publication No. 2011/0026495A1 (“Lee”)
1006	U.S. Patent Publication No. 2011/0103326A1 (“Kim”)
1007	U.S. Provisional Application No. 61/256,294 (“Kim 294 Provisional”)
1008	U.S. Provisional Application No. 61/257,427 (“Kim 427 Provisional”)
1010	Harri Holma & Antti Toskala, “LTE for UMTS – OFDMA and SC-FDMA Based Radio Access” (Wiley 2009) (“Holma”)
1011	Change Request R2-103427, Third Generation Partnership Process

Exhibit No.	Description
1012	Certified Translation of Korean Pat. App. No. 10-2010-0077880 (Aug. 12, 2010)
1015	G. Yuan, X. Zhang, W. Wang and Y. Yang, “Carrier aggregation for LTE-advanced mobile communication systems,” in <i>IEEE Communications Magazine</i> , vol. 48, no. 2, pp. 88-93, February 2010, doi: 10.1109/MCOM.2010.5402669.

12. I also reviewed any other materials I refer to in this Declaration in support of my opinions.

13. My opinions contained in this Declaration are based on the documents I reviewed and my knowledge and professional judgment. My opinions have also been guided by my appreciation of how a person of ordinary skill in the art would have understood the state of the art, the prior art, and the claims and the specification of the '662 Patent at the time of the alleged invention.

IV. LEGAL STANDARDS

14. Petitioners’ attorneys have explained to me the legal standards that apply in this case. My understanding of those standards is described below. I am not an attorney, and I do not have formal training in the law regarding patents. I have used my understanding of the following legal principles set forth in this section in reaching my opinions.

15. I understand that, in this proceeding, Petitioners have the burden of proving that the challenged claims are invalid by a preponderance of the evidence.

A. Obviousness

16. I have been informed that a claim is invalid as obvious under 35 U.S.C. § 103 (pre-AIA) if the differences between the claimed subject matter and the prior art are such that the subject matter as a whole would have been obvious at the time of the invention to a person of ordinary skill in the art. I have been informed that the following matters are relevant to determining whether the claimed invention would have been obvious: (1) the scope and content of the prior art, (2) the difference or differences between the patent claim and the prior art, (3) the level of ordinary skill in the art at the time the invention of the patent, and (4) any secondary considerations or objective indicia of non-obviousness.

17. I have been informed that the combination of familiar elements according to known methods is likely to be obvious when it does no more than yield predictable results. When a claim simply arranges prior art elements with each performing the same function it had been known to perform and yields no more than one would expect from such an arrangement, then such a combination is obvious. When a patent claims a structure already known in the prior art altered by the mere substitution of one element for another known in the field, the combination is likely to be obvious unless the combination yields an unpredictable result.

18. I have been informed that when a work is available in one field of endeavor, design incentives and other market forces can prompt variations of it,

either in the same field or a different one. If a person of ordinary skill in the art can implement a predictable variation, such a variation is likely unpatentable. For the same reason, if a technique has been used to improve one device, and one of ordinary skill in the art would recognize that it would improve similar devices in the same way, using the technique is obvious unless its actual application is beyond his or her skill. One question to consider is whether the improvement is more than predictably using prior art elements according to their established functions.

19. I have been informed that it may often be necessary, in a validity analysis, to consider whether there was an apparent reason to combine the known elements in the fashion claimed by the patent at issue. This can be accomplished by looking to interrelated teachings of multiple patents or other publications or pieces of prior art; the effects of demands known to the design community or present in the marketplace; and the background knowledge possessed by one of ordinary skill in the art.

20. I have been informed that a validity analysis need not seek out precise teachings directed to the specific subject matter of the challenged claim; it is appropriate to take account of the inferences and creative steps that a person of ordinary skill in the art would employ. I have been informed that a person of ordinary skill in the art is a person of ordinary creativity, not an automaton.

21. I have been informed that a claim composed of several elements is not proved obvious merely by demonstrating that each element was, independently, known in the prior art. I have been informed that it can be important to identify a reason that would have prompted a person of ordinary skill in the art in the relevant field to combine the elements in the way the claimed new invention does. I am told that one way that subject matter can be proved obvious is by noting there existed at the time of the invention a known problem for which there was an obvious solution encompassed by the patent's claims. I have been informed that any need or problem known in the field of endeavor at the time of the claimed invention and addressed by the patent can provide a reason for combining the elements in the manner claimed.

22. I have been informed that one should not assume that a person of ordinary skill in the art attempting to solve a problem will be led only to those elements of prior art designed to solve the same problem. Instead, I have been informed that since familiar items may have obvious uses beyond their primary purposes, in many cases a person of ordinary skill in the art will be able to fit the teachings of multiple prior art references together like pieces of a puzzle.

23. I have been informed that, when there is a design need or market pressure to solve a problem and there are a finite number of identified, predictable solutions, persons of ordinary skill in the art have good reason to pursue the known options within their technical grasp. If this leads to the anticipated success, the

product was likely not accomplished by innovation but by using ordinary skill and common sense. I have been informed that, in such an instance, the fact that the combination was obvious to try may show that the combination was obvious.

24. I have been informed that, when determining whether a claimed combination would have been obvious, the correct analysis is not whether a person of ordinary skill in the art, writing on a blank slate, would have chosen the particular combination of elements described in the claim. Instead, I have been informed that the correct analysis considers whether one of ordinary skill, facing the wide range of needs created by developments in the field of endeavor, would have seen a benefit to selecting the combination claimed.

25. I have been informed that, when determining whether a claimed invention is obvious, any “secondary considerations” of non-obviousness identified by the patentee should also be considered. These secondary considerations can include:

- commercial success of the invention, causally related to the invention itself rather than to companion factors, such as advertising or attractive packaging;
- the invention taught away from the technical direction followed by those skilled in the art;

- a long-felt but unsatisfied need for the invention while the needed implementing arts and elements had long been available;
- the invention achieves results unexpected to those skilled in the art;
- copying of the invention by competitors as distinguished from their independent development
- unsuccessful attempts by those skilled in the art to make the invention;
- acquiescence by the industry to the patent's validity by honoring the patent through taking licenses or not infringing the patent, or both; and
- skepticism, disbelief in or incredulity by those skilled in the art that the patentee's approach worked.

26. I have been informed that, for the above information to impact the obviousness of a patent claim, there must be a nexus between the alleged secondary considerations and the claims. In addition, I have been informed that the burden of introducing evidence of secondary considerations generally is on the Patent Owner. If the Patent Owner or its expert should assert secondary considerations of non-obviousness, I reserve the right to provide a Declaration addressing assertions of non-obviousness due to secondary considerations.

B. Written Description

27. I have been informed that a patent must contain a written description of the method claimed in the patent. I have been informed that the written-description requirement helps ensure that the patent applicant invented the claimed subject matter. To satisfy the written-description requirement, the patent specification must describe each and every limitation of a patent claim, with clear, concise, and exact terms. When determining whether the specification discloses the invention, the claim must be viewed as a whole.

28. The written-description requirement is satisfied if persons of ordinary skill in the field of the invention would recognize, from reading the patent specification, that the inventor possessed the subject matter finally claimed in the patent. The written-description requirement is satisfied if the specification shows that the inventor possessed his or her invention as of the effective filing date of the claimed invention, even though the claims may have been changed or new claims added since that time.

29. I have been informed that the exact words found in the claim need not be used. It is unnecessary to spell out every detail of the invention in the specification, and specific examples are not required. Enough must be included in the specification to convince persons of ordinary skill in the art that the inventor

possessed the full scope of the invention. In evaluating whether the specification has provided an adequate written description, a POSITA may consider such factors as:

- the nature and scope of the patent claims;
- the complexity, predictability, and maturity of the technology at issue;
- the existing knowledge in the relevant field; and
- the scope and content of the prior art.
- The sufficiency of the written description is decided on a claim-by-claim basis, not as to the entire patent or groups of claims.

C. Claim Construction

30. I have been informed that claim terms are typically given their plain and ordinary meanings, as would have been understood by a person of ordinary skill in the art at the time of the earliest alleged priority date. I have further been informed that when considering the meaning of any terms in the Challenged Claims of the '662 Patent, I should apply the plain and ordinary meaning of those terms. I have further been informed that in considering the meaning of the claims, one must consider the language of the claims, the specification, and the prosecution history of record.

V. PERSON OF ORDINARY SKILL IN THE ART AT THE TIME OF THE ALLEGED INVENTION

31. I understand that Wireless Alliance contends the Challenged Claims are entitled to a priority date of August 12, 2010. I understand that Petitioners contend the alleged priority date is no earlier than November 8, 2010, and I agree

for the reasons stated in Section VIII below. Because the dates are close in time, the definition of a person of ordinary skill in the art would not change regardless of which date is chosen.

32. Based on the materials and information I have reviewed and based on my experience in the technical areas relevant to the '662 Patent, a person of ordinary skill in the art at the time of the alleged invention of the '662 Patent would have had at least a bachelor's degree in electrical engineering, computer engineering, computer science, physics, or the equivalent, and at least two years of experience working in the field. Relevant working experience would include experience with telecommunications and networking, radio-access networking, and/or service provisioning in wireless networks. More education can supplement practical experience and vice versa.

33. Based on my knowledge and experience, including as discussed above in Section II, I was a person of ordinary skill in the art at the time of the alleged invention of the '662 Patent and can provide opinions regarding the knowledge of a person of ordinary skill in the art as of that time. My opinions herein are, where appropriate, based on my understandings as to a person of ordinary skill in the art at that time. I myself had these capabilities at the time of the alleged invention of the '662 Patent.

VI. TECHNICAL BACKGROUND

A. Carrier Aggregation

34. Carrier aggregation is a technique that allows mobile devices to use more than one frequency band at the same time in a particular traffic direction to transmit and/or receive data. Ex. 1010 at 407-09.

35. Prior to the filing of the applications that led to the '662 Patent, a POSITA would have been aware of carrier aggregation and its use in cellular communications. Ex. 1015 at 2-3. For example, the textbook “LTE for UMTS – OFDMA and SC-FDMA Based Radio Access” by Harri Holma and Antti Toskala published in 2009 (“Holma”) (Ex. 1010) explains that carrier aggregation was first introduced in 3GPP Release 8 for High-Speed Packet Access (“HSPA”) networks in 2008. Ex. 1010 at 13-14, 408, Fig. 2.1; Ex. 1010 at Figure 13.12.

36. This form of carrier aggregation was known as dual carrier (or dual cell) High-Speed Downlink Packet Access (“HSDPA”) and enabled a single terminal to receive data on two adjacent HSDPA carriers (each of which were 5 MHz) to allow the terminal a total of 10 MHz of downlink bandwidth. Ex. 1010 at 408; *see also* Ex. 1010 at Figure 13.12 (below).

Ex. 1010 at Fig. 13.12.

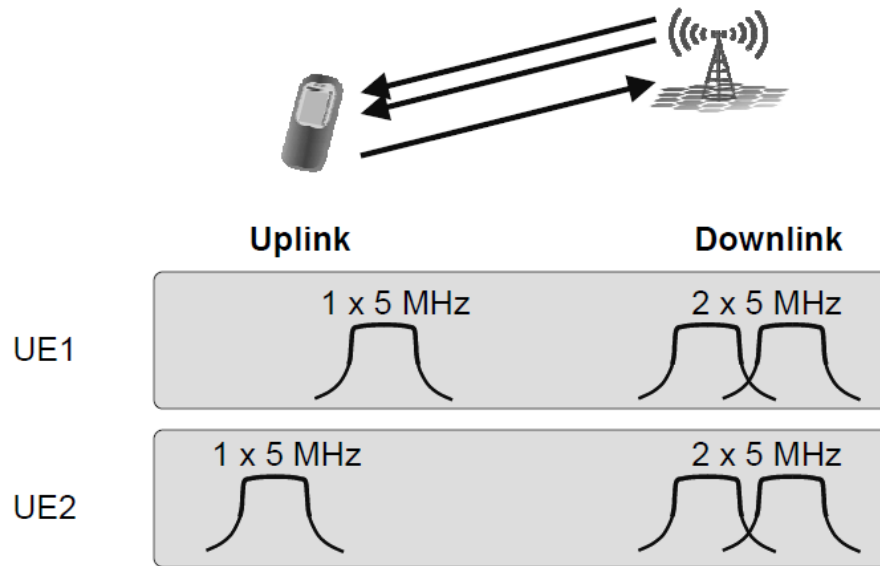


Figure 13.12 Downlink Dual carrier HSDPA concept

37. HSPA was developed by the 3GPP standards body, and, after HSPA development was complete, the standards body turned their attention to developing the LTE standard. The initial release of LTE, which was Release 8, did not include specification for implementation of carrier aggregation, but there were plans to add carrier aggregation to a later release.

38. With Release 10 in 2010, which was referred to as LTE-Advanced, the 3GPP standards body incorporated carrier aggregation into LTE. *See* Ex. 1011. The carrier aggregation incorporated into LTE was more robust than the carrier aggregation for HSPA.

39. The carriers used for carrier aggregation are often referred to as either a “primary” or a “secondary” carrier. A primary carrier is typically the carrier used

by a mobile device and base station for control and data signaling, while a secondary carrier is typically just used for increased data throughput.

40. A person of ordinary skill in the art would understand that, in LTE and many other standards, carrier aggregation can be used for Frequency Division Duplex (FDD) or Time Division Duplex (TDD). In TDD, a carrier is typically shared in the uplink and downlink direction in a time-multiplexed fashion. Ex. 1011 at 6 (“In typical TDD deployments, the number of CCs and the bandwidth of each CC in UL and DL is the same.”). In other words, as an example, the same frequency band would be shared for a downlink primary carrier and an uplink primary carrier, but a different frequency band would be shared for the downlink secondary carrier and uplink secondary carrier.

41. In TDD, while these CC resources are shared in the uplink and downlink direction, the time spent in the up or down direction is weighted according to the traffic demand. Ex. 1015 at 4 (“Regarding LTE-Advanced systems working in time-division duplex (TDD) mode, besides the above schemes using different numbers of component carriers in supporting asymmetric traffic loads on uplink and downlink channels, asymmetric CA can also be achieved by adjusting the ratio of allocated time slots for uplink and downlink transmissions.”). In other words, while there are the same frequency bands allocated to both uplink and downlink, the time

in which that channel is asymmetric and allocated according to the traffic demand per direction, often favoring the downlink direction.

B. HARQ Procedure

42. Prior to the filing of the applications that led to the '662 Patent, Hybrid Automatic Repeat reQuest³ (“HARQ”) was a well-known procedure used in wireless communications. Ex. 1010 at 118–119.

43. For example, Holma (Ex. 1010) explains that the HARQ process was used to confirm messages were received correctly. When using a HARQ process, a receiver that receives a message will either transmit a positive acknowledgement (“ACK”) or negative acknowledgement (“NACK”) message back to the original transmitter depending on whether the message was received correctly. Ex. 1010 at 118. One method for the receiver to determine if a message is received correctly is by performing a Cyclic Redundancy Check (“CRC”) on the message. Ex. 1010 at 118.

³ Sometimes this process is referred to as “Hybrid Adaptive Repeat and Request,” but it is the same process and is most often referred to simply as “HARQ.” See Ex. 1010 at 118-119.

44. If the receiver determines that it correctly received the data, the receiver transmits an ACK message to the transmitter, at which point the transmitter may send the next packet of data (assuming there is one). Ex. 1010 at 118.

45. If, however, the receiver determines that the message was not correctly received, the receiver stores the failed message in a buffer and sends a NACK message back to the original transmitter. Ex. 1010 at 118. The transmitter will then re-transmit the previous message, which the receiver can combine with the stored message and perform another check. Ex. 1010 at 118. If the check passes, then the receiver sends the ACK message, and the transmitter moves on to the next data packet (assuming there is one). Ex. 1010 at 118. If the check fails, then another NACK message is sent back to the transmitter, and the transmitter will send the first message again until an ACK message is received. Ex. 1010 at 118.

46. Given the “stop-and-wait” nature of the HARQ process, there are often multiple HARQ processes running simultaneously. Ex. 1010 at 118. Figure 5.38 (below) from Holma shows an example of how the HARQ process works.

Ex. 1010 at Fig. 5.38.

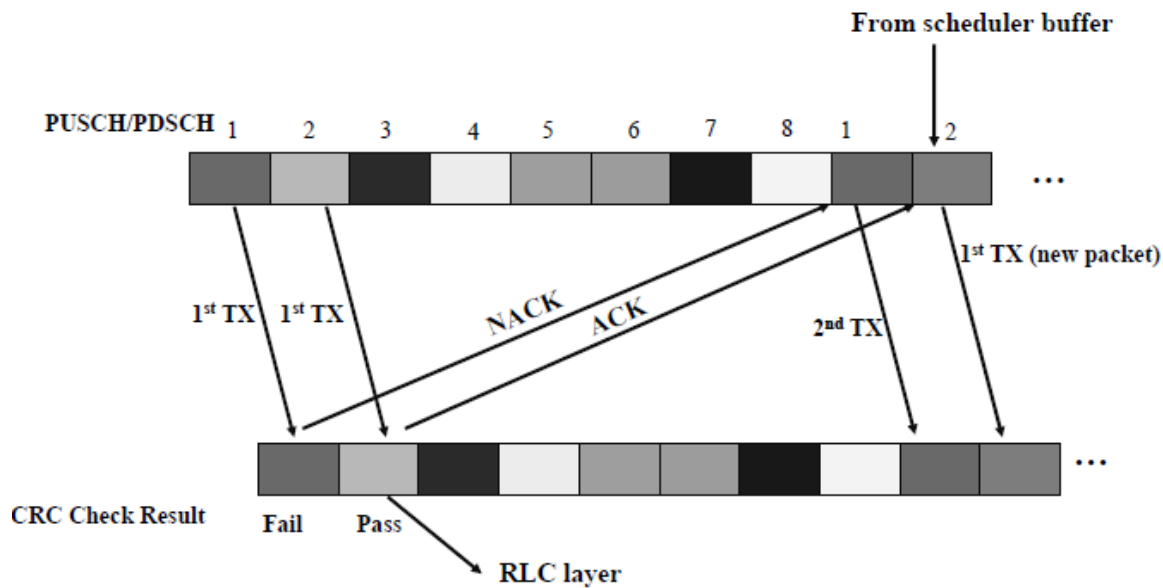
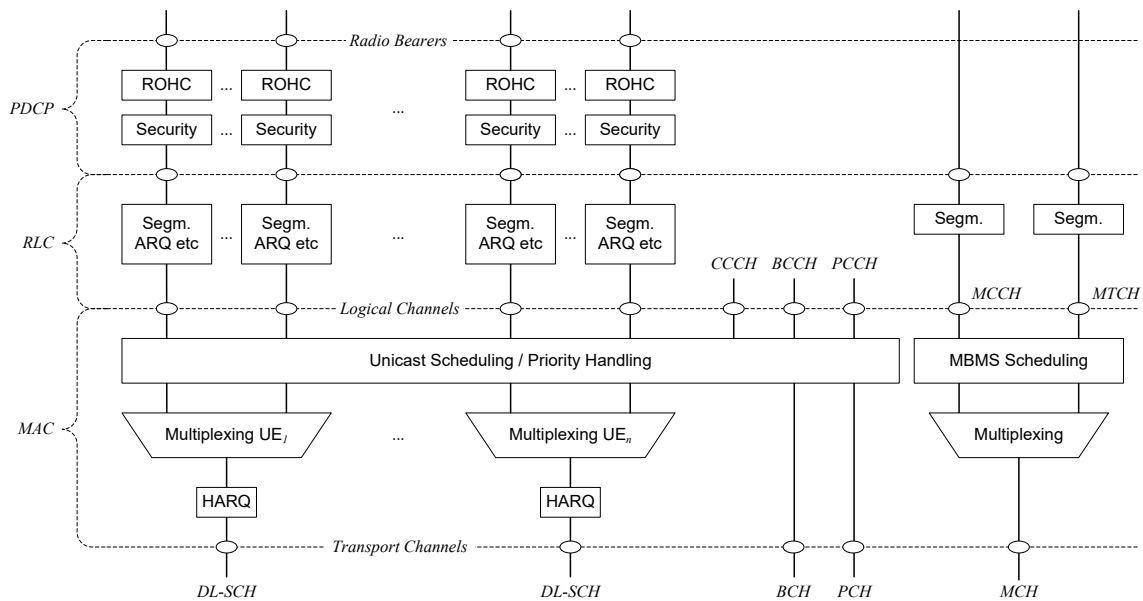


Figure 5.38 LTE HARQ operation with 8 processes

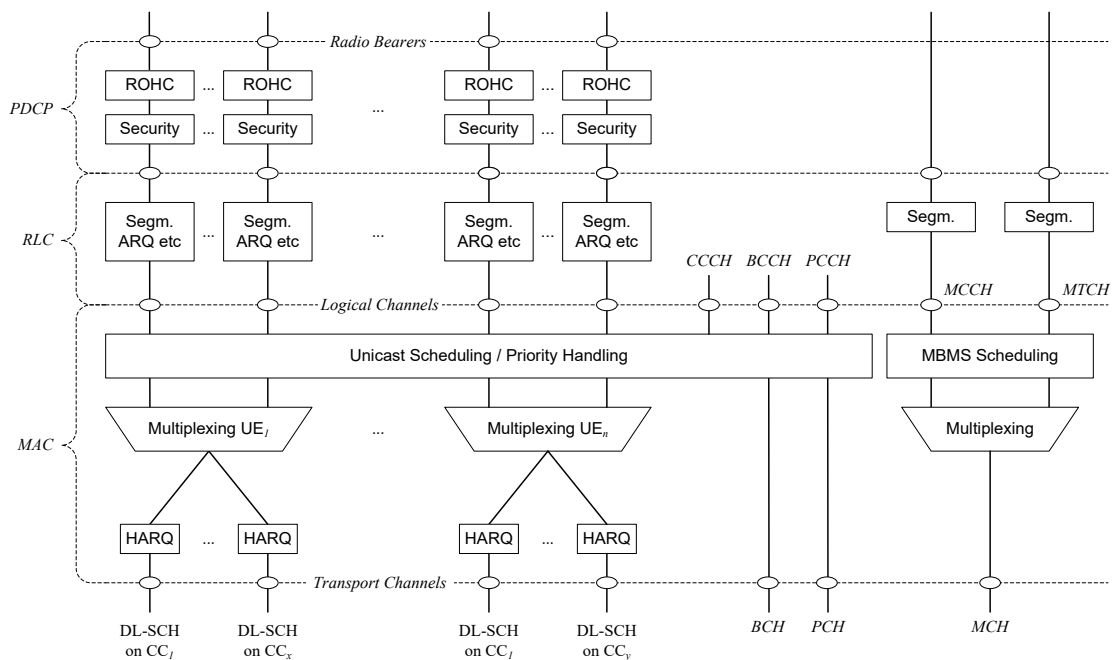
C. Use of HARQ with Carrier Aggregation

47. HARQ processes had also been used with carrier aggregation prior to the filing of the applications that led to the '662 Patent. For example, it was known that an independent HARQ process could exist for each carrier. For example, the following figures show the difference between the standard Layer 2 Structure for DL in Fig. 6-1 and the Layer 2 Structure for DL with CA configured in Fig. 6.4-1 from R2-103427. Ex. 1011 at 8 and 10.

Ex. 1011 at Fig 6-1: Layer 2 Structure for DL.



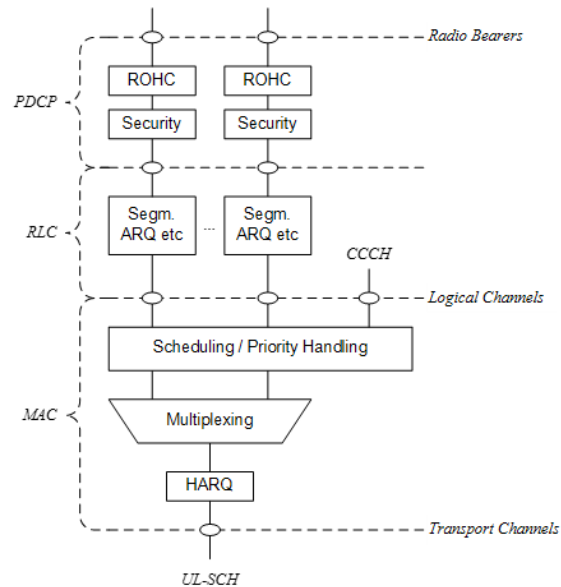
Ex. 1011 at Fig. 6.4-1: Layer 2 Structure for DL with CA configured.



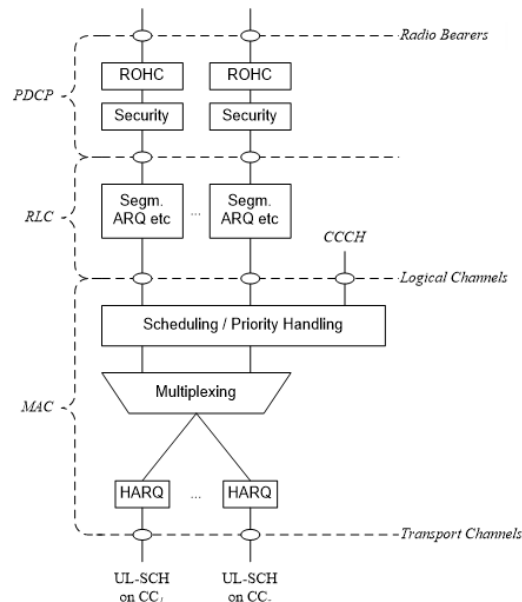
48. In particular, as multiple carriers are used, it was known that the number of HARQ processes could be scaled proportionally. The same also holds in

the UL direction, as can be seen in Figures 6-2 and 6.4-2 from R2-103427, where there is no CA configured in the first figure and CA is configured in the second figure. Ex. 1011 at 9 and 10.

Ex. 1011 at Fig. 6-2: Layer 2 Structure for UL.

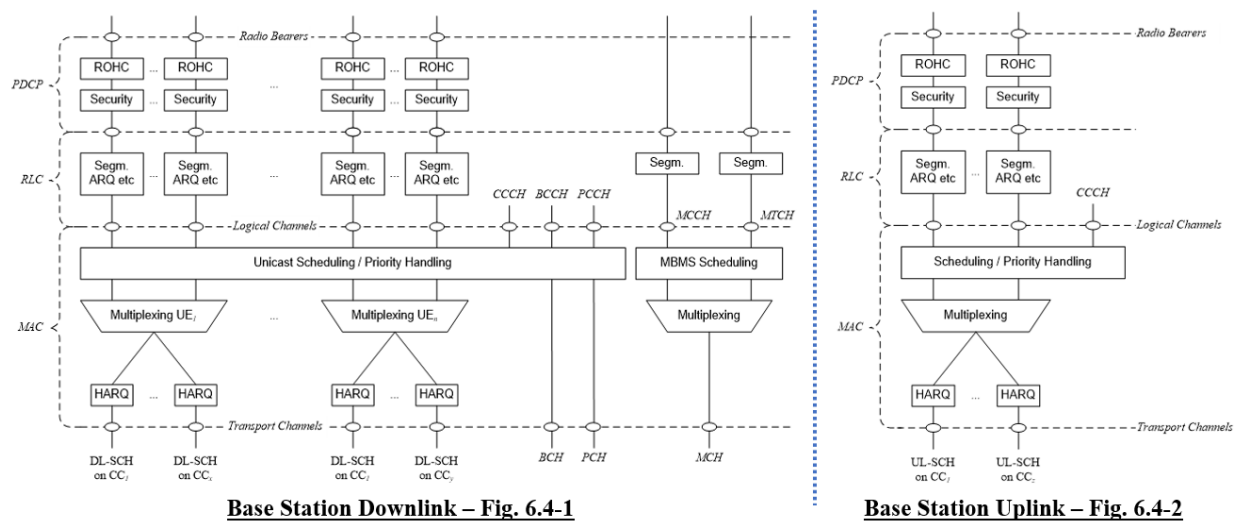


Ex. 1011 at Fig. 6.4-2: Layer 2 Structure for UL with CA configured.



49. In TDD, the component carriers in Fig. 6.4-1 (DL) and Fig. 6.4-2 (UL) would be shared with HARQ buffers on either side of the shared component carrier. In other words, because in “typical TDD deployments, the number of CCs and the bandwidth of each CC in UL and DL is the same,” it was known that the base station (or UE) could both have HARQ buffers on both the uplink and downlink performing HARQ processes. Ex. 1011 at 6. As such, it was known that these HARQ processes could be treated similarly and initialized or wiped whenever a given component carrier is activated or deactivated. Furthermore, it was known that there could be uplink and downlink buffers associated with each component carrier.

Ex. 1011 at Fig. 6.4-2: Layer 2 Structure for UL and DL with CA configured.



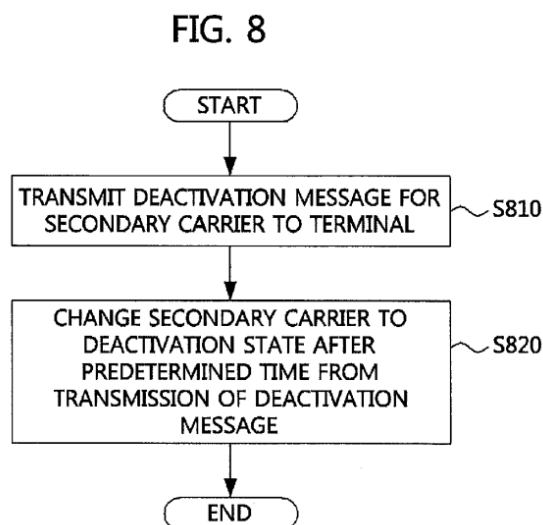
VII. THE '662 PATENT

A. Description of the '662 Patent's Specification

50. The '662 Patent is titled “Method for Carrier Management in a Carrier Aggregation Environment of a Mobile Communication System” and discloses “a carrier management method for use in a carrier aggregation environment of a mobile communication system.” Ex. 1001, Abstract.

51. The '662 Patent states that it is directed to “a carrier management method of a base station capable of preventing inconsistency of carrier states that are managed by the base station and a terminal when a secondary carrier, which is configured and operated in a carrier aggregation environment, is deactivated, as a carrier state management method of the base station.” *Id.* at 2:9-15. Figure 8 is a flow chart that illustrates the steps involved in the deactivation method.

Ex. 1001, Fig. 8.



52. Figure 8 illustrates a process that involves: (1) “transmit deactivation message for secondary carrier to the terminal” and (2) “change secondary carrier to deactivation state after predetermined time from transmission of deactivation message.” Ex. 1001, 2:26-33, Fig. 8.

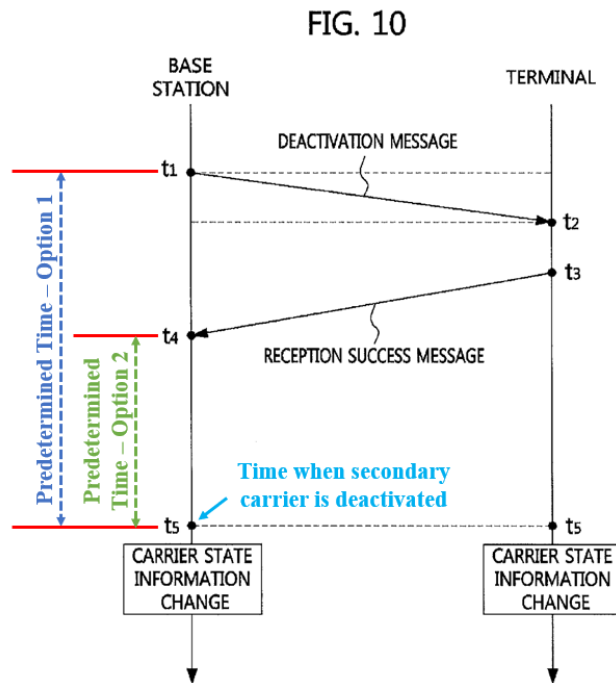
53. As I will describe below, Claim 1 adds an additional step to this process. Specifically, Claim 1 requires: “stopping downlink (DL) data transmission of the secondary carrier and initializing uplink (UL) and DL buffers associated with the secondary carrier after transmitting the deactivation message.” Ex. 1001, Claim 1.

54. The '662 Patent explains the “predetermined time” referenced in Figure 8 may be “a value predefined to make state information that is managed by the base station consistent with state information that is managed by the terminal for the secondary carrier.” Ex. 1001, 2:26-33. The '662 Patent discloses two possibilities for the start of the “predetermined time.” First, the '662 Patent describes that a predetermined time could start at the transmission of the deactivation message. Second, the '662 Patent describes that a predetermined time could start when a success message for the deactivation message is received. Ex. 1001, 13:50-59, Fig. 10.

55. Figure 10 illustrates these two potential options for the “predetermined time,” which I have illustrated with red lines and color-coded text below. The first

option (based on the time from the transmission of the deactivation message) is shown below in blue. The second option (based on the time from the reception of the success message for the deactivation message) is shown below in green.

Ex. 1001, Fig. 10 (Annotated).



56. As shown above, time t_5 is the time when the secondary carrier is deactivated.

57. According to the '662 Patent, “[i]n general, a difference $(t_4 - t_1)$ between the transmission time t_1 of the deactivation message of the base station and the reception time t_4 of the reception success message transmitted by the terminal is configured to have a fixed value, except for the influence of propagation delay of the reception success message, so that $(t_5 - t_1)$ may also be defined if $(t_5 - t_4)$ is defined.” Ex. 1001, 14:5-11.

B. The '662 Patent's Prosecution History

58. I have reviewed the prosecution history of the '662 Patent.

59. The '662 Patent is a continuation of U.S. Patent No. 9,144,106 (the "'106 Patent) (Ex. 1002) and bears an identical specification. Furthermore, the '662 Patent and '106 Patent contain nearly identical claims.

60. The first Office Action rejected the original eight claims for non-statutory double patenting in light of the '106 Patent in view of Nimbalker (US 2012/0087396). Ex. 1003 at 115. The original claims were also rejected as being obvious in view of Xu (PCT/CN2010/07091) in further view of Nimbalker. *Id.* at 117.

61. In response to this Office Action the applicant filed a terminal disclaimer as to the '106 Patent to obviate the Examiner's rejection. *Id.* at 133. The applicant also differentiated the Xu and Nimbalker combination. *Id.* at 144-45.

62. In light of the terminal disclaimer and the Applicant's arguments relating to Xu and Nimbalker, the Examiner issued a Notice of Allowance. *Id.* at 150. In the same, the Examiner noted that "independent claim 1 now almost mirrors independent claim one of parent patent US 9,144,106, with minor word changes from 'after a predetermined time' to 'based on a predetermined time.'" *Id.* at 155 (emphasis added).

63. Claim 1 of the '662 Patent differs from Claim 1 of the '106 Patent in one other minor way. Namely, limitation 1.c of the '662 Patent was changed to be “stopping downlink (DL) *data* transmission of the secondary carrier and initializing uplink (UL) and DL buffers *associated with the secondary carrier* after transmitting the deactivation message” as opposed to “stopping downlink (DL) transmission of the secondary carrier and initializing uplink (UL) and DL *retransmission* buffers after transmitting the deactivation message,” as it was in the '106 Patent.

64. Otherwise, the claims in the '106 and '662 Patent are identical, including the dependent claims.

C. Interpretation of the '662 Challenged Claims

65. For the purposes of my analysis in this IPR proceeding, I understand that the words of a claim are given their plain meaning that those words would have had to a POSITA at the time of the alleged invention. I also understand that the structure of the claims, the specification, and the prosecution history may also be used to better construe a claim insofar as the plain meaning of the claims cannot be understood. Moreover, I understand that even treaties and dictionaries may be used, albeit under limited circumstances, to determine the meaning attributed by a POSITA to a claim term at the time of filing.

66. I have followed this approach in my analysis, and I have applied the plain and ordinary meaning of those terms as they would have been interpreted by a POSITA at the time the invention was made (not today).

VIII. THE CHALLENGED PATENTS ARE NOT ENTITLED TO THEIR PURPORTED PRIORITY DATE

67. I have been asked to determine whether the Challenged Claims are entitled to a priority date of August 12, 2010. The only way that the Challenged Claims are entitled to that priority date is if the priority claim to both Korean priority applications is correct.

68. The face of the patent shows that the '662 Patent claims ultimate priority to two Korean Applications: (1) No. 10-2010-0077880 (the "'880 Application") filed August 12, 2010 (Ex. 1012), and (2) Korean Application No. 10-2010-0110649 (the "'649 Application"), filed November 8, 2010. Ex. 1001 at Cover.⁴

69. It is clear from a comparison of the Challenged Claims to the '880 Application that certain elements are missing from the '880 Application. For example, the '880 Application fails to show that the inventor was in possession of

⁴ For the purposes of this IPR, I have not been asked to assume that the '662 Patent properly claims priority to the '106 Patent, which is why my analysis focuses on the ultimate Korean parent applications.

the “changing the secondary carrier to a deactivation state based on a predetermined time from the transmission of the deactivation message” limitation in Claim 1.

70. Therefore, the '662 Patent claims are not entitled to claim priority to the '880 Application.

A. Legal Standards

71. The following legal standards were provided to me regarding the priority date of the Challenged Claims.

72. In order to gain the benefit of the filing date of an earlier application, each application in the chain leading back to the earlier application must comply with the written description requirement of 35 U.S.C. § 112. To satisfy the written description requirement, the specification must describe the invention sufficiently to convey to a person of skill in the art that the patentee had possession of the claimed invention at the time of the application, *i.e.*, that the patentee invented what is claimed.

B. The '880 Application Does Not Show the Inventor Was in Possession of the “based on a predetermined time” Limitation

73. Claim 1 requires: “changing the secondary carrier to a deactivation state based on a predetermined time from the transmission of the deactivation message.” Dependent Claim 3 requires: “changing, by the base station, the secondary carrier to the deactivation state after a predetermined time.”

74. The '880 Application discloses a fundamentally different technique. Specifically, the '880 Application discloses “a method for managing a channel, including . . . determining a downlink carrier with an unstable wireless channel state among multi-carriers; and, based on the determination result, stopping transmitting data to that carrier.” Ex. 1012 at 23. The '880 Application discloses monitoring various carriers and stopping transmissions on carriers that become unstable. Ex. 1012 at 13 (“In an example of the present invention, when a base station receives a wireless channel state report of a multi-carrier from a terminal, if the wireless channel state of some downlink carriers is bad, the base station instructs those carriers to stop the transmission.”). This does not relate to the timing of when to change the secondary carrier to a deactivation state.

75. The difference in approach between the claims of the '662 Patent and the '880 Application is illustrated by the fact that the phrase “predetermined time” does not appear in the '880 Application. *See generally*, Ex. 1012. The word “time” only appears nine times in the '880 Application and none of those occurrences are in reference to “changing the secondary carrier to a deactivation state” based on that time. Rather, the '880 Application’s use of the word “time” refers to the evaluation of channel state information collected by the base station and when the channel quality remains below an acceptable performance level. *See generally*, Ex. 1012 at ¶¶23, 24, 44, 47, 48. On the other hand, the phrase “predetermined time” appears

thirty-seven times in the written specification of the '662 Patent, which shows that the concept was added later.

76. In addition, the '880 Application contains three figures, and none of them relate to the predetermined time aspect of the claim. For example, Figures 8 and 10 of the '662 Patent described above are not disclosed on the '880 Application.

77. Therefore, I have concluded that the Challenged Patents are not entitled to claim priority to the '880 Application.

IX. SUMMARY OF THE PRIOR ART

A. U.S. Patent App. Pub. No. 2011/0026495 to Lee et al. (“Lee”) (Ex. 1005)

78. Lee is titled “Method for Performing Carrier Management Procedure in a Multi-Carrier Supported Wideband Wireless Communications System and Apparatus for the Same” and was filed on July 27, 2010. Lee is assigned to LG Electronics Inc.

79. Lee discloses “a method and apparatus for performing a carrier management procedure in a broadband wireless communication system supporting multiple carriers.” Ex. 1005, ¶[0003].

80. In the background section, Lee discloses that multi-carrier aggregation was a known technique. Ex. 1005, ¶[0006]. As part of the known multi-carrier aggregation technique, Lee discloses how a mobile station (“MS” or “user equipment” or “UE”) transmits and receives data with a base station (“BS”) through

a plurality of carriers. *Id.* Lee further explains that the various carriers can be controlled through a single MAC message transmitted on a single carrier. Ex. 1005, ¶[0008]; *see also id.* at ¶[0073].

81. For example, Lee discloses two such MAC control messages: “an Advanced Air Interface Carrier Management Command (AAI_CM-CMD) message and an Advanced Air Interface Carrier Management Indication (AAI_CM-IND) message.” Ex. 1005, ¶[0010]. Lee explains that “the AAI_CM-CMD message received from the base station (BS) [can control] primary carrier change, secondary carrier management (secondary carrier activation and/or deactivation), and carrier switching.” Ex. 1005, ¶[0010]. Lee also explains that the exemplary “AAI_CM-IND message is a MAC control message used as a response to the AAI_CM-CMD message, and is transmitted from the mobile station (MS) to the base station (BS).” Ex. 1005, ¶[0010].

82. Lee discloses that one of its goals is to help prevent faults, which may negatively impact communications between MSs and BSs. Ex. 1005, ¶[0012]. To help address this issue, Lee proposes utilizing “a carrier management command and an acknowledgement response to the carrier management command” and establishing “correct time point(s)” for carrier activation and/or deactivation caused by the carrier management command.” Ex. 1005, ¶[0013]. Lee explains that carrier state changes occurring at “correct time point(s)” can be implemented using “action

times” and “disconnection times.” Ex. 1005, ¶¶[0019], [0024]; *see also* Ex. 1005, ¶¶[0141], [0144]-[0147], Table 4-12, Fig. 7.

83. Lee described the Disconnection Time as “LSB bits of Superframe number at the time to disconnect the connection with the target carriers(s).” Ex. 1005, Table 6-12; *see also* Ex. 1005 at Fig. 14, [0017], page 2, and [0099] (similar description for “Action Time”). Lee also explains, in the case of a carrier change that the “disconnection time” may be the same as the “action time.” Ex. 1005, ¶[0146].

84. Table 5 (below) discloses the basic parameters that can be configured in the AAI_CM-CMD messages disclosed by Lee. Ex. 1005, ¶[0162].

Ex. 1005, Table 5 (Annotated).

TABLE 5		
Field	Size (bit)	Description
AAI_Carrier Management Command message		
format() {		
Management Message Type	8	AAI_CM-CMD
Action code	1	0: Secondary Carrier Management 1: Primary carrier change
If (Action code == 0) {		This message is for secondary carrier activation and/or deactivation
Indication Type	2	For Activation and/or Deactivation Bit #0: '0': No action, '1': Activation Bit #1: '0': No action, '1': Deactivation
If (Indication Type #0 == 1)		
Num of target carrier	[TBD]	The number of newly activated carrier(s)
For(i=0; i< Num of target carrier; i++){		
Target carrier index	[TBD]	Target carrier index for activation
Activation of DL/UL	1	'0': Both DL/UL are activated '1': DL is activated but UL is not activated
Ranging indicator	1	Ranging indicator for target carrier '0': No ranging is required for the target carrier '1': Periodic ranging is required for the target carrier
}		
}		
If (Indication Type #1 == 1) {		
Num of target carrier	[TBD]	The number of deactivated carrier(s)
For(i=0; i< Num of target carrier; i++){		
Target carrier index	[TBD]	Target carrier index for deactivation
Deactivation of DL/UL	1	'0': Both DL/UL are deactivated '1': UL is deactivated but DL is kept active
}		
}		
If (Action code == 1) {		This message is for primary carrier change.
Target carrier index	[TBD]	Target carrier index for primary carrier change
Action Time	[TBD]	LSB bits of Superframe number at the time to switch to the target carrier This value shall be set to the value more than the retransmission time for AAI_CM-CMD message
Next state of serving primary carrier	1	'0': Serving carrier will be deactivated after primary carrier change '1': Serving carrier is kept active after primary carrier change
}		
}		

85. Table 6 (below) discloses parameters that can be configured in the AAI_CM-CMD messages when deactivating a secondary carrier. Ex. 1005, ¶[163]; *see also* Ex. 1005, ¶[0164]-[0169], Tables 5, 7-12.

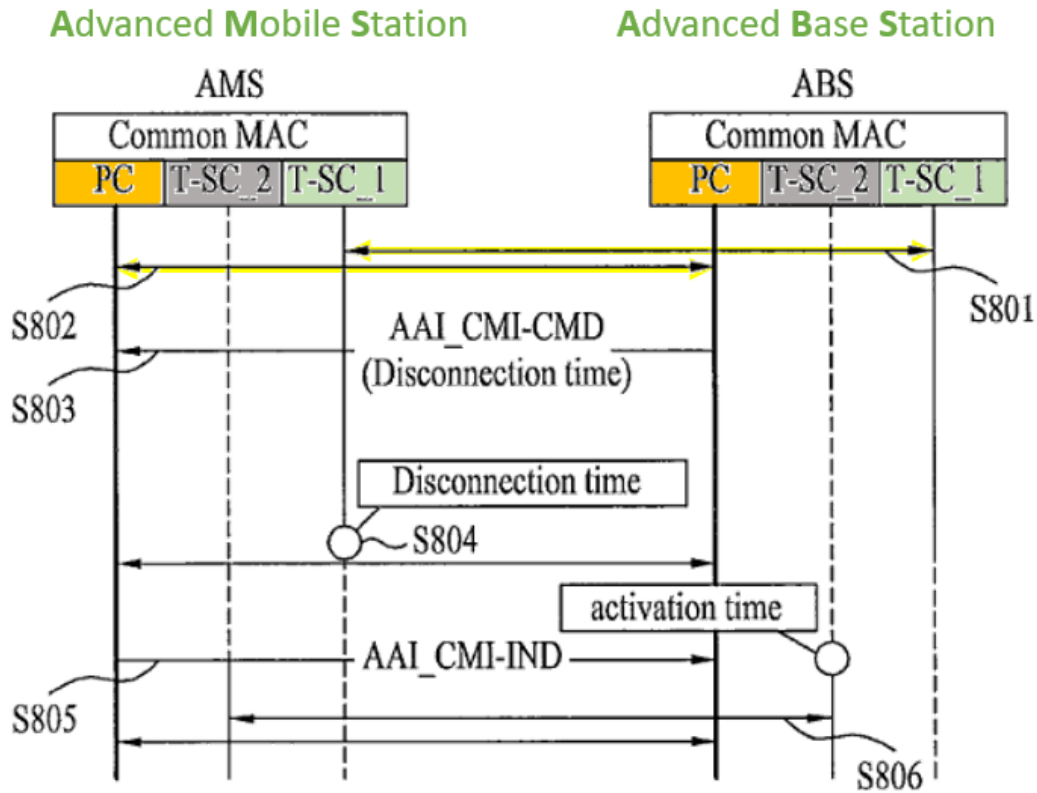
Ex. 1005, Table 6 (Annotated).

TABLE 6		
Field	Size (bit)	Description
...		
If (Indication Type #1 == 1){		
Num of target carrier	[TBD]	The number of deactivated carrier(s)
Disconnection time	[TBD]	LSB bits of Superframe number at the time to disconnect the connection with the target carrier(s)
For(i=0; i< Num of target carrier; i++){		
Target carrier index	[TBD]	Target carrier index for deactivation
Deactivation of DL/UL	1	'0': Both DL/UL are deactivated '1': UL is deactivated but DL is kept active
}		
}		
...		

86. Table 6 shows how the AAI_CM-CMD messages disclosed by Lee contain parameters that control the deactivation of secondary carriers and define disconnection times for doing so.

87. Figure 8 from Lee illustrates the usage of a specific disconnection time as described in Lee as part of the secondary carrier deactivation. Ex. 1005, ¶[0159].

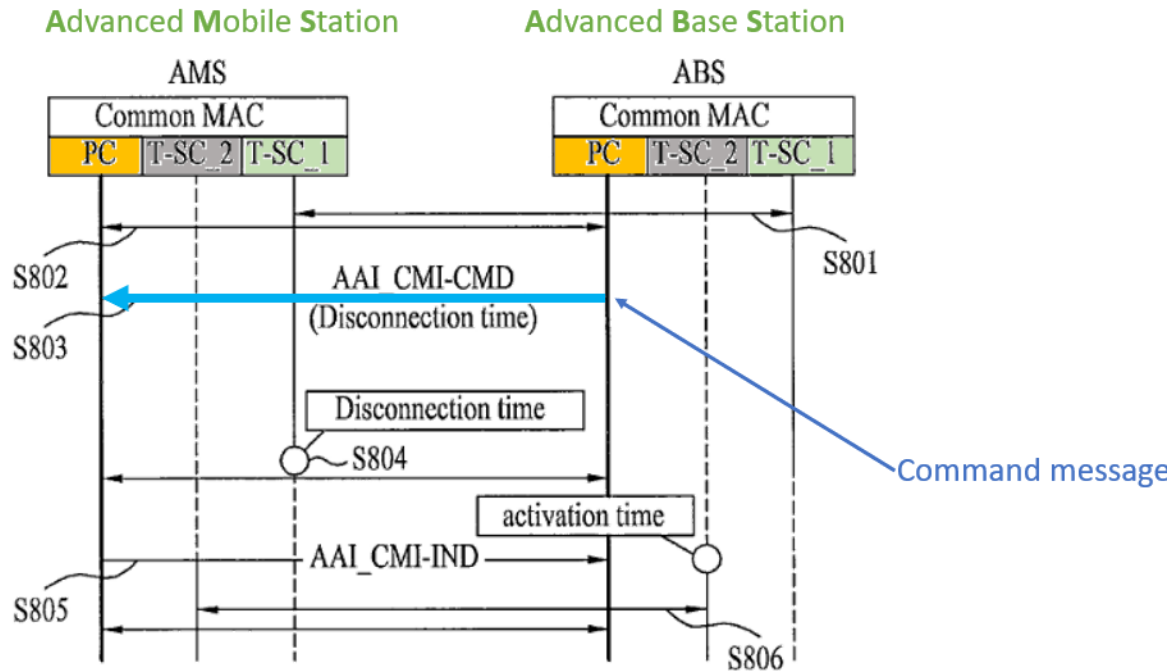
Ex. 1005, Fig. 8 (Annotated).



88. In Figure 8, the Advanced Mobile Station (AMS) and Advanced Base Station (ABS) are in communication. The two carriers that are active on the primary carrier (“PC,” shown in orange) and the Secondary Carrier 1 (labeled “T-SC_1” shown in green). The communications S801 and S802, highlighted in yellow, show the active connection.

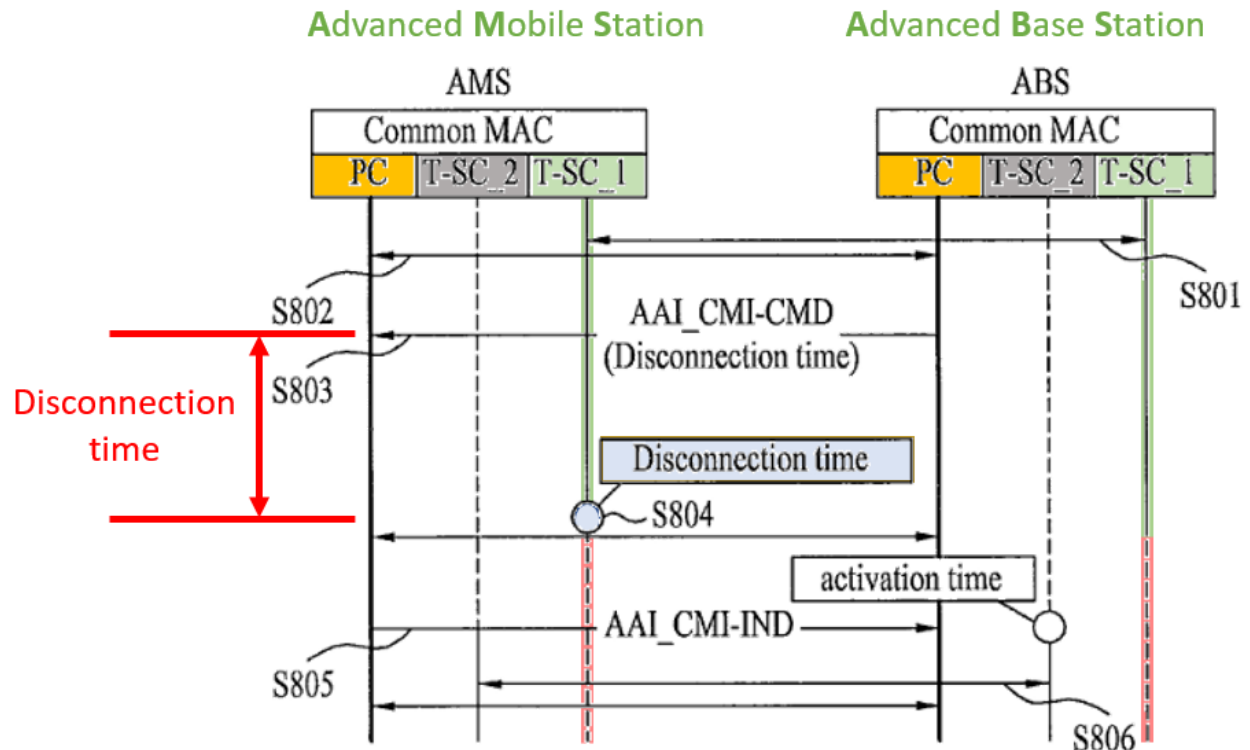
89. In the second step (shown below), the MAC command message “AAI_CMI-CMD” is sent by the base station to the mobile station with a command to deactivate T-SC_1. The command contains a “disconnection time” which informs the UE about the timing to disconnect.

Ex. 1005, Fig. 8 (Annotated).



90. At the indicated disconnection time S804 (shown below in light blue), both the base station and the mobile station deactivate and disconnect from T-SC_1.

Ex. 1005, Fig. 8 (Annotated).



91. Lee also explains that the HARQ process can be applied to the MAC control messages described by Lee. Ex. 1005, ¶¶[0117]-[0124]. Lee also describes that the BS may contain buffers to store arithmetically processed information for a predetermined time. Ex. 1005, ¶[0304].

B. U.S. Patent App. Pub. No. 2011/0103326 to Kim et al. (“Kim”) (Ex. 1006)

1. Overview

92. Kim is titled “Method of Operating User Equipment in Wireless Communication System Using a Plurality of Uplink Frequencies.” Kim is assigned to LG Electronics Inc.

93. Kim was filed on October 28, 2010, and claims priority to two provisional applications: Provisional Application No. 61/256,294 (“Kim 294 Provisional”) filed on October 29, 2009, and Provisional Application No. 61/257,427 (“Kim 427 Provisional”) filed on November 2, 2009.

94. Kim discloses “a method of operating the user equipment in the wireless communication system using the plurality of uplink frequencies [which] includes identifying deactivation of a specific uplink frequency among the plurality of uplink frequencies, and flushing a Hybrid Automatic Repeat reQuest (HARQ) process associated with the specific uplink frequency.” Ex. 1006, Abstract.

95. In the background section, Kim discloses that “simultaneous communication between a UE and a base station using a plurality of frequencies or carriers is referred to as carrier aggregation.” Ex. 1006, ¶[0016]; *see also* Ex. 1006, ¶[0054]-[0057]. Kim discloses that during carrier aggregations communications HARQ processes are running for the various carriers on which data is being sent. Ex. 1006, ¶[0017].

96. Furthermore, Kim explains that sometimes the network may deactivate a secondary carrier for which a UE is still holding buffered HARQ information, which can result in an unnecessary retransmission of data should that secondary carrier be reactivated at a later time. Ex. 1006, ¶[0017].

During the dual cell E-DCH operation or carrier aggregation, a secondary frequency or a certain carrier

may be activated or deactivated according to the data transmission rate. However, if a UE transmits last data stored in a buffer of the UE to a network through an activated secondary uplink frequency using a Hybrid Automatic Repeat reQuest (HARQ) operation, and, if the network successfully receives the data, the network transmits an ACK signal to the UE as HARQ feedback information. The network may deactivate the secondary uplink frequency. However, if the UE erroneously determines that the HARQ feedback information is a NACK signal, the UE does not delete the transmitted data and thus the data is present in the buffer of the HARQ process corresponding to the deactivated secondary uplink frequency. Thereafter, if the network reactivates the secondary uplink frequency, the UE unnecessarily retransmit the data present in the HARQ buffer. That is, radio resource waste and interference occur due to unnecessary retransmission.

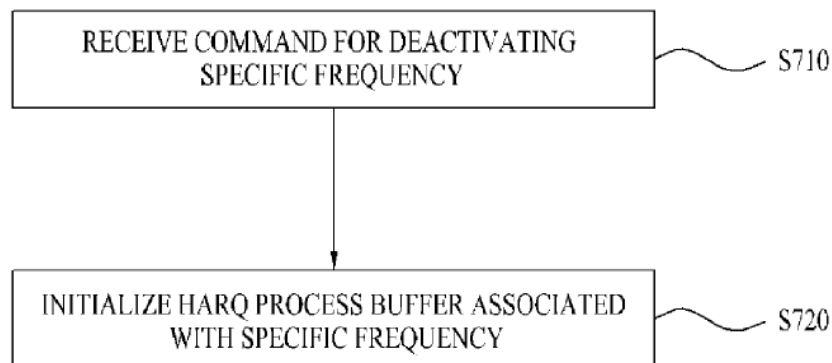
Ex. 1006, ¶[0017].

97. Kim proposes flushing or initializing the HARQ buffers/process when a specific carrier is deactivated to address the issues above. Ex. 1006, ¶¶[0024], [0029], Fig. 7, Fig. 8.

98. Figure 7 (below) is a flowchart of its disclosed secondary carrier deactivation process. Ex. 1006, ¶[0073]. Ex. 1006, Fig. 7.

Ex. 1006, Fig. 7.

FIG. 7



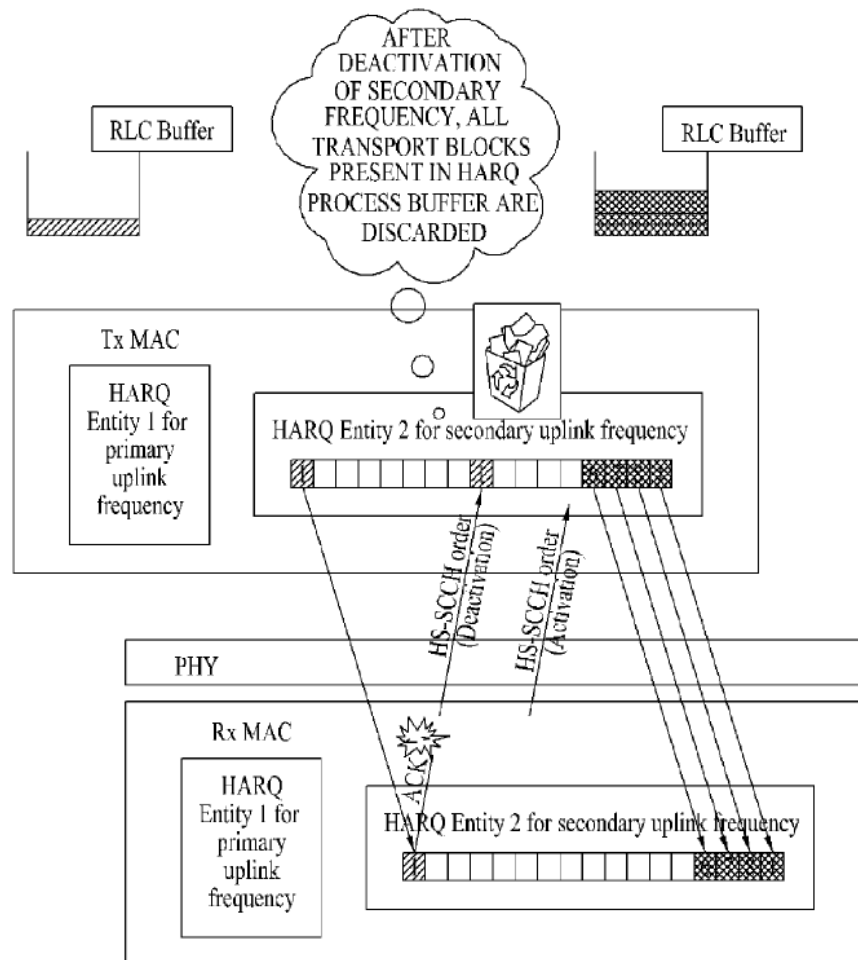
99. The deactivation process involves (1) “[r]eceive command for deactivating specific frequency” and (2) “[i]nitalize HARQ process buffer associated with specific frequency.” Ex. 1006, Fig. 7; ¶[0074]-[0079].

100. Kim discloses that “[o]ne independent HARQ entity exists for each of the plurality of uplink frequencies, and the HARQ entity manages a plurality of HARQ processes.” Ex. 1006, ¶[0080]. Kim discloses that initializing of the HARQ process buffer involves “discard[ing] data present in all HARQ process buffers of the HARQ entity associated with the deactivated secondary uplink frequency.” Ex. 1006, ¶[0080].

101. Figure 8 (below) illustrates how after deactivation the HARQ buffers associated with a given secondary frequency are flushed or discarded. Ex. 1006, ¶[0073], Fig. 8.

Ex. 1006, Fig. 8.

FIG. 8



102. Kim's disclosure largely focuses on the uplink side. However, as described above in Section VI.B.–VI.C., the HARQ process is not novel and is well known by a POSITA. Furthermore, it is well known that HARQ processes run on both uplink and downlink messages on both the UE and BS side. Thus, a POSITA would understand and know that its disclosure could be applied to the base station side as well. Ex. 1015 at 3.

2. Kim is prior art as of its priority date

103. To the extent that the Patent Owner argues that the '662 Patent is entitled to an August 12, 2010 priority date, I show below that Kim is entitled to the priority of the Kim Provisional Applications from 2009. I understand a reference is entitled to claim the benefit of the filing date of its provisional application if the disclosure of the provisional application provides support for the claims in the reference patent.

(i) The Kim provisional applications provide written description for Kim Claim 1

104. Kim is entitled to at least a November 2, 2009, prior art date because Kim's priority applications provide the support for at least Claim 1 as well as support for the subject matter relied on herein.

105. The Kim provisional applications (Kim 294 Provisional (Ex. 1007) and Kim 427 Provisional (Ex. 1008)) provide written description for Kim Claim 1, as shown at least by the below table, which shows exemplary disclosures from the Kim provisional applications providing the written description for Kim Claim 1.

Kim Claim 1	Disclosure from Kim Provisional Applications
1. <u>A method of operating a user equipment in a wireless communication system using a plurality of uplink</u>	<u>Kim 294 Provisional</u> (Ex. 1007) • <u>"In DC-HSUPA, unlike primary carrier, secondary carrier is dynamically activated or de-activated by NodeB."</u> Ex. 1007 at 53. • <u>When secondary carrier of UE is de-activated</u>, it is possible that there exists data to be transmitted in

<u>frequencies, the method comprising:</u> <u>identifying deactivation of a specific uplink frequency among the plurality of uplink frequencies; and</u> <u>flushing a Hybrid Automatic Repeat reQuest (HARQ) process associated with the specific uplink frequency.</u>	HARQ buffer. For instance, when secondary carrier is de-activated after NodeB receives data through the secondary carrier from the UE and transmits HARQ ACK, if ACK-to-NACK takes place in the UE's side, the UE may not discard the data from the HARQ buffer. After that, if the secondary carrier of the UE is re-activated by Node B, the UE would try to retransmit the remaining data in the HARQ buffer since the HARQ buffer of the UE is not empty. <u>Therefore, when the secondary carrier is de-activated, the UE can prevent unnecessary transmission by flushing the HARQ buffer.</u>" Ex. 1007 at 53. • <u>"Proposal 1: The UE shall flush HARQ process buffer corresponding to the secondary carrier when secondary carrier is de-activated (or re-activated)."</u> Ex. 1007 at 53. • <u>"De-activation on Secondary Uplink Frequency: If Secondary Uplink Frequency is de-activated by lower layer, the UE shall: deactivate all HARQ processes corresponding to secondary carrier; flush all buffers corresponding to secondary carrier."</u> Ex. 1007 at 54 <u>Kim 427 Provisional</u> (Ex. 1008) • <u>"In Dual Cell E-DCH operation, unlike the primary carrier, the secondary carrier is dynamically activated/de-activated by Node B."</u> Ex. 1008 at 19. • <u>"When the secondary carrier is de-activated, the data to be transmitted on the carrier might be remained in the HARQ process buffer on the UE. Assuming that Node B receives data on the secondary carrier from the UE then transmits the HARQ ACK to the UE and de-activates the secondary carrier. If ACK-to-NACK error occurs at the UE side, the UE will not flush HARQ process buffer on the secondary carrier. Moments later if the secondary carrier is re-activated by Node B, the UE might try to re-transmit the data in the HARQ process buffer since the buffer is not empty. In order to prevent this problem, the UE</u>
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	<u>should flush HARQ process buffer on the secondary carrier when the carrier is deactivated (or re-activated)."</u> Ex. 1008 at 19. • <u>"Proposal 1: The UE shall flush HARQ process buffer corresponding to the secondary carrier when secondary carrier is de-activated (or re-activated)."</u> Ex. 1008 at 19. • <u>"De-activation on Secondary Uplink Frequency: If Secondary Uplink Frequency is de-activated by lower layer, the UE shall on the secondary carrier: deactivate all HARQ processes and flush all buffers."</u> Ex. 1008 at 20.
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106. As the above chart shows Kim 294 Provisional (Ex. 1007) and Kim 427 Provisional (Ex. 1008) both disclose that secondary carriers are dynamically activated or deactivated by the base station. *See* Ex. 1007 at 53-54; Ex. 1008 at 19-22. The Kim provisional applications also disclose that these secondary carriers can be used as secondary uplink frequencies by the user equipment. *See* Ex. 1007 at 53-54; Ex. 1008 at 19-22. As such, the Kim provisional application to provide written disclosure for the preamble of Claim 1 from Kim: "[a] method of operating a user equipment in a wireless communication system using a plurality of uplink frequencies."

107. The Kim provisional applications' disclosure of dynamically activating and deactivating secondary carriers also provides written support for the first limitation of Claim 1 from Kim: "identifying deactivation of a specific uplink frequency among the plurality of uplink frequencies." *See* Ex. 1007 at 53-54; Ex. 1008 at 19-22. A POSITA would understand that dynamically activating and

deactivating secondary carriers would necessarily involve the UE “identifying deactivation of a specific uplink frequency among the plurality of uplink frequencies.” The Kim provisional applications also provide further support for this limitation by explaining what the UE does once a secondary uplink frequency is deactivated. *See* Ex. 1007 at 53-54; Ex. 1008 at 20. For example, the Kim provisional applications explain that “[i]f Secondary Uplink Frequency is de-activated by lower layer, the UE shall on the secondary carrier: deactivate all HARQ processes and flush all buffers.” *See* Ex. 1007 at 54; Ex. 1008 at 19-22. Again, a POSITA would understand that for a UE to do anything following the deactivation of a secondary uplink frequency that the UE would first need to “identify[] deactivation of a specific uplink frequency among the plurality of uplink frequencies.” The Kim 427 Provisional also further provides written description for this limitation by explaining that there can be multiple secondary component carriers used for uplink. *See* Ex. 1008 at 22-23 (explaining carrier aggregation in LTE and providing Figure 5.2.1-2 which show multiple component carriers for the uplink as notated by the ellipses between CC₁ and CC_x).

108. The Kim provisional applications also explicitly provide written description for the final limitation of Claim 1 from Kim: “flushing a Hybrid Automatic Repeat reQuest (HARQ) process associated with the specific uplink frequency.” *See* Ex. 1007 at 53-54; Ex. 1008 at 19-22. For example, the Kim

provisional applications disclose that “[t]he UE shall flush HARQ process buffer corresponding to the secondary carrier when secondary carrier is de-activated.” See Ex. 1007 at 53; Ex. 1008 at 19. This exemplary disclosure provides written descriptions for “flushing a Hybrid Automatic Repeat reQuest (HARQ) process associated with the specific uplink frequency.” As such, the Kim provisional applications provide written description for Claim 1 from Kim.

(ii) The Kim provisional applications describe the subject matter relied upon as prior art in this petition

109. The Kim provisional applications (Kim 294 Provisional (Ex. 1007) filed on October 29, 2009, and Kim 427 Provisional (Ex. 1008) filed on November 2, 2009) describe the subject matter relied upon as prior art in this petition.

110. As described below, Kim is primarily being utilized to provide support for the limitation of “initializing uplink (UL) and DL buffers associated with the secondary carrier” (’662 Patent Claim 1). As can be seen in the table above, the Kim provisional applications disclose that “[t]he UE shall flush HARQ process buffer corresponding to the secondary carrier when secondary carrier is de-activated (or re-activated).” Ex. 1007 at 53; Ex. 1008 at 19. Thus, the Kim provisional applications include a disclosure of the subject matter that is being relied on for purposes of the invalidity analysis below.

111. Thus, Kim is entitled to claim the benefit of the filing date of its provisional application and is prior art to the ’662 Patents even if the ’662 Patent is

entitled to its alleged priority date, which they are not for the reasons discussed in Section VIII above.

C. Motivation to Combine

112. A POSITA would have been motivated to combine Lee with Kim with a reasonable expectation of success.

113. *First*, Lee and Kim are directed to improvements to carrier aggregation. For example, both Lee and Kim propose improvements to the ways in which base station and terminal aggregate carriers dynamically. Of relevance, both Lee and Kim propose improvements related to the deactivation of secondary cells as part of the carrier aggregation process. *E.g.*, Ex. 1005, ¶[0097]; Ex. 1006, ¶¶[0004], [0024]; Ex. 1001, Abs..

114. *Second*, while Lee discloses concepts associated with secondary carriers, timing of deactivation, and retransmission messages, Lee does not provide certain details regarding the processing necessary once deactivation initiated. Lee did not need to provide that detail because it is obvious to a person of ordinary skill in the art that there would need to be some steps to clean up the buffers and messaging stack to account for the deactivation of a carrier. A person of ordinary skill in the art would be motivated to combine Lee with Kim because Kim discloses the steps that would occur after deactivation, such as the steps to clean up the buffers and messaging stack.

115. For example, Lee discloses a “a carrier management procedure” that uses MAC messages to activate and deactivate carriers. Ex. 1005, ¶¶[0003], [0014]-[0019]. Lee discloses that HARQ processes can be applied to the MAC control messages described by Lee. Ex. 1005, ¶¶[0117]-[0124]. Lee also describes that the BS may contain buffers to store arithmetically processed information for a predetermined time. Ex. 1005, ¶[0304]. A POSITA implementing the concepts from Lee would have understood that the HARQ processes would be impacted by the secondary carrier deactivation described in Lee. A POSITA would have thus been motivated to look for similar art for guidance on what to do with the HARQ processes after secondary carrier deactivation.

116. Kim is a reference a POSITA would look for and find. Kim’s deactivation process involves (1) receiving the deactivation command and (2) initializing the HARQ process buffer for the associated secondary carrier. Ex. 1006, ¶[0074]-[0079]. Kim discloses that “[o]ne independent HARQ entity exists for each of the plurality of uplink frequencies, and the HARQ entity manages a plurality of HARQ processes.” Ex. 1006, ¶[0080]. Kim discloses that initializing of the HARQ process buffer involves “discard[ing] data present in all HARQ process buffers of the HARQ entity associated with the deactivated secondary uplink frequency.” Ex. 1006, ¶[0080]. And while Kim focuses on the uplink frequency, the same logic would apply to the downlink frequency in the BS (*e.g.*, those HARQ buffers could

be flushed as well). Thus, a POSITA following the steps of deactivation from Lee would look to Kim to understand an obvious way to complete the process. Moreover, a POSITA would have a reasonable expectation of success in combining the two references since Kim's steps of initializing the HARQ buffers follows Lee's steps of deactivation.

117. *Third*, Lee and Kim are assigned to LG Electronics. *See* Ex. 1005; Ex. 1006. When looking for art to combine with Lee, a POSITA would have been motivated to look for other art by LG Electronics as a POSITA would have a higher expectation of success by combining art from the same company directed to the same technological area.

118. *Fourth*, a POSITA would have had a reasonable expectation of success in combining Lee with Kim, as both are directed to carrier aggregation in known LTE systems. Ex. 1005, ¶¶[0066]-[0067]; Ex. 1006, ¶¶[0056]-[0058]. A POSITA looking to understand how LTE systems work would naturally look to art directed to the same process in the same LTE system.

119. Thus, a POSITA looking to implement the disclosures from Lee would have been motivated to look to Kim for guidance as to what one could do to the HARQ processes (or other buffers associated with the secondary carrier) after deactivating a secondary carrier.

X. GROUND 1: LEE IN VIEW OF KIM OBVIOUS CLAIMS 1-4

A. Independent Claim 1

[1.p] A carrier management method of a base station for use in a carrier aggregation environment, comprising:

120. To the extent the preamble is limiting, Lee renders obvious this claim limitation.

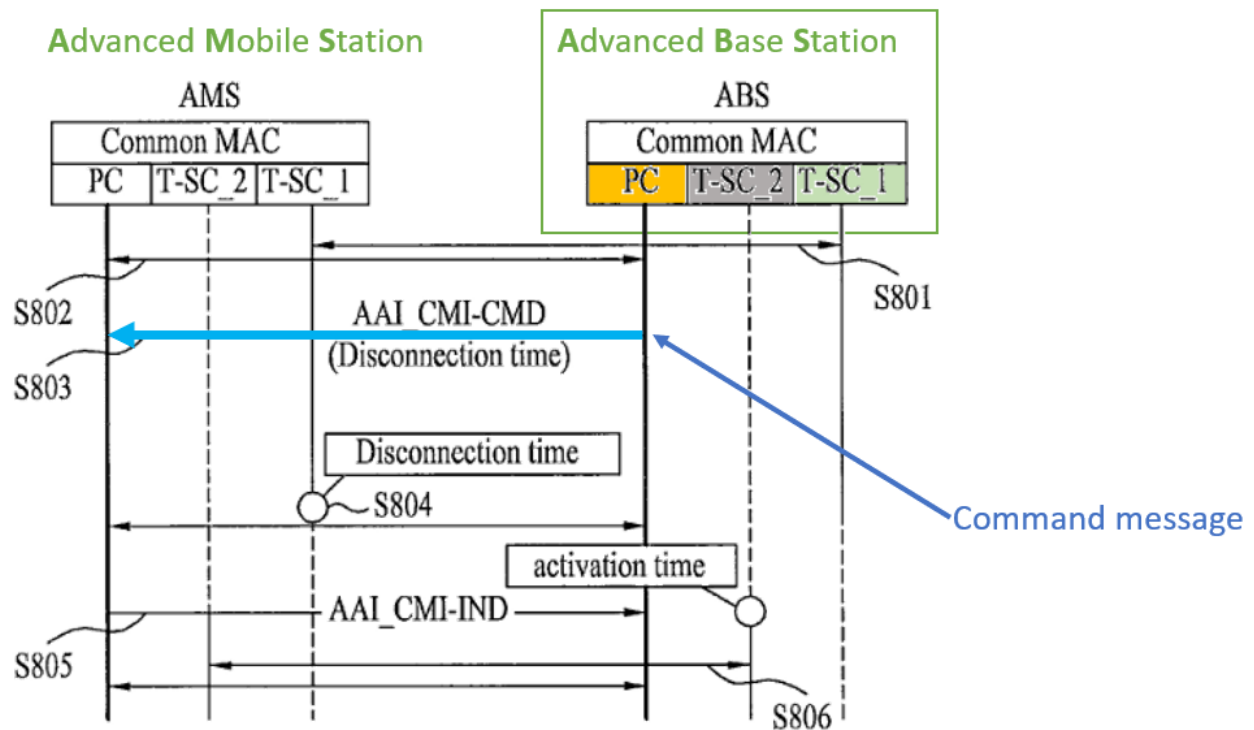
121. Lee describes “a method and apparatus for performing a carrier management procedure in a broadband wireless communication system supporting multiple carriers.” Ex. 1005, ¶[0003]. Lee discloses that “multi-carrier aggregation . . . allow[s] the MS to exchange data with the BS through a plurality of carriers.” Ex. 1005, ¶[0006]. Lee discloses that secondary carriers are additional carriers that can be used by an MS, which are “used according to a specific command by the base station (BS).” Ex. 1005, ¶[0009].

122. Lee likewise discloses the use of control messages sent by the base station for use in the carrier management procedure. Ex. 1005, ¶[0010]; *see also* Ex. 1005, ¶[0095] (“The base station (BS) may activate and/or deactivate the secondary carrier using an AAI Carrier Management Command (AAI_CM-CMD) message.”); Ex. 1005, ¶[0104]. Lee discloses that the “Advanced Air Interface Carrier Management Command (AAI_CM-CMD) message” that is “received from the base station (BS)” enables “primary carrier change, secondary carrier management

(secondary carrier activation and/or deactivation), and carrier switching.” Ex. 1005, ¶[0010].

123. Figure 8 from Lee illustrates an exemplary system utilizing Lee’s disclosed method. Ex. 1005, ¶[0049]. Figure 8 shows how the base station in Lee performs carrier management in a carrier aggregation environment. In Figure 8, (i) “PC” (in orange) represents the primary carrier, (ii) “T-SC_2” (in grey) is one secondary carrier, and (iii) “T-SC_1” (in green) is another secondary carrier. The command message (in blue arrow) is, for example, the “AAI_CMI-CMD” message. Ex. 1005, ¶¶[0159]-[0160].

Ex. 1005, Fig. 8 (Annotated).



124. Claim 10 of Lee also discloses this limitation. Ex. 1005, Claim 10. For example, Claim 10 states “[a] *method for a multi-carrier supported base station to support a carrier change of a single-carrier supported mobile station, the method comprising: . . . transmitting a carrier management command message including an action code and an action time, to the mobile station on a serving carrier.*” Ex. 1005, Claim 10 (emphasis added).

125. A POSITA would understand that Lee teaches a carrier management method of a base station for use in a carrier aggregation environment. Thus, Lee renders obvious “[a] carrier management method of a base station for use in a carrier aggregation environment,” as recited in Claim 1.

[1.a] transmitting a deactivation message for a secondary carrier to a terminal;

126. Lee renders obvious this claim limitation.

127. The AAI_CM-CMD message is a deactivation message for a secondary carrier. Lee discloses “[t]he base station (BS) may activate and/or *deactivate the secondary carrier* using an AAI Carrier Management Command (AAI_CM-CMD) message.” Ex. 1005, ¶[0095] (emphasis added); *see also* Ex. 1005, ¶[0104], ¶[0010]. Lee also discloses that the AAI_CM_CMD message is transmitted from a base station to a terminal. Ex. 1005, ¶[0104]; *see also id.* at ¶¶[0049], [0159]-[0160], Fig. 8.

128. Lee provides an overview of the parameters that can be configured in the AAI_CM-CMD messages. Ex. 1005, ¶¶[0162]. For example, Table 5 shows the contents of an AAI_CM-CMD message. One of the fields is the “Action Code” field. If the “Action Code” is cleared (assigned a value of 0), then the AAI_CM-CMD message “is for secondary carrier activation and/or deactivation.” Ex. 1005, Table 5; *see also* Ex. 1005, ¶¶[0133], [0150], [0153]. Another field is “Indication Type.” This parameter controls whether the message is an activation message or a deactivation message, where Bit #1 is cleared (assigned a value of 0) for deactivation. Ex. 1005, Table 5; *see also* Ex. 1005, ¶¶[0095], [0135], [0153].

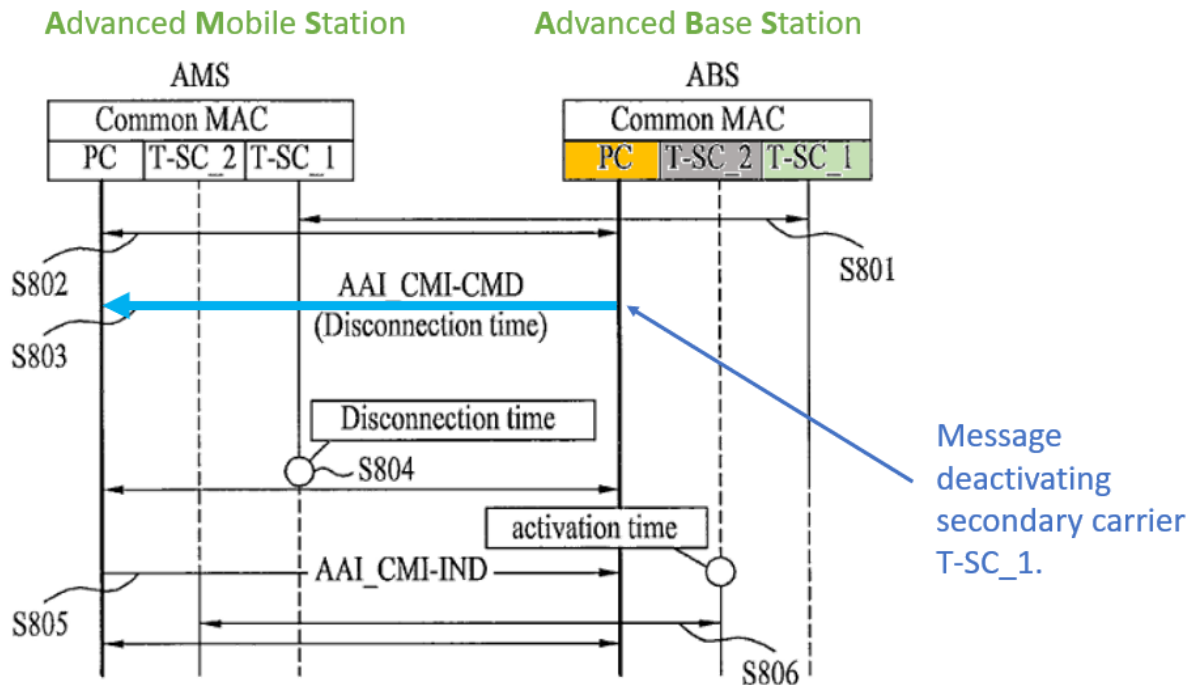
Ex. 1005, Table 5 (Annotated, Partial).

TABLE 5		
Field	Size (bit)	Description
AAI_Carrier Management Command message		
format() {		
Management Message Type	8	AAI_CM-CMD
Action code	1	0: Secondary Carrier Management 1: Primary carrier change
If (Action code == 0) {		This message is for secondary carrier activation and/or deactivation
Indication Type	2	For Activation and/or Deactivation Bit #0: '0': No action, '1': Activation Bit #1: '0': No action, '1': Deactivation

129. Figure 8 illustrates the message flow and shows that the AAI_CM-CMD message is sent from the ABS (the base station) to the AMS (the mobile station). For example, at step S803, the AAI_CM-CMD message is transmitted from the ABS to the AMS and “includes parameters that are needed to deactivate the first

target secondary carrier (T-SC_1) and activate the second target secondary carrier (T-SC_2).” Ex. 1005, ¶¶[0159]-[0160]⁵, Fig. 8.

Ex. 1005, Fig. 8 (Annotated).



130. Thus, a POSITA would understand that Lee discloses the base station transmitting a deactivation message for a secondary carrier to a terminal.

131. Thus, Lee renders obvious “transmitting a deactivation message for a secondary carrier to a terminal,” as recited in Claim 1.

⁵ The specification states the message is sent from AMS to AMS, but that is a clear typographical error. The arrows in Figure 8 show that the message is sent from the ABS to the AMS.

[1.b] changing the secondary carrier to a deactivation state based on a predetermined time from the transmission of the deactivation message; and

132. Lee renders obvious this claim limitation.

133. The “disconnection time” described above is a predetermined time from the transmission of the deactivation message. Lee discloses that the AAI_CM-CMD control messages contain a “disconnection time.” Ex. 1005, ¶¶[140]-[142], [0146]-[0147], [0153]-[0161], Tables 4-12.

134. The disconnection time: (i) is included in the deactivation (AAI_CM-CMD) message, (ii) is a predetermined time, and (iii) indicates when the change to a deactivation state should occur with respect to the deactivation (AAI_CM-CMD) message.

135. As explained by Lee, the “disconnection time” is the least significant bits (LSB) of the “Superframe number at the time to disconnect the connection with the target carrier(s).” Ex. 1005, Tables 4-12; *see also* Ex. 1005, ¶[0159] (“[T]he AMS firstly deactivates the first target secondary carrier (T-SC_1) *at the disconnection time indicated by the AAI_CM-CMD message* at step S804.” (emphasis added)). Said another way, the digits on the far right of the Superframe (*i.e.*, the least significant of those digits) hold the time in which the connection would be disconnected, meaning when the secondary carrier would be deactivated.

136. *First*, the disconnection time is included in the deactivation (AAI_CM-CMD) message. The disconnection time is a predetermined time because it is time determined before the UE receives the command to deactivate.

137. Lee described four different exemplary methods for determining the “disconnection time.” Ex. 1005, ¶¶[0153]-[0157].

138. In the first example, “[i]n the case where the action code of the AAI_CM-CMD message is set to ‘0’ (secondary carrier management) and the indication type #1 is set to ‘1’ (deactivation), *a disconnection time is defined.*” Ex. 1005, ¶[0154] (emphasis added).

139. In the second example, “when the action code of the AAI_CM-CMD message is set to ‘0’ (secondary carrier management), the indication type #0 is set to ‘1’ (activation), and the indication type #1 is also set to ‘1’ (deactivation), *a disconnection time is defined.*” Ex. 1005, ¶[0154] (emphasis added).

140. In the third example, “when a disconnection time flag is defined and the disconnection time flag is set to ‘1’, *a disconnection time is defined.*” Ex. 1005, ¶[0156] (emphasis added).

141. In the fourth example, “[n]o disconnection time is defined in the AAI_CM-CMD message, and a *reception time of the AAI_CM-CMD message is implicitly defined as a disconnection time* of the target carrier.” Ex. 1005, ¶[0157] (emphasis added).

142. Lee further discloses “In the case where the number of target carriers to be deactivated in the above-mentioned [examples 1 and 2] is set to ‘n’, n disconnection times for individual carriers *may be defined*, and the same one disconnection time may be defined for all the n target carriers.” Ex. 1005, ¶[0158] (emphasis added). A POSITA would have understood that to deactivate carriers at different times or simultaneously, the disconnection timing would have to be predetermined. These situations show that Lee discloses defining a predetermined “disconnection time” when deactivate secondary carriers.

143. Tables 6 through 12 provide exemplary AAI_CM-CMD message formats.

144. Table 6 is included below to illustrate the potential contents of the AAI_CM-CMD message. For example, the AAI_CM-CMD message could include: (i) a “Disconnection time” which indicates the time to disconnect the target carrier, (ii) an index that identifies the carrier for deactivation (“Target carrier index”), and (iii) an indication of whether uplink and/or downlink communications are to be deactivated (“Deactivation of DL/UL”). Ex. 1005, ¶[163]; *see also* Ex. 1005, ¶[0164]-[0169], Tables 5, 7-12.

Ex. 1005, Table 6 (Annotated, Partial); see also Ex. 1005, ¶[0164].

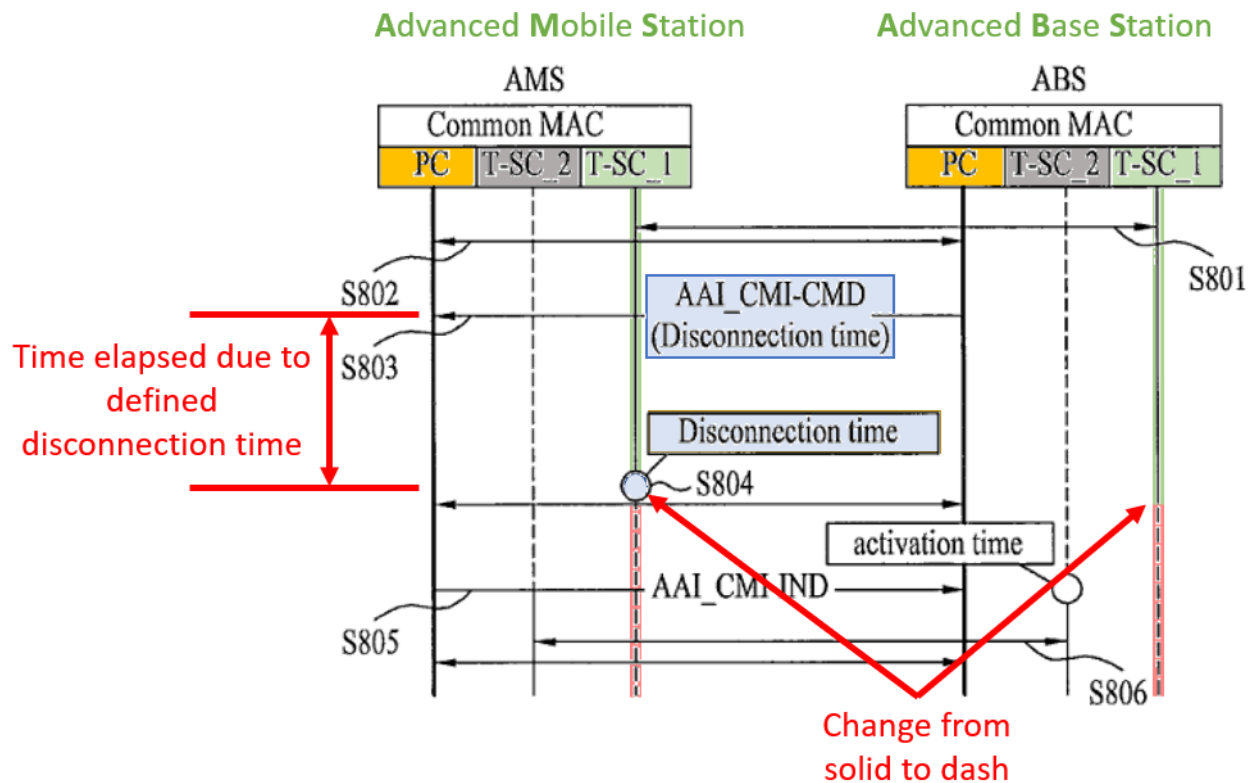
TABLE 6

Field	Size (bit)	Description
...		
If (Indication Type #1 == 1){		
Num of target carrier		[TBD] The number of deactivated carrier(s)
Disconnection time		[TBD] LSB bits of Superframe number at the time to disconnect the connection with the target carrier(s)
For(i=0; i< Num of target carrier; i++){		
Target carrier index		[TBD] Target carrier index for deactivation
Deactivation of DL/UL	1	'0': Both DL/UL are deactivated '1': UL is deactivated but DL is kept active
}		
}		
...		

145. Tables 7 through 12 include alternative formats for the AAI_CM-CMD message. For example, Tables 7 and 9 adds the requirement that a disconnection time flag must also be included for deactivation to take place. *Id.* ¶[0165]. Table 8 allows for different disconnection times to be defined for each carrier. And Tables 10 and 11 include an example format for messaging activation and deactivation of carriers simultaneously.

146. Second, Lee discloses changing the secondary carrier to a deactivation state after the disconnection time. Figure 8 (below) from Lee also shows this process. Ex. 1005, ¶¶[0159]-[0160]. As shown below, “the representation of the first target secondary carrier (T-SC_1) is changed from a solid line (activation) to a dotted line (deactivation) at the disconnection time.”

Ex. 1005, Fig. 8 (Annotated).



147. A POSITA would have understood that changing from “activation” to “deactivation” at the disconnection time entails changing the state from an activation state to a deactivation state. Here, state refers to the condition that the AMS or ABS would perceive about the status of the carrier. The purpose of the signaling (or deactivation messaging) of Lee in Figure 8 (above) is to prevent a misinterpretation of state between the AMS and ABS, the same problem that was attempting to be addressed later in the ‘662 Patent.

148. *Third*, the disconnection time is based off the transmission of the deactivation (AAI_CM-CMD) message. Lee states that “a disconnection time of the

target carrier can be defined *in relation to* the AAI_CM-CMD message.” Ex. 1005, ¶[0153] (emphasis added). Figure 8 shows this same time with the red arrow and what I labeled, “Time elapsed due to defined disconnection time,” which is connected to the time the AAI_CMI-CMD message is sent/received and the disconnection time.

149. As such, Lee discloses that the secondary carrier is deactivated based on a predetermined time from the transmission of the deactivation (AAI_CM-CMD) message.

150. Thus, Lee discloses and/or renders obvious “changing the secondary carrier to a deactivation state based on a predetermined time from the transmission of the deactivation message,” as recited in Claim 1.

[1.c] stopping downlink (DL) data transmission of the secondary carrier and initializing uplink (UL) and DL buffers associated with the secondary carrier after transmitting the deactivation message.

151. Lee alone or in combination with Kim renders obvious this claim limitation.

152. I have broken this claim limitation into two parts. First, the claim requires “stopping downlink (DL) data transmission of the secondary carrier . . . after transmitting the deactivation message.” Second, the claim requires (1) “initializing uplink and downlink buffers associated with the secondary carrier after transmitting the deactivation message.”

- (i) *Stopping downlink (DL) data transmission of the secondary carrier . . . after transmitting the deactivation message*

153. Lee describes that when the secondary carrier is deactivated after the deactivation message, downlink transmission is stopped.

154. Lee discloses it can deactivate the downlink (DL) data transmission specifically. Lee describes the deactivation of the secondary carrier through the use of AAI_CM-CMD messages as described above. Ex. 1005, ¶[0095]. Lee also discloses a parameter of the AAI_CM-CMD message that indicates whether the deactivation will occur in the downlink (DL). Ex. 1005, Table 6 (below).

Ex. 1005, Table 6 (Annotated).

TABLE 6		
Field	Size (bit)	Description
...		
If (Indication Type #1 == 1){		
Num of target carrier	[TBD]	The number of deactivated carrier(s)
Disconnection time	[TBD]	LSB bits of Superframe number at the time to disconnect the connection with the target carrier(s)
For(i=0; i< Num of target carrier; i++){		
Target carrier index	[TBD]	Target carrier index for deactivation
Deactivation of DL/UL	1	'0': Both DL/UL are deactivated '1': UL is deactivated but DL is kept active
}		
}		
...		

155. Further, as explained above, Lee discloses that the specified secondary carrier deactivation can occur at the “disconnection time.” The disconnection time is after the deactivation message is transmitted because the disconnection time starts at the time the deactivation message is transmitted but ends after the period expires.

See e.g., Ex. 1005, ¶[0159] (“[T]he AMS firstly deactivates the first target secondary carrier (T-SC_1) at the disconnection time indicated by the AAI_CM-CMD message at step S804”), Table 4 (The disconnection time is the “LSB bits of Superframe number at the time to disconnect the connection with the target carrier(s).”).

156. Lee also discloses that its method of carrier change “includes disconnecting a signal path on the serving carrier at the disconnection time.” Ex. 1005, ¶[0024]. Figure 8 of Lee also illustrates stopping downlink transmission of the secondary carrier. See Ex. 1005, ¶[0159], Fig. 8. Lee explains that “the representation of the first target secondary carrier (T-SC_1) is changed from a solid line (activation) to a dotted line (deactivation) at the disconnection time.” See Ex. 1005, ¶[0159] (emphasis added), Fig. 8; see also Ex. 1005, ¶[0110]. In Figure 8, no signals are passed between deactivated carriers (dotted line), further showing the signal is stopped. A POSITA would have thus understood that disconnecting a signal path means stopping transmissions on that path.

157. A POSITA would understand from this signal flow diagram that the dotted line means that data is no longer being transmitted on that secondary carrier for that AMS. As such, a POSITA would understand that deactivating a carrier in Lee would involve at least stopping downlink transmission on the secondary carrier.

(ii) *Initializing uplink and downlink buffers associated with the secondary carrier after transmitting the deactivation message*

158. Lee discloses some aspects of the HARQ process in the context of deactivation. For example, Lee discloses that the HARQ can be used with the MAC control messaging disclosed in Lee. Ex. 1005, ¶¶[0122]-[0124]. Lee likewise discloses the use of retransmission timers and of buffers associated with the secondary carrier such as the known concept of HARQ buffers and retransmission buffers. Ex. 1005, ¶¶[0105], [0107-0108], [0120-0123], [0125-0126], [0131], [0142], [0147], Table 4, Table 5 (stating the action time must be a value more than the retransmission time for the control message), Fig. 8. Lee discloses that the AAI_CM-IND message can be sent “[i]n order to inform the ABS of the successful reception of the AAI_CM-CMD message.” Ex. 1005, ¶[0112]. Finally, Lee also discloses that the BS may contain buffers to store arithmetically processed information for a predetermined time. Ex. 1005, ¶[0304].

159. Based on Lee alone, a POSITA would have found it obvious to initialize the uplink and downlink buffers associated with the secondary carrier after transmitting the deactivation message in view of Lee’s disclosures of the HARQ process and retransmission timers. It would have been obvious to a POSITA that, if a HARQ process is running on the MAC control messages, as disclosed by Lee, then the HARQ buffers (or other buffers associated with the secondary carrier) would be

flushed once the process is completed as a means to reduce errors and preserve resources like memory. A POSITA would have understood that flushing the HARQ buffer would be an option to ensure that the future transmissions and remaining retransmissions would be halted and interference mitigated with the appropriate transmission settings for the next time the component carrier is used.

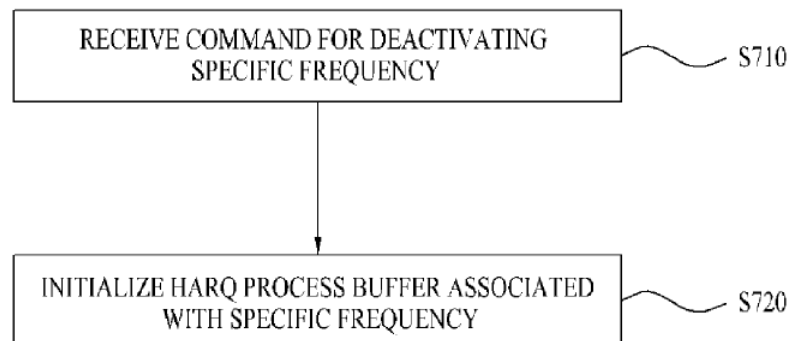
160. For example, Kim (Ex. 1006) mentions that when you turn off a secondary carrier that had just transmitted a piece of data but did not successfully receive an ACK (or inappropriately received a NACK), that piece of data is still sitting in the buffer when you re-activate the secondary carrier later, thereby sending old data. Ex. 1006, ¶¶[0017]. Also, Kim mentions that when you turn off a secondary carrier and then return to that carrier later, the transmission settings may now be inappropriate because the channel conditions have changed, thereby causing interference. Ex. 1006, ¶¶[0019]. Thus, a POSITA would have recognized that flushing the buffers associated with the secondary carrier would be an obvious design choice.

161. Alternatively, Kim discloses initializing the uplink and downlink buffers associated with the secondary carrier after transmitting the deactivation message. Ex. 1006, ¶¶[0073]-[0074], [0079]-[0080], Figs. 7-8. Furthermore, a POSITA would have been motivated to combine Lee with Kim and had a reasonable expectation of success (*see* Section IX.C. and incorporated herein by reference).

162. Kim discloses that when a UE receives an instruction to deactivate a given carrier, “[t]he UE *initializes the HARQ process buffer* associated with the specific frequency which is instructed to be deactivated by the base station.” Ex. 1006, ¶[0079] (emphasis added), Fig. 7. Kim discloses that “if the UE determines that a specific frequency is deactivated, the UE discards data present in the buffer of the HARQ process associated with the deactivated frequency.” Ex. 1006, ¶[0074], Fig. 7. Figure 7 (below) from Kim provides further disclosure of initializing the uplink and downlink buffers associated with the secondary carrier after transmitting the deactivation message. Ex. 1006, Fig. 7; *see also* Ex. 1006, Fig. 8.

Ex. 1006, Fig. 7.

FIG. 7



163. Further, although Kim primarily discusses uplink processing, a POSITA would have known that HARQ processes are executed on both uplink and downlink communications on both the UE and BS side. Indeed, Lee explicitly

discloses that the secondary carrier could be associated with both uplink and downlink through the use of the DL/UL parameter. Ex. 1005, Table 6 (below).

Ex. 1005, Table 6 (Annotated).

TABLE 6		
Field	Size (bit)	Description
...		
If (Indication Type #1 == 1){		
Num of target carrier	[TBD]	The number of deactivated carrier(s)
Disconnection time	[TBD]	LSB bits of Superframe number at the time to disconnect the connection with the target carrier(s)
For(i=0; i< Num of target carrier; i++){		
Target carrier index	[TBD]	Target carrier index for deactivation
Deactivation of DL/UL	1	'0': Both DL/UL are deactivated '1': UL is deactivated but DL is kept active
}		
}		
...		

164. When applying Kim's teaching about HARQ buffers to situations dealing with both UL and DL secondary carriers, a POSITA would have known (or at least found it obvious) that Kim's teaching of initializing the UL HARQ buffer associated with the secondary carrier could be applied to both the UL and DL carriers being deactivated in a TDD configuration. Indeed, in the discussion of the 3GPP documentation from Section VI where the carrier aggregation change was made to the cellular standard, both the UL and the DL have HARQ buffers associated with each component carrier when carrier aggregation is activated, as would be the case, for example, in UE's operation in TDD. Ex. 1011 at Fig. 6.4-1 (DL) and 6.4-2 (UL). A POSITA would have likewise known that these component carriers would be shared in a TDD context. Ex. 1011 at 6 ("In typical TDD deployments, the number

of CCs and the bandwidth of each CC in UL and DL is the same.”). Thus, a POSITA would recognize that Kim’s teachings about initializing a buffer could obviously include the UL and DL buffers associated with the secondary carrier. Likewise, while Kim’s disclosure largely focused on the UE side, a POSITA would have understood and known (or it would at least be obvious) that its disclosure could be applied to the base station side as well.

165. Thus, Lee alone or in combination with Kim renders obvious “stopping downlink (DL) data transmission of the secondary carrier and initializing uplink (UL) and DL buffers associated with the secondary carrier after transmitting the deactivation message,” as recited in Claim 1.

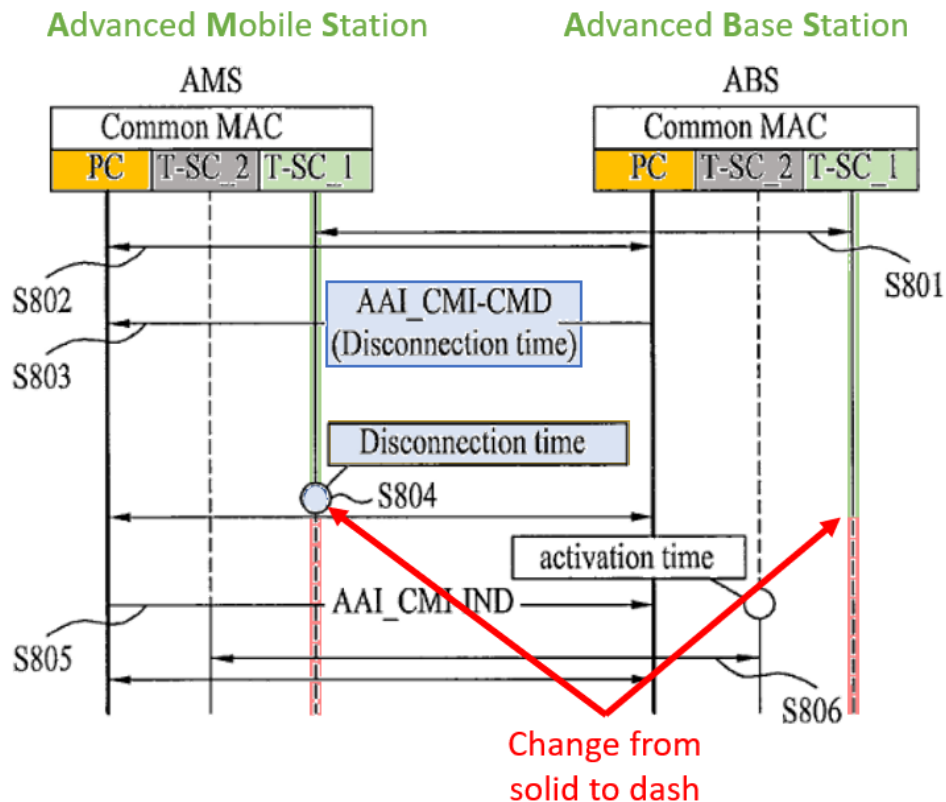
B. Dependent Claim 2

[2] The carrier management method of claim 1, wherein the predetermined time is a value predefined to make state information that is managed by the base station consistent with state information that is managed by the terminal for the secondary carrier.

166. Lee alone or in combination with Kim renders obvious this claim. Claim 2 depends from Claim 1. I incorporate my discussion of Claim 1 by reference.

167. As discussed above, Figure 8 in Lee shows the “disconnection time” is a time determined to make the state information that is managed by the base station consistent with state information that is managed by the terminal for the secondary carrier. Ex. 1005, ¶¶[0159]-[0160], Fig. 8.

Ex. 1005, Fig. 8 (Annotated).



168. As can be seen in my annotated version of Figure 8, the secondary carriers are deactivated at the same time in the MS and the BS, thus making the states consistent. This transition is shown where the lines for T-SC_1 transition from solid (highlighted in green) to dashed (highlighted in red) at the same time. Ex. 1005, Fig. 8; *see also* Ex. 1005, ¶[0159] (“As can be seen from FIG. 8, the representation of the first target secondary carrier (T-SC_1) is changed from a solid line (activation) to a dotted line (deactivation) at the disconnection time.”); *see also id.* at ¶[0110] (“[A] carrier denoted by a solid line may represent an activated carrier, and a carrier

denoted by a bold line may represent a primary carrier, and a carrier denoted by a dotted line may represent a deactivated carrier.”).

169. Furthermore, to the extent that Lee does not explicitly disclose Claim 2, Claim 2 would have been obvious to a POSITA.

170. Lee states that “carrier activation and/or deactivation caused by the carrier management command should be achieved at correct time point(s).” Ex. 1005, ¶¶[0013]. As shown above by Figure 8, a POSITA would have known that the reference to “correct time points” is a reference to ensuring that the states in the base station and UE remain consistent. One of the purposes of Lee is to avoid faults in a carrier management procedure (such as carrier activation and/or deactivation) that “may negatively affect communication between the mobile station (MS) and the base station (BS)” or even make it “impossible” to achieve said communication. Ex. 1005, ¶¶[0012]-[0013], [0015].

171. Moreover, Lee explains that its disclosed carrier management procedure uses deactivation times to effectively perform carrier management. Ex. 1005, ¶¶[0038], [0144], [0146], [0159], [0161], Tables 4-12. For example, Lee states “[s]ince the disconnection time is defined in an arbitrary case in which the deactivation of the target secondary carrier (T-SC) is indicated in the secondary carrier management procedure, those skilled in the art can easily appreciate that *the error encountered in the secondary carrier management procedure is prevented and*

the accuracy of operation is increased.” Ex. 1005, ¶[0161] (emphasis added); *see also* Ex. 1005, ¶¶[0143]-[0144], [0170].

172. Thus, Lee expressly describes that its goal is to prevent error or faults and to improve the accuracy of the carrier management operation. *See* Ex. 1005, ¶¶[0012]-[0013], [0015], [0143]-[0144], [0161] [0170]. A POSITA would understand that one of the main faults that can occur is when a base station believes a carrier is activated or deactivated, while the mobile station believes the opposite. As such, a POSITA reading Lee would understand that the deactivation time or action time (*i.e.*, the predetermined time) is a value predefined to make state information that is managed by the base station consistent with state information that is managed by the terminal for the secondary carrier.

173. Lee alone or in combination with Kim renders obvious Claim 2.

C. Dependent Claim 3

[3] The carrier management method of claim 1, further comprising: receiving a reception success message for the deactivation message from the terminal after transmitting the deactivation message, wherein the changing of the secondary carrier to the deactivation state includes changing, by the base station, the secondary carrier to the deactivation state after a predetermined time from an arrival time of the reception success message.

174. Claim 3 depends from Claim 1. I incorporate the discussion above with respect to Claim 1 by reference.

175. Lee alone or in combination with Kim renders obvious this claim.

176. Lee also discloses the use of an *indication* message called: AAI_CM_IND. Ex. 1005, ¶[0010]. Lee states “The AAI_CM-IND message is a MAC control message used as a response to the AAI_CM-CMD message, and is transmitted from the mobile station (MS) to the base station (BS).” Ex. 1005, ¶[0010].

177. Lee discloses that the AAI_CM-IND message can be sent “[i]n order to inform the ABS of the successful reception of the AAI_CM-CMD message.” Ex. 1005, ¶[0112].

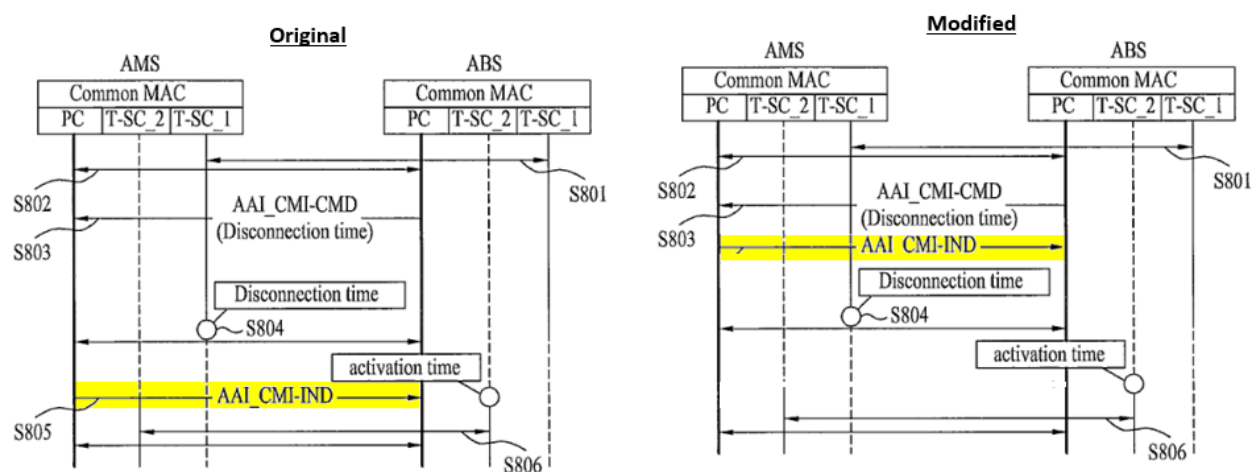
178. Lee also discloses that AAI_MSG-ACK messages can be sent to the base station to acknowledge receipt of the MAC control messages. Ex. 1005, ¶¶[0120]-[0124], [0128]. Each of these messages meets the limitation of receiving a reception success message for the deactivation message from the terminal after transmitting the deactivation message.

179. As discussed above, Lee describes multiple different exemplary methods for defining the “disconnection time.” Ex. 1005, ¶¶[0153]-[0157]. The fourth of those methods states: “[n]o disconnection time is defined in the AAI_CM-CMD message, and *a reception time of the AAI_CM-CMD message is implicitly defined as a disconnection time of the target carrier.*” Ex. 1005, ¶[0157] (emphasis added).

180. In such a situation, a POSITA would understand that the BS disconnects at a predetermined time from the reception of the success message. In this instance, the predetermined time is zero.

181. Furthermore, Lee explains that “[t]he mobile station (MS) transmits the AAI CM IND MAC control message to the base station (BS) through the primary carrier, such that the base station (BS) can confirm that the mobile station (MS) has successfully activated/deactivated the carriers listed in the AAI CM-CMD message.” Ex. 1005, ¶[0097]. Lee further explains “the AAI CM-IND message may be used in different ways according to indicated actions.” Ex. 1005, ¶[0109]. As such, a POSITA would have found it obvious to modify Figure 8 and have the base station wait to deactivate the secondary carrier until after it receives the IND message from the mobile station. An example of such a modification is shown in the figure below.

Ex. 1005 Fig. 8 (original, left) (annotated, right).



182. A POSITA would be motivated to modify Figure 8 in such a way because waiting until after the mobile station responds ensures the base station does not need to reactivate the secondary carrier for any reason until after the UE confirms it has been deactivated on the UE side as well. For example, by waiting for AAI_CMI-IND, the BS can ensure that the mobile station has completed any uplink transmission on the secondary carrier.

183. Thus, Lee alone or in combination with Kim renders obvious Claim 3.

D. Dependent Claim 4

[4] The carrier management method of claim 1, further comprising: immediately stopping, by the base station, data transmission and retransmission using the secondary carrier immediately after transmitting the deactivation message.

184. Claim 4 depends from Claim 1. I incorporate my discussion of Claim 1 by reference. Furthermore, Lee alone or in combination with Kim renders obvious this claim.

185. As discussed above, Lee describes multiple different exemplary methods for defining the “disconnection time.” Ex. 1005, ¶¶[0153]-[0157]. The fourth of those methods states: “[n]o disconnection time is defined in the AAI_CM-CMD message, and a reception time of the AAI_CM-CMD message is implicitly defined as a disconnection time of the target carrier.” Ex. 1005, ¶[0157] (emphasis added).

186. In light of Lee's disclosure, a POSITA would have been motivated to modify Lee so that the BS could immediately stop data transmission and retransmission on the secondary carrier after transmitting the deactivation message. A POSITA would have known that the BS does not need to continue to monitor that secondary carrier after transmitting the deactivation message, and thus there is no disconnection time set. A POSITA would have understood this because Lee describes that the BS can send the AAI_CM-CMD messages on the *primary* carrier. Ex. 1005, ¶[0095]. As such, given the responsive success message will be returned on the primary carrier, which remains activated even after the secondary carrier deactivates, a POSITA would understand that the BS could immediately deactivate the secondary carrier after transmission of the deactivation message. Furthermore, a POSITA would be motivated to do so because doing so would ensure that the traffic on the secondary component carrier (*e.g.*, remaining retransmissions of the HARQ process and future transmissions of data) is stopped, which in turn could free up spectral, computational, and storage resources in the base station. Given resources in a base station are limited, these freed up resources could then be reallocated to other mobile equipment. In addition, this could help to conserve energy resources on the mobile equipment that is being deactivated.

187. Furthermore, Lee explains that one of the advantages of defining a disconnection time is that it can help to prevent the errors that can arise when a time

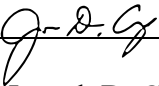
is not defined. Ex. 1005, ¶[0161]. In light of this disclosure from Lee, a POSITA would understand Lee to disclose and/or render obvious that, in certain prior art systems predating, Lee the BS immediately stops data transmission and retransmission on the secondary carrier immediately after transmitting the deactivation message.

188. Thus, Lee alone or in combination with Kim renders obvious “immediately stopping, by the base station, data transmission and retransmission using the secondary carrier immediately after transmitting the deactivation message,” as recited in Claim 4.

XI. CONCLUSION

189. I hereby declare that all statements made of my own knowledge are true and that all statements made on information and belief are believed to be true. I further declare that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of the Title 18 of the United States Code and that such willful false statements may jeopardize the validity of this proceeding.

Executed on this February 29, 2024 by:



Joseph D. Camp, Ph.D.

XII. '662 PATENT CLAIM LISTING

Elem.	Claim Language
1.pre	A carrier management method of a base station for use in a carrier aggregation environment, comprising:
1.a	transmitting a deactivation message for a secondary carrier to a terminal;
1.b	changing the secondary carrier to a deactivation state based on a predetermined time from the transmission of the deactivation message; and
1.c	stopping downlink (DL) data transmission of the secondary carrier and initializing uplink (UL) and DL buffers associated with the secondary carrier after transmitting the deactivation message.
2	The carrier management method of claim 1, wherein the predetermined time is a value predefined to make state information that is managed by the base station consistent with state information that is managed by the terminal for the secondary carrier.
3	The carrier management method of claim 1, further comprising: receiving a reception success message for the deactivation message from the terminal after transmitting the deactivation message, wherein the changing of the secondary carrier to the deactivation state includes changing, by the base station, the secondary carrier to the deactivation state after a predetermined time from an arrival time of the reception success message.
4	The carrier management method of claim 1, further comprising: immediately stopping, by the base station, data transmission and retransmission using the secondary carrier immediately after transmitting the deactivation message.

Attachment A

Joseph D. Camp

CONTACT INFORMATION

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RESEARCH INTERESTS

Wireless systems and drone communications, specifically building real systems at-scale and analyzing the performance within representative environments.

EDUCATION

Rice University, Houston, Texas USA

Ph.D., Electrical and Computer Engineering, May 2009

- Dissertation: "Experimental and Analytical Evaluation of Embedded Link Performance with Small-Scale Channel Fluctuations" (Best Engineering Thesis 2010)
- Advisor: Professor Edward W. Knightly

M.S., Electrical and Computer Engineering, January 2006

- Thesis: "Measurement Driven Deployment of a Two-Tier Urban Mesh Access Network"
- Advisor: Professor Edward W. Knightly

The University of Texas at Austin, Austin, Texas USA

B.S. with Honors, Electrical and Computer Engineering, May, 2003

POSITIONS

Southern Methodist University, 11/22-present. *Department Chair, ad interim.*

Southern Methodist University, 9/21-present. *Professor.*

Southern Methodist University, 9/15-8/21. *Associate Professor.*

Southern Methodist University, 10/09-8/15. *J. Lindsay Embrey Trustee Professor.*

Southern Methodist University, 7/09-8/15. *Assistant Professor.*

HONORS AND AWARDS

Best Paper Award of IEEE LATINCOM (2022)

Gerald J. Ford Research Fellowship (2021)

Golden Mustang Teaching Award (2014)

NSF CAREER Award (2012)

Ralph Budd Award for Best Engineering Thesis at Rice University (2010)

SMU Provost Instructional Grant (2009)

NSF Travel Grant for ACM MobiCom (2008)

Rice Presidential Fellowship (August 2003 to May 2009)

First Place in Advanced Micro Devices/Rice VLSI Design Contest (2004)

Outstanding Intel Intern (2000 and 2002)

University of Texas Scholarships (1998): Terry Foundation, Jesse H. Jones (Houston Endowment), Texas

Engineering Foundation, University of Texas Exes, Houston Northwest Chamber of Commerce, Cy-Fair

Federal Credit Union, BankOne

Salutatorian (2/460) and Senior Class President of Cy-Fair High School (1998)

GRANTS AND CONTRACTS AWARDED

2018-2024, “Radiation Background Characterization for Advanced Anomaly Detection”
co-PI, DHS (DNDO Program), PI: Bruce Gnade \$1,505,787

2021-2022, “Planning Grant: Engineering Research Center for Agricultural and Rural Connectivity (ARC)”
SMU PI, NSF (Planning Grant for Engineering Research Center), PI: Mehmet Can Vuran, \$100,000 total

2019-2022, “CNS Core: Small: Collaborative Research: Many-Antenna Full-Duplex for Mobile and Multi-hop Topologies”
SMU PI, NSF (CNS Core Program), \$250,000, PI: Ehsan Aryafar (Portland State University), \$500,000 total

2019-2022, “On-the-Fly Topological Formation of Drone Swarms”
PI, AFOSR (DDDAS Program), co-PI: Dinesh Rajan, \$225,055

2018-2021, “II-New: Multi-Dimensional Drone Communication Infrastructure (MuDDI)”
PI, NSF (NeTS CISE CRI Program), co-PI: Dinesh Rajan \$849,839

2020, “PAWR Platform Full proposal: NEXTT: Nebraska Experimental Testbed of Things”
SMU PI, NSF (PAWR Program Finalist - Planning Grant), PI: Mehmet Can Vuran, \$300,000 total

2019, “REU Supplement: Channel Recognition for Optimized Links And Networks (CROLA)”
PI, NSF REU Program, \$16,000

2015-2018, “NeTS: Small: Channel Recognition for Optimized Links And Networks (CROLA)”
PI, NSF (NeTS/CNS Program), co-PI: Dinesh Rajan \$460,000

2012-2017, “CAREER: Leveraging Simultaneous Access to Multiple Frequency Bands in Multihop Wireless Networks”
PI, NSF CAREER Program, \$450,000

2016, “I-Corps: Efficient Terrain-Based Measurement Gathering for Path Loss Inference”
PI, NSF (I-Corps Program), \$50,000

2013-2016, “NeTS: Small: Collaborative Research: Theory, Algorithms, and Experiments for Frequency-Agile Beamforming Mesh (FabMesh)”
PI, NSF CNS NeTS, Co-PI: Mung Chiang (Princeton University), \$498,000

2015, “Student Travel Support for the IEEE SECON 2015 Conference”
PI, NSF (NeTS/CNS Program), \$15,000

2012-2013, “REU Supplement: Dallas-ARea Testbed for Context-Aware, Cognitive Research (DART-CARs)”
PI, NSF REU Program, Co-PI: Dinesh Rajan, \$16,000

2010-2013, “MRI Consortium: Development of Wireless Networking Testbed and Emulator (WiNeTestEr)”
co-PI, NSF Award (MRI Program), PIs: Ravi Prakash and Dinesh Rajan, \$985,958

2010-2013, “CRI/II-New: Dallas-ARea Testbed for Context-Aware, Cognitive Research (DART-CARs)”
PI, NSF Award (CRI Program), Co-PI: Dinesh Rajan, \$535,000 (over 3 annual increments)

2010-2013, “Adaptive Filter-Bank Modulation for Ubiquitous Landline-Based Broadband Access”
co-PI, SBIR Award with XtendWave, Inc., PI: Dinesh Rajan, \$22,802

2010-2012, “Context-Aware, Resilient, and Scalable Architectures for Multi-Band Vehicular Networks”

co-PI, Contract with Toyota InfoTechnology Center, PI: Dinesh Rajan, \$125,000

2010-2011, “Transceiver Techniques for Multiband Communications over Wired Channels”
co-PI, Contract with XtendWave, Inc., PI: Dinesh Rajan, \$8,925

LEGAL CONSULTING

Alston & Bird (2023) on the ASUSTeK side: Atlas Global Technologies LLC v. ASUSTeK Computer Inc., Case No. 6:21-cv-820-ADA (WD Texas - Waco Division).

Braun, Hagey, & Borden (2022-2023) on the Sweat Equity side: Sweat Equity Partners, LLC vs. Swoop Search, LLC, et al., Case No. CGC-21-591702

Quinn Emanuel (2020-2021) on the Verizon side: Huawei Technologies Co. Ltd. v Verizon Communications, Inc., et. al., 2:20-cv-00030

Alston & Bird (2016-2017) on the Nokia side: NSN v. Huawei (16-cv-0753, 16-cv-0754, 16-cv-0755, 16-cv-0756)

JOURNAL ARTICLES

M. H. Syed, M. Singh, and J. Camp. “Direction Estimation in 3D Outdoor Air–Air Wireless Channels through Machine Learning,” in *MDPI Electronics*, 23(23):9524, November 2023.

Y. Alkhrijah, J. Camp, and D. Rajan. “Multi-Band Full Duplex MAC Protocol (MB-FDMAC),” in *IEEE Journal on Selected Areas of Communications: Special Issue on Full Duplex*, 41(9):2864-2878, September 2023.

S. Gupta, D. Rajan, and J. Camp. “NOMA-Enabled Computation and Communication Resource Trading for a Multi-User MEC System,” in *IEEE Transactions on Vehicular Technology*, 71(7): 7532-7547, July 2022.

M. H. Syed, S. Gupta, G. Megson, E. Aryafar, and J. Camp. “Rate Maximization in a UAV based Full-Duplex Multi-user Communication Network using Multi-Objective Optimization,” in *MDPI Electronics*, 71(401):1-18, January 2022.

M. Badi, S. Gupta, D. Rajan, and J. Camp. “Characterization of the Human Body Impact on UAV-to-Ground Channels at Ultra-low Altitudes,” in *IEEE Transactions on Vehicular Technology*, 71(1):339-353, January 2022.

G. Megson, S. Gupta, M. H. Syed, E. Aryafar, and J. Camp. “An Experiment-Based Comparison between Fully Digital and Hybrid Beamforming Radio Architectures for Many-Antenna Full-Duplex Wireless Communication,” in *MDPI Electronics*, 11(59):1-14, December 2021.

Y. Shi, M. Badi, D. Rajan, and J. Camp. “Channel Reciprocity Analysis and Feedback Mechanism Design for Mobile Beamforming Systems,” in *IEEE Transactions on Vehicular Technology*, 70(6):6029-6043, June 2021.

R. Enami, S. Gupta, D. Rajan, and J. Camp. “LAIK: Location-Specific Analysis to Infer Key Performance Indicators,” in *IEEE Transactions on Vehicular Technology*, 70(5):4406-4418, May 2021.

M. Badi, J. Wensowitch, D. Rajan, and J. Camp. “Experimentally Analyzing Diverse Antenna Placements and Orientations for UAV Communications,” in *IEEE Transactions on Vehicular Technology*, 69(12), 2020.

H. Liu, J. He, S. Gupta, D. Rajan, and J. Camp. “FIT: On-the-Fly, In-Situ Training for SNR-Based Rate Selection,” in *IEEE Transactions on Vehicular Technology*, 69(10):11295-11307, October 2020.

G. Dvorocsik, E. Sarris, and J. Camp. "Using Clustering to Find Pitch Subtypes and Effective Pairings," in *SABR Baseball Research Journal*, 49(1):91-98, 2020. **Finalist for SABR Contemporary Baseball Analysis Award**

P. Huang, M. Tonnemacher, Y. Du, D. Rajan, and J. Camp. "Towards Massive MIMO Channel Emulation: Channel Accuracy Versus Implementation Resources," in *IEEE Transactions on Vehicular Technology*, 69(5):4635-4651, May 2020.

H. Liu, J. He, J. Wensowitch, D. Rajan, and J. Camp. "Architecture and Experimental Evaluation of Context-Aware Adaptation in Vehicular Networks," in *EURASIP Journal on Wireless Communications and Networking*, 2020.

R. Holz, M. Mellia, H. Haddadi, M. Caesar, S. Gorinsky, G. Antichi, J. Camp, K. Klaffy, B. Raman, A. Sperotto, A. Viana, S. Uhlig. "Update on ACM SIGCOMM CCR reviewing process: towards a more open review process." in *ACM SIGCOMM Computer Communications Review*, 50(3): 55-56, 2020.

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Y. Du, P. Huang, Y. Shi, D. Rajan, and J. Camp. "Design of Coherence-Aware Channel Indication and Prediction for Rate Adaptation," in *EURASIP Journal on Wireless Communications and Networking*, 2019.

P. Cui, S. Chen, and J. Camp. "GreenLoading: Using the Citizens Band Radio for Energy-Efficient Offloading of Shared Interests," in *Elsevier Computer Communications Journal*, August, 2019. [4+ citations (Google Scholar)]

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Y. Shi and J. Camp. "Downlink Resource Allocation for Enhanced Inter-Cell Interference Coordination (eICIC) in Heterogeneous Cellular Networks," in *International Journal of Enhanced Research in Science, Technology & Engineering*, 5(2):45-53, February 2016. [1+ citation (Google Scholar)]

J. Beshay, Y. Du, P. Huang, N. Mahabaleshwar, B. McMillin, E. Nourbakhsh, K. Subramani, T. Xi, B. Banerjee, J. Camp, J. Chen, P. Gui, R. Prakash, and D. Rajan. "Wireless Networking Testbed and Emulator (WiNeTestEr)," in *Elsevier Computer Communications Journal*, 73(PA):99-107, January 2016. <http://dx.doi.org/10.1016/j.comcom.2015.08.007> [14+ citations (Google Scholar)]

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J. Camp, E. Aryafar, and E. Knightly. "Coupled 802.11 Flows in Urban Channels: Model and Experiment-

tal Evaluation,” *IEEE/ACM Transactions on Networking*, 20(5):1452-1465, October 2012. [18+ citations (Google Scholar)]

H. Patil, J. Camp, and S. Szygenda. “Secure Routing in Wireless Sensor Networks Using Identity-based Cryptography,” in *International Journal of Applied Science and Technology*, 1(5):1-14, October 2011.

J. Camp and E. Knightly, “Modulation Rate Adaptation in Urban and Vehicular Environments: Cross-layer Implementation and Experimental Evaluation,” *IEEE/ACM Transactions on Networking*, 18(6):1949-1962, December 2010. [264+ citations (Google Scholar)]

J. Camp and E. Knightly, “The IEEE 802.11s Extended Service Set Mesh Networking Standard,” *IEEE Communications Magazine*, 46(8):120-126, August 2008. [270+ citations (Google Scholar)]

A. Khattab, J. Camp, C. Hunter, P. Murphy, A. Sabharwal, and E. Knightly, “WARP: A Flexible Platform for Clean-Slate Wireless Medium Access Protocol Design,” in *ACM SIGMOBILE Mobile Computing and Communications Review*, 12(1):56-58, January 2008. [110+ citations (Google Scholar)]

J. Camp, E. Knightly, and W. Reed, “Developing and Deploying Multihop Wireless Networks for Low-Income Communities,” *Journal of Urban Technology*, 13(3): 129-137, December 2006. [36+ citations (Google Scholar)]

PEER-REVIEWED CONFERENCE AND WORKSHOP PAPERS

C. Sayre, E. Larson, G. DiLiegro, J. Camp, and B. Gnade. “Radiation Anomaly Detection Using an Adversarial Autoencoder,” in *Proceedings of IEEE Asilomar Conference on Signals, Systems, and Computers*, November 2023.

H. Hosseini, A. Almutairi, M. H. Syed, E. Aryafar, and J. Camp. “An Outdoor Experimental Study of Many Antenna Full-Duplex Wireless,” in *Proceedings of 35th International Teletraffic Congress (ITC 35)*, October 2023.

M. H. Syed, M. C. Vuran, and J. Camp. “ECHO: Empirical Characterization and Height Optimization of UAV-To-Underground Channels,” in *Proceedings of IEEE 34th Annual International Symposium on Personal, Indoor and Mobile Radio Communications (PIMRC): Track 1: PHY and Fundamentals*, September 2023.

M. Badi, D. Rajan, and J. Camp. “Experimental Analysis of Phase Error in Centralized and Distributed SDR Systems,” in *Proceedings of The 5th International Workshop on Smart City Communication and Networking (SmartCityCom) at IEEE ICCCN*, July 2023.

Y. Alkhrijah, J. Camp, and D. Rajan. “HyFDMAC: A Hybrid Access Full-Duplex MAC Protocol,” in *Proceedings of IEEE International Conference on COMmunication Systems & NETworks (IEEE COMSNETS)*, January 2023.

N. C. Matson, D. Rajan, and J. Camp. “Effect of Antenna Orientation and UAV Position on UAV Communications in 3D Space,” in *Proceedings of IEEE Latin-American Conference on Communications (IEEE LATINCOM)*, December 2022. **BEST PAPER AWARD WINNER**

N. C. Matson, D. Rajan, and J. Camp. “Design and Analysis of Neural-Network-based, Single-User Codes for Multiuser Channels,” in *Proceedings of IEEE Latin-American Conference on Communications (IEEE LATINCOM)*, December 2022.

Y. Alkhrijah, J. Camp, and D. Rajan. “Throughput-Fairness Tradeoff MAC for Multiuser IBFD (TFMAC),” in *Proceedings of IEEE Vehicular Technology Conference (VTC)*, September 2022.

M. Badi, N. C. Matson, D. Rajan, and J. Camp. “Leveraging UAV Rotation To Increase Phase Coherency

in Distributed Transmit Beamforming,” in *Proceedings of IEEE Consumer Communications and Networking Conference (CCNC) - Work in Progress Section*, January 2022.

M. Badi, S. Gupta, D. Rajan, and J. Camp. “Measurement-Based Characterization of the Human Body Impact on Ultra-Low UAV-To-Ground Channels,” in *Proceedings of IEEE MILCOM*, November 2021.

M. Lunar, J. Sun, J. Wensowitch, H. Tulay, V. Karanam, B. Qiu, D. Nadiq, G. Attebury, H. Yu, J. Camp, C. E. Koksall, D. Pompili, B. Ramamurthy, M. Hashemi, E. Ekici, and M. C. Vuran. “One Link to Rule Them All: Web-based Wireless Experimentation for Multi-vendor Remotely Accessible Indoor/Outdoor Testbeds,” in *Proceedings of ACM Workshop on Wireless Network Testbeds, Experimental evaluation & CHaracterization (WiNTECH’21)*, October 2021.

N. C. Matson, M. H. Syed, S. Song, D. Rajan, and J. Camp. “Effect of Antenna Orientation on the Air-to-Air Channel in Arbitrary 3D Space,” in *Proceedings of IEEE WoWMoM: 3rd Workshop on Wireless Networking, Planning, and Computing for UAV Swarms (SwarmNet)*, June 2021.

S. Gupta, D. Rajan, and J. Camp. “NOMA Enabled Computation and Communication Resource Trade-off for Mobile Edge Computing,” in *Proceedings of IEEE WCNC*, April 2021.

Y. Alkhrijah, J. Camp, and D. Rajan. “Full Duplex Multiuser MIMO MAC Protocol (FD-MUMAC),” in *IEEE Global Communications Conference: Mobile and Wireless Networks (GLOBECOM)*, December, 2020.

J. Wensowitch, M. Badi, D. Rajan, and J. Camp. “Building and Simulating Multi-Dimensional Drone Topologies,” in *ACM International Conference on Modeling, Analysis and Simulation of Wireless and Mobile Systems (ACM MSWiM)*, November, 2020.

H. Rathore, A. Samant, G. Koutitas. “mmMoReEdge: A mmWave Modular and Reconfigurable Testbed Design using a Smart Edge Framework,” in *Proceedings of IEEE PerCom - SmartEdge 2020: 4th International Workshop on Smart Edge Computing and Networking (invited)*, March, 2020.

G. Dvorocsik, E. Sarris, and J. Camp. “Using Clustering to Find Pitch Subtypes and Effective Pairings,” in *SABR Analytics Conference*, March 2020.

M. Badi, J. Wensowitch, D. Rajan, and J. Camp. “Experimental Evaluation of Antenna Polarization and Elevation Effects on Drone Communications,” in *ACM MSWiM 2019*, November 2019.

M. Tonnemacher, C. Tarver, J. Cavallaro, and J. Camp. “Machine Learning Enhanced Channel Selection for Unlicensed LTE,” in *Proceedings of IEEE DySPAN 2019*, Newark, NJ, November 2019.

P. Cui, S. Chen, and J. Camp. “GreenLoading: Using the Citizens Band Radio for Energy-Efficient Offloading of Shared Interests,” in *Proceedings of 21st ACM International Conference on Modeling, Analysis and Simulation of Wireless and Mobile Systems (ACM MSWiM 2018)*, Montreal, Canada, November 2018. (Best Paper Award Finalist) [4+ citations (Google Scholar)]

M. Tonnemacher, C. Tarver, V. Chandrasekhar, H. Chen, P. Huang, J. Zhang, J. Cavallaro, and J. Camp. “Opportunistic Channel Access Using Reinforcement Learning in Tiered CBRS Networks,” in *Proceedings of IEEE DySPAN 2018*, Seoul, South Korea, October 2018. [11+ citations (Google Scholar)]

Y. Shi, R. Enami, J. Wensowitch, and J. Camp. “UABeam: UAV-Based Beamforming System Analysis with In-Field Air-to-Ground Channels,” in *Proceedings of IEEE SECON 2018*, Hong Kong, China, June 2018. [10+ citations (Google Scholar)]

Y. Shi, J. Wensowitch, A. Ward, M. Badi, and J. Camp. “Building UAV-based Testbeds for Autonomous Mobility and Beamforming Experimentation,” in *Proceedings of IEEE SECON 2018 - First Workshop on Com-*

munications, Data Processing and Control for Unmanned Autonomous Systems (CPC-UAV), Hong Kong, China, June 2018. [1+ citation (Google Scholar)]

R. Enami, D. Rajan, and J. Camp. “RAIK: Regional Analysis with Geodata and Crowdsourcing to Infer Key Performance Indicators,” in *Proceedings of IEEE Wireless Communications and Networking Conference (WCNC) - Emerging Technologies, Architectures and Services*, Barcelona, Spain, April 2018. [5+ citations (Google Scholar)]

Y. Shi, R. Enami, J. Wensowitch, and J. Camp. “Measurement-Based Characterization of LOS and NLOS Drone-to-Ground Channels,” in *Proceedings of IEEE Wireless Communications and Networking Conference (WCNC) - PHY and Fundamentals*, Barcelona, Spain, April 2018. [14+ citations (Google Scholar)]

R. Enami, Y. Shi, D. Rajan, and J. Camp. “Pre-Crowdsourcing: Predicting Wireless Propagation with Phone-Based Channel Quality Measurements,” in *Proceedings of 20th ACM International Conference on Modeling, Analysis and Simulation of Wireless and Mobile Systems (ACM MSWiM 2017)*, Miami, FL, November 2017. [5+ citations (Google Scholar)]

M. Tonnemacher, D. Rajan, and J. Camp. “GeoRIPE: Efficiently Harvesting Field Measurements for Map-Based Path Loss Modeling,” in *Proceedings of 20th ACM International Conference on Modeling, Analysis and Simulation of Wireless and Mobile Systems (ACM MSWiM 2017)*, Miami, FL, November 2017.

Y. Shi, J. Wensowitch, E. Johnson, and J. Camp. “A Measurement Study of User-Induced Propagation Effects for UHF Frequency Bands,” in *Proceedings of IEEE SECON 2017*, San Diego, CA, June 2017. [4+ citations (Google Scholar)]

P. Cui, Y. Dong, H. Liu, D. Rajan, E. Olinick, and J. Camp. “WhiteMesh: Leveraging White Spaces in Wireless Mesh Networks,” in *Proceedings of IEEE WiOpt 2016 (WiNMeE Workshop-The 12th International Workshop on Wireless Network Measurements and Experimentation)* (Invited), Tempe, Arizona, May 2016. [6+ citations (Google Scholar)]

J. He, H. Liu, P. Cui, J. Landon, D. Rajan, and J. Camp. “Geometry-Based Channel Recognition for Context-Aware Applications,” in *Proceedings of IEEE WiOpt 2016 (WiNMeE Workshop-The 12th International Workshop on Wireless Network Measurements and Experimentation)* (Invited), Tempe, Arizona, May 2016.

P. Cui, M. Tonnemacher, D. Rajan, and J. Camp. “WhiteCell: Energy-Efficient Use of Unlicensed Frequency Bands for Cellular Offloading,” in *Proceedings of IEEE DySPAN 2015*, Stockholm, Sweden, October 2015.

Y. Du, E. Aryafar, P. Cui, J. Camp, and M. Chiang, “SAMU: Design and Implementation of Selectivity-Aware MU-MIMO for Wideband WiFi,” in *Proceedings of IEEE SECON 2015*, Seattle, Washington, June 2015. [28% acceptance rate, 20+ citations (Google Scholar)]

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J. Beshay, Y. Du, P. Huang, N. Mahabaleshwar, B. McMillin, E. Nourbakhsh, K. Subramani, T. Xi, B. Banerjee, J. Camp, J. Chen, P. Gui, R. Prakash, and D. Rajan. “Wireless Networking Testbed and Emulator (WiNeTestEr),” in *Proceedings of ACM MSWiM*, Montreal, Canada, September 2014. [24% acceptance rate, 14+ citations (Google Scholar)]

P. Cui, H. Liu, D. Rajan, and J. Camp, “A Measurement Study of White Spaces Across Diverse Population Densities,” in *Proceedings of IEEE WiOpt 2014 (WiNMeE Workshop)*, Hammamet, Tunisia, May, 2014.

Y. Du, E. Aryafar, J. Camp, and M. Chiang. “iBeam: Intelligent Client-Side Multi-User Beamforming in Wireless Networks,” in *Proceedings of IEEE INFOCOM 2014*, Toronto, Canada, April 2014. [19% accep-

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H. Liu, J. He, D. Rajan, and J. Camp. "Outlier Detection for Training-Based Adaptive Protocols," in *Proceedings of IEEE WCNC 2013 - MAC*, Shanghai, China, April 2013. [3+ citations (Google Scholar)]

P. Huang, D. Rajan, and J. Camp. "Weibull and Suzuki Fading Channel Generator Design to Reduce Hardware Resources," in *Proceedings of IEEE WCNC 2013 - PHY*, Shanghai, China, April 2013. [12+ citations (Google Scholar)]

R. Meikle and J. Camp. "A Global Measurement Study of Context-Based Propagation and User Mobility," in *Proceedings of ACM MobiSys (HotPlanet 2012 Workshop)*, Low Wood Bay, Lake District, United Kingdom, June 2012. [12+ citations (Google Scholar)]

H. Liu, J. He, P. Cui, J. Camp, and D. Rajan. "ASTRA: Application of Sequential Training to Rate Adaptation," in *Proceedings of IEEE SECON*, Seoul, Korea, June 2012. [19% acceptance rate, 8+ citations (Google Scholar)]

J. He, H. Liu, P. Cui, J. Landon, O. Altintas, R. Vuyyuru, D. Rajan, and J. Camp. "Design and Experimentation of Context-aware Link-level Adaptation," in *Proceedings of IEEE INFOCOM 2012 (Mini-Conference)*, Miami, FL, March 2012. [15+ citations (Google Scholar)]

J. Camp, O. Altintas, R. Vuyyuru and D. Rajan, "Context-aware Collection, Decision, and Distribution (C2D2) Engine for Multi-Dimensional Adaptation in Vehicular Networks," in *The Eighth ACM International Workshop on Vehicular Inter-NETworking (ACM VANET 2011)*, Las Vegas, Nevada, September, 2011. [4+ citations (Google Scholar)]

H. Patil, J. Camp, and S. Szygenda, "Identity Based Authentication using Cross Layer Design approach in Wireless Sensor Networks," in *Proceedings of World Multiconference on Systemics, Cybernetics and Informatics (WMSCI 2011)*, Orlando, Florida, July, 2011. [4+ citations (Google Scholar)]

J. Camp, E. Aryafar, and E. Knightly. "Coupled 802.11 Flows in Urban Channels: Model and Experimental

Evaluation,” in *Proceedings of INFOCOM 2010*, San Diego, California, March, 2010. [18% acceptance rate, 18+ citations (Google Scholar)]

J. Camp and E. Knightly, “Modulation Rate Adaptation in Urban and Vehicular Environments: Cross-layer Implementation and Experimental Evaluation,” in *Proceedings of ACM MobiCom 2008*, San Francisco, California, September 2008. [12% acceptance rate, 264+ citations (Google Scholar)]

J. Camp, V. Mancuso, O. Gurewitz, and E. Knightly, “A Measurement Study of Multiplicative Overhead Effects in Wireless Networks,” in *Proceedings of IEEE INFOCOM 2008*, Phoenix, Arizona, April 2008. [20% acceptance rate, 45+ citations (Google Scholar)]

J. Shi, O. Gurewitz, V. Mancuso, J. Camp and E. Knightly, “Measurement and Modeling of the Origins of Starvation in Congestion Controlled Mesh Networks,” in *Proceedings of IEEE INFOCOM 2008*, Phoenix, Arizona, April 2008. [20% acceptance rate, 73+ citations (Google Scholar)]

C. Hunter, J. Camp, P. Murphy, A. Sabharwal, and C. Dick, “A Flexible Framework for Wireless Medium Access Protocols,” Invited Paper in *Proceedings of Asilomar Conference 2006*, Pacific Grove, CA, November 2006. [41+ citations (Google Scholar)]

J. Camp, J. Robinson, C. Steger, and E. Knightly, “Measurement Driven Deployment of a Two-Tier Urban Mesh Access Network,” in *Proceedings of ACM MobiSys 2006*, Uppsala, Sweden, June 2006. [16% acceptance rate, 273+ citations (Google Scholar)]

THESES

J. Camp, “Experimental and Analytical Evaluation of Embedded Link Performance with Small-Scale Channel Fluctuations,” PhD Thesis, Rice University, May 2009. (**Best Engineering Thesis**) [14+ citations (Google Scholar)]

J. Camp, “Measurement Driven Deployment of a Two-Tier Urban Mesh Access Network,” MS Thesis, Rice University, December 2005. [273+ citations (Google Scholar)]

DEMONSTRATIONS

J. Camp, A. Khattab, C. Hunter, P. Murphy, A. Sabharwal, and E. Knightly, “Cross-Layer Rate Adaptation Using WARP,” ACM MobiCom, San Francisco, California, September 2008.

J. Camp, A. Khattab, C. Hunter, P. Murphy, A. Sabharwal, and E. Knightly, “Cross-Layer Rate Adaptation Using WARP,” IEEE INFOCOM, Phoenix, Arizona, April 2008.

A. Khattab, J. Camp, C. Hunter, P. Murphy, A. Sabharwal, and E. Knightly, “WARP: A Flexible Platform for Clean-Slate Wireless Medium Access Protocol Design,” ACM MobiCom, Montreal, Canada, September 2007. [2+ citations (Google Scholar)]

J. Camp, A. Khattab, C. Hunter, P. Murphy, A. Sabharwal, and E. Knightly, “Clean-slate Mesh Protocol Design using WARP,” ACM MobiSys, San Juan, Puerto Rico, June 2007.

P. Murphy, C. Hunter, J. Camp, A. Khattab, E. Knightly, and A. Sabharwal, “Clean-slate Multi-hop Wireless Networks using WARP,” IEEE INFOCOM, Anchorage, Alaska, May 2007.

PATENTS

B. Story, D. Rajan, and J. Camp. “Method and Apparatus to Infer Structural Response from User-Device Measurements,” Patent pending (since 2017).

B. Story, D. Rajan, and J. Camp. “Method and Apparatus to Infer Structural Stresses with Visual Image and

Video Data,” U.S. Patent Number: 10846819, Publication Date: November 24, 2020.

M. Tonnemacher, D. Rajan, and J. Camp. “Using Geographical Features to Reduce In-Field Propagation Experimentation,” U.S. Patent Number: 9913146, Publication Date: March 6, 2018, Priority Date: January 6, 2017.

J. Camp, O. Altintas, R. Vuyyuru, and D. Rajan. “Context-Aware Analysis and Adaptation,” U.S. Patent Number: US20130073506 A1, Publication Date: March 21, 2013, Priority Date: September 16, 2011. [33+ citations (Google Scholar)]

TEACHING EXPERIENCE

Course Instructor, Southern Methodist University (SMU), Dallas, TX

- ECE 1381 (Fall 2023): Microcontrollers and Embedded Systems
- ECE 1181 (Fall 2023): Microcontrollers and Embedded Systems Lab
- ECE 5393/7393 (Taos August 2023): In-Field Drone Communications Experimentation
- ECE 1381 (Spring 2023): Microcontrollers and Embedded Systems
- ECE 1181 (Spring 2023): Microcontrollers and Embedded Systems Lab
- ECE 3381 (Spring 2023): Microcontrollers and Embedded Systems
- ECE 3181 (Spring 2023): Microcontrollers and Embedded Systems Lab
- ECE 5/7392 (Fall 2022): Blockchain Programming and Network Effects
- ECE 5393/7393 (Taos June 2022): In-Field Drone Communications Experimentation
- ECE 3381 (Spring 2022): Microcontrollers and Embedded Systems
- ECE 3181 (Spring 2022): Microcontrollers and Embedded Systems Lab
- ECE 5/7377 (Fall 2021): Embedded Wireless Design Laboratory
- ECE 3381 (Spring 2021): Microcontrollers and Embedded Systems
- ECE 3181 (Spring 2021): Microcontrollers and Embedded Systems Lab
- ECE 5/7377 (Fall 2020): Embedded Wireless Design Laboratory
- ECE 5393/7393 (Taos July 2020): In-Field Drone Communications Experimentation
- ECE 3381 (Spring 2020): Microcontrollers and Embedded Systems
- ECE 3181 (Spring 2020): Microcontrollers and Embedded Systems Lab
- ECE 5/7377 (Fall 2019): Embedded Wireless Design Laboratory
- ECE 5393/7393 (Taos June 2019): Intro to/Advanced Drone Communications
- ECE 3381 (Spring 2019): Microcontrollers and Embedded Systems
- ECE 3181 (Spring 2019): Microcontrollers and Embedded Systems Lab
- EE 5393/7393 (Taos June 2018): Introduction to Drone Communications
- EE 3381 (Spring 2018): Microcontrollers and Embedded Systems
- EE 3181 (Spring 2018): Microcontrollers and Embedded Systems Lab
- EE 5/7377 (Fall 2017): Embedded Wireless Design Laboratory
- EE 7395/CSE 5394 (Taos June 2017): Measurement Study Design with Phones and Drones
- EE 3381 (Spring 2017): Microcontrollers and Embedded Systems
- EE 3181 (Spring 2017): Microcontrollers and Embedded Systems Lab
- EE 5/7378 (Fall 2016): Mobile Phone Embedded Design
- EE 5/7378 (Taos June 2016): Mobile Phone Embedded Design

- EE 3381 (Spring 2016): Microcontrollers and Embedded Systems
- EE 3181 (Spring 2016): Microcontrollers and Embedded Systems Lab
- EE 5/7377 (Fall 2015): Embedded Wireless Design Laboratory
- EE 3381 (Spring 2015): Microcontrollers and Embedded Systems
- EE 3181 (Spring 2015): Microcontrollers and Embedded Systems Lab
- EE 5/7378 (Fall 2014): Mobile Phone Embedded Design
- EE 3381 (Spring 2014): Microcontrollers and Embedded Systems
- EE 3181 (Spring 2014): Microcontrollers and Embedded Systems Lab
- EE 5/7377 (Fall 2013): Embedded Wireless Design Laboratory
- EE 3381 (Spring 2013): Microcontrollers and Embedded Systems
- EE 3181 (Spring 2013): Microcontrollers and Embedded Systems Lab
- EE 5/7378 (Fall 2012): Mobile Phone Embedded Design
- EE 8378 (Spring 2012): Performance Modeling in Communication Networks
- EE 3381 (Spring 2012, Spring 2011): Microprocessors
- EE 3181 (Spring 2012, Spring 2011): Microprocessors Lab
- EE 5/7377 (Fall 2011): Wireless Communications and Lab
- EE 5/7390 (Fall 2010): Mobile Phone Application Programming
- EE 8391 (Spring 2010): Embedded Wireless Protocol Design Lab
- EE 5/7392 (Fall 2009): Special Topics in Wireless Networking

Teaching Assistant, Rice University, Houston, TX

- ELEC 438 (Spring 2005, Spring 2007): Wireless Networking for Under-Resourced Urban Communities
- ELEC 220 (Spring 2004, Spring 2006): Fundamentals of Computer Engineering

PRIOR PROFESSIONAL EXPERIENCE

Rice University, Houston, Texas USA

Research Assistant

Fall 2003 - Summer 2009

Performed research: (i) architecting, deploying, and evaluating an urban mesh network, the Technology For All (TFA) Wireless Network, which serves 4,000 users and covering 3 km², surpassing the density of any existing wireless research testbed, and (ii) designing, implementing, and evaluating clean-slate protocols for media access and modulation rate adaptation on the Wireless Open-Access Research Platform (WARP).

At-scale Urban Experimentation

Spring 2004 - Summer 2009

Developed a measurement-driven deployment strategy for the TFA Network which decreased the deployment cost by an order of magnitude. Showed the overhead on a wireless network has an amplified effect, causing the throughput of the network to decrease by up to 50 times the injected overhead rate and significantly altering the overhead-vs.-benefit tradeoff of control algorithms. Measured and first to analytically model the unfairness of information asymmetry and the physical layer capture effect in the TFA Network and generally for multirate CSMA networks.

Clean-slate and Cross-Layer Design

Spring 2004 - Summer 2009

Developed a CSMA MAC protocol and co-designed a flexible MAC framework enabling cross-layer interaction of MAC and PHY on the WARP platform. Implemented and designed multiple and previously unimplemented modulation rate adaptation algorithms using WARP. In residential and downtown environments, experimentally showed that all prior rate adaptation protocols fail to track urban channel conditions. First

to consider vehicular mobility in rate adaptation evaluation and found that SNR and coherence time must be considered jointly to accurately track urban channel conditions.

Technology For All, Houston, Texas USA

Chief Network Architect and TFA Staff

May, 2004 - June, 2009

Deployed and managed a wireless mesh network in the low-income neighborhood of Pecan Park (East End of Houston). Collaborated with individuals from Methodist Hospital, Houston Public Library, Houston Community College, Young Men's Christian Association (YMCA), and Houston Independent School District. Other responsibilities include operations, inventory, and ordering as well as marketing the network to neighborhood residents.

Intel Corporation, Austin, Texas USA

Hardware Design Engineer/Co-op

May, 2002 - August, 2003

Used Perl and MySQL to build a regression management system database used to store test results of a next-generation network processor (Gigabit speed).

University of Texas at Austin, Austin, Texas USA

Volunteer Undergraduate Researcher

December, 2002 - May, 2003

Worked on a team of three, under the supervision of Dr. Yale Patt, to envision, architect, design, and verify a fully-functioning LC-3 (16 instruction set designed by Yale Patt) computer implemented in VHDL with monitor and keyboard device drivers written in LC-3 assembly.

Intel Corporation, Folsom, CA USA

Component Design Engineer/Co-op

January, 2000 - August, 2000

Used Perl to aid P64H2 (Bridge from PCI/PCI-X to Hublink Buses) Design Team by porting and debugging Full Chip Tests (133) from P64H in the Bus Functional Language on the PCI Bus.

NASA - Johnson Space Center, Houston, TX USA

Pre-Co-op

May, 1998 - August, 1999

Programmed in 4th Dimension database environment, Multilinx, to build an operational database containing the internal systems of the X-38 Emergency Crew Return Vehicle. Produced a mathematical correlation of an infrared lamp experiment in a vacuum chamber using a UNIX application for the TransHab, an inflatable inhabitant module for the International Space Station.

SHARP Apprentice

May, 1997 - August, 1997

Created a FORTRAN simulation to emulate the reception of an antenna set to travel on the International Space Station from the TDRS (Tracking Data Relay Satellite).

MEDIA COVERAGE

SMU Names Dinesh Rajan as Senior Associate Dean, Joe Camp as Interim Chair of ECE, SMU News Archives, November 1, 2022.

(<https://www.smu.edu/Lyle/News/2022/Rajan-named-Senior-Associate-Dean-and-Camp-named-ECE-interim-chair>)

3-D Drone Applications Hold Great Promise for Communications Networks, SMU Lyle Now Magazine, Spring 2020.

(<https://online.flippingbook.com/view/767518/4/>)

On the Fly: SMU Engineers Set Up Innovative Lab for Drone Study, SMU.edu Home Page, February, 2020.

(<https://www.smu.edu/stories/on-the-fly>)

Helping Drones Communicate with Joseph Camp, Ph.D., Associate Professor of Electrical Engineering, MarketScale Software and Technology Podcast, November 2, 2018.

(<https://marketscale.com/industries/software-and-technology/helping-drones-communicate-with-joseph-camp-ph-d-associate-professor-of-electrical-engineering-at-smu/>)

SMU Engineering Profs Receive NSF Grant to Build Multi-Dimensional Drone Communication Framework, SMU Blog, September 26, 2018.

(<https://blog.smu.edu/research/2018/09/26/smu-engineering-profs-receive-nsf-grant-to-build-multi-dimensional-drone-communication-framework/>)

DARPA's Software Defined Radio (SDR) Hackfest Creates Solutions for Spectrum Challenges: SDR community answers call to explore interplay of radio and drone technology during weeklong event, Defense Advanced Research Projects Agency: News and Events, Dec. 14, 2017.

(<https://www.darpa.mil/news-events/2017-12-14>)

DARPA Software Defined Radio (SDR) Hackfest Selects Teams to Explore Cyber-Physical Intersection of SDR and Drone Technology: Yearlong roadshow culminates in finale event where eight teams will convene to explore the emerging confluence of radio and information technology, Defense Advanced Research Projects Agency: News and Events, Oct. 16, 2017.

(<https://www.darpa.mil/news-events/2017-10-16>)

SMU Students Taking Wireless Vehicle Tech to the Streets, Dallas Innovates, Jan 18, 2017.

(<https://dallasinnovates.com/smu-students-taking-wireless-vehicle-tech-to-the-streets/>)

31 SMU professors receive tenure, promotions effective in 2015-16, SMU Blog, May 13, 2015.

(<https://blog.smu.edu/forum/2015/05/13/31-smu-professors-receive-tenure-promotions-effective-in-2015-16/>)

SMU's Lyle School students win 20over20 hackathon and \$10k prize, Dallas Morning News, Sept. 25, 2013. Students Involved: Matthew Tonnemacher (Ph.D. Student) and Eric Johnson (MS Alumni)

(<http://bizbeatblog.dallasnews.com/2013/09/smus-lyle-school-students-win-20over20-hackathon-and-10k-prize.html>)

Lyle School's Joseph Camp Wins Prestigious NSF CAREER Award for Wireless Network Research, SMU Press Release, Feb. 23, 2012.

(<http://www.smu.edu/News/2012/joseph-camp-nsf-23feb2012>)

WiEye - WiFi Scanner, Android Blip, Apr. 14, 2011.

(<http://www.androidblip.com/android-apps/wieye-wifi-scanner-156543.html>)

"Dude, Where's My Droid?" - Seek Droid - Securing Your Android Devices, PRWeb, Mar. 3, 2011.

(<http://www.prweb.com/releases/2011/03/prweb5127134.htm>)

Self-tracking software helping people stay in shape, Pegasus News, Oct. 27, 2009.

(<http://www.pegasusnews.com/news/2009/oct/27/self-tracking-software-helping-people-stay-shape/>)

In-Home Health Care Via Wireless Networks, NSF Awards \$1.5M For Study, Medical News Today, April 28, 2008.

(<http://www.medicalnewstoday.com/articles/105396.php>)

Rice team Brings Wireless Internet to Houston Community, Rice at Large, Issue 6, Spring 2008.

(http://tfa.rice.edu/news_n_media/Rice-at-Large-Spring-08.pdf)

Bringing Wireless Internet to the Masses, CBS11 News KHOU/TV, Feb. 5, 2008.

(<http://www.khou.com/video/news-index.html?nvid=215101>)

One East Houston Section Wi-Fi Friendly, FOX26 News KRIV/TV, Aug. 29, 2007.

(<http://www.myfoxboston.com/myfox/pages/News/Detail?contentId=4212221&version=1&locale=EN-US&layoutCode=VS>)

Can Houston fit into an Internet bubble?, ABC13 News KTRK/TV, Apr. 4, 2007.

(http://abclocal.go.com/ktrk/story?section=sci_tech&id=5184404)

Wireless Project Breaks New Ground: Pecan Park users may test new medical devices, Houston Chronicle, Feb. 15, 2007.

(http://www.chron.com/CDA/archives/archive.mpl?id=2007_4284632)

Wireless Advances: Mesh Wi-Fi is one post-Katrina success story in New Orleans, IEEE Spectrum Radio, Aug. 2006.

(<http://www.spectrum.ieee.org/radio?date=08.06&segDlink=2>)

Wi-Fi Nodes to Talk Amongst Themselves, IEEE Spectrum Magazine, July 2006.

(<http://www.spectrum.ieee.org/jul06/4114>)

Doctoral Student Helps Provide Wireless Computer Access, Rice News, Sept. 22, 2005.

(<http://www.media.rice.edu/media/NewsBot.asp?MODE=VIEW&ID=7724&SnID=2>)

Evacuees Reconnecting with Loved Ones, NPR, Sept. 6, 2005.

(<http://www.kuhf.org/site/News2?page=NewsArticle&id=13662>)

Municipal Wireless Networks Open New Access and Old Debates, IEEE Internet Computing Magazine, June 2005.

(<http://ieeexplore.ieee.org/iel5/4236/30969/01438298.pdf?arnumber=1438298>)

Bringing Wireless Internet to Houston's East End, Rice News, Feb. 24, 2005.

(<http://www.media.rice.edu/media/NewsBot.asp?MODE=VIEW&ID=7118&SnID=2>)

ACTIVITIES

Member, Institute of Electrical and Electronics Engineers (IEEE, 2003-present)

Member, Association for Computing Machinery (ACM, 2009-present)

Member, Society for American Baseball Research (SABR, 2009-present)

Vestry Member, St. Matthews Episcopal Church (2022-present)

Leader, Munger Place Church Small Group (2015-2016)

Leader, Munger Place Church Kitchen Group (2010-2012)

Deacon Chairman, City of Refuge (COR) Evangelical Presbyterian Church (2007-2009)

Founder/Leader, Crossover: COR Small Group for Inner-City College Students (2007-2009)

Leader, COR Youth Group (2004-2007)

Finisher, Too Cold To Hold Half Marathon (January 2017 - 2:02:15)

Finisher, Too Cold To Hold Half Marathon (January 2016 - 2:02:15)

Finisher, Rock n' Roll Dallas Half Marathon (March 2014 - 2:03:59)

Finisher, Rock n' Roll San Antonio Half Marathon (November 2013 - 2:13:13)

Finisher, Rock n' Roll Dallas Half Marathon (March 2013 - 2:14:47)

Finisher, Aramco Houston Half Marathon (January 2009 - 2:15:19)

Finisher, Big D Texas Half Marathon (April 2006 - 2:34:12)

Southern Methodist University

UAV and UAS (Drone) Comprehensive Program (2021-present)

Library Resources Task Force (2016-2019)

General Education Review Task Force (2016-2018)

Presidential Scholar Review Committee (2014-2017)
Undergraduate Research Steering Committee (2013-2017)

SMU Lyle School of Engineering

Search Committee for the Dean of Lyle School of Engineering (2022-2023)
Strategic Plan Culture Task Force Co-Chair (2018)
Senior Design Review Task Force (2016)
Lyle Engineering IT Task Force (2013, 2016)
Lyle in the City Volunteer (2009)

SMU Electrical and Computer Engineering Department

Interim Department Chair (2022-present)
ECE Undergraduate Curriculum Committee Chair (2016-2023)
Telecommunications Program Committee Member (2009-2017)
MS in Telecommunications Advisor (2009-2017)
EE Undergraduate Curriculum Committee Member (2009-2013, 2014-2016)

Area Editor

Elsevier Computer Networks (COMNETs, 2019-present)
ACM SIGCOMM Computer Communication Review (CCR, 2012-present)

Technical Program Committee Co-Chair

IEEE WiNMeE Workshop 2014: co-located with IEEE WiOpt
IEEE WiNTECH Workshop 2011: co-located with ACM MobiCom
IEEE MeshTech Workshop 2010: co-located with IEEE MASS
ACM MobiHoc S³ Workshop 2009: co-located with ACM MobiHoc

Demo/Poster Co-Chair

IEEE International Conference on Computer Communications, IEEE INFOCOM 2016

Workshop Co-Chair

IEEE Communications Society Conference on Sensor, Mesh and Ad Hoc Communications and Networks, IEEE SECON 2013

Finance Chair

20th ACM Annual International Conference on Mobile Computing and Networking, ACM MobiCom 2014
20th IEEE International Conference on Network Protocols, IEEE ICNP 2012

Publication Chair

IEEE International Symposium on Dynamic Spectrum Access Networks, IEEE DySPAN 2017
IEEE Communications Society Conference on Sensor, Mesh and Ad Hoc Communications and Networks, IEEE SECON 2011

Travel Grants Co-Chair

IEEE Communications Society Conference on Sensor, Mesh and Ad Hoc Communications and Networks, IEEE SECON 2015

Technical Program Committee Member

IEEE International Symposium on Dynamic Spectrum Access Networks, IEEE DySPAN 2017, 2018
IEEE International Conference on Computer Communications, IEEE INFOCOM 2016
ACM International Conference on Modeling, Analysis and Simulation of Wireless and Mobile Systems, ACM MSWiM 2015
ACM Annual International Conference on Mobile Computing and Networking, ACM MobiCom 2014

IEEE Communications Society Conference on Sensor, Mesh and Ad Hoc Communications and Networks, IEEE SECON 2010-2015
ACM International Symposium on Mobile Ad Hoc Networking and Computing, ACM MobiHoc 2011, 2012
IEEE WiNTECH Workshop 2014: co-located with ACM MobiCom
IEEE MeshTech Workshop 2011: co-located with IEEE MASS
5th IEEE Workshop on Wireless Mesh Networks, IEEE WiMesh 2010
11th IEEE International Symposium on a “World of Wireless, Mobile and Multimedia Networks,” IEEE WoWMoM 2010, 2013
29th Conference of the IEEE Communications Society, Work In Progress Session, IEEE INFOCOM 2010 WiP

Technical Reviewer

Journals: IEEE Journal of Selected Areas of Communications, IEEE Transactions on Wireless Communications, IEEE Transactions on Mobile Computing, IEEE Transactions on Wireless and Mobile Computing, IEEE/ACM Transactions on Networking, IEEE Transactions on Vehicular Technology; **Magazines:** IEEE Network Magazine, IEEE Communications Magazine, IEEE Communication Letters; **Conferences:** IEEE INFOCOM, ACM MobiCom, ACM MobiHoc, IEEE VTC, ACM SIGMETRICS, ACM WICON; **Workshops:** ACM E-Wind, ACM/SIGMOBILE REALMAN, IEEE WinMee, IEEE CCNC

DOCTORAL DISSERTATIONS SUPERVISED

Mahmoud Badi, “Characterization of UAV-based Channels with Diverse Antenna Configurations,” December 2021.
Yan Shi, “Feedback Mechanisms for Centralized and Distributed Mobile Systems,” December 2019.
Matthew Tonnemacher, “Leveraging Geographical and Spectral Information for Efficient Cellular Systems,” December 2019.
Rita Enami, “Wireless Channel Characterization based on Crowdsourced Data and Geographical Features,” May 2019.
Pengfei Cui, “Exploiting Spectrum Agility in Wireless Links and Networks,” September 2015.
Yongjiu Du, “Exploiting Dynamic Channel Information for FPGA-Based Emulation and Adaptation,” May 2014.

MASTER’S THESES SUPERVISED

Cameron Matson, “Empirical Models of 3D Air-to-Air Channels,” August 2022.
John Wensowitch, “Design of a Drone-Flight-Enabled Wireless Isolation Chamber,” May 2020.
Eric Johnson, “Smartphone-based Crowdsourcing for Wireless Characterization,” August 2015.
Matthew Tonnemacher, “Analyzing the Impact of Path Loss Variation in Time and Space,” August 2013.

CURRENT GRADUATE STUDENT SUPERVISION

Muhammad Hashir Syed (2019-present)
Gabs DiLiegro (2022-present)
Will Bjorndahl (2023-present)

UNDERGRADUATE STUDENT SUPERVISION

Sam Hamby, Marc Pham, Ryan Sweeney, Eddie Kayizzi (2023)
Arian Shamaei, Steven Pecoraro, Maggie Asare, Giancarlos Dominguez, Leilani Guzman (2022)
Jimmy Gassner (2020-2022)
Felicity Gonzalez (2020-2022)
Ryan Gloria and Patrick Wojcik (2020)
John Wensowitch (2016-2019)
Shel Matongo, Dani Farren, Kyle Melliza, Lauren Dube, Harry Wang, Ankit Pradhan (2019)
Lexie Hancock, Evan Siewert, Dylan Colbert (2018)
Alex Ward (2017-2018)

Cameron Matson (2015-2017)
Jeff Limbocker (2014)
Philip Davis (2013-2015)
Eric Johnson (2012-2014)
Jonathan Landon (2011-2013)
Robert Syer, Rod Meikle (2011-2012)
Joseph Esau (2010)

REFERENCES

Available upon request.