

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

VOLKSWAGEN GROUP OF AMERICA, INC.
Petitioner

v.

CARUCEL INVESTMENTS L.P.
Patent Owner

Case IPR2019-01102
Patent 7,848,701

DECLARATION OF SCOTT A. DENNING

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Ex. 1003
Volkswagen v. Carucel
U.S. Patent No. 7,848,701

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I, Scott A. Denning, declare as follows:

I. Introduction

1. I have been asked by Volkswagen Group of America, Inc. (“VWGoA”) to provide expert opinions in the above-captioned *Inter Partes* Review proceeding involving U.S. Patent No. 7,848,701 (“the ’701 patent”), which is entitled “Mobile Communication System With Moving Base Station.”

2. Specifically, I have been retained as a technical expert by VWGoA to study and provide my opinions on the technology claimed in, and the patentability or unpatentability of, claims 10, 15-18, 31, and 33-35 of the ’701 patent (“the Challenged Claims”). For purposes of this declaration, I was not asked to provide any opinions that are not expressed herein.

3. This declaration is directed to the Challenged Claims of the ’701 patent, and sets forth the opinions I have formed, the conclusions I have reached, and the bases for each.

4. I am familiar with the technology described in the ’701 patent as of its earliest possible priority date of June 2, 1995. I have been asked to provide my technical review, analysis, insights, and opinions regarding the ’701 patent. I have used this experience and insight along with the references identified herein as the basis for my opinions that support the grounds of unpatentability set forth in the Petition for *Inter Partes* Review of the ’701 patent.

5. I am being compensated by VWGoA at my standard hourly rate of \$ 450 dollars per hour for the time I spend in connection with this proceeding. My compensation is not dependent in any way on the substance of my opinions or in the outcome of this proceeding.

II. Qualifications

6. In formulating my opinions, I have relied upon my training, knowledge, and experience in the relevant art. I have over 20 years of experience working with mobile communication systems, networking, optical communication, and mobile embedded systems. As detailed below, I have worked on many projects that are highly relevant to the subject matter of the '701 patent.

7. I have worked in the mobile communication field since 1990. I have extensive expertise in wireless/mobile communication system both at mobile and base station sites. One position I held was as an embedded systems engineer, consulting for Pac-Tel Cellular (now Verizon). During my time at Pac-Tel, I designed and built prototype Advanced Mobile Phone System (AMPS) cellular modems. The modems communicated using analog cellular voice and control channels. Thus, I am very familiar with how mobile units handle signals and data as well as perform hard and soft hand-offs with the cell-sites. In addition, I have interfaced cellular network monitoring equipment to high-speed data links (fiber

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and microwave) that connect cell-sites to the Mobile Telephone Switching Office (MTSO). This project required extensive knowledge of the cellular network infrastructure as well as data flow between the cell-sites and MTSO. From these experiences, I gained an excellent understanding of mobile communication systems around the time of 1995, which is the effective filing date of '701 patent.

8. I worked as a consulting engineer for Optical Robotics in 1995. In my official capacity, I designed and built many robotics components including wireless and cellular communication components. In this project, data was collected from numerous devices inside the robotics devices as well as support trucks and relayed back to the home office via cellular data. These systems used commercially available AMPS cellular phone modules that were modified to accept a data connection and then utilize the AMPS cellular control channels for transmitting and receiving digital data.

9. I was a founder of Purple Mountain Labs in Colorado Spring which focused on supercomputing and high-speed communications research and development. During the time I was chief scientist, I led product development for the client Lockheed, which included a new compact massively parallel multi-core supercomputing architecture for military applications.

10. Additionally, I have strong expertise in robotics communication. This includes designing and building the communication components in pipeline inspection and repair robots to support wireless signal transmission and reception.

11. With the exception of defending my dissertation, I have completed all requirements for my Ph.D. degree from University of Colorado with a focus on Machine Learning and Natural Language Processing. I expect to defend my dissertation and graduate in the Fall of 2019. I received a Bachelor of Science degree in Computer Science from Southern College of Technology in 1993.

12. A copy of my *curriculum vitae* is provided as Ex. 1004, which contains further details on my experience, technical expertise, and other qualifications.

III. Materials considered

13. In formulating my opinions, I have relied upon my training, knowledge, and experience that are relevant to the '701 patent. Furthermore, I have considered specifically the following documents listed below in addition to any other documents cited in this declaration:

<i>Exhibit</i>	<i>Description</i>
1001	U.S. Patent No. 7,848,701 B2 to Gavrilovich (“the ’701 patent”)
1002	Prosecution File History of U.S. Patent No. 7,848,701 (“’701 Prosecution History”)

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<i>Exhibit</i>	<i>Description</i>
1004	Mr. Denning's Curriculum Vitae
1005	U.S. Patent No. 5,276,686 to Ito ("Ito")
1006	U.S. Patent No. 5,504,786 to Gardner ("Gardner")
1007	U.S. Patent No. 5,109,390 to Gilhousen et al. ("Gilhousen390")
1008	U.S. Patent No. 4,001,692 to Fenwick et al. (Fenwick)
1009	U.S. Patent No. 5,559,865 to Gilhousen ("Gilhousen865")
1010	George Calhoun, <i>Digital Cellular Radio</i> , Artech House, Inc., 1988 ("Calhoun")
1011	Young et al., "Advanced Mobile Phone Service: Introduction, Background, and Objectives," <i>The Bell System Technical Journal</i> , vol. 58, no. 1, Jan. 1979; pp. 1-14. (accessible at https://archive.org/details/bstj58-1-1) ("Young")
1012	Mac Donald et al., "Advanced Mobile Phone Service: The Cellular Concept," <i>The Bell System Technical Journal</i> , vol. 58, no. 1, Jan. 1979; pp. 15-41. (accessible at https://archive.org/details/bstj58-1-15) ("Donald")
1013	John Scourias, "Overview of the Global System for Mobile Communications," May 19, 1995. ("Scourias")
1014	"Advanced Communications Project, Technology Reference Document," VisiCom Laboratories Inc., September 1993. ("VisiCom")
1015	<i>Law Enforcement News</i> , vol. V, no. 20, Nov. 26, 1979. (accessible at https://archive.org/details/lawenforcementne20john_1/page/n15) ("News")
1016	Excerpts from <i>Mobile Radio Technology</i> , vol. 6, no. 8, August 1988 (accessible at https://archive.org/details/MRT08August1988?q=mobile+extender) ("Standard")
1017	U.S. Patent No. 5,504,935 to Vercauteren ("Vercauteren")
1018	A.S. Acampora and J. H. Winters, "System Applications for Wireless Indoor Communications," <i>IEEE Communications magazine</i> , vol. 25, no. 5, August 1987; pp. 11-20. ("Acampora")

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<i>Exhibit</i>	<i>Description</i>
1019	T. O. Mottl, “Dual-Polarized Channel Outages During Multipath Fading,” <i>The Bell System Technical Journal</i> , vol. 56, no. 5, May-June 1977; pp. 675-701. (accessible at https://archive.org/details/bstj56-5-675) (“Mottl”)
1020	Jack Salz, and Jack H. Winters, “Effect of Fading Correlation on Adaptive Arrays in Digital Mobile Radio,” <i>IEEE transactions on Vehicular Technology</i> , vol. 43, no. 4, Nov. 1994; pp. 1049-1057. (“Salz”)
1021	U.S. Patent No. 5,481,533 to Honig et al. (“Honig”)
1022	U.S. Patent No. 7,221,904 to Gavrilovich (“the ’904 patent”)
1023	Prosecution File History of U.S. Patent No. 7,221,904 (“’904 Prosecution History”)
1024	U.S. Patent No. 5,566,209 to Forssén et al. (“Forssén”)
1025	U.S. Patent No. 5,345,467 to Lomp et al. (“Lomp”)
1026	U.S. Patent No. 6,393,281 to Capone et al. (“Capone”)
1027	U.S. Patent No. 5,434,853 to Hemmady et al. (“Hemmady”)
1028	U.S. Patent No. 5,267,261 to Blakeney, II et al. (“Blakeney”)
1029	U.S. Patent No. 5,101,501 to Gilhousen et al. (“Gilhousen501”)
1030	U.S. Patent No. 4,539,706 to Mears et al. (“Mears”)
1031	U.S. Patent No. 5,509,028 to Marque-Pucheu (“Marque-Pucheu”)
1032	U.S. Patent No. 4,675,863 to Paneth et al. (“Paneth”)
1033	Excerpts from Webster’s New World Dictionary, 3 rd College Edition, Simon & Schuster, 1993. (“Webster”)

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

IV. Legal Standards

A. My Understanding of Claim Construction

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

B. A Person of Ordinary Skill in the Art

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

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

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

18. My opinion below explains how a person of ordinary skill in the art would have understood the technology described in the references I have identified herein around the June 2, 1995 timeframe. I have been advised that the alleged earliest possible effective filing date for some claims of the '701 Patent is June 2, 1995.

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

C. My Understanding of Obviousness

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

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

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

22. To obtain a patent, a claimed invention must have been, as of its priority date, non-obvious in view of the prior art in the field. I understand that a patent claim is obvious when the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person of ordinary skill in the art.

23. I understand that in order to prove that the prior art, or a combination of prior art, render a claim obvious, it is necessary to (1) identify the particular references that, singly or in combination, make the claim obvious; (2) specifically identify which elements of the claim appear in each of the asserted references; and (3) explain how the prior art references could have been combined to teach or suggest the limitations in the claim.

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

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

26. I understand that certain objective indicia (secondary indicia) can be important evidence in determining whether a claim is obvious or non-obvious. Such indicia include: commercial success of products covered by the patent claims; a long-felt need for the invention; failed attempts by others to make the invention; copying of the invention by others in the field; unexpected results achieved by the invention as compared to the closest prior art; praise of the invention by the infringer or others in the field; the taking of licenses under the patent by others; expressions of surprise by experts and those skilled in the art at the making of the invention; and the patentee proceeded contrary to the accepted wisdom of the prior art. At this point, I am not aware of any secondary indicia of

non-obviousness. But, I reserve the right to review and opine on any evidence of objective indicia of non-obviousness that may be presented during this proceeding.

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

28. My analysis below is always from the perspective of a POSITA unless otherwise noted, even if that is not explicitly stated. My analysis of the prior art is always made as of the time the alleged invention was made from the perspective of a POSITA.

V. Level of Ordinary Skill in the Art

29. In my opinion, a person of ordinary skill in the art (“POSITA”) in the context of the ’701 patent as of June 2, 1995 (the earliest priority date of the ’701 patent), would have a B.S. degree in Computer Science, Electrical Engineering,

or an equivalent field, as well as at least 2–3 years of academic or industry experience in mobile wireless communications or comparable industry experience. Experience could take the place of some formal training, as domain knowledge may be learned on the job. This description is approximate, and a higher level of education or skill might make up for less experience and vice versa.

30. I am well qualified to determine the level of ordinary skill in the art. First, I am very familiar with the technology of the '701 patent during the June 1995 timeframe. As mentioned above, by 1995, I had acquired extensive experience relating to AMPS cellular modems and cell-site monitoring and communications equipment development. Specifically, by 1995 I had acquired experience in data processing and signal handing of mobile terminals and cell-sites, hand-offs, and the systems architecture used in mobile communication.

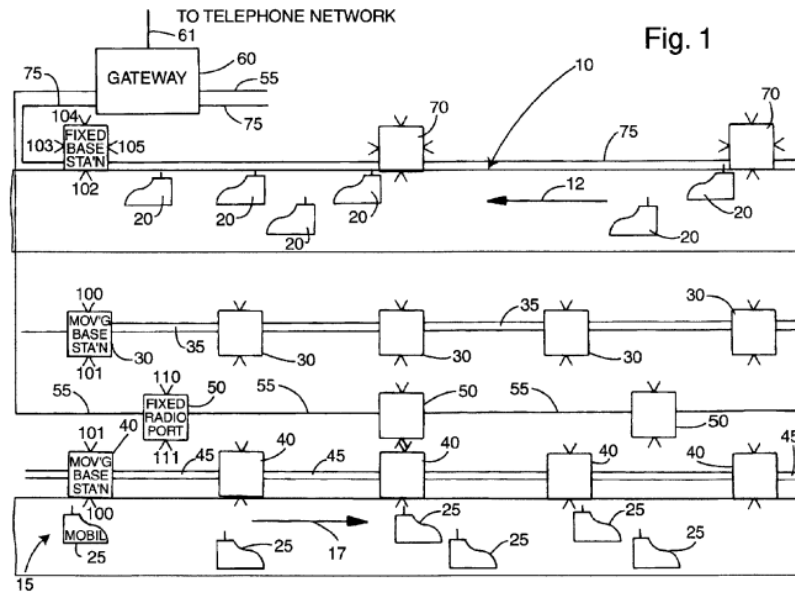
VI. Overview of the '701 Patent

31. Like the prior art techniques discussed above, the '701 patent generally relates to a mobile communication system that includes a moving base station configured to communicate with fixed radio ports. '701 patent, Ex. 1001, Abstract. In particular, the '701 patent describes the “moving base station” being “interposed between a moving mobile telephone unit and a fixed base station” and facilitating communication between the two systems. *Id.*, 2:66-3:1.

32. According to the '701 patent, “[a] problem with existing mobile telephone systems is the considerable time required in handoffs.” *Id.*, 1:58-59. A “handoff” refers to a procedure occurring when a mobile unit moves “away from one cell site and toward another cell site.” *Id.*, 1:39-43. Based on the signal quality, a call that is in progress may be transferred from one cell site to another as the mobile unit moves to the next cell site. *See id.*, 1:43-47. Part of the handoff process includes “sending a message to the mobile unit transmitter/receiver to tune from its present voice channel to a voice channel in the new cell site[.]” *Id.*, 1:45-47. As previously described, the '701 patent alleges that the amount of time required to perform a handoff is lengthy and undesirable. *See id.*, 1:58-59.

33. The '701 patent purports to solve the alleged handoff problem using a “moving base station.” *See id.*, 5:12-18. The moving base station performs the handoff function, and “[a]dvantageously, because [] movement of the base station [is] in the same direction as the traveling mobile unit, the number of handoffs is greatly reduced.” *Id.*, 5:16-18. That is, the mobile unit is able to maintain communication with the moving base station while the mobile unit is moving, reducing the number of handoffs occurring at the mobile unit. *See id.*, 5:12-5:18. The moving base station is interposed between a moving mobile telephone unit and fixed base stations and performs the handoff function to facilitate

communication between the systems. *See id.*, 2:67-3:1. The claims are directed to the functionality and circuitry of the moving base station.

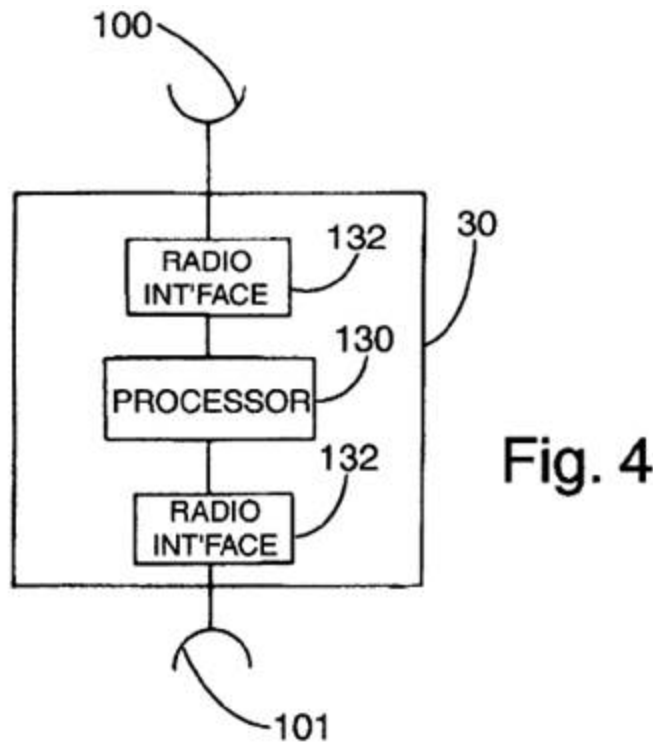


Ex. 1001, Fig. 1.

34. The moving base station is configured to move as a vehicle: “The moving base stations 30 may be moved by means of a rail 35, or other suitable conveying device which may include an automotive vehicle traveling on the roadway, in the same direction as the traffic flow on the roadway 10[.]” *Id.*, 4:6-10. “In accordance with this invention, a movable base station moves with the traffic at a rate of speed which is comparable to the speed of the traffic and communicates with a moving mobile telephone unit via standard mobile radio transmission.” *Id.*, 3:1-5.

35. To facilitate communications, the circuitry of the moving base station uses conventional hardware components: “FIG. 4 is a block diagram

representation of a moving base station[.]” *Id.*, 3:51-52. “Each of the moving base stations 30, 40 is provided with antennas 100, 101.” *Id.*, 5:17-18. “The antennas 100 on the base stations 30, 40 are used to communicate with the mobile units 20, 25 whereas the antennas 101 on the moving base stations 30, 40 are used to communicate with the fixed radio ports 50.” *Id.*, 5:22-26.



Ex. 1001, Fig. 4.

36. “As the moving base stations 30, 40 move relative to the fixed radio ports 50, data representing voice signals and call related information is transmitted between the antennas 101 on the moving base stations 30, 40 and the antennas [] on the fixed radio ports 50.” *Id.*, 5:36-41. In this manner the moving base stations may facilitate communications from a fixed radio port to a mobile

unit using antennas 100 and 101. *See id.* To process communications between fixed radio ports and mobile devices, the moving base station uses processor and radio interface circuits—“processor 130 may be a standard microprocessor and the radio interface circuits 132 may be standard radio interface circuits.” *Id.*, 6:26-28. The radio interface circuits 132 “are well known and commercially available circuits.” *See id.*, 6:33-36. Despite the use of these well-known components, the ’701 patent claims are directed to the circuitry and functionality of the moving base station.

37. As discussed in earlier this Section, the ’701 patent does not purport to invent either wireless communications between a mobile device and a base station or to perform handoffs. Instead, the ’701 patent merely purports to add a technique to these known systems and methods for facilitating communications between mobile telephones and fixed base stations whereby an intermediary (e.g., a mobile base station) moves relative to the base station and facilitates the communication between the base station and the mobile device. This lone point of purported novelty is also confirmed by the prosecution history in related U.S. Patent No. 7,221,904. *See* ’904 Prosecution History, Ex. 1023, 182. (“The exemplary embodiments of the invention, however, overcome this problem [of the identified prior art] by providing a [mobile base station with] relatively smaller communication cell that tracks the expected motion of the mobile unit.”)

38. As I discuss in the following section, it is my opinion that each of the technological aspects of the claims, including the purported point of novelty, were well-known in the art prior to the '701 patent.

VII. Background of the Technology

39. I understand that analyzing the state of electronic communications and/or wireless/mobile communications during the years prior to the earliest possible priority date of June 2, 1995 can provide valuable insight into what people of ordinary skill in the art were aware of at the time, and in what direction the industry was taking.

40. Prior to the priority date of the '701 patent, all the technology at issue in the '701 patent was broadly applied and well known by developers of the wireless/mobile communications industry in general. No individual elements of the '701 claims were novel at the time of the alleged invention, and there was nothing novel about the manner in which those elements were combined in the claims. Further, there were no technological barriers to combining these elements to form the claimed invention. Indeed, combining these elements would have yielded predictable results. Thus, the concept of a moving base station providing connectivity between a fixed base station and mobile device has been well known prior to 1995. Below, I discuss the this, and the other claimed technological aspects, in the prior art.

A. Communications Between Mobile Telephones and Fixed Base Stations were Well-known.

41. In the “Background” section of the ’701 patent, the ’701 patent admits that cellular communications were well-known and describes a “typical cellular telephone system [where] an area is divided into a plurality of cells with each cell having a centrally located cell site.” Ex. 1001, 1:25-27. “A mobile unit moving in such a cellular network communicates by radio with a nearest cell site.” *Id.*, 1:27-28. “The cell sites are each connected by cable or point-to-point microwave to a telephone network interface.” *Id.*, 1:27-30. “The network interface typically provides communication among cell sites and between the cell sites and the so-called wire line telephone network.” *Id.*, 1:30-33. The ’701 patent further discloses that “the functions of a typical network interface are described in The Bell System Technical Journal, January 1979, Volume 58, No. 1” (“Young”) and “[o]ne of the functions to be performed by the telephone network interface is the so-called ‘handoff’ function.” *Id.*, 1:35-37.

42. As was commonly known and summarized in the Background section of the ’701 patent, in cellular communications, as “a mobile unit moves through a cellular network, it will move away from one cell site and toward another cell site.” *Id.*, 1:37-39. “Each cell site monitors [the] signal quality of the signal received from the mobile unit and passes [this] information to the telephone

network interface and determines when a call in progress is to be transferred from one cell site to another.” *Id.*, 1:39-42. This transfer of call in progress of the mobile unit from one cell site to another cell site is known as a “handoff.” *Id.*, 1:42-43. In view of this description, the ’701 patent explains that communication between mobile telephones moving to different cell sites and communicating with different base stations was a well-known concept prior to the earliest priority date of the ’701 patent.

43. In fact, this type of communication was known as early as 1921. As explained in The Bell System Technical Journal, January 1979, Volume 58, No. 1 (“Young”) cited in the Background of the ’701 patent, “In 1921 the Detroit police department made the earliest significant use of mobile radio in a vehicle.” Young, Ex. 1011, 2. “That system operated at frequency close to 2 MHz.” *Id.* “The utility of this idea was so obvious that the channels in this low-frequency band were soon crowded” and “[n]ew frequencies between 30 and 40 MHz were made available about 1940.” *Id.* “A natural outgrowth of that development was the use of frequency modulation to improve reception in the presence of fading of the signal, electrical noise, and static.” *Id.*

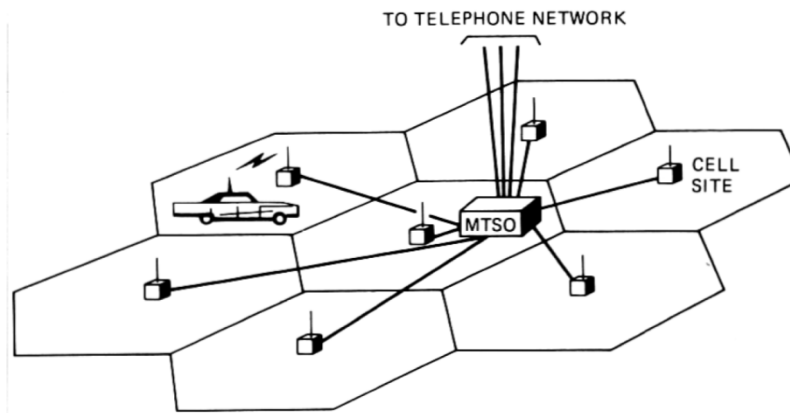


Fig. 1—The components and layout of the AMPS system.

Ex. 1011, Fig. 1.

44. FIG. 1 above shows the communication between a mobile unit in a vehicle and a fixed base station and further demonstrates that communication between a mobile terminal and a fixed base station was well-known prior to the earliest priority date of the '701 patent.

45. Additionally, U.S. Patent No. 5,559,865 to Gilhousen ("Gilhousen865"), U.S. Patent No. 5,504,935 to Vercauteren ("Vercauteren"), U.S. Patent No. 5,109,390 to Gilhousen ("Gilhousen390") and U.S. Patent No. 5,566,209 to Forssén ("Forssén") are few among many which disclose wireless communication between a mobile unit and fixed base station.

B. The Handoff Problem Was Well-Known

46. The '701 patent explains that while hand-offs were well-known, problems existed with the handoff process, such as the amount of time required to perform a handoff. *See* Ex. 1001, 2:59-61. This problem was known at least as

early as 1991, as disclosed by U.S. Pat. No. 5,345,467 to Lomp (“Lomp”).

Similarly, issues with maintaining a seamless call during a handoff process were also well-known as early as 1993, as demonstrated by U.S. Pat. No. 6,393,281 to Capone (“Capone”). POSITAs knew of these problems and had developed several well-known solutions for more efficiently performing hand-offs prior to the ’701 patent. *See e.g.*, Gilhousen390, Ex. 1007, 7:49-62.

47. As previously explained, handoffs occur when “a mobile unit moves through a cellular network... away from one cell site and toward another cell site.” Ex. 1001, 1:37-39. “Each cell site monitors [the] signal quality of the signal received from the mobile unit and passes information to the telephone network interface and determines when a call in progress is to be transferred from one cell site to another.” *Id.*, 1:38-42. This transfer of call in progress of the mobile unit from one cell site to another cell site is known as “handoff.” *Id.*, 1:24-43. The ’701 patent further discloses that the hand-off function is “described in The Bell System Technical Journal, January 1979, Volume 58, No. 1” *Id.*, 1:33-35. Thus, the hand-off process was well-known since at least 1979, well before the earliest priority date of the ’701 patent.

48. As admitted in the ’701 patent, however, this handoff process may take a considerable amount of time to perform. *See id.*, 2:60-61. For example, a communication network may utilize a “locating” process “for determining

whether it would be better from the point of view of signal quality and potential interference to transfer an active connection with a mobile unit to another land transmit/receive equipment, or perhaps to another land site.” Ex. 1011, 8. “The process entails sampling the signal from the mobile unit to determine if handoff from one voice channel to another is required.” *Id.* The significant time associated with performing a hand-off meant that devices moving at a high rate of speed (e.g., in a car or other vehicle) would lose connection before completion of the hand-off, resulting in a call being dropped.

49. This “handoff problem” was well-known in the art and was described in several references. For example, U.S. Pat. No. 5,434,853 to Hemmady (“Hemmady”) explains that a problem with traditional networks was, “as [a] mobile moves from cell to cell, the circuit connection between the cell site and the switch must be torn down and re-established to the new cell site. Tearing down and re-establishing a circuit connection as a mobile moves from cell to cell and from switch to switch is known in the art as a ‘hard handoff.’ Hard handoffs are perceivable by the user as noticeable clicks and/or pauses in service. It is desirable in the art to provide ‘soft handoffs,’ or handoffs from cell to cell and from switch to switch that are not perceptible to the user.” Hemmady, Ex. 1027, 1:51-61.

50. Further, U.S. Pat. No. 6,393,281 to Capone explains that handoffs were particularly troublesome in “high speed” mobile communications. For

example, Capone describes an airplane: “with mobile communications involving a high speed aircraft[,] the time during which an aircraft remains within good quality communication range of a base station is very much reduced and the likelihood that a hand-off will be required during a particular call is very much increased.” Capone, Ex. 1026, 2:47-51.

51. “Further, time relationships and propagation delays are constantly changing. Therefore, it is difficult to provide a change of communications links which is ‘seamless’ and not readily detectable by an operator since such a change is often accompanied by momentary high noise levels or the omission or repetition of a portion of the communication or a very audibly noticeable change in the quality of the communication link. The changing time relationships also would complicate the scanning for the call from the mobile unit if a complex, synchronous system such as...mobile assisted hand-off systems were to be employed.” *Id.*, 2:52-62.

52. U.S. Pat. No. 5,345,467 to Lomp also describes the issue of hand-offs for “fast moving vehicle[s]” such as cars: “The hand-off method used for the cellular voice communications system employing frequency modulation (FM) channels may not work for a spread-spectrum CDMA system because the time required to acquire synchronization of the new sequence may result in the loss of considerable digital data. In addition, for certain applications, the CDMA system

could employ cells which may be placed close to one another, e.g. 1000 feet apart. *In such a case, since the handing-off occurs more frequently if the radiotelephone is in a fast moving vehicle, the switching time is far more critical than when the cells are 3 miles apart, which is typical for present FDMA systems.*” Lomp, 2:35-47, emphasis added.

53. As seen from these references, handoff problems, especially with high speed vehicles, were well known before the earliest priority date of the '701 patent.

C. Prior Art Solutions to the Handoff Problem

54. In view of the described handoff problems, many prior art solutions were well-known, some of which were described more than a decade prior to the '701 patent. As will be further explained below, the '701 patent adopted these well-known solutions to solve the same problem.

55. One well-known solution to the hand-off problem was known as “cell-site diversity.” The book, Digital Cellular Radio, published in 1988 explains:

According to calculations presented by Jakes *et al.*, the *use of multiple base stations*, with the ability to *select and hand off the mobile within the cell to the best one*, should improve average signal-to-noise ratio by something on the order of 10dB.

Calhoun, Ex. 1010, 229, emphasis added.

56. Also, as explained in Gilhousen390, in order to avoid the situation of connections being dropped, the cell-site diversity technique allows a mobile unit to simultaneously connect with multiple base stations from multiple cell sites to ensure that there is at least one connection available for the phone at any time:

During call handoff, mobile unit communications with the various cell-sites is subject to path diversity. These communications are also processed by the multiple receivers at the mobile unit for diversity combination. Furthermore the signals transmitted through the various cell-sites are combined in a diversity combiner at the system controller. ***The present invention further permits what is referred to herein as the cell-site diversity mode at times other than a handoff. In this mode the mobile unit is permitted to communicate with various cell-sites on an ongoing basis.***

In the cell-site diversity mode the call is allowed to linger in the in-between state as described above with reference to ***the call being processed by two cell-sites.***

Ex. 1007, 7:49-62, emphasis added.

57. Cell-site diversity allows a mobile unit to communicate and stay connected with multiple base stations. In such a case, Gilhousen390 explains that the signal at the mobile unit is enhanced by receiving multiple copies of the signal:

When the cell-diversity mode is in use, the mobile unit will use the searcher receiver to find and trap the strongest multipath signal from ***each***

of the two cell-sites. The digital data receivers will be controlled by the searcher receiver and the control processor so as to demodulate the strongest signals.

Id., 17:44-50, emphasis added.

58. In view of these descriptions, a POSITA would have known to use cell-site diversity as a solution to the handoff problem in as early as 1988.

59. Further, another well-known solution touted by the '701 patent is the "soft" handoff. *See* Ex. 1001, 11:1-3. This technique, however, was well known in 1992 as explained in U.S. Pat. No. 5,267,261 to Blakeney, II. In particular, Blakeney explains that during a "soft" handoff, communication is provided to a "mobile station through more than one cell base stations." Blakeney, Ex. 1028, 2:60-63 "***[T]wo or more base stations or sectors of a base station transmit concurrently*** to the mobile station." *Id.*, 2:67-3:5, emphasis added. In this manner, the communication is "uninterrupted by the eventual handoff from the base station corresponding to [the] from which the mobile station is existing to the base station corresponding to [the] cell from which the mobile station is entering." *Id.*, 2:63-68.

60. "Since the mobile station is communicating with the user via ***at least one base station at all times*** throughout the handoff there is no interruption in communications between the mobile station and the user. A soft handoff in communications provides significant benefits in its inherent '***make before break***'

communication over conventional ‘break before make’ techniques employed in other cellular communication systems.” *Id.*, 4:36-43, emphasis added. “[T]he purpose of a soft handoff is to provide diversity in communication of signals between the mobile station and the base stations on the boundaries between base stations. In addition, soft handoff provides uninterrupted transmission between the mobile station and the base station in transitions between base station coverage areas.” *Id.*, 26:30-37.

61. U.S. Pat. No. 5,101,501 to Gilhousen further describes this “soft” handoff scheme: “a new cell-site modem is assigned to a mobile unit while the old cell-site continues to service the call. When the mobile unit is located in the transition region between the two cell-sites, the call can be switched back and forth between cell-sites as signal strength dictates. Since the mobile unit is always communicating through at least one cell-site, no disrupting effects to the mobile unit or in service will occur.” Gilhousen 501, Ex. 1029, 3:11-18. “When mobile unit communications are firmly established with the new cell-site, e.g. the mobile unit is well within the new cell, the old cell-site discontinues servicing the call.” *Id.*, 3:19-22.

62. In view of these descriptions, the “soft” handoff technique was a well-known strategy by at least 1992 for maintaining seamless communication even when a mobile device moves to different cell sites.

63. It was also well-known in the art, at least as early as 1994, to reduce handoffs experienced by a moving mobile device. Specifically, Gilhousen865 describes a system for providing wireless connectivity to a mobile device traveling in an airplane. To reduce the handovers experienced by the mobile device, Gilhousen865's system includes an onboard repeater that functions as an intermediary between the mobile device and ground base stations. In some embodiments, the repeater is "replaced by a base station-type unit that registers the radiotelephone aboard the aircraft... the aircraft base station then searches for the strongest pilot signal from a ground base station and registers with that base station." Similar to the '701 patent, Gilhousen865 teaches that the mobile unit on the airplane is registered with the onboard base station, and the onboard base station performs all the necessary handoffs to maintain connectivity with ground base stations. Since space on an aircraft is limited, and can typically be fully serviced by one to two onboard base stations, the hand-off experienced by the mobile device become minimum to none.

64. Additionally, the prior art solutions to hand-offs were applicable to different protocols for increasing spectral efficiency, such as Frequency-Division Multiple-Access (FDMA), Time-Division Multiple-Access (TDMA), and Code-Division Multiple-Access (CDMA). *See* Honig, Ex. 1021, 1:37-62, 4:33-67. For example, in a well-known combined TDMA/CDMA configuration, different

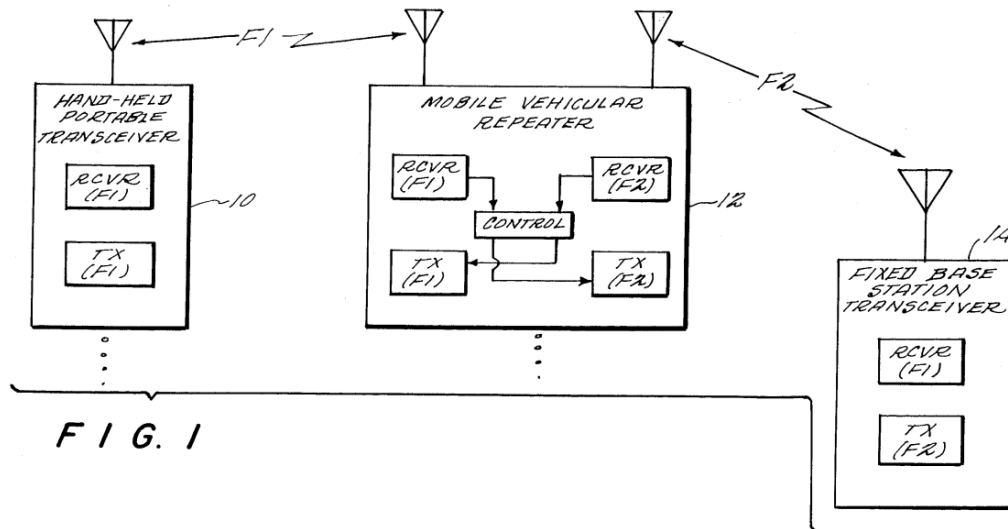
“spreading codes” are “assigned to different cells. Within each cell, all users take turns (as in TDMA) transmitting [a] signal... where the pulse shape is associated with the particular spreading sequence assigned to that cell. In addition, when a user is handed off to an adjacent cell, the spreading code [is] changed.” *Id.*, 5:12-19. In this manner, the prior art solutions alleviating the handoff problem also incorporated well-known channel division protocols, such as TDMA and CDMA. Further, it was well-known in the art to provide solutions to the hand-off problem while incorporating a ***combination*** of these diverse channel division protocols, such as a TDMA/CDMA combination. *See id.*, Abstract, 1:55-62.

D. Repeaters and Moving Base Stations Were Well-Known

65. Mobile repeaters and moving base stations were well known by at least 1979, more than 15 years prior to the '701 patent. A mobile repeater is substantially similar to a movable base station because both devices operate as intermediary systems that facilitate communications between a mobile device and a fixed base station. These prior art devices acted as intermediary systems to facilitate communications between a mobile device and a fixed base station.

66. In one well-known early example, a moving repeater (*i.e.*, moving base station) configuration was used in law enforcement and other emergency contexts. *See, e.g.*, News, Ex. 1015, 16; *see also* Mears, Ex. 1030, 1:19-27. Mears

depicts an example of a mobile vehicular repeater acting as a mobile base station for hand-held portable devices:



Ex. 1030, Fig. 1.

67. Mears' system allowed an officer to send out an emergency radio signal through his cruiser's radio to notify the dispatcher as well as nearby patrol. The cruiser's radio is an example of a moving base station, which forwards the signal from device carried by officer to police center to dispatch backup. In addition, since it is installed in the cruiser, the moving base station moves with the cruiser. As News explains:

In law enforcement applications, the device can be used as a radio extender for patrol cars. An officer, even when alone, out of his car and possibly immobilized, can activate WHEPPS to send out a distress call **through his cruiser's radio**, notifying both the dispatcher and nearby patrol cars that needs assistance.

Ex. 1015, 16, emphasis added.

68. In addition, U.S. Pat. No. 5,509,028 to Marque-Pucheu describes a conventional “repeater station” “used to transmit digital signals by radio over a predefined frequency band between a base station and mobile stations.” Marque-Pucheu, Ex. 1031, Abstract. “At least one repeater station is used to receive radio signals transmitted by the base station and to retransmit radio signals to the mobile stations over the same frequency band.” *Id.*, Abstract.

69. Marque-Pucheu explains that as POSITAs were attempting to reduce the size of mobile device, POSITAs were also attempting to “reduce the power and the range of mobile stations so as to limit the volume and the cost.” *Id.*, 1:26-28. This reduction also led to a reduced “range” for “radio links between mobile stations and fixed base stations. It [was] therefore necessary to increase the number of base stations.” *Id.*, 1:30-32.

70. One solution was to use “one or more repeater stations for one or more of the fixed base stations.” *Id.*, 1:35-36. “In general, the repeater stations merely comprise amplifiers connected between reception antennas and transmission antennas.” *Id.*, 1:38-40. In this manner, repeaters extended the range of the base stations and facilitated communications between fixed base stations and mobile devices.

71. As demonstrated in the News/Mears examples above, these repeater systems were incorporated into moving devices, such as vehicles, and operated as mobile base stations. From the perspective of a mobile device receiving signals from the moving base stations (e.g., repeaters), the communications appeared to have been received from a fixed base station. Additional references prior to the '701 patent expanded the application of News/Mears to cellular communications.

72. For example, U.S. Pat. No. 5,276,686 to Ito describes an example of cellular communications with a moving vehicle. As shown in Figure 6 from Ito, "a mobile base device MSS" is installed in a car and connects a "base station BSS" and a "portable devices PSS" through radio channels. *See* Ito, Ex. 1005, 5:41-46, 13:60-63. The mobile base device MSS moves with the car and facilitates communication between base station and mobile unit. *Id.*, 2:5-10.

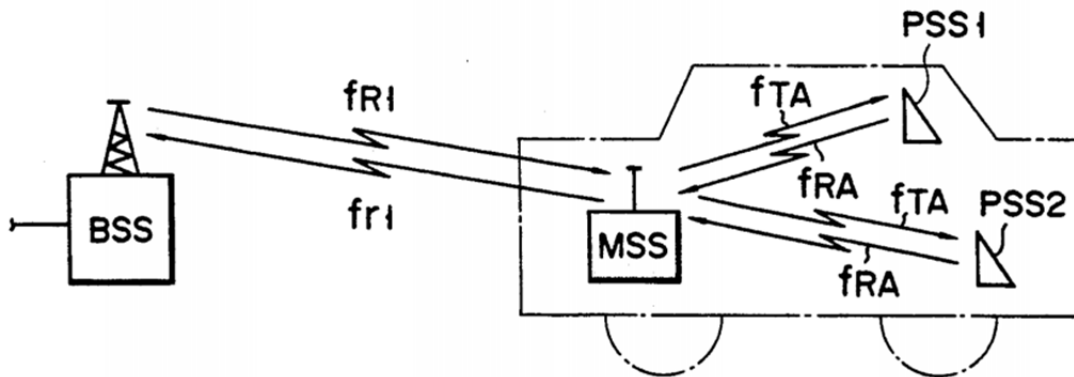


FIG. 6

Ex. 1005, Fig. 6.

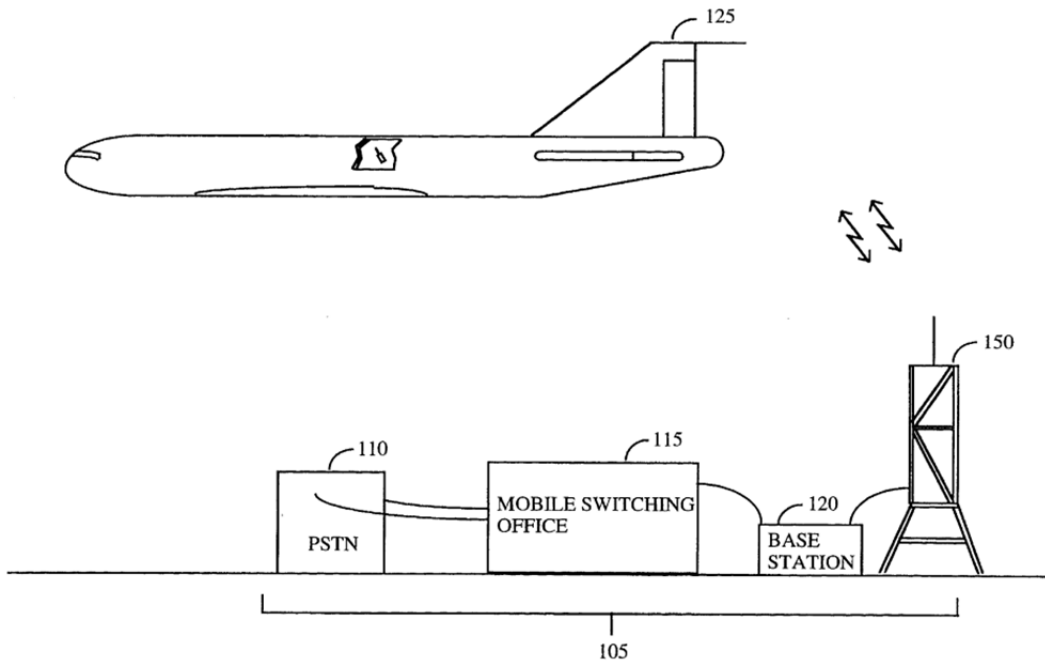
73. While Ito demonstrates that it was well known to install moving base stations in a car or bus for cellular communications, it was also well-known in the art that moving base stations could be installed in other vehicles. For example, as explained in Vercauteren, a train could be equipped with a moving base station serving mobile users on the train with cellular connections:

“The terrestrial mobile radio network TMRN adapted to serve handheld terminals TMT, DMT would provide an unviable solution if these terminals were situated on the train and had to communicate directly with fixed relay stations FFRS or fixed base stations FBS. However, through its generic structure, the present mobile network MCN allows the traffic of these latter mobile terminals to be concentrated via **a high power roaming relay station RRS mounted on the train** and coupled to the fixed level FL via a specific type of relay link. In the present case the latter link has to be a mobile radio link within MTGCRN.”

Ex. 1017, 16:53-64, emphasis added.

74. As described in Gilhousen⁸⁶⁵, moving base stations were also installed in airplanes. Ex. 1009, 1:7-10. The onboard moving base station provided a connection between base stations on the ground and mobile units onboard the aircraft. *Id.*, 2:9-12. As shown in Figure 1, the ground base stations communicated with mobile units inside airplane through onboard radio system. *See id.*, 2:53-63.

FIG. 1



Ex. 1009, Fig. 1.

75. As stated by Glihousen865, “In the preferred embodiment, the aircraft is equipped with a repeater that relays a signal from the airborne radiotelephone to the ground base station and vice versa.” Ex. 1009, Abstract.

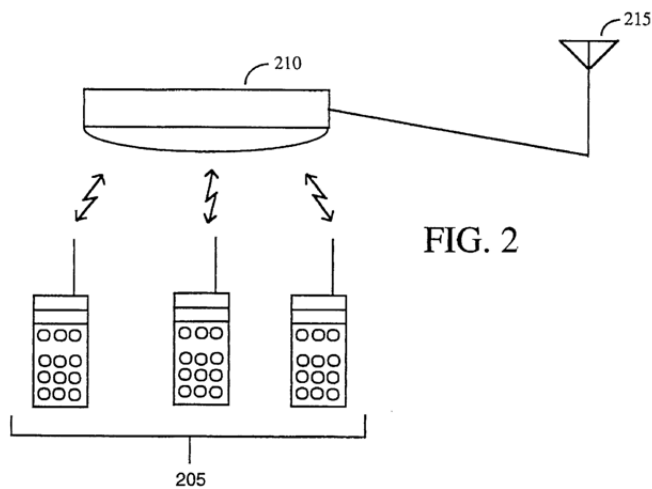


FIG. 2

Ex. 1009, Fig. 3.

76. As seen in the figure above, “[t]he repeater (210) receives the signals from the individual radiotelephones (205) within the aircraft and relays them to an antenna (215) mounted on the outside of the aircraft. The outside antenna (215) relays the signals to the base station on the ground.” Ex. 1009, 2:53-57.

77. In view of these well-known configurations, the function of repeating signals to facilitate communication between a fixed base station and a mobile device was well known. Further, it was well-known to use a mobile base station or mobile repeater to facilitate this communication, and to place the repeater inside a moving vehicle for purposes of service wireless communication devices inside the moving vehicle.

E. The Multipath Fading Problem and Prior Art Solutions were Well known

1. The Fading Problem

78. Another well-known problem with mobile communications is known as fading. This problem was recognized at least as early as 1988, more than 6 years earlier than ’701 patent. *See* Ex. 1010, 212; Paneth, Ex. 1032, 1:33-36, 71:64-66. Fading may occur as the result of “free space loss” meaning that “the power of [a transmitted] signal at any given point steadily diminishes as a function of the distance of the receiver from the transmitter.” Ex. 1010, 206. Fading may also occur due to the radio wave being “partially blocked, or

absorbed, by some feature of the environment” causing “attenuation” of the signal. *Id.*, 207-208.

79. Yet another source of fading is “multipath propagation.” *Id.*, 212. In the multipath scenario, a radio signal transmitted from a base station or mobile terminal may be reflected by many objects in its path, such as building, a tree, or a vehicle, reflecting the signal into different directions. Calhoun, 212. As a result, reflections may “produce not one but many different paths between the transmitter and receiver.” *Id.* “This is known as multipath propagation.” *Id.* “[M]ultipath propagation creates some of the most difficult problems associated with the mobile environment.” *Id.*, 213. One of the problems is “[r]andom phase shift which creates *rapid fluctuations in signal strength* known as *Rayleigh fading*.” *Id.*, emphasis added.

80. Under the Rayleigh fading effect, “the reflected radio wave may undergo drastic alteration in some of its fundamental characteristics, particularly *phase* and *amplitude*.” *Id.*, 216, emphasis added. “If the two signals, assuming for the moment that there are only two, are exactly 180° out of phase, they will cancel each other out at the receiver. The signal effectively disappears.” *Id.* In other less extreme cases, “multiple received signals [may] produce lesser reductions in measured signal strength.” *Id.*

81. The fading effect is even more impactful on moving devices, such as those within a moving vehicle. When “an automobile antenna” moves at “60 miles per hour,” “[t]he antenna passes through hundreds of [fading] holes of varying depths every second, causing the signal strength to fluctuate very rapidly between normal levels and fades ranging up to 40 dB or more.” *Id.*, 217. The fading of 40 dB means the signal strength becomes 10,000 times smaller which makes the signal very hard to decode if not impossible. *Id.*

2. Prior Art Solution to the Multipath Fading Problem

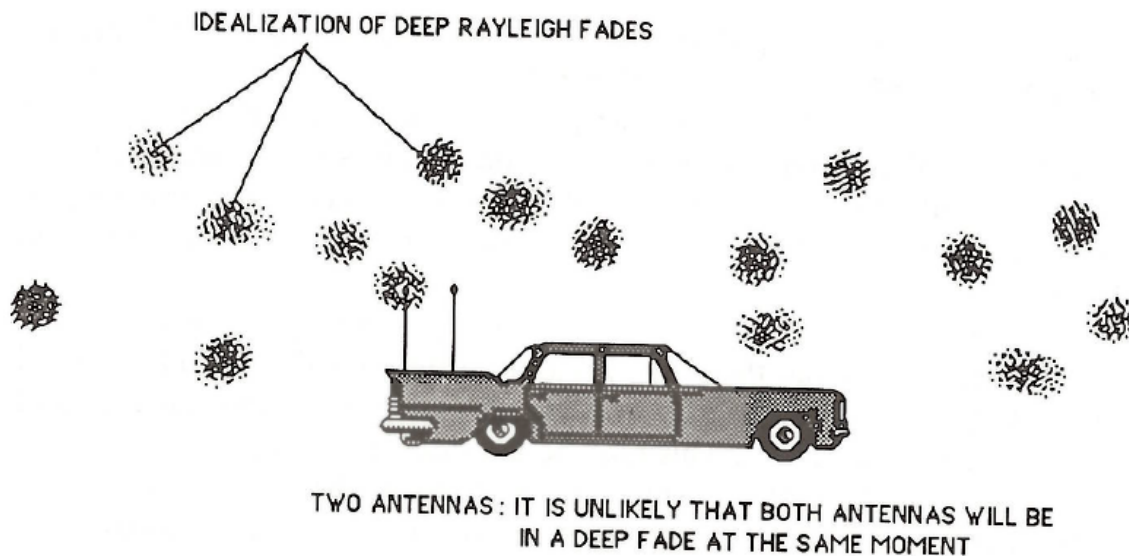
82. While the concept of fading was a well-known problem, the idea that fading was a “spatial concept” was also well-known by as early as 1988, more than 6 years earlier than ’701 patent. *Id.*, 216. The signal strength at a particular receiver would be identified by the “sum of all direct and reflected paths from a transmitter to [that] receiver” for the “***given spot occupied by the receiver.***” *Id.*, emphasis added. In this manner, the fading effect would differ in magnitude at different receiver locations. *Id.* Using this understanding, POSITAs were able to design spatial antennas to combat the effects of this fading.

83. Because of the spatial nature of signal fading, a receiver may experience fading in one location, but may experience none in a different location. In view of this understanding, a well-known solution was to place two or more antennas in spatially separated locations. *See id.*, 226. In this manner,

each antenna will experience different and uncorrelated fading effects. This technique is known as space or spatial diversity:

[T]he most common form [of diversity] is known as *space diversity*, which in layman's terms means simply having *two or more antennas separated by a minimum of half a wavelength* (several inches at 800-900 MHz) [26]. Two antennas so separated will show uncorrelated fading patterns; if *one antennas is in a deep fade it is quite likely that the other antenna is not in a fade*. (See Figure 8.25.) The radio circuitry can be programmed to select the antenna branch with the better signal. The more branches, the better the average signal.

Id., emphasis added.



Ex. 1010, Fig. 8.25.

84. With two or more received signals experiencing uncorrelated fading from multiple antennas, spatial diversity can be achieved by “either combining these signals or selecting the best of them, improving the signal-to-noise ratio at

the receiver” since “if one antenna is in a deep fade it is quite likely that the other antenna is not in a fade.” Ex. 1010, 226.

85. In conclusion, using spatially separated antennas to overcome multipath fading problem was well known to a POSITA by at least 1988, well before the effective filing date of '701 patent, June 2, 1995.

VIII. Prosecution History of the '701 Patent

86. The '701 patent was filed on April 9, 2007. '701 Prosecution History, Ex. 1002, 00036. A first Office Action was issued on January 10, 2008. *Id.*, 0067. The Office Action rejected 14 of the 20 claims, and identified 6 claims as containing allowable subject matter. *Id.*, 0068. Specifically, claims 1, 2, 4-6, 9-11, 12, 14-16, 19 and 20 were rejected over U.S. Patent No. 4,539,706 to Mears. *Id.*, 0069. On May 25, 2008, Patent Owner filed an amendment in reply to the Office Action that amended independent claim 11 (patented claim 10) to include subject matter from a dependent claim that was identified as allowable. *Id.*, 0078, 0080. Namely, claim 11 was amended to recite “a controller configured to align and combine the received fixed port signals.” As discussed herein, this limitation was well-known in the art at the time of the '701 patent. In the same amendment, Patent Owner also added 24 new claims. *Id.*, 0082-0085.

87. On August 22, 2008, the Patent Office issued a subsequent Office Action allowing all original claims and some of the added claims, but rejecting

others of the added claims over Mears. *Id.*, 0093-0094. In a reply filed September 1, 2008, Patent Owner amended the rejected claims to recite “a plurality of spatially separated antennas configured as a plurality of phased array antennas to provide directional radio frequency beams.” This limitation is not recited in any of the challenged claims. *Id.*, 0107.

88. Subsequently, the Patent Office issued another rejection rejecting all claims over U.S. Patent No. 5,404,570 to Charas et al. (“Charas”). *Id.*, 0117. On July 1, 2009, Patent Owner filed a reply in which no changes were made to the challenged claims (e.g., claims 11 and 33). Instead, Patent Owner argued that the combination of Charas and U.S. Patent No. 5,260,968 to Gardner was improper. *Id.*, 0133. The Patent Office maintained the rejection in a Final Office Action issued on October 29, 2009. *Id.*, 0144-0150.

89. Patent Owner filed a Pre-Appeal brief on February 27, 2010. *Id.*, 0154-0155. The pre-appeal conference panel maintained the rejections of the Examiner. *Id.*, 0167. Patent Owner filed an Appeal Brief on June 27, 2010 repeating the combinability arguments presented in the July 1, 2009 reply. *Id.*, 0185-0193. Thereafter, rather than file an Examiner’s Answer to the Appeal Brief, the Examiner withdrew the rejection and allowed the application in a Notice of Allowance issued on September 17, 2010.

90. As explained in Petitioner's grounds below, the claimed concepts existed well before the earliest possible priority date of the '701 patent. Indeed, had any of the aforementioned references been before the examiner during prosecution, the '701 patent should not have been allowed.

IX. Claim Construction

91. I have been instructed that the challenged claims of the '701 patent are to be given their ordinary and customary meaning as understood by one of ordinary skill in the art at the time of the invention in light of the specification and the prosecution history pertaining to the patent. Based on my review of the challenged claims, it is my opinion that none of the claim terms require explicit constructions. Accordingly, all claim terms should receive their plain and ordinary meaning, in the context of the '701 patent specification, under the *Phillips* standard.

X. Overview of the Applied References

A. U.S. Patent No. 5,276,686 (Ito)

92. Ito, like the '701 patent, is directed to "a radio communication system to be used as an automobile telephone system." Ex. 1005, 1:8-9. Ito describes that prior automobile communication systems included a mobile station that wirelessly communicated with fixed base stations. *See Id.*, 1:16-27. However, in this configuration, the mobile station and the telephone were not wirelessly

connected, but rather connected via a “signal cord.” *Id.*, 1:51-53. As a result, in addition to other limitations imposed by the corded connection, the curled cord was “an annoying obstacle when the driver drives and speaks into the telephone transmitter simultaneously.” *See id.*, 1:55-57; *see also id.*, 1:58-2:2.

93. Therefore, Ito discloses a mobile radio communication system for an automobile “that wirelessly connects not only between a base station and a mobile station but also between a mobile station, or a mobile base device, and a portable device by a radio channel[.]” *Id.*, 2:5-10. According to Ito, this “eliminate[s] the necessity of wiring the mobile base device and portable device and enhance[s] the maneuverability of an automobile telephone handset.” *Id.*, 2:10-12.

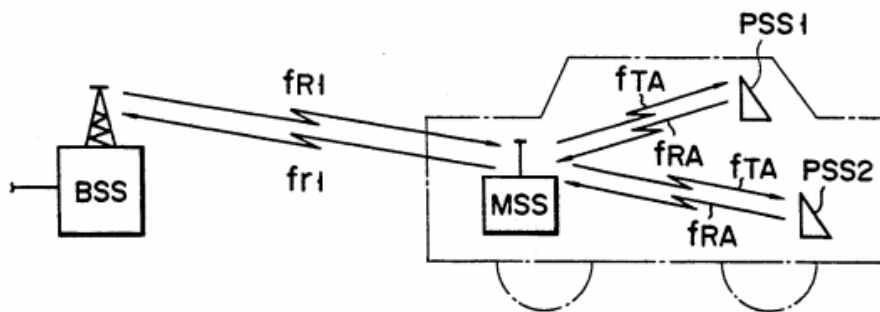


FIG. 6

Ex. 1005, Fig. 6.

94. The configuration of Ito's communication system is shown in Fig. 6, above.¹ As shown in that figure, an automobile is equipped with a mobile base device MSS. *Id.*, 12:52. Meanwhile, users inside the vehicle use telephones (portable devices PSS) that wirelessly communicate with the mobile base device. For example, as shown in Fig. 6, the mobile base device MSS communicates with a fixed base station BSS via frequencies f_{R1} and f_{T1} ², and communicates with one or more portable devices PSS1 and PSS2 via frequencies f_{RA} and f_{TA} . Ito illustrates the configuration of the mobile base device in further detail in Fig. 3.

¹ Although Fig. 6 depicts a "second embodiment" of Ito, that embodiment merely facilitates the use of multiple portable devices inside the vehicle, as opposed to a single portable device described in the first embodiment. Fig. 6, otherwise, is merely a magnified version of vehicle MS2 depicted in Fig. 1, and is relied upon merely for ease of reference.

² Although Fig. 6 shows the frequency as f_{r1} , Ito's specification clarifies that this is actually frequency f_{T1} . *See* Ex. 1005, 12:50-63.

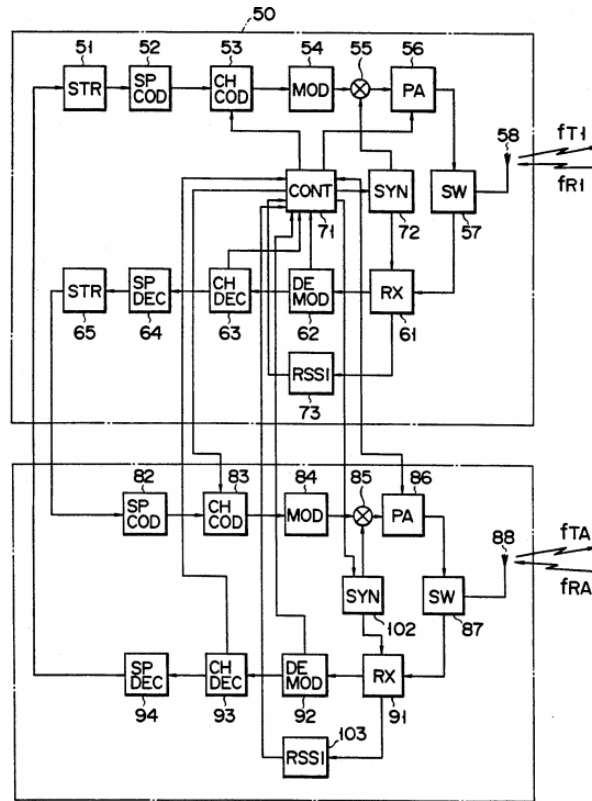


FIG. 3

Ex. 1005, Fig. 3.

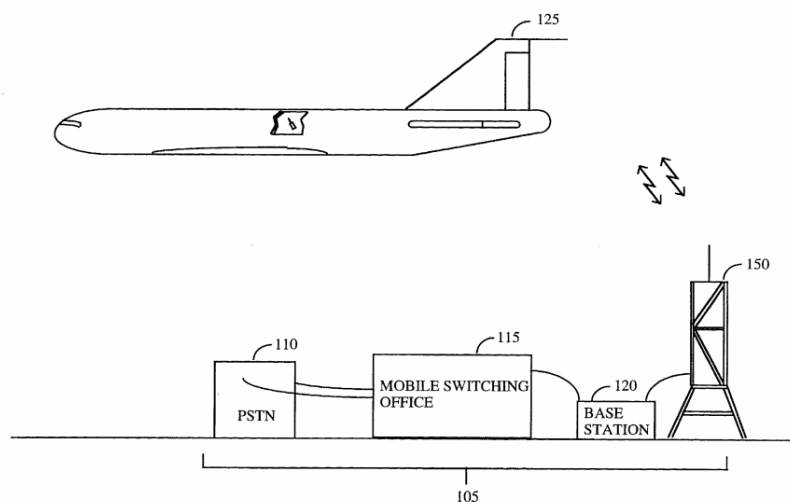
95. As shown in Ito's Fig. 3, the mobile base device MSS includes a first transmitter-receiver unit 50 and a second transmitter-receiver unit 80. *Id.*, 7:9-12. Whereas the first transmitter-receiver 50 facilitates communication with the base station BSS, the second transmitter-receiver 80 facilitates communication with the portable devices PSS. *Id.*, 7:12-20. Thus, in operation, the mobile base device MSS receives signals from the base station BSS via the first transmitter-receiver 50 and forwards those signals to the portable device PSS via the second transmitter-receiver 80. *Id.*, 13:17-18. Similarly, the second transmitter receiver receives signals from the portable device PSS and forwards them to the base

station BSS via the first transmitter-receiver 50. *Id.*, 7:25-28, 7:51-54. In this manner, the mobile base device MSS provides a moving source of communications connectivity for portable devices located within a moving vehicle. Specifically, as the vehicle moves, the mobile base device MSS moves with the vehicle and maintains communications connectivity.

B. U.S. Patent No. 5,559,865 (Gilhousen865)

96. Gilhousen865, like the '701 patent, describes a system for providing communications between a ground base station and a mobile wireless telephone—in Gilhousen865's case, a wireless telephone located on an airplane. Ex. 1009, 1:7-10. Specifically, the system of Gilhousen865 comprises two subsystems: a ground based subsystem and an airborne based subsystem. *Id.*, 2:9-12.

FIG. 1



Ex. 1009, Fig. 1.

97. The ground subsystem includes a base station 120 coupled to the public switched telephone network (PSTN) 110 via a switching center 115. Ex. 1009, 2:21-24. The base station 120 wirelessly transmits signals to, and receives signals from, radiotelephones to provide communication between the radiotelephones and the network 110. *Id.*, 2:24-33. According to Gilhousen865, the base station “is coupled to an antenna (150) that receives and radiates the CDMA radiotelephone signals.” *Id.*, 2:32-33.

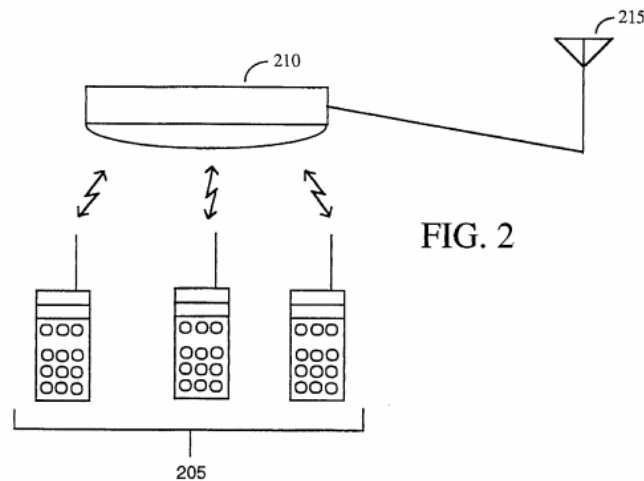


FIG. 2

Ex. 1009, Fig. 2.

98. The airborne subsystem, on the other hand, includes a repeater 210 installed in the airplane in which the wireless phone 205 is located. As shown in Fig. 2, the repeater includes an external antenna 215 that sends and receives signals with the base station. *See id.*, 2:53-65. According to Gilhousen865, the system can function both to provide outgoing calls from the radiotelephone to the ground base station, and incoming calls originating from the ground subsystem to

the airborne radiotelephone. *See id.*, 2:53-63. In the incoming direction, the external antenna 215 receives the signals from the base station and provides them to the repeater 210, which then “communicates the signal to the proper radiotelephone (205) in the aircraft.” *Id.*, 2:64-65. When configured to receive incoming calls, the repeater is configured like a base station. *Id.*, 3:3-10.

C. U.S. Patent No. 5,504,786 (Gardner)

99. Gardner is directed to a receiver for use in cellular communications. Gardner, Ex. 1006, 1:10-12, 2:17-19. According to Gardner, it was well known in the art that “[o]ne of the most useful techniques for improving receiver performance in the mobile (Rayleigh) channel is to use spatial diversity[.]” *See id.*, 1:15-17; *see also id.*, 1:28-32. This involves using “two (or more) antennas spaced far enough apart so that the characteristics of the fading encountered by the desired signal are independent for each of the two receiver paths.” *Id.*, 1:17-20. However, Gardner explains that that the most difficult aspect of receiving spatially diverse signals is “determining how to align the phases” of those signals. *Id.*, 1:38-39.

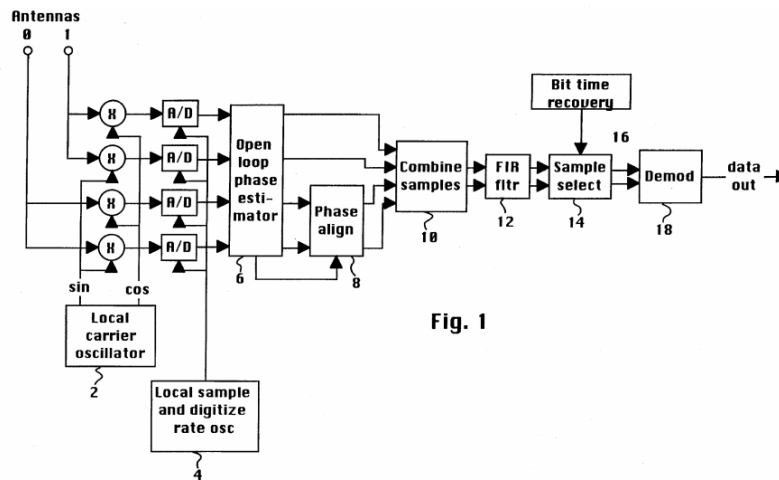


Fig. 1

Ex. 1006, Fig. 1.

100. Thus, Gardner describes a receiver configured to receive spatially diverse signals, and to properly align and combine the received signals.

Gardner's exemplary receiver is illustrated in Fig. 1, above. As shown in Gardner's Fig. 1, the receiver includes two spatially diverse antennas 0 and 1. *Id.*, 2:23-24. After demodulation and conversion, the received signals are processed by Gardner's receiver for alignment and combining. *See id.*, 2:64-3:10. Specifically, after the signals are converted to digital, phase difference detection is performed in order to detect "a good estimate of the actual phase difference between the two signals." *Id.*, 2:66-67. Then, the phase difference is used by Phase Align 8 to "phase align... the two digitized signal vectors... by shifting the phase of the vector." *Id.*, 3:1-7. Once aligned, the signals can be combined. *Id.*, 3:7-10.

D. U.S. Patent No. 5,109,390 (Gilhousen390)

101. Gilhousen390 is directed to “a novel and improved receiver design for enhancing the reliability and communications in the cellular telephone environment.” Ex. 1007, 1:7-12. Gilhousen390 explains that, in a cellular communication environment, transmitted signals are reflected by environmental surfaces. *Id.*, 3:1-6. These reflections result in the received signal consisting of multiple components, at least some of which have undergone fading. *Id.*, 2:54-68.

102. In order to compensate for fading in the received signal, Gilhousen390 discloses a variety of “diversity” configurations. *See, e.g., id.*, 5:22-34. One such diversity configuration is “cell-site diversity”: “The present invention further permits what is referred to herein as the cell-site diversity mode at times other than a handoff.” *Id.*, 7:55-57. In this mode, a call can be routed to a mobile device “through multiple cell-sites.” *Id.*, 11:58-59. Specifically, the mobile device is configured with at least two receivers that “are used as a two channel diversity receiver.” *Id.*, 7:66-68. The two receivers are then “assigned to demodulate the signals on the strongest two paths of the paths available from the original cell-site and from the new cell-site.” *Id.*, 8:13-15. According to Gilhousen390, this diversity configuration results in “a greatly improved resistance to deleterious fading that may occur in the multipath cellular telephone environment.” *Id.*, 8:18-21.

E. U.S. Patent No. 4,001,692 (Fenwick)

103. U.S. Pat. No. 4,001,692 to Fenwick is directed to a “time diversity transmission apparatus.” Fenwick, Ex. 1008, Abstract. Fenwick describes several negative effects that transmitted signals can undergo during transmission: “Signal fading, impulsive noise and interference are deleterious effects frequently encountered in many transmission circuits.” *Id.*, 1:13-15. These effects reduce the quality of transmission and increase errors. *Id.*, 1:16-18. According to Fenwick, one method of reducing these deleterious effects is through “diversity.” *Id.*, 1:30-36. Although many different types of diversity are available, Fenwick focuses on “time diversity.” *Id.*, 1:32-40.

104. Fenwick explains that time diversity means “transmission of data two or more times with a time delay between each transmission.” *Id.*, 1:37-40. Although previous systems employed synchronous time diversity, Fenwick proposes an asynchronous system as an improvement to prior art system for “permit[ting] many different transmission data rates to be utilized without requiring changes in operating frequency.” *Id.*, 2:5-8. A receiver in Fenwick’s system receives the multiple time-delayed data streams, which, “after removal of time diversity, are algebraically added to form a sum data stream.” *Id.*, 2:25-29.

XI. Ground 1: Obviousness based on Ito in view of Gardner (Claims 10, 15-18, 31, and 33-35)

A. A POSITA would have been motivated to combine Ito and Gardner.

105. As discussed above, Ito is directed to a radio communication system for use in an automobile. Ex. 1005, 1:9-10. As part of that communication system, Ito discloses a mobile base device MSS that facilitates communication between the base station BSS and the portable device PSS. However, as shown in Ito's Fig. 3, first receiver-transmitter 50 (base station side) and second receiver-transmitter 80 (portable device side) each include only a single antenna. Thus, neither receiver-transmitter is configured to receive spatially diverse signals.

106. Ito also discloses that signals transmitted to a moving device often have higher error rates due to "high speed fading phenomena." *Id.*, 16:49-61. However, Ito does not specifically describe how such errors can be reduced. Therefore, a POSITA would have looked to the prior art, such as Gardner, for determining how to combat the deleterious effects of fading incumbent on signals transmitted to a moving device. As discussed in Section VII.E, A POSITA would have known that the problem of multipath fading in a moving device can be overcome by spatially diverse antennas, and Gardner provides a detail design solution. Hence, a POSITA would have been naturally motivated to have used Gardner to modify Ito.

107. Like Ito, Gardner discloses a receiver for use in a wireless communication system. However, Gardner emphasizes the importance of employing spatially diverse antennas in the receiver to reduce the effects of fading on received signals. *See* Ex. 1006, 1:15-24. Specifically, Gardner discloses that “[o]ne of the most useful techniques for improving receiver performance...is to use spatial diversity.” *Id.*, 1:15-17. According to Gardner, spatial diversity reduces the effect of fading encountered by the received signal and provides “[c]onsiderable performance improvement.” *Id.*, 1:19-23.

108. Based on the teachings of Gardner, a POSITA would have been motivated to modify Ito so as to incorporate spatially diverse antennas. For example, a POSITA would have recognized that the receiver disclosed by Gardner, having spatially diverse antennas, would have significantly improved the signal quality and receiving performance of Ito’s receiver under influence of fading channel. In fact, as I have demonstrated above, it was well known in the art at least as early as 1988, as discussed in Section VII.E, that using multiple spatially diverse antennas at a receiver would improve the signal quality (e.g., signal-to-noise ratio, error rate, etc.). Gardner describes its receiver in generic terms, and out of the context of any particular application. In other words, the receiver in Gardner is a general-purpose receiver useable in a wide variety of receiver systems, including Ito’s. Thus, a POSITA would have recognized

Gardner's spatially diverse receiver to be modular. Meanwhile, as shown in Fig. 3 of Ito, both the first receiver-transmitter 50 and the second receiver-transmitter 80 include single antennas that provide both transmission and reception functionality by way of a switch. Thus, modifying Ito with Gardner would have required minimal modifications. Namely, in place of the antenna 58 connected to the switch in Ito, at least one antenna would be provided for transmission and at least two antennas for reception. The transmitter mode does not need any modification as it could still use single antenna to transmit. And in receiver mode, an additional antenna connection can be added parallel to original antenna connection and controlled by the same switch. In this manner, two antennas simultaneously receive a signal. The switch would then not only switch between the transmission-side circuitry (e.g. elements 51-56) and the receive-side circuitry (e.g., elements 61-65), but also between the transmission antenna and the receive antennas, respectively. Finally, in order to achieve all the benefits of Gardner's receiver, the receive-side circuitry (e.g., elements 61-65) would be modified to match the receiver circuitry illustrated in Gardner. I provide below one example of how Ito and Gardner could have been combined.

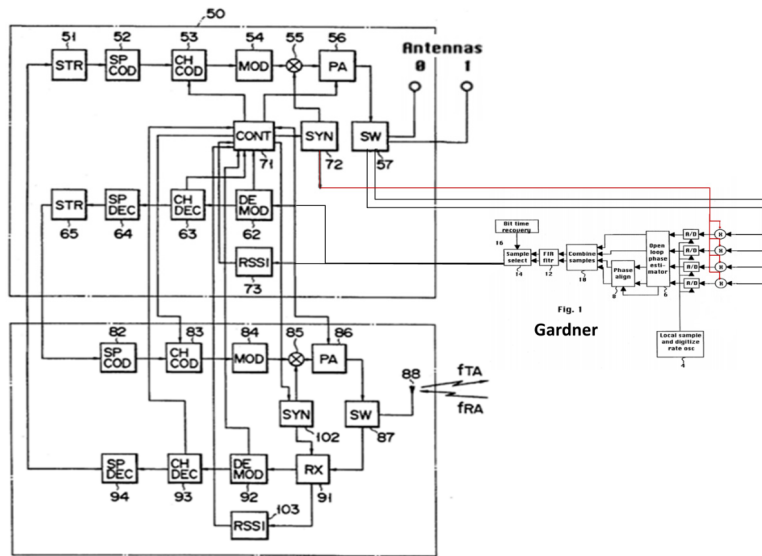


FIG. 3 Ito

Ex. 1005, Fig. 3, annotated; Ex. 1006, Fig. 1, annotated.

109. Although the modification has been described with respect to the first receiver-transmitter 50, it would have been apparent to a POSITA that the second receiver-transmitter 80 of Ito could likewise have been modified. This is because the second receiver-transmitter 80 shares substantially the same receiver componentry configuration as that of the first receiver-transmitter 50.

110. In addition to the motivations described above, a POSITA would have been further motivated to combine Ito and Gardner because both are in the same general field of mobile communications, and address the same problem—improving the performance of wireless communication systems. They both propose solutions for wireless communication systems. Further, as evident from the above discussion, a POSITA could have combined the system of Ito with the teachings of Gardner by known methods, and the results of the combination

would have been predictable to a POSITA (e.g., by including a second signal path for processing the signal received from a second antenna, substantially similar to the first signal path). As I've already discussed, the advantages of adding multiple spatially diverse antenna were well-known. Finally, the proposed combination of Ito and Gardner would involve nothing more than incorporating a well-known concept (*i.e.*, Gardner's signal diversity) into a well-known system (*i.e.*, Ito's radio communication system). The signal diversity concept and mobile base station were well-known at the time of the '701 patent. *See* Section X.A, X.C above.

B. Ito in view of Gardner renders obvious claim 10.

111. Claim 10 is an independent claim. For purposes of my analysis, and ease of review, I have separated claim 10 into component parts, which I identify in brackets for reference:

10. [P] *A movable base station configured to move relative to Earth, the movable base station comprising:*

[A] *a plurality of spatially separated antennas;*

[B] *a receiver configured to receive fixed port signals from a fixed port through the plurality of spatially separated antennas;*

[C] *a controller configured to align and combine the received mobile device signals; and*

[D] *a transmitter configured to transmit radio frequency signals to a mobile device corresponding to the received fixed port signals.*

112. As I demonstrate below, it is my opinion that each and every element of independent claim 10 was well-known in the art prior to the '701 patent, and that claim 10 would have been obvious over the art.

1. Claim 10 Preamble (Element [10P])

113. As shown in Fig. 6 of Ito, an automobile is equipped with a mobile base device MSS (*“movable base station”*). Ex. 1005, 12:52. The mobile base device MSS communicates with a fixed base station BSS, and communicates with one or more portable devices PSS within the automobile. In this manner, the mobile base device MSS facilitates communication between the portable device PSS and the base station BSS. Because the mobile base device MSS is located in an automobile, it would have been obvious to a POSITA that the mobile base device MSS is *“configured to move relative to Earth.”* In particular, whenever the automobile moves, the mobile base device MSS inside the automobile moves with the automobile in the same direction.

2. Element [10A]

114. As shown in Ito's Fig. 1 (annotated below), the mobile base device MSS (*“movable base station”*) facilitates communication between a stationary base station BSS2 (*“fixed port”*) and a portable device PSS located within the

vehicle. *See id.*, 1:8-13. As shown in Ito's Fig. 3, the mobile base device MSS includes a first transmitter-receiver 50 "used for radio communication with the base station BSS," and includes a second transmitter-receiver 80 "used for radio communication with its portable device PSS." *Id.*, 7:12-16.

115. Ito does not explicitly disclose that first transmitter-receiver 50 includes "*a plurality of spatially separated antennas.*" However, Gardner discloses this limitation. Specifically, Gardner discloses a modular receiver for use in cellular communications, like that of Ito. Ex. 1006, 1:10-12. Gardner explains that "[o]ne of the most useful techniques for improving receiver performance in the mobile (Rayleigh) channel is... spatial diversity." *Id.*, 1:15-17. Gardner further explains that spatial diversity is achieved by "us[ing] two (or more) antennas spaced far enough apart" so as to reduce the effects of fading on the received signal. *Id.*, 1:15-19. Gardner explains that, during operation, multiple "RF signals [are] received on the two antennas" in order to improve receiver performance and combat fading issues. *Id.*, 2:28-30; 1:19-24. Gardner illustrates this configuration in Fig. 1, where "two spatially diverse antennas 0 and 1 are used." *Id.*, 2:23-24. Therefore, Gardner discloses "*a plurality of spatially separated antennas.*"

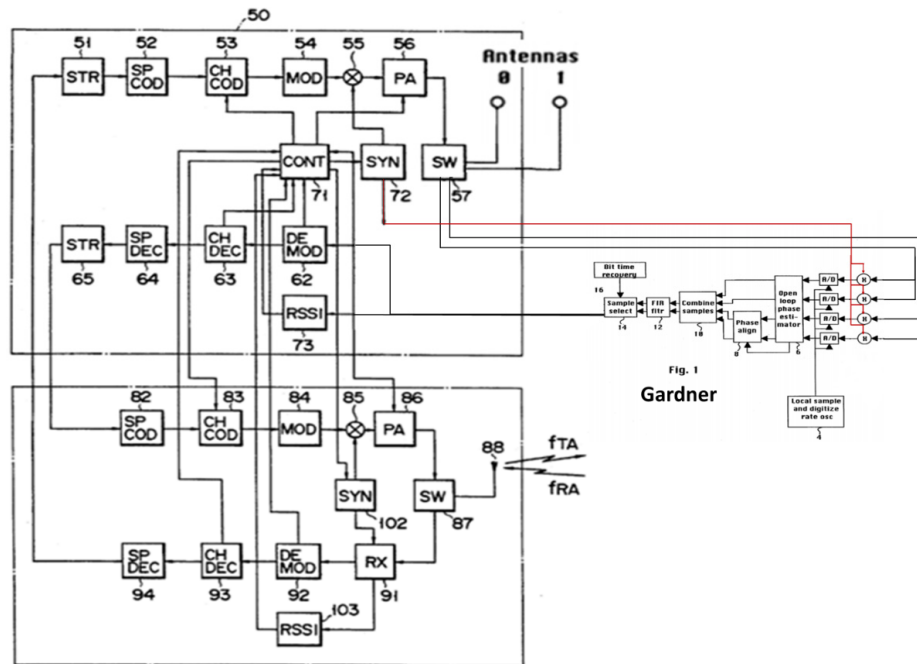


FIG. 3 Ito

Ex. 1005, Fig. 3, annotated; Ex. 1006, Fig. 1, annotated.

116. As discussed above, a POSITA would have been motivated to employ Gardner's spatially diverse antennas in the first transmitter-receiver 50 of Ito, at least for the reasons of reducing the effects of fading in the received signals. A POSITA would have known that wireless signals would experience fading when receiver is moving, as discussed in Section VII.E. After reading Gardner, a POSITA would realize Gardner provides a solution for the fading problem. When combined, the antenna 58 of Ito's first transmitter-receiver 50 would be replaced with Gardner's spatially diverse antennas, such as in the manner I have shown in the annotated combined figure above. After modification, signal reception would

take place through the spatially diverse antennas. This would have resulted in Ito's mobile base unit MSS having "*a plurality of spatially separated antennas.*"

3. Element [10B]

117. Ito discloses a wireless communication environment for providing communication capabilities to a portable device PSS located within a moving vehicle. Ex. 1005, 1:8-13, Fig. 1. In order to achieve this objective, Ito describes outfitting the vehicle with a mobile base device MSS ("*movable base station*").

Id. As shown in Ito's Fig. 1 (annotated below), the mobile base device MSS facilitates communication between a stationary base station BSS2 (*fixed port*) and a portable device PSS located within the vehicle. *See id.*, 5:62-65.

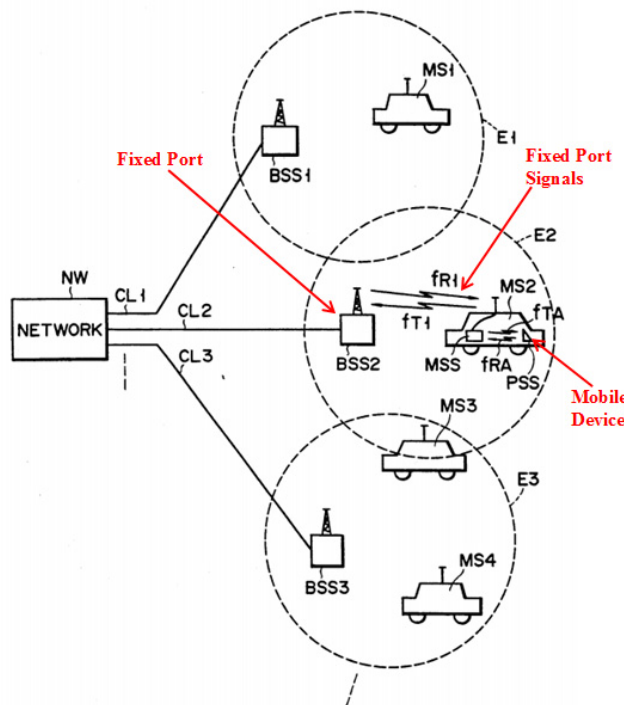


FIG. 1

Ex. 1005, Fig. 1, annotated.

118. As shown in Ito's Fig. 3, the mobile base device MSS includes a first transmitter-receiver 50 ("receiver") "used for radio communication with the base station BSS," and includes a second transmitter-receiver 80 "used for radio communication with its portable device PSS." Ex. 1005, 7:12-16. The MSS thus "receive[s] a signal from the base station BSS2" ("receive [a] fixed port signal[] from a fixed port") via the first transmitter-receiver 50 and "forward[s] it to the portable device PSS2" via the second transmitter-receiver 80. *Id.*, 13:15-18.

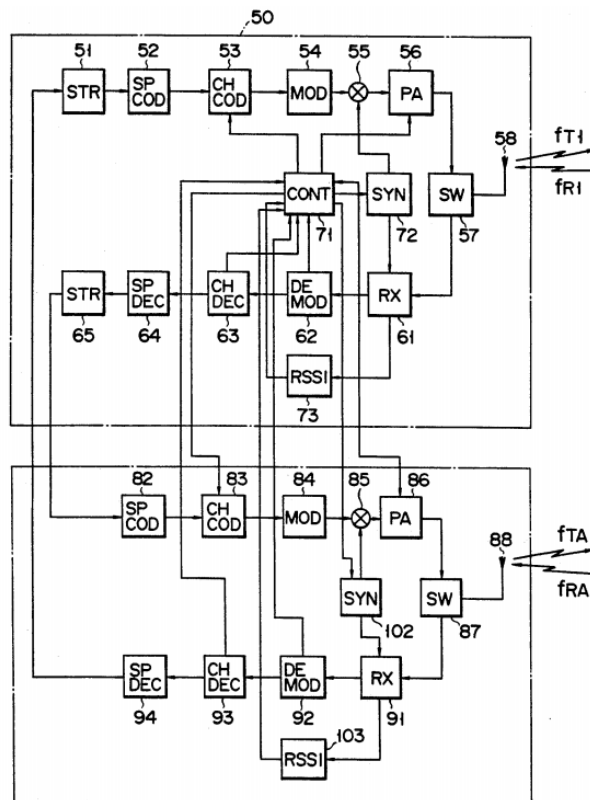


FIG. 3
Ex. 1005, Fig. 3.

119. Ito does not explicitly disclose that first transmitter-receiver 50 includes “*spatially separated antennas*” for receiving multiple “*fixed port signals*.” However, Gardner discloses this limitation. Specifically, Gardner discloses a modular receiver for use in cellular communications, like that of Ito. Ex. 1006, 1:10-12. Gardner explains that “[o]ne of the most useful techniques for improving receiver performance in the mobile (Rayleigh) channel is to use spatial diversity.” *Id.*, 1:14-16. Gardner further explains that spatial diversity is achieved by “us[ing] two (or more) antennas spaced far enough apart” so as to reduce the effects of fading on the received signal. *Id.*, 1:15-20. Gardner explains that, during operation, multiple “RF signals [are] received on the two antennas” in order to improve receiver performance and combat fading issues. *Id.*, 2:24-30; 1:15-24. Gardner illustrates this configuration in Fig. 1, where “two spatially diverse antennas 0 and 1 are used.” *Id.*, 2:23-24. Therefore, Gardner discloses “*receiv[ing] fixed port signals... through the plurality of spatially separated antennas.*”

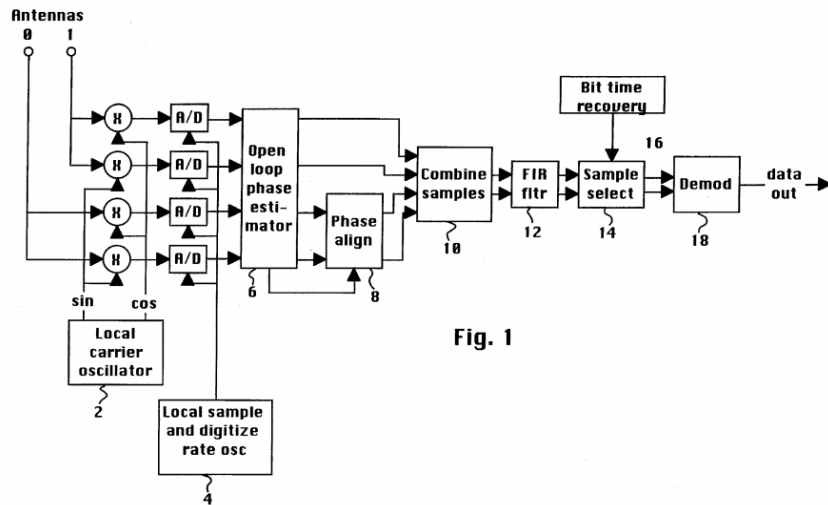


Fig. 1

Ex. 1006, Fig. 1.

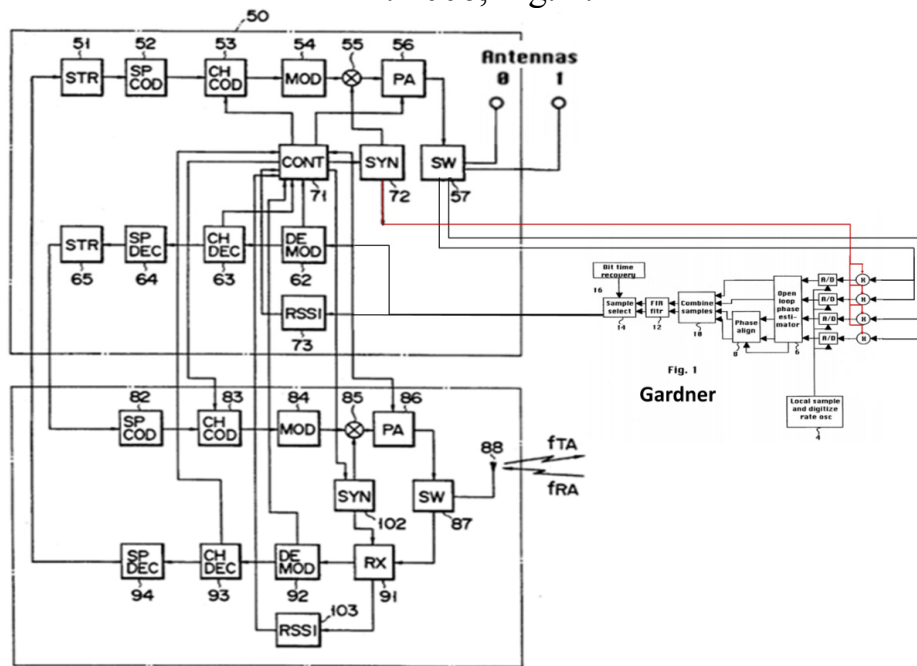


FIG. 3 Ito

Ex. 1005, Fig. 3, annotated; Ex. 1006, Fig. 1, annotated.

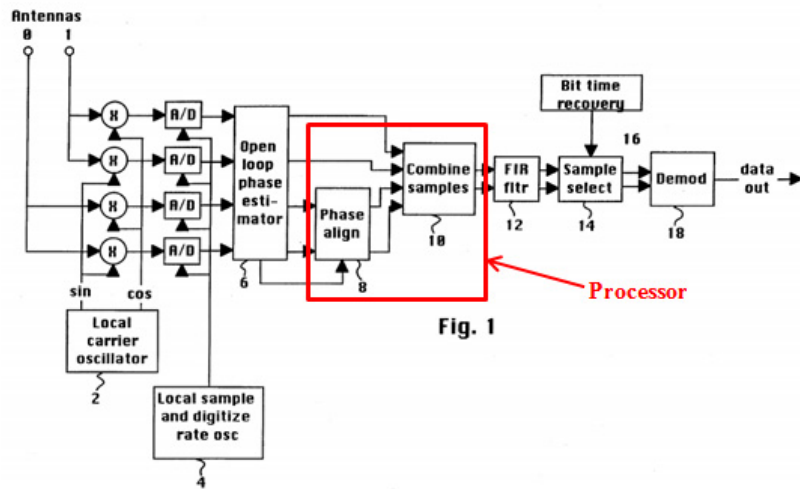
120. As discussed above, a POSITA would have been motivated to employ Gardner's spatially diverse antennas in the first transmitter-receiver 50 of Ito, at least for the reasons of reducing the effects of fading in the received signals. A POSITA would have known that wireless signals would experience fading when

receiver is moving, as discussed in Section VII.E. After reading Gardner, a POSITA would realize Gardner provides a solution for fading problem. When combined, the antenna 58 of Ito's first transmitter-receiver 50 would be replaced with Gardner's spatially diverse antennas, such as in the manner I have shown in the annotated combined figure above. After modification, signal reception would take place through the spatially diverse antennas. This would have resulted in the receiver being "*configured to receive fixed port signals from a fixed port through the plurality of spatially separated antennas.*"

4. Element [10C]

121. Gardner discloses detecting a phase difference of the signals received from the two spatially diverse antennas. Ex. 1006, 2:64-67. According to Gardner, "[t]his phase difference is used to phase **align**, as shown in block 8, the two digitized signal vectors... by shifting the phase" of the antenna 0 signal to be inphase with the antenna 1 signal. *Id.*, 3:1-7, emphasis added. Therefore, Gardner discloses "*align[ing]...the received radio frequency signals.*"

122. Once the signals have been properly aligned, Gardner discloses "**combining** of the samples as shown in block 10, in the preferred embodiment by adding" the two aligned signals. *Id.*, 3:7-10, emphasis added. Therefore, Gardner also discloses "*combin[ing] the received radio frequency signals.*"



Ex. 1006, Fig. 1, annotated.

123. Gardner further discloses that a processor (“*controller*”) performs the *aligning* and *combining* functions. Ex. 1006, 2:53-63. Therefore, Gardner discloses “*a controller configured to*” perform the “*align[ing]*” and “*combin[ing]*.”

5. Element [10D]

124. As shown in Ito’s Fig. 1, a mobile base device MSS (“*movable base station*”) facilitates communication between a base station BSS2 (“*fixed port*”) and a portable device PSS (“*mobile device*”) located within a vehicle. Whereas the first transmitter-receiver 50 of the mobile base device MSS communicates with the base station BSS2, the second transmitter-receiver 80 (“*transmitter*”) communicates with the portable device PSS. Ex. 1005, 7:12-17. According to Ito, the mobile base device MSS “receive[s] a signal from the base station BSS2 and **forward[s] it to the portable device PSS2.**” *Id.*, 13:15-18, emphasis added.

From this explanation, and the plain meaning of “forward,” a POSITA would have understood that the signal transmitted to the portable device PSS corresponds to those received from the base station BSS2. Specifically, the term “forward” means that a signal received is equivalent to the signal transmitted, without significant modification, such that the recipient device receives the same information whether from the base station directly or from the mobile base device. The signal may be amplified and retransmitted, but it carries the same information. Ito further explains that this forwarding process is performed for multiple signals. Specifically, Ito discloses both that the portable device PSS receives multiple signals and that the BSS transmits multiple signals. *Id.*, 6:41-46, 8:62-64. Because Ito discloses forwarding a signal received from a base station to the portable device, it would have been obvious to a POSITA that the multiple received signals are forwarded in the same manner. Ito uses the time division multiple access (TDMA) technique, which is designed in a way such that multiple signals arrive at the receiver in multiple time slots. Therefore, Ito in view of Gardner discloses “*a transmitter configured to transmit... signals to a mobile device corresponding to the received fixed port signals.*”

125. Ito further describes that the signals transmitted to the portable device PSS are “*radio frequency signals.*” For example, Ito discloses that “the portable device PSS and the mobile base device MSS are mutually connected by way of a

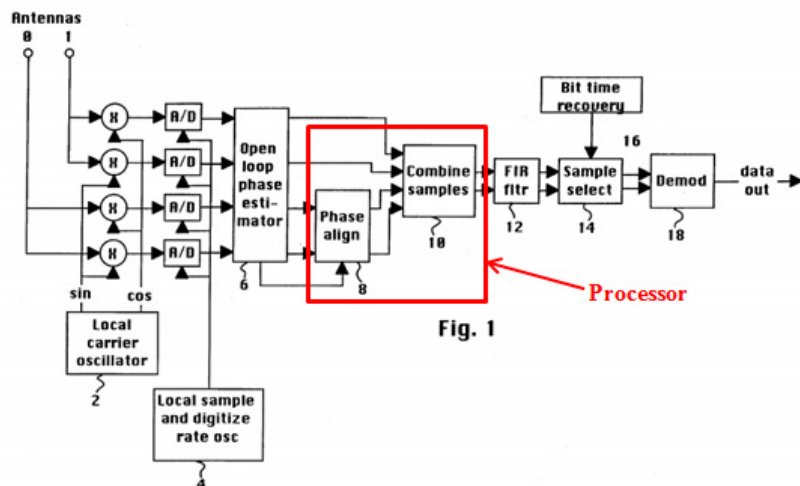
second radio channel having radio frequencies fTA and fRA[.]” *Id.*, 11:65-12:1, Abstract.

C. Claim 15

126. Claim 15 depends from claim 10, and recites “*further comprising a controller configured to compare the received fixed port signals received through the spatially separated antennas and to select a best signal.*” In my opinion, Ito in view of Gardner discloses claim 15.

127. As discussed above, Ito in view of Gardner discloses “*a receiver configured to receive fixed port signals from a fixed port through the plurality of spatially separated antennas.*” See Section X.C. Gardner discloses that, while there are many well-known ways to make use of the signals received from the multiple antennas, “[t]he simplest of these is to just choose the antenna that provides the strongest signal.” Ex. 1006, 1:25-27. In order to identify the strongest signal, a POSITA would have found it obvious to first compare the signals. As discussed in Section VII.E, it is well-known that signals received by multiple antennas are from multiple paths. Hence the signals’ strengths could be very different, and it is beneficial to identify the best antenna to use. Gardner suggests this, disclosing that the process of selecting the strongest antenna is “referred to as selection diversity.” *Id.*, 1:28. Selection diversity, as opposed to diversity combining, is a well-known technique of comparing properties of

multiple received signals for the purpose of selecting a preferred one of the signals. As Acampora explains: “With multipath in buildings, the fading statistics of two antennas are (usually) nearly independent when the antennas are separated by more than a quarter wavelength (for example, 8.3 cm at 900 MHz). Thus, with appropriately spaced antennas, the probability of multiple antennas all in a fade is much less than with a single antenna. Therefore, we first consider selection diversity. With selection diversity, the receiver selects for reception the signal from that antenna with the highest signal power.” Acampora, Ex. 1018, 13. Therefore, Gardner discloses “*compar[ing]*” the received signals and “*select[ing]*” a best signal,” as recited in claim 15.



Ex. 1006, Fig. 1, annotated.

128. Gardner further discloses that a processor (“*controller*”) performs the “*compar[ing]*” and “*select[ing]*” functions. Ex. 1006, 2:53-63. Therefore,

Gardner discloses “*a controller configured to*” perform the “*compar[ing]*” and “*select[ing]*.”

D. Claim 16

129. Claim 16 depends from claim 10, and recites “*the transmitter further configured to transmit the radio frequency signals within time slots of time-division multiplex channels.*” In my opinion, Ito in view of Gardner discloses claim 16.

130. As discussed above, Ito discloses that the mobile base device MSS (“*mobile base station*”) receives radio frequency signals from the base station BSS2 via a first receiver-transmitter 50 and forwards them to the portable device PSS via a second receiver-transmitter 80 (“*transmitter*”). *See* Ex. 1005, 13:15-18; *see also* Section X.A. Ito further discloses that the mobile base device MSS “utilizes a FDMA/**TDMA** technique... for connection between a mobile base device MSS and a portable device PSS.” Ex. 1005, 5:47-50, emphasis added. In the TDMA configuration, “radio frequencies have a time division signal unit format where a time frame is divided into a number of time slots, e.g., six time slots TS1 through TS6.” *Id.*, 5:53-55. Ito further discloses that the mobile base device MSS transmits signals to the portable device PSS (via a receiver 21 of the portable device PSS) in the time-division multiplex format: “High frequency signals [are] received by the receiver 21 in each predetermined **time slot**[.]” *Id.*,

6:40-41, emphasis added. Therefore, Ito discloses “*the transmitter further configured to transmit the radio frequency signals within time slots of time-division multiplex channels.*”

E. Claim 17

131. Claim 17 depends from claim 10, and recites “*wherein the movable base station is conveyed by a vehicle.*” In my opinion, Ito in view of Gardner discloses claim 17.

132. As discussed above in Section XI.B., Ito in view of Gardner discloses a mobile base device MSS (“*mobile base station*”) that “*receive[s] fixed port signals from a fixed port through the plurality of antennas.*” Ito further discloses that the mobile base device MSS “may be constituted by an automobile telephone main unit installed in a car.” *Id.*, 3:17-23. Therefore, Ito discloses that the mobile base device MSS is “*conveyed by a vehicle.*”

F. Claim 18

133. Claim 18 depends from claim 17, and recites “*wherein the vehicle is an automotive vehicle.*” In my opinion, Ito in view of Gardner discloses claim 18.

134. As discussed above, Ito discloses that the mobile base device MSS (“*mobile base station*”) “may be constituted by an automobile telephone main unit installed in a car.” *Id.*, 3:17-23. Therefore, Ito discloses that “*the vehicle is an automotive vehicle.*”

G. Ito in view of Gardner renders obvious claim 31

135. Claim 31 is an independent claim. For purposes of my analysis, and ease of review, I have separated claim 31 into component parts, which I identify in brackets for reference:

31. [P] *A movable base station configured to move relative to Earth, the movable base station comprising:*

[A] *a plurality of spatially separated antennas;*

[B] *a receiver configured to receive fixed port signals from a fixed port through the plurality of spatially separated antennas; and*

[C] *a transmitter configured to transmit radio frequency signals to a mobile device corresponding to the received fixed port signals, the radio frequency signals transmitted within time slots of time-division multiplex channels.*

136. As I demonstrate below, it is my opinion that each and every element of independent claim 31 was well-known in the art prior to the '701 patent, and that claim 31 would have been obvious over the art.

1. Claim 31 Preamble (Element [31P])

137. As shown in Fig. 6 of Ito, an automobile is equipped with a mobile base device MSS ("*movable base station*"). Ex. 1005, 12:52. The mobile base device MSS communicates with a fixed base station BSS, and communicates with one or more portable devices PSS within the automobile. In this manner, the mobile base device MSS facilitates communication between the portable device

PSS and the base station BSS. Because the mobile base device MSS is located in an automobile, it would have been obvious to a POSITA that the mobile base device MSS is “*configured to move relative to Earth.*” In particular, whenever the automobile moves, the mobile base device MSS inside the automobile moves with the automobile in the same direction.

2. Element [31A]

138. As shown in Ito’s Fig. 1 (annotated below), the mobile base device MSS (“*movable base station*”) facilitates communication between a stationary base station BSS2 and a portable device PSS located within the vehicle. *See id.*, 5:62-65. As shown in Ito’s Fig. 3, the mobile base device MSS includes a first transmitter-receiver 50 “used for radio communication with the base station BSS,” and includes a second transmitter-receiver 80 “used for radio communication with its portable device PSS.” *Id.*, 7:12-16.

139. Ito does not explicitly disclose that first transmitter-receiver 50 includes “*a plurality of spatially separated antennas.*” However, Gardner discloses this limitation. Specifically, Gardner discloses a modular receiver for use in cellular communications, like that of Ito. Ex. 1006, 1:10-12. Gardner explains that “[o]ne of the most useful techniques for improving receiver performance in the mobile (Rayleigh) channel is to use spatial diversity.” *Id.*, 1:14-16. Gardner further explains that spatial diversity is achieved by “us[ing]

two (or more) antennas spaced far enough apart” so as to reduce the effects of fading on the received signal. *Id.*, 1:15-19. Gardner explains that, during operation, multiple “RF signals [are] received on the two antennas” in order to improve receiver performance and combat fading issues. *Id.*, 2:28-30; 1:15-24. Gardner illustrates this configuration in Fig. 1, where “two spatially diverse antennas 0 and 1 are used.” *Id.*, 2:23-24. Therefore, Gardner discloses “*a plurality of spatially separated antennas.*”

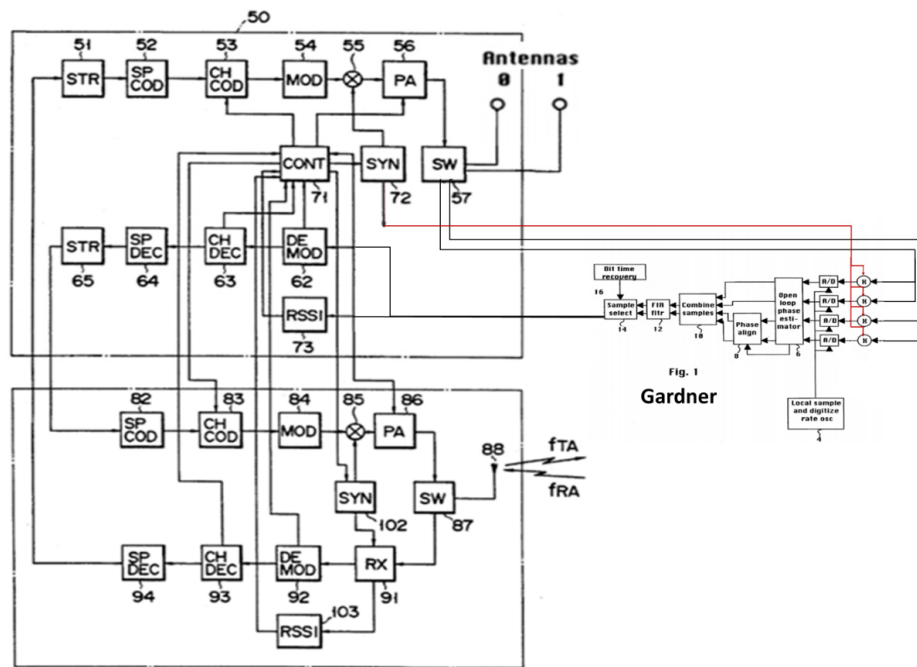


FIG. 3 Ito

Ex. 1005, Fig. 3, annotated; Ex. 1006, Fig. 1, annotated.

140. As discussed above, a POSITA would have been motivated to employ Gardner's spatially diverse antennas in the first transmitter-receiver 50 of Ito, at least for the reasons of reducing the effects of fading in the received signals. A

POSITA would have known that wireless signals would experience fading when receiver is moving, as discussed in Section VII.E. After reading Gardner, a POSITA would realize Gardner provides a solution for the fading problem. When combined, the antenna 58 of Ito's first transmitter-receiver 50 would be replaced with Gardner's spatially diverse antennas, such as in the manner I have shown in the annotated combined figure above. After modification, signal reception would take place through the spatially diverse antennas. This would have resulted in Ito's mobile base unit MSS having "*a plurality of spatially separated antennas.*"

3. Element [31B]

141. Ito discloses a wireless communication environment for providing communication capabilities to a portable device PSS located within a moving vehicle. Ex. 1005, 1:8-13, Fig. 1. In order to achieve this objective, Ito describes outfitting the vehicle with a mobile base device MSS ("*movable base station*"). *Id.* As shown in Ito's Fig. 1 (annotated below), the mobile base device MSS facilitates communication between a stationary base station BSS2 ("*fixed port*") and a portable device PSS located within the vehicle. *See id.*, 5:62-65.

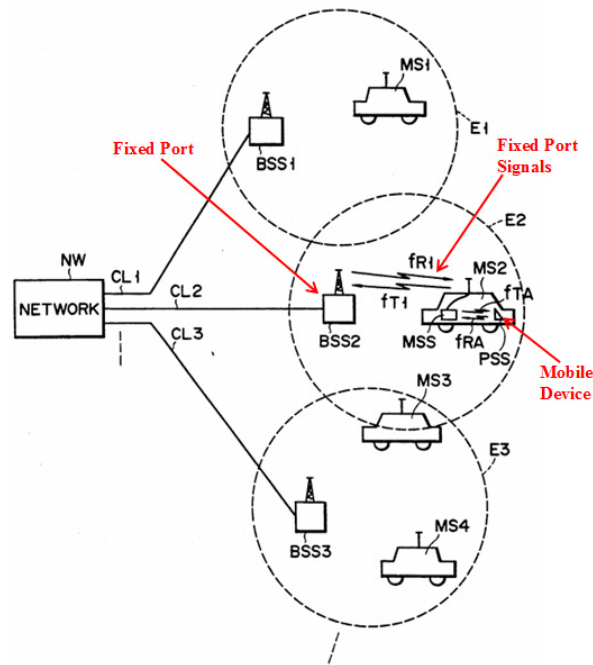


FIG. 1

Ex. 1005, Fig. 1, annotated.

142. As shown in Ito's Fig. 3, the mobile base device MSS includes a first transmitter-receiver 50 ("receiver") "used for radio communication with the base station BSS," and includes a second transmitter-receiver 80 "used for radio communication with its portable device PSS." *Id.*, 7:12-16. The MSS thus "receive[s] a signal from the base station BSS2" ("receive [a] fixed port signal[] from a fixed port") via the first transmitter-receiver 50 and "forward[s] it to the portable device PSS2" via the second transmitter-receiver 80. *Id.*, 13:15-18.

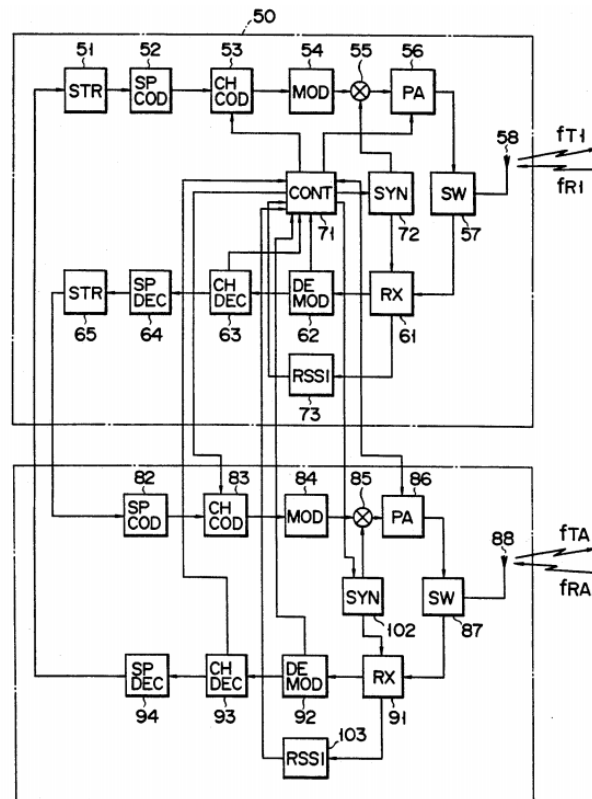


FIG. 3

Ex. 1005, Fig. 3.

143. Ito does not explicitly disclose that first transmitter-receiver 50 includes “*spatially separated antennas*” for receiving multiple “*fixed port signals*.” However, Gardner discloses this limitation. Specifically, Gardner discloses a modular receiver for use in cellular communications, like that of Ito. Ex. 1006, 1:10-12. Gardner explains that “[o]ne of the most useful techniques for improving receiver performance in the mobile (Rayleigh) channel is to use spatial diversity.” *Id.*, 1:14-16. Gardner further explains that spatial diversity is achieved by “us[ing] two (or more) antennas spaced far enough apart” so as to reduce the

effects of fading on the received signal. *Id.*, 1:16-20. Gardner explains that, during operation, multiple “RF signals [are] received on the two antennas” in order to improve receiver performance and combat fading issues. *Id.*, 2:28-30; 1:19-24. Gardner illustrates this configuration in Fig. 1, where “two spatially diverse antennas 0 and 1 are used.” *Id.*, 2:23-24. Therefore, Gardner discloses “receiving fixed port signals ... through the plurality of spatially separated antennas.”

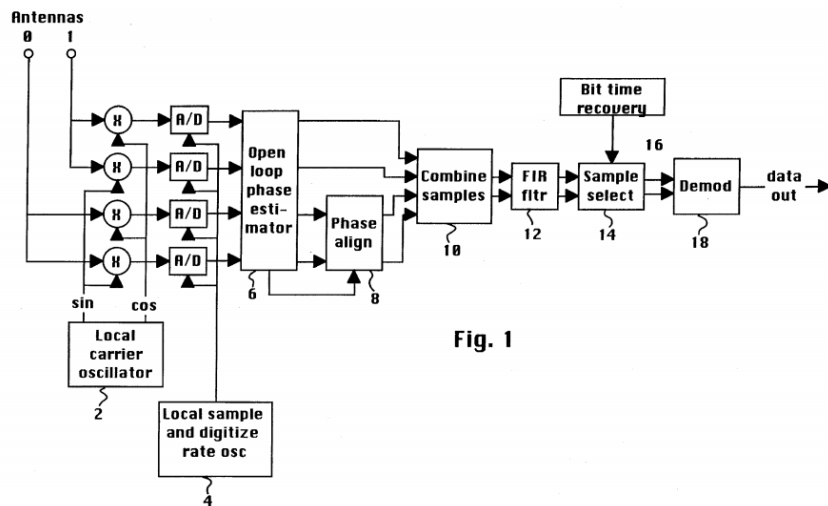


Fig. 1

Ex. 1006, Fig. 1.

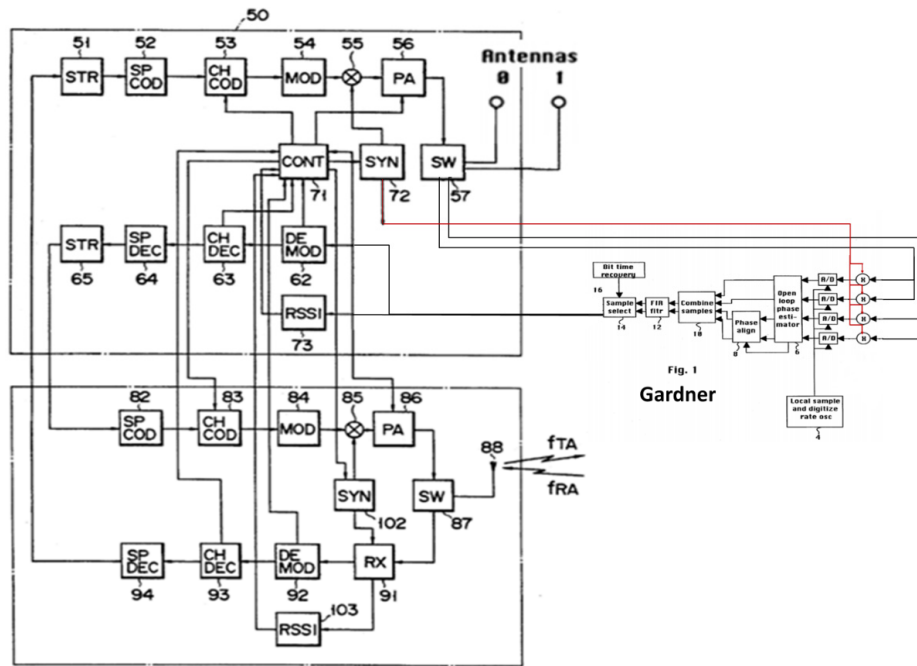


FIG. 3 Ito

Ex. 1005, Fig. 3, annotated; Ex. 1006, Fig. 1, annotated.

144. As discussed above, a POSITA would have been motivated to employ Gardner's spatially diverse antennas in the first transmitter-receiver 50 of Ito, at least for the reasons of reducing the effects of fading in the received signals. A POSITA would have known that wireless signals would experience fading when receiver is moving, as discussed in Section VII.E. After reading Gardner, a POSITA would realize Gardner provides a solution for the fading problem. When combined, the antenna 58 of Ito's first transmitter-receiver 50 would be replaced with Gardner's spatially diverse antennas, such as in the manner I have shown in the annotated combined figure above. After modification, signal reception would take place through the spatially diverse antennas. This would have resulted in the

receiver being “*configured to receive fixed port signals from a fixed port through the plurality of spatially separated antennas.*”

4. Element [31C]

145. As shown in Ito’s Fig. 1, a mobile base device MSS (“*movable base station*”) facilitates communication between a base station BSS2 (“*fixed port*”) and a portable device PSS (“*mobile device*”) located within a vehicle. Whereas the first transmitter-receiver 50 of the mobile base device MSS communicates with the base station BSS2, the second transmitter-receiver 80 (“*transmitter*”) communicates with the portable device PSS. Ex. 1005, 7:12-17. According to Ito, the mobile base device MSS “receive[s] a signal from the base station BSS2 and **forward[s] it to the portable device PSS2.**” *Id.*, 13:15-18, emphasis added.

From this explanation, and the plain meaning of “forward,” a POSITA would have understood that the signal transmitted to the portable device PSS corresponds to those received from the base station BSS2. Specifically, the term “forward” means that a signal received is equivalent to the signal transmitted, without significant modification, such that the recipient device receives the same information whether from the base station directly or from the mobile base device. The signal may be amplified and retransmitted, but it carries the same information. Ito further explains that this forwarding process is performed for multiple signals. Specifically, Ito discloses both that the portable device PSS

receives multiple signals and that the BSS transmits multiple signals. *Id.*, 6:40-46, 8:62-64. Because Ito discloses forwarding a signal received from a base station to the portable device, it would have been obvious to a POSITA that the multiple received signals are forwarded in the same manner. Ito uses time division multiple access (TDMA) technique which is designed in the way that multiple signals arrive at the receiver in multiple time slots. Therefore, Ito in view of Gardner discloses “*a transmitter configured to transmit... signals to a mobile device corresponding to the received fixed port signals.*”

146. Ito further describes that the signals transmitted to the portable device PSS are “*radio frequency signals.*” For example, Ito discloses that “the portable device PSS and the mobile base device MSS are mutually connected by way of a second radio channel having radio frequencies f_{TA} and f_{RA} ...” *Id.*, 11:65-68, Abstract.

147. As discussed above, Ito discloses that the mobile base device MSS (“*mobile base station*”) receives radio frequency signals from the base station BSS2 via a first receiver-transmitter 50 and forwards them to the portable device PSS via a second receiver-transmitter 80 (“*transmitter*”). Ex. 1005, 13:15-18; *see also* Section XI.B. Ito further discloses that the mobile base device MSS “utilizes a FDMA/**TDMA** technique...for connection between a mobile base device MSS and a portable device PSS.” Ex. 1005, 5:47-50, emphasis added. In the TDMA

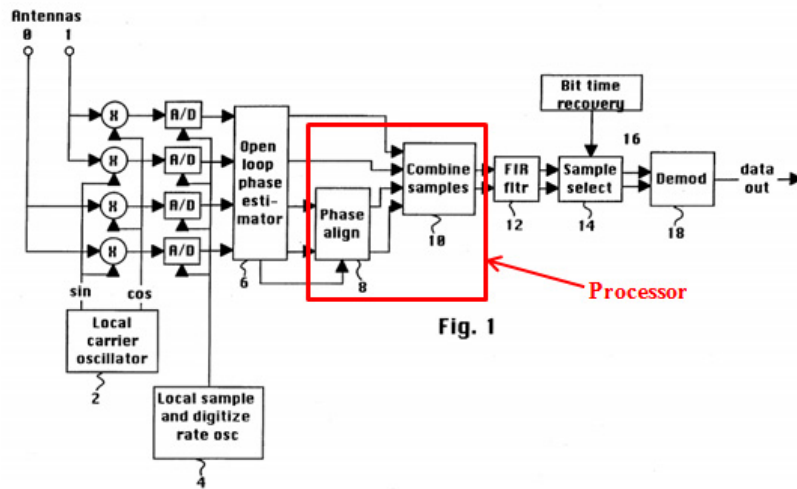
configuration, “radio frequencies have a time division signal unit format where a time frame is divided into a number of time slots, e.g., six time slots TS1 through TS6.” *Id.*, 5:52-55. Ito further discloses that the mobile base device MSS transmits signals to the portable device PSS (via a receiver 21 of the portable device PSS) in the time-division multiplex format: “High frequency signals [are] received by the receiver 21 in each predetermined **time slot**[.]” *Id.*, 6:40-43, emphasis added. Therefore, Ito discloses “*the radio frequency signals transmitted within time slots of time-division multiplex channels.*”

H. Claim 33

148. Claim 33 depends from claim 31, and recites “*further comprising a controller configured to compare the received fixed port signals received through the spatially separated antennas and to select a best signal.*” In my opinion, Ito in view of Gardner discloses claim 33.

149. As discussed above, Ito in view of Gardner discloses “*a receiver configured to receive fixed port signals from a fixed port through the plurality of spatially separated antennas.*” See Section XI.B. Gardner discloses that, while there are many well-known ways to make use of the signals received from the multiple antennas, “[t]he simplest of these is to just choose [sic] the antenna that provides the strongest signal.” Ex. 1006, 1:26-27. In order to identify the strongest signal, a POSITA would have found it obvious to first compare the

signals. As discussed in Section VII.E, it is well-known that signals received by multiple antennas are from multiple paths. Hence the signals strengths could be very different, and it is beneficial to identify the best antenna to use. Gardner suggests this, disclosing that the process of selecting the strongest antenna is “referred to as selection diversity.” *Id.*, 1:28. Selection diversity, as opposed to diversity combining, is a well-known technique of comparing properties of multiple received signals for the purpose of selecting a preferred one of the signals. As Acampora explains: “With multipath in buildings, the fading statistics of two antennas are (usually) nearly independent when the antennas are separated by more than a quarter wavelength (for example, 8.3 cm at 900 MHz). Thus, with appropriately spaced antennas the probability of multiple antennas all in a fade is much less than with a single antenna. Therefore, we first consider selection diversity. With selection diversity, the receiver selects for reception the signal from that antenna with the highest signal power.” Ex. 1018, 13. Therefore, Gardner discloses “*compar[ing]*” the received signals and “*select[ing] a best signal,*” as recited in claim 33.



Ex. 1006, Fig. 1, annotated.

150. Gardner further discloses that a processor (“controller”) performs the “compar[ing]” and “select[ing]” functions. Ex. 1006, 2:53-63. Therefore, Gardner further discloses “a controller configured to” perform the “compar[ing]” and “select[ing]”.

I. Claim 34

151. Claim 34 depends from claim 31, and recites “*wherein the movable base station is conveyed by a vehicle*” In my opinion, Ito in view of Gardner discloses claim 34.

152. As discussed above in Section XI.B., Ito in view of Gardner discloses a mobile base device MSS (“mobile base station”) that “receive[s] fixed port signals from a fixed port through the plurality of antennas.” Ito further discloses that the mobile base device MSS “may be constituted by an automobile telephone

main unit installed in a car.” Ex. 1005, 3:18-20. Therefore, Ito discloses that the mobile base device MSS is “*conveyed by a vehicle.*”

J. Claim 35

153. Claim 35 depends from claim 34, and recites “*wherein the vehicle is an automotive vehicle.*” In my opinion, Ito in view of Gardner discloses claim 35.

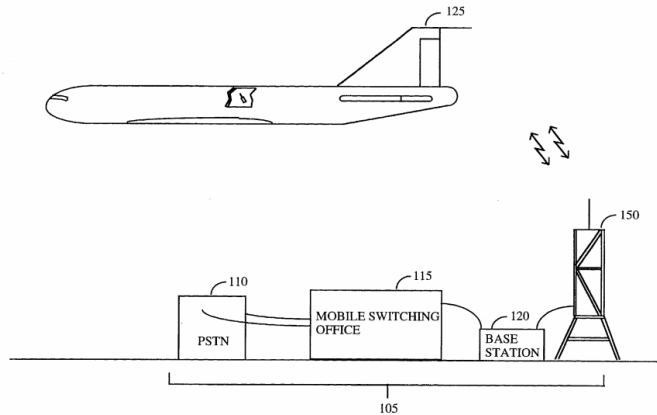
154. As discussed above, Ito discloses that the mobile base device MSS (“*mobile base station*”) “may be constituted by an automobile telephone main unit installed in a car.” Ex. 1005, 3:18-20. Therefore, Ito discloses that “*the vehicle is an automotive vehicle.*”

XII. Ground 2: Obviousness based on Gilhousen865 in view of Gilhousen390 (Claims 10, 15-18, 31, 33-35)

A. A POSITA would have been motivated to combine Gilhousen865 and Gilhousen390.

155. Gilhousen865 describes a system for providing communications between a ground base station and a wireless telephone located on an airplane. Ex. 1009, 1:7-10. Specifically, the system of Gilhousen865 includes a ground based subsystem and an airborne based subsystem. *Id.*, 2:9-12.

FIG. 1



Ex. 1009, Fig. 1.

156. The ground subsystem includes a base station 120 coupled to the public switched telephone network (PSTN) 110 via a switching center 115. The base station 120 wirelessly transmits signals to, and receives signals from, radiotelephones to provide communication between the radiotelephones and the network 110. *Id.*, 2:24-33. According to Gilhousen865, the base station “is coupled to an antenna (150) that receives and radiates the CDMA radiotelephone signals.” *Id.*, 2:32-33.

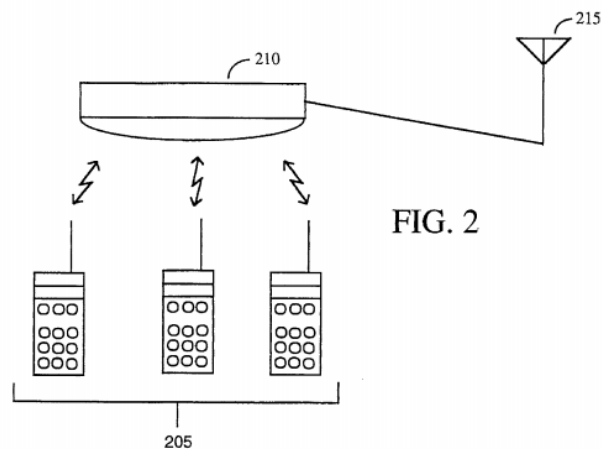


FIG. 2

Ex. 1009, Fig. 2.

157. The airborne subsystem, on the other hand, includes a repeater 210 installed in the airplane in which the wireless phone 205 is located. As shown in Fig. 2 above, the repeater includes an external antenna 215 that sends and receives signals with the base station. *See Id.*, 2:53-65. According to Gilhousen865, the system can function both to provide outgoing calls from the radiotelephone to the ground base station, and incoming calls originating from the ground subsystem to the airborne radiotelephone. *See Id.*, 2:53-63.

158. Deleterious effects on wirelessly-transmitted signals, such as fading, interference, and other degradations to signal quality were well-known at the time of the '701 patent. For example, as I discussed in Section VII.E, Calhoun disclosed the effect of multipath fading. In addition, Mottl proposed a statistical model for outages during periods of multipath fading in a dual-polarized frequency radio channel in 1977. *See Mottl*, Ex. 1019. However, Gilhousen865 does not describe any measures for countering those negative effects. Therefore, a POSITA would have been motivated to look to the prior art, such as Gilhousen390, for methods of reducing the negative effects on signals during wireless transmission. Gilhousen390 would have been a particularly relevant starting point, as it is by the same inventor as Gilhousen865.

159. Like Gilhousen865, Gilhousen390 discloses a wireless communication system specifically applicable to communications terminals associated with moving vehicles. *See, e.g.*, Ex. 1007, Fig. 1. Specifically, Gilhousen390 explains that fading, a common negative effect a signal quality in wireless transmissions, can be especially profound with respect to signals transmitted to/from a vehicle. *Id.*, 3:17-24. In order to counter the negative effects of fading, Gilhousen390 describes employing various configurations to achieve signal diversity at the receiver. In one such example, Gilhousen390 describes cell-site diversity, in which a mobile terminal receives signals from multiple base stations simultaneously. *Id.*, 11:58-62. For example, as shown in Gilhousen390's Fig. 1, a receiver 16 may simultaneously receive signal transmissions from both cell-sites 12 and 14. In another example, Gilhousen390 describes configuring the receiver with multiple antennas for "space diversity." *Id.*, 14:36-39.

160. Gilhousen390 illustrates an exemplary mobile unit in Fig. 2. *Id.*, 11:63-64. The mobile unit includes an antenna 30 connected to multiple receivers 40 and 42. *Id.*, 13:21-22. The antenna 30 receives signals from multiple base stations, which it forwards to data receivers 40 and 42. *Id.*, 11:66-12:2, 12:34-36. The data receivers are controlled by a control processor to tune to received signals with the best signal qualities from among those received. *Id.*, 13:10-12. Each of the data receivers 40 and 42 is capable of tuning to a different signal. *Id.*

Therefore, when “another cell-site transmitted pilot signal is of greater signal strength than the current cell-site signal strength,” one of the receivers will be retuned such that “[r]eceivers 40 and 42...handle calls through two different cell-sites.” *Id.*, 13:12-20.

161. Based on the teachings of Gilhousen390, a POSITA would have been motivated to modify Gilhousen865’s system with any one or more of the signal diversity configurations of Gilhousen390 at least for the purpose of reducing the errors caused by well-known deleterious effects on wirelessly-transmitted signals. Specifically, I have demonstrated above that fading was a well-known problem at the time of the ’701 patent, especially with respect to moving devices, and Gilhousen865 does not appear to incorporate any method for countering such fading. As shown in Gilhousen390’s Fig. 3, Gilhousen865’s repeater could be modified with multiple data receivers that are individually configurable to extract different signals received from different base stations and/or with multiple antennas for space diversity, as taught by Gilhousen390. The receiver part including “DIVERSITY COMBINER & DECODER” disclosed in Gilhousen390’s Fig. 3 can be migrated to Gilhousen865’s, since diversity is not specified in Gilhousen865. Modifying Gilhousen865 in this manner would have required minimal modifications. The design in Gilhousen390 is modular, and could have easily been incorporated into Gilhousen865.

162. In addition to the motivations described above, a POSITA would have been further motivated to combine Gilhousen865 and Gilhousen390 because both are in the same general field of mobile communications, address the same problem— improving the performance of wireless communication systems —and are both by the same named inventor. Thus, a POSITA when considering Gilhousen865 would naturally consider other disclosures by the same inventor, such as Gilhousen390. Further, as evident from the above discussion, a POSITA could have combined the system of Gilhousen865 with the teachings of Gilhousen390 by known methods, and the results of the combination would have been predictable to a POSITA (e.g., by replacing Gilhousen865's antenna with spatially separated antennas). Because Gilhousen865's receiver is disposed in an airplane, a POSITA would have recognized that the receiver would suffer from frequent handoffs, and Gilhousen390 provides a soft handoff solution. Finally, the proposed combination of Gilhousen865 and Gilhousen390 would involve nothing more than incorporating well-known concepts (*i.e.*, Gilhousen390's diversity techniques) into a well-known system (*i.e.*, Gilhousen865 radio communication system). Because the cell-site diversity concept and onboard base station system were well-known at the time of the '701 patent.

B. Gilhousen865 in view of Gilhousen390 renders obvious claim 10.

163. Claim 10 is an independent claim. For purposes of my analysis, and ease of review, I have separated claim 16 into component parts, which I identify in brackets for reference:

10. [P] *A movable base station configured to move relative to Earth, the movable base station comprising:*

[A] *a plurality of spatially separated antennas;*

[B] *a receiver configured to receive fixed port signals from a fixed port through the plurality of spatially separated antennas;*

[C] *a controller configured to align and combine the received fixed port signals; and*

[D] *a transmitter configured to transmit radio frequency signals to a mobile device corresponding to the received fixed port signals.*

164. As I demonstrate below, it is my opinion that each and every element of independent claim 10 was well-known in the art prior to the '701 patent, and that claim 10 would have been obvious over the art.

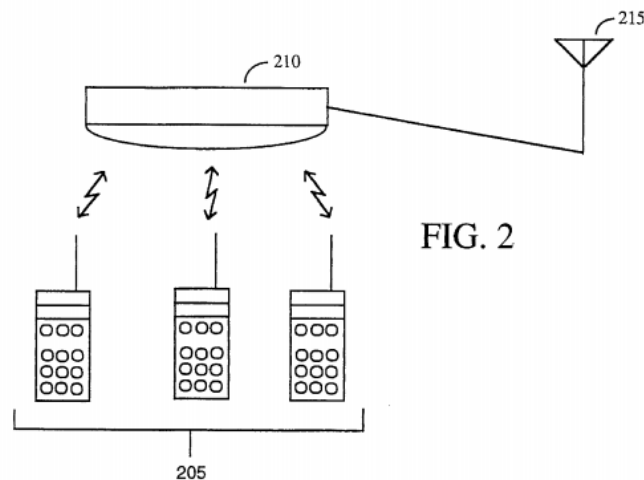
1. Preamble of Claim 10 (Element [10P])

165. As discussed above, Gilhousen865 describes a repeater 210 (“*movable base station*”) installed in an airplane that functions both to provide outgoing calls from the radiotelephone to the ground base station, and incoming calls originating from the ground subsystem to the airborne radiotelephone. *See Ex.*

1009, 2:53-63. Because the repeater is installed in an airplane, it would have been obvious to a POSITA that the repeater is “*configured to move relative to Earth.*”

2. Element [10A]

166. Gilhousen865 discloses a repeater 210 (“*movable base station*”) located on an airplane. Ex. 1009, 2:45-48. As shown in Gilhousen865’s Fig. 2, the repeater includes an antenna 215. *Id.*, 2:53-56.



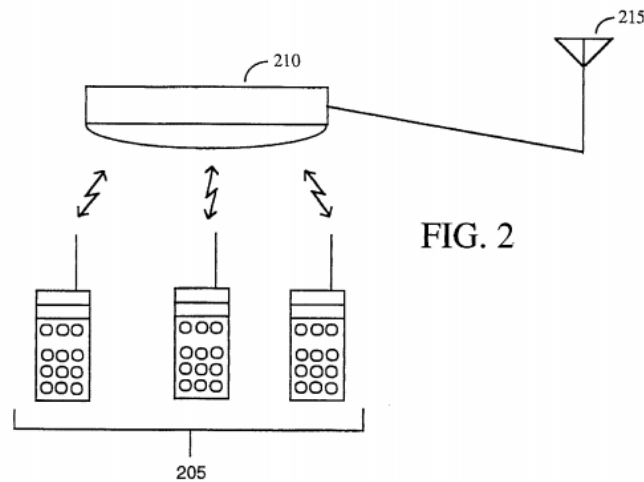
Ex. 1009, Fig. 2.

167. Gilhousen865 does not explicitly disclose that the repeater includes “*a plurality of spatially separated antennas.*” However, a POSITA would have found it obvious to modify Gilhousen865’s repeater to include a plurality of spatially separated antennas, as taught by Gilhousen390. Specifically, Gilhousen390 describes a cell-site (base station) that includes a two “*separate antenna[s]...for space diversity reception.*” Ex. 1007, 14:37-39. Spatial diversity was a well-known antenna configuration at the time of the ’701 patent for

improving signal quality in the face of a variety of negative effects experienced by the signal during transmission, such as fading. As discussed in Section VII.E, a POSITA would have known that wireless signals would experience fading when the receiver is moving. After reading Gilhousen390, a POSITA would have realized that Gilhousen390 provides a solution for the fading problem of Gilhousen865. Gilhousen865 describes that the repeater is a base station when configured to receive calls originating from the ground. Ex. 1009, 3:3-10. Therefore, it would have been obvious to a POSITA to configure Gilhousen865's repeater with "*a plurality of spatially separated antennas*," as Gilhousen390 employs in its base station, at least for the purposes of achieving the benefits of "space diversity." *See id.*

3. Element [10B]

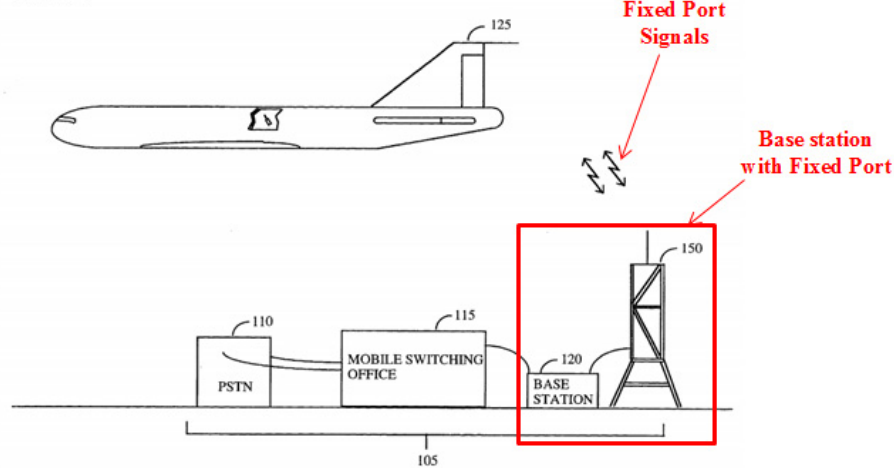
168. Gilhousen865 discloses a repeater 210 ("*movable base station*") located on an airplane. *Id.*, 2:45-48. As shown in Gilhousen865's Fig. 2, the repeater includes an antenna 215. *Id.*, 2:53-56.



Ex. 1009, Fig. 2.

169. According to Gilhousen865, and as illustrated in annotated Fig. 1 below, the repeater 210 facilitates communication between a radiotelephone and a ground-based base station (“*fixed port*”), in part by receiving signals (“*fixed port signals*”) from the ground-based base station: “Telephone calls from the PSTN to the base station on the ground are transmitted to the outside antenna (215) that relays them to the repeater (210) mounted in the aircraft.” Ex. 1009, 2:61-63. Therefore, a POSITA would have understood that the repeater 210 includes a “*receiver*.” The part of the repeater performing receiving activity can be called a receiver, or in general, an apparatus like repeater having functionality of receiving can be called a receiver. Therefore, Gilhousen865 discloses “*a receiver configured to receive fixed port signals from a fixed port through [an antenna].*”

FIG. 1



Ex. 1009, Fig. 1.

170. Gilhousen865 does not explicitly disclose that the repeater receives the signals “*through [a] plurality of spatially separated antennas.*” However, a POSITA would have found it obvious to modify Gilhousen865’s repeater to include a plurality of spatially separated antennas, as taught by Gilhousen390. Specifically, Gilhousen390 describes a cell-site (base station) that includes a two “separate antenna[s]...for space diversity reception.” Ex. 1007, 14:37-39. Spatial diversity was a well-known antenna configuration at the time of the ’701 patent for improving signal quality in the face of a variety of negative effects experienced by the signal during transmission, such as fading. As discussed in Section VII.E, a POSITA would have known that wireless signals would experience fading when the receiver is moving. After reading Gilhousen390, a POSITA would have realized that Gilhousen390 provides a solution for the fading problem of Gilhousen865. Gilhousen865 describes that the repeater is a

base station when configured to receive calls originating from the ground. Ex. 1009, 3:3-10. Therefore, it would have been obvious to a POSITA to configure Gilhousen865's repeater with "*a plurality of spatially separated antennas*," as Gilhousen390 employs in its base station, at least for the purposes of achieve the benefits of "space diversity." *See id.*

4. Element [10C]

171. As discussed above, Gilhousen865's repeater 210 ("*movable base station*") includes a plurality of spatially diverse antennas, as modified by the teachings of Gilhousen390. *See* Section XII.A. When configured for signal diversity in this manner, Gilhousen865's repeater is further modified with a diversity combiner (as taught by Gilhousen390) to process the multiple received signals. This would allow for the receiver to appropriately process the multiple received signals. *See* Section XII.A. According to Gilhousen390, the diversity combiner 104 ("*controller*") "adjusts the timing of the two streams of received signals into **alignment**[.]" Ex. 1007, 13:22-25. The diversity combiner then "adds [the signals] together." *Id.*, 13:25. Therefore, Gilhousen390 discloses "*a controller configured to align and combine the received fixed port signals.*"

5. Element [10D]

172. Gilhousen865 explains that the repeater ("*movable base station*") receives signals ("*fixed port signals*") from the ground base station ("*fixed port*"),

and then “[t]he signals from the ground base stations are received by the external antenna of the airborne subsystem and repeated to the radiotelephones [(“*mobile device*”)].” Ex. 1009, 3:55-57. Because Gilhousen865 discloses sending the signals to the radiotelephones, a POSITA would have found it obvious that the repeater includes a “*transmitter*.” The part of the repeater performing transmitting activity can be called a transmitter, or in general, an apparatus like repeater having functionality of transmitting can be called a transmitter. Therefore, Gilhousen865 discloses “*a transmitter configured to transmit... signals to a mobile device corresponding to the received fixed port signals.*”

173. Gilhousen865 discloses that the telephone is a **radiotelephone**, and that the repeater transmits the signal to the radiotelephone from its antenna. *Id.* Therefore, a POSITA would have understood the transmitted signals to be “*radio frequency signals.*” Gilhousen390 also discloses transmitting radio frequency signals: “Receiver 34 receives the RF frequency signals from diplexer 32 which are typically in the 850 MHz frequency band...” Ex. 1007, 12:2-4.

C. Claim 15

174. Claim 15 depends from claim 10 and recites, “*further comprising a controller configured to compare the received fixed port signals received through the spatially separated antennas and to select a best signal.*” In my opinion, Gilhousen865 in view of Gilhousen390 discloses this limitation.

175. As discussed above, Gilhousen865's repeater 210 ("*movable base station*") includes an antenna 215 that receives signals (*fixed port signals*) from a base station. See Ex. 1009, 2:61-63; see also Section X.B. Further, a POSITA would have been motivated to modify the antenna of Gilhousen865's repeater based on the teachings of Gilhousen390 to include a plurality of spatially separated antennas. See Ex. 1007, 14:37-39; see also Section XII.A. Therefore, the combination of Gilhousen865 and Gilhousen390 discloses "*fixed port signals received through the spatially separated antennas.*"

176. Gilhousen390 further discloses how to process the multiple received signals received via the multiple spatially diverse antennas. Specifically, Gilhousen390 discloses that a diversity combiner 104 ("*controller*") receives the multiple signals (e.g., "cell-site signals" in Gilhousen390) and "compares the signal quality indicators accompanying the information bits from the two or more cell-site signals." Ex. 1007, 17:1-4. Therefore, Gilhousen390 discloses "*a controller configured to compare the received fixed port signals.*" Then, the diversity combiner 104 "selects the bits corresponding to the highest quality cell-site on a frame-by-frame basis." *Id.*, 17:4-7. Therefore, Gilhousen390 also discloses "*a controller configured to... select a best signal.*" Gilhousen390 indicates that the diversity combiner 104 performs these functions both in a cell diversity mode (e.g., multiple signals from different base stations), or in non-cell-

diversity mode (e.g., spatially diverse signals from a single base station). *Id.*, 16:59-66. It would have been obvious to a POSITA to incorporate Gilhousen390's signal selection functionality into Gilhousen865's repeater for processing the spatially diverse signals received from the base station. As Gilhousen865's repeater moves through cells in an airplane with high speed, it is highly susceptible to fading. And cell diversity is one of many combinable techniques for combating fading and improving received signal strength.

D. Claim 16

177. Claim 16 depends from claim 10, and recites "*the transmitter further configured to transmit the radio frequency signals within time slots of time-division multiplex channels.*" In my opinion, Gilhousen865 in view of Gilhousen390 discloses this limitation.

178. Gilhousen865 discloses a time division protocol as an available communication protocol. Specifically, although Gilhousen865 describes its communication system in terms of Code Division Multiple Access (CDMA), Gilhousen865 indicates that "[a]n alterative embodiment uses the time division multiple access system." Ex. 1009, 2:15-16. A POSITA would have understood that this communication protocol could be applied to Gilhousen865's repeater in the same manner as it is applied to Gilhousen865's ground based subsystem 105, at least because Gilhousen865 discloses that the repeater "has the same

functionality of its ground-based counterpart” for incoming calls. *Id.*, 3:3-10. As described by Gilhousen865, the repeater would register onboard mobile units to the communication network, which is a common function of the ground base station. Additionally, it was well-known in the art that signals transmitted in a time division transmission protocol (such as TDMA, for example) are transmitted “*within time slots of time-division multiplex channels.*” As described by VisiCom, the time is partitioned by time slots for different signals. Therefore, Gilhousen865 renders obvious “*the transmitter configured to transmit the radio frequency signals within time slots of time-division multiplex channels.*”

E. Claim 17

179. Claim 17 depends from claim 10, and recites “*wherein the movable base station is conveyed by a vehicle.*” Gilhousen865 in view of Gilhousen390 discloses this limitation.

180. As discussed above, Gilhousen865 in view of Gilhousen390 discloses a repeater (“*movable base station*”) that receives signals from a base station (“*fixed port*”), “*through the plurality of spatially separated antennas.*” Ex. 1009, 2:61-63; Ex. 1007, 14:37-39; *see also* Section XII.B. Gilhousen865 further discloses that the repeater is mounted in an airplane (“*vehicle*”). Ex. 1009, 2:45-49. Therefore, Gilhousen865 in view of Gilhousen390 discloses that the plurality of antennas are “*conveyed by a vehicle.*”

F. Claim 18

181. Claim 18 depends from claim 17, and recites “*wherein the vehicle is an automotive vehicle.*” Gilhousen865 in view of Gilhousen390 discloses this limitation.

182. Gilhousen865 discloses that the repeater 210 (“*movable base station*”) is mounted in an airplane (“*automotive vehicle*”). For example, according to Webster’s New World Dictionary published in 1993, a vehicle is defined as: “**any device or contrivance** for carrying or conveying persons or object, esp. over land or in space,,” and even provides “spacecraft” as an example. Webster, Ex. 1033, 1479, emphasis added. Meanwhile, the term “automotive” is defined as “self-moving” or “moving by means of its own power”. *Id.*, 93. An airplane, like a car, is self-moving since it is pushed and moved by its own engine. Thus, “*automotive vehicle*” was clearly understood at the time of the ’701 patent to include airplanes. Ex. 1009, 2:45-49; Therefore, Gilhousen865 discloses “*wherein the vehicle is an automotive vehicle.*”

G. Gilhousen865 in view of Gilhousen390 renders obvious claim 31.

183. Claim 31 is an independent claim. For purposes of my analysis, and ease of review, I have separated claim 31 into component parts, which I identify in brackets for reference:

31. [P] A movable base station configured to move relative to Earth, the movable base station comprising:

[A] a plurality of spatially separated antennas;

[B] a receiver configured to receive fixed port signals from a fixed port through the plurality of spatially separated antennas; and

[C] a transmitter configured to transmit radio frequency signals to a mobile device corresponding to the received fixed port signals, the radio frequency signals transmitted within time slots of time-division multiplex channels.

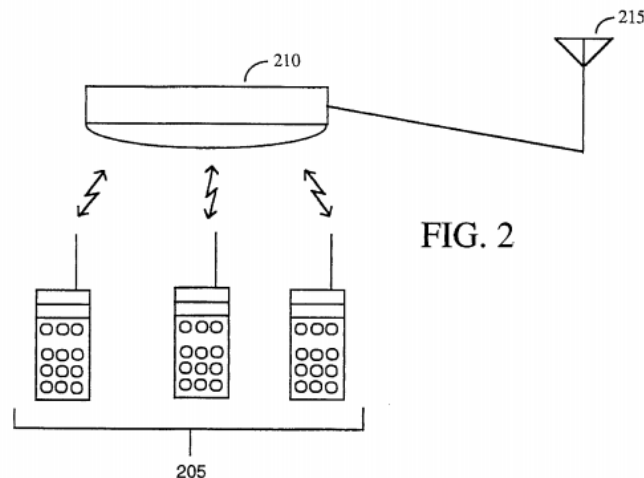
184. As I demonstrate below, it is my opinion that each and every element of independent claim 31 was well-known in the art prior to the '701 patent, and that claim 31 would have been obvious over the art.

1. Claim 31 Preamble (Element [31P])

185. As discussed above, Gilhousen⁸⁶⁵ describes a repeater 210 (“*movable base station*”) installed in an airplane that functions both to provide outgoing calls from the radiotelephone to the ground base station, and incoming calls originating from the ground subsystem to the airborne radiotelephone. *See* Ex. 1009, 2:53-63. Because the repeater is installed in an airplane, it would have been obvious to a POSITA that the repeater is “*configured to move relative to Earth.*”

2. Element [31A]

186. Gilhousen865 discloses a repeater 210 (“*movable base station*”) located on an airplane. *Id.*, 2:45-48. As shown in Gilhousen865’s Fig. 2, the repeater includes an antenna 215. *Id.*, 2:53-56.



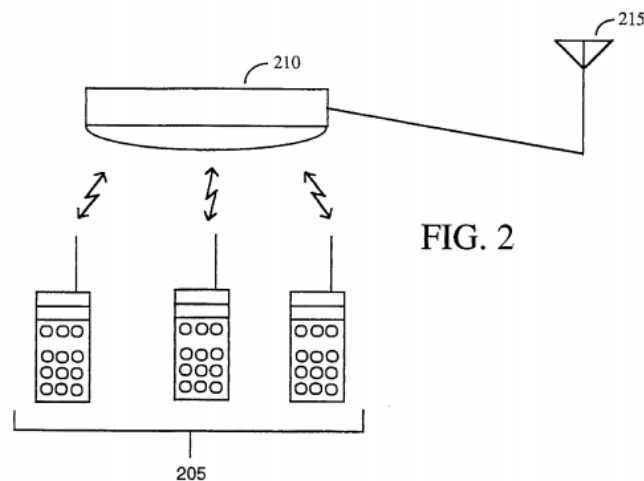
Ex. 1009, Fig. 2.

187. Gilhousen865 does not explicitly disclose that the repeater includes “a plurality of spatially separated antennas.” However, a POSITA would have found it obvious to modify Gilhousen865’s repeater to include a plurality of spatially separated antennas, as taught by Gilhousen390. Specifically, Gilhousen390 describes a cell-site (base station) that includes a two “separate antenna[s]...for space diversity reception.” Ex. 1007, 14:37-39. Spatial diversity was a well-known antenna configuration at the time of the ’701 patent for improving signal quality in the face of a variety of negative effects experienced by the signal during transmission, such as fading. As discussed in Section VII.E,

a POSITA would have known that wireless signals would experience fading when the receiver is moving. After reading Gilhousen390, a POSITA would have realized that Gilhousen390 provides a solution for the fading problem of Gilhousen865. Gilhousen865 describes that the repeater is a base station when configured to receive calls originating from the ground. Ex. 1009, 3:3-10. Therefore, it would have been obvious to a POSITA to configure Gilhousen865's repeater with "*a plurality of spatially separated antennas*," as Gilhousen390 employs in its base station, at least for the purposes of achieving the benefits of "space diversity." *See id.*

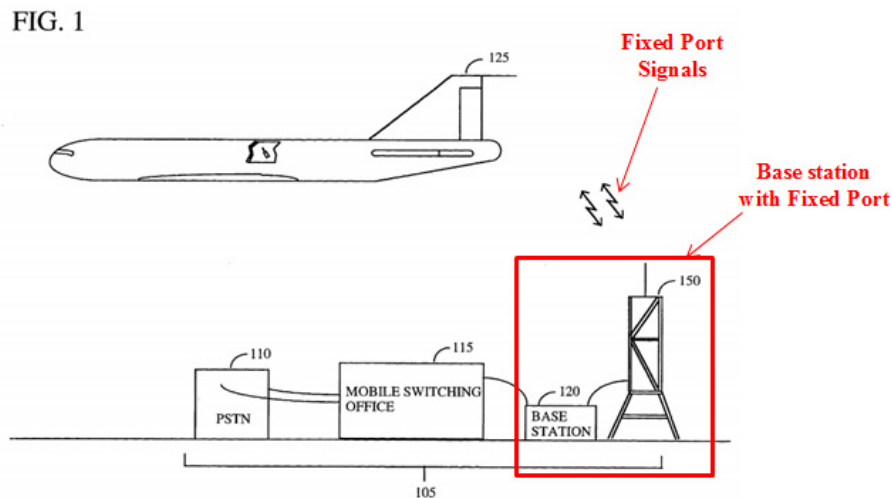
3. Element [31B]

188. Gilhousen865 discloses a repeater 210 ("*movable base station*") located on an airplane. Ex. 1009, 2:45-48. As shown in Gilhousen865's Fig. 2, the repeater includes an antenna 215. *Id.*, 2:53-56.



Ex. 1009, Fig. 2.

189. According to Gilhousen865, and as illustrated in annotated Fig. 1 below, the repeater 210 facilitates communication between a radiotelephone and a ground-based base station (“*fixed port*”), in part by receiving signals (“*fixed port signals*”) from the ground-based base station: “Telephone calls from the PSTN to the base station on the ground are transmitted to the outside antenna (215) that relays them to the repeater (210) mounted in the aircraft.” *Id.*, 2:61-63. Therefore, a POSITA would have understood that the repeater 210 includes a “*receiver*.” The part of the repeater performing receiving activity can be called a receiver, or in general, an apparatus like repeater having functionality of receiving can be called a receiver. Therefore, Gilhousen865 discloses “*a receiver configured to receive fixed port signals from a fixed port through [an antenna].*”



Ex. 1009, Fig. 1, annotated.

190. Gilhousen865 does not explicitly disclose that the repeater receives the signals “*through [a] plurality of spatially separated antennas.*” However, a

POSITA would have found it obvious to modify Gilhousen865's repeater to include a plurality of spatially separated antennas, as taught by Gilhousen390. Specifically, Gilhousen390 describes a cell-site (base station) that includes a two "separate antenna[s]...for space diversity reception." Ex. 1007, 14:37-39. Spatial diversity was a well-known antenna configuration at the time of the '701 patent for improving signal quality in the face of a variety of negative effects experienced by the signal during transmission, such as fading. As discussed in Section VII.E, a POSITA would have known that wireless signals would experience fading when the receiver is moving. After reading Gilhousen390, a POSITA would have realized that Gilhousen390 provides a solution for the fading problem of Gilhousen865. Gilhousen865 describes that the repeater is a base station when configured to receive calls originating from the ground. Ex. 1009, 3:3-10. Therefore, it would have been obvious to a POSITA to configure Gilhousen865's repeater with "*a plurality of spatially separated antennas*," as Gilhousen390 employs in its base station, at least for the purposes of achieve the benefits of "space diversity." *See id.*

4. Element [31C]

191. Gilhousen865 explains that the repeater ("*movable base station*") receives signals ("*fixed port signals*") from the ground base station ("*fixed port*"), and then "[t]he signals from the ground base stations are received by the external

antenna of the airborne subsystem and repeated to the radiotelephones [(“*mobile device*”)].” *Id.*, 3:55-57. Because Gilhousen865 discloses sending the signals to the radiotelephones, a POSITA would have found it obvious that the repeater includes a “*transmitter*.” The part of the repeater performing transmitting activity can be called a transmitter, or in general, an apparatus like repeater having functionality of transmitting can be called a transmitter. Therefore, Gilhousen865 discloses “*a transmitter configured to transmit... signals to a mobile device corresponding to the received fixed port signals.*”

192. Gilhousen865 discloses that the telephone is a **radiotelephone**, and that the repeater transmits the signal to the radio telephone from its antenna. *Id.* Therefore, a POSITA would have understood the transmitted signals to be *radio frequency signals*. Gilhousen390 also discloses transmitting radio frequency signals: “Receiver 34 receives the RF frequency signals from diplexer 32 which are typically in the 850 MHz frequency band.” Ex. 1007, 12:2-6.

193. Gilhousen865 discloses a time division protocol as an available communication protocol. Specifically, although Gilhousen865 describes its communication system in terms of Code Division Multiple Access (CDMA), Gilhousen865 indicates that “[a]n alternative embodiment uses the time division multiple access system.” Ex. 1009, 2:15-16. A POSITA would have understood that this communication protocol could be applied to Gilhousen865’s repeater in

the same manner as it is applied to Gilhousen865's ground based subsystem 105, at least because Gilhousen865 discloses that the repeater "has the same functionality of its ground-based counterpart" for incoming calls. *Id.*, 3:3-10; As described by Gilhousen865, the repeater would register onboard mobile unit to the communication network, which is a common function of the ground base station. Additionally, it was well-known in the art that signals transmitted in a time division transmission protocol (such as TDMA, for example) are transmitted "*within time slots of time-division multiplex channels.*" As described by VisiCom, the time is partitioned by time slots for different signals. Therefore, Gilhousen865 renders obvious "*the transmitter configured to transmit the radio frequency signals within time slots of time-division multiplex channels.*"

H. Claim 33

194. Claim 33 depends from claim 31, and recites "*further comprising a controller configured to compare the received fixed port signals received through the spatially separated antennas and to select a best signal.*" In my opinion, Gilhousen865 in view of Gilhousen390 discloses this limitation.

195. As discussed above, Gilhousen865's repeater 210 ("*movable base station*") includes an antenna 215 that receives signals ("*fixed port signals*") from a base station. *See* Ex. 1009, 2:61-63; *see also* Section X.B. Further, a POSITA would have been motivated to modify the antenna of Gilhousen865's repeater

based on the teachings of Gilhousen390 to include a plurality of spatially separated antennas. Ex. 1007, 14:37-39; *see also* Section XII.A. Therefore, the combination of Gilhousen865 and Gilhousen390 discloses “*fixed port signals received through the spatially separated antennas.*”

196. Gilhousen390 further discloses how to process the multiple received signals received via the multiple spatially diverse antennas. Specifically, Gilhousen390 discloses that a diversity combiner 104 (“*controller*”) receives the multiple signals (e.g., “cell-site signals” in Gilhousen390) and “compares the signal quality indicators accompanying the information bits from the two or more cell-site signals.” Ex. 1007, 17:1-4. Therefore, Gilhousen390 discloses “*a controller configured to compare the received fixed port signals.*” Then, the diversity combiner 104 “selects the bits corresponding to the highest quality cell-site on a frame-by-frame basis.” *Id.*, 17:4-7. Therefore, Gilhousen390 also discloses “*a controller configured to... select a best signal.*” Gilhousen390 indicates that the diversity combiner 104 performs these functions both in a cell diversity mode (multiple signals from different base stations), or in non-cell-diversity mode (e.g., spatially diverse signals from a single base station). *Id.*, 16:59-66. It would have been obvious to a POSITA to incorporate Gilhousen390’s signal selection functionality into Gilhousen865’s repeater for processing the spatially diverse signals received from the base station. As

Gilhousen865's repeater moves through cells in an airplane with high speed, it is highly susceptible to fading. And cell diversity is one of many combinable techniques for combating fading and improving received signal strength.

I. Claim 34

197. Claim 34 depends from claim 31, and recites "*wherein the movable base station is conveyed by a vehicle.*" In my opinion, Gilhousen865 in view of Gilhousen390 discloses this limitation.

198. As discussed above, Gilhousen865 in view of Gilhousen390 discloses a repeater ("*movable base station*") that receives signals from a base station ("*fixed port*"), "*through the plurality of spatially separated antennas.*" Ex. 1009, 2:61-63; Ex. 1007, 14:37-39; *see also* Section XII.B. Gilhousen865 further discloses that the repeater is mounted in an airplane ("*vehicle*"). Ex. 1009, 2:45-49. Therefore, Gilhousen865 in view of Gilhousen390 discloses that the plurality of antennas are "*conveyed by a vehicle.*"

J. Claim 35

199. Claim 35 depends from claim 34, and recites "*wherein the vehicle is an automotive vehicle.*" Gilhousen865 in view of Gilhousen390 discloses this limitation.

200. Gilhousen865 discloses that the repeater 210 ("*mobile base station*") is mounted in an airplane ("*automotive vehicle*"). Ex. 1009, 2:45-49. For

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example, according to Webster's New World Dictionary published in 1993, a vehicle is defined as: "any device or contrivance for carrying or conveying persons or objects, esp. over land or in space," and even provides "spacecraft" as an example. Meanwhile, the term "automotive" is defined as "self-moving" or "moving by means of its own power". Webster, Ex. 1033, 93, 1479. An airplane, like a car, is self-moving since it is pushed and moved by its own engine. Thus, "automotive vehicle" was clearly understood at the time of the '023 patent to include airplanes. Ex. 1009, 2:45-49. Therefore, Gilhousen⁸⁶⁵ discloses "wherein the vehicle is an automotive vehicle."

XIII. Conclusion

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

Executed this 20th day of March 2019 in Colorado Springs, Colorado.

Respectfully submitted,



Scott A. Denning