IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent of:	Xiaodong Li et al.	
U.S. Patent No.:	8,467,366	Attorney Docket No.: 00035-0024IP1
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Appl. Serial No.:	13/205,579	
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Title:	METHODS AND APPARATUS FOR RANDOM ACCESS IN MULTI-CARRIER COMMUNICATION SYSTEMS	

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DECLARATION OF DR. VALENTI

I declare that all statements made herein on 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.

By: Matthew Valenti

Matthew Valenti, Ph.D.

Date: 9/15/21

Contents

I. QUALIFICATIONS AND BACKGROUND INFORMATION

1. I am currently a Professor of Computer Science and Electrical Engineering at West Virginia University in Morgantown, West Virginia. I have over 25 years' experience in telecommunications and communication technology, with an emphasis on wireless and cellular networks. In particular, this experience includes physical-layer technology and issues related to cellular network call processing, along with current cellular standards including the 3GPP family of specifications related to LTE and UMTS. I have particular research and teaching interests in communication theory and statistical signal processing. My full qualifications and experience are set out in my *Curriculum Vitae* ("CV"), as EX1004.

2. I received a Bachelor of Science in Electrical Engineering from Virginia Polytechnic Institute and State University (Virginia Tech) in 1992 and a Master of Science in Electrical Engineering at Johns Hopkins University in 1995. I subsequently completed a Ph.D. in Electrical Engineering from Virginia Tech in 1999.

3. In 1992, I started as a full-time Electronics Engineer at the U.S Naval Research Laboratory (NRL) in Washington D.C after having served as an intern there during the summer of 1991. I subsequently was awarded a Bradley Fellowship by Virginia Tech's Bradley Department of Electrical and Computer Engineering from August, 1995 to July, 1999. The Fellowship allowed me to go

on leave from my position at NRL and pursue my Ph.D. full time. In addition to being supported by the Bradley Fellowship, I served as a Research Assistant and as an Instructor at Virginia Tech.

4. Upon receiving my Ph.D., in August, 1999, I joined the Lane Department of Computer Science and Electrical Engineering at West Virginia University initially as an Assistant Professor. I was promoted to Associate Professor with Tenure in August, 2005 and to Professor in August, 2010; a position I still hold today.

5. From July 1, 2019 through June 30, 2021, I served as the Department Chair, first as an Interim Chair (2019-2020) and then as the Raymond Lane Chair of the Lane Department (2020-2021).

6. Through my work in the engineering field, I have been recognized as a registered Professional Engineer since 2011.

7. In 2018, I was elevated by the IEEE to the rank of Fellow in recognition of my contributions to wireless communications technology. In 2000, 2001, and 2008, I won awards for Outstanding Researcher in the Statler College of Engineering and Mineral Resources at West Virginia University.

8. I have published 38 journal papers and technical magazine articles and over 100 conference papers in the telecommunications field, focusing on wireless technologies, including ten papers in the journal *IEEE Transactions on Wireless*

Communications. Many of these papers are on technologies used by 3G, 4G, and 5G wireless systems. My CV (EX1004) also contains a list of my publications.

9. I am active in the editorship of journal publications in the field of wireless communications. I have served in several roles for the journal *IEEE Transactions on Wireless Communications*, a premier journal on wireless communication technology, including as Associate Editor (2007-2011), Member of the Executive Editorial Committee (2014-2017), Chair of the Executive Editorial Committee (2016-2017), and member of the Steering Committee (2021-present). I have also acted as an Editor for several other journals, including *IEEE Transactions on Communications, IEEE Transactions on Vehicular Technology*, and *IEEE Wireless Communications Letters*. Since 2015, I have acted as Editor-in-Chief of *IEEE Communications Society Best Readings*, which is an online resource containing curated collections of papers on specific state-of-the-art technologies including *Network Localization and Navigation*, *Non-Orthogonal Multiple Access*, and *Device-to-Device Communications*.

10. I am active in the organization of the Technical Program for major conferences sponsored by the IEEE's Communication Society. I was Co-Chair of the Technical Program Committee (TPC) for the *2021 IEEE International Conference on Communications (ICC)*, a flagship conference on communication technology that typically receives over 2,000 paper submissions. I currently serve

as the Chair of the *IEEE GLOBECOM/ICC Technical Content (GITC)* committee, which is the technical steering committee for both *ICC* and *GLOBECOM*, the Communication Society's other flagship conference. I was the TPC Chair for the *2017 IEEE Military Communications Conference (MILCOM)*, which is the premier conference on military communications, and I have served on the steering committee for *MILCOM* as well. In addition to these high-level positions, I have served as the TPC chair for tracks or symposia within many other conferences, including other installments of *ICC, GLOBECOM,* and *MILCOM*.

11. I am responsible for the design and delivery of academic courses in communication technologies at the undergraduate and graduate level. I have taught courses on Digital Signal Processing, Communication Theory, and Wireless Networks at West Virginia University, and have been instrumental in developing and creating student study guides (workbooks) on the topics of Wireless Networking, Coding Theory, and Digital Signal Processing.

12. I run an active research program focused on the development and evaluation of advanced communication transmission technology, including physical-layer technologies such as error control coding, hybrid ARQ, frequency hopping, multi-antenna transmission, and modulation. I have secured external competitive funding from agencies including the National Science Foundation (NSF) and the Office of Naval Research (ONR) to support my work. My duties include the

mentoring of graduate students, many of whom have supported my research activities as research assistants. To date, I have supervised the research of 49 students successfully graduating with advanced degrees, 9 at the Ph.D. level and 40 at the M.S. level.

13. I have extensive experience in developing software for the simulation and implementation of various aspects of wireless communication systems, such as Turbo Codes and hybrid ARQ. My software is available to the public in a package called the Coded Modulation Library (CML).[1] The software contains simulations of error-control codes such as Turbo Codes and technologies such as hybrid ARQ. Various aspects of the LTE, UMTS, HSDPA, cdma2000, and DVB-S2 standards are implemented in this software. The code has been incorporated into several commercial products.

14. I previously have been retained as an expert witness in US Proceedings in the United States District Courts, the United States Patent and Trademark Office, and the ITC. This has included acting as an expert for major technology companies and wireless carriers in patent disputes and investigations involving telephone modems, mobile phone handsets, LTE, WCDMA/UMTS and other core wireless technologies.

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[1] https://github.com/wvu-wcrl/CML

15. Based on my above-described near three decades of experience in communications technologies, and the acceptance of my publications and professional recognition by societies in my field, I believe that I am qualified to be an expert in wireless communication systems, communication networks, and signal processing.

16. I have been retained on behalf of Petitioner to offer technical opinions relating to U.S. Patent No. 8,467,366 ("the '366 Patent") and prior art references relating to its subject matter. I have reviewed the '366 Patent, and relevant excerpts of the prosecution history of the '366 Patent. Among various textbooks, documents, and publications, I have also reviewed the following prior art references:

Prior Art References	
EX1005	U.S. Patent Application Publication No. US20040001429 to Ma et al. ("Ma")
EX1006	TR 101 146 V3.0 ("TR")
EX1007	U.S. Patent No. US6101179 to Soliman ("Soliman")
EX1008	U.S. Patent No. US6600772 to Zeira et al. ("Zeira")
EX1009	U.S. Patent Application Publication No. US20020159422 to Li et al. ("Li")
EX1010	U.S. Patent Application Publication No. US20040114504A1 to Jung et al. ("Jung")
EX1011	U.S. Patent No. US6839876 to Tong et al. ("Tong")

EX1014	U.S. Patent No. US7263058 to Joo (“Joo”)
EX1015	U.S. Patent No. US8199632 to Geile et al. (“Geile”)
EX1016	ETSI Special Mobile Group (SMG) Report of UMTS 30.06 v3.0.0 (SMG-Report) [2]
EX1019	Dictionary Definition of “guard band” - McGraw-Hill Dictionary of Scientific and Technical Terms 6th Edition (Copyright@2003)
EX1022	Excerpts from *Digital Communications: Fundamentals and Applications*, 2nd Edition (Copyright@2001) (“Textbook”)

17. Counsel (Fish & Richardson) has informed me that I should consider these materials through the lens of one of ordinary skill in the art related to the ’366 Patent at the time of the earliest possible priority date of the ’366 Patent, and I have done so during my review of these materials. The ’366 Patent claims priority to US Provisional Application Serial No. 60/551,589, filed on February March 9, 2004. I have been informed by Counsel to use March 9, 2004 as the “Priority Date” in my analysis below.

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[2] TR and SMG-Report are referred in the alternative because they are technically identical in content, with different document formats (PDF vs. zip file with a word document and annex). *See generally* EX1006, EX1016. All citations will be to the former and not the latter.

18. I have no financial interest in the outcome of this proceeding. I am being compensated for my time spent as an expert on an hourly basis. My compensation is not dependent on the outcome of these proceedings or the content of my opinions.

19. In writing this declaration, I have considered the following: my own knowledge and experience, including my work experience in the fields of electrical engineering and wireless communication networks; my experience in teaching related subjects; and my experience in working with others involved in those fields. In addition, I have analyzed various publications and materials, in addition to other materials I cite in my declaration.

20. My opinions, as explained below, are based on my education, experience, and expertise in the fields relating to the '366 Patent. Unless otherwise stated, my testimony below refers to the knowledge of one of ordinary skill in the art as of the earliest possible priority date. Any figures that appear within this document have been prepared with the assistance of Counsel and reflect my understanding of the '366 Patent and the prior art discussed below.

II. OVERVIEW OF CONCLUSIONS FORMED

21. This declaration explains the conclusions that I have formed based on my analysis. To summarize those conclusions, based upon my knowledge and experience and my review of the prior art references listed above, I believe that:

- Claims 1-4, 6-12, 14-20, 22-24 are obvious over Ma in view of TR.
- Claims 5 and 21 are obvious over Ma in view of TR and Soliman.
- Claim 13 is obvious over Ma in view of TR and Li.
- Claims 1-4, 6-12, 14-20, 22-24 are obvious over Ma in view of Jung.
- Claims 5 and 21 are obvious over Ma in view of Jung and Soliman.
- Claim 13 is obvious over Ma in view of Jung and Li.

22. In support of these conclusions, I provide an overview of the references in Section VI and more detailed comments regarding the obviousness of claims 1-24 ("**the Challenged Claims**") of the '366 Patent in Section VII.

III. LEVEL OF ORDINARY SKILL IN THE ART

23. One of ordinary skill in the art relating to, and at the time of, the Priority Date would have been someone with at least a Bachelor's degree in an academic area emphasizing electrical engineering or a similar discipline, and at least two years of experience in the field working with, teaching, or researching wireless communication networks. Superior education could compensate for a deficiency in work experience, and *vice-versa*.

24. Based on my experience, I have an understanding of the capabilities of a person of ordinary skills in the art (POSITA). Indeed, I have taught, mentored, participated in organizations, and worked closely with many such persons over the

course of my career. For example, from my industry consulting or conference interactions, I am familiar with what a POSITA would have known and found predictable in the art. From teaching and supervising my graduate students, I also have an understanding of the knowledge that a person with this academic experience possesses. Furthermore, I possess those capabilities myself.

IV. LEGAL STANDARDS

A. Terminology

25. I have been informed by Counsel and understand that the best indicator of claim meaning is its usage in the context of the patent specification as understood by one of ordinary skill. I further understand that the words of the claims should be given their plain meaning unless that meaning is inconsistent with the patent specification or the patent's history of examination before the Patent Office. Counsel has also informed me, and I understand that, the words of the claims should be interpreted as they would have been interpreted by one of ordinary skill at the time of the invention was made (not today). I have been informed by Counsel that I should use March 9, 2004 as the point in time for claim interpretation purposes with respect to this petition.

B. Legal Standards

26. I have been informed by Counsel and understand that documents and materials that qualify as prior art can render a patent claim unpatentable as being anticipated or obvious.

27. I am informed by Counsel and understand that all prior art references are to be looked at from the viewpoint of a person of ordinary skill in the art at the time of the invention, and that this viewpoint prevents one from using his or her own insight or hindsight in deciding whether a claim is anticipated or rendered obvious.

1. Anticipation

28. I understand that patents or printed publications that qualify as prior art can be used to invalidate a patent claim as anticipated or as obvious.

29. I understand that, once the claims of a patent have been properly construed, the second step in determining anticipation of a patent claim requires a comparison of the properly construed claim language to the prior art on a limitation-by-limitation basis.

30. I understand that a prior art reference "anticipates" an asserted claim, and thus renders the claim invalid, if all limitations of the claim are disclosed in that prior art reference, either explicitly or inherently (i.e., necessarily present).

2. Obviousness

31. I understand that even if a patent is not anticipated, it is still invalid if the differences between the claimed subject matter and the prior art are such that the

subject matter as a whole would have been obvious at the time the invention was made to a POSITA.

32. I have been informed by Counsel and understand that a claim is unpatentable for obviousness and that obviousness may be based upon a combination of prior art references. I am informed by Counsel and understand that the combination of familiar elements according to known methods is likely to be obvious when it does no more than yield predictable results. However, I am informed by Counsel and understand that a patent claim composed of several elements is not proved obvious merely by demonstrating that each of its elements was, independently, known in the prior art.

33. I am informed by Counsel and understand that when a patented invention is a combination of known elements, a court determines whether there was an apparent reason to combine the known elements in the fashion claimed by the patent at issue by considering the teachings of prior art references, the effects of demands known to people working in the field or present in the marketplace, and the background knowledge possessed by a person having ordinary skill in the art.

34. I am informed by Counsel and understand that a patent claim composed of several limitations is not proved obvious merely by demonstrating that each of its limitations was independently known in the prior art. I am informed by Counsel and understand that identifying a reason those elements would be combined can be

important because inventions in many instances rely upon building blocks long since uncovered, and claimed discoveries almost of necessity will be combinations of what, in some sense, is already known. I am informed by Counsel and understand that it is improper to use hindsight in an obviousness analysis, and that a patent's claims should not be used as a "roadmap."

35. I am informed by Counsel and understand that an obviousness inquiry requires consideration of the following factors: (1) the scope and content of the prior art, (2) the differences between the prior art and the claims, (3) the level of ordinary skill in the art, and (4) any so called "secondary considerations" of non-obviousness, which include: (i) "long felt need" for the claimed invention, (ii) commercial success attributable to the claimed invention, (iii) unexpected results of the claimed invention, and (iv) "copying" of the claimed invention by others.

36. I have been informed by Counsel and understand that an obviousness evaluation can be based on a single reference or a combination of multiple prior art references. I understand that the prior art references themselves may provide a suggestion, motivation, or reason to combine, but that the nexus linking two or more prior art references is sometimes simple common sense. I have been informed by Counsel and understand that obviousness analysis recognizes that market demand, rather than scientific literature, often drives innovation, and that a

motivation to combine references may be supplied by the direction of the marketplace.

37. I have been informed by Counsel and understand that if a technique has been used to improve one device, and a person of ordinary skill at the time of invention would have recognized that it would improve similar devices in the same way, using the technique is obvious unless its actual application is beyond his or her skill.

38. I have been informed by Counsel and understand that practical and common sense considerations should guide a proper obviousness analysis, because familiar items may have obvious uses beyond their primary purposes. I have been informed by Counsel and understand that a person of ordinary skill looking to overcome a problem will often be able to fit together the teachings of multiple prior art references. I have been informed by Counsel and understand that obviousness analysis therefore takes into account the inferences and creative steps that a person of ordinary skill would have employed at the time of invention.

39. I have been informed by Counsel and understand that a proper obviousness analysis focuses on what was known or obvious to a person of ordinary skill at the time of invention, not just the patentee. Accordingly, I understand that any need or problem known in the field of endeavor at the time of invention and addressed by the patent can provide a reason for combining the elements in the manner claimed.

40. I have been informed by Counsel and understand that a claim can be obvious in light of a single reference, without the need to combine references, if the elements of the claim that are not found explicitly or inherently in the reference can be supplied by the common sense of one of skill in the art.

41. I have been informed by Counsel and understand that there must be a relationship between any such secondary considerations and the invention, and that contemporaneous and independent invention by others is a secondary consideration supporting an obviousness determination.

42. In sum, my understanding is that prior art teachings are properly combined where one of ordinary skill having the understanding and knowledge reflected in the prior art and motivated by the general problem facing the inventor, would have been led to make the combination of elements recited in the claims. Under this analysis, the prior art references themselves, or any need or problem known in the field of endeavor at the time of the invention, can provide a reason for combining the elements of multiple prior art references in the claimed manner.

43. I have been informed by Counsel and understand that in an *inter partes* review (IPR), "the petitioner shall have the burden of proving a proposition of unpatentability," including a proposition of obviousness, "by a preponderance of the evidence." 35 U.S.C. § 316(e).

V. THE ’366 PATENT

A. Overview of the ’366 Patent

44. The ’366 Patent is directed to “[m]ethod and apparatus in a multi-carrier cellular wireless network with random access [that] improve receiving reliability and reduce interference of uplink signals of a random access, while improving the detection performance of a base station receiver by employing specifically configured ranging signals.” EX1001, Abstract.

45. As the ’366 Patent acknowledges in the Background section, it had been known “In a wireless communication system, a mobile station first needs to perform a random access for establishing communication with a base station. **The random access typically includes**[3] two steps: **(1) Ranging** and (2) Resource Request and Allocation.” EX1001, 1:24-28.

46. More specifically, it had been known that the **(1) Ranging step** includes the steps:

[i] the mobile station sends a signal to the base station,

[ii] the base station can identify the mobile station and measure the power and time delay of the mobile station, and

[3] Bold represents added emphasis, unless otherwise specified.

[iii] [the base station informs] the mobile station for power adjustment and time advance.

EX1001, 1:28-32.

47. Then, during the (2) Resource Request and Allocation, "the uplink and downlink resources for communication are requested and allocated." EX1001, 1:32-34.

48. The '366 Patent goes on to acknowledge that it had been known that **"[t]he ranging process typically involves an exchange of messages between the base station and the mobile station** by which th**e mobile station aligns itself with the start of each time slot** after compensating for propagation delay and other factors." EX1001, 1:43-47.

49. The '366 Patent attempts to solve the "problem in a shared medium communication network [that] involves the ranging of many mobile stations[:] When many mobile stations attempt to perform the ranging simultaneously, they are forced to contend for access to the shared channel and it becomes difficult for any of **the mobile stations to complete the ranging process** due to the large number of collisions. As a result, the time needed for all of the mobile stations to complete the ranging process is excessive, and much bandwidth on the shared channel is wasted." EX1001, 1:47-55.

50. The ’366 Patent purports “to improve receiving reliability and to reduce interference with other uplink signals” by designing “ranging signals.” EX1001, 2:41-44. Specifically, the ’366 patent uses “**ranging subchannels**”, “each of which is composed of multiple blocks of subcarriers” to transmit ranging signals. EX1001, 3:27-29.

51. FIG. 4 of the ’366 patent “illustrates two ranging subchannels”:

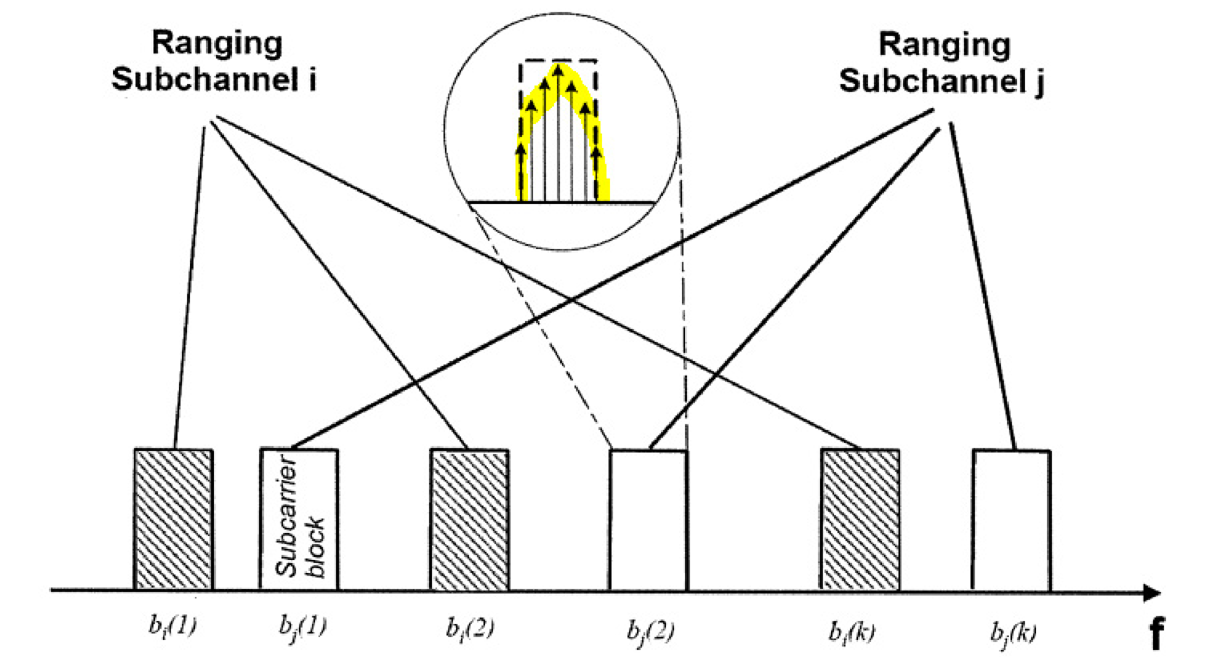

FIG. 4

52. The ’366 Patent-FIG. 4 (highlighted).

53. The ’366 Patent discloses that “FIG. 4 schematically shows that the signal power of the subcarriers towards the boundary (the lower ends and the higher ends in frequency) of a block is lower than that of the subcarriers towards the center of

the block." EX1001, 3:29-33. The '366 Patent notes "**a special case**, [where] **the power levels of the two subcarriers at both ends of a block are set to zero**," which is also the case claimed in all the claims of the '366 Patent. EX1001, 3:33-35, claims 1, 9, 17 and 22. *See e.g.*, claim 1 of the '366 Patent recites:

> 1. 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:
>
> 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
>
> an apparatus configured to transmit a ranging signal to the serving base station in the cell over a ranging subchannel for random access, 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;
>
> 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**.

54. The ’366 Patent discloses “Because different factors may cause possible overlap of two subcarrier blocks from to [sic] different transmitters, **the attenuated boundary subcarriers will minimize the resulting interference**.” EX1001, 3:35-38.

55. However, using **attenuated boundary subcarriers**, such as **null or zero subcarriers “at both ends of a block**” as the special case claimed by the ’366 Patent is nothing more than a “guard band,” a feature well-known in the prior art for reducing interference as of the Critical Date of the ’366 Patent. A guard band is “a narrow frequency band provided between adjunct channels in certain portions of the radio spectrum to prevent interference between stations.” EX1019, 3. The “guard band as is known to one skilled in the art” at least as of 1995, if not earlier. EX1015, 24:45, 119:59. “**Guard bands** are provided **at each end of the spectrum** to **allow for selectivity filtering** after transmission and prior to reception.” EX1015, 55:20-23. In fact, guard bands had been used in OFDM systems. For example, Geile discloses “**guard bands [being] provided at each end** of [a block of] the 6 MHz band” to “separate[] from carriers of adjacent [blocks of] 6 MHz

bands," "**to allow for filter selectivity** at the transmitter and receivers of the system." EX1015, 40: 32-41, FIG. 13.

56. Moreover, Joo discloses that, in an OFDM system, a **guard band** can be implemented as **null or zero subcarriers at both ends of a block of subcarriers** as described/claimed in the '366 patent. *See* EX1014, 3:3-8 ("a **guard band is defined to minimize adjacent channel interference**. In OFDM being a multi-carrier system, **null data is inserted in the outermost sub-carriers in the frequency domain** to solve the problem of adjacent channel interference. The **outermost sub-carriers are the middle indexes among IFFT input indexes**.")

57. From at least the above reasons, as well as my explanation below in Sections VI and VII, the alleged "**special case**, [where] **the power levels of the two subcarriers at both ends of a block are set to zero**" claimed by the '366 Patent, is essentially the well-known "guard band" feature, which had already been implemented in OFDM systems before the Critical Date of the '366 Patent. EX1001, 3:33-35, claims 1, 9, 17 and 22.

B. Prosecution History of the '366 Patent

58. The '366 Patent issued from U.S. Patent Application No. US13/205,579 ("the '579 application"), which was filed on 2011-08-08 and claims the benefit of U.S. Provisional Patent Application No. 60/551,589, entitled "METHODS AND APPARATUS FOR RANDOM ACCESS IN MULTI-CARRIER

COMMUNICATION SYSTEMS," filed Mar. 9, 2004. EX1001, cover. The '366 Patent issued without receiving any Office Action. *See generally* EX1002. The Examiner allowed the '366 patent over the prior art of record, Um US2010/0111017, with the reason for allowance being:

> The prior art of record Um does not disclose [1] the ranging signal lasts over a period of one or multiple orthogonal frequency division multiplexing (OFDM) symbols and [2] the ranging signal exhibits a low peak-to-average power ratio in the time domain; and [3] the ranging subchannel comprises at least one block of subcarriers within the communication channel and [4] 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, 126.

59. However, as I explain below in Sections VI and VII, these features were known and rendered obvious by prior art references.

VI. OVERVIEW AND COMBINATIONS OF PRIOR ART REFERENCES

A. Ma (EX1005)[4]

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[4] General descriptions provided for the references and combinations discussed in Section VI are incorporated into each subsection addressing/applying those references, as are the discussions of combinations.

60. Similar to the ’366 patent, Ma is directed to a multi-carrier wireless network, specifically, an Orthogonal Frequency Division Modulation (OFDM) network. EX1005, Abstract. Ma discloses “an uplink **air interface** used in a **wireless communication network**” that includes “two different **OFDMA** modes [i.e.,] Mode-1 and Mode-2” that share “a common wireless channel … within an overall OFDM band.” EX1005, 0002, 0124. The first mode, “Mode-1[,] is used to provide low rate circuit oriented connectivity for multiple users simultaneously preferably using orthogonal code separation,” EX1005, 0124. The second mode, “Mode-2[,] is used to provide higher rate bursty packet connectivity.” *Id.* “**Mode-1 supports** the provision of **user dedicated channels with fixed data** rate to support real-time service, uplink signalling and simple messaging.” EX1005, 0143. **Mode-2**, on the other hand, “**supports** the transmission of **high speed data bursts**.” *Id.*

61. Similar to the ’366 patent, Ma also “provides a **Random Access Channel (RACH)** for UE’s new to a particular wireless network to access the system.” EX1005, 0205. Ma discloses that “**the RACH is transmitted simultaneously** both in time and frequency **with the transmission of the other Mode-1 signals by other users**.” EX1005, 205.

62. Ma discloses an example random access “procedure for UE to initiate a connection with access network” through use of the RACH:

1) After power on, **UE** synchronizes to the base station for timing and frequency and at the same time **selects the serving base station**, for example through the detection of a downlink preamble.

2) **UE** listens to a DL [downlink] signaling channel for the information identifying the **RACH PN [pseudo-noise] codes to be used in that cell/sector**.

3) UE measures the DL long term C/I [Carrier to Interference].

4) **UE sends RACH code** chosen randomly from serving base station's code set **via** an ALOHA **RACH channel**. The transmit power is determined inversely proportional to the DL long term C/I measurement.

5) If **the base station detects the RACH code successfully it measures the time offset of that UE** and then sends the initial dedicated uplink access channel grant, together with the RACH code index as well as **the time offset information**. The UE then detects such signature to identify access grant through DL signaling channel.

6) **UE adjusts its timing** and sends back its ID, its CQI report information, and uplink traffic load request if it wants to start uplink data transmission, for example via an initial dedicated uplink signalling channel, one of the parallel low delay circuitry data channels discussed previously.

7) Base station schedules the uplink multi-user accesses based on the measured uplink channel condition from Mode-1 pilot, and the traffic requirements reported from different active UEs.

8) The channel resource assignment and the coding/modulation primitives for different UE are signaled via DL signaling channel.

EX1005, 0234-0242.

63. As shown, Ma discloses a **random access** process that includes **ranging** (e.g., steps (2)-(6)) using a ranging signal (e.g., a signal formed from "the RACH code") as claimed by the '366 Patent, consistent with the '366 Patent's description. *See e.g.,* the '366 Patent discloses that "**random access** … improving the detection performance of a base station receiver **by employing** specifically configured **ranging signals,**" EX1001, Abstract. The '366 Patent explains that "**The random access typically includes … (1) Ranging** …. **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, 1:26-33. "The **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.

B. TR (EX1006)

64. TR is a technical report that "describes the detailed evaluation work towards the definition of the Universal Mobile Telecommunications System UMTS Terrestrial Radio Access (UTRA)." EX1006, 5. It provides "technical proposals for radio access technologies for the UMTS Terrestrial Radio Access," which includes a "β-concept based on OFDMA" "as a possible basis for the UTRA standard" as

detailed in Annex B. EX1006, 1-3, 5-6, 174. TR "describes the basic concept behind the OFDMA proposal and its advantages and featuers [sic] which is the most advanced of its kind present today." EX1006, 175.

65. TR describes "RACH (Random Access Channel) Physical Structure" and "OFDMA Resource Allocation/Physical Channel." EX1006, 191, 196-200. Similar to the '366 patent, TR describes a random access process that includes ranging that "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." EX1001, 1:43-47. *See* EX1006, 206:

> "After the mobile has detected the basestations [*sic*] timing **it sends an RACH to the basestation. The BS measures the time offset for the received RACH and sends back the necessary timing advance to the MS** (very similar to GSM). In the frame structure of the OFDMA system reserved slots for reception of RACH exist."

66. Similar to the '366 patent's claimed "*subchannel*," TR discloses "bandslots" where "The whole system frequency band is divided into small blocks (bandslots) with a fixed number of subcarriers." EX1006, 199. A RACH can use one bandslot, as shown in "Figure 4: RACH Structure," EX1006, 197.

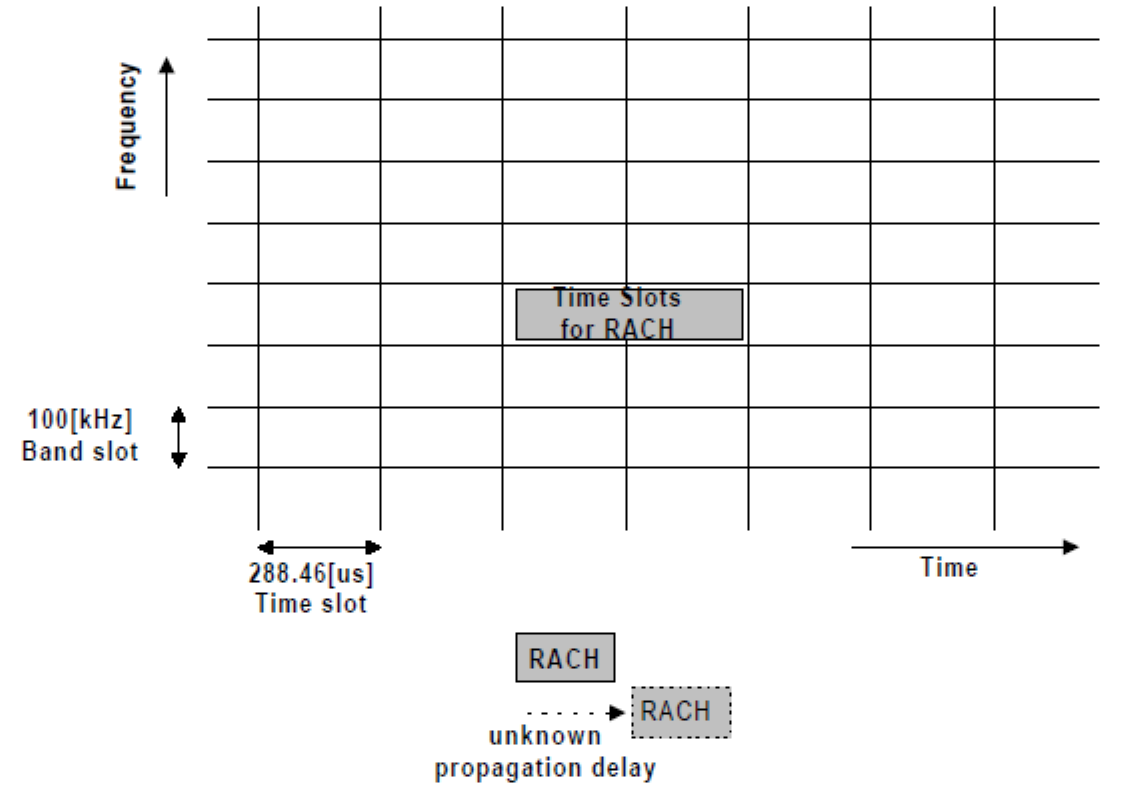


Figure 4: RACH Structure

TR-Figure.4

67. Similar to the '366 patent's claimed feature that "*power levels of subcarriers at both ends of a block are set to zero*," TR discloses "Unmodulated Guard Carrier," namely, "the two subcarriers at the edge of the bandslot [that] are left unmodulated" (i.e., unused and thus having zero power) in each bandslot "to reduce adjacent channel emissions and facilitate easy bandslot separation." EX1006, 199. Modulation is described in Section 5.3.22 of TR and may be either differential QPSK (quadrature phase shift keying) or differential 8PSK (8-ary phase shift keying). EX1006, 202. A POSITA would recognize that this means a

subcarrier would convey a QPSK or 8PSK symbol of non-zero power when that subcarrier was modulated, and that when the subcarrier was unmodulated, the power would be zero due to the absence of a QPSK or 8PSK symbol. The guard carrier is used "to relax receiver blocking requirements. In addition, the interference of two adjacent blocks of subcarriers is reduced, which may occur when their orthogonality is compromised due to nonlinear PA [power amplifier] effects." *Id.* The fact that interference is reduced is a consequence of the subcarriers at the ends of the block having zero power due to the absence of a modulated symbol. As I discussed above in paragraphs 55-57, such a use of unmodulated subcarriers is a well-known implementation of a "guard band" to prevent interference in an OFDM system.

C. Combination of Ma and TR ("Ma-TR")

68. As explained above, Ma discloses an OFDMA-based air interface system and TR proposes an OFDMA-based air interface for a UMTS system. EX1005, 0002, 0124. EX1006, 175. Moreover, both Ma and TR disclose random access processes using RACH. *See e.g.,* EX1005, 0205. EX1006, 197, 206. To implement Ma's OFDMA-based air interface system, a POSITA would have reasons to leverage the basic system characteristics of the OFDMA-based air interface proposal for a UMTS system as disclosed in TR, especially given various advantages of the OFDMA-based air interface identified in TR, including

flexibility in supporting both circuit switched services (e.g., voice) and packet oriented services. EX1006, 177, 180 and 182. For example, an obvious integration of TR into Ma would have involved configuring Ma's RACH channel with the guard carrier/guard band feature as disclosed by TR, (e.g., by leaving subcarriers on the edge of a bandslot unmodulated/unused) to create a guard band between adjacent subchannels as taught by TR, because per TR, such a guard carrier/guard band feature can advantageously (1) reduce adjacent channel emissions (2) facilitate easy bandslot separation, (3) relax receiver blocking requirements, and (4) reduce the interference of two adjacent blocks of subcarriers. EX1006, 199.

69. In fact, the Ma and TR combination ("Ma-TR") would have merely involved incorporating prior art elements (the well-known guard carrier/guard band feature as disclosed by TR, as well as Joo and Geile) to a known system (Ma's OFDMA communication system) ready for improvement to yield predictable results. EX1019, 3, EX1006, 199, EX1014, 3:3-8, EX1015, 40: 32-41, FIG. 13. A POSITA would have had a reasonable expectation of success in this implementation at least because Ma and TR are related to similar methods and systems (i.e., data transmission and random access in OFDMA-based communication systems).

D. Soliman (EX1007)

70. Soliman discloses "A method and System for **open loop power control** in a CDMA communication system." EX1007, Abstract. Open loop power control has

been known and used in legacy/existing communication standards such as IS-95, "the Telecommunications Industry Association/Electronic Industries Association (TIA/EIA) Interim Standard IS-95," where "the **mobile station uses the measured total received power** along with typical values of certain base station parameters to get a rough **estimate of the transmission loss between the unit and the base station**. Based on these measurements, the forward link transmission loss is estimated and used to determine the proper open loop power control setting for the mobile station transmitter. The **mobile station's transmit power is adjusted to match the estimated path loss**, **to arrive at the base station at a predetermined level**." EX1007, 2:22-35; 1:19-23.

71. Soliman discloses the open loop power control method is used during a random access process, i.e., "When it is necessary for mobile station 102 to **send a message on the access channel,** such as in order **to initiate a call origination or perform a registration**, **mobile station** controller 116 **calculates the proper initial access probe power level** to be used by transmitter 122." EX1007, 6:48-52.

E. Combination of Ma, TR and Soliman ("Ma-TR-Soliman")

72. With respect to power control, Ma discloses, similar to Mode-1 operation, "open-loop power control[]" can be applied to RACH. EX1005, 0170, 0147, 0186, 0196–0200. More specifically, Ma discloses "preferably a **power ramping**

procedure is applied, and therefore the **RACH channel is transmitted with minimized power** to reduce the inter-channel interference to Mode-1 traffic and signaling channels. More specifically, an initial attempt is made with a very low power. The absence of power control commands from the base station is construed as a failed attempt and **the next attempt is made with a slightly increased power**." EX1005, 0209.

73. Ma also discloses the UE controls the RACH's "**power [to be] inversely proportional to the long-term estimated DL C/I measurement** … (more generally, RACH power increases as estimate decreases)." EX1005, 0197. A POSITA would understand that Ma's power control scheme applied to the RACH is "*an open-loop power control method*" because, consistent with the known open-loop power control method in the field, Ma's power control scheme applied to the RACH does not require an explicit power control command from the base station. For example, Soliman discloses "Based on these measurements, the forward link transmission loss is estimated and used to determine the proper open loop power control setting for the mobile station transmitter." EX1005, 0170; EX1007, 2:22-35. "For subsequent probes on the access channel, each access probe sequence is sent at an increased power level until a response is obtained or the sequence ends." EX1007, 2:60-64. Indeed, open-loop power control is well-known in the prior art as of the Critical Date of the '366 Patent. For example, Zeira describes a typical

open loop power control process of a "UE's transmission power level" that does not require an explicit power control command from the base station but the UE's estimation of a "downlink pathloss" and "a desired received power level at the base station":

> One approach to control transmission power levels is open loop power control. **In open loop power control, typically** a base station 30_1 transmits to a UE 32_1 a reference downlink communication and the transmission power level of that communication. The UE 32_1 receives the reference communication and measures its received power level. By subtracting the received power level from the transmission power level, a **pathloss for the reference communication is determined**. To **determine a transmission power level for the uplink**, the downlink pathloss is added to a **desired received power level at the base station** 30_1. The **UE's transmission power level is set to the determined uplink transmission power level**.
>
> EX1008, 1:51-63.

74. Moreover, TR makes it clear that the RACH uses "(Open Loop Power Control)," in that "The RACH burst will be transmitted at the same power which was estimated as the down link signal strength (Open Loop Power Control) based on the received IACH and BCCH information." EX1006, 197. It would have been obvious to a POSTA, in view of both Ma's and TR's disclosure and explanation of

open-loop power control of RACH, that TR-Ma discloses "an open-loop power control method" applied to RACH. EX1005, 0170; EX1006, 197.

75. As such, Ma-TR discloses "*an open-loop power control method" applied to RACH.* To the extent that one argues that Ma-TR does not explicitly disclose implementation details of "*open loop power control*," Soliman discloses the implementation details. *See e.g.,* EX1007, 2:22-35,1:19-23, 6:48-7:44. A POSITA would have turned to Soliman's teachings to predictably implement "*open loop power control*" in Ma-TR's OFDM communication system, resulting in a predictable combination, Ma-TR-Soliman.

76. In fact, a POSITA would have multiple reasons to combine Ma-TR and Soliman. **First**, a POSITA would have understood that the implementation details were well-known techniques in the field and had been incorporated in standards such as IS95 as expressly disclosed by Soliman. *See e.g.,* EX1008, 1:51-63; EX1007, 2:23-24; **Second**, to a POSITA, implementing the open loop power control as disclosed by Soliman in the random access process disclosed by Ma-TR would have been merely an application of a known technique (open loop power control) to a known system (Ma's communication system) ready for improvement to yield predictable results. EX1007, 2:22-35,1:19-23, 6:48-7:44. **Third**, a POSITA would have recognized that, compared to closed loop power control which requires explicit signaling (a power control command) from the base station,

xopen loop power control can reduce the system signaling overhead, especially "when the quality of the path loss measurement is high," or "Under certain conditions, the network operator may desire to use solely open loop… power control." EX1005, 0197, 0209. EX1008, 5:45-47; 7:18-20. A POSITA thus would have been prompted to apply the implementations details of open loop power control as disclosed by Soliman in the random access process disclosed by Ma-TR to achieve these predictable benefits with a reasonable expectation of success.

F. Li (EX1009)

77. Li discloses "multi-subscriber systems utilizing the basic modulation formats of orthogonal frequency division multiplexing (OFDM) and spread spectrum transmission." EX1009, 0001. Li discloses "a base station having a receiver." EX1009, 0061. "The received signal samples are input to correlator 701, which despreads the samples using the same spreading sequence that was used during transmit and correlates the incoming signal with a subscriber's spreading code. In **an alternative embodiments, correlator 701 may be replaced with a match filter**" to serve the same purpose. EX1009, 0063.

G. Combination of Ma, TR, and Li ("Ma-TR-Li")

78. As discussed above, Li expressly discloses "correlator 701 may be replaced with a match filter." EX1009, 0063. In view of Li's disclosure, it would have been obvious to a POSITA to replace the correlator as disclosed by Ma-TR (e.g., *the*

“**physical blocks,** or [] **a single design** implemented **in software and/or hardware and/or firmware**” of the “**OFDMA receiver 600** [that] **would typically be a base station**” for performing the correlation function as disclosed by Ma, EX1005, 0264) with a match filter as disclosed by Li, resulting in a predicable combination, Ma-TR-Li, that renders obvious a base station comprising an apparatus that applies *matched filtering to the received ranging signal to detect the ranging sequence*.

79. Moreover, other reasons existed that would have prompted a POSITA to combine Ma-TR, and Li. **First**, the combination would have been merely the application of a known technique (swapping a correlator with a matched filter, as taught by Li) to a known system (Ma’s communication system) to yield predictable results, without significantly altering or hindering the functions performed by the communication system. Indeed, it had been known to a POSITA as of the Critical Date of the ’366 Patent that a matched filter can be used to perform correlation and is an alternative of a “correlator.” For example, a Textbook I have owned and used before the Critical Date of the ’366 Patent explicitly states: “The term **‘matched filter’ is** often used **synonymously with ‘correlator**,” and “Therefore, it is valid to implement the receiving filter in Figure 3.1 with **either a matched filter or a correlator**.” EX1022, 8. *See also* Figure 3.1 of the Textbook, which shows both a matched filter and a correlator and is entitled “**Equivalence of matched filter and**

correlator." EX1022, 9. **Second**, in scenarios where the base station is already equipped with a matched filter to decode signals transmitted according to legacy communication standards (e.g., CDMA-based standards), reusing the matched filter would have advantageously saved implementation cost while maintaining the base station's backward compatibility with legacy communication standards.

H. Jung (EX1010)

80. Jung relates to "generating a preamble sequence in an orthogonal frequency division multiplexing (OFDM) communication system having m subcarriers in a frequency domain" and "generating a preamble sequence having a minimum peak-to-average power ratio (PAPR)." EX1010, Abstract, 0003. Jung notes that "the low PAPR condition which must be considered first of all for the preamble sequence." EX1010, 0052.

81. Jung makes it clear that the preamble sequence is used for **ranging**, including "initial ranging", "bandwidth request ranging", and "periodic ranging". EX1010, 0029-0033.

82. Jung discloses and emphasizes the notion of "**a guard interval in a frequency domain,**" EX1010, 0043, 0076, 0105, which is analogous to the guard interval in the time domain to reduce interference. EX1010, 0009. The guard interval in the frequency domain can be implemented by inserting null data to subcarriers at both ends of the frequency band of the OFDM symbol. EX1010,

0043. For example, among all subcarriers of an OFDM symbol (e.g., “of the 256 subcarriers”), “only 200 subcarriers are used” whereas “**Null data, or 0-data, is inserted in each of** the 0^{th} subcarrier, **-128^{th} to -101^{st} subcarriers and 101^{st} to 127^{th} subcarriers, before being transmitted**.” EX1010, 0042. Jung explains that “the reason for inserting null data into 28 subcarriers of the -128^{th} to -101^{st} subcarriers and 27 subcarriers of the 101^{st} to 127^{th} subcarriers is **to provide a guard interval in a frequency domain** because the 28 subcarriers of the -128^{th} to -101^{st} subcarriers and the 27 subcarriers of the 101^{st} to 127^{th} subcarriers correspond to a high frequency band in the frequency domain.” EX1010, 0043. *See also* Joo’s similar disclosure that “**null data is inserted in the outermost sub-carriers in the frequency domain** to solve the problem of adjacent channel interference. The **outermost sub-carriers are the middle indexes among IFFT input indexes**,” which is to create “a **guard band [] to minimize adjacent channel interference**.” EX1014, 3:3-8.

I. Combination of Ma and Jung (“Ma-Jung”)

83. As explained above in Section VI-A, Ma discloses a random access process that transmits a ranging sequence with low PAPR over a RACH channel in an OFDM system. EX1005, 0205, 0234-0242, 0193, 0019. Jung discloses generating a ranging sequence with minimum PAPR. EX1010, 0029-003, 0052. A POSITA would have been motivated to use Jung’s proposed sequence for ranging in Ma’s

RACH channel to achieve the known benefits of using sequences of a minimal PAPR in an OFDM system (which is Ma's system) "to maximize transmission efficiency of a power amplifier (PA) in a transmitter of an OFDM communication system," "thereby improving performance of the OFDM communication system," and for "reason why the OFDM communication system uses a preamble sequence having a minimal PAPR." EX1010, 0019, 0115, 0006.

84. Moreover, Jung, like TR as well as Joo and Geile, again shows the well-known guard band feature in OFDM systems by inserting "null data" into subcarriers on both ends of a block of subcarriers "to provide a guard interval in a frequency domain," EX1010, 0042-0043. *See also* EX1006, 199, EX1014, 3:3-8, EX1015, 40: 32-41, FIG. 13. A POSITA would have been motivated to insert null tones on both ends of the block of subcarriers of Ma's RACH channel "to provide a guard interval in a frequency domain" and thus reduce interference, as taught by Jung. *Id*. Indeed, this ordinary implementation of the guard interval in the frequency domain would have been merely the application of a known technique (applying "**Null data, or 0-data"** in the frequency domain on both ends of a subchannel for transmitting a ranging sequence, as taught by Jung and consistent with the well-known guard band feature) to a known system (Ma's OFDMA communication system) ready for improvement to create a guard band between multiplexed subchannels to yield predictable results. A POSITA would have had a

reasonable expectation of success in this implementation at least because Ma and Jung are related to similar methods and systems (i.e., transmitting preamble sequences for ranging/random access in OFDM systems).

J. Combination of Ma, Jung and Soliman ("Ma-Jung-Soliman")

85. As explained above in Section VI-D, a POSITA would understand that Ma's power control scheme applied to the RACH is "*an open-loop power control method*" and thus Ma-Jung discloses that *the UE comprises an apparatus configured to control a transmission power of the ranging signal using an open-loop power control method*. See the discussion of Ma-Jung combination in Section VI-I.

86. To the extent that one argues that Ma-Jung does not explicitly disclose implementation details of "*open loop power control*," Soliman discloses the implementation details. *See e.g.,* EX1007, 2:22-35,1:19-23, 6:48-7:44. Multiple reasons existed that would have prompted a POSITA to combine Ma-Jung and Soliman, resulting in a predictable combination, Ma-Jung-Soliman.

87. For example, **first**, a POSITA would have understood that the implementation details were well-known techniques in the field and had been incorporated in standards such as IS95 as expressly disclosed by Soliman. *See e.g.,* EX1008, 1:51-63; EX1007, 2:23-24. **Second**, to a POSITA, implementing the open loop power control as disclosed by Soliman in the random access process disclosed

by Ma-Jung would have been merely an application of a known technique (open loop power control) to a known system (Ma's communication system) ready for improvement to yield predictable results. **Third**, a POSITA would have recognized that, compared to closed loop power control which requires explicit signaling (a power control command) from the base station, open loop power control can reduce the system signaling overhead, especially "when the quality of the path loss measurement is high," or "Under certain conditions, the network operator may desire to use solely open loop… power control." EX1008, 5:45-47; 7:18-20. A POSITA thus would have been prompted to apply the implementations details of open loop power control as disclosed by Soliman in the random access process disclosed by Ma-Jung to achieve these predictable benefits with a reasonable expectation of success.

K. Combination of Ma, Jung and Li ("Ma-Jung-Li")

88. Similar to discussion in Section VI-G, multiple reasons existed that would have prompted a POSITA to combine Ma-Jung, and Li, resulting in a predicable combination, Ma-Jung-Li.

89. **First**, Li expressly discloses that "correlator 701 may be replaced with a match filter" for a base station to detect a received sequence. EX1009, 0063. Li's disclosure would have prompted a POSITA to replace the correlator as disclosed by Ma-Jung with a match filter as disclosed by Li. EX1009, 0063. **Second**, the

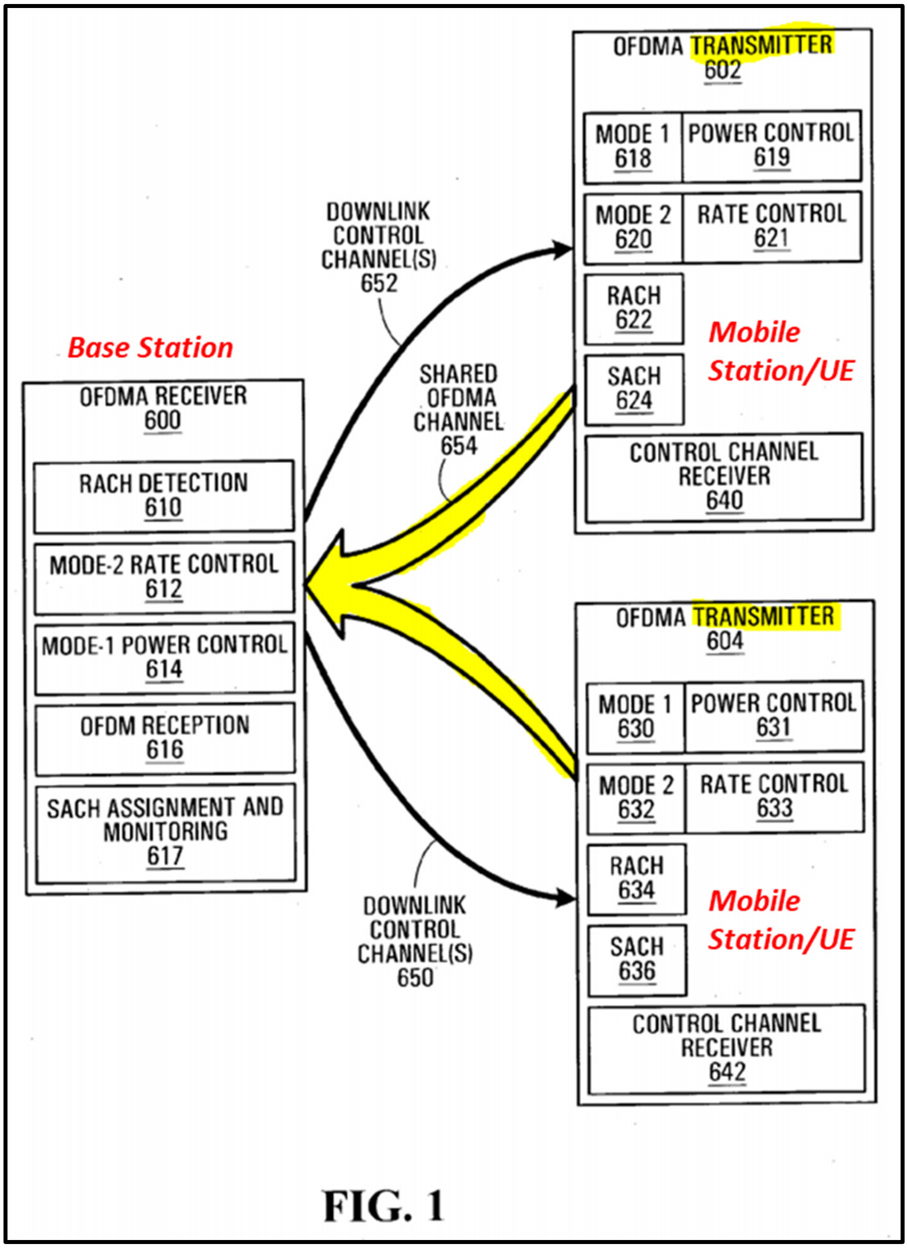
combination would have been merely the application of a known technique (swapping a correlator with a matched filter, as taught by Li) to a known system (Ma's communication system) to yield predictable results with a reasonable expectation of success, without significantly altering or hindering the functions performed by the communication system. Indeed, it had been known to a POSITA as of the Critical Date of the '366 Patent that a matched filter can be used to perform correlation and is an alternative of a "correlator." For example, a Textbook I have owned and used before the Critical Date of the '366 Patent explicitly states: "The term **'matched filter' is** often used **synonymously with 'correlator**,'' and "Therefore, it is valid to implement the receiving filter in Figure 3.1 with **either a matched filter or a correlator**." EX1022, 8. *See also* Figure 3.1 of the Textbook, which shows both a matched filter and a correlator and is entitled "**Equivalence of matched filter and correlator**." EX1022, 9. **Third**, in scenarios where the base station is already equipped with a matched filter to decode signals transmitted according to legacy communication standards (e.g., CDMA-based standards), reusing the match filter would have advantageously saved implementation cost while maintaining the base station's backward compatibility with legacy communication standards.

VII. MANNER IN WHICH THE PRIOR ART REFERENCES RENDER THE '366 CLAIMS UNPATENTABLE

A. Ground-A1 - Claims 1-4, 6-12, 14-20, 22-24 are Obvious in view of Ma-TR

[1Pre/9Pre/17Pre/22Pre] In a [multi-cell] orthogonal frequency division multiple access (OFDMA) wireless communication system comprising a plurality of base stations and mobile stations,

90. Ma discloses "FIG. 1 is a system diagram of an **OFDMA system**," (i.e., *OFDMA wireless communication system*). Ma discloses that "A **wireless network** typically **includes access points (e.g. base stations)** [*comprising a plurality of base stations*] through which **User Equipment (UE)** [*mobile stations*] may access the wireless network," e.g., through "OFDMA," "the OFDM-based uplink **multiple-user** access scheme," "in a common wireless channel." EX1005, 0003, 0110. Ma's "FIG. 1 is a system diagram of an **OFDMA system**." EX1005, 0093, 0264. As shown in FIG. 1, the UE can be "the OFDMA **transmitter 602,604** [that] is a **wireless terminal such as a mobile station**." EX1005, 0093, 0264.



Ma-FIG. 1 (annotated)

91. Ma discloses a *multi-cell* OFDMA system by disclosing, e.g., "**multiple cells**" and noting that "In cellular networks the uplink air interface must take into account transmissions from **multiple UE's** operating **in the same cell** as well as transmissions from UE's operating **in adjacent cells**." EX1005, 0126, 0005.

[1Pre] a mobile station configured to communicate with a serving base station in a cell via a communication channel, the mobile station comprising:

[17Pre] a method for signal transmission by a mobile station to a serving base station via a communication channel, the method comprising:

92. Ma discloses *a mobile station* (i.e., UE or wireless terminal) *configured to communicate with a serving base station in a cell via a communication channel* *See* e.g., EX1005, 0004 ("in a cellular network [*in a cell*], **an uplink** consists of many point-to-point transmissions that are all directed to **a base station** (access point) [*a serving base station*] and that originate from **respective UE's** [*a mobile station*] **operating within a cell (coverage area) serviced by the base station**") [*configured to communicate with a serving base station in a cell/a method for signal transmission by a mobile station to a serving base station*]. Ma discloses *a communication channel* between the base station and the UE such as "**a common wireless channel 50** [*a communication channel*] is implemented using an OFDM transmission scheme within an overall OFDM band." EX1005, 0004, EX1005, 0124.

93. Ma also discloses such a *mobile station* and such a *method for signal transmission by a mobile station to a serving base station* by disclosing various operations of the *mobile station* (i.e., UE or wireless terminal) as described below, as well as by explicitly disclosing, for example, "a **method** and **apparatus** for **uplink multiple-user access** is provided." EX1005, 0110.

[9Pre] a base station configured to communicate with mobile stations in a cell via a communication channel, the base station comprising:

[22Pre] a method for receiving signals by a base station from a plurality of mobile stations via a communication channel, the method comprising:

94. Ma discloses "a base station (access point)" *configured to communicate with (including receiving signals from) mobile stations* (i.e., UE or wireless terminal) *in a* "cell (coverage area)" *via a communication channel. See* e.g., EX1005, 0004, 0003 ("Each **access point** [*a serving base station*] typically **services** a softly delineated geographic **area that is known as a coverage area**, in which **UE** [*mobile stations*] **can be used to establish a wireless link with the particular access point**.")

95. Ma discloses *a base station configured to communicate with mobile stations/a method for receiving signals by a base station receiving signals from a plurality of mobile stations*, via "**a common wireless channel 50**[that] is implemented using an OFDM transmission scheme within an **overall OFDM band** [*a communication channel*]." EX1005, 0004, 0003, 0124.

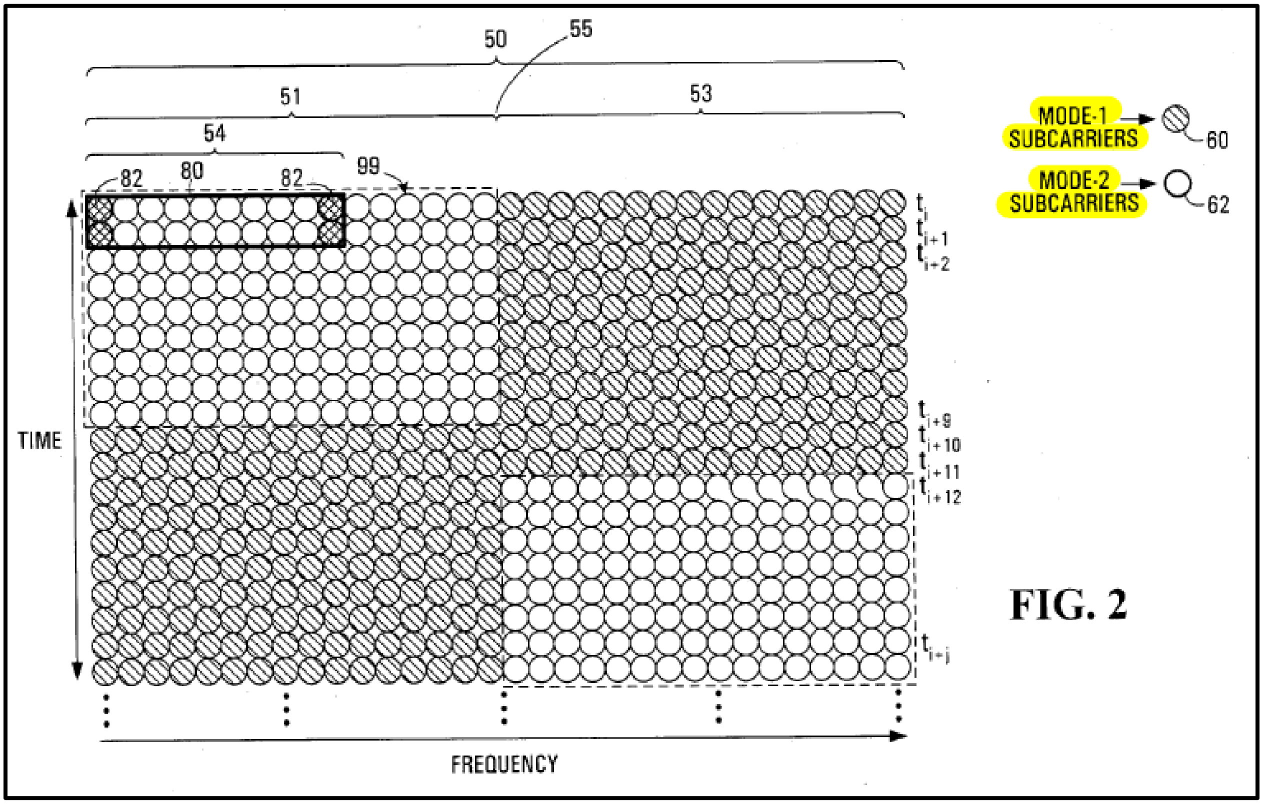
96. Ma also discloses such a *mobile station* and such *a method for receiving signals by a base station from a plurality of mobile stations* by disclosing various operations of the "base station (access point)" as described below, as well as by explicitly disclosing "a **method** and **apparatus** for **uplink multiple-user access** is provided." EX1005, 0110.

[1a/17a] [an apparatus configured to transmit]/[transmitting] a data signal [over a data subchannel] 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

[9a/22a] [an apparatus configured to receive]/[receiving] a data signal [over a data subchannel] 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

97. Ma discloses the UE *transmits data to the serving base station in the cell over* "data channels" [*data subchannel*]. EX1005, 0244. Specifically, Ma discloses "two types of uplink traffic channel" [*data subchannel*] including "Fixed Data Rate Dedicated Traffic Channel (Mode-1)" and "dedicated fast traffic channel" ("Mode-2"). EX1005, 0183-0185; 0245-247. "FIG. 2 shows an example of time-frequency resource allocation for Mode-1 and Mode-2." EX1005, 0125. As shown, "**a common wireless channel 50** [*the communication channel*] is implemented using an OFDM transmission scheme within **an overall OFDM band**. … during a given symbol duration, the OFDM band is divided into **two frequency bands 51, 53 which can be used interchangeably to provide two different OFDMA modes** provided by embodiments of the invention. **The two different OFDMA modes are referred to** herein generally **as Mode-1 and Mode-2** respectively." EX1005, 0124. Mode-1 and Mode-2 are allocated with respective time-frequency resources, and "FIG. 2 shows an example of time-frequency

resource allocation for Mode-1 and Mode-2." EX1005, 0125.



Ma-FIG. 2 (highlighted)

98. Ma discloses for "a given user" (UE), a *data subchannel* includes "a respective set of Space-Time Coded Sub-Blocks **(STC-SB)** in the time-frequency dimension" that "**map[] data to the band,**" wherein "**An STC-SB is a mapping of data to a wireless channel that has both a time and a frequency dimensions**." EX1005, 0130. Ma's *data subchannel comprises a plurality of subcarriers* because "**a single STC-SB spans multiple sub-carriers** and multiple symbol durations." *Id.* Ma further discloses that "**STC-SB's from different UE's** [*data subchannels comprising a plurality of subcarriers*]," "**[w]ithin frequency**

band 50 of FIG. 2 [*within the communication channel*],” “do not overlap in time or in frequency within the same cell/sector for **both Mode-1 and Mode-2 operation**. This has the effect of significantly reducing intra-cell interference. Moreover, in some embodiments, **orthogonal mapping patterns are employed for each user** that also provide time-frequency diversity. A discussion detailing **orthogonal hopping (mapping) patterns that can be used for Mode-1 or Mode-2 transmissions are provided further below in relation to the details of Mode-1.**” EX1005, 0135.

99. For example, for a Mode-1 *data subchannel*, Ma discloses that “FIG. 4 provides an example illustration of the transmission in time and frequency of **a user's Mode-1 signal**…. In this example, the **Mode-1 frequency band is divided** into **three sub-bands**, and each of the three **sub-bands is sized to carry an STC sub-block** in the form of sub-block 16 of FIG.3” and “**Each of the sub-bands defines a channel for Mode-1 transmission** [a Mode-1 *data subchannel*].” EX1005, 0158-0159. As shown in FIG. 4, “during each symbol duration, **the user is transmitting on one of the three sub-bands**” (i.e., the mobile station *transmits a data signal to the serving base station/the base station receives a data signal from a first mobile station in the cell over a data subchannel*) and “each of the three **sub-bands** [*the data subchannel*] **is sized to carry** an STC[Space-Time Coded Sub-Blocks **(STC-SB)] sub-block” “span[ing] multiple sub-carriers”**

[*comprises a plurality of subcarriers*] of the "Mode-1 frequency band" within the "frequency band 50"/"common wireless channel 50 [that] is implemented using an OFDM transmission scheme within an overall OFDM band [*within the communication channel*]" EX1005, 0158, 0135, 0124. That is, the UE transmits data in *a data subchannel* (e.g., "a channel for Mode-1 transmission") that *comprises a plurality of adjacent subcarriers* (e.g., "data subcarriers") *within the communication channel* (e.g., "a common wireless channel 50 … within an overall OFDM band"). *Id.*

100. Ma's data subchannel spans multiple *adjacent* sub-carriers," which satisfies the limitation that recites "*adjacent* ***or*** *non-adjacent subcarriers,*" because either "adjacent subcarriers" or "non-adjacent subcarriers" would satisfy the limitation. EX1005, 0130, FIG. 4.

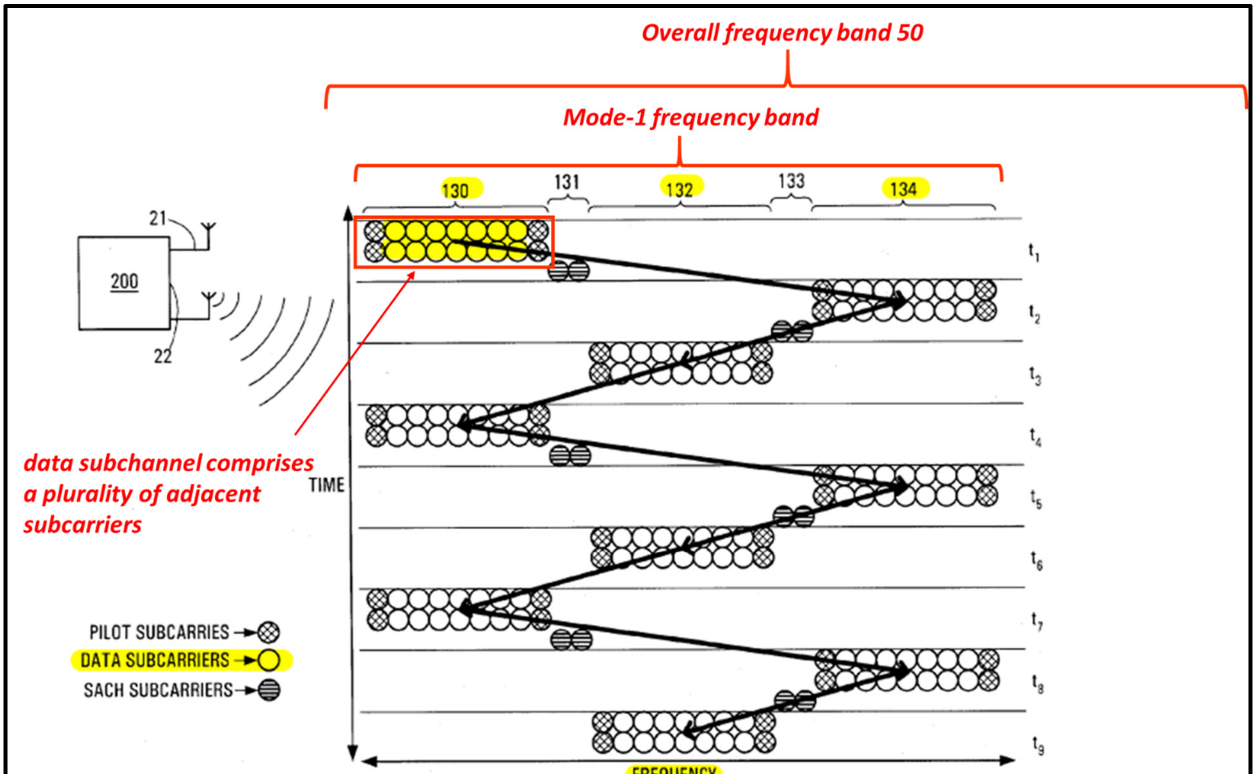


FIG. 4

Ma-FIG. 4 (annotated)

101. For a Mode-2 *data subchannel*, Ma discloses "in the example assignment of **STC sub-blocks for Mode-2** [Mode-2 *data subchannel*] given in FIG. 12, the **STC sub-blocks** of a given user are **contiguously assigned**." EX1005, 0251. As shown in FIG. 12, Ma shows "**a frequency band assigned for Mode-2 operation** …, preferably they are **assigned in contiguous blocks** both in time and frequency. Thus, in the illustrated example shown is **a first block of STC sub-blocks 84 consisting of two adjacent STC sub-blocks in frequency** transmitted for four STC sub-blocks in time. This is used for **user 1 pilot sub-carriers 93 and**

user 1 data sub-carriers 94" [*comprises a plurality of adjacent subcarriers*] EX1005, 0248. That is, for the Mode-2 *data subchannel*, a given UE (e.g., "UE 1") transmits data in *a data subchannel* (e.g., the TC sub-blocks contiguously assigned to UE 1) that *comprises a plurality of adjacent subcarriers* (e.g., "user 1 pilot sub-carriers 93 and user 1 data sub-carriers 94") *within the communication channel* (t "a frequency band assigned for Mode-2 operation" which is within "a common wireless channel 50 … within an overall OFDM band"). EX1005, 0248, 0251, 0125.

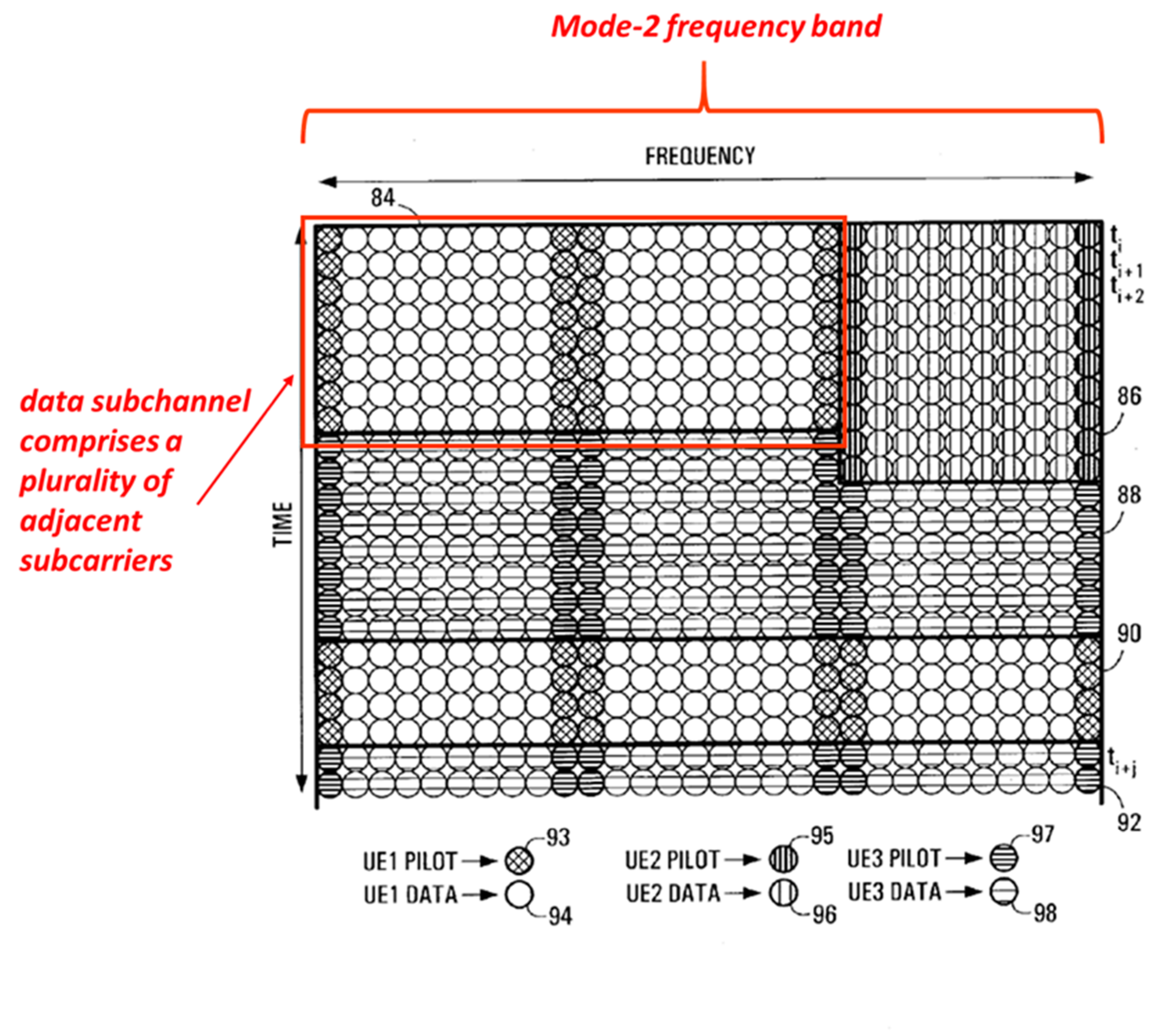
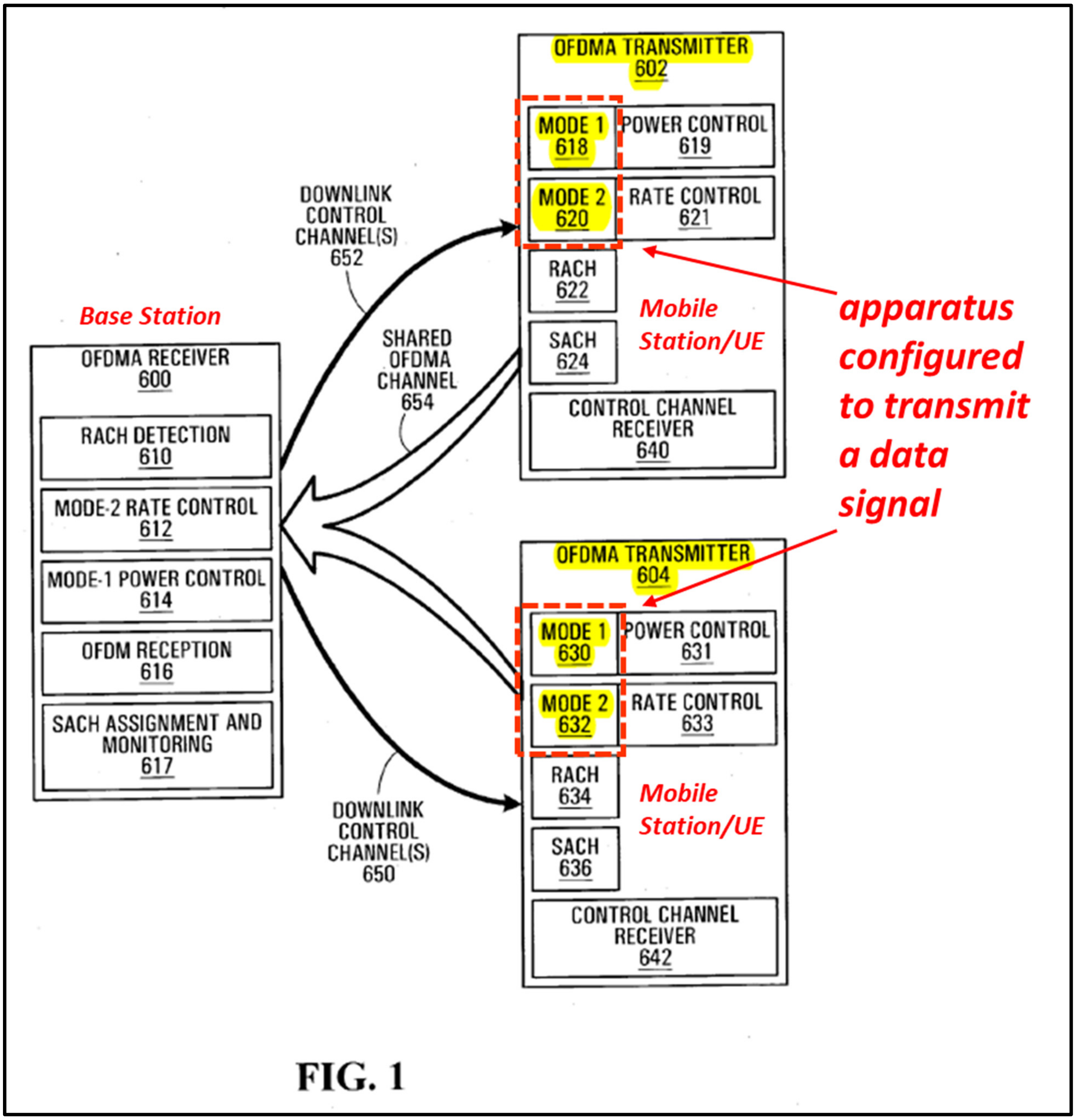


FIG. 12

Ma-FIG. 12 (annotated)

102. Ma discloses the mobile station/UE comprising *an apparatus configured to transmit such a data signal.* For example, as shown in FIG. 1, "**the OFDMA transmitter 602,604 is** a wireless terminal such as **a mobile station,**" "Each **OFDMA transmitter 602,604** [the mobile station/UE] **has a respective Mode-1**

function 618,630, a respective Mode-2 function 620,632 [*an apparatus configured to transmit the data signal*]." EX1005, 0264.



Ma-FIG. 1 (annotated)

103. Ma discloses the base station comprising *an apparatus configured to receive such a data signal.* For example, as shown in FIG. 1, "The **OFDMA receiver 600 would typically be a base station** …. The **OFDMA receiver 600** [the base station] is shown to **include** … **OFDMA reception functionality 616** [*an apparatus configured to receive such a data signal*] **which is responsible for receiving the Mode-1 and Mode-2 data of multiple users**." EX1005, 0264.

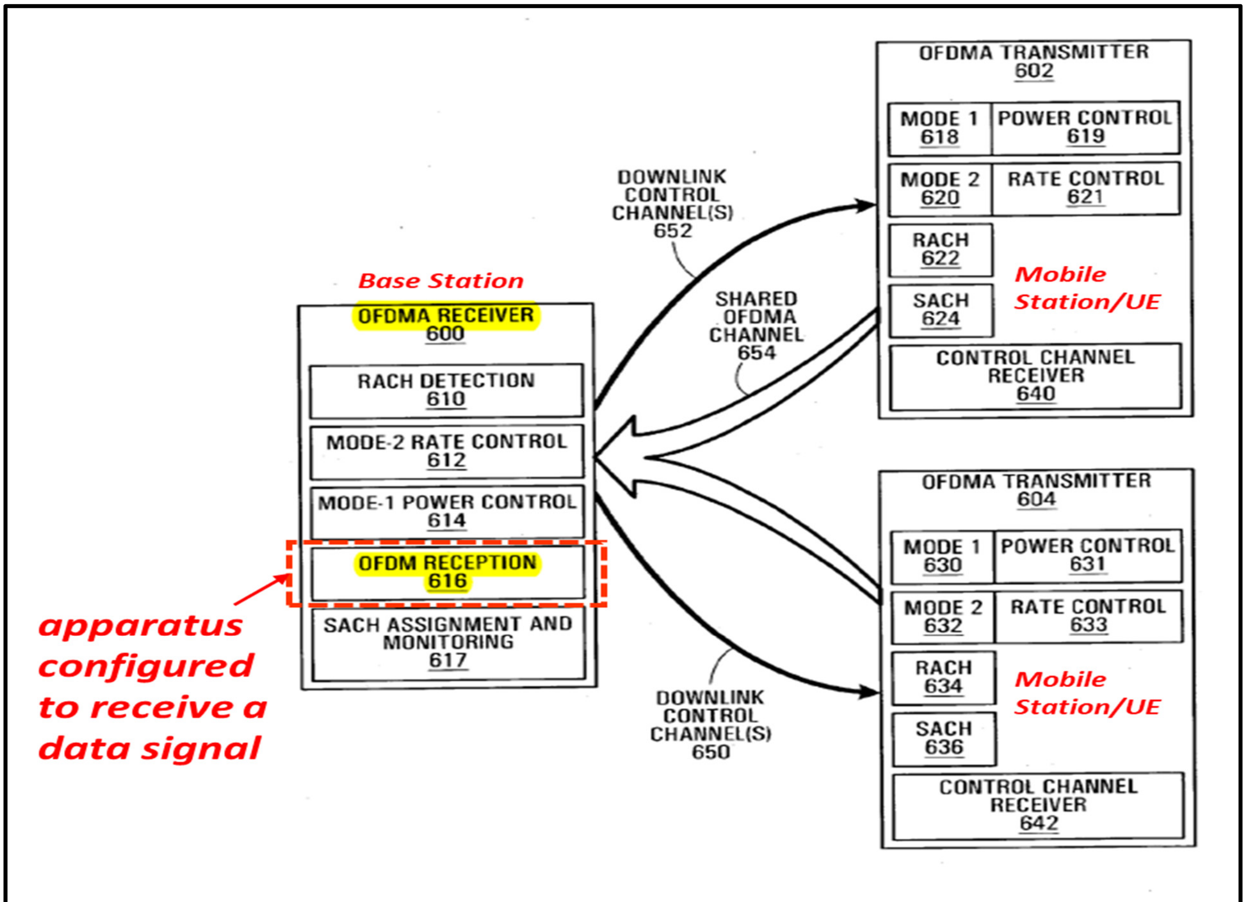


FIG. 1

Ma-FIG. 1 (annotated)

104. Ma makes it clear that the "**Mode-1 function 618,630, [and] Mode-2 function 620,632**" are *apparatuses* of the mobile stations and the "**OFDMA reception functionality 616**" is an *apparatus* of the base station by disclosing that "It is to be understood that in the **OFDMA receiver 600**, typically many other functions would be required in a complete system. Furthermore, the **functions** which are shown **can be implemented** as separate physical blocks, or can be integrated into a single design implemented **in software and/or hardware and/or firmware**. The **same is true for each of the OFDMA transmitters 602**,**604**." EX1005, 0264.

[1b/17b] [an apparatus configured to transmit]/[transmitting] a ranging signal [over a ranging subchannel] to the serving base station [in the cell over a ranging subchannel] for random access, wherein:

[9b/22b] [an apparatus configured to receive]/[receiving] a ranging signal [from a second mobile station in the cell] over a ranging subchannel for random access [by a second mobile station], wherein:

105. The '366 Patent does not define the "*ranging subchannel*," but merely repeats that "a ranging subchannel [] contains multiple subcarriers" or "is composed of multiple blocks of subcarriers." EX1001, 3:40-41; 3:27-28, 4:6-7. Nor does the '366 Patent define a "*ranging signal*," except broadly describing that "the ranging signal is carried over a ranging subchannel that contains multiple subcarriers. Either binary or non-binary signals can be modulated on the subcarriers of a ranging subchannel." EX1001, 3:39-42.

106. The '366 Patent appears to define "*a ranging sequence*" based on the broadly disclosed "*ranging subchannel*": "**The sequence of modulating signals in a ranging subchannel** is called **a ranging sequence**. Multiple ranging sequences are permitted in a cell. A mobile station chooses a ranging sequence for random access and uses the sequence to identify itself in the initial communication with a base station. The period of a ranging signal is called a ranging slot." EX1001, 3:43-48.

107. As set forth in Section VI.A, Ma discloses a random access process that includes ranging. Ma discloses a RACH code/signature transmitted in a RACH channel, *see e.g.*, EX1005, 0238 ("UE sends **RACH code** chosen randomly from serving base station's code set **via** an ALOHA **RACH channel**"); EX1005, 0207 ("The **RACH** is preferably implemented using **a long spreading code** which is then mapped to OFDM symbols in a defined **RACH slot**"); EX1005, 0208 ("The **RACH channel** structure is preferably **based on PN spreading**, overlaid over the MC-OFDMA. **For each RACH slot,** a plurality of Quasi-orthogonal **PN codes define a set of RACH signatures**."); EX1005, 0214 ("A Golay sequence can be used as RACH signature"). The RACH code/signature, which is a PN/Golay sequence, constitutes "*a ranging sequence*" of modulating signals in the "RACH channel" and the "RACH channel" constitutes *a ranging subchannel,* consistent with the '366 Patent's description. *Id. See also,* EX1005, 0205 ("a Random Access

Channel (RACH) for UE's new to a particular wireless network to access the system"); EX1001, 3:43-48.

108. Ma also discloses a *ranging signal* (e.g., a signal formed from "the RACH code/signature" transmitted via the "RACH channel." *See e.g.,* EX1005, 0238 ("**UE sends RACH code** chosen randomly from **serving base station**'s code set **via** an ALOHA **RACH channel**"). Ma thus discloses that the UE sends a ranging signal that includes a RACH code/signature over the RACH channel to a serving base station. *Id.*

109. Correspondingly, the serving base station receives such a ranging signal from the UE. *See* EX1005, 0219 ("After randomly selecting one of **the RACH signatures, an accessing UE transmits** using the whole available access band—this preferably includes all Mode-1 sub-carriers. **The base station looks for these access attempts**.") Ma further discloses that "the **base station detects the RACH** code" and discloses "**detection of the RACH channel at the base station**" and "a joint RACH detection is summarized in the flowchart of FIG. 11" which includes "Step 11-7: Extract **received RACH** after interference cancellation [of a received signal]" by the base station. EX1005, 0239, 0218, 0220-0232. Accordingly, Ma also discloses that the base station *receives a ranging signal from a mobile station in the cell over a ranging subchannel for random access*.

110. Ma also envisions that the base station can receive the ranging signal "*from a* ***second*** *mobile station in the cell,*" different from a "***first*** *mobile station in the cell*" from which the data signal is received in claim element [***9a/22a***] as Ma discloses "transmissions from multiple UE's operating in the same cell." EX1005, 0005. "**While the RACH is being used, the user** is in an in-active state and as such **is not transmitting on the data channels**. Similarly, **when the user is transmitting data, there is no need for the RACH**." EX1005, 0244.

111. Ma discloses the mobile station/UE comprising *an apparatus configured to transmit such a ranging signal.* For example, as shown in FIG. 1, "**the OFDMA transmitter 602,604 is** a wireless terminal such as **a mobile station,**" "Each **OFDMA transmitter 602,604** [the mobile station/UE] **has … a respective RACH function 622,634** [*an apparatus configured to transmit the ranging signal*]." EX1005, 0264.

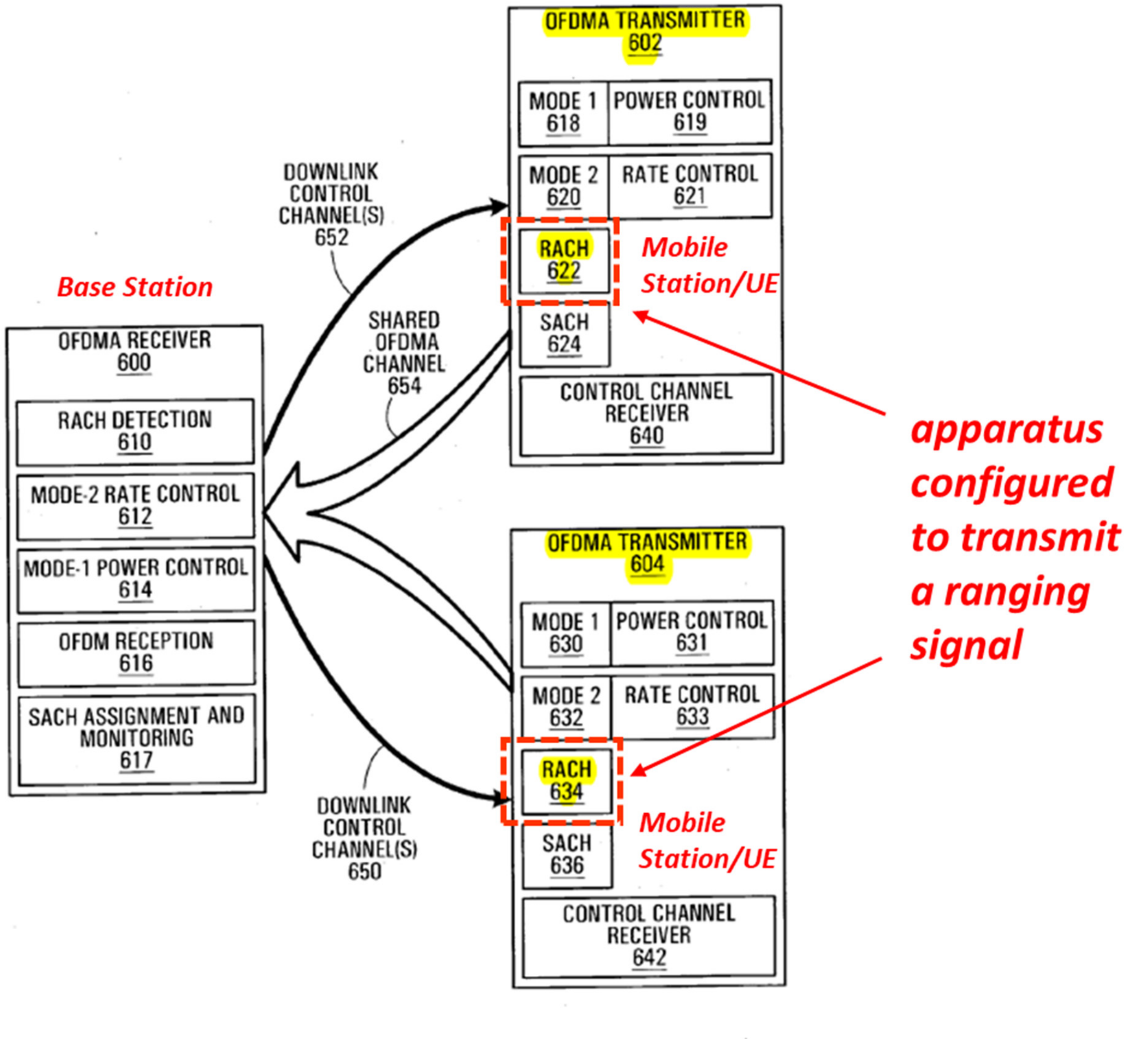


FIG. 1

Ma-FIG. 1 (annotated)

112. Ma discloses, as shown in FIG. 1, "The **OFDMA receiver 600 would typically be a base station** …. The **OFDMA receiver 600** [the base station comprising *an apparatus* (e.g., "**RACH detection function 610** [*an apparatus*

configured to receive such a ranging signal (e.g., signal transmitted in a RACH channel/a "received RACH" signal)]. EX1005, 0264, 0239, 0218, 0220-0232.

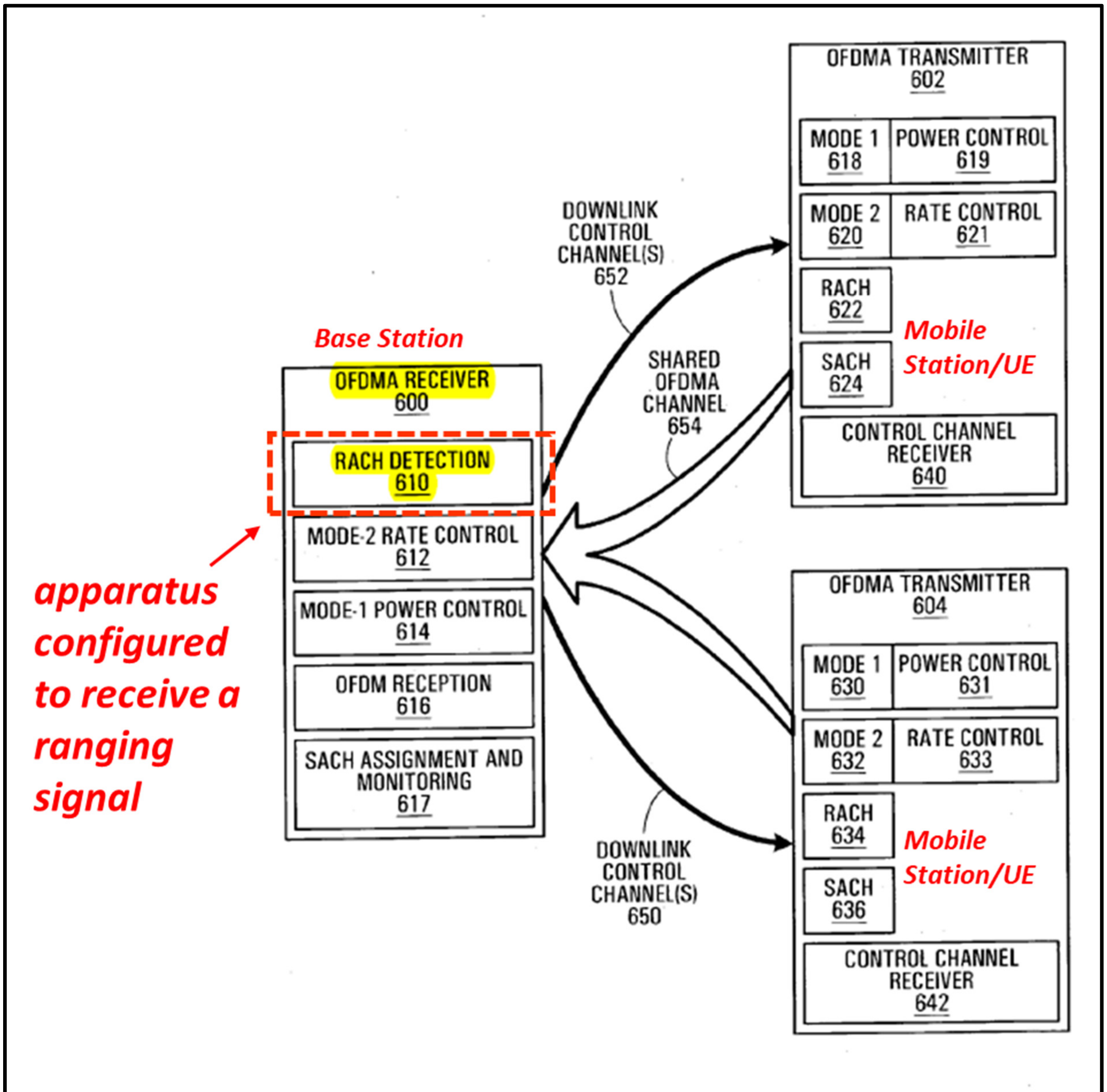


FIG. 1

Ma-FIG. 1 (annotated)

113. Ma makes it clear that the "**respective RACH function 622,634**" are *apparatuses* of the mobile stations and the "**RACH detection function 610**" is an *apparatus* of the base station by disclosing that "It is to be understood that in the **OFDMA receiver 600**, typically many other functions would be required in a complete system. Furthermore, the **functions** which are shown **can be implemented as separate physical blocks**, or can be integrated into a single design implemented **in software and/or hardware and/or firmware**. The **same is true for each of the OFDMA transmitters 602**,**604**." EX1005, 0264.

[1c/9c/17c/22c] 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;

114. As set forth in Section VII.A.[*1b/9b/17b/22b]*, Ma discloses the ranging signal is formed from a RACH code/signature (i.e., *a ranging sequence*), which is a PN/Golay sequence. *See* EX1005, 0238 (the "**RACH code** chosen randomly from **serving base station's code set**" [i.e., *a set of ranging sequences associated with the cell*]); EX1005, 0215 ("A dedicated long complex **PN/Golay code set** is **reserved for RACH of each base station**"); EX1005, 0214 ("A **Golay sequence can be used as RACH signature**").

115. The *ranging signal and/or* RACH code is used *for identifying the UE* because "If the base station detects the RACH code successfully it measures the time offset of that UE and then sends the initial dedicated uplink access channel

grant, together with the RACH code index as well as the time offset information. The UE then detects such signature to identify access grant through DL signaling channel." EX1005, 0239. That is, the RACH code is a unique identifier for the UE that allows the base station to associate a specific time offset and uplink channel grant for the particular UE and send that information back to the UE via the DL signaling channel. The UE, upon detecting its RACH code in the DL signaling channel, retrieves the corresponding time offset and uplink channel grant information, which the UE can then use to upload data to the base station via a dedicated uplink. *Id.*

[1d/9d/17d/22d] 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

116. Ma's ranging signal is transmitted in a RACH channel, and "T**he RACH is preferably implemented** using a long spreading code which is then mapped to OFDM symbols **in a defined RACH slot**" (i.e., *the ranging signal lasts* a RACH slot) EX1005, 0238, 0207. In an example, "**each RACH slots consisting of 4 OFDM symbols**," (i.e., each RACH slot lasts 4 OFDM symbols) Thus, Ma discloses *the ranging signal lasts over a period of multiple* (e.g., 4) *OFDM symbols*. EX1005, 0214.

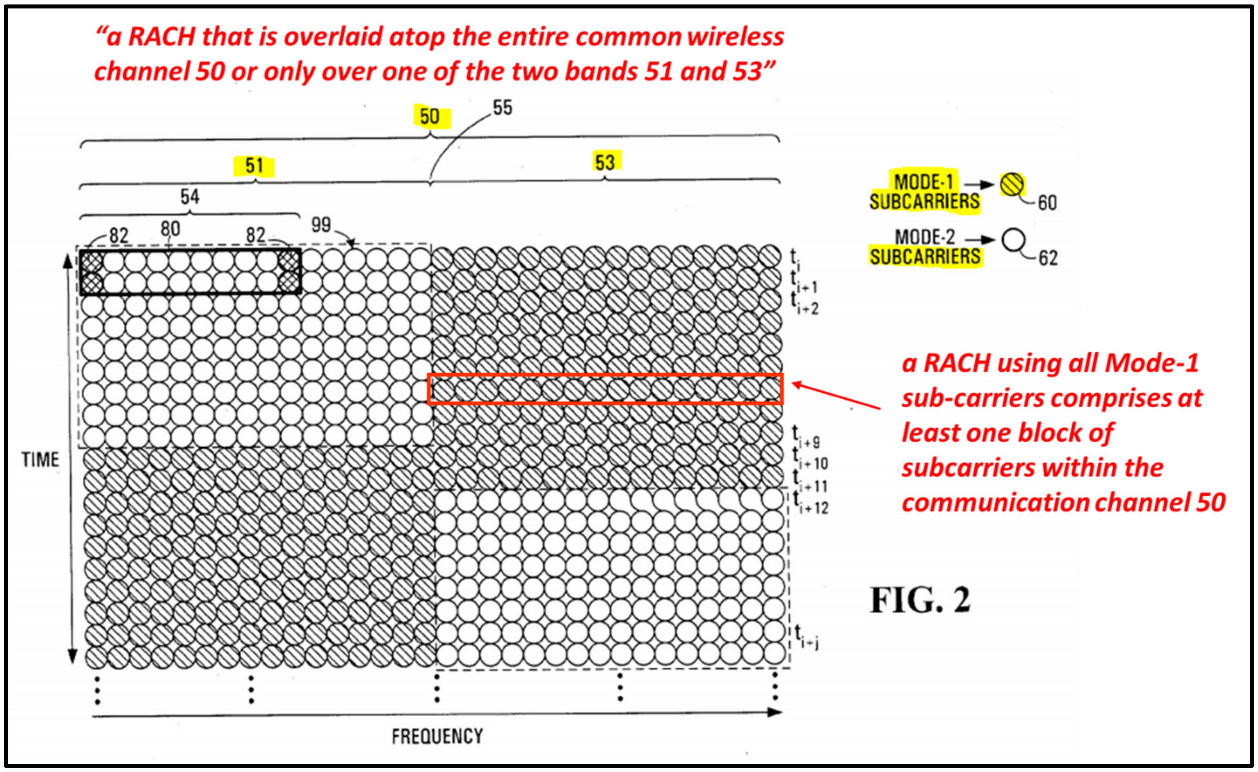
117. As discussed in Section VII.A.[*1c/9c/17c/22c]*, Ma discloses the ranging signal being formed from a RACH code/signature. "**A Golay sequence can be**

used as RACH signature for a lower peak-to-average power ratio (PAPR)." EX1005, 0214. Indeed, Ma notes that "several PAPR reduction techniques to be employed … to increase the UE transmit power efficiency" because low PAPR in the time domain is a well-known, desirable feature for a transmission signal in an OFDM system. EX1005, 0193. *See e.g.,* EX1010, 0006 ("the preamble sequence having **a low PAPR must be used** as a preamble sequence of the OFDM communication system"); EX1010, 0019 ("**A PAPR of an OFDM symbol should be low** in a ratio of maximum power to average power of **a time-domain OFDM symbol** corresponding to an IFFT output terminal of the transmitter").

[1e/9e/17e/22e] 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.

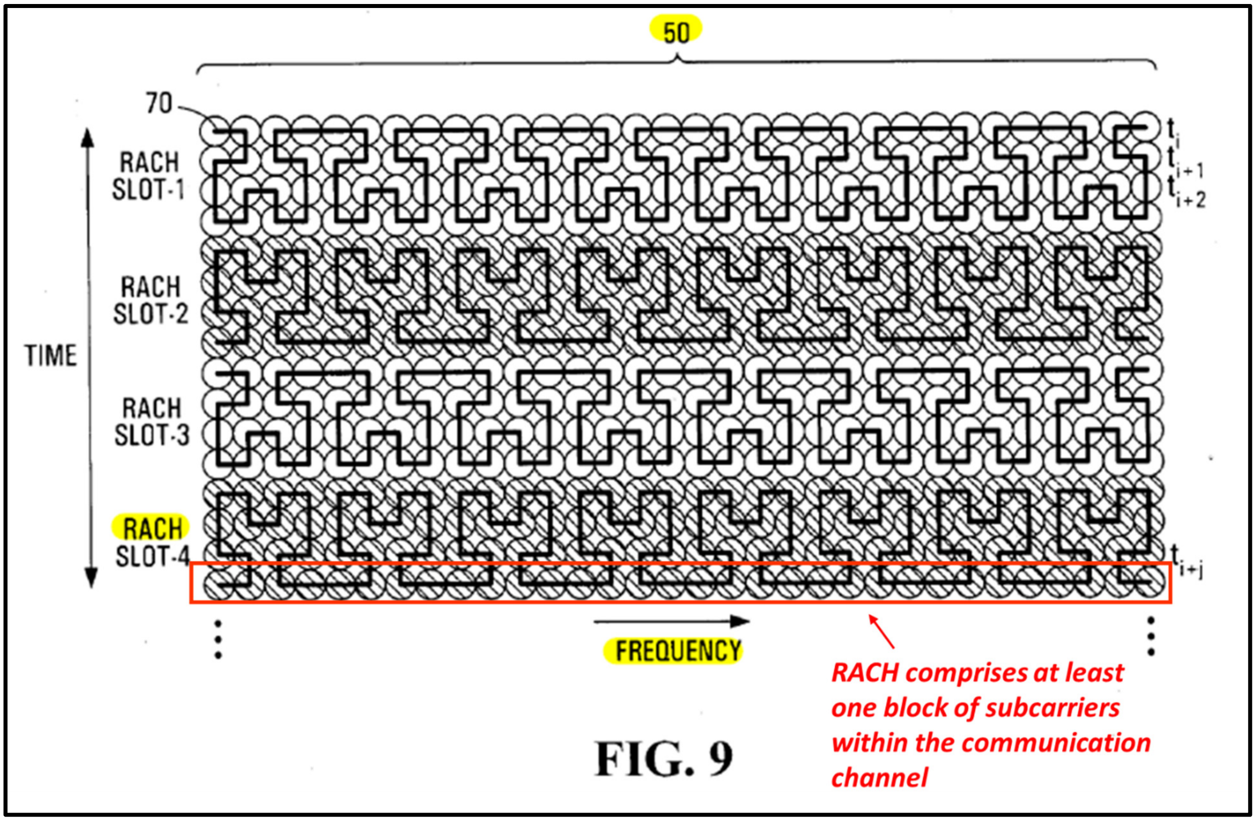
118. Ma discloses that "After randomly selecting **one of the RACH signatures**," **an accessing UE transmits** [the RACH signature on RACH (i.e., *ranging subchannel*)] **using the whole available access band**—this preferably **includes all Mode-1 sub-carriers**." EX1005, 0219. The RACH signature is transmitted on RACH (i.e., *ranging subchannel*) that *comprises at least one block of subcarriers* (e.g., "all Mode-1 sub-carriers") *within the communication channel* (e.g., "common wireless channel 50." EX1005, 0219. *See also* EX1005, 0206, 0122-0124 ("**a RACH that is overlaid** atop **the entire common wireless channel 50 or only over one of the two bands 51 and 53**," wherein the "**common wireless**

channel 50 is implemented using an OFDM transmission scheme **within an overall OFDM band**" that includes multiple subcarriers. For example, as shown in FIG. 2, "the **OFDM band** is shown to contain **32 sub-carriers**" and "The **first frequency band 51 has the first 16 sub-carriers** of the OFDM band 50, while the **second frequency band 53 has the second 16 sub-carriers** of the OFDM band 50.")



Ma-FIG.2 (annotated)

119. FIG. 9 also expressly shows that the RACH (i.e., *ranging subchannel*) comprises at least one block of subcarriers within the communication channel (e.g., "common wireless channel 50").

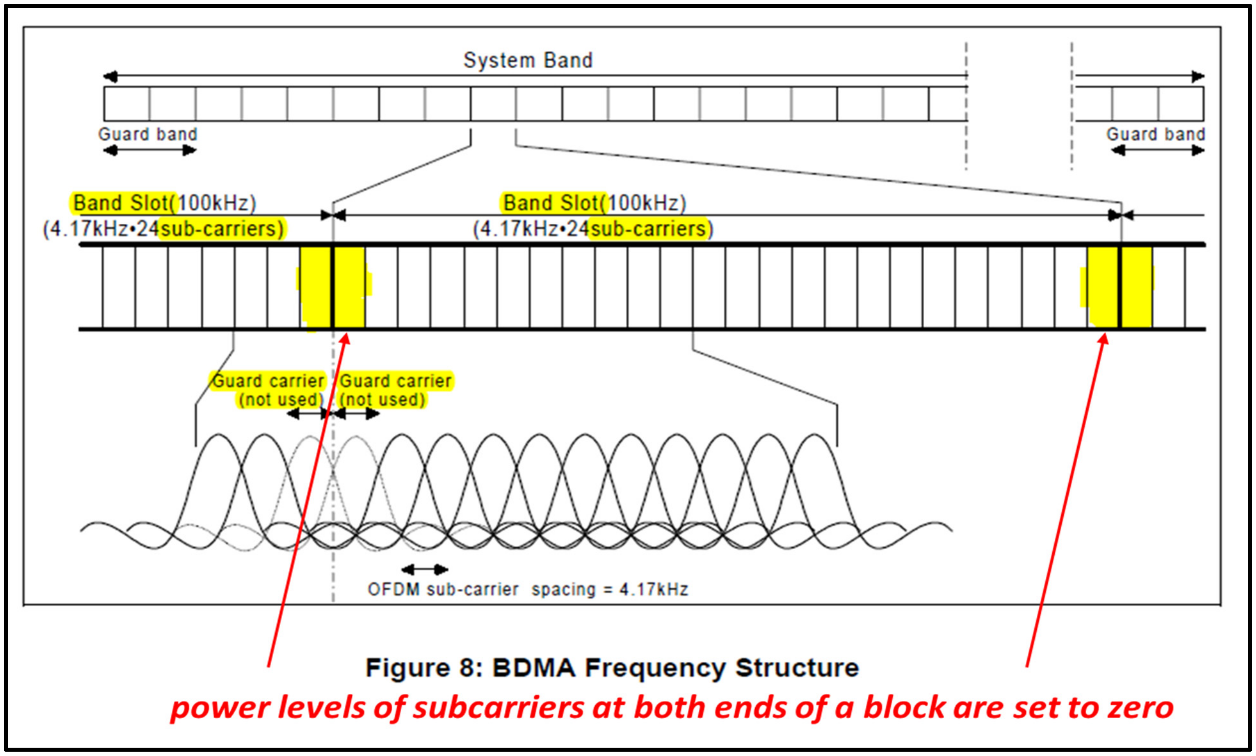


Ma-FIG.9 (annotated)

120. TR also discloses the RACH channel *comprises at least one block of subcarriers* (e.g., a band slot) *within the communication channel*. *See* EX1006, 199 ("The whole system frequency band is divided into small **blocks (bandslots) with a fixed number of subcarriers.**")

121. TR further discloses "Unmodulated Guard Carriers" "to reduce adjacent channel emissions and facilitate easy bandslot separation." EX1006, 199. As shown in Figure 8 (reproduced below), "In each bandslot the **two subcarriers at the edge of the bandslot are left unmodulated** to relax receiver blocking

requirements." EX1006, 199. As I discussed above in paragraph 67, "**unmodulated**" subcarriers means zero power is applied to the subcarriers. EX1006, 199, 202. Consistent with typical guard band configurations in an OFDM system as discussed in, for example, Joo and Geile, these guard carriers *at both ends of the block* (i.e., the bandslot) are "not used" and thus the *power levels of guard carriers are set to zero*. EX1006, 199, 202, EX1014, 3:3-8, EX1015, 40: 32-41, FIG. 13.



TR-Figure.8 (annotated)

122. As discussed in Section VI.C, a POSITA would have been motivated to apply the "guard carrier" feature as disclosed in TR to Ma's RACH, for example,

to achieve various known advantages such as (1) "to relax receiver blocking requirements" (2) to reduce "the interference of two adjacent blocks of subcarriers…, which may occur when their orthogonality is compromised due to nonlinear PA [power amplifier] effects" and (3) to "reduce adjacent channel emissions" and (4) "facilitate easy bandslot separation," as discussed in TR. Moreover, this ordinary implementation of the guard carrier would have been merely the application of a known technique (leaving subcarriers on the edge of a bandslot unmodulated, as taught by TR and consistent with the known guard band feature) to a known system (Ma's OFDMA communication system) ready for improvement to create a guard band between adjacent subchannels to yield predictable results. EX1006, 199, EX1014, 3:3-8, EX1015, 40: 32-41, FIG. 13. A POSITA would have had a reasonable expectation of success in such an implementation at least because both Ma and TR are related to similar methods and systems (i.e., OFDM-based communications using subcarriers).

123. Accordingly, Ma-TR combination renders obvious that *power levels of subcarriers at both ends of a block are set to zero*. EX1006, 199.

[2/10] wherein the subcarrier configuration of the ranging subchannel for the cell is different from subcarrier configurations of ranging subchannels for other cells,

124. Ma discloses that the subcarrier configuration of the RACH for one cell can include "one of the two bands 51 and 53." EX1005, 0206, 0122-0124. The "**two**

frequency bands 51, 53 [] can be used interchangeably to **provide two different OFDMA modes**…, **Mode-1 and Mode-2**." EX1005, 0125. Ma also discloses "the time-**frequency resource allocation (provided for Mode-1 and Mode-2) can vary from cell to cell**." EX1005, 0126. Ma discloses **frequency resource allocation** (e.g., *subcarrier configuration*) of the frequency bands 51, 53 provided for Mode-1 and Mode-2 "can vary from cell to cell," which means Ma discloses (or it would have been obvious to a POSITA that Ma discloses) the *subcarrier configuration* of the *ranging channel,* RACH, for the cell that uses "one of the two bands 51 and 53" can be *different from subcarrier configurations of ranging subchannels for other cells*. EX1005, 0205-0206. Additionally or alternatively, because Ma suggests different frequency resource configurations for Mode-1 (and Mode-2) in different cells, it would have been obvious to a POSITA that the *subcarrier configuration* of RACH "**using the whole available access band**—this preferably **includes all Mode-1 sub-carriers**" would be different, for the same reasons that Ma discloses different subcarrier configurations for Mode-1 (and Mode-2). EX1005, 0219, 0126. *See also* discussion of Ma's disclosure of *data subchannel* in Section VII.A.[*1a/9a/17a/22a*] and *ranging subchannel* in VII.A.[*1e/9e/17e/22e*].

[3/11] wherein the set of ranging sequences for the cell is different from sets of ranging sequences for other cells.

125. Ma discloses downlink data transmitted "A **dedicated** long complex PN/Golay code **set is reserved for RACH of each base station**," and each base station has "a cell (coverage area) serviced by the base station." EX1005, 0215, 0004. Ma further discloses that "The **RACH signatures** can be also **re-used** by the **non-adjacent base stations**." EX1005, 0213. Because Ma specifies that RACH signatures would be re-used in ***non***-adjacent base stations, a POSITA would have understood that different RACH signatures should be used for adjacent base stations. This would reduce "inter-cell interferences" as Ma emphasizes: "In cellular networks the uplink air **interface must take into account** transmissions from multiple UE's operating in the same cell as well as transmissions from UE's operating in adjacent cells" and "the total multiple-access interference can be made up of intra-cell and inter-cell multiple-access interferences." EX1005, 0005, 0007.

126. Accordingly, Ma discloses *the set of ranging sequences for the cell is different from sets of ranging sequences for other cells*.

[4/20] wherein subcarriers in a block are contiguous in frequency.

127. Ma discloses *subcarriers in a block are contiguous in frequency*, for example, as shown in FIG. 2 and FIG. 9.

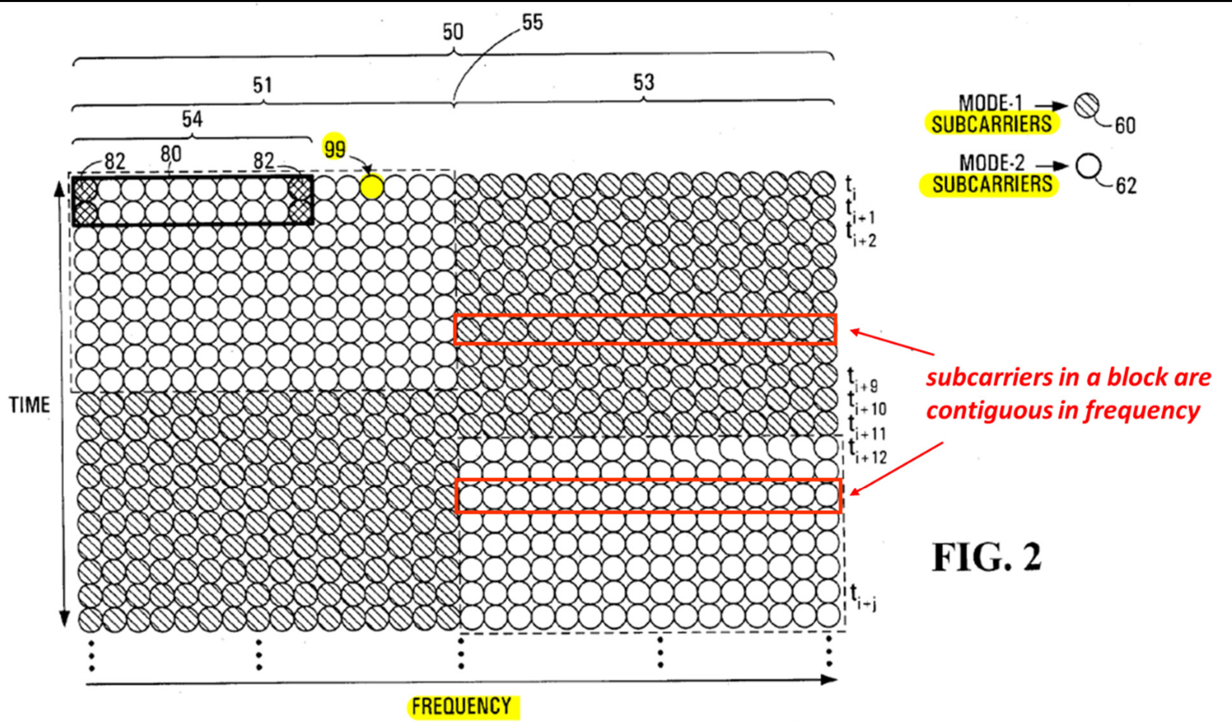


FIG. 2

Ma-FIG. 2 (annotated)

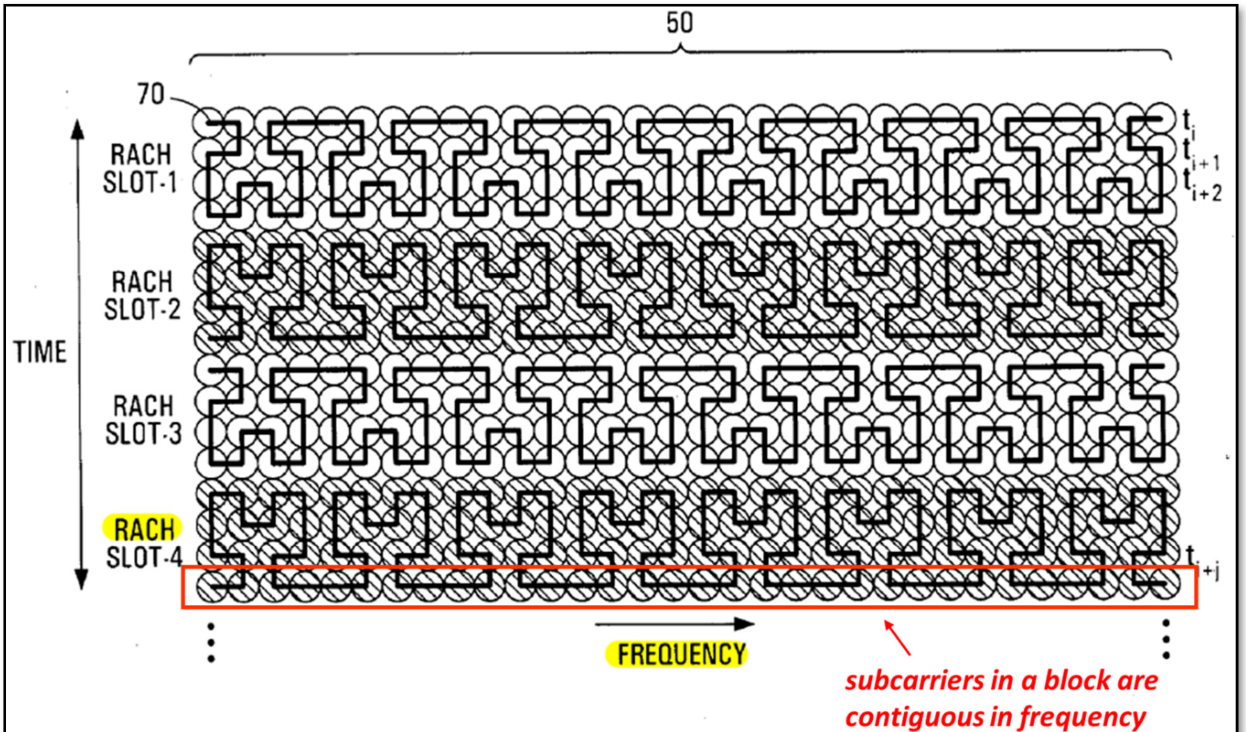


FIG. 9

Ma-FIG. 9 (annotated)

128. Alternatively or additionally, TR also discloses *subcarriers in a block are contiguous in frequency*, for example, as shown in Figure 8. EX1006, 199. It would have been obvious to a POSITA, in view of both Ma's and TR's explicit showings of contiguous subcarriers in frequency in a block, that TR-Ma discloses *subcarriers in a block are contiguous in frequency.* EX1005, FIGS. 2 and 9; EX1006, Figure. 8, 199.

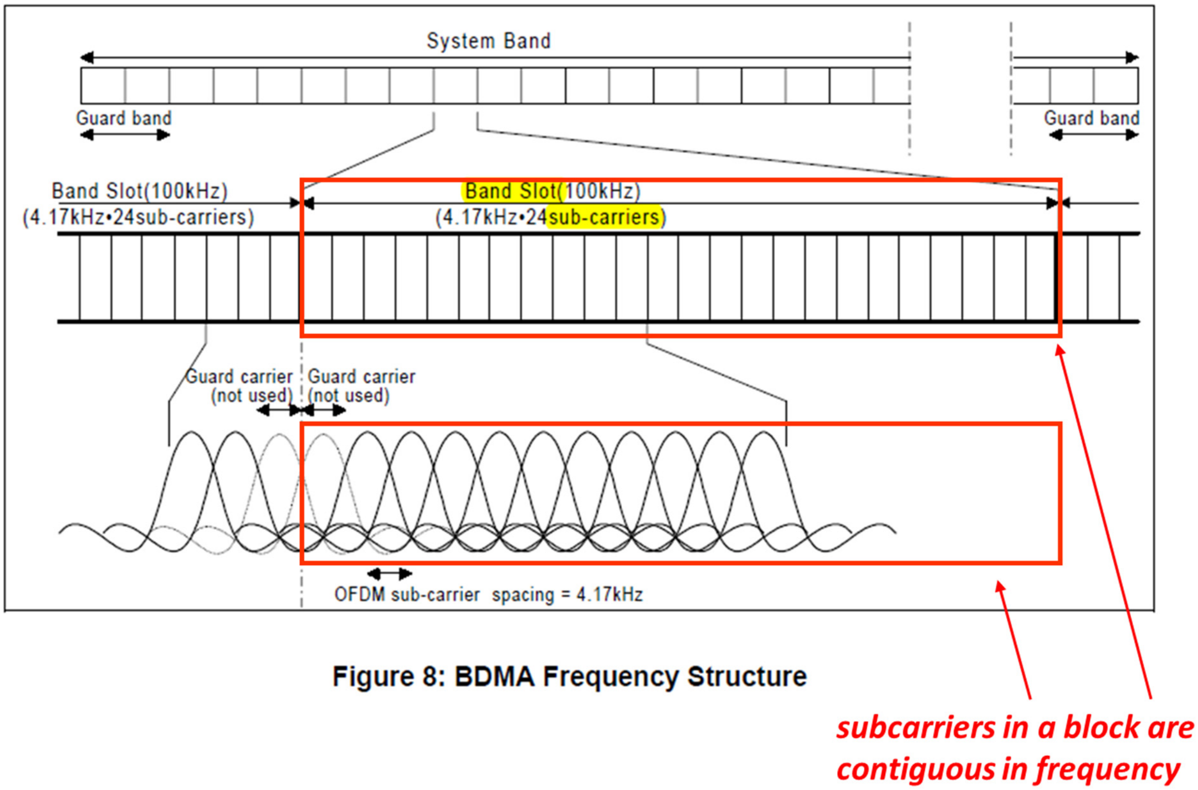


Figure 8: BDMA Frequency Structure

TR-Figure.8 (annotated)

[6/18] 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.

129. *See* Section VII.A.[*1e/9e/17e/22e]* and as shown in TR's Figure 8, MA-TR discloses *power levels of subcarriers at both ends of a block are set to zero,* while the other subcarriers towards the center of the block are modulated/used (i.e., the power levels are larger than zero). EX1006, 199. Accordingly, MA-TR discloses *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. Moreover, it would have been obvious to a POSITA that multiple "Unmodulated Guard Carriers" can be put towards the high-end and low-end frequency boundaries of a block to provide wider guard bands to further "relax receiver blocking requirements" and "reduce adjacent channel emissions and facilitate easy bandslot separation." EX1006, 199. Such an implementation has been well-known and commonly used in an OFDM system, for example, as evidenced from Jung's disclosure of putting 28 and 27 null subcarriers towards the high-end and low-end frequency boundaries respectively to reduce the interference. *See e.g.,* EX1010, 0067, 0069, 0076, FIG. 5.

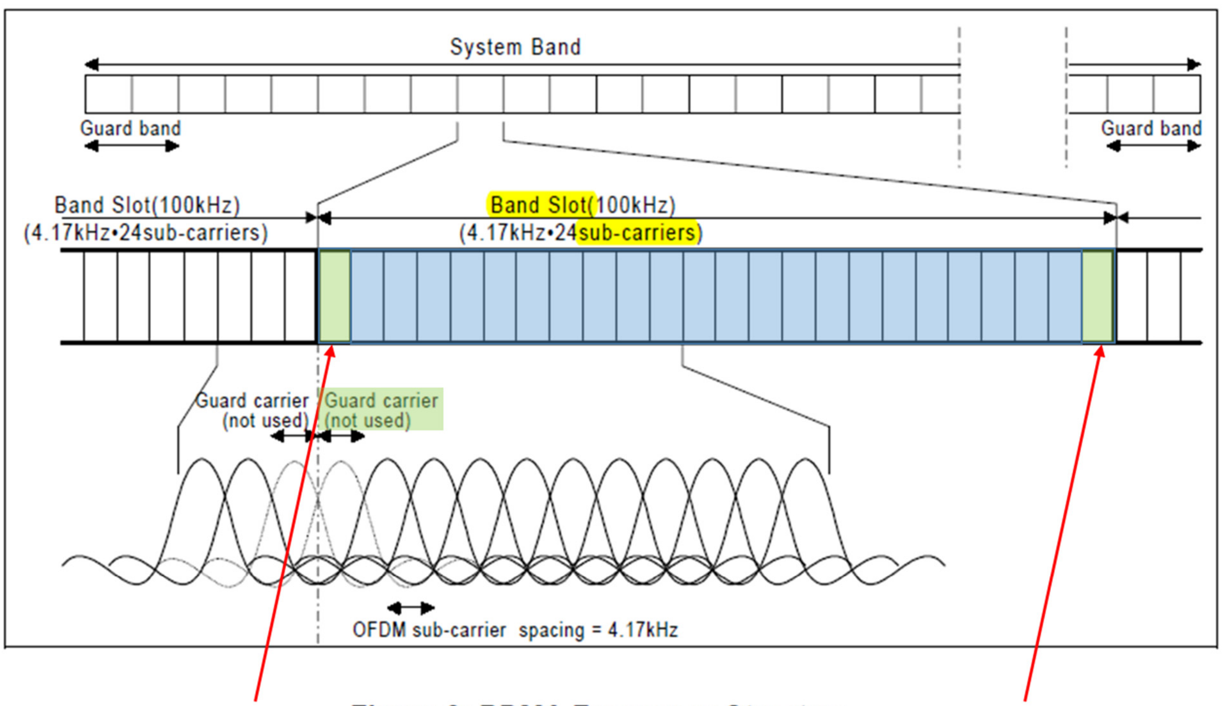


Figure 8: BDMA Frequency Structure

power levels of subcarriers at high-end & low-end are lower than power level of subcarriers towards the center

TR-Figure.8 (annotated)

[7/19] 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.

130. TR discloses "In each bandslot the **two subcarriers at the edge of the bandslot are left unmodulated**" (i.e., *attenuated*) to reduce "**the interference of two adjacent blocks of subcarriers**." EX1006, 199. The power level of an unmodulated subcarrier (i.e., zero) is lower than, and thus *attenuated* relative to, the power level of a modulated subcarrier (larger than zero). *See also* my discussion in paragraph 67 and Section VII.A.*[1e/9e/17e/22e]*. A POSITA would have understood that the "interference of two adjacent blocks of subcarriers" is "*interference with other uplink signals*" when the blocks of subcarriers adjacent to the RACH bandslot are *other uplink signals* sent from the UE to the base station. TR discloses the "interference of two adjacent blocks of subcarriers… may occur when their orthogonality is compromised due to nonlinear PA [power amplifier] effects." EX1006, 199. A POSITA would have understood that *when signal time misalignment occurs at the base station*, the orthogonality of subcarriers would be compromised as well, resulting the "interference of two adjacent blocks of subcarriers." Accordingly, TR discloses that *boundary subcarriers of a block of subcarriers in the ranging subchannel* (i.e., the two subcarriers at the edge of the

RACH bandslot) *are attenuated to reduce interference with other uplink signals when signal time misalignment occurs at the base station*.

[8] wherein the ranging sequence is a binary or non-binary sequence.

131. Claim 8 is non-limiting because a sequence is either binary or non-binary. Regardless, Ma discloses the ranging sequence can be a "PN sequence" or a "Golay sequence." EX1005, 0215. A Golay sequence is a binary sequence. *See e.g.*, Tong discloses the Golay sequence is a binary sequence:

> In submission TSGR1#3(99)205 to the TSG-RAN Working Group 1 meeting #3, Mar. 22-26, 1999, entitled "**New RACH preambles** with low auto-correlation sidelines and reduced detector complexity", it is proposed that the preamble, which comprises 4096 code chips providing one of 16 orthogonal signatures of length 16 complex signals, be provided by **binary Golay sequences**, which have the advantageous property that the sum of their aperiodic auto-correlation functions is zero for all non-zero time shifts. Consequently, that submission purposes that **the preamble be formed from a pair of complementary sequences A and B**, which **together constitute a Golay sequence** and are referred to as constituent Golay sequences, each of 256 chips, repeated in a specific one of 16 signature patterns, so that the overall sequence has a length of 4096 chips, as shown by Table 1 below.

TABLE 1

1	A	A	B	B	A	−A	−B	B	A	−A	B	−B	A	A	−B	−B
2	A	A	B	B	A	−A	−B	B	−A	A	−B	B	−A	−A	B	B
3	A	−A	B	−B	A	A	−B	−B	A	A	B	B	A	−A	−B	B
4	A	−A	B	−B	A	A	−B	−B	−A	−A	−B	−B	−A	A	B	−B
5	A	A	B	B	−A	A	B	−B	A	−A	B	−B	−A	−A	B	B
6	A	A	B	B	−A	A	B	−B	−A	A	−B	B	A	A	−B	−B
7	A	−A	B	−B	−A	−A	B	B	A	A	B	B	−A	A	B	−B
8	A	−A	B	−B	−A	−A	B	B	−A	−A	−B	−B	A	−A	−B	B
9	A	A	−B	−B	A	−A	B	−B	A	−A	−B	B	A	A	B	B
10	A	A	−B	−B	A	−A	B	−B	−A	A	B	−B	−A	−A	−B	−B
11	A	−A	−B	B	A	A	B	B	A	A	−B	−B	A	−A	B	−B
12	A	−A	−B	B	A	A	B	B	−A	−A	B	B	−A	A	−B	B
13	A	A	−B	−B	−A	A	−B	B	A	−A	−B	B	−A	−A	−B	−B
14	A	A	−B	−B	−A	A	−B	B	−A	A	B	−B	A	A	B	B
15	A	−A	−B	B	−A	−A	−B	−B	A	A	−B	−B	−A	A	−B	B
16	A	−A	−B	B	−A	−A	−B	−B	−A	−A	B	B	A	−A	B	−B

EX1011, 1:26-40.

[12] 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.

132. Ma discloses an example method for "**detection of the RACH channel** at the base station" in FIG. 11, including, among others, "Step 11-1: Transfer **input data from *time domain* to *frequency domain*** by FFT," and "Step 11-7: Extract **received RACH** after interference cancellation." "The **output of this process is the RACH signature index** and sync position (**RACH signature** and FFT window position corresponding to the final maximum)." EX1005, 0218-0232. Accordingly, Ma discloses *detecting the ranging sequence in the received ranging signal in the time domain, frequency domain, or both time and frequency domain*.

133. Ma discloses the base station comprising *an apparatus* (e.g., "RACH detection function 610") *configured to detect the ranging sequence* (e.g., "RACH

signature") *in the received ranging signal* (e.g., the ranging signal transmitted in the RACH channel). For example, as shown in FIG. 1, "The **OFDMA receiver 600 would typically be a base station** …. The **OFDMA receiver 600** is shown to **include a RACH detection function 610**." EX1005, 0264.

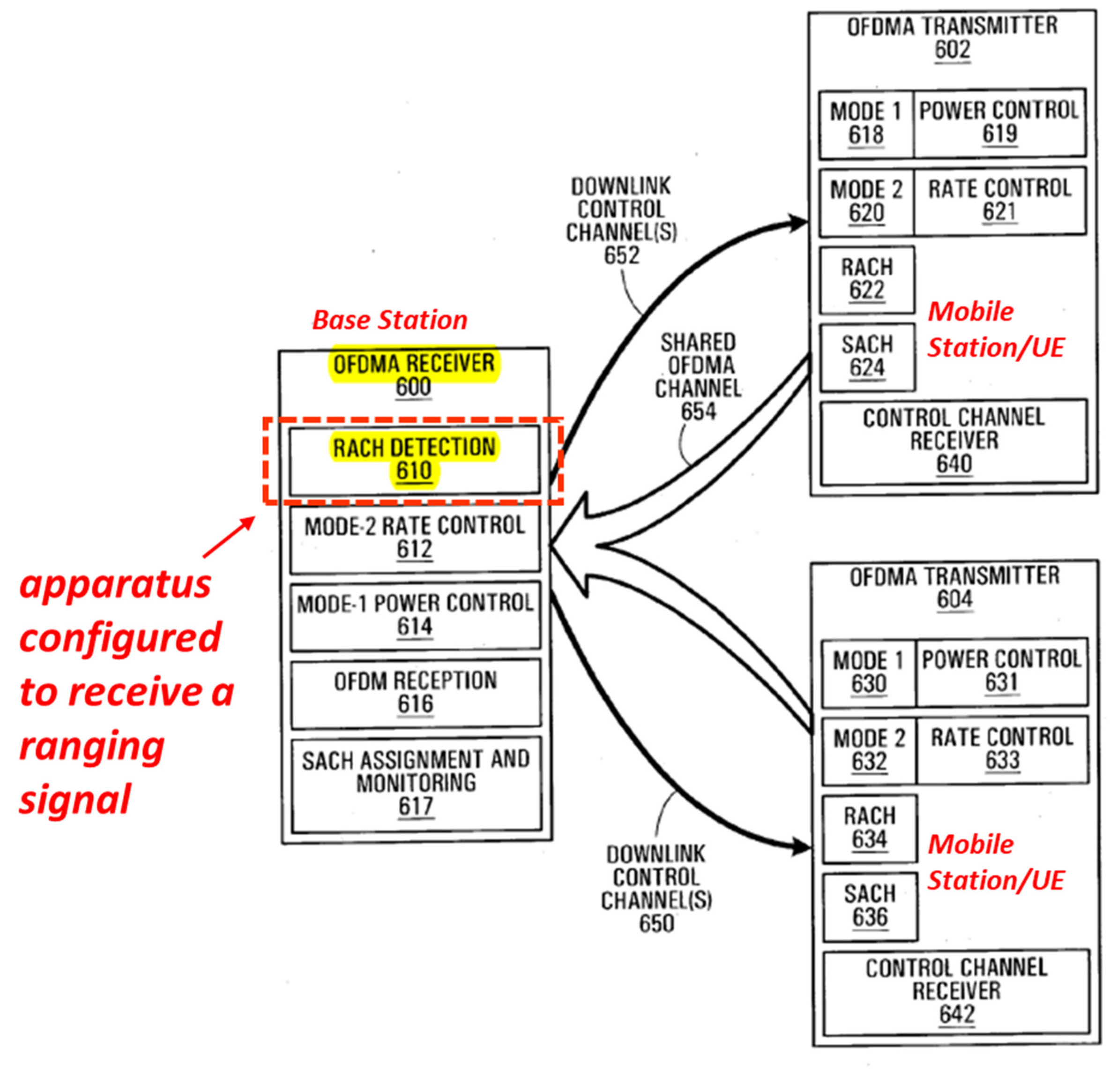


FIG. 1

Ma-FIG. 1 (annotated)

134. Regardless of whether "***an apparatus configured to detect the ranging sequence in the received ranging signal***" of claim 12 is the same or different from "an apparatus configured to receive a ranging signal" of claim 1, Ma discloses such apparatuses. For example, Ma discloses that the functions of *receiving a ranging signal and detect the ranging sequence in the received ranging signal* as well as that the "**RACH detection function 610**" can be implemented as multiple separated apparatuses or a single apparatus: "the **functions** which are shown **can be implemented** as **separate physical blocks,** or can be i**ntegrated into a single design** implemented **in software and/or hardware and/or firmware**." EX1005, 0264.

[14] wherein the apparatus correlates the received ranging signal with a ranging sequence stored at the base station to detect the ranging sequence.

135. As discussed in Section VII.A. [*1c/9c/17c/22c*], Ma discloses the received *ranging signal* is formed from a RACH code/signature (i.e., *a ranging sequence*). As discussed in Section VII.A.[*12],* Ma discloses the apparatus (e.g., "RACH detection function 610") configured to detect the ranging sequence according to an example method in FIG. 11, including, among others, "Step 11-8: **Correlate the received RACH** Y_{RACH} [received *ranging signal*] **with all RACH signatures** [*ranging sequence*] and find the maximum," EX1005, 0228. Accordingly, Ma

discloses *the apparatus correlates the received ranging signal with a ranging sequence.* It would have been obvious to a POSITA that the base station would store all the RACH signatures, i.e., "ranging sequence[s]" to perform the disclosed correlation for "detection of the RACH channel at the base station." Moreover, it would have been obvious to a POSITA that the base station would store all the RACH signatures to improve detection efficiency (compared to any alternative that does not store the RACH signatures), especially the disclosed correlation is performed on a regular basis for "detection of the RACH channel" when UE tries to access the network.

[15/23] [further comprising an apparatus configured to detect]/[detecting] 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.

136. Ma discloses "RACH is also used for initial timing and synchronization….The **base station looks for these access attempts**, and simultaneously **performs timing** and synchronization **to determine a timing offset** [*a time delay*] **for the UE** which **tells the user when the start of its OFDM symbol transmission** should be such that all UE's transmissions will share a more or less common OFDM symbol boundary at the base station." EX1005, 0219. Ma thus discloses the base station being configured to *detect a time delay of the received ranging signal and to inform the second mobile station* (i.e., the accessing

UE) *to adjust transmission time based on the detected time delay* (i.e., the timing offset).

137. Ma discloses the base station comprising *an apparatus configured to detect a time delay of the received ranging signal and to inform the second mobile station* by disclosing such a function as well as disclosing the base station comprising an apparatus for implementing such a disclosed function. *See* EX1005, 0264 ("The **OFDMA receiver 600 would typically be a base station** …. in the **OFDMA receiver 600, typically many other functions would be required in a complete system**. Furthermore, the functions which are shown can be implemented as separate physical blocks, or can be integrated into a single design **implemented in software and/or hardware and/or firmware**.")

[16/24] [further comprising an apparatus configured to detect]/[detecting] 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.

138. Ma discloses that the "Base station **measures the power of RACH from UE** and **sends back the power control command to UE** for increasing/unchanging/decreasing transmit power." EX1005, 0198. Ma thus discloses the base station comprises *an apparatus configured to detect a power level of the received ranging signal and to inform the second mobile station* (i.e., the accessing UE) *to adjust a transmission power based on the detected power level* by disclosing such a function as well as disclosing the base station comprising

an apparatus for implementing such a disclosed function. *See* EX1005, 0264 ("The **OFDMA receiver 600 would typically be a base station** …. in the **OFDMA receiver 600, typically many other functions would be required in a complete system**. Furthermore, the functions which are shown can be implemented as separate physical blocks, or can be integrated into a single design **implemented in software and/or hardware and/or firmware**.")

B. Ground-A2 - Claims 5 and 21 are Obvious in view of Ma-TR-Soliman

[5Pre/21Pre] further comprising [an apparatus configured to control]/[controlling] a transmission power of the ranging signal using an open-loop power control method by:

139. As discussed in Section VI.E, a POSITA would understand that Ma's power control scheme applied to RACH is "*an open-loop power control method." See e.g.,* EX1005, 0170, 0147, 0186, 0196–0200.

140. Ma also discloses that *the UE comprises an apparatus configured to control a transmission power of the ranging signal using an open-loop power control method* by disclosing such a power control function as well as disclosing the UE comprising an apparatus for implementing such a disclosed function. *See* EX1005, 0264 ("**the OFDMA transmitter 602,604 is** a wireless terminal such as **a mobile station;"** "**for each of the OFDMA transmitters 602,604,**" **"typically many other functions would be required** in a complete system. Furthermore, **the**

functions which are shown can be implemented as separate physical blocks, or can be integrated into a single design implemented **in software and/or hardware and/or firmware**.")

141. Moreover, TR makes it clear that the RACH uses "(Open Loop Power Control)," in that "The RACH burst will be transmitted at the same power which was estimated as the down link signal strength (Open Loop Power Control)," EX1006, 197.

142. Accordingly, a POSITA would have understood that Ma alone or Ma-TR discloses that *the UE comprises an apparatus configured to control a transmission power of the ranging signal using an open-loop power control method*.

[5a/21a] estimating a path loss between the serving base station and the mobile station based on a received downlink signal;

143. Soliman discloses "to calculate the proper initial access probe power level, **mobile station controller 116 determines the forward link path loss** [that] is the ratio of the **output power of the base station transmitter** 101 **to the total power received at** the termination of the receiving antenna 104 of **mobile station 102**" (i.e., *estimating a path loss between the serving base station and the mobile station*). EX1007, 6:52-63.

144. The *path loss* is estimated *based on a received downlink signal* (e.g., "**received pilot powers**" that is a downlink/reverse-link signal **"transmitted by base station transmitter"**). *See* EX1007, 6:52-7:44 ("to **estimate the forward link path loss**, the mobile station controller 116 **needs to know** only the transmitted and **received pilot powers**").

[5b/21b] setting the transmission power of the ranging signal based on the path loss; and

145. Soliman discloses "**Knowing the forward link path loss** from equation (7) above, and the receiver sensitivity from equation (8) above, **mobile station controller 116 can then calculate the mobile station transmit power necessary** to arrive at base station receiver 105 with the minimum detectable level, thereby minimizing interference to other users while still ensuring adequate reception." EX1007, 7:54-64.

[5c/21c] increasing the transmission power of the ranging signal for retransmission.

146. Ma discloses "a **power ramping procedure** is applied [to the ranging signal], and therefore **the RACH channel is transmitted with minimized power** to reduce the inter-channel interference to Mode-1 traffic and signaling channels. More specifically, an initial attempt is made with a very low power. The absence of power control commands from the base station is construed as a failed attempt

and **the next attempt is made with a slightly increased power**" (i.e., *increasing the transmission power of the ranging signal for retransmission*). EX1005, 0209.

147. Soliman also discloses "**For subsequent probes, the access probe sequence are sent at increased power levels** (each probe is incremented by a value equal to PWR-- STEP) **until a response is obtained or the sequence ends** (see IS-95 section 6.6.3.1)." EX1007, 8:34-38.

148. As discussed in Section VI.E, a POSITA would have multiple reasons to apply the known implementation details of "*open loop power control*" as disclosed in Soliman to the RACH channel as disclosed in Ma-TR. The resulting Ma-TR-Soliman combination renders obvious claims 5 and 21.

C. Ground-A3 - Claim 13 is Obvious in view of Ma-TR-Li

[13] wherein the apparatus applies matched filtering[5] to the received ranging signal to detect the ranging sequence.

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[5] The '366 Patent fails to define "*matched filtering*" or "matched filter" but generally states "the base station receiver detects the presence of each ranging signal, its time delay, and its power level **through the use of a matched filter**, a correlator, or other means in the time domain, the frequency domain, or both." EX1001, 5:19-23.

149. As explained in Section VII.A.[*14*], Ma discloses *the apparatus correlates the received ranging signal with a ranging sequence stored at the base station to detect the ranging sequence*. *See* Section VII.A.[*14*]. Ma also discloses the apparatus (e.g., "RACH detection function 610") that performs the correlation function and "the functions which are shown can be implemented as separate physical blocks, or can be integrated into a single design implemented in software and/or hardware and/or firmware." EX1005, 0264. A POSITA would understand that "separate physical blocks, or […] a single design implemented in software and/or hardware and/or firmware" in Ma's apparatus (e.g., "RACH detection function 610") that performs the correlation would constitute a correlator.

150. Li discloses "correlator 701 may be replaced with a match filter." EX1009, 0063. Li's disclosure would have prompted a POSITA to replace the correlator as disclosed by Ma-TR (e.g., *the "***physical blocks,** or [] **a single design** implemented **in software and/or hardware and/or firmware**" of the "**OFDMA receiver 600** [that] **would typically be a base station**" for performing the correlation function as disclosed by Ma, EX1005, 0264) with a match filter that performs matched filtering as disclosed by Li, resulting in a predicable combination, Ma-TR-Li, that renders obvious a base station comprising an apparatus that applies *matched filtering to the received ranging signal to detect the ranging sequence*.

151. Moreover, as discussed in Section VI.G, other reasons existed that would have prompted a POSITA to combine Ma-TR, and Li. **First**, the combination would have been merely the application of a known technique (swapping a correlator with a matched filter, as taught by Li) to a known system (Ma's communication system) to yield predictable results, without significantly altering or hindering the functions performed by the communication system. *See e.g.,* EX1022, 8-9. **Second**, in scenarios where the base station is already equipped with a matched filter to decode signals transmitted according to legacy communication standards (e.g., CDMA-based standards), reusing the match filter would have advantageously saved implementation cost while maintaining the base station's backward compatibility with legacy communication standards.

D. Ground-B1 - Claims 1-4, 6-12, 14-20, 22-24 are Obvious in view of Ma-Jung

[1Pre/9Pre/17Pre/22Pre] In a [multi-cell] orthogonal frequency division multiple access (OFDMA) wireless communication system comprising a plurality of base stations and mobile stations,

152. This limitation is rendered obvious based on Ma's disclosure of this limitation as discussed in Section VII.A.[*1Pre/9Pre/17Pre/22Pre*].

[1Pre] a mobile station configured to communicate with a serving base station] in a cell via a communication channel, the mobile station comprising:

[17Pre] a method for signal transmission by a mobile station to a serving base station via a communication channel, the method comprising:

153. This limitation is rendered obvious based on Ma's disclosure of this limitation as discussed in Section VII.A.[*1Pre/17Pre*].

[9Pre] a base station configured to communicate with mobile stations in a cell via a communication channel, the base station comprising:

[22Pre] a method for receiving signals by a base station from a plurality of mobile stations via a communication channel, the method comprising:

154. This limitation is rendered obvious based on Ma's disclosure of this limitation as discussed in Section VII.A.[*9Pre/22Pre*].

[1a/17a] [an apparatus configured to transmit]/[transmitting] a data signal [over a data subchannel] 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

[9a/22a] [an apparatus configured to receive]/[receiving] a data signal [over a data subchannel] 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

155. This limitation is rendered obvious based on Ma's disclosure of this limitation as discussed in Section VII.A.[*1a/9a/17a/22a*].

[1b/17b] [an apparatus configured to transmit]/[transmitting] a ranging signal [over a ranging subchannel] to the serving base station [in the cell over a ranging subchannel] for random access, wherein:

[9b/22b] [an apparatus configured to receive]/[receiving] a ranging signal [from a second mobile station in the cell] over a ranging subchannel for random access [by a second mobile station], wherein:

156. This limitation is rendered obvious based on Ma's disclosure of this limitation as discussed in Section VII.A.[*1b/9b/17b/22b*].

157. To the extent that one argues that Ma does not expressly recite the word "ranging," the predictable combination, Ma-Jung, renders this limitation obvious because Jung expressly discloses *a ranging sequence* (e.g., a "long preamble sequence [] used for initial ranging" and "short preamble sequence is used for periodic ranging"). EX1010, 0029-0033. As discussed in Section VI.C, a POSITA would have multiple reasons to combine Ma and Jung, and the combination would have result in *a ranging signal* formed from *a ranging sequence* transmitted by a UE to the serving base station (correspondingly received by the serving base station) *in the cell over a ranging subchannel for random access*.

[1c/9c/17c/22c] 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;

158. This limitation is rendered obvious based on Ma's disclosure of this limitation as discussed in Section VII.A.[*1c/9c/17c/22c*], as well as Jung's express disclosure of *a ranging sequence* (e.g., a "long preamble sequence [] used for initial ranging" and "short preamble sequence is used for periodic ranging"). EX1010, 0029-0033 as discussed in Section VII.D.[*1b/9b/17b/22b*].

[1d/9d/17d/22d] 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

159. This limitation is rendered obvious based on Ma's disclosure of this limitation as discussed in Section VII.A.[*1d/9d/17d/22d*], as well as Jung's express

disclosure of *a ranging signal* formed from *a ranging sequence* "having a minimum PAPR"/"low PAPR" in the time domain) as discussed in Section VII.D.[*1b/9b/17b/22b*] *and* [*1c/9c/17c/22c*]. EX1010, 0003, 0018. *See also* EX1010, 0019 ("**A PAPR of an OFDM symbol should be low** in a ratio of maximum power to average power **of a time-domain OFDM symbol corresponding to an IFFT output terminal of the transmitter"**).

[1e/9e/17e/22e] 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.

160. This limitation is rendered obvious based on Ma's disclosure of this limitation as discussed in Section VII.A.[*1e/9e/17e/22e*] and Jung's disclosure of "a guard interval in a frequency domain," EX1010, 0043, 0076, 0105.

161. For example, Jung discloses preamble sequence mapping rules that map ranging sequences (e.g., short preamble sequences "used for periodic ranging") to the subcarriers. EX1010, 0033, 0077-0078. For example, as shown in FIG. 5, "short preamble sequences P(−100:100)" are applied to a *block of subcarriers within the communication channel* comprising 256 subcarriers, and "if the number of all of the subcarriers for the OFDM communication system is 256 (−128, . . . , 127), the number of **subcarriers actually used is 200** (−100,. . . , 100)," and the subcarriers on both ends of the block of 256 subcarriers are left as "**guard interval: left (28 in number);** −128, . . . ,−101, **right (27 in number);**

101, . . . ,127" with power level set to zero, i.e., "**null** data" "or **0-data.**" EX1010, 0067, 0069, 0076, FIG. 5. *See Jung* explains that "null data" is "0-data:" "**Null data, or 0-data, is inserted in each of** the 0th subcarrier, **−128th to −101st subcarriers and 101st to 127th subcarriers, before being transmitted**." EX1010, 0042-0043.

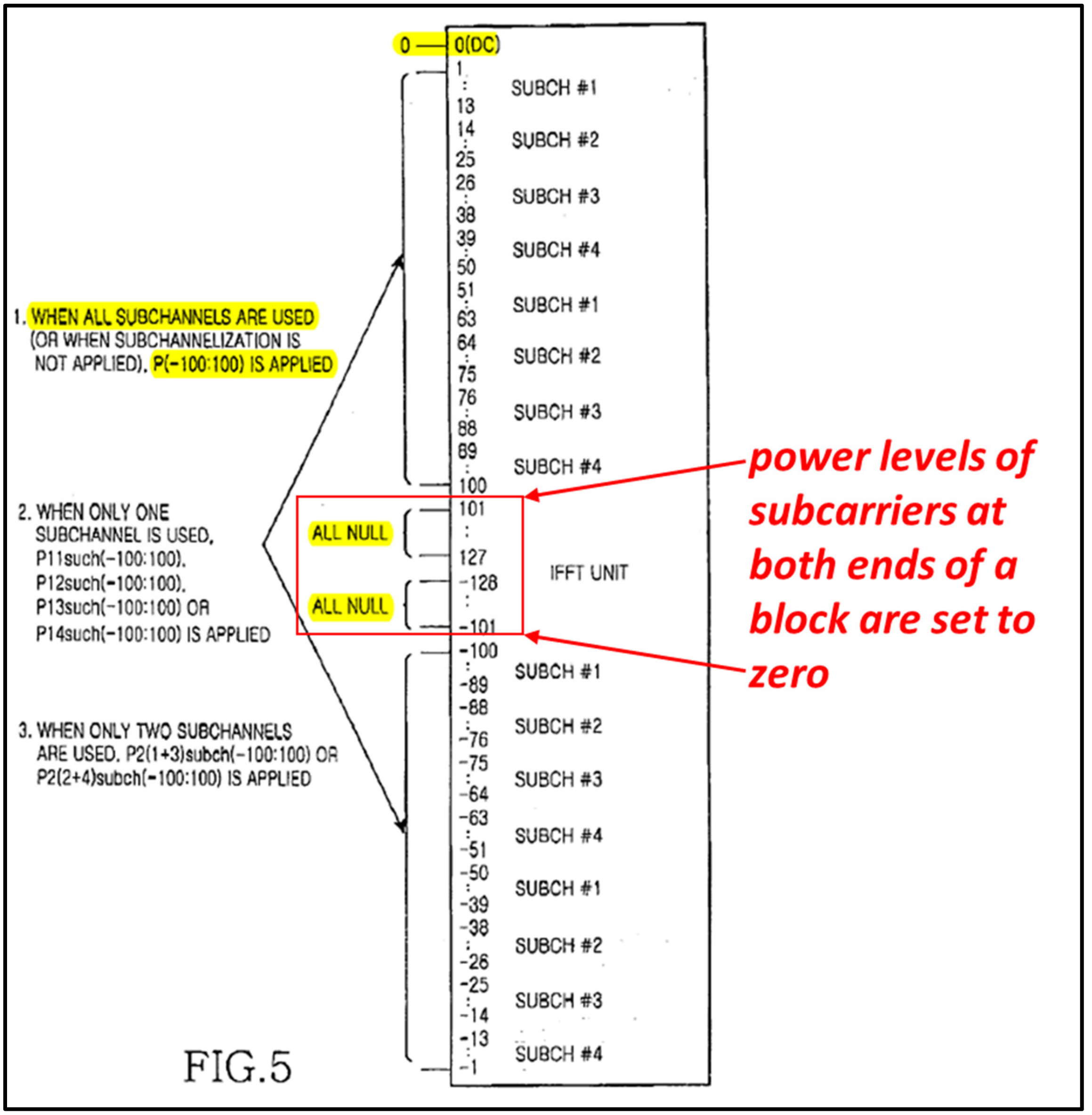


FIG.5

Jung-FIG.5 (annotated)

162. As discussed in Section VI.I, a POSITA would have recognized that applying Jung's ranging sequence and the frequency-domain guard interval to Ma's RACH channel would have led to predictable, advantageous results (e.g., reduced interference, low PAPR) without significantly altering or hindering the functions performed by the wireless communication system. Ma-Jung combination thus renders obvious that *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*.

[2/10] wherein the subcarrier configuration of the ranging subchannel for the cell is different from subcarrier configurations of ranging subchannels for other cells,

163. This limitation is rendered obvious based on Ma's disclosure of this limitation as discussed in Section VII.A.[*2/10*].

[3/11] wherein the set of ranging sequences for the cell is different from sets of ranging sequences for other cells.

164. This limitation is rendered obvious based on Ma's disclosure of this limitation as discussed in Section VII.A.[*3/11*].

[4/20] wherein subcarriers in a block are contiguous in frequency.

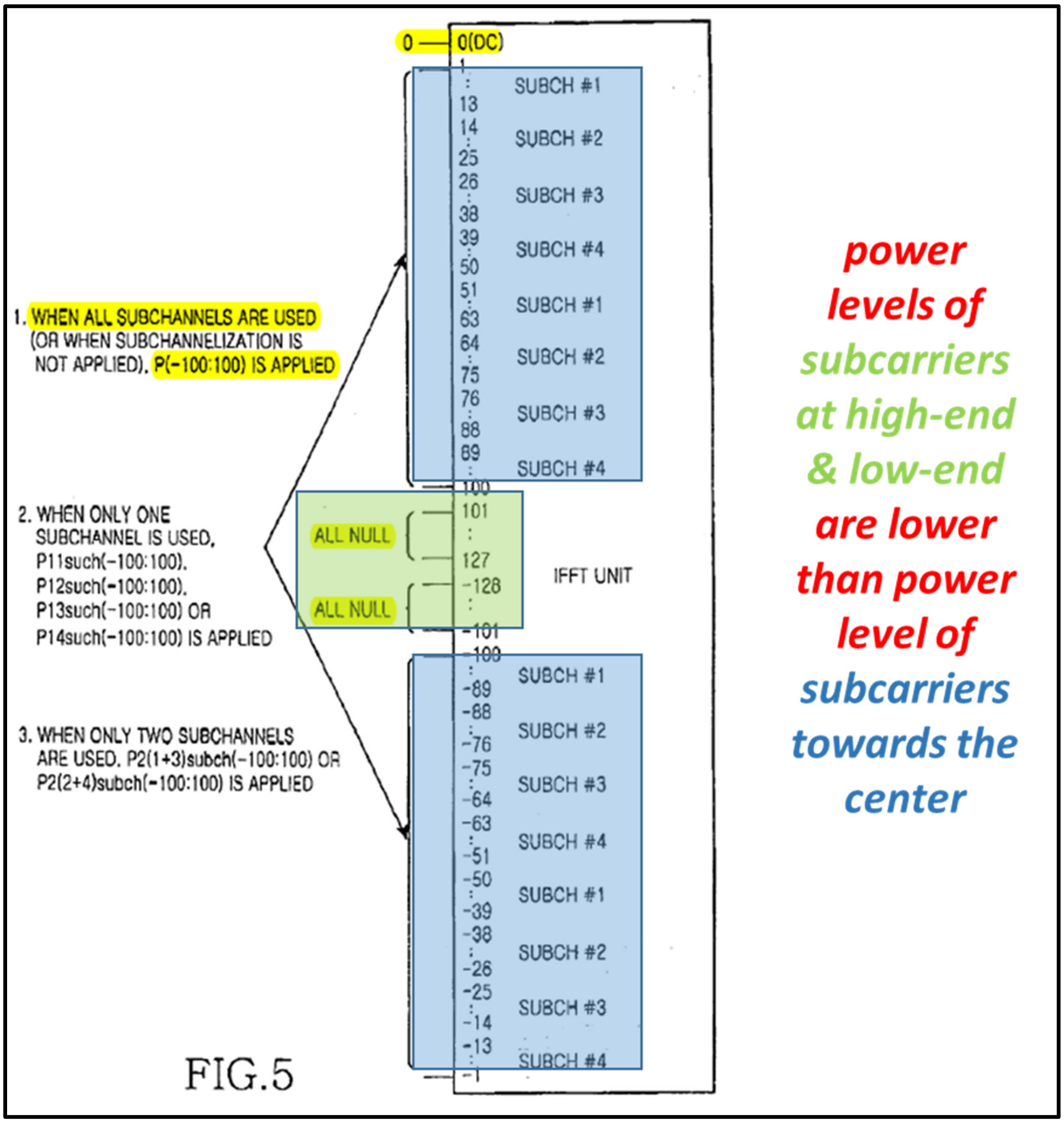
165. This limitation is rendered obvious based on Ma's disclosure of this limitation as discussed in Section VII.A.[*4/20*].

[6/18] 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.

166. This limitation is rendered obvious based on Ma's disclosure of this limitation as discussed in Section VII.A.[*6/8*] and Jung's of "a guard interval in a frequency domain," EX1010, 0043, 0076, 0105. *See also* Section VII.D.[*1e/9e/17e/22e*].

167. Specifically, as shown in FIG. 5, Jung discloses *power levels of subcarriers towards both ends of a block of subcarriers are zero* (i.e., null data or zero data), lower than the power level of the other subcarriers towards the center of the block (e.g., "a DC (Direct Current) component") which are modulated with sequences (e.g., "short preamble sequences P(−100:100)"). EX1010, 0077-0078. The "28 subcarriers of the −128th to −101st subcarriers and the 27 subcarriers of the 101st to 127th subcarriers" (where the null data are located) are *the high-end and low-end frequency boundaries* because they "correspond to a high frequency band in the frequency domain" as explicitly disclosed by Jung and it is well-established and understood by a POSITA that, for IFFT/FFT of a frequency block with −128th to 127th subcarriers, the 0th subcarriers corresponds to DC, *the center of the block*, while the −128th and 127th subcarriers are *the high-end and low-end frequency boundaries* of the block. *See e.g.,* Joo explicitly discloses that "The **outermost sub-carriers are the middle indexes among IFFT input indexes**," and "**null**

data is inserted in the outermost sub-carriers in the frequency domain to solve the problem of adjacent channel interference," which is to create "a **guard band [] to minimize adjacent channel interference**." EX1014, 3:3-8.



Jung-FIG.5 (annotated)

[7/19] 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.

168. This limitation is rendered obvious based on Ma's disclosure of this limitation as discussed in Section VII.A.[*6/18*] and Jung's disclosure of "inserting **null data** into the 28 subcarriers of -128^{th} to -101^{st} subcarriers and the 27 subcarriers of 101^{st} to 127^{th} subcarriers" (i.e., *boundary subcarriers of a block of subcarriers in the ranging subchannel* are null/zero data having zero power and thus *are attenuated* compared to the non-boundary subcarriers with preamble sequences having a power level larger than zero) "to provide a guard interval in a frequency domain." EX1010, 0076. *See also* Section VII.D.[*1e/9e/17e/22e*].

169. Jung discloses the guard interval is inserted to remove interference, and *when signal time misalignment occurs at the base station*, e.g., "if a receiver incorrectly estimates a start point of an OFDM symbol, **interference occurs between subcarriers**, causing an increase in an error probability of a received OFDM symbol." EX1010, 0009. A POSITA would have understood that the "interference between subcarriers" may also be "*interference with other uplink signals* when subcarriers adjacent to the ranging subchannel are used for sending *other uplink signals* from the UE to the base station, especially when "subchannelzation" as Jung proposed is applied to "for efficient utilization of a frequency." EX1010, 0035.

170. Accordingly, Jung discloses that *boundary subcarriers of a block of subcarriers in the ranging subchannel* (e.g., "the 28 subcarriers of −128th to −101st subcarriers and the 27 subcarriers of 101st to 127th subcarriers") *are attenuated to reduce interference with other uplink signals when signal time misalignment occurs at the base station*.

[8] wherein the ranging sequence is a binary or non-binary sequence.

171. Claim 8 is non-limiting because a sequence is either binary or non-binary. Regardless, this limitation is rendered obvious based on Ma's ranging sequence such as a "PN sequence" or a "Golay sequence" EX1005, 0215, which is a binary sequence. EX1011, 1:32, as well as Jung's disclosure of ranging sequences, such as example "short preamble sequences P(−100:100)" as shown below is a binary sequence. EX1010, 0077.

```
P(−100:100) =      {
                    1   0  −1   0  −1   0  −1   0   1   0   1   0       [−100:−89]
                    1   0   1   0  −1   0   1   0  −1   0  −1   0  −1   [−88:−76]
                    0   1   0  −1   0   1   0   1   0   1   0   1       [−75:−64]
                    0  −1   0   1   0   1   0   1   0  −1   0   1   0   [−63:−51]
                   −1   0   1   0   1   0  −1   0  −1   0   1   0       [−50:−39]
                   −1   0   1   0  −1   0   1   0   1   0  −1   0   1   [−38:−26]
                    0   1   0  −1   0  −1   0  −1   0   1   0  −1       [−25:−14]
                    0  −1   0  −1   0  −1   0  −1   0   1   0   1   0   [−13:−1]
                    0
                    0   1   0  −1   0  −1   0   1   0  −1   0   1   0   [1:13]
                    1   0   1   0   1   0  −1   0   1   0   1   0       [14:25]
                    1   0   1   0  −1   0   1   0  −1   0  −1   0  −1   [26:38]
                    0  −1   0   1   0   1   0  −1   0   1   0  −1       [39:50]
                    0  −1   0  −1   0  −1   0  −1   0  −1   0  −1   0   [51:63]
                   −1   0   1   0   1   0   1   0  −1   0  −1   0       [64:75]
                   −1   0   1   0   1   0  −1   0  −1   0  −1   0   1   [76:88]
                    0  −1   0  −1   0   1   0  −1   0  −1   0  −1       [89:100]
}*sqrt(2)*sqrt(2)*(±1)
```

172. Jung also discloses other example ranging sequences that are binary sequences. *See* EX1010*,* 0080-0081. As such, this limitation is rendered obvious based on the disclosure of Ma-Jung.

[12] 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.

173. This limitation is rendered obvious based on Ma's disclosure of this limitation as discussed in Section VII.A.[*12*].

[14] wherein the apparatus correlates the received ranging signal with a ranging sequence stored at the base station to detect the ranging sequence.

174. This limitation is rendered obvious based on Ma's disclosure of this limitation as discussed in Section VII.A.[*14*].

[15/23] 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.

175. This limitation is rendered obvious based on Ma's disclosure of this limitation as discussed in Section VII.A.[*15/23*].

[16/24] 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.

176. This limitation is rendered obvious based on Ma's disclosure of this limitation as discussed in Section VII.A.[*16/24*].

E. Ground-B2 - Claims 5 and 21 are Obvious in view of Ma-Jung-Soliman

177. Similar to discussion in Section VII.B, the limitations of claims 5 and 21 are rendered obvious based on the predictable combination, Ma-Jung-Soliman.

F. Ground-B3 - Claim 13 is Obvious in view of Ma- Jung -Li

[13] wherein the apparatus applies matched filtering to the received ranging signal to detect the ranging sequence.

178. As discussed in Section VII.D.[*14*], Ma (and thus Ma-Jung) renders obvious a base station comprising an apparatus that uses a correlator to *correlate the received ranging signal with a ranging sequence to detect the ranging sequence*. EX1005, 0264. Li discloses "correlator 701 may be replaced with a match filter." EX1009, 0063. Li's disclosure would have prompted a POSITA to replace the correlator as disclosed by Ma-Jung (e.g., *the "***physical blocks,** or [] **a single**

design implemented **in software and/or hardware and/or firmware**" of the "**OFDMA receiver 600** [that] **would typically be a base station**" for performing the correlation function as disclosed by Ma, EX1005, 0264) with a match filter that performs matched filtering as disclosed by Li, resulting in a predicable combination, Ma-Jung-Li, that renders obvious a base station comprising an apparatus that applies *matched filtering to the received ranging signal to detect the ranging sequence*. *See also* EX1022, 8-9, Section VII.C.[*13*]. Moreover, as discussed in Section VI.K, multiple reasons existed that would have prompted a POSITA to combine Ma-Jung, and Li. Accordingly, the predicable combination, Ma-Jung-Li renders obvious a base station comprising an apparatus that applies *matched filtering to the received ranging signal to detect the ranging sequence*.

VIII. CONCLUSION

179. For all the reasons I have noted in the foregoing paragraphs, the Challenged claims of the '366 Patent are obvious in view of the references discussed above.