UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

VOLKSWAGEN GROUP OF AMERICA, INC.,
Petitioner

v.

NEO WIRELESS LLC,
Patent Owner

Case IPR2023-00426
U.S. Patent No. 8,467,366

DECLARATION OF LEONARD J. CIMINI, JR., PH.D.

Mail Stop "PATENT BOARD"
Patent Trial and Appeal Board
U.S. Patent & Trademark Office
P.O. Box 1450
Alexandria, VA 22313-1450

TABLE OF CONTENTS

I. INTRODUCTION 1

II. GROUNDS OF UNPATENTABILITY 3

III. QUALIFICATIONS 5

IV. MATERIALS CONSIDERED 9

V. LEGAL UNDERSTANDING 11

- A. My Understanding of Claim Construction 11
- B. My Understanding of Obviousness 11
- C. My Understanding of a Person Having Ordinary Skill in the Art 14

VI. THE ’366 PATENT 15

- A. Overview 15
- B. Prosecution History 18
- C. IPR2021-01480 19
- D. Level of Ordinary Skill in the Art 20
- E. Claim Construction 21

VII. BACKGROUND OF THE TECHNOLOGY 23

- A. Multiple Access Techniques 23
- B. Orthogonal Frequency-Division Multiplexing (OFDM) & Orthogonal Frequency-Division Multiple Access (OFDMA) 25
- C. Guard Bands and Guard Periods 26
- D. Peak-to-Average Power Ratio (PAP, PAR, or PAPR) 27
- E. Reducing or Eliminating Signal Interference 28

VIII. GROUND 1: CLAIMS 1-4, 6-20, 22-24 WOULD HAVE BEEN OBVIOUS OVER JEONG AND SUZUKI 30

- A. Jeong 30
- B. Suzuki 35
- C. Motivation to Combine 39
- D. Independent Claim 1 41
  - 1. Claim 1’s Preamble 42

2. Limitation 1.1 44
3. Limitation 1.2 46
4. Limitation 1.3 47
5. Limitation 1.4 50
6. Limitation 1.5 51
E. Independent Claims 9, 17, and 22 54
F. Dependent Claims 2 and 10 63
G. Dependent Claims 3 and 11 65
H. Dependent Claims 4 and 20 66
I. Dependent Claims 6 and 18 68
J. Dependent Claims 7 and 19 69
K. Dependent Claim 8 70
L. Dependent Claims 12-14 71
M. Dependent Claims 15 and 23 73
N. Dependent Claims 16 and 24 74
IX. GROUND 2: CLAIMS 2-3, 5, 10-11, AND 21 WOULD HAVE BEEN OBVIOUS OVER JEONG, SUZUKI, AND GIBSON. 75
A. Gibson 75
B. Dependent Claims 2 and 10 76
C. Dependent Claims 3 and 11 77
D. Dependent Claims 5 and 21 79
X. GROUND 3: CLAIMS 1, 4, 6-9, 12, 15-20, AND 22-24 WOULD HAVE BEEN OBVIOUS OVER THE COMBINATION OF KOO, 802.16AB, CHAYAT, AND SUZUKI. 83
A. Koo 83
B. IEEE 802.16ab-01/01r2 (“802.16ab”) 86
C. Chayat 96
D. Suzuki 97
E. Motivation to Combine 97

1. Koo with 802.16ab 97
2. Koo and 802.16ab with Chayat 98
3. Koo, 802.16ab, and Chayat with Suzuki 100
F. Independent Claim 1 101
1. Claim 1's Preamble 101
2. Limitation 1.1 104
3. Limitation 1.2 107
4. Limitation 1.3 108
5. Limitation 1.4 111
6. Limitation 1.5 112
G. Independent Claims 9, 17, and 22 115
H. Dependent Claims 4 and 20 119
I. Dependent Claims 6 and 18 120
J. Dependent Claims 7 and 19 121
K. Dependent Claim 8 122
L. Dependent Claim 12 122
M. Dependent Claims 15 and 23 123
N. Dependent Claims 16 and 24 124
XI. GROUND 4: CLAIMS 2-3, 5, 10-11, 13-14, AND 21 WOULD HAVE BEEN OBVIOUS OVER THE COMBINATION OF KOO, 802.16AB, CHAYAT, SUZUKI, AND GIBSON. 126
A. Dependent Claims 2 and 10 126
B. Dependent Claims 5 and 21 128
C. Dependent Claims 13 and 14 129
XII. CONCLUSION 131

I, Leonard J. Cimini, Jr., declare as follows:

I. INTRODUCTION

1. I have been retained by Sterne, Kessler, Goldstein & Fox, P.L.L.C., on behalf of Volkswagen Group of America ("VWGoA" and/or "Petitioner") for the above-captioned *inter partes* review proceeding. I understand that this proceeding involves U.S. Patent No. 8,467,366 (EX1001, "the '366 patent"), which is titled "Methods and apparatus for random access in multi-carrier communication systems," and that the '366 patent is currently assigned to Neo Wireless LLC ("Patent Owner").

2. I have been retained as a technical expert by VWGoA to study and provide my opinions on the technology claimed in, and the patentability or unpatentability of, claims 1-24 of the '366 patent ("the challenged claims"). This declaration is directed to the challenged claims of the '366 patent, and sets forth the opinions I have formed, the conclusions I have reached, and the bases for each. For purposes of this declaration, I was not asked to provide any opinions that are not expressed herein.

3. I am familiar with the technology described in the '366 patent as of its earliest possible priority date of March 9, 2004. I have been asked to provide my technical review, analysis, insights, and opinions regarding the '366 patent. I have used this experience and insight along with the references identified herein as the

basis for my opinions that support the grounds of unpatentability set forth in the Petition for *Inter Partes* Review of the ’366 patent.

4. I have reviewed and am familiar with the specification of the ’366 patent, which issued on June 18, 2013. I understand that the ’366 patent has been provided as EX1001. I will cite to the specification using the following formats: EX1001, ’366 patent, 1:1-10 (long form) and EX1001, 1:1-10 (short form). These example citations both point to the ’366 patent specification at column 1, lines 1-10.

5. I am being compensated by VWGoA at my standard hourly rate for the time I spend in connection with this proceeding. My compensation is not dependent in any way on the substance of my opinions or on the outcome of this proceeding.

II. GROUNDS OF UNPATENTABILITY

6. In forming my opinions about the ’366 patent, I have considered the following grounds of unpatentability. Based on my review of the prior art references that form the basis of these grounds, it is my opinion that claims 1-24 of the ’366 patent would have been obvious to a person of ordinary skill in the art (“POSA”) as of March 9, 2004. I have not formed an opinion as to whether the claims of the ’366 patent are entitled to the March 9, 2004 priority date, but I reserve the right to do so in the future, if necessary. For the purposes of my opinions and analysis herein, I have been asked to treat March 9, 2004, as the time of the invention of the challenged claims.

Ground	Basis	Claims	References
1	§ 103	1-4, 6-20, 22-24	Jeong & Suzuki
2	§ 103	2-3, 5, 10-11, 21	Jeong, Suzuki, & Gibson
3	§ 103	1, 4, 6-9, 12, 15-20, 22-24	Koo, 802.16ab, Chayat, & Suzuki
4	§ 103	2-3, 5, 10-11, 13-14, 21	Koo, 802.16ab, Chayat, Suzuki, & Gibson

7. I have been asked to consider how a POSA would have understood the challenged claims in light of the disclosures of the ’366 patent. I also have been asked to consider how a POSA would have understood the prior art references Jeong, Suzuki, Gibson, Koo, 802.16ab, and Chayat. Further, I have been asked to consider and provide my technical review, analysis, insights, and opinions

regarding whether a POSA would have understood that the combinations of the prior art references listed in the table above render obvious claims 1-24 of the ’366 patent.

III. QUALIFICATIONS

8. In formulating my opinions, I have relied upon my training, knowledge, and experience in the relevant art. I have over 40 years of academic and industry experience in wireless technologies and standards, various communications technologies, networking, orthogonal frequency-division multiplexing (OFDM), and physical and media access control (MAC) layer technology. Over my career, among other activities, I have worked with companies (including Fortune 500 companies) to enable the high-date-rate wireless communication systems and networks that we have today. I have published over 70 journal articles and over 120 conference papers. I also am a named inventor on 29 patents.

9. My academic background in electrical engineering provides a technical foundation for work in transmission of data in telecommunication systems. I received a Bachelor of Science degree in Electrical Engineering from the University of Pennsylvania in 1978. A year later, I received a Master of Science degree in Electrical Engineering from the University of Pennsylvania. In 1982, I received the Doctor of Philosophy (Ph.D.) degree in Electrical Engineering, also from the University of Pennsylvania.

10. After receiving my Ph.D. in 1982, I began working for AT&T Bell Laboratories, in West Long Branch, as a Member of Technical Staff. I continued to

work at this branch of AT&T Bell Laboratories until 1985. In my role as a Member of Technical Staff, I proposed and analyzed speech privacy techniques for cellular mobile radio systems. I further designed and demonstrated 10- and 18-GHz hardware for a personal communication system. I also proposed and analyzed the use of OFDM in mobile radio systems. My proposal at that time was the first application of OFDM to wireless systems. This has become the basis for much of the current, widespread use of OFDM today.

11. After that, I continued to work as a Member of Technical Staff at AT&T Bell Laboratories, but at a different branch. I held this position from 1985 to 1996. During this time, I invented and analyzed new algorithms for dynamic channel selection in wireless communication systems, among other things. I also proposed and analyzed the use of multicarrier techniques to overcome the limitations to high-bit-rate wireless transmission caused by multipath. Further, I invented, analyzed, designed, and built a 20-Mbps packet-based wireless modem using clustered OFDM. During this phase of my career, I also devised techniques for providing reliable transmission for both light-wave (i.e., fiber), and wireless communication systems.

12. From 1996 to 2002, I was a Technology Consultant (the next level on the AT&T employee technology ladder) for AT&T Laboratories Research. During this time, I studied the effect of channel mismatch on adaptive modulation for

OFDM for wireless applications. I also invented and analyzed techniques for robust channel estimation and peak power reduction in OFDM. Further, I invented and analyzed solutions to both the physical layer and MAC layer challenges for providing high-bit-rate packet data to wide-area cellular users, using OFDM.

13. Since 2002, I have been a Professor at the University of Delaware. I teach undergraduate courses in linear systems, probability, and communications. I also teach graduate courses in digital and wireless communications, and I research topics such as OFDM and multiuser networks.

14. I have authored or co-authored more than 190 scientific and industry publications relating to various communications technologies, networking, and OFDM. I have also presented numerous tutorials and short courses to industry and academic audiences on these topics. I am listed as an inventor on over 20 patents that relate to these topics.

15. Since receiving my Ph.D. in 1982, I was awarded nine of the industry's most prestigious honors and awards. These awards include the 2010 Innovator's Award from the New Jersey Inventors Hall of Fame for innovative research related to high-speed wireless communications. I also received the 2007 James Evans Avant Garde Award from the IEEE Vehicular Technology Society in recognition of my pioneering contributions to high-data-rate wireless communications, and the Stephen O. Rice Prize in the Field of Communications

Theory for a 2009 paper in the IEEE Transactions on Communications. In 2010, I won the IEEE Communications Society's Wireless Communications Technical Committee Recognition Award for having a high degree of visibility and contribution in the field of Wireless and Mobile Communications Theory, Systems, and Networks. In 2000, I became a Fellow of the IEEE for my contributions to the theory of high-speed wireless communications. More recently, I have received a number of other awards, including the Career Technical Achievement Award from the Communication Theory Committee of the IEEE Communications Society for contributions to OFDM for wireless communication.

16. A copy of my *curriculum vitae* is provided as EX1004, which contains further details on my experience, technical expertise, and other qualifications.

IV. MATERIALS CONSIDERED

17. In formulating my opinions, I have relied upon my training, knowledge, and experience that are relevant to the ’366 patent. Furthermore, I have considered specifically the following documents listed below in addition to any other documents cited in this declaration:

Exhibit No.	***Description***
1001	U.S. Patent No. 8,467,366 B2 to Li et al. (“the ’366 patent”)
1002	Prosecution History of U.S. Patent No. 8,467,366 B2
1007	KR 2003-0058589 A to Jeong et al.
1008	Certified translation of KR 2003-0058589 A to Jeong et al. (“**Jeong**”)
1009	U.S. Patent No. 5,903,614 to Suzuki et al. (“**Suzuki**”)
1010	Jerry D. Gibson, “The Mobile Communications Handbook,” 2nd Edition, CRC Press LLC, 1999 (“**Gibson**”)
1011	U.S. Pub. No. 2003/0198179 A1 to Koo et al. (“**Koo**”)
1012	Air Interface for Fixed Broadband Wireless Access Systems, Part A: Systems between 2 and 11 GHz, IEEE 802.16ab-01/01r2, July 2001 (“**802.16ab**”)
1013	WO 03/075500 A2 to Chayat et al. (“**Chayat**”)
1016	October 26, 2001 Letter from Chairman of ETSI Project Broadband Radio Access Networks, Jamshid Khun-Hush, Dr.-Ing., to Dr. Roger B. Marks, Chair IEEE 802.16 Working Group on Broadband Wireless Access
1018	Cimini, “Analysis and Simulation of a Digital Mobile Channel Using Orthogonal Frequency Division Multiplexing,” IEEE Trans. Comm., Vol. 33, No. 7, July 1985.

Exhibit No.	***Description***
1019	U.S. Patent No. 3,488,445 to Chang
1020	*Dell Inc. v. Neo Wireless LLC*, IPR2021-01480, Paper 11 (P.T.A.B. March 16, 2022).
1021	Defendant's Proposed Interpretations, *In Re Neo Wireless, LLC Patent Litigation*, 2:22-MD-03034-TGB, December 30, 2022.
1022	U.S. Patent No. 6,556,557 to Cimini, Jr. et al.
1023	U.S. Patent No. 6,928,084 to Cimini, Jr. et al.
1028	Plaintiff Neo Wireless LLC's Disclosure Of Proposed Interpretations And Evidence Of Disputed Claim Terms, *In Re Neo Wireless, LLC Patent Litigation*, 2:22-MD-03034-TGB, December 30, 2022.

18. To the best of my knowledge, the above-mentioned documents and materials are true and accurate copies of what they purport to be. An expert in the field would reasonably rely on them to formulate opinions such as those set forth in this declaration.

19. Exhibit 1018 is a true and accurate copy of the 1985 article, "Analysis and Simulation of a Digital Mobile Channel Using Orthogonal Frequency Division Multiplexing," that I authored.

20. I have also relied upon various legal principles (as explained to me by VWGoA's counsel) in formulating my opinions. My understanding of these principles is summarized below.

V. LEGAL UNDERSTANDING

A. My Understanding of Claim Construction

21. I understand that during an *inter partes* review proceeding, claims are to be construed in light of the specification as would be read by a person of ordinary skill in the relevant art at the time the application was filed. I understand that claim terms are given their ordinary and customary meaning as would be understood by a person of ordinary skill in the relevant art in the context of the entire disclosure. A claim term, however, will not receive its ordinary meaning if the patentee acted as his own lexicographer and clearly set forth a definition of the claim term in the specification. In this case, the claim term will receive the definition set forth in the patent.

B. My Understanding of Obviousness

22. I understand that a patent claim is invalid if the claimed invention would have been obvious to a person of ordinary skill in the art at the time the application was filed. I understand that this means that even if all of the requirements of the claim cannot be found in a single prior art reference that would anticipate the claim, the claim can still be invalid.

23. To obtain a patent, a claimed invention must have been, as of its priority date, nonobvious in view of the prior art in the field. I understand that a patent claim is obvious when the differences between the subject matter sought to

be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art.

24. I understand that to prove that prior art or a combination of prior art renders a patent obvious, it is necessary to: (1) identify the particular references that, singly or in combination, render the patent obvious; (2) specifically identify which elements of the patent claim appear in each of the asserted references; and (3) explain how the prior art references could have been combined in order to create the inventions claimed in the asserted claim.

25. I also understand that prior art references can be combined under several different circumstances. For example, it is my understanding that one such circumstance is when a proposed combination of prior art references results in a system that represents a predictable variation, which is achieved using prior art elements according to their established functions.

26. I also understand that when considering the obviousness of a patent claim, one should consider whether a teaching, suggestion, or motivation to combine the references exists so as to avoid impermissibly applying hindsight when considering the prior art. I understand this test should not be rigidly applied, but that the test can be important to avoiding such hindsight.

27. I understand that certain objective indicia can be important evidence

as to whether a patent is obvious or nonobvious. Such indicia include: (1) commercial success of products covered by the patent claims; (2) a long-felt need for the invention; (3) failed attempts by others to make the invention; (4) copying of the invention by others in the field; (5) unexpected results achieved by the invention as compared to the closest prior art; (6) praise of the invention by the infringer or others in the field; (7) the taking of licenses under the patent by others; (8) expressions of surprise by experts and those skilled in the art at the making of the invention; and (9) the patentee proceeded contrary to the accepted wisdom of the prior art. At this point, I am not aware of any secondary indicia of non-obviousness. But I reserve the right to review and opine on any evidence of objective indicia of nonobvious that may be presented during this proceeding.

28. I also understand that "obviousness" is a legal conclusion based on the underlying factual issues of the scope and content of the prior art, the differences between the claimed invention and the prior art, the level of ordinary skill in the pertinent art, and any objective indicia of non-obviousness. For that reason, I am not rendering a legal opinion on the ultimate legal question of obviousness. Rather, my testimony addresses the underlying facts and factual analysis that would support a legal conclusion of obviousness or non-obviousness, and when I use the term obvious, I am referring to the perspective of one of ordinary skill at the time of invention.

C. My Understanding of a Person Having Ordinary Skill in the Art

29. I understand that a person of ordinary skill in the relevant art (herein "POSA") is presumed to be aware of all pertinent art, thinks along conventional wisdom in the art, and is a person of ordinary creativity—not an automaton.

30. I have been asked to consider the level of ordinary skill in the field that someone would have had at the time the claimed invention was made. In deciding the level of ordinary skill, I considered the following:

- the levels of education and experience of persons working in the field;
- the types of problems encountered in the field; and
- the sophistication of the technology.

31. My opinion below explains how a POSA would have understood the technology described in the references I have identified herein around the March 9, 2004 timeframe.

32. Regardless if I use "I" or a "POSA" during my technical analysis below, all of my statements and opinions are always to be understood to be based on how a POSA would have understood or read a document at the time of the invention.

VI. THE ’366 PATENT

A. Overview

33. The ’366 patent is titled “Methods and Apparatus for Random Access in Multi-Carrier Communication Systems,” EX1001, (54), and is directed to ranging in a multi-cell orthogonal frequency division multiple access (OFDMA) wireless communication system, EX1001, 1:24-55. The specification describes a wireless communication system that uses technologies that were well-known by March 2004, such as: random access and ranging; multi-carrier signals made up of subcarriers, including subcarriers used as guard bands; a typical cellular structure; and the use of sequences that, when modulated via OFDM, exhibit low peak-to-average power ratio (often abbreviated “PAP,” “PAPR,” or “PAR”), such as Hadamard sequences. The ’366 patent acknowledges that some of these technologies (such as random access and ranging) were well-known but includes others in its Detailed Description without acknowledging that they were also well-known, widely studied, and routinely implemented technologies by March 2004.

34. In the Background section, the ’366 patent admits that “random access” including “Ranging” was well-known. EX1001, 1:26-28. Indeed, the ’366 patent describes ranging as a “critical part of [a] wireless communication system.” EX1001, 1:24-55. It admits that “***a mobile station*** first needs to perform a ***random access*** for establishing communication with ***a base station***” and that “random

access typically includes … ***Ranging***." EX1001, 1:24-27 (emphasis added). "During Ranging, the mobile station sends a signal to the base station, so that the base station can identify the mobile station and measure the power and time delay of the mobile station, and inform the mobile station for power adjustment and time advance." EX1001, 1:28-32. The '366 patent further admits that "[t]he ranging process typically involves an exchange of messages between the base station and the mobile station by which the mobile station aligns itself with the start of each time slot after compensating for propagation delay and other factors." EX1001, 1:43-47.

35. In the Detailed Description, the '366 patent describes "a multi-carrier communication system such as … orthogonal frequency division multiple access (OFDMA) systems" in which "information data are multiplexed on subcarriers that are mutually orthogonal in the frequency domain." EX1001, 2:47-51. Multi-carrier communication systems, including OFDMA communication systems, were well-known by March 2004. *See, e.g.*, EX1008, 0002, Abstract; EX1009, 3:31-4:21, FIGS. 2A-2G; EX1012, 0077-79; EX1013, 1:5-32.

36. The '366 patent explains that "[a] basic structure of a multi-carrier signal in the frequency domain is made up of subcarriers" and that "[t]here are three types of subcarriers: 1. Data subcarriers, which carry information data; 2. Pilot subcarriers, whose phases and amplitudes are predetermined and made known

to all receivers and which are used for assisting system functions such as estimation of system parameters; and 3. Silent subcarriers, which have no energy and are used for guard-bands and DC carriers." EX1001, 2:61-3:4. This merely describes the well-known structure of a multi-carrier signal, as demonstrated by 802.16ab's frequency domain description in Section 8.3.5.1.3, explaining that an "OFDM symbol is made up from carriers" and "[t]here are several carrier types" including "Data carriers – for data transmission," "Pilot carriers – for different estimation purposes," and "Null carriers – [having] no transmission at all, for guard bands and DC carrier[s]." EX1012, 0175. The '366 patent's depiction of a multi-carrier signal in the frequency domain is also very similar to those in 802.16ab. *Compare* EX1001, FIG. 1 *with* EX1012, FIGS. 214-215. I also note that the use of no energy or zero-power subcarriers as guard band was also well known. *See, e.g.*, EX1009, 3:16-20.

37. Turning to the claims, the '366 patent claims a mobile station and corresponding method (claims 1-8, 17-21) and a base station and corresponding method (claims 9-16, 22-24) that use a "ranging signal" exhibiting a low PAPR in the time domain. *See, e.g.*, EX1001, 7:21-22. The ranging signal is transmitted in a "ranging subchannel" comprising a block of subcarriers in which the power levels of the subcarriers at both ends of a block are set to zero, forming guard bands or intervals. *See, e.g.*, EX1001, 7:13-15, 7:23-26. During prosecution, the Examiner

identified these two features (i.e., the low PAPR ranging signal and zero-power subcarriers) when allowing the claims.

B. Prosecution History

38. The application that issued as the ’366 patent received a first action allowance, i.e., was allowed without receiving rejections. EX1002, 0120-28. The Examiner’s reason for allowance was that the prior art of record, particularly U.S. Pub. No. 2010/0111017 (“Um”), failed to disclose a ranging signal exhibiting low PAPR (limitation 1.4) and zero-power subcarriers at the ends of a subchannel block (limitation 1.5):

> The prior art of record Um does not disclose the ranging signal lasts over a period of one or multiple orthogonal frequency division multiplexing (OFDM) symbols and the ranging signal exhibits a low peak-to-average power ratio in the time domain; and the ranging subchannel comprises at least one block of subcarriers within the communication channel and power levels of subcarriers at both ends of a block are set to zero as applied to independent claims 1, 9, 17 and 22.

EX1002, 0126.

39. The prior art and supporting evidence demonstrate that these features were well-known by March 2004, and that the claims of the ’366 patent would have been obvious.

C. IPR2021-01480

40. I understand that, in IPR2021-01480, Dell Inc. and Dell Technologies Inc. (collectively, "Dell") filed a petition for *inter partes* review that challenged the validity of claims 1-24 of the '366 patent. EX1020, 2. Dell's petition presented the following obviousness grounds based on prior art references that are not used in the obviousness grounds that I present below:

Claim(s) Challenged	35 U.S.C. §	References/Basis
1–4, 6–12, 14–20, 22–24	103(a)[1]	Ma,[2] TR[3]
5, 21	103(a)	Ma, TR, Soliman[4]
13	103(a)	Ma, TR, Li[5]
1–4, 6–12, 14–20, 22–24	103(a)	Ma, Jung[6]
5, 21	103(a)	Ma, Jung, Soliman
13	103(a)	Ma, Jung, Li

[2] U.S. Pub. No. 2004/0001429 A1, published Jan. 1, 2004 (Ex. 1005).
[3] *Universal Mobile Telecommunications System (UMTS); UMTS Terrestrial Radio Access (UTRA); Concept evaluation (UMTS 30.06 version 3.0.0)*, TR 101 146 V3.0.0, European Telecommunications Standards Institute (December 1997) (Ex. 1006).
[4] U.S. Patent No. 6,101,179, issued Aug. 8, 2000 (Ex. 1007).
[5] U.S. Pub. No. 2002/0159422 A1, published Oct. 31, 2002 (Ex. 1009).
[6] U.S. Pub. No. 2004/0114504 A1, published June 17, 2004 (Ex. 1010).

EX1020, 6.

41. I understand that the Board denied Dell's petition and did not institute review of the '366 patent based on the invalidity grounds presented in Dell's petition. As shown above, all of Dell's grounds were based on the combination of

Ma and TR (Grounds 1-3) or Ma and Jung (Grounds 4-6). The Board's decision turned on whether a POSA would have been motivated to combine the teachings of Ma and TR or Ma and Jung to satisfy the limitation of claim 1: "the ranging subchannel comprises at least one block of subcarriers within the communication channel and power levels of subcarriers at both ends of a block are set to zero," which I address below as Limitation 1.5. *See* Sections VIII.D.6, X.F.6. The Board denied institution of Dell's petition because the Board determined that Dell did "not show sufficiently, on this record, that the above-discussed disclosures of Ma and TR, or Ma and Jung, would have led an ordinarily skilled artisan to incorporate guard carriers or null data on both ends of the block of subcarriers of Ma's RACH." EX1020, 17. The obviousness grounds that I present below do not rely on combinations of Ma and TR or Ma and Jung, and do not suffer from a similar deficiency with respect to zero-power sub-carriers (or guard bands) at both ends of a ranging subchannel. *See* Sections VIII.D.6, X.F.6.

D. Level of Ordinary Skill in the Art

42. In my opinion, a person of ordinary skill in the art of the '366 patent as of March 9, 2004, would have a B.S. degree in electrical engineering, computer engineering, or computer science, or an equivalent field, as well as at least 3-5 years of academic or industry experience in mobile wireless communications, or comparable industry experience. A greater amount of education, e.g., a doctorate in

electrical engineering, computer engineering, computer science, or an equivalent field would also qualify as a POSA for the ’366 patent in lieu of a B.S. degree. Experience could take the place of some formal training, as domain knowledge may be learned on the job. This description is approximate, and a higher level of education or skill might make up for less experience and vice versa.

43. I am well-qualified to determine the level of ordinary skill in the art. I am very familiar with the technology of the ’366 patent before and during the March 2004 timeframe. As mentioned above, by 2004, I had obtained both a Masters and a Ph.D. in Electrical Engineering from the University of Pennsylvania. By 2004, I had also acquired extensive experience relating to wireless communication systems, including 20 years of experience working at AT&T Bell Laboratories and AT&T Laboratories Research. I more than qualify as a POSA of the ’366 patent.

E. Claim Construction

44. I have been instructed that the challenged claims of the ’366 patent are to be given their ordinary and customary meaning as understood by one of ordinary skill in the art at the time of the invention in light of the specification and the prosecution history pertaining to the patent. Based on my review of the challenged claims, it is my opinion that none of the claim terms require explicit constructions. Accordingly, all claim terms should receive their plain and ordinary meaning, in

the context of the ’366 patent specification, which I understand is sometimes referred to as the *Phillips* standard.

45. I understand that Neo Wireless and certain defendants in multi-district litigation involving the ’366 patent provided certain positions regarding some of the claim terms of the ’366 patent. EX1021; EX1028. I understand that the Petitioner is involved in that multi-district litigation but did not join the other defendants’ proposed claim constructions. I have no opinion on the proposed claim constructions. The grounds of unpatentability discussed below render the claims obvious under all of the proposed constructions.

VII. BACKGROUND OF THE TECHNOLOGY

46. I understand that analyzing the state of wireless or mobile communications during the years prior to the earliest possible priority date of March 9, 2004, can provide valuable insight into what a POSA was aware of at the time, and in what direction the industry was taking. Accordingly, I discuss below some of the wireless communications concepts and technologies that would have been known to a POSA in the March 2004 timeframe and that are relevant to the ’366 patent.

47. In my opinion, by March 2004, all of the technology at issue in the ’366 patent was broadly applied and well-known by a POSA working in the wireless or mobile communications industry. No individual elements of the ’366 claims were new or novel by March 2004, and, as I demonstrate below, there was nothing new or novel about the way in which those elements were combined in the claims of the ’366 patent. There were no technological barriers to combining these elements to form the claimed invention. The claims recite nothing more than the predictable use of prior art elements according to their established functions.

A. Multiple Access Techniques

48. Multiple access techniques—including frequency-division multiple access (FDMA), time-division multiple access (TDMA), and code-division

multiple access (CDMA)—were well-known in cellular communication systems by 2004. *See* EX1010, 0312-24. Gibson explains:

> There are three basic multiple access methods. Time division multiple access, frequency division multiple access, and spread spectrum multiple access (SSMA). SSMA comes in two versions; frequency-hopping SSMA and discrete-sequence SSMA. The latter is usually referred to as CDMA. There are also many hybrids of these systems. EX1010, 0435; *see also* EX1010, 0320 ("[B]ecause of their wideband nature CDMA systems are often called spread-spectrum systems.").

49. In FDMA systems, "[s]imultaneous access to the radio channel is facilitated by assigning nonoverlapping frequency bands to different users." EX1010, 0323. TDMA "[s]ystems assign nonoverlapping time slots to different users in a round-robin fashion." EX1010, 0324. CDMA "[s]ystems use signals with very small cross-correlations to facilitate sharing of the broadcast radio channel. Correlators are used to extract the desired user's signal while simultaneously suppressing interfering, parallel transmissions." EX1010, 0323.

50. Figure 17.1 of Gibson, below, illustrates FDMA, TDMA, and CDMA.

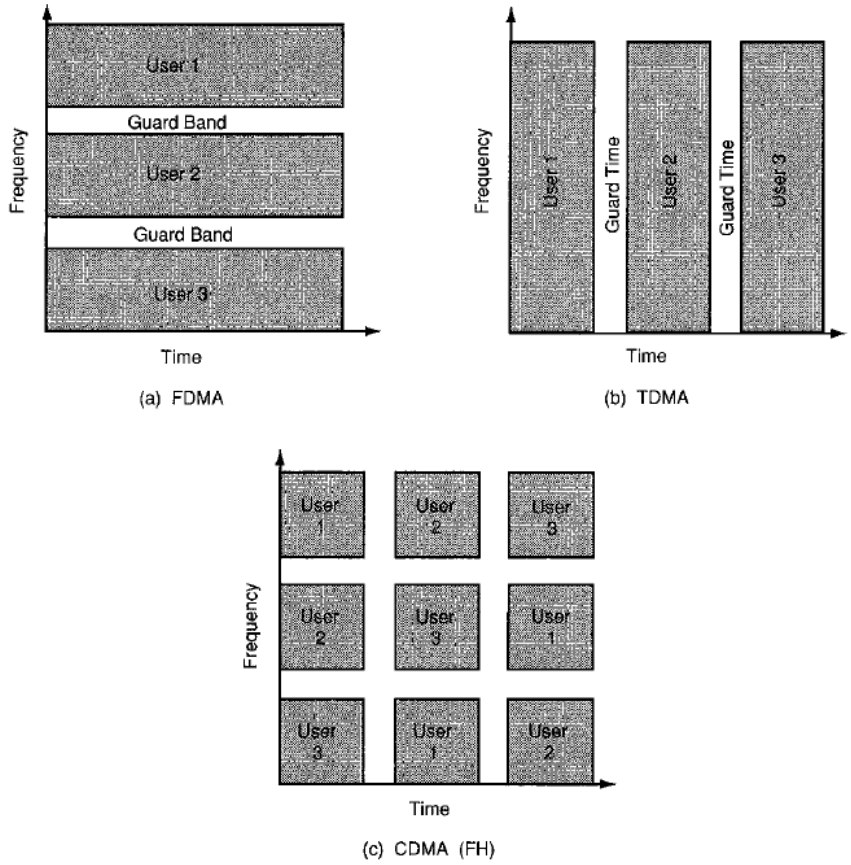


FIGURE 17.1 Multiple-access methods for wireless communication systems.

EX1010, 0314, FIG. 17.1.

B. Orthogonal Frequency-Division Multiplexing (OFDM) & Orthogonal Frequency-Division Multiple Access (OFDMA)

51. OFDM is a modulation technique in which "information is spread over multiple subcarriers in the frequency domain and is transmitted after converting the information to the time domain using a Fourier transform." EX1013, 1:15-19; *see also* EX1010, 0076, 0132, 0308-11, 0352. OFDM dates back at least to the 1960s. *See* EX1019. I have studied and been considered an authority on OFDM since at least the 1980s. *See* EX1018.

52. OFDMA is a multiple-access technique based on OFDM. EX1013, 1:15-32. “The main difference between OFDM and OFDMA is that with OFDM a single transmitter uses a whole range of subcarriers to transmit its information, while in OFDMA different transmitters are assigned disjoint sets of subcarriers, and each user sends his information on the subcarriers assigned to him.” EX1013, 1:15-32.

C. Guard Bands and Guard Periods

53. Inserting guard bands between frequency bands and guard periods between transmissions were well-known techniques used to reduce signal interference in cellular communication systems by 2004. For example, systems using FDMA routinely employed “guard bands between frequency bands to reduce adjacent channel interference, i.e., interference from signals transmitted in adjacent frequency bands; see also Fig. 17.l(a).” EX1010, 0315. Similarly, systems using TDMA routinely employed “[g]uard times” or periods between timeslots. EX1010, 0318. Figures 17.1(a) and (b) of Gibson, above, illustrate guard bands in FDMA and guard times/periods in TDMA, respectively. In fact, I note that each of Jeong, Suzuki, and Gibson discloses using guard bands. *See, e.g.*, EX1008, 0008 (“the guard interval between the ranging sub-channels provides 2 subcarriers for a length of 128 ranging sub-channel and 3 subcarriers for a length of 127”), FIG. 7; EX1009, 3:16-20; EX1010, 0315.

D. Peak-to-Average Power Ratio (PAP, PAR, or PAPR)

54. By March 2004, a well-known "disadvantage of employing OFDM for wireless applications is the potentially large peak-to-average power ratio (PAP) characteristic of a multicarrier signal with a large number of subchannels." EX1022, 1:39-42; *see also* EX1023, 1:31-40; EX1013, 2:8-9 ("Typically OFDM systems produce high PAPR waveforms …."); EX1010, 0073. Several of my patents address this issue and describe solutions to reduce PAPR in OFDM systems that had been developed by the late 1990s / early 2000s. EX1022, 1:50-2:58; EX1023, 1:41-2:9. One such known solution was to use complementary sequences or codes in conjunction with OFDM modulation. EX1013, 2:8-3:31. For example, Chayat explains that "[t]here are several recent works searching for families of waveforms with low PAPR. One set of waveforms is based on Golay's complementary sequences, which have the property that their Fourier transform has a PAPR of at most 2, which is equivalent to 3 dB. Van Nee has shown [1] how to use sets of complementary sequences in conjunction with OFDM modulation for conveying information with low PAPR waveforms." EX1013, 2:26-31 (citing "R.D.J. van Nee, 'OFDM codes for peak-to-average power reduction and error correction', Global Telecommunications Conference, London, Nov.1996.").

E. Reducing or Eliminating Signal Interference

55. As Gibson explains, "Radio-frequency interference is one of the most important issues to be addressed in the design, operation, and maintenance of mobile communication systems." EX1010, 0415. Two such forms of interference that were well-known and widely studied by March 2004 were adjacent channel interference and co-channel interference. EX1010, 0415. As its name suggests, adjacent channel interference occurs when a signal in one channel (such as a frequency band or group of subcarriers) interferes with a signal in an adjacent channel (such an adjacent frequency band or group of subcarriers). By March 2004, various techniques had been developed to mitigate adjacent channel interference, including the use of guard bands. *See* EX1010, 0315, 0416.

56. Gibson describes co-channel interference as "the most critical of all interferences that can be engineered by the designer in cellular planning." EX1010, 0416. Co-channel interference "arises in mobile radio systems using cellular architecture because of the frequency reuse philosophy," EX1010, 0416, that is, the same frequency band is used in different geographic locations or cells. By March 2004, various techniques had been developed to minimize co-channel interference, including "frequency reuse patterns, which ensure that the same frequencies are not used in adjacent cells; efficient power control, which minimizes the transmitted

power; cochannel interference cancellation techniques; and orthogonal [signaling] (time, frequency, or code).” EX1010, 0458.

VIII. GROUND 1: CLAIMS 1-4, 6-20, 22-24 WOULD HAVE BEEN OBVIOUS OVER JEONG AND SUZUKI

57. In my opinion, the combination of Jeong and Suzuki teaches, suggests, or renders obvious each and every element of claims 1-4, 6-20, 22-24 of the ’366 patent, and a POSA would have been motivated to combine the references and had a reasonable expectation of success in doing so.

A. Jeong

58. Jeong “relates to a method for ranging interval and ranging sub-channel allocation for initial ranging in a multi-user [OFDMA-]type wireless communication system in a point-to-multipoint broadband wireless access (BWA) system.” EX1008, 0003. Jeong discloses an “OFDMA wireless communication system” in which “data can be transmitted between a base station (‘BS’) and a subscriber station (‘SS’).” EX1008, 0003. Jeong discloses “a cell” and “performing a cell plan,” EX1008, 0004, 0007, which would have informed a POSA that Jeong discloses a cellular system. Gibson explains, for example, that “[i]n cellular communication systems, the service area is divided into cells, each covered by a single base station.” EX1010, 0459. Such systems were well-known and widely deployed by March 2004. *See, e.g.*, EX1010, 0256, TABLE 15.1.

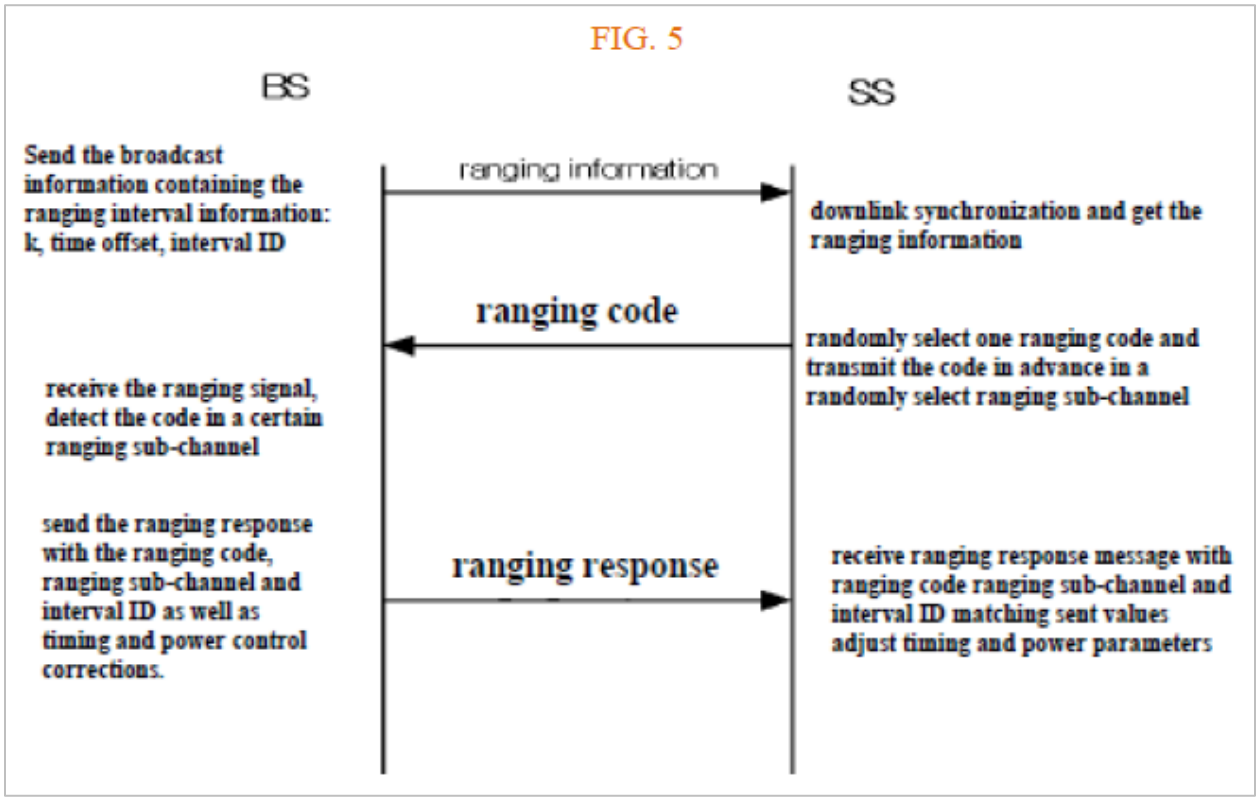
59. Like the ’366 patent, Jeong explains that “[r]anging in the OFDMA wireless communication system … periodically adjusts an accurate time offset

between the base station and the subscriber station, and performs a power correction process." EX1008, 0003; *cf.* EX1001, 1:28-32. Jeong mentions "three types" of ranging, including "Initial," "Bandwidth Request," and "Maintenance," but focuses on initial ranging. EX1008, 0003-05.

60. Jeong explains that "initial ranging is performed in an initial state in which transmission power and time offset are not adjusted between the base station and the subscriber station." EX1008, 0004. "It enables the transmission of the SS with a predetermined power required in the OFDMA wireless communication system in a state being synchronized with symbol marking the start of the burst boundary." EX1008, 0004. Jeong describes a "procedure for performing such initial ranging … with reference to FIG. 5," EX1008, 0004, FIG. 5; *see also* EX1008, 0009 (describing exchange between BS and SS during initial ranging).

61. As shown in Figure 5 below, the BS first "transmits system information necessary for initial ranging such as time offset, interval ID, and the like to the [SS]." EX1008, 0004. The SS then "randomly selects one ranging code with reference to the information for the initial ranging and transmits it to the base station." EX1008, 0004; *see also* EX1008, 0004 ("each user randomly selects one code from the binary code bank set as the ranging code, and transmits it through ranging sub-channel which is also randomly selected."). "When the [BS] detects a signal transmitted from the [SS], the [BS] transmits time control information and

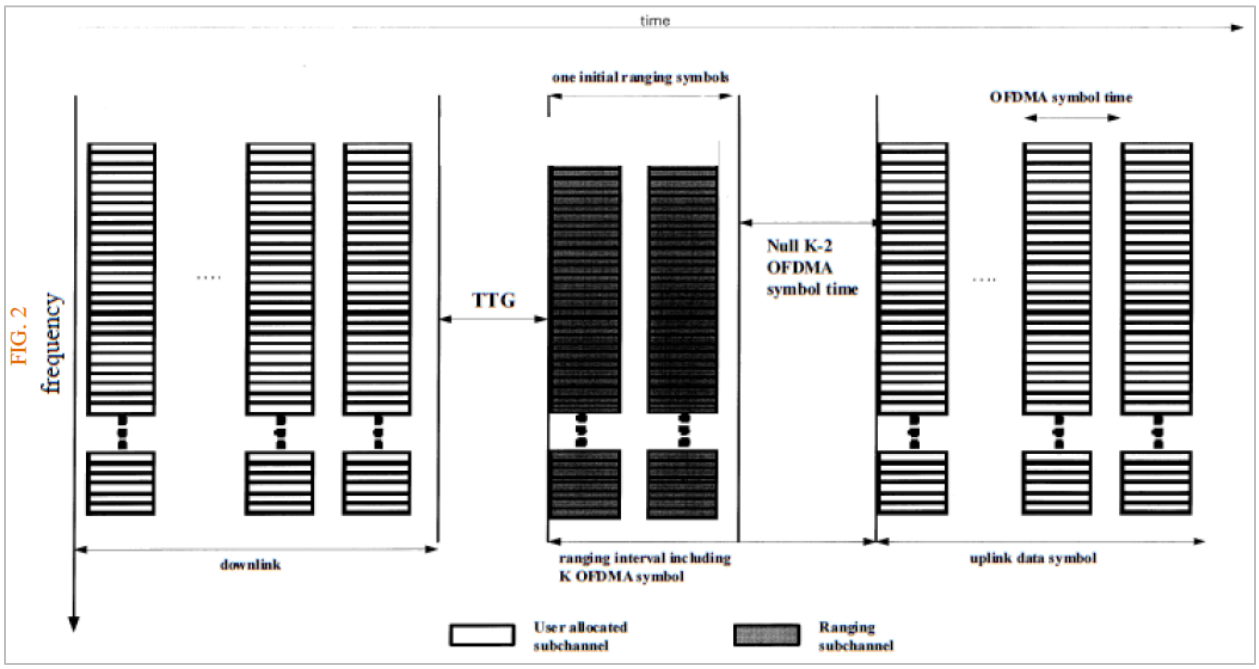
power control information to the [SS] using a code randomly selected." EX1008, 0004. Upon receiving the "ranging response," the SS "performs time adjustment and power control with reference to the time control information and power control information." EX1008, 0004.



EX1008, FIG. 5.

62. Jeong explains that there were different "channel structure[s]" in which the system can operate, including "the [frequency-division duplex (FDD)] mode" of Figure 1 and "the [time-division duplex (TDD)] mode" of Figure 2. EX1008, 0004. As shown, in the TDD mode, "a ranging signal section … and a signal section for data transmission are temporally separated," and the frequency

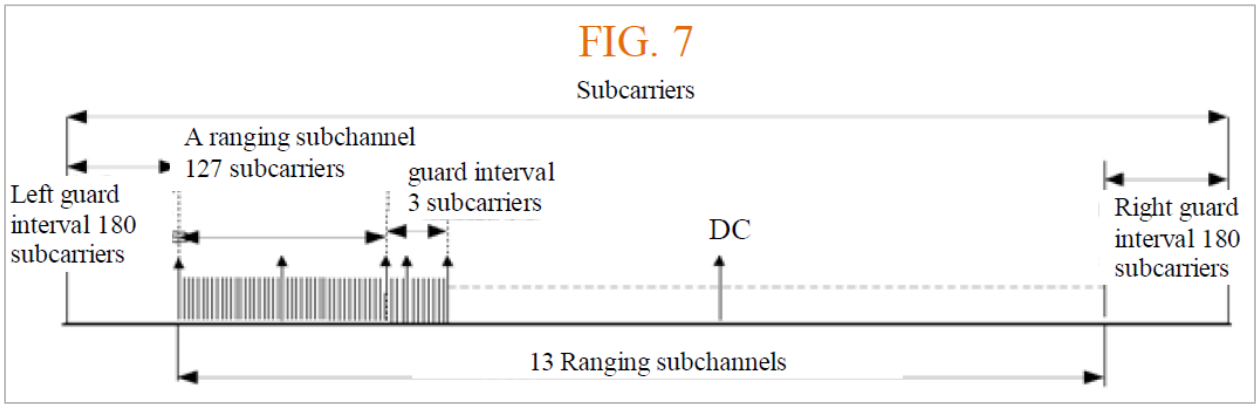
band is divided into ranging subchannels during the ranging-signal section and into data (or user allocated) subchannels during data transmission. EX1008, 0004. Jeong focuses on the TDD mode of operation. EX1008, 0004, 0008.



EX1008, FIG. 2.

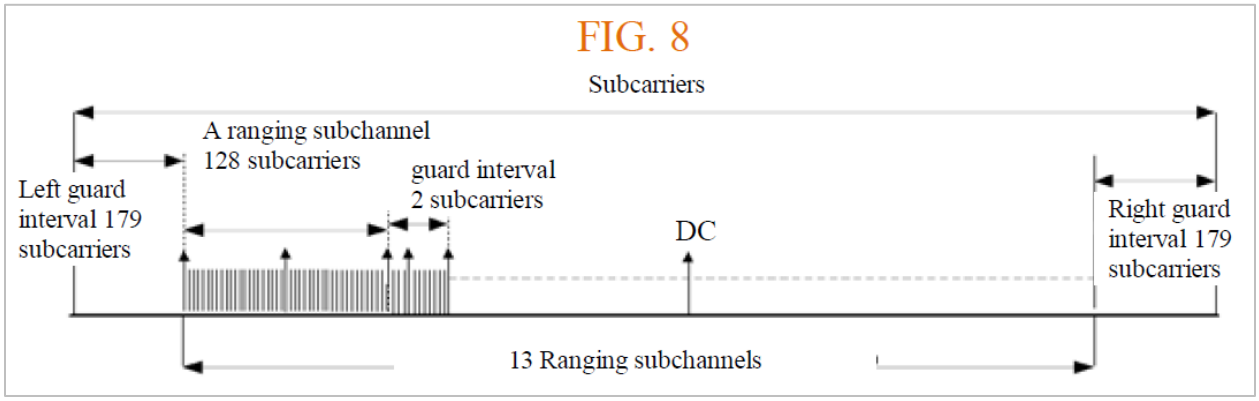
63. Jeong discloses ranging sub-channel allocation methods for an OFDMA wireless communication system in which (1) guard bands (or guard carriers) are provided between adjacent ranging sub-channels and (2) ranging sequences are used that provide low peak-to-average power ratio. EX1008, 0008-09, FIGS. 7-8. Figure 7 of Jeong (below) illustrates a "2K mode with 180 guard intervals on the left and right sides of the ranging sub-channel structure." EX1008, 0008. This "ranging sub-channel allocation method" produces 13 ranging sub-channels each of which "consist[s] of 128 or 127 adjacent carriers" with "a guard

interval" of two or three carriers "between adjacent ranging sub-channels." EX1008, 0008-09. "The ranging code used here is a [G]old code" where "63 gold codes" are produced using a "[G]old sequence generator." EX1008, 0008. Jeong explains that the Gold codes provide "a low PAR." EX1008, 0009.



EX1008, FIG. 7.

64. Figure 8 of Jeong (below) illustrates another sub-channel allocation method in which, "as the ranging code, in addition to the Gold code, a Golay Complementary Sequence ('GCS') or an M sequence may be used." EX1008, 0009. The "ranging sub-channel allocation method" shown in Figure 8 produces 13 ranging sub-channels, each having 128 subcarriers, that are separated by guard intervals of two subcarriers. EX1008, 0009. A POSA would have understood that, when modulated via OFDM, GCS sequences, for example, exhibit low PAPR. *See e.g.*, EX1013, 2:26-31.



EX1008, FIG. 8.

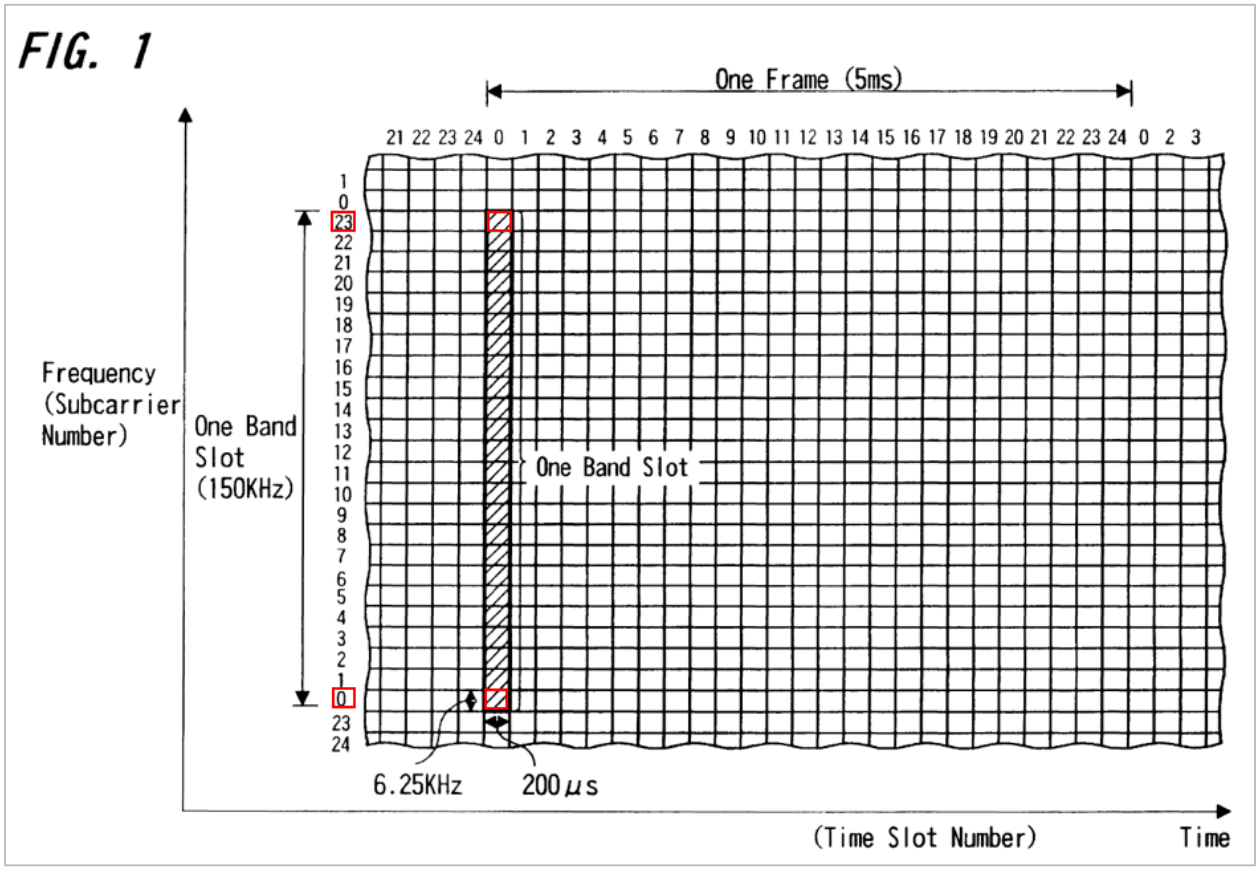
65. Jeong further discloses procedures for BS and SS operation during ranging. EX1008, 0009-10, FIGS. 10-12. Specifically, Figures 10-11 show a "procedure related to the BS ranging" and Figure 12 shows "operation of the SS according to the transmission and reception operation of the BS of FIGS. 10 and 11." EX1008, 0009-10.

B. Suzuki

66. Suzuki describes an OFDM-based "mobile communication" system, "such as a wireless telephone system or the like," that employs OFDMA. EX1009, 1:5-30 (describing OFDM), 2:57-3:30 (same), 3:31-4:34 (describing OFDMA), FIGS. 1-3. Suzuki describes the "wireless telephone system" as "a cellular system in which a base station is arranged in a predetermined condition to form a service area and communicate with a portable station (terminal device)," EX1009, 2:57-61, which was conventional by March 2004. Suzuki explains that a plurality of portable or mobile stations may communicate with a given base station in a given

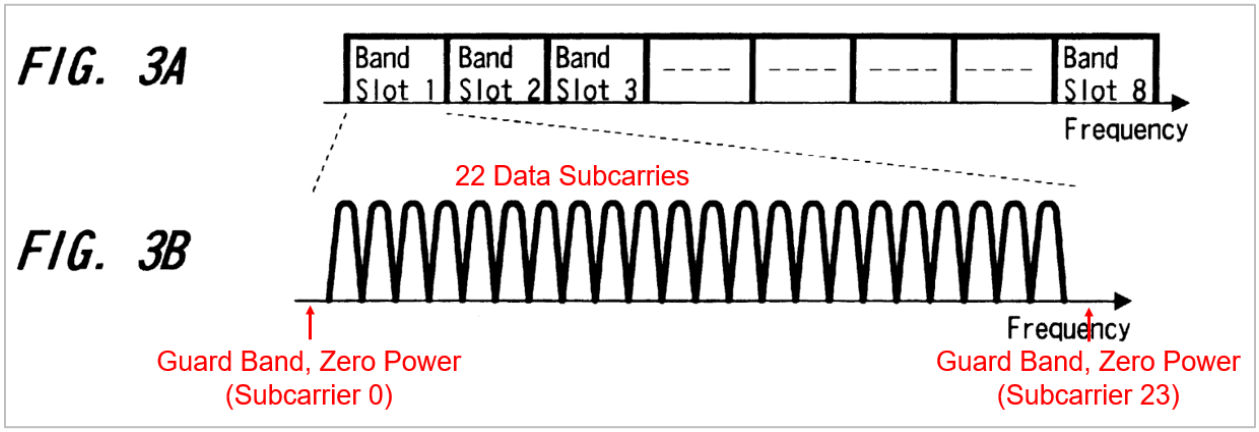
cell of the cellular system. EX1009, 3:31-4:21, FIGS. 2A-2G (describing and illustrating six portable stations communicating with a base station via OFDMA and TDMA). A POSA would have understood and found obvious that Suzuki's cellular system has a plurality of cells forming the system, and that each cell has a base station. *See* EX1009, 4:22-26 ("the cellular system where one cell is comprised of one base station"); *see also* EX1010, 0459 ("In cellular communication systems, the service area is divided into cells, each covered by a single base station.").

67. Figure 1 of Suzuki (below) shows an OFDM communication method. EX1009, 2:18-21, 2:64-3:30. Specifically, Figure 1 shows a grid having "a plurality of [OFDM] subcarriers [] successively arranged within a preallocated [frequency] band," where the grid's "vertical axis represents frequency" and "horizontal axis represents time." EX1009, 2:64-3:9. Suzuki discloses "one transmission band" or "band slot" as having "twenty-four subcarriers," such as subcarriers numbered 0 to 23 in Figure 1. EX1009, 3:5-16. Suzuki explains that only 22 of the subcarriers are available to carry information because "the subcarrier numbers 0 and 23 at both ends within one band slot," shown in red below, "are made guard bands in which no subcarrier is arranged and their powers are made zero." EX1009, 3:16-20; *see also id.*, 4:35-40 ("twenty-two subcarriers are arranged … for data transmission").



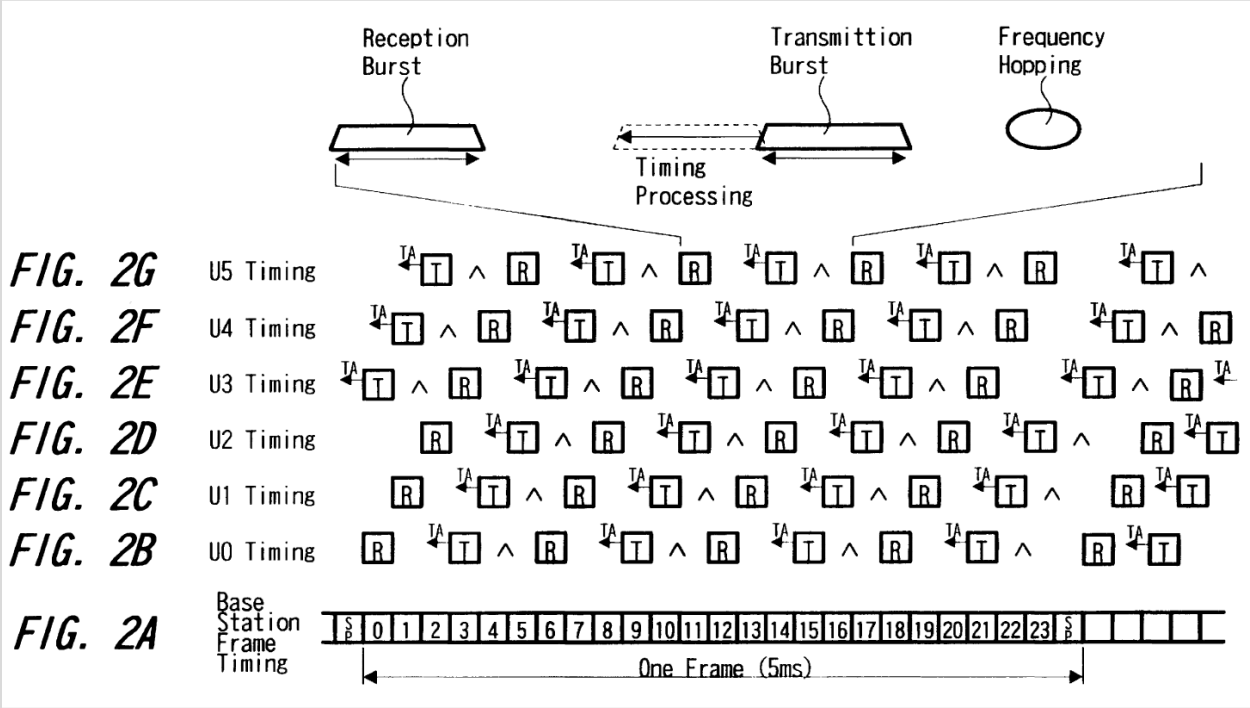
EX1009, FIG. 1 (annotated).

68. Figures 3A-3B of Suzuki (below) show another view of the 22 data subcarriers in a band slot, here with frequency plotted on the horizontal axis. EX1009, 4:35-57. The figure below has been modified to show Suzuki's zero-power subcarriers at both ends of the band slot. EX1009, 3:13-20.



EX1009, FIGS. 3A-3B (annotated).

69. Suzuki also discloses OFDMA "in which the cell station communicates simultaneously with a plurality of portable stations," which Suzuki illustrates in Figures 2A-2G (below). EX1009, 3:30-4:34. As shown, six portable stations simultaneously communicate with a base station in a given cell by assigning band slots (frequency) and time slots to each of the portable stations using a combination of OFDMA and TDMA techniques. EX1009, 3:30-4:34.



EX1009, FIGS. 2A-2G.

C. Motivation to Combine

70. It would have been obvious to a POSA to use zero-power subcarriers at both ends of a group of subcarriers, as disclosed by Suzuki, in the guard intervals of the ranging sub-channel allocation methods disclosed by Jeong in order to reduce or prevent interference between ranging sub-channels. In the methods of Figures 7 and 8, for example, Jeong discloses guard intervals/subcarriers at both ends of the frequency band as well as guard intervals/subcarriers "between adjacent ranging sub-channels." EX1008, 0008-09. Jeong explains that such guard subcarriers "prevent interference caused by using all carriers of a predetermined interval as ranging sub-channels as in the channel structure." EX1008, 0008.

Jeong, however, does not describe the details of the guard subcarriers, which would have led a POSA to Suzuki's zero-power subcarriers.

71. A POSA would have been both motivated to make this combination and had a reasonable expectation of success in doing so because the combination requires no more than the predictable use of Suzuki's prior-art, zero-power subcarriers according to their established functions for Jeong's guard subcarriers. Indeed, inserting guard bands between frequency bands was a well-known technique used to reduce signal interference in wireless communication systems by March 2004, and setting the guard-band subcarriers to zero power, as disclosed by Suzuki, would provide well-defined boundaries between blocks of subcarriers of Jeong's ranging sub-channels. As I explained in above, signal interference, including adjacent channel interference, was a well-known problem, and using guard bands in the frequency domain was a well-known technique to address adjacent channel interference. Section VII.E. Accordingly, the Jeong-Suzuki combination is nothing more than the combination of well-known, prior-art elements (e.g., zero-power subcarriers) according to their established functions, yielding predictable results (e.g., zero-power guard bands that reduce signal interference).

D. Independent Claim 1

72. In my opinion, the combination of Jeong and Suzuki teaches, suggests, or renders obvious each and every element of independent claim 1, and a POSA would have been motivated to combine the references and had a reasonable expectation of success in doing so. Claim 1 is reproduced below.

> **[1.P]** In a multi-cell orthogonal frequency division multiple access (OFDMA) wireless communication system comprising a plurality of base stations and mobile stations, a mobile station configured to communicate with a serving base station in a cell via a communication channel, the mobile station comprising:
> **[1.1]** an apparatus configured to transmit a data signal to the serving base station in the cell over a data subchannel, wherein the data subchannel comprises a plurality of adjacent or non-adjacent subcarriers within the communication channel; and
> **[1.2]** an apparatus configured to transmit a ranging signal to the serving base station in the cell over a ranging subchannel for random access, wherein:
> **[1.3]** the ranging signal is formed from a ranging sequence selected from a set of ranging sequences associated with the cell for identifying the mobile station;
> **[1.4]** the ranging signal lasts over a period of one or multiple orthogonal frequency division multiplexing (OFDM) symbols and the ranging signal exhibits a low peak-to-average power ratio in the time domain; and
> **[1.5]** the ranging subchannel comprises at least one block of

subcarriers within the communication channel and power levels of subcarriers at both ends of a block are set to zero.

1. Claim 1's Preamble

[1.P] *In a multi-cell orthogonal frequency division multiple access (OFDMA) wireless communication system comprising a plurality of base stations and mobile stations, a mobile station configured to communicate with a serving base station in a cell via a communication channel, the mobile station comprising:*

73. The combination of Jeong and Suzuki renders obvious Claim 1's preamble. Jeong discloses an "OFDMA wireless communication system." EX1008, 0003-05, 0008-09. Jeong explains that "data can be transmitted between a base station ('BS') and a subscriber station ('SS')." EX1008, 0003; *see also* EX1008, FIGS. 5, 10-12. Jeong discloses "a cell" and "performing a cell plan," EX1008, 0004, 0007, which would have informed a POSA that Jeong discloses a cellular system. By 2004 it was well-known and obvious for cellular systems to include more than one cell, and thus a POSA would have understood and found obvious that Jeong's system is a "*multi-cell*" system. *See* EX1010, 0459 ("In cellular communication systems, the service area is divided into cells, each covered by a single base station.").

74. Jeong discloses that a cell has a base station. *See e.g.*, EX1008, 0007 ("for a given cell, the BS may know its own cell radius after performing a cell

plan"). A POSA would have understood and found obvious that Jeong's system has "*a plurality of base stations*," at least one BS per cell. *See* EX1010, 0459 ("In cellular communication systems, the service area is divided into cells, each covered by a single base station.").

75. Jeong discloses a plurality of subscriber stations that are "*configured to communicate with a serving base station in a cell via a communication channel*." *See, e.g.*, EX1008, 0004 (describing FIG. 5), 0011 (describing FIG. 12). Jeong, however, does not expressly disclose that the subscriber stations are "*mobile stations*."

76. Suzuki teaches this feature. Suzuki discloses an OFDM-based "***mobile*** communication" system "such as a wireless telephone system" that comprises "portable stations." EX1009, 1:12-16, 3:31-4:4, FIGS. 2A-2G (showing six portable stations) (emphasis added). Because Suzuki discloses a "***mobile***" communication system, a POSA would have understood and found obvious that Suzuki's "portable station" is a "*mobile station*" that operates with the disclosed system. It also would have been obvious for a "mobile … wireless telephone system" to have multiple cells. *See* EX1010, 0459 ("In cellular communication systems, the service area is divided into cells, each covered by a single base station."). Further, it would have been obvious use a mobile station (as disclosed by Suzuki) in Jeong's system or to modify Jeong's subscriber stations to be

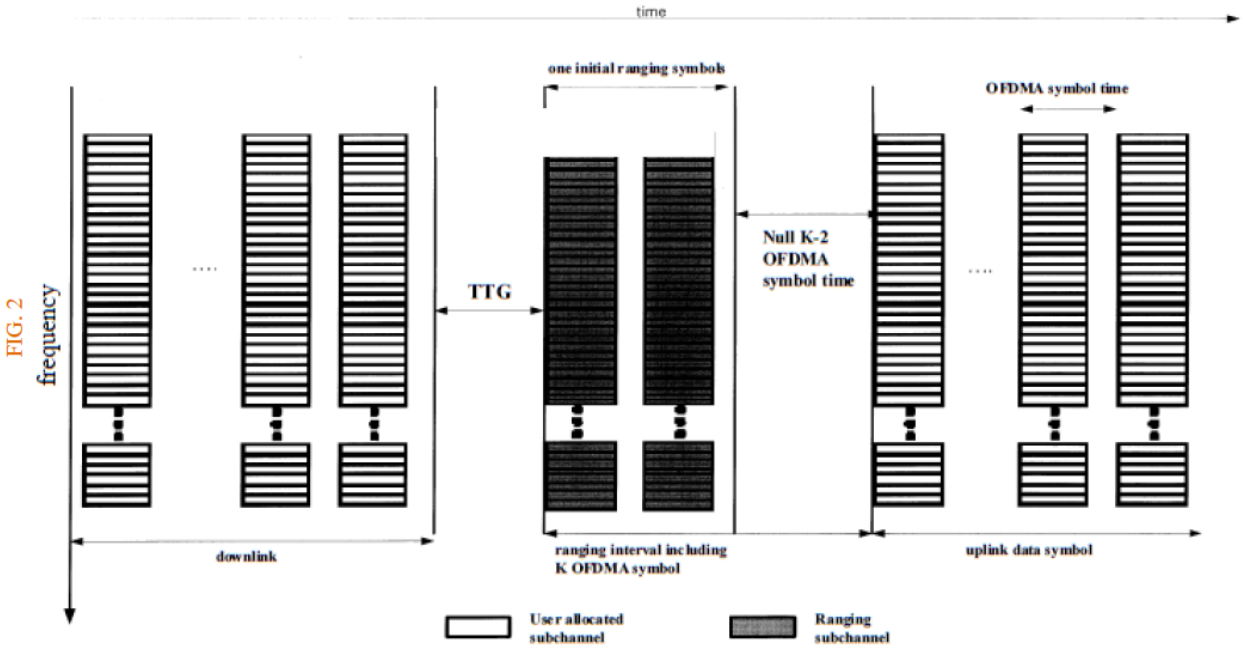
mobile, because mobile communication systems, including mobile stations, were well-known by March 2004. *See, e.g.*, EX1010, 0256, TABLE 15.1.

2. Limitation 1.1

[1.1] *an apparatus configured to transmit a data signal to the serving base station in the cell over a data subchannel, wherein the data subchannel comprises a plurality of adjacent or non-adjacent subcarriers within the communication channel;*

77. Jeong teaches or suggests Limitation 1.1. Jeong discloses a "***data sub-channel***." EX1008, 0002 (abstract), 0007 ("when the BS processes the data sub-channel"), 0008 ("data sub-channels"), 0010 ("the data sub-channel") (emphasis added). Jeong further discloses that, in the TDD mode "shown in FIG. 2, a ranging signal section … and a signal section for data transmission are temporally separated" such that "in the ***data signal transmission*** and reception section, a corresponding data transmission and reception operation can be performed." EX1008, 0004 (emphasis added). Referring to Figure 2, for example, a POSA would have understood that the "User allocated subchannel[s]" in the uplink (shown in red below) are the data sub-channels in which an SS transmits a data signal to the BS. EX1008, 0010 (describing the BS receiving "general data being transmitted from the SS"), FIG. 10 (step 1040), FIG. 11 (step 1140); *see also* EX1008, 0011 (describing "operation of the SS," including data signal

transmission in step 1240 of FIG. 12), FIG. 12 (step 1240). A POSA would have understood and found obvious that Jeong's subscriber station includes "*an apparatus*" configured to transmit signals to the base station, including the data signal. For example, a POSA would have understood that Jeong's subscriber station would include hardware and/or software for transmitting and receiving signals, such as the various signals described in Jeong. *See* EX1008, FIGS. 10-12.



EX1008, FIG. 2.

78. Jeong discloses that a sub-channel is a group of subcarriers. *See, e.g.*, EX1008, 0003 ("each OFDMA symbol is carried on a subcarrier and bundled into a predetermined sub-channel"), 0004 (describing "'sub-channels' composed of 53 carriers"), 0008 (describing an "OFDMA wireless communication system having a capacity of 1696 carriers," which is "is divided into 32 basic data sub-channels …

and each of the basic sub-channels is composed of 53 carriers"). As shown in Figure 2, the TDD mode includes "User allocated subchannel[s]" in the "uplink" that carry data signals from the SSs. EX1008, 0004, FIG. 2. Each "user allocated subchannel" includes a group or block of subcarriers in the frequency domain (e.g., 53 carriers), and thus a POSA would have understood that Jeong's data sub-channel "*comprises a plurality of adjacent or non-adjacent subcarriers within the communication channel*." For example, Figure 2 of Jeong shows user-allocated sub-channels as blocks/groups of adjacent subcarriers. EX1008, FIG. 2.

3. Limitation 1.2

[1.2] *an apparatus configured to transmit a ranging signal to the serving base station in the cell over a ranging subchannel for random access;*

79. Jeong teaches or suggests Limitation 1.2. Jeong discloses that "[a]fter acquiring information being broadcasted by the BS to obtain information necessary for ***initial ranging***, the SS ***transmits a ranging signal to the BS using a ranging sub-channel*** and a ranging code randomly selected in a ranging interval section." EX1008, 0010 (emphasis added); *see also* EX1008, 0004 ("the subscriber station randomly selects one ranging code with reference to the information for the initial ranging and transmits it to the base station"; "each user randomly selects one code from the binary code bank set as the ranging code, and transmits it through ranging sub-channel which is also randomly selected"), FIG. 2 (showing ranging sub-

channels in the uplink). A POSA would have understood and found obvious that Jeong's subscriber station includes "*an apparatus*" configured to transmit signals to the base station, including the ranging signal. For example, a POSA would have understood that Jeong's subscriber station would include hardware and/or software for transmitting and receiving signals, such as the various signals described in Jeong. *See* EX1008, FIGS. 10-12.

80. Referring to Figure 12, which illustrates the transmission/reception operation of a subscriber station, Jeong discloses that "[w]hen system information for initial ranging is received in step 1260, the process proceeds to step 1270, and the SS transmits the ***ranging signal*** … by randomly selecting ***a ranging sub-channel and code to be used in a ranging code set*** and a ranging sub-channel set with a channel structure for the ranging signal so that the ranging signal can be detected in the BS ranging interval reception interval." EX1008, 0011, FIG. 12 (steps 1260-1270) (emphasis added).

4. Limitation 1.3

[1.3] *wherein: the ranging signal is formed from a ranging sequence selected from a set of ranging sequences associated with the cell for identifying the mobile station;*

81. Jeong teaches or suggests Limitation 1.3. Jeong discloses that "***the SS*** transmits the ***ranging signal, on which the IFFT has been performed*** … by

randomly selecting a ranging sub-channel and ***code*** to be used in ***a ranging code set*** and a ranging sub-channel set with a channel structure for the ranging signal so that the ranging signal can be detected in the BS ranging interval reception interval." EX1008, 0011, FIG. 12 (emphasis added). A POSA would have been familiar with IFFT, which stands for inverse fast Fourier transform, and would have known that IFFT transforms a signal in the frequency domain to the time domain. *See, e.g.*, EX1009, 5:14-22; EX1010, 0309 ("A key advantage of using OFDM is that the modulation can be achieved in the discrete domain by using either an inverse discrete Fourier transform (IDFT) or the more computationally efficient inverse fast Fourier transform (IFFT)."); EX1012, 0107. A POSA would have also understood that Jeong's ranging signal is "*formed*" by performing an IFFT on the ranging code that Jeong's subscriber station selects from the ranging code set.

82. Jeong also discloses that a ranging code is a "*ranging sequence*," such as a "[G]old code" generated using a "[G]old ***sequence*** generator." EX1008, 0009 (emphasis added) (further disclosing "Golay Complementary ***Sequence***"). Accordingly, Jeong's "*ranging signal is formed from a ranging sequence selected from a set of ranging sequences*."

83. Jeong discloses that "the BS sets a ranging interval section in consideration of the cell radius, ***determines*** the initial ranging sub-channel

allocation method and ***the ranging code, and broadcasts it within its own cell***." EX1008, 0010 (emphasis added); *see also* EX1008, 0004 (disclosing that the BS first "transmits system ***information necessary for initial ranging*** such as time offset, interval ID, and the like to the [SS]"; the SS then "randomly selects one ranging code ***with reference to the information for the initial ranging*** and transmits it to the [BS]." (emphasis added)), 0011 (claim 2). Because each cell has a base station (which determines the ranging codes), a POSA would have understood and found obvious that Jeong's ranging codes are "*associated with the cell*" in which the base station resides and serves.

84. A POSA would have further understood and found obvious that the ranging code is "*for identifying the mobile station*." Jeong discloses that, in the "ranging response," the base station transmits to the subscriber station the ranging code originally sent by the subscriber station. EX1008, FIG. 5 ("detect ***the code***"; "send the ranging response with ***the ranging code***" (emphasis added)). A POSA would have understood and found obvious that the base station includes the original ranging code in the ranging response to direct the ranging response to the subscriber station that sent the particular ranging code, and thus the ranging code is "*for identifying the mobile station*." In other words, the original ranging code is used by the base station as an identifier to direct the ranging response message to the appropriate subscriber station.

5. Limitation 1.4

[1.4] *wherein … the ranging signal lasts over a period of one or multiple orthogonal frequency division multiplexing (OFDM) symbols and the ranging signal exhibits a low peak-to-average power ratio in the time domain;*

85. Jeong teaches or suggests Limitation 1.4. Jeong discloses that "the initial ranging uses a long ranging method in which an SS within the area of the BS is transmitted ***in two OFDM symbols*** when a new call is established with the BS." EX1008, 0004 (emphasis added); *see also* EX1008, 0013 (claim 13). Jeong discloses ranging sub-channel allocation methods for an OFDMA wireless communication system that uses ranging sequences, such as Gold codes and Golay Complementary Sequences, that, when modulated via OFDM, exhibit low PAPR in the time domain. EX1008, 0008-09, FIGS. 7-8. For example, referring to the ranging sub-channel allocation method associated with Figure 7, Jeong discloses that "[t]he ranging code used here is a [G]old code," and a "[G]old sequence generator … generates 63 gold codes" that provide "***a low PAR***." EX1008, 0009 (emphasis added). As another example, referring to the ranging sub-channel allocation method associated with Figure 8, Jeong discloses using, as ranging codes, "Golay Complementary Sequence ('GCS'), EX1008, 0009, which, when modulated via OFDM, were known to exhibit low PAPR in the time domain. *See*

Section VII.D; *see also* EX1013, 2:26-31 ("There are several recent works searching for families of waveforms with low PAPR. One set of waveforms is based on Golay's complementary sequences, which have the property that their Fourier transform has a PAPR of at most 2, which is equivalent to 3 dB. Van Nee has shown [1] how to use sets of complementary sequences in conjunction with OFDM modulation for conveying information with low PAPR waveforms.").

6. Limitation 1.5

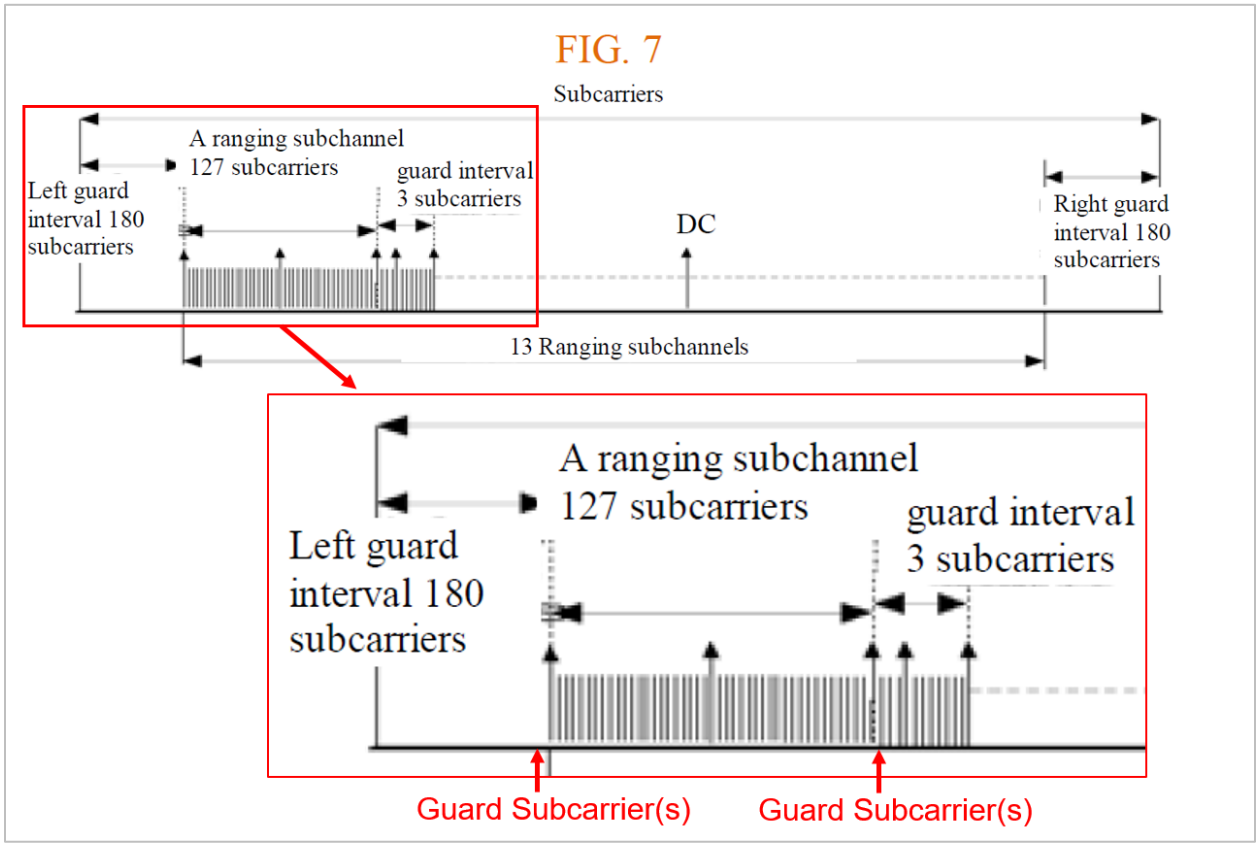
[1.5] *wherein … the ranging subchannel comprises at least one block of subcarriers within the communication channel and power levels of subcarriers at both ends of a block are set to zero.*

86. The combination of Jeong and Suzuki renders obvious Limitation 1.5. I note that the '366 patent does not define a "*block of subcarriers*" but Limitation 1.5 recites that the "*block*" is "*of subcarriers*," i.e., has plural subcarriers.

87. Jeong teaches or suggests that "*the ranging subchannel comprises at least one block of subcarriers within the communication channel*." For example, Jeong discloses "a ranging sub-channel consisting of 128 or 127 adjacent carriers." EX1008, 0008, FIG. 7; *see also* EX1008, 0009 (referring to Figure 8, disclosing that the "ranging sub-channel is 128 in length"). Jeong further discloses that, in the embodiment of Figure 7, guard intervals of 180 subcarriers on the left and right most portions of the frequency band, and "guard interval[s] between the [13]

ranging sub-channels provides 2 subcarriers for a length of 128 ranging sub-channel and 3 subcarriers for a length of 127." EX1008, 0008, FIGS. 7-8.

88. The figure below, for example, shows the left most ranging sub-channel of Figure 7 of Jeong. As shown, the highlighted ranging sub-channel has 127 subcarriers used for signal transmission and is bounded, at both ends, by guard subcarriers. EX1008, 0008, FIG. 7. A POSA would have understood and found obvious that Jeong's 127 subcarrier ranging sub-channel is a "*block of subcarriers*." Alternatively, to the extent "*block of subcarriers*" is interpreted to include the guard subcarriers at both ends, Jeong's 127 subcarrier ranging sub-channel plus one or more guard subcarriers on each end is a "*block of subcarriers*."



EX1008, FIG. 7 (annotated).

89. The Jeong-Suzuki combination renders obvious that "*power levels of subcarriers at both ends of a block are set to zero*." In the methods of Figures 7 and 8, for example, Jeong discloses guard subcarriers at both ends of the frequency band as well as guard subcarriers "between adjacent ranging sub-channels." EX1008, 0008-09. Jeong explains that such guard subcarriers "prevent interference caused by using all carriers of a predetermined interval as ranging sub-channels as in the channel structure." EX1008, 0008. Jeong, however, does not describe the

details of the guard subcarriers, which would have led a POSA to Suzuki's zero-power subcarriers.

90. Suzuki discloses "one transmission band" or "band slot" as having "twenty-four subcarriers," such as subcarriers numbered 0 to 23 in Figure 1. EX1009, 3:5-16. Suzuki explains that only 22 of the subcarriers are available to carry information because "the subcarrier numbers 0 and 23 at both ends within one band slot, they are made guard bands in which no subcarrier is arranged and their powers are made zero." EX1009, 3:16-20. It would have been obvious to a POSA to use zero-power subcarriers at both ends of a group of subcarriers, as disclosed by Suzuki, in the guard intervals of the ranging sub-channel allocation methods disclosed by Jeong in order to reduce or prevent interference between ranging sub-channels, as explained above. *See* Sections VII.C, VII.E.

E. Independent Claims 9, 17, and 22

91. In my opinion, the combination of Jeong and Suzuki teaches, suggests, or renders obvious each and every element of independents claim 9, 17, and 22, and a POSA would have been motivated to combine the references and had a reasonable expectation of success in doing so. Claims 9, 17, and 22 are reproduced below.

> **[9.P]** In a multi-cell orthogonal frequency division multiple access (OFDMA) wireless communication system, a base station configured

to communicate with mobile stations in a cell via a communication channel, the base station comprising:

[9.1] an apparatus configured to receive a data signal from a first mobile station in the cell over a data subchannel, wherein the data subchannel comprises a plurality of adjacent or non-adjacent subcarriers within the communication channel; and

[9.2] an apparatus configured to receive a ranging signal from a second mobile station in the cell over a ranging subchannel for random access, wherein:

[9.3] the ranging signal is formed from a ranging sequence selected from a set of ranging sequences associated with the cell for identifying a mobile station;

[9.4] the ranging signal lasts over a period of one or multiple orthogonal frequency division multiplexing (OFDM) symbols and the ranging signal exhibits a low peak-to-average power ratio in the time domain; and

[9.5] the ranging subchannel comprises at least one block of subcarriers within the communication channel and power levels of subcarriers at both ends of a block are set to zero.

[17.P] In an orthogonal frequency division multiple access (OFDMA) wireless communication system, a method for signal transmission by a mobile station to a serving base station via a communication channel, the method comprising:

[17.1] transmitting a data signal over a data subchannel to the serving base station, wherein the data subchannel comprises a plurality of

adjacent or non-adjacent subcarriers within the communication channel; and

[17.2] transmitting a ranging signal over a ranging subchannel to the serving base station for random access, wherein:

[17.3] the ranging signal is formed from a ranging sequence selected from a set of ranging sequences for identifying the mobile station;

[17.4] the ranging signal lasts over a period of one or multiple orthogonal frequency division multiplexing (OFDM) symbols and the ranging signal exhibits a low peak-to-average power ratio in the time domain; and

[17.5] the ranging subchannel comprises at least one block of subcarriers within the communication channel and power levels of subcarriers at both ends of a block are set to zero.

[22.P] In an orthogonal frequency division multiple access (OFDMA) wireless communication system, a method for receiving signals by a base station from a plurality of mobile stations via a communication channel, the method comprising:

[22.1] receiving a data signal over a data subchannel from a first mobile station, wherein the data subchannel comprises a plurality of adjacent or non-adjacent subcarriers within the communication channel; and

[22.2] receiving a ranging signal over a ranging subchannel for random access by a second mobile station, wherein:

[22.3] the ranging signal is formed from a ranging sequence selected from a set of ranging sequences for identifying the mobile station;

[22.4] the ranging signal lasts over a period of one or multiple orthogonal frequency division multiplexing (OFDM) symbols and the ranging signal exhibits a low peak-to-average power ratio in the time domain; and

[22.5] the ranging subchannel comprises at least one block of subcarriers within the communication channel and power levels of subcarriers at both ends of a block are set to zero.

92. Independent claim 17 is a method corresponding to and reciting nearly identical limitations as the mobile station recited in claim 1, as shown in the chart below.

[1.P] In a multi-cell orthogonal frequency division multiple access (OFDMA) wireless communication system comprising a plurality of base stations and mobile stations, a mobile station configured to communicate with a serving base station in a cell via a communication channel, the mobile station comprising:	**[17.P]** In an orthogonal frequency division multiple access (OFDMA) wireless communication system, a method for signal transmission by a mobile station to a serving base station via a communication channel, the method comprising:
[1.1] an apparatus configured to transmit a data signal to the serving base station in the cell over a data subchannel, wherein the data subchannel comprises a plurality of adjacent or non-adjacent	**[17.1]** transmitting a data signal over a data subchannel to the serving base station, wherein the data subchannel comprises a plurality of adjacent or non-adjacent subcarriers within the

subcarriers within the communication channel; and	communication channel; and
[1.2] an apparatus configured to transmit a ranging signal to the serving base station in the cell over a ranging subchannel for random access, wherein:	**[17.2]** transmitting a ranging signal over a ranging subchannel to the serving base station for random access, wherein:
[1.3] the ranging signal is formed from a ranging sequence selected from a set of ranging sequences associated with the cell for identifying the mobile station;	**[17.3]** the ranging signal is formed from a ranging sequence selected from a set of ranging sequences for identifying the mobile station;
[1.4] the ranging signal lasts over a period of one or multiple orthogonal frequency division multiplexing (OFDM) symbols and the ranging signal exhibits a low peak-to-average power ratio in the time domain; and	**[17.4]** the ranging signal lasts over a period of one or multiple orthogonal frequency division multiplexing (OFDM) symbols and the ranging signal exhibits a low peak-to-average power ratio in the time domain; and
[1.5] the ranging subchannel comprises at least one block of subcarriers within the communication channel and power levels of subcarriers at both ends of a block are set to zero.	**[17.5]** the ranging subchannel comprises at least one block of subcarriers within the communication channel and power levels of subcarriers at both ends of a block are set to zero.

93. Claim 17 is thus obvious over the Jeong-Suzuki combination for the same reasons as claim 1, as shown in the chart below.

[17.P] In an orthogonal frequency	*See* Section VIII.D.1.

division multiple access (OFDMA) wireless communication system, a method for signal transmission by a mobile station to a serving base station via a communication channel, the method comprising:	
[17.1] transmitting a data signal over a data subchannel to the serving base station, wherein the data subchannel comprises a plurality of adjacent or non-adjacent subcarriers within the communication channel; and	*See* Section VIII.D.2.
[17.2] transmitting a ranging signal over a ranging subchannel to the serving base station for random access, wherein:	*See* Section VIII.D.3.
[17.3] the ranging signal is formed from a ranging sequence selected from a set of ranging sequences for identifying the mobile station;	*See* Section VIII.D.4.
[17.4] the ranging signal lasts over a period of one or multiple orthogonal frequency division multiplexing (OFDM) symbols and the ranging signal exhibits a low peak-to-average power ratio in the time domain; and	*See* Section VIII.D.5.
[17.5] the ranging subchannel comprises	*See* Section VIII.D.6.

at least one block of subcarriers within the communication channel and power levels of subcarriers at both ends of a block are set to zero.	

94. Independent claims 9 and 22 are directed to a base station and a method, respectively, for receiving (from a mobile station) data and ranging signals that are similar to those recited in independent claim 1. The chart below, for example, shows a side-by-side comparison between claims 1 and 9. That is, claims 9 and 22 are directed to a base station and method corresponding to the mobile station and method recited in claims 1 and 17, respectively. The base station and method of claims 9 and 17, however, require receiving the "*data signal from a **first** mobile station*" while receipt of the "*ranging signal [is] from a **second** mobile station*." EX1001, 7:60-67, 9:17-22 (Limitations 9.1/22.1 and 9.2/22.2) (emphasis added).

[1.P] In a multi-cell orthogonal frequency division multiple access (OFDMA) wireless communication system comprising a plurality of base stations and mobile stations, a mobile station configured to communicate with a serving base station in a cell via a	**[9.P]** In a multi-cell orthogonal frequency division multiple access (OFDMA) wireless communication system, a base station configured to communicate with mobile stations in a cell via a communication channel, the base station comprising:

communication channel, the mobile station comprising:	
[1.1] an apparatus configured to transmit a data signal to the serving base station in the cell over a data subchannel, wherein the data subchannel comprises a plurality of adjacent or non-adjacent subcarriers within the communication channel; and	**[9.1]** an apparatus configured to receive a data signal from a first mobile station in the cell over a data subchannel, wherein the data subchannel comprises a plurality of adjacent or non-adjacent subcarriers within the communication channel; and
[1.2] an apparatus configured to transmit a ranging signal to the serving base station in the cell over a ranging subchannel for random access, wherein:	**[9.2]** an apparatus configured to receive a ranging signal from a second mobile station in the cell over a ranging subchannel for random access, wherein:
[1.3] the ranging signal is formed from a ranging sequence selected from a set of ranging sequences associated with the cell for identifying the mobile station;	**[9.3]** the ranging signal is formed from a ranging sequence selected from a set of ranging sequences associated with the cell for identifying a mobile station;
[1.4] the ranging signal lasts over a period of one or multiple orthogonal frequency division multiplexing (OFDM) symbols and the ranging signal exhibits a low peak-to-average power ratio in the time domain; and	**[9.4]** the ranging signal lasts over a period of one or multiple orthogonal frequency division multiplexing (OFDM) symbols and the ranging signal exhibits a low peak-to-average power ratio in the time domain; and
[1.5] the ranging subchannel comprises at least one block of subcarriers within the communication channel and power	**[9.5]** the ranging subchannel comprises at least one block of subcarriers within the communication channel and power

levels of subcarriers at both ends of a block are set to zero.	levels of subcarriers at both ends of a block are set to zero.

95. Jeong discloses a base station for receiving the data and ranging signals transmitted by a plurality of subscriber stations. EX1008, 0004-05, 0009-10, FIGS. 2, 5, 10-11. Jeong further discloses that, in the TDD mode, the base station receives ranging and data signals from subscriber stations in different time slots. EX1008, FIG. 2. A POSA would have understood and found obvious that Jeong's base station would receive a data signal from a first subscriber station (e.g., during the uplink data transmission time) and receive a ranging signal from a second, different subscriber station that was also being served by the base station (e.g., during the uplink ranging transmission time). That is, a POSA would have understood that the base station simultaneously serves a plurality of subscriber stations in the cell, and that the subscriber stations transmit ranging and data signals during the appropriate transmission times set in the TDD mode. Accordingly, it is my opinion that the Jeong-Suzuki combination renders obvious Limitations 9.1/22.1 and 9.2/22.2, as well as the preambles and other limitations of claims 9 and 22 that are nearly identical to claims 1 and 17 for at least the reasons discussed above, as shown in the chart below.

[9.P] & **[22.P]**	*See* Section VIII.D.1.

[9.1] & **[22.1]**	*See* Section VIII.D.2; *see also* EX1008, 0004-05, 0009-10, FIGS. 2, 5, 10-11.
[9.2] & **[22.2]**	*See* Section VIII.D.3; *see also* EX1008, 0004-05, 0009-10, FIGS. 2, 5, 10-11.
[9.3] & **[22.3]**	*See* Section VIII.D.4.
[9.4] & **[22.4]**	*See* Section VIII.D.5.
[9.5] & **[22.5]**	*See* Section VIII.D.6.

F. Dependent Claims 2 and 10

2. *The mobile station of claim 1, wherein the subcarrier configuration of the ranging subchannel for the cell is different from subcarrier configurations of ranging subchannels for other cells.*

10. *The base station of claim 9, wherein the subcarrier configuration of the ranging subchannel for the cell is different from subcarrier configurations of ranging subchannels for other cells.*

96. Jeong renders obvious the limitations of claims 2 and 10. Jeong discloses that "the BS sets a ranging interval section in consideration of the cell radius, ***determines the initial ranging sub-channel allocation method and the ranging code***, and broadcasts it within its own cell." EX1008, 0010 (emphasis added); *see also* EX1008, 0005-08, FIG. 4 (describing ranging in consideration of cell radius). Jeong further discloses four "initial ranging sub-channel allocation methods" that have different ranging sub-channel configurations and that use

different ranging sequences. EX1008, 0002 (abstract), 0008-09, FIGS. 6-9. For example, the allocation method shown in Figure 7 has "180 guard intervals on the left and right sides of the ranging sub-channel structure," "ranging sub-channel[s] consisting of 128 or 127 adjacent carriers," "guard interval[s] … between adjacent ranging sub-channels" of 2 or 3 subcarriers, and uses "[G]old codes." EX1008, 0008-09, FIG. 7. By contrast, the allocation method shown in Figure 8 has "179 guard intervals … provided on the left and right sides," ranging sub-channels "with a length of 128," guard intervals between adjacent ranging sub-channels of 2 subcarriers, and use GCS or M sequences. EX1008, 0009, FIG. 8.

97. Jeong's disclosures of (1) the base station determining the initial ranging sub-channel allocation method and (2) different allocation methods would have suggested and render obvious to a POSA that base stations in different cells use different sub-carrier configurations, such as the allocation method of Figure 7 in a first cell and the allocation method of Figure 8 in an adjacent, second cell. A POSA would have been motivated to do so in order to avoid interference between the adjacent cells, which was a well-known problem in cellular wireless communication systems by March 2004. In the example above, the base station in the first cell would ignore any ranging signal that does not comply with the configuration shown in Figure 7 (such as a signal configured according to the

method of Figure 8). Accordingly, the Jeong-Suzuki combination renders claims 2 and 10 obvious.

G. Dependent Claims 3 and 11

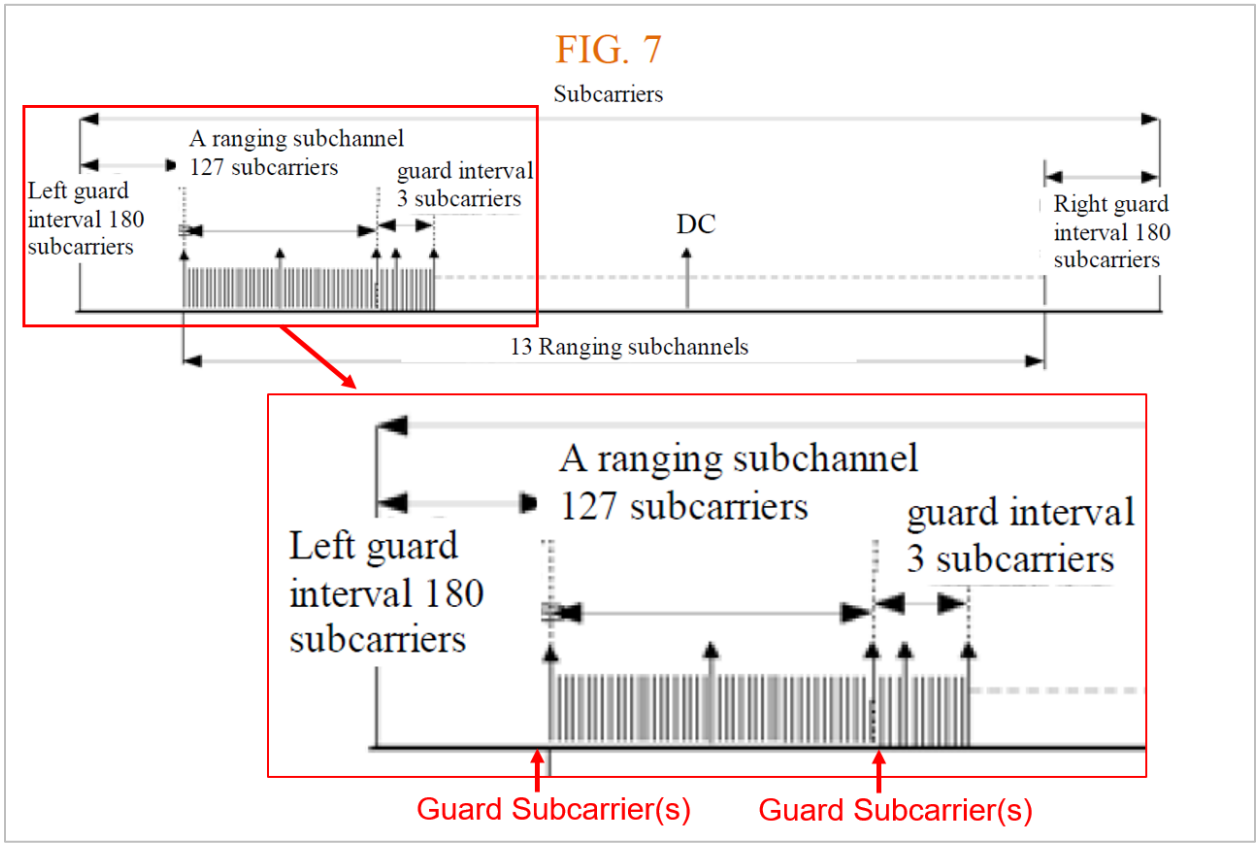
3. *The mobile station of claim 1, wherein the set of ranging sequences for the cell is different from sets of ranging sequences for other cells.*
11. *The base station of claim 9, wherein the set of ranging sequences for the cell is different from sets of ranging sequences for other cells.*

98. For reasons similar to those explained with respect to claims 2 and 10, Jeong renders obvious the limitations of claim 3 and 11. Continuing the example above, the first cell would employ Gold codes (in accordance with the allocation method shown in Figure 7 of Jeong) while the adjacent second cell would employ GCS or M sequences (in accordance with the allocation method shown in Figure 8 of Jeong). As in claims 2 and 10, a POSA would have been motivated to do so in order to avoid interference between adjacent cells, which was a well-known problem in the field of cellular wireless communication systems. *See* Section VII.E. Here, the base station in the first cell (using Gold codes) would ignore any ranging signal formed using any sequence other than a Gold code (such as the GCS or M sequence associated with the second, adjacent base station). Accordingly, the Jeong-Suzuki combination renders claims 3 and 11 obvious.

H. Dependent Claims 4 and 20

4. *The mobile station of claim 1, wherein subcarriers in a block are contiguous in frequency.*
20. *The method of claim 17, wherein subcarriers in a block are contiguous in frequency.*

99. Jeong teaches the limitations of claims 4 and 20. For example, the annotated figure below shows the leftmost ranging sub-channel in the allocation method of Figure 7 of Jeong. The highlighted ranging sub-channel has 127 subcarriers used for signal transmission and is bounded, at both ends, by guard subcarriers, all of which are "*contiguous in frequency*." EX1008, 0008, FIG. 7. As additional examples, the ranging sub-channels shown in the allocation methods of Figures 6, 8, and 9 of Jeong also arrange subcarriers in a block (bounded at both ends by guard subcarriers) and are contiguous in frequency. EX1008, FIGS. 6, 8-9. Accordingly, the Jeong-Suzuki combination renders obvious claims 4 and 20.



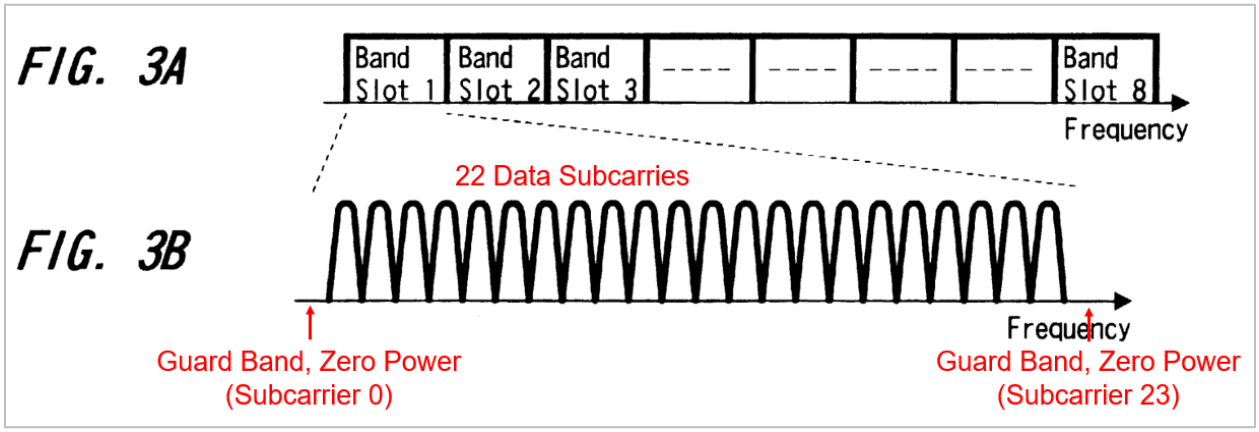
EX1008, FIG. 7 (annotated).

I. Dependent Claims 6 and 18

6. *The mobile station of claim 1, wherein a power level of subcarriers towards the high-end and low-end frequency boundaries of a block of subcarriers is lower than a power level of subcarriers towards the center of the block.*

18. *The method of claim 17, wherein a power level of subcarriers towards the high-end and low-end frequency boundaries of a block of subcarriers is lower than a power level of subcarriers towards the center of the block.*

100. The combination of Jeong and Suzuki renders obvious claims 6 and 18. Suzuki discloses that the power levels of "the subcarrier[s] … at both ends within one band slot[] … are made zero," EX1009, 3:13-20, which is illustrated below in the annotated version of Figures 3A-3B of Suzuki. As shown below, the subcarriers at both ends are "*towards the high-end and low-end frequency boundaries of a block*." Suzuki further discloses that subcarriers "*towards the center of the block*," such as the 22 data subcarriers shown in the annotated figures below, carry information. EX1009, 3:16-17. A POSA would have understood that in the combined Jeong-Suzuki system the zero-power subcarriers (those at the high- and low-end frequency boundaries) have "*lower*" power than information-carrying subcarriers "*towards the center of the block*," which are not set to zero.



EX1009, FIGS. 3A-3B (annotated).

J. Dependent Claims 7 and 19

7. *The mobile station of claim 1, wherein boundary subcarriers of a block of subcarriers in the ranging subchannel are attenuated to reduce interference with other uplink signals when signal time misalignment occurs at the base station.*

19. *The method of claim 17, wherein boundary subcarriers of a block of subcarriers in the ranging subchannel are attenuated to reduce interference with other uplink signals when signal time misalignment occurs at the base station.*

101. The combination of Jeong and Suzuki renders obvious claims 7 and 19. A POSA would have understood that Suzuki's zero-power "*boundary subcarriers of a block … are attenuated*" as compared to information-carrying subcarriers. Accordingly, a POSA would have understood that in the combined Jeong-Suzuki system, Suzuki's "*attenuated*" or zero-power boundary subcarriers applied to Jeong's ranging sub-channel would "*reduce interference with other*

uplink signals when signal time misalignment occurs at the base station." Again, using guard bands or subcarriers, including those having zero power, was a well-known technique to reduce signal interference by March 2004. *See* Section VII.C.

K. Dependent Claim 8

8. *The mobile station of claim 1, wherein the ranging sequence is a binary or non-binary sequence.*

102. Claim 8 requires that the ranging sequence is a "*binary or non-binary sequence*," which covers all sequences; that is, any sequence satisfies the limitations of claim 8. In any event, Jeong teaches or suggests the limitations of claim 8. Jeong describes a ranging code as a "***binary*** code." EX1008, 0004 (emphasis added). Jeong also discloses Gold, GCS, and M sequences, which a POSA would have known were "*binary or non-binary sequence[s]*." *See* EX1010, 0138-40 (discussing m sequences), 0143-44 (discussing Gold codes), 0170 (discussing Golay codes). Accordingly, the Jeong-Suzuki combination renders claim 8 obvious.

L. Dependent Claims 12-14

12. *The base station of claim 9, further comprising an apparatus configured to detect the ranging sequence in the received ranging signal in the time domain, frequency domain, or both time and frequency domain.*

13. *The base station of claim 12, wherein the apparatus applies matched filtering to the received ranging signal to detect the ranging sequence.*

14. *The base station of claim 12, wherein the apparatus correlates the received ranging signal with a ranging sequence stored at the base station to detect the ranging sequence.*

103. Jeong teaches or suggests the limitations of claim 12. Jeong discloses that the base station "detect[s] the [ranging] code" transmitted by the subscriber station. EX1008, FIG. 5. Jeong discloses that "the BS detects a ranging signal from the SS ***by performing FFT*** with the ranging sub-channel structure." EX1008, 0010 (emphasis added). A POSA would have been familiar with FFT, which stands for fast Fourier transform, and would have understood that FFT transforms a signal in the time domain to the frequency domain. *See* EX1010, 0134 ("fast Fourier transform"); EX1012, 0107 ("fast Fourier transforms (FFTs)"). Jeong further discloses that "the ***BS detects the ranging code*** used by the SS by multiplying the received ranging signal by each ranging code in the ranging code set." EX1008, 0010, FIG. 11 (emphasis added). A POSA would have understood that Jeong's

base station detects the ranging signal, performs FFT, and detects the ranging code in at least the frequency domain.

104. Jeong renders obvious the limitations of claims 13 and 14. Jeong discloses that "the BS detects the ranging code used by the SS by multiplying the received ranging signal by each ranging code in the ranging code set." EX1008, 0010. In light of these teachings, a POSA would have understood and found obvious that the BS applies "*matched filtering to the received ranging signal to detect the ranging sequence*" (claim 13) and "*correlates the received ranging signal with a ranging sequence stored at the base station to detect the ranging sequence*" (claim 14). Specifically, a POSA would have understood that the process Jeong discloses of multiplying the received ranging signal by each ranging code in the base station's ranging code set is describing matched filtering of claim 13, resulting in the required correlation of claim 14.

105. Accordingly, the combination of Jeong and Suzuki renders obvious claims 12-14.

M. Dependent Claims 15 and 23

15. *The base station of claim 9, further comprising an apparatus configured to detect a time delay of the received ranging signal and to inform the second mobile station to adjust transmission time based on the detected time delay.*

23. *The method of claim 22, further comprising detecting a time delay of the received ranging signal and informing the second mobile station to adjust transmission time based on the detected time delay.*

106. Jeong teaches or suggests the limitations of claims 15 and 23. Jeong discloses that "[w]hen the base station detects a signal transmitted from the subscriber station, the base station transmits ***time control information*** and power control information to the subscriber station using a code randomly selected. The subscriber station performs time adjustment and power control with reference to the time control information and power control information." EX1008, 0004 (emphasis added), FIG. 5 (the base station "send[s] … timing and power control corrections"). A POSA would have understood and found obvious that the base station would detect the time delay and power level of the ranging signal in order to determine and send "timing and power control corrections." Accordingly, the combination of Jeong and Suzuki renders obvious claims 15 and 23.

N. Dependent Claims 16 and 24

16. *The base station of claim 9, further comprising an apparatus configured to detect a power level of the received ranging signal and to inform the second mobile station to adjust a transmission power based on the detected power level.*
24. *The method of claim 22, further comprising detecting a power level of the received ranging signal and informing the second mobile station to adjust a transmission power based on the detected power level.*

107. Jeong teaches or suggests the limitations of claims 15 and 23. Jeong discloses that "[w]hen the base station detects a signal transmitted from the subscriber station, the base station transmits time control information and ***power control information*** to the subscriber station using a code randomly selected. The subscriber station performs time adjustment and power control with reference to the time control information and power control information." EX1008, 0004 (emphasis added), FIG. 5 (the base station "send[s] … timing and power control corrections"). A POSA would have understood and found obvious that the base station would detect the time delay and power level of the ranging signal in order to determine and send "timing and power control corrections." Accordingly, the combination of Jeong and Suzuki renders obvious claims 16 and 24.

IX. GROUND 2: CLAIMS 2-3, 5, 10-11, AND 21 WOULD HAVE BEEN OBVIOUS OVER JEONG, SUZUKI, AND GIBSON.

108. In my opinion, the combination of Jeong, Suzuki, and Gibson teaches, suggests, or renders obvious each and every element of claims 2-3, 5, 10-11, and 21 of the ’366 patent, and a POSA would have been motivated to combine the references and had a reasonable expectation of success in doing so.

A. Gibson

109. Gibson is a comprehensive treatise on mobile communications that was published in 1999 and is titled *The Mobile Communications Handbook*. Gibson explains that the treatise “covers the entire field—from principles of analog and digital communications to cordless telephones, wireless local area networks (LANs), and international technology standards.” EX1010, 0003 (back cover). Gibson covers many mobile communication technologies that were well-known and routinely implemented by March 2004, including: pseudo-noise sequences, such as binary m-sequences, and Gold and Golay codes, EX1010, 0137-49 (chapter 8); cell design principles and channel assignment techniques, EX1010, 0406-22 (chapter 21), 0438-45 (chapter 23); and power control, EX1010, 0458-70 (chapter 25), among other topics. Gibson demonstrates that the features briefly covered in the ’366 patent’s detailed description but yet recited in claims 2-3, 5, 10-11, and 21 were well-known and obvious by March 2004.

B. Dependent Claims 2 and 10

2. *The mobile station of claim 1, wherein the subcarrier configuration of the ranging subchannel for the cell is different from subcarrier configurations of ranging subchannels for other cells.*
10. *The base station of claim 9, wherein the subcarrier configuration of the ranging subchannel for the cell is different from subcarrier configurations of ranging subchannels for other cells.*

110. The combination of Jeong, Suzuki, and Gibson renders obvious the limitations of claims 2 and 10. Jeong discloses that "the BS … ***determines the initial ranging sub-channel allocation method and the ranging code***, and broadcasts it within its own cell." EX1008, 0010 (emphasis added).

111. Gibson teaches that "[i]n cellular communication systems, the service area is divided into cells, each covered by a single base station." EX1010, 0459. To avoid co-channel interference, "the channel frequency is usually not reused in adjacent cells in most of the cellular systems." EX1010, 0459. Gibson discloses that "a typical reuse pattern reuses the frequency in every seventh cell (frequency reuse factor = 1/7)." EX1010, 0459; *see also* EX1010, 439-440 (showing a seven-cell cluster in Figure 23.1), 0458 ("To minimize the cochannel interference, several techniques are proposed[, including] frequency reuse patterns, which ensure that the same frequencies are not used in adjacent cells").

112. Based on Gibson's teachings, it would have been obvious to use a different "*subcarrier configuration of the ranging subchannel*" in different cells, particularly in adjacent cells, in the Jeong-Suzuki system. For example, applying a frequency reuse factor of 1/7 (as disclosed by Gibson) to the Jeong-Suzuki system, the ranging sub-channel(s) in each cell of a seven-cell cluster would be in different frequency bands, and thus have different subcarrier configurations. A POSA would have been motivated to do so in order to minimize or avoid co-channel interference between adjacent cells. A POSA would have reasonably expected success in making the combination because, as Gibson teaches, it was routine and conventional to configure adjacent cells to operate differently (e.g., use different frequency configurations) to avoid co-channel interference.

C. Dependent Claims 3 and 11

3. *The mobile station of claim 1, wherein the set of ranging sequences for the cell is different from sets of ranging sequences for other cells.*

11. *The base station of claim 9, wherein the set of ranging sequences for the cell is different from sets of ranging sequences for other cells.*

113. For similar reasons, the combination of Jeong, Suzuki, and Gibson renders obvious the limitations of claims 3 and 11. Again, to avoid co-channel interference, as Gibson teaches, it would have been obvious to a POSA to use different sets of ranging sequences in different cells (such as different Gold codes

or m-sequences), particularly in adjacent cells, in the Jeong-Suzuki system. Indeed, using different codes to avoid interference and share resources is the basic principle behind code-division multiple access, which was well-known by March 2004, *see, e.g.*, EX1010, 0193-95, and thus a POSA would have reasonably expected success in using different sets of ranging sequences in different cells to avoid interference. Accordingly, the combination of Jeong, Suzuki, and Gibson renders claims 3 and 11 obvious.

D. Dependent Claims 5 and 21

[5.P] *The mobile station of claim 1, further comprising an apparatus configured to control a transmission power of the ranging signal using an open-loop power control method by:*

[5.1] *estimating a path loss between the serving base station and the mobile station based on a received downlink signal;*

[5.2] *setting the transmission power of the ranging signal based on the path loss; and*

[5.3] *increasing the transmission power of the ranging signal for retransmission.*

[21.P] *The method of claim 17, further comprising controlling a transmission power of the ranging signal using an open-loop power control method by:*

[21.1] *estimating a path loss between the serving base station and the mobile station based on a received downlink signal;*

[21.2] *setting the transmission power of the ranging signal based on the path loss; and*

[21.3] *increasing the transmission power of the ranging signal for retransmission.*

114. The Jeong-Suzuki-Gibson combination renders obvious claims 5 and 21. These claims recite an "*open-loop power control method*" that was conventional by March 2004.

115. Gibson teaches that "open-loop power control estimates the channel and adjusts the transmitted power accordingly but does not attempt to obtain feedback information on its effectiveness," and shows the "principle operation of open-loop power control … in Fig. 25.1," which is reproduced below. EX1010, 460-61. The mobile station "estimates the channel by measuring the received power level of the pilot from the base station in the forward link and sets the transmitted power level inversely proportional to it." EX1010, 0460. Gibson explains that "[e]stimating the power of pilot is, in general, more reliable than estimating the power of the voice (or data) channel since the pilot is usually transmitted at higher power levels." EX1010, 0460-61.

116. Gibson also defines "Path loss" as a "[d]escription of the attenuation of signal power with distance from a transmitter." EX1010, 0456. Because of this relationship between path loss and signal power, a POSA would have understood and found obvious that estimating "the received power level of the pilot from the base station," as Gibson discloses, EX1010, 460, also estimates the path loss on the downlink (which Gibson refers to as the forward link; Gibson refers to the uplink as the reverse channel, EX1010, 0459).

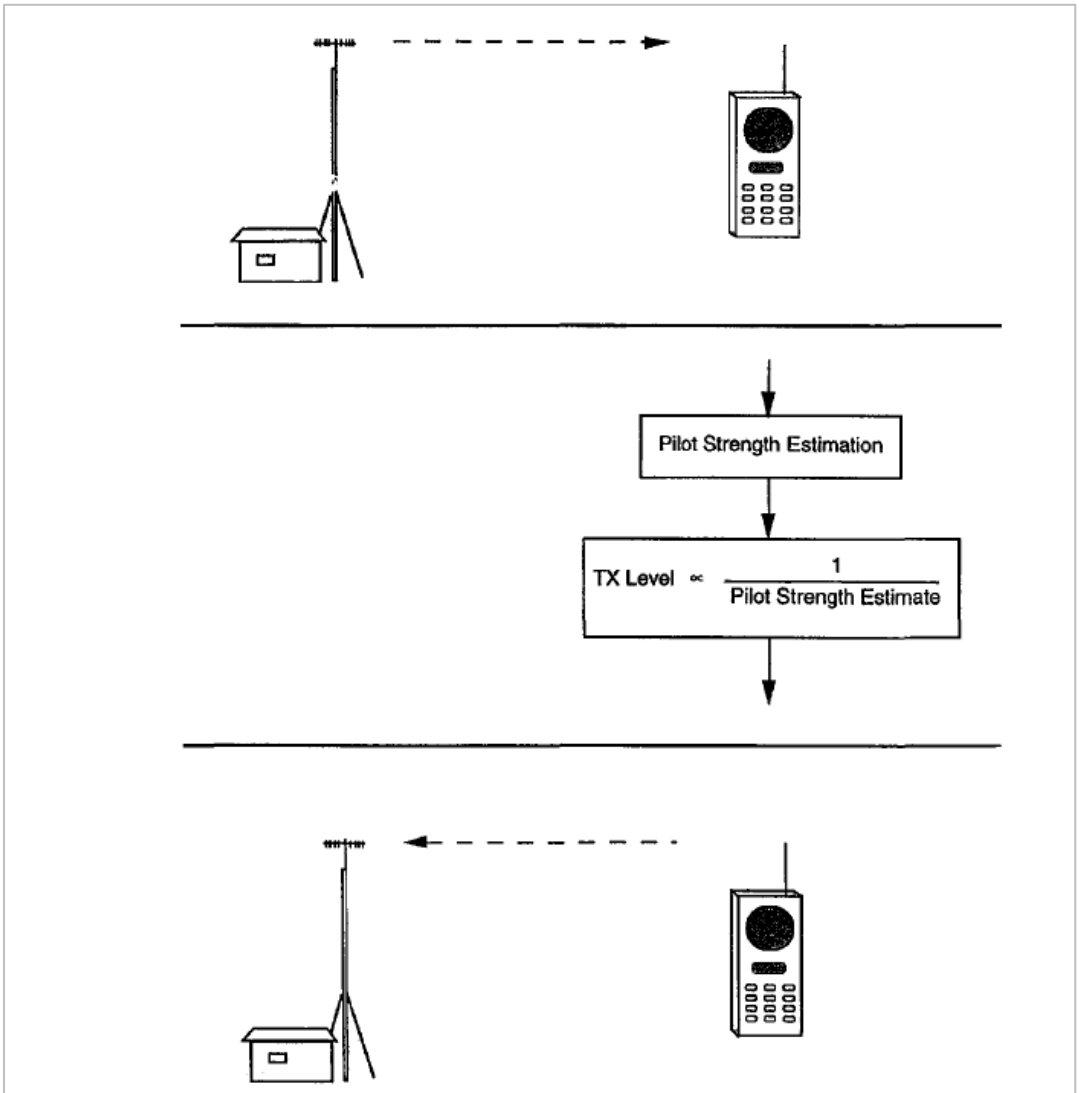


FIGURE 25.1 Reverse link open-loop power control.

EX1010, 0461.

117. Accordingly, as shown in Figure 25.1, Gibson discloses open-loop power control comprising (1) "*estimating a path loss between the serving base station and the mobile station based on a received downlink signal*," (2) "*setting the transmission power of the [] signal based on the path loss*," and (3) "*increasing*

the transmission power of the [] signal for retransmission" (as shown above, the lower the "Pilot Strength Estimate," the higher the mobile station's "TX Level").

118. It would have been obvious to use Gibson's open-loop power control in the ranging process of the Jeong-Suzuki system for a number of reasons, including maintaining appropriate transmit power for reliable communication, conserving battery energy of the mobile station, and alleviating the near-far effect, as discussed by Gibson. EX1010, 0459. Addressing these known problems would have motivated a POSA to make the combination.

119. Gibson provides additional express teachings that would have motivated the combination. Gibson explains that a benefit of open-loop power control is that "it may be relatively fast" because "it does not have to wait for the feedback information." EX1010, 0460. Indeed, Gibson explains that open-loop power control is particularly suited for "TDD-based systems" in which "the forward and reverse link are highly correlated," EX1010, 0462-63, such as Jeong's system, EX1008, 0008 ("TDD mode"). In such systems, open-loop power control is both fast and accurate, EX1010, 0463, which would have motivated its use in the Jeong-Suzuki system. A POSA also would have had a reasonable expectation of success in making the combination because it requires no more than the predictable use of conventional open-loop power control according to its established function.

X. GROUND 3: CLAIMS 1, 4, 6-9, 12, 15-20, AND 22-24 WOULD HAVE BEEN OBVIOUS OVER THE COMBINATION OF KOO, 802.16AB, CHAYAT, AND SUZUKI.

120. In my opinion, the combination of Koo, 802.16ab, Chayat, and Suzuki teaches, suggests, or renders obvious each and every element of claims 1, 4, 6-9, 12, 15-20, and 22-24 of the ’366 patent, and a POSA would have been motivated to combine the references and had a reasonable expectation of success in doing so.

A. Koo

121. Koo describes “a ranging method for a mobile communication system using an OFDMA … scheme.” EX1011, Abstract, ¶3. Like the ’366 patent, Koo explains that “[a] communication system using the OFDMA scheme needs to periodically execute a ranging procedure to correctly establish a time offset between a transmission side, i.e., a Node B, and a reception side, i.e.[,] a UE (User Equipment), and to adjust power between them.” EX1011, ¶5; *cf*. EX1001, 1:28-32. Koo’s system is a cellular communication system, wherein each cell includes a Node B that can communicate with a plurality of UEs. *See* EX1011, ¶¶20, 23-25, 35, 37, 40-43, 50, FIG. 2. A POSA would have understood that a “Node B” is a base station.

122. Koo discloses a “ranging procedure” that includes three processes: “an initial ranging process, a bandwidth request ranging process, and a maintenance ranging process.” EX1011, ¶6. Each process has different

"objectives" that "have been defined in the IEEE[] 802.16" standard. EX1011, ¶8. The initial ranging process is for "UEs attempting to execute an initial access" to a Node B. *See* EX1011, ¶37.

123. Koo explains that the ranging procedures use "ranging sub-channels and [ranging codes (RCs)]." EX1011, ¶9. "Typically, one ranging channel is composed of two ranging sub-channels each having the length of 53 bits," and an "RC is created by segmenting a PN(Pseudorandom Noise) code having a prescribed length … in prescribed units." EX1011, ¶32, FIG. 1. A POSA would have understood that UEs transmit the RCs over ranging sub-channels to the Node B.

124. Koo discloses that the "Node B generates a plurality of RCs by segmenting a PN code having the length of 2^{15-1} bits in predetermined units." EX1011, ¶40. "The Node B assigns RCs to be used for three ranging processes having different objectives, i.e. the initial ranging process, the bandwidth request ranging process, and the maintenance ranging process, to the three ranging processes, respectively." EX1011, ¶40. "[T]he Node B assigns N number of RCs to the initial ranging process, assigns L number of RCs to the bandwidth request ranging process, and assigns M number of RCs to the maintenance ranging process," EX1011, ¶40. Koo provides an example in which "10 RCs are assigned with an initial ranging process" and "10 RCs assigned with a bandwidth request

ranging process and a maintenance ranging process." EX1011, ¶37. The allocation of RCs to each ranging process may be based on the congestion state of the cell. EX1011, ¶¶41-43, FIG. 2.

125. After generating the RCs, the "Node B creates a UL_MAP message having [the] plurality of RCs classified according to ranging objectives" and "transmits the UL_MAP message" to the UEs. EX1011, ¶44; *see id*., ¶10 ("The UL_MAP message is transmitted to all the UEs of a cell over broadcast data of the Node B.").

126. Koo explains that a UE receives the UL_MAP message and executes a ranging procedure according to its ranging objective. EX1011, ¶¶45-49, FIG. 3. For example, if the UE's "current ranging objective is the initial ranging objective," the "UE selects [] the initial RC and its backoff value from among the" RCs allocated for initial ranging. EX1011, ¶48; *see also* EX1011, ¶¶24 (explaining that "the reception sides [] select a RC"), 25 (same), 37 (describing UEs selecting an initial RC from a set of 10 initial RCs). The UE then attempts "uplink access with the selected RC." EX1011, ¶49.

127. Koo describes its mobile communications systems and methods in the context of the IEEE 802.16 standard, EX1011, ¶¶8-10, 33, and thus does not expressly describe certain well-known features and functionality, such as the

details of ranging and data sub-channels. This would have led a POSA to published IEEE 802.16 documentation, such as 802.16ab.

B. IEEE 802.16ab-01/01r2 ("802.16ab")

128. 802.16ab is an IEEE 802.16 working document dated September 28, 2001. EX1012, 0001 ("2001-09-28"). It was a proposed amendment to the then-current IEEE 802.16 standard for medium-access and physical-layer components. EX1012, 0001. 802.16ab describes, among other things, OFDMA-based communications between subscriber stations ("SS") and base stations ("BS"), including OFDMA-based ranging. *See, e.g.*, EX1012, 0015-16, 0077-90, 0107-08, 0173-210.

129. The Institute of Electrical and Electronics Engineers (IEEE) is a professional organization for electronic engineering and electrical engineering. I have been heavily involved in the IEEE since 1977: as a member from 1977-1988, as a senior member from 1989-1999, and as a fellow from 2000 to present. Since 1977, I have been active on committees and held various leadership positions within the IEEE, which are listed on my CV (EX1004). One of the IEEE's missions is to develop and advance industry standards, which the IEEE does through working groups or committees. IEEE 802 was a working group that developed many well-known wireless communication standards, such as the 802.11 and 802.16 families of standards. The 802.16 family of standards was

officially named “WirelessMAN” within the IEEE, as screenshots of the IEEE’s 802.16 website from the early 2000s show. EX1006. IEEE 802.16, however, was commercialized under the more familiar name “WiMAX.” The IEEE, the 802 working group, and the 802.16 working group were all prominent and well-known to skilled artisans (both within IEEE as well as those who were not members of IEEE) in the wireless communications field at and before March 2004. Indeed, Gibson provides a chapter on telecommunications standardization, and describes many of the standard settings bodies, including IEEE, that were prominent at and before March 2004 (and many still are today). EX1010, 0230-45; *see also* EX1010, 0243 (describing IEEE).

130. Before March 2004, the 802.16 working group had a publicly available website. EX1006. I reviewed screenshots of this website from the early 2000s (prior to March 2004). The website provided links to a variety of information related to 802.16, including news, general information, and details for participants (such as information about previous and upcoming meetings, resources, working group documents, etc.). The website also included search functionality so that persons interested in 802.16 developments could search the 802.16 webspace for 802.16 documents and information. The search functionality supported general searching, searching by document number, and searching by document author. EX1006. Based on my personal experience in the industry and

with IEEE, it is my opinion that the 802.16 working group's website was a prominent channel through which 802.16 information (including working documents such as 802.16ab) was publicized that would have been well-known to skilled artisans (both within IEEE as well as those who were not members of IEEE) in the wireless communications field in the early 2000s and well before March 2004.

131. Based on my experience with IEEE and my review of the Exhibits in this proceeding, it is also my belief that skilled artisans could have located 802.16ab long before March 2004. Jeong, for example, is a publication of a Korean patent application that was filed on December 31, 2001, and that was published on July 7, 2003. EX1008, 0002. Jeong mentions "IEEE802.16ab-01/01r2," which, in my opinion, demonstrates that at least the seven inventors listed on Jeong had access to 802.16ab by at least the December 31, 2001 filing date of Jeong. EX1008, 0008. Jeong would have also provided a skilled artisan who was reading Jeong after its July 7, 2003 publication a roadmap to locating 802.16ab because it specifically mentions the IEEE working document; indeed, it mentions a particular section of the document that deals with ranging code sequences: "In this method, the ranging code consists of a code sequence made by cutting a PN code sequence generated by a Pseudo Random Binary Sequence ("PRBS") generator (not shown) described in ***section 8.3.5.3.4.3.1 of IEEE802.16ab-01/01r2*** into bit length of 159

bits." EX1008, 0008 (emphasis added); *see* EX1012, 0204-05 (section 8.3.5.3.4.3.1).

132. I also reviewed a letter dated October 26, 2001, from the Chairman of ETSI Project Broadband Radio Access Networks, Jamshid Khun-Jush, Dr.-Ing., to the Chair, IEEE 802.16 Working Group on Broadband Wireless Access, Dr. Roger B. Marks. EX1016. I understand that the letter was posted to the IEEE 802.16 website on November 7, 2001. EX1006. ETSI stands for the European Telecommunications Standards Institute, and was a prominent European standards setting body at and before March 2004. EX1010, 0230-31, 0235-37. The letter indicates that the HIPERMAN group of ETSI had decided to adopt certain technologies described in 802.16ab, as shown in the annotated snippet of the letter below. The letter demonstrates that ETSI, another prominent standards setting body that would have been comprised of skilled artisans in the wireless communications field, had access to the IEEE's working document 802.16ab.

> During the BRAN#25 Session different base-line proposals, as IEEE 802.16, BWIF and DVB-RCT, both for HIPERMAN PHY and DLC, were considered. The HIPERMAN group has decided as follows:
>
> 1. DLC base-line:
> - MAC relevant chapters from the documents IEEE P802.16/D5-2001 and P802.16ab-01/01r2.
> 2. PHY working assumption:
> - OFDM PHY from IEEE 802.16a document IEEE P802.16ab-01/01r2,
> - BWIF chapter referring to diversity, from Radio Frequency Interface Specification, SP-WRFI-000829, Version 1.0, as was submitted to ETSI-HIPERMAN.

EX1016 (annotated).

133. 802.16ab provides a frequency-domain description of OFDM/OFDMA that is remarkably similar to the ’366 patent. *Compare* EX1012, 0175-76, FIG. 215, *with*, EX1001, 2:57-3:16, FIG. 1. For example, 802.16ab explains that an “OFDM symbol is made up from carriers” and describes three carrier types: “Data carriers - for data transmission”; “Pilot carriers - for different estimation purposes”; and “Null carriers - no transmission at all, for guard bands and DC carrier.” EX1012, 0175; *cf.* EX1001, 2:64-3:4. “[G]uard bands … enable the signal to naturally decay and create the FFT ‘brick wall’ shaping.” EX1012, 0175.

134. 802.16ab also explains that a “symbol is divided into logical sub-channels to support scalability, multiple access, and advanced antenna array processing capabilities.” EX1012, 0175; *cf*. EX1001, 3:5-6. 802.16ab further explains that “[t]he carriers forming one subchannel may, but need not be adjacent” and “[i]n the OFDMA mode, only part of all active carriers may be used by the transmitter.” EX1012, 0175, FIG. 215; *cf.* EX1001, 3:6-8, FIG. 1. Figure 215 of 802.16ab shows three example OFDMA sub-channels:

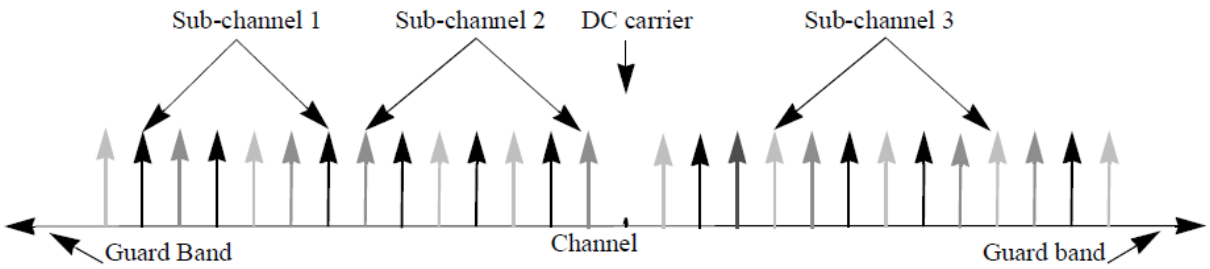


Figure 215—OFDMA frequency description (3 channel schematic example)

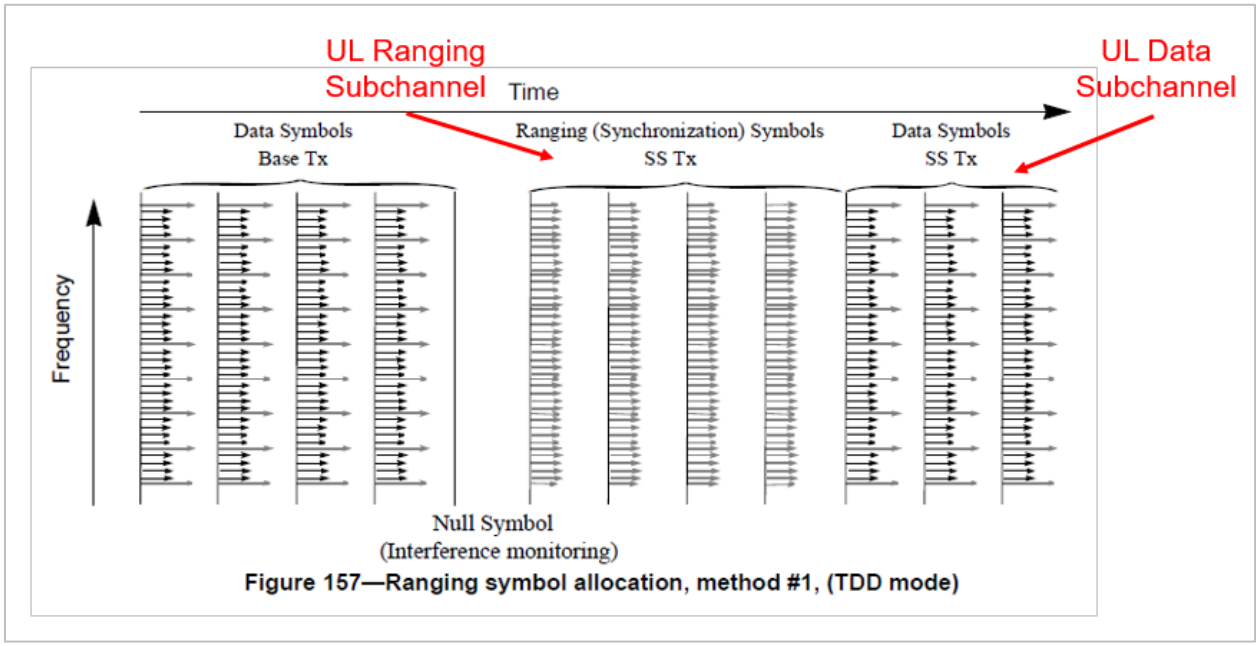
EX1012, 0175; *cf.* EX1001, FIG. 1.

135. 802.16ab also discloses OFDMA-based ranging. *See, e.g.*, EX1012, 0086-91, 205-07. Like the '366 patent and Koo, 802.16ab explains that "ranging is the process of acquiring the correct timing offset and power corrections such that the SS's transmissions are aligned to a symbol that marks the beginning of a burst(s) boundary with the required power." EX1012, 0088; *cf.* EX1011, ¶5; EX1001, 1:28-32; *see also* EX1012, 0204-07 (describing OFDMA-based ranging in Section 8.3.5.3.4.3.1).

136. 802.16ab explains that "[o]n network entry … the SS that whishes [*sic*] to perform ranging must select randomly a Ranging Code (Long or Short), which will be transmitted on a Ranging Sub-Channel in a randomly chose OFDMA symbol." EX1012, 0088; *see also id.*, 0088-90 (describing OFDMA-based ranging in Section 6.2.7.10.4.1), 0106. "The Long Ranging transmission shall be used by any SS that wants to synchronize to the system channel for the first time." EX1012, 0205. 802.16ab explains that "Long Ranging transmission

shall be performed during the two first consecutive symbols of the UL frame. The same ranging code is transmitted during each symbol." EX1012, 0205. 802.16ab further discloses that "[s]ending for a consecutive period of two OFDMA signals a preamble shall perform the long ranging transmission," where "[t]he preamble structure is defined by modulating one Ranging Code, up on the Ranging Sub-Channel carriers." EX1012, 0205.

137. 802.16ab discloses "upstream access schemes" for ranging, including a first scheme in which "[e]ach OFDMA (OFDM)symbol will carry either data or ranging slots," which is shown in Figure 157. EX1012, 0086-87. 802.16ab explains that "[t]he basic OFDMA allocation unit" is a "slot," which "is a combination of a time symbol and a sub-channel." EX1012, 0086; *see also* EX1012, 0077 ("OFDMA Slot Definition"). As shown below, the first access scheme creates ranging and data subchannels in the uplink (UL) based on time division.



EX1012, 0087, FIG. 157 (annotated).

138. Figure 160 of 802.16ab illustrates message exchange between a subscriber station and a base station using the first access scheme. EX1012, 0089. Figure 160 shows, among other things, that the subscriber station randomly selects and transmits a ranging code in a randomly selected ranging slot to the base station. EX1012, 0089. The base station, in turn, transmits a ranging response to the subscriber station that includes, among other things, the original ranging code and ranging slot. EX1012, 0089. A POSA would have understood and found obvious that the randomly selected ranging code identifies the subscriber station. That is, base station includes the original ranging code in the ranging response to direct the ranging response to the SS that sent the particular ranging code.

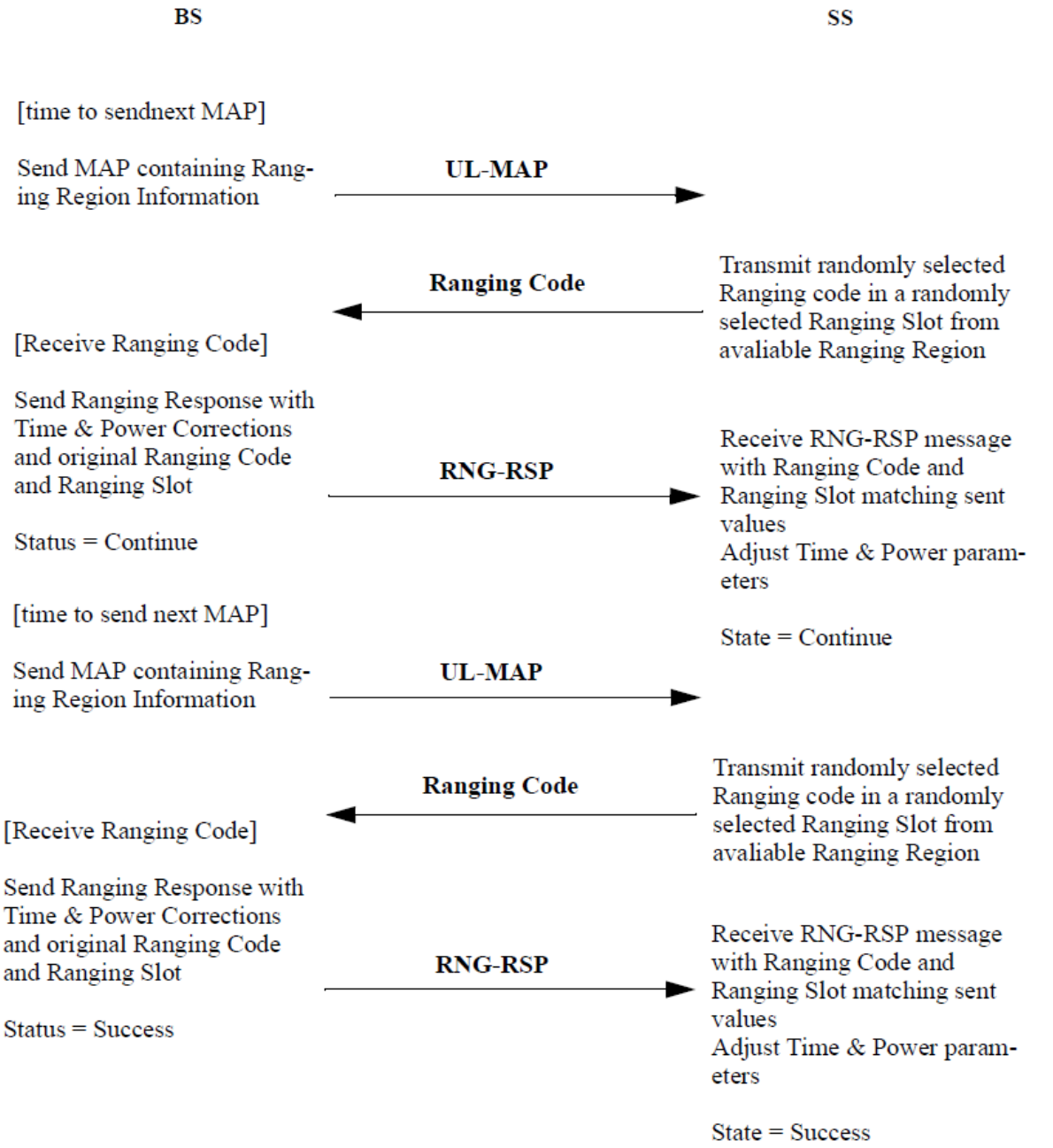


Figure 160—Ranging and automatic adjustments procedure for access scheme 1.

EX1012, 0089.

139. 802.16ab also discloses a second scheme in which "[e]ach OFDMA (OFDM)symbol will carry both data and ranging slots," which is shown in Figures

158 and 159 below. EX1012, 0086. As shown in Figure 158, a “Ranging subchannel” is allocated in the portion of the frequency band, and “User allocated subchannel[s]” are allocated in other portions of the frequency band. EX1012, 0087. A POSA would have understood and found obvious that data is transmitted in the user allocated subchannels. In Figure 161, 802.16ab also illustrates message exchange between a subscriber station and a base station during the second access scheme. EX1012, 0090.

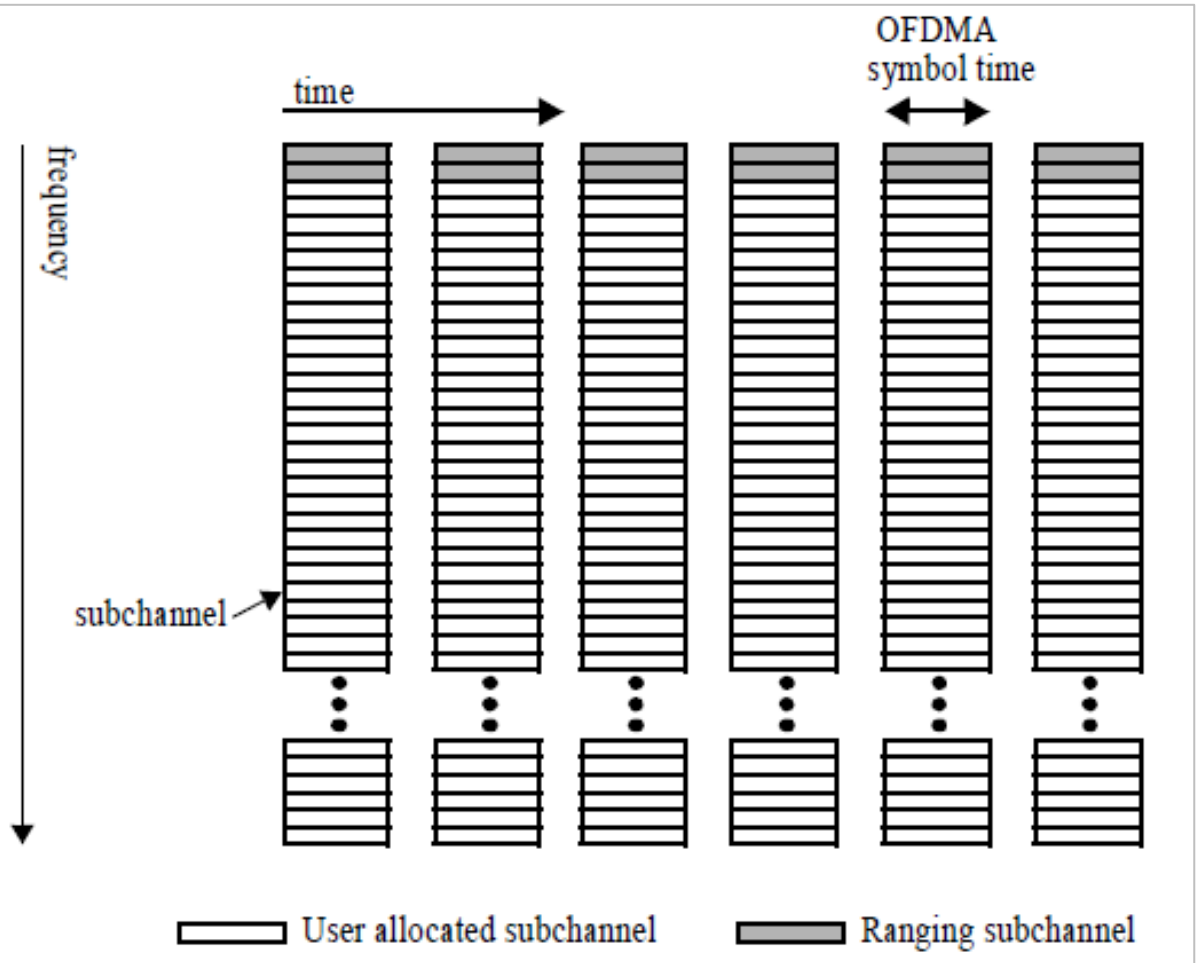


Figure 158—Ranging subchannel allocation, method #2

EX1012, 0087, FIG. 158.

140. 802.16ab discloses that "a ***preamble*** shall perform the long ranging transmission," EX1012, 0205 (emphasis added), and that "OFDM can incorporate ***peak-to-average reduction signal processing*** to partially (but not completely) alleviate its high sensitivity to power amplifier nonlinearities," EX1012, 0128 (emphasis added); *see id.*, 0107. 802.16ab, however, does not expressly describe processing techniques to reduce PAPR, which would have led a POSA to Chayat.

C. Chayat

141. Chayat describes "OFDMA systems with enhanced preamble properties" that "utilize preambles with a low Peak-to-Average Power ratio (PAPR) property." EX1013, Abstract. Chayat explains that "[t]ypically OFDM systems produce high PAPR waveforms," EX1013, 2:8, and some prior-art techniques sought to "achieve low PAPR property for the data portion of the [OFDM] signal rather than for the preamble, EX1013, 2:29-36. But, "[b]y using as a preamble[] a carefully crafted set of subcarrier modulation values," Chayat teaches that "the PAPR of the preamble can be kept at about 3 dB …." EX1013, 2:11-13. Chayat explains that using such preambles is beneficial because (1) it "avoid[s] excessive distortion in the power amplifier," EX1013, 2:4-6, and (2) "result[s] in a more accurate [channel] estimate," EX1013, 2:13-15; *see also* EX1013, 5:11-14.

142. Accordingly, Chayat discloses "sets of preambles satisfying good PAPR properties in OFDMA systems," using, for example, "Golay's complementary sequences." EX1013, 4:9-19; *see also* EX1013, 6:1-14.

D. Suzuki

143. I provided an overview of Suzuki above, in Section VIII.B.

E. Motivation to Combine

1. Koo with 802.16ab

144. It would have been obvious to a POSA to combine 802.16ab's OFDMA-based ranging techniques, including the allocation of data and ranging sub-channels, with Koo's mobile communication system. Koo provides express teachings that would have motivated a POSA to make this combination. For example, Koo states that "[t]he ranging procedure needs ranging sub-channels and [ranging codes (RCs)]," EX1011, ¶9, and describes an OFDMA communication system in the context of the IEEE 802.16 standard, EX1011, ¶¶8, 9, 33. Koo's references to the IEEE 802.16 standard would have motivated a POSA to look to publicly available IEEE 802.16 documents describing OFDMA-based ranging, which would have led to 802.16ab.

145. A POSA would have had a reasonable expectation of success in making this combination because Koo's system is based on IEEE 802.16, and thus a POSA would have expected that combining techniques described in

contemporaneous IEEE 802.16 documents (such as 802.16ab) with Koo's system would yield predictable results. Indeed, Koo and 802.16ab provide overlapping descriptions of IEEE 802.16 ranging procedures (such as the use of ranging codes, ranging channels, UL_MAP messages, etc.) that demonstrate that the disclosed technologies would have been compatible, readily combined, and yielded predictable results. *See, e.g.*, EX1011, ¶¶2-17; EX1012, 0085-88.

2. Koo and 802.16ab with Chayat

146. It would have been obvious to a POSA to combine Chayat's low-PAPR preamble sequences with the combined Koo-802.16ab system in order to reduce PAPR during ranging. First, 802.16ab provides teachings that would have motivated a POSA to make the combination. For example, 802.16ab discloses that "a preamble shall perform the long ranging transmission," EX1012, 0205, and that "OFDM can incorporate peak-to-average reduction signal processing to partially (but not completely) alleviate its high sensitivity to power amplifier nonlinearities," EX1012, 0127. But 802.16ab does not describe specific PAPR-reduction techniques, which would have led a POSA to look to Chayat's disclosure of preamble sequences that when used for OFDMA result in time domain signals that have low PAPR.

147. Second, Chayat also provides teachings that would have motivated the combination. To start, Chayat describes OFDMA systems based on IEEE 802.16,

EX1013, 1:29-32, 3:19-21, which would have motivated a POSA to use Chayat's sequences in an IEEE 802.16 system, such as the combined Koo-802.16ab system. Chayat also teaches that using preamble sequences with low PAPR "avoid[s] excessive distortion in the power amplifier," EX1013, 2:3-6, and that "[b]y using as a preamble, a carefully crafted set of subcarrier modulation values, the PAPR of the preamble can be kept at about 3 dB, significantly less than the values typical for data. This property is beneficial in that during the channel estimation phase the signal experiences smaller distortion, resulting in a more accurate estimate," EX1013, 2:11-15. Chayat's teachings would have motivated a POSA to use Chayat's sequences in the combined Koo-802.16ab system in order to (1) avoid excessive distortion in the power amplifier and (2) obtain more accurate channel estimations.

148. Third, that OFDM signals exhibited high PAPR was a well-known problem that had known solutions by March 2004. Section VII.D. One such known and obvious solution is disclosed by Chayat: generating and using preambles that have low PAPR. EX1013, 4:4-19.

149. A POSA would have had a reasonable expectation of success in making this combination. Chayat's references to IEEE 802.16 demonstrate that Chayat's system and method are compatible with IEEE 802.16, and their combination would yield predictable results. Further, each of Koo, 802.16ab, and

Chayat describe similar OFDMA-based communication systems, which were known to exhibit high PAPR. A POSA would thus have reasonably expected that using Chayat's preamble sequences would predictably result in reducing PAPR, as Chayat expressly teaches.

3. Koo, 802.16ab, and Chayat with Suzuki

150. It would have been obvious to combine Suzuki's zero-power guard bands with the Koo-802.16ab-Chayat system in order to reduce interference between groups of subcarriers. 802.16ab provides express teachings that would have motivated the combination, explaining that "[a]n OFDM symbol is made up from carriers," which may include "[n]ull carriers" that have "no transmission at all, for guard bands and DC carrier." EX1012, 0175. 802.16ab further teaches that "guard bands … enable the signal to naturally decay and create the FFT 'brick wall' shaping." EX1012, 0175. These teaching would have motivated a POSA to look to Suzuki, who discloses additional details of guard bands, such as where to place guard bands (e.g., both ends of one band slot) and their power level (e.g., zero). EX1009, 3:17-20.

151. Additionally, inserting guard bands between frequency bands was a well-known technique used to reduce signal interference in cellular communication systems by March 2004, and setting the guard-band subcarriers to zero power, as disclosed by Suzuki, would provide well-defined boundaries between blocks of

subcarriers of the ranging sub-channels in the Koo-802.16ab-Chayat combination. *See* Sections VII.C, VII.E. As such, employing Suzuki's zero-power guard bands in the Koo-802.16ab-Chayat system represents nothing more than the predictable use of prior art elements (e.g., Suzuki's zero-power guard bands) according to their established function yielding predictable results (e.g., zero-power guard bands that reduce signal interference). And because they were well-known and commonly used, a POSA would have had a reasonable expectation of success in combining Suzuki's guard bands in the Koo-802.16ab-Chayat system.

F. Independent Claim 1

152. In my opinion, the combination of Koo, 802.16ab, Chayat, and Suzuki teaches, suggests, or renders obvious each and every element of independent claim 1, and a POSA would have been motivated to combine the references and had a reasonable expectation of success in doing so.

1. Claim 1's Preamble

[1.P] *In a multi-cell orthogonal frequency division multiple access (OFDMA) wireless communication system comprising a plurality of base stations and mobile stations, a mobile station configured to communicate with a serving base station in a cell via a communication channel, the mobile station comprising:*

153. Koo teaches or suggests the preamble of claim 1. Koo teaches or suggests "*[i]n a multi-cell orthogonal frequency division multiple access*

(OFDMA) wireless communication system." Koo discloses a "mobile communication system using an OFDMA … scheme." EX1011, Title, Abstract, ¶3. Koo discloses that the system is a cellular communication system. *See, e.g.*, EX1011, ¶¶20 ("cell status"), 23 ("a current cell"), 40 ("the Node B checks its own cell status"), 41 ("any cell"; "this cell"). A POSA would have understood and found obvious that Koo's cellular system is a "*multi-cell*" system. For example, Koo repeatedly references "a current cell" and mentions "any cell" and "this cell," which would have suggested and rendered obvious that the system has more than one cell. Further, it was well-known for cellular systems to include more than one cell. *See* EX1010, 0459 ("In cellular communication systems, the service area is divided into cells, each covered by a single base station.").

154. Koo teaches or suggests that the OFDMA system comprises "*a plurality of base stations and mobile stations*." For example, Koo discloses a "number of UEs attempting to execute initial access" with a "Node B" in a given cell. EX1011, ¶37; *see also* EX1011, ¶¶5 ("Node B" and "UE (User Equipment")), 10 ("all the UEs of a cell"), 35 (describing a "small" or "large" "number of UEs are interconnected"), 40-41, FIG. 2. Koo discloses a "mobile" communication system, EX1011, Title, Abstract, ¶3, and thus a POSA would have understood and found obvious that Koo's UE is a "*mobile station*." A POSA would have further understood that Koo's "Node B" refers to a "*base station*," and that in a cellular

system, each cell would include a base station. *See* EX1010, 0459 ("In cellular communication systems, the service area is divided into cells, each covered by a single base station.").

155. Koo teaches or suggests "*a mobile station configured to communicate with a serving base station in a cell via a communication channel*." For example, Koo discloses that in an "OFDMA scheme" data and ranging information are transmitted as "OFDMA symbols [that] are separately loaded on [frequency] sub-carriers and transmitted over prescribed sub-channels," EX1011, ¶5, such as "ranging sub-channels" during the "ranging procedure," EX1011, ¶9. Koo further discloses that during the ranging procedure, UEs select and transmit ranging codes to the Node B. EX1011, ¶¶46-49, FIG. 3.

156. Alternatively, the Koo-802.16ab-Chayat-Suzuki combination renders obvious claim 1's preamble. For example, 802.16ab teaches a "*multiple-cell*" system and "*base stations*." EX1012, 0015 ("base station"; "multiple- cell frequency reuse systems"), 0096 ("Base Stations"), 0271 ("multiple cell system"), 0170. A POSA would have understood and found obvious that each cell in a multi-cell system has a base station. *See* EX1010, 0459 ("In cellular communication systems, the service area is divided into cells, each covered by a single base station."). Suzuki discloses a "wireless telephone system," such as "a cellular system in which a base station is arranged in a predetermined condition to form a

service area and communicate with a portable station (terminal device)." EX1009, 2:57-61. Suzuki further discloses that a plurality of portable ("*mobile*") stations may communicate with a base station in a given cell of the system. EX1009, 3:31-4:21. A POSA would have combined Koo, 802.16ab, Chayat, and Suzuki for the reasons discussed above. Section X.E.

2. Limitation 1.1

[1.1] *an apparatus configured to transmit a data signal to the serving base station in the cell over a data subchannel, wherein the data subchannel comprises a plurality of adjacent or non-adjacent subcarriers within the communication channel;*

157. The combination of Koo and 802.16ab renders obvious Limitation 1.1. Koo discloses UE and "transmitting data using the OFDMA scheme" in which "OFDMA symbols are separately loaded on sub-carriers and transmitted over prescribed sub-channels." EX1011, ¶5. Koo describes a "mobile communication system," EX1011, ¶3, in the context of the IEEE 802.16 standard, EX1011, ¶¶8-10, 33. A POSA would have understood and found obvious that Koo's UE includes "*an apparatus*" configured to transmit data signals to a Node B. For example, a POSA would have understood that Koo's UE would include hardware and/or software for transmitting and receiving signals, such as the various signals described in Koo. *See* EX1011, FIG. 3. Koo, however, does not expressly disclose

that UEs transmit data signals "*over a data subchannel, wherein the data subchannel comprises a plurality of adjacent or non-adjacent subcarriers within the communication channel*."

158. 802.16ab teaches or suggests this feature. 802.16ab discloses "upstream access schemes," including a first scheme in which "[e]ach OFDMA (OFDM)symbol will carry either data or ranging slots," and a second access scheme in which "[e]ach OFDMA (OFDM)symbol will carry both data and ranging slots." EX1012, 0086-87, FIGS. 157-159.

159. The first access scheme, shown in Figure 157 below, creates data subchannel(s) in the uplink (UL) using time division. As shown, a data subchannel in Figure 157 "*comprises a plurality of adjacent or non-adjacent subcarriers within the communication channel*."

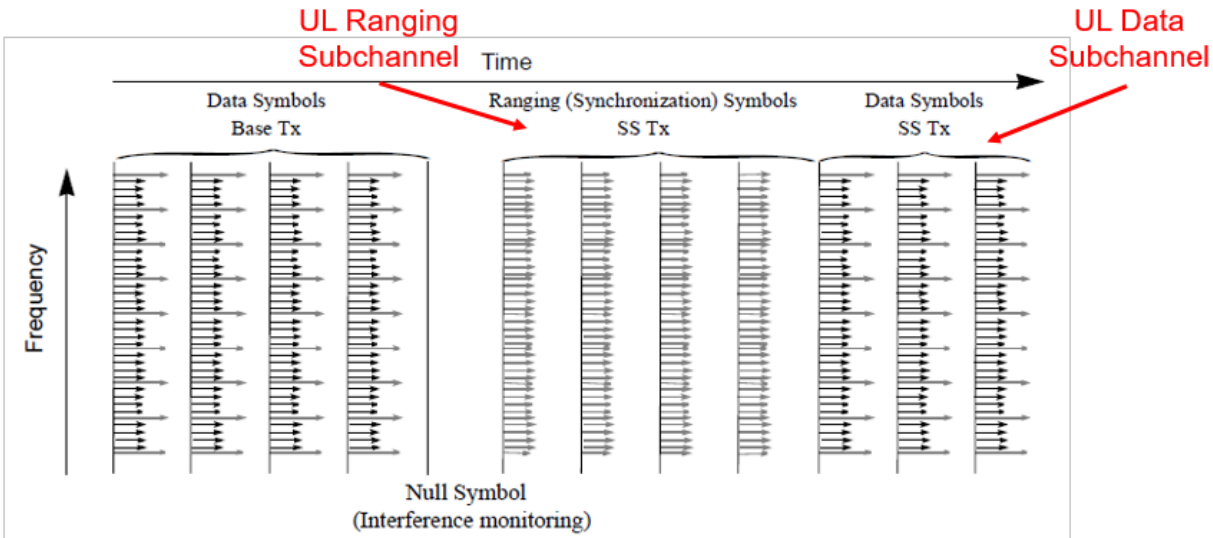


Figure 157—Ranging symbol allocation, method #1, (TDD mode)

EX1012, 0087, FIG. 157 (annotated).

160. Figures 158-159 of 802.16ab show the second access scheme. EX1012, 0087-88. Figure 158 (below) shows a "User allocated subchannel," which a POSA would have understood as including at least one data subchannel. EX1012, 0206-07. As shown, a data subchannel in Figure 158 "*comprises a plurality of adjacent or non-adjacent subcarriers within the communication channel*." Figure 158 below illustrates user allocated subchannels, or data subchannels, each of which comprise a plurality of adjacent subcarriers.

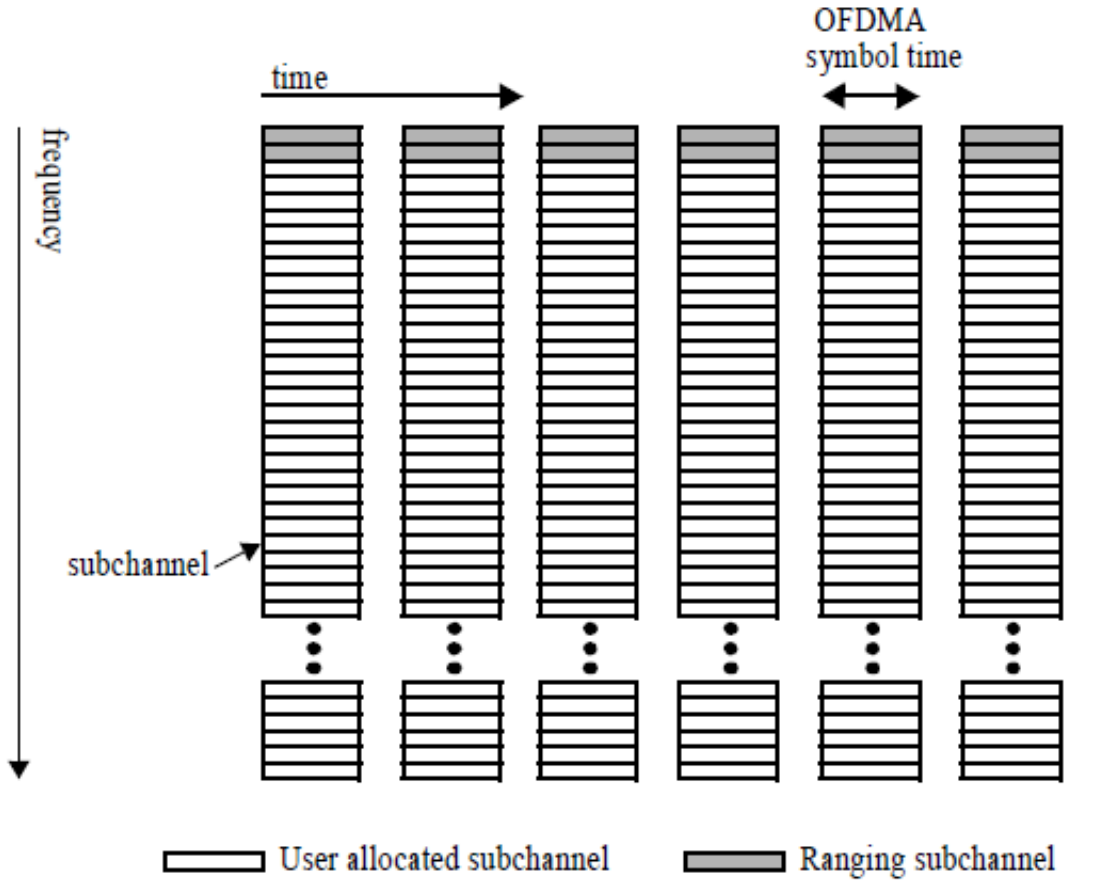


Figure 158—Ranging subchannel allocation, method #2

EX1012, 0087, FIG. 158.

161. Figure 159 of 802.16ab illustrates another example of the second access method, showing non-adjacent sub-carriers. EX1012, 0088.

3. Limitation 1.2

[1.2] *an apparatus configured to transmit a ranging signal to the serving base station in the cell over a ranging subchannel for random access;*

162. Koo teaches or suggests Limitation 1.2. Koo discloses that a UE selects an RC based on its ranging objective and attempts to execute uplink access to a Node B using the selected RC. EX1011, ¶¶37, 44-49, FIG. 3. For example, "UEs attempting to execute initial access" would select and use an RC "assigned with an initial ranging process" to generate and transmit a ranging signal to the Node B in the cell. EX1011, ¶37, FIG. 3 (steps 324, 326, 334). A POSA would have understood Koo's "initial ranging process" is "*for random access*." *See* EX1011, ¶37 (describing contention-based random access); *see also* EX1001, 1:24-28 (admitting that random access includes ranging).

163. Koo also discloses that "[t]he ranging procedure needs ranging sub-channels and RCs …." EX1011, ¶7. A POSA would have understood that Koo's UE transmits ranging signals "*over a ranging subchannel*." Accordingly, a POSA would have understood and found obvious that Koo's UE includes "*an apparatus configured to transmit a ranging signal*" (as explained in Limitation 1.3 below, the

modulated signal formed using the selected RC) "*to the serving base station in the cell*" (the Node B) "*over a ranging subchannel for random access*" (over a ranging subchannel during initial access).

164. Alternatively, the combination of Koo and 802.16ab renders obvious Limitation 1.2. Again, 802.16ab discloses OFDMA-based ranging. EX1012, 0086-90, 0204-06. 802.16ab discloses that when an SS "wants to synchronize to the system channel for the first time," it sends "for a consecutive period of two OFDMA signals a preamble" that is "defined by modulating one Ranging Code[] up on the ranging Sub-Channel carriers." EX1012, 0205; *see also* EX1012, 0088-90. 802.16ab further discloses that the logical "Uplink Contention Channel" is "used for SS initiated ***random access***, including ***ranging*** and bandwidth request." EX1012, 0101 (emphasis added). A POSA would have combined 802.16ab with Koo for the reasons discussed above. Section X.E.1.

4. Limitation 1.3

[1.3] *wherein: the ranging signal is formed from a ranging sequence selected from a set of ranging sequences associated with the cell for identifying the mobile station;*

165. The Koo-802.16ab combination renders obvious Limitation 1.3. Koo discloses that a Node B "generates a plurality of RCs" and "assigns N number of RCs to the initial ranging process." EX1011, ¶40, FIG. 2 (steps 212 and 214). For

example, Koo discloses that "10 RCs are assigned with an initial ranging process over UL_MAP message." EX1011, ¶37. A POSA would have understood that each RC of the "N" RCs is "*a ranging sequence [in] a set of ranging sequences*" (e.g., a set of 10 RCs). Koo's ranging sequences are "*associated with the cell*" because they are generated by the Node B. EX1011, ¶40.

166. Koo discloses that, upon receipt of the UL_MAP message, a UE selects an RC based on its ranging objective from the set of RCs in the UL_MAP message, and attempts to "execute[] uplink access" to the Node B using the selected RC. EX1011, ¶¶37, 44-49; FIG. 3. For example, "UEs attempting to execute an initial access" select one of the "N" (e.g., "10") RCs that the Node B assigned to use for initial ranging. *See* EX1011, ¶¶37, 40. A POSA would have understood that Koo's UE modulates the selected RC "using the OFDMA scheme" to transmit a ranging signal as "OFDMA symbols [that] are separately loaded on sub-carriers and transmitted over prescribed [ranging] sub-channels" to the Node B. EX1011, ¶5. That is, Koo's UE transmits a "*ranging signal [] formed from a ranging sequence selected from a set of ranging sequences associated with the cell*."

167. 802.16ab similarly discloses that a subscriber station "chooses randomly a Ranging Code (from the Initial Ranging domain) and sends it to the BS (as a CDMA code)." EX1012, 0088. Further, the subscriber station "[s]end[s] for a

consecutive period of two OFDMA signals a preamble shall perform the long ranging transmission," where "[t]he preamble structure is defined by modulating one Ranging Code, up on the Ranging Sub-Channel." EX1012, 0205.

168. 802.16ab also discloses that in each of the first and second access schemes, the base station transmits a ranging response to the subscriber station that includes the "original Ranging Code and Ranging Slot" that the subscriber station originally transmitted to the base station. EX1012, 0088-90, FIGS. 160-161; *see id*., 0088 ("The BS upon successfully receiving a Ranging Code sends a Ranging Response message that addressed the sending SS by supplying the Ranging Code and Ranging Slot in the message."). 802.16ab explains that in the base station's ranging response, "the combination of Ranging Symbol, []Ranging sub-channel and Ranging Code shall be used to address the sending SS." EX1012, 0021-22. A POSA thus would have understood and found obvious that the randomly selected ranging code "*identif[ies] the mobile station*." That is, base station includes the original ranging code in the ranging response to direct the ranging response to the subscriber station that sent the particular ranging code.

5. Limitation 1.4

[1.4] *wherein … the ranging signal lasts over a period of one or multiple orthogonal frequency division multiplexing (OFDM) symbols and the ranging signal exhibits a low peak-to-average power ratio in the time domain;*

169. The Koo-802.16ab-Chayat combination renders obvious Limitation 1.4. The Koo-802.16ab combination renders obvious "*the ranging signal*" recited in Limitations 1.2-1.3. Sections X.F.3, X.F.4. 802.16ab further teaches or suggests that "*the ranging signal lasts over a period of one or multiple [OFDM] symbols*." 802.16ab discloses that the "Long Ranging transmission shall be performed during the two first consecutive symbols of the UL frame. The same ranging code is transmitted during each symbol." EX1012, 0205.

170. 802.16ab discloses that "a ***preamble*** shall perform the long ranging transmission," EX1012, 0205 (emphasis added), and that "OFDM can incorporate ***peak-to-average reduction signal processing*** to partially (but not completely) alleviate its high sensitivity to power amplifier nonlinearities," EX1012, 0127 (emphasis added). But 802.16ab does not expressly disclose that "*the ranging signal exhibits a low peak-to-average power ratio in the time domain*."

171. Chayat teaches or suggests OFDM signals that "*exhibit[] a low peak-to-average power ratio in the time domain*." Chayat discloses "sets of preambles

satisfying good PAPR properties in OFDMA systems." EX1013, 4:12-13. Chayat's "preambles satisfy a ***low Peak-to-Average Power Ratio (PAPR)*** property for numerous subsets of the useable subcarrier set." EX1013, 4:14-15 (emphasis added). Chayat discloses that "[b]y using as a preamble, a carefully crafted set of subcarrier modulation values, the PAPR of the preamble can be kept at about 3 dB, significantly less than the values typical to data." EX1013, 2:11-12. A POSA would have understood that the PAPR discussed in 802.16ab and Chayat is "*in the time domain*." PAPR is measured in the time domain.

172. A POSA would have been motivated to combine Chayat's low-PAPR preamble sequences with the combined Koo-802.16ab system for the reasons discussed above. Section X.E.2.

6. Limitation 1.5

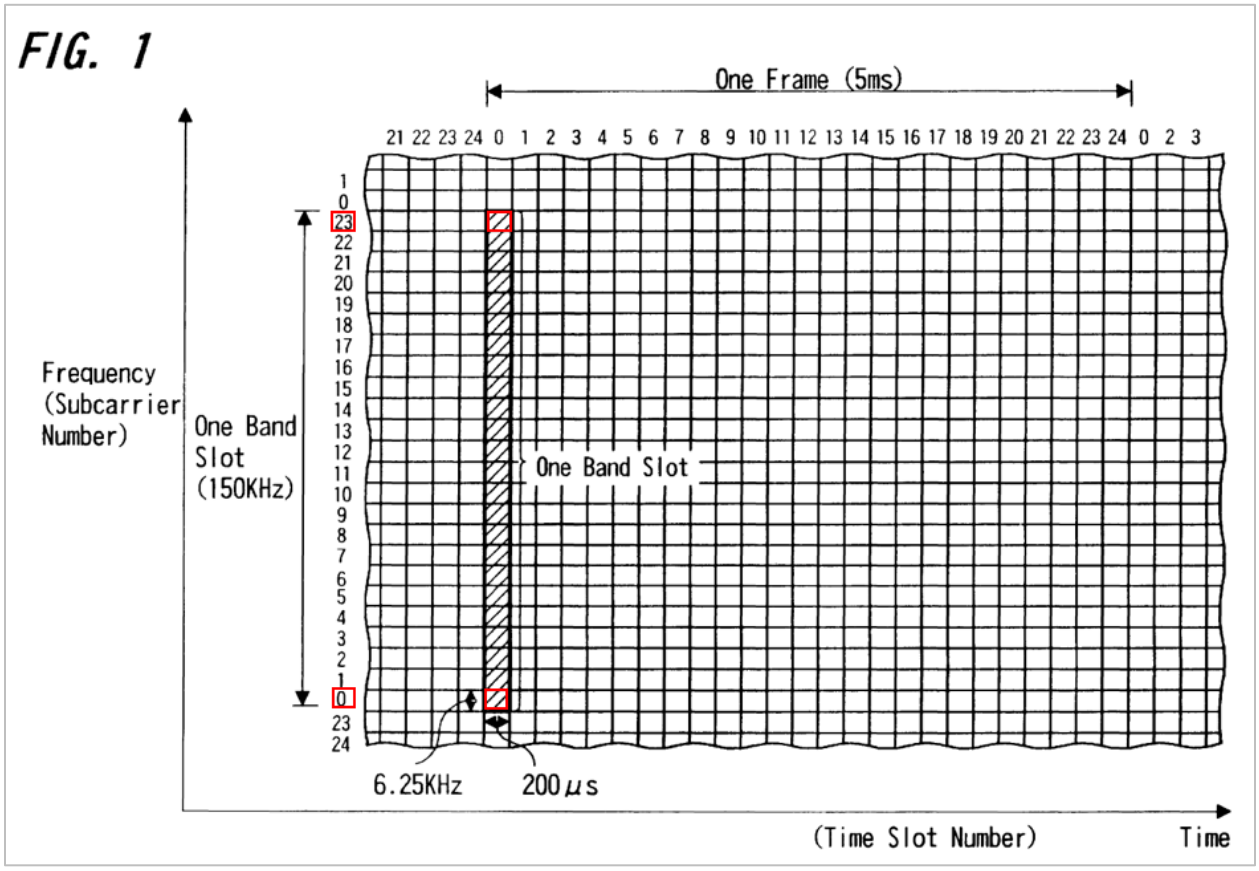
[1.5] *wherein … the ranging subchannel comprises at least one block of subcarriers within the communication channel and power levels of subcarriers at both ends of a block are set to zero.*

173. The Koo-802.16ab-Suzuki combination renders obvious Limitation 1.5. 802.16ab teaches or suggests that "*the ranging subchannel comprises at least one block of subcarriers within the communication channel*." 802.16ab discloses that "subcarriers" are "grouped into sub-channels." EX1012, 0077; *see also* EX1012, 0198-201. 802.16ab further describes and shows ranging subchannels as

including “ranging slots.” EX1012, 0086. A POSA thus would have understood and found obvious that the ranging subchannel(s) disclosed by 802.16ab, *see e.g.*, EX1012, 0086-90, include “*at least one block of subcarriers within the communication channel*.” *See, e.g.*, EX1012, FIGS. 157-158.

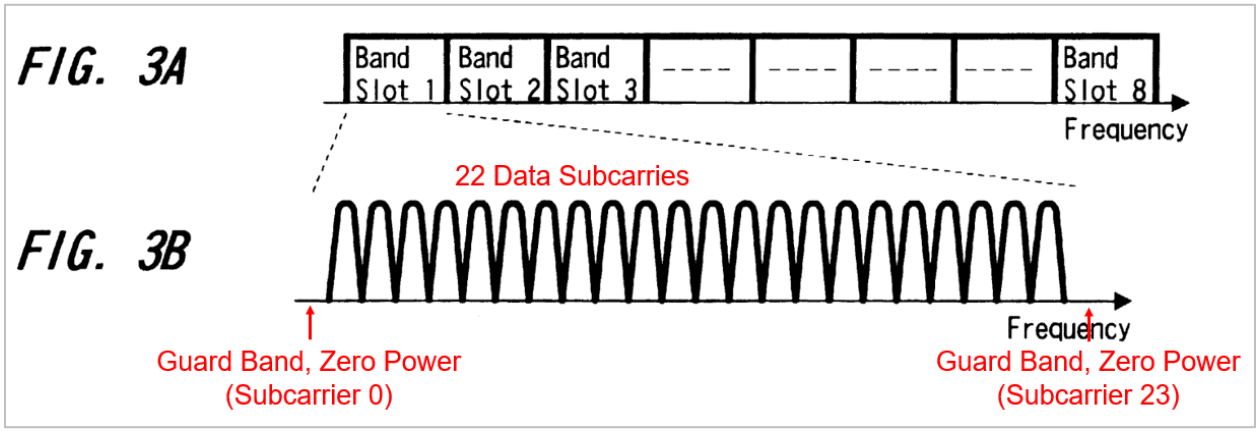
174. 802.16ab also discloses “[n]ull carriers” that have “no transmission at all, for guard bands and DC carrier,” and explains that “guard bands … enable the signal to naturally decay and create the FFT ‘brick wall’ shaping.” EX1012, 0175. But 802.16ab does not expressly disclose that the “*power levels of subcarriers at both ends of a block are set to zero*.”

175. Suzuki teaches or suggest this feature. In Figure 1, Suzuki shows a grid having “a plurality of [OFDM] subcarriers [] successively arranged within a predetermined [frequency] band,” where the grid’s “vertical axis represents frequency” and “horizontal axis represents time.” EX1009, 2:64-3:9. Suzuki discloses “one transmission band” or “band slot” as having “twenty-four subcarriers,” such as subcarriers numbered 0 to 23 in Figure 1. EX1009, 3:5-16. Suzuki explains that only 22 of the subcarriers are available to carry information because “the subcarrier numbers 0 and 23 at both ends within one band slot,” shown in red below, “are made guard bands in which no subcarrier is arranged and their powers are made zero.” EX1009, 3:16-20; *see also id.*, 4:35-40 (“twenty-two subcarriers are arranged … for data transmission”).



EX1009, FIG. 1 (annotated).

176. Figures 3A-3B of Suzuki (below) show another view of the 22 data subcarriers in a band slot, with frequency plotted on the horizontal axis. EX1009, 4:35-57. The figure below has been modified to show Suzuki's zero-power guard bands at the ends of the band slot (subcarriers 0 and 23). EX1009, 3:13-20.



EX1009, FIGS. 3A-3B (annotated).

177. A POSA would have been motivated to combine Suzuki's zero-power guard bands (zero-power subcarriers) at both ends of a block of subcarriers in 802.16ab's ranging subchannel in order to reduce interference between adjacent blocks of subcarriers, as discussed in Section X.E.3.

G. Independent Claims 9, 17, and 22

178. In my opinion, the combination of Koo, 802.16ab, Chayat, and Suzuki teaches, suggests, or renders obvious each and every element of independents claim 9, 17, and 22, and a POSA would have been motivated to combine the references and had a reasonable expectation of success in doing so.

179. Independent claim 17 is a method corresponding to and reciting nearly identical limitations as the mobile station recited in claim 1. *See* Section VIII.E above. Claim 17 is thus obvious over the combination of Koo, 802.16ab, Chayat, and Suzuki for the same reasons as claim 1, as shown in the chart below.

[17.P] In an orthogonal frequency division multiple access (OFDMA) wireless communication system, a method for signal transmission by a mobile station to a serving base station via a communication channel, the method comprising:	*See* Section X.F.1.
[17.1] transmitting a data signal over a data subchannel to the serving base station, wherein the data subchannel comprises a plurality of adjacent or non-adjacent subcarriers within the communication channel; and	*See* Section X.F.2.
[17.2] transmitting a ranging signal over a ranging subchannel to the serving base station for random access, wherein:	*See* Section X.F.3.
[17.3] the ranging signal is formed from a ranging sequence selected from a set of ranging sequences for identifying the mobile station;	*See* Section X.F.4.
[17.4] the ranging signal lasts over a period of one or multiple orthogonal frequency division multiplexing (OFDM) symbols and the ranging signal exhibits a low peak-to-average power ratio in the time domain; and	*See* Section X.F.5.

[17.5] the ranging subchannel comprises at least one block of subcarriers within the communication channel and power levels of subcarriers at both ends of a block are set to zero.	*See* Section X.F.6.

180. Independent claims 9 and 22 are directed to a base station and a method, respectively, for receiving (from a mobile station) data and ranging signals that are similar to those recited in independent claim 1. That is, claims 9 and 22 are directed to a base station and method corresponding to the mobile station and method recited in claims 1 and 17, respectively. The base station and method of claims 9 and 17, however, require receiving the "*data signal from a **first** mobile station*" while receipt of the "*ranging signal [is] from a **second** mobile station*." EX1001, 7:60-67, 9:17-22 (Limitations 9.1/22.2 and 9.2/22.2) (emphasis added).

181. Each of Koo, 802.16ab, and Suzuki disclose a base station (or Node B) for receiving the data and ranging signals transmitted by a plurality of mobile stations (UEs, SSs, or portable stations) that are served by the base station. *See, e.g.*, EX1011, ¶¶38-44, FIG. 2; EX1012, 0088-90, FIGS. 160-161; EX1009, 2:57-61. A POSA would have understood and found obvious that these base stations would receive a data signal from a first mobile (e.g., via a data sub-channel), and receive a ranging signal from a second, different mobile that was also being

serviced by the base station (e.g., via a ranging sub-channel). The Koo-802.16ab-Chayat-Suzuki combination thus renders obvious Limitations 9.1/22.1 and 9.2/22.2, as well as the preambles and other limitations of claims 9 and 22 that are nearly identical to claims 1 and 17 for at least the reasons discussed above and as shown in the chart below.

[9.P] & **[22.P]**	*See* Section X.F.1.
[9.1] & **[22.1]**	*See* Section X.F.2; *see also* EX1011, ¶¶38-44, FIG. 2; EX1012, 0088-90, FIGS. 160-161; EX1009, 2:57-61.
[9.2] & **[22.2]**	*See* Section X.F.3; *see also* EX1011, ¶¶38-44, FIG. 2; EX1012, 0088-90, FIGS. 160-161; EX1009, 2:57-61.
[9.3] & **[22.3]**	*See* Section X.F.4.
[9.4] & **[22.4]**	*See* Section X.F.5.
[9.5] & **[22.5]**	*See* Section X.F.6.

H. Dependent Claims 4 and 20

4. *The mobile station of claim 1, wherein subcarriers in a block are contiguous in frequency.*
20. *The method of claim 17, wherein subcarriers in a block are contiguous in frequency.*

182. 802.16ab teaches or suggests that "*subcarriers in a block are contiguous in frequency*." 802.16ab discloses that "[t]he carriers forming one subchannel may, but need not be adjacent." EX1012, 0175, FIGS. 157-158.

183. Suzuki also teaches or suggests these limitations. Suzuki discloses a "band slot" having "twenty-four subcarriers" that are "successively arranged at an equal interval." EX1009, 3:9-16, FIGS. 3A-3B.

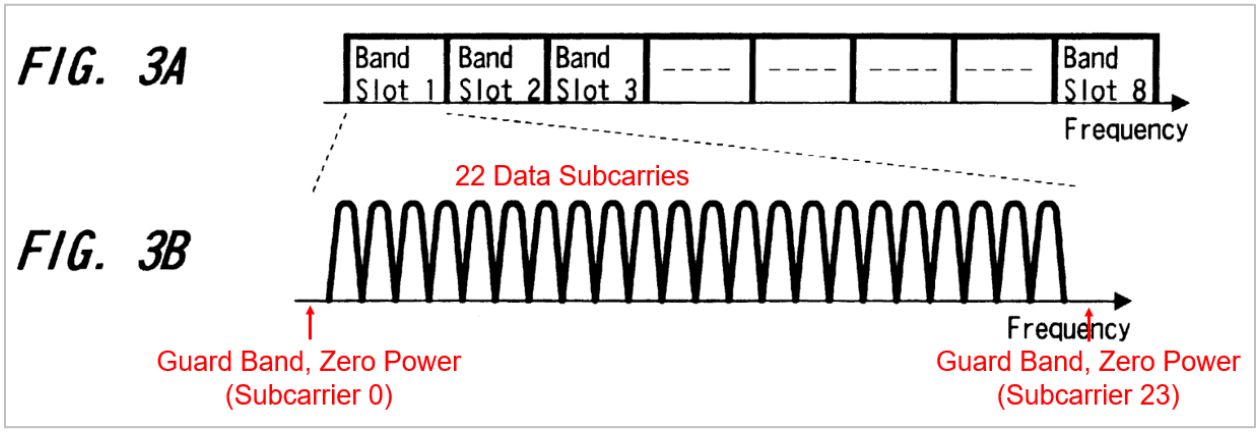
184. Accordingly, the Koo-802.16ab-Chayat-Suzuki combination renders claims 4 and 20 obvious.

I. Dependent Claims 6 and 18

6. *The mobile station of claim 1, wherein a power level of subcarriers towards the high-end and low-end frequency boundaries of a block of subcarriers is lower than a power level of subcarriers towards the center of the block.*

18. *The method of claim 17, wherein a power level of subcarriers towards the high-end and low-end frequency boundaries of a block of subcarriers is lower than a power level of subcarriers towards the center of the block.*

185. The Koo-802.16ab-Chayat-Suzuki combination renders obvious claims 6 and 18. Suzuki discloses that the power levels of "the subcarrier[s] … at both ends within one band slot[] … are made zero," which is illustrated below in the annotated version of Figures 3A-3B of Suzuki. EX1009, 3:17-20. As shown below, the subcarriers at both ends are "*towards the high-end and low-end frequency boundaries of a block*." Suzuki further discloses that subcarriers "*towards the center of the block*," such as the 22 data subcarriers shown in the annotated figures below, carry information. EX1009, 3:16-17. A POSA would have understood that in the combined Jeong-Suzuki system the zero-power subcarriers (those at the high- and low-end frequency boundaries) have "*lower*" power than information-carrying subcarriers "*towards the center of the block*," which are not set to zero.



EX1009, FIGS. 3A-3B (annotated).

J. Dependent Claims 7 and 19

7. *The mobile station of claim 1, wherein boundary subcarriers of a block of subcarriers in the ranging subchannel are attenuated to reduce interference with other uplink signals when signal time misalignment occurs at the base station.*

19. *The method of claim 17, wherein boundary subcarriers of a block of subcarriers in the ranging subchannel are attenuated to reduce interference with other uplink signals when signal time misalignment occurs at the base station.*

186. The Koo-802.16ab-Chayat-Suzuki combination renders obvious claims 7 and 19. A POSA would have understood that Suzuki's zero-power "*boundary subcarriers of a block … are attenuated*" as compared to information-carrying subcarriers. Accordingly, a POSA would have understood that in the combined system Suzuki's "*attenuated*" or zero-power boundary subcarriers applied to a ranging sub-channel would "*reduce interference with other uplink*

signals when signal time misalignment occurs at the base station." Again, using guard bands or subcarriers, including those having zero power, was a well-known technique to reduce signal interference by March 2004. *See* Section VII.C.

K. Dependent Claim 8

8. *The mobile station of claim 1, wherein the ranging sequence is a binary or non-binary sequence.*

187. Chayat teaches or suggests "*wherein the ranging sequence is a binary or non-binary sequence*." Chayat discloses "utilize[ing] and further generaliz[ing] the abovementioned works towards the construction of hierarchical sets of OFDMA preambles," where the works included Golay's "binary sequences" as well as non-binary sequences. EX1013, 6:6-14. Accordingly, the Koo-802.16ab-Chayat-Suzuki combination renders obvious claim 8.

L. Dependent Claim 12

12. *The base station of claim 9, further comprising an apparatus configured to detect the ranging sequence in the received ranging signal in the time domain, frequency domain, or both time and frequency domain.*

188. 802.16ab renders obvious claim 12's limitations. 802.16ab discloses that the base station performs "user code detection." EX1012, 0204. 802.16ab also discloses that the base station transmits, in the ranging response message, the original ranging code sent by the subscriber. EX1012, 0021-22, 0089-90, FIGS.

160-161. Accordingly, the Koo-802.16ab-Chayat-Suzuki combination renders obvious claim 12.

M. Dependent Claims 15 and 23

15. *The base station of claim 9, further comprising an apparatus configured to detect a time delay of the received ranging signal and to inform the second mobile station to adjust transmission time based on the detected time delay.*
23. *The method of claim 22, further comprising detecting a time delay of the received ranging signal and informing the second mobile station to adjust transmission time based on the detected time delay.*

189. 802.16ab teaches or suggests that the base station is configured to detect "*a time delay*" (claims 15, 23) and "*a power level*" (claims 16, 24) "*of the received ranging signal*" and to inform the SS that sent the ranging signal to adjust "*transmission time based on the detected time delay*" (claims 15, 23) and "*a transmission power based on the detected power level*" (claims 16, 24).

190. 802.16ab discloses that the base station's "Ranging Response message contains all the needed adjustment (e.g.[,] ***time***,[]*power* and possibly frequency corrections)and a status notification." EX1012, 0088 (emphasis added); *see also* EX1012, 0089-90, FIGS. 160-161. Upon receiving the ranging response message, the subscriber station adjusts time and power parameters. EX1012, 0088-90, FIGS. 160-161. A POSA would have understood and found obvious that the base station

would detect the time delay and power level of the ranging signal in order to determine and send the needed time and power adjustments.

N. Dependent Claims 16 and 24

16. *The base station of claim 9, further comprising an apparatus configured to detect a power level of the received ranging signal and to inform the second mobile station to adjust a transmission power based on the detected power level.*
24. *The method of claim 22, further comprising detecting a power level of the received ranging signal and informing the second mobile station to adjust a transmission power based on the detected power level.*

191. 802.16ab teaches or suggests that the BS is configured to detect "*a time delay*" (claims 15, 23) and "*a power level*" (claims 16, 24) "*of the received ranging signal*" and to inform the SS that sent the ranging signal to adjust "*transmission time based on the detected time delay*" (claims 15, 23) and "*a transmission power based on the detected power level*" (claims 16, 24).

192. 802.16ab discloses that the base station's "Ranging Response message contains all the needed adjustment (e.g.[,] *time*,[]***power*** and possibly frequency corrections)and a status notification." EX1012, 0088 (emphasis added); *see also* EX1012, 0089-90, FIGS. 160-161. Upon receiving the ranging response message, the subscriber station adjusts time and power parameters. EX1012, 0088-90, FIGS. 160-161. A POSA would have understood and found obvious that the base station

would detect the time delay and power level of the ranging signal in order to determine and send the needed time and power adjustments.

XI. GROUND 4: CLAIMS 2-3, 5, 10-11, 13-14, AND 21 WOULD HAVE BEEN OBVIOUS OVER THE COMBINATION OF KOO, 802.16AB, CHAYAT, SUZUKI, AND GIBSON.

193. In my opinion, the combination of Koo, 802.16ab, Chayat, Suzuki, and Gibson teaches, suggests, or renders obvious each and every element of claims 2-3, 5, 10-11, 13-14, and 21 of the ’366 patent, and a POSA would have been motivated to combine the references and had a reasonable expectation of success in doing so.

A. Dependent Claims 2 and 10

2. *The mobile station of claim 1, wherein the subcarrier configuration of the ranging subchannel for the cell is different from subcarrier configurations of ranging subchannels for other cells.*

3. *The mobile station of claim 1, wherein the set of ranging sequences for the cell is different from sets of ranging sequences for other cells.*

10. *The base station of claim 9, wherein the subcarrier configuration of the ranging subchannel for the cell is different from subcarrier configurations of ranging subchannels for other cells.*

11. *The base station of claim 9, wherein the set of ranging sequences for the cell is different from sets of ranging sequences for other cells.*

194. Based on Gibson’s teachings regarding configuring adjacent cells to operate differently to avoid interference, *see* Section IX.B, it would have been obvious that the “*subcarrier configuration of the ranging subchannel*” is different

for different cells (claims 2, 10) and to use different "*set[s] of ranging sequences*" in different cells (claims 3, 11), particularly for adjacent cells in the combined Koo-802.16ab-Chayat-Suzuki system. A POSA would have been motivated to do so in order to minimize or avoid co-channel interference between adjacent cells. *See* Section VII.E. And a POSA would have had a reasonable expectation of success in making the combination because, as Gibson teaches, it was routine and conventional to configure adjacent cells to operate differently (e.g., use different frequency configurations) in order to avoid inter-cell interference.

B. Dependent Claims 5 and 21

[5.P] *The mobile station of claim 1, further comprising an apparatus configured to control a transmission power of the ranging signal using an open-loop power control method by:*

[5.1] *estimating a path loss between the serving base station and the mobile station based on a received downlink signal;*

[5.2] *setting the transmission power of the ranging signal based on the path loss; and*

[5.3] *increasing the transmission power of the ranging signal for retransmission.*

[21.P] *The method of claim 17, further comprising controlling a transmission power of the ranging signal using an open-loop power control method by:*

[21.1] *estimating a path loss between the serving base station and the mobile station based on a received downlink signal;*

[21.2] *setting the transmission power of the ranging signal based on the path loss; and*

[21.3] *increasing the transmission power of the ranging signal for retransmission.*

195. Gibson discloses the conventional open-loop power control method recited in claims 5 and 21, explaining the benefits of power control in general and

open-loop power control in particular, specifically for TDD-based systems such as 802.16ab's first upstream access scheme. Section IX.D; EX1010, 0459-64; EX1012, 0086. A POSA would have been motivated and had a reasonable expectation of success in using Gibson's open-loop power control in the combined Koo-802.16ab-Chayat-Suzuki system for the same reasons discussed in Section IX.D (e.g., fast and accurate in TDD-based systems, and predictable use of conventional technique).

C. Dependent Claims 13 and 14

13. *The base station of claim 12, wherein the apparatus applies matched filtering to the received ranging signal to detect the ranging sequence.*

14. *The base station of claim 12, wherein the apparatus correlates the received ranging signal with a ranging sequence stored at the base station to detect the ranging sequence.*

196. The Koo-802.16ab-Chayat-Suzuki-Gibson combination renders obvious claims 13 and 14. 802.16ab discloses detecting "*the ranging sequence*," as recited in claim 12, but does not expressly disclose the "*matched filtering*" and "*correlat[ing]*" required in claims 13 and 14, respectively.

197. Gibson demonstrates that a "matched filter receiver" and a "correlation receiver" were well-known and obvious elements in mobile communication systems, such as base stations detecting a user's code. EX1010,

0154, 0193 (“most CDMA detectors are correlation receivers”). It would have been obvious to a POSA to include a matched-filter receiver or a correlation receiver, as taught by Gibson, in the BS of the Koo-802.16ab-Chayat-Suzuki system, which would have predictably enabled the BS to detect ranging codes.

XII. CONCLUSION

198. In signing this declaration, I recognize that the declaration will be filed as evidence in a contested case before the Patent Trial and Appeal Board of the United States Patent and Trademark Office. I also recognize that I may be subject to cross-examination in the case and that cross-examination will take place within the United States. If cross-examination is required of me, I will appear for cross-examination within the United States during the time allotted for cross-examination.

199. I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further 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 Title 18 of the United States Code.

Executed this 17 day of January, 2023.

Respectfully submitted,

Leonard J. Cimini, Jr., Ph.D.