

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

SMARTSKY NETWORKS LLC,

Petitioner,

v.

GOGO BUSINESS AVIATION LLC,

Patent Owner

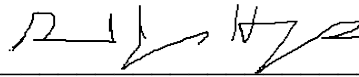
Case: IPR2025-00672

Patent 9,954,600

**DECLARATION OF DR. GERARD JAMES HAYES
IN SUPPORT OF PETITION FOR *INTER PARTES* REVIEW OF U.S.
PATENT NO. 9,954,600**

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

Date: February 27, 2025

A handwritten signature in black ink, appearing to read "Gerard James Hayes", written over a horizontal line.

Gerard James Hayes

TABLE OF CONTENTS

	Page
I. Introduction	1
II. Background and Experience	2
III. Legal Principles	5
A. Person of Ordinary Skill in the Art	5
B. Anticipation Invalidity	6
C. Obviousness Invalidity	6
D. Claim Construction	7
E. Effective Filing Date	8
IV. The '600 Patent	9
A. Background and Priority Claims	9
B. Prosecution History	10
C. Claims	11
V. Prior Art Analysis	14
A. Brief Statement of Prior Art Relied Upon	14
1. de La Chapelle - U.S. Patent No. 9,306,657	14
2. Jalali - U.S. Patent Application Publication No. 2014/0200045.....	15
3. Nelson - U.S. Patent No. 7,177,939	16
4. McGuffin - European Patent No. 2,207,275	16
5. Prior Art Status for Cited References	17
VI. Opinions on grounds for Inter Partes Review	18
A. Disclosure of Claim Limitations in the Prior Art	18
B. GROUND 1: de La Chapelle Discloses all Limitations of Claims 1-4, 6, 13-15, 17, and 19	18

TABLE OF CONTENTS

(Continued)

	Page
C. GROUND 2: Jalali and de La Chapelle Discloses All Limitations of Claims 1-4, 6-15, and 17-19	45
E. GROUND 3: Jalali, de La Chapelle and Nelson et al. Discloses All Limitations of Claims 5 and 16.....	86
F. GROUND 4: Jalali, de La Chapelle, Nelson and McGuffin Discloses All Limitations of Claims 1-4, 6-15, and 17-19.....	89
VII. Conclusion	93

I, Gerard James Hayes, declare and state as follows:

I. INTRODUCTION

1. I have been retained by counsel for SmartSky Networks LLC (“SmartSky” or “Patent Owner”) for the *inter partes* review (“IPR”) proceeding.

2. I have been asked to consider whether certain references disclose, teach and/or suggest the features recited in claims 1-19 of U.S. Patent No. 9,954,600 (“the ‘600 patent”).

3. I understand that the ‘600 patent is assigned to Gogo Business Aviation LLC. (“Gogo”).

4. I have been asked to review relevant materials and render my independent analysis and expert opinion in connection with technical matters related to the ‘600 patent.

5. I have been asked to consider what a “person of ordinary skill in the art” (“POSA”) at the time of the invention of the ‘600 patent would have understood from the teachings of the ‘600 patent, including scientific and technical knowledge related to the ‘600 patent.

6. I am being compensated for my time at my normal hourly rate and for reasonable expenses incurred in preparing this declaration. My compensation is not dependent on the outcome of this proceeding, and in no way affects the substance of

my statements in this Declaration. I have no financial interest in the Petitioner. I similarly have no financial interest in the '600 patent.

7. My current curriculum vitae, attached as Appendix A, lists my professional activities and publications. The following paragraphs briefly summarize some of my relevant experience.

II. BACKGROUND AND EXPERIENCE

8. I am an electrical engineer by education and professional experience. I received a Bachelor of Science in Electrical Engineering from the North Carolina State University in 1987, a Master of Science in Electrical Engineering from the Ohio State University in 1989, a Master of Science in Applied Mathematics from the North Carolina State University in 1993, and a Doctorate of Philosophy in Electrical Engineering from the North Carolina State University in 2012.

9. Throughout the last 35 years, my academic and professional career has been closely integrated with communications, wireless, and radio frequency (RF) technologies. As an undergraduate intern, I supported the development of airborne radar systems at ITT Avionics, a division of ITT Inc., and the investigation of multi-gigabit private optical fiber communication links at the Waveguide Product Engineering Laboratory of Corning Glass Works. Communication theory (analog and digital) was a cornerstone of my undergraduate studies and post-graduate

relationships. My advanced degrees focus on electromagnetic theory, applied mathematical analysis, and antenna design.

10. In 1989, I was introduced to advanced phased array technologies for space-based synthetic aperture radar systems at Lockheed Missiles and Space Company (now Lockheed Martin Corporation). Supporting both classified and commercial projects, I assisted in the development and deployment of electronically controlled beam-steering systems that were comprised of digitally controlled transmit/receive MMIC (monolithic microwave integrated circuit) modules for both amplitude and phase adjustment.

11. In 1993, I joined Ericsson Inc. and its team in North Carolina that supported the development of hybrid analog/digital handsets for the emerging digital cellular market in the US (“1G”). For the next 16 years, my career with Ericsson, and then Sony Ericsson Inc., transitioned through each generation of wireless standards (including parallel protocols such as CDMA, EVDO, and WiMAX) up to LTE (“4G”). Many of my technical activities included supporting standardization efforts with IEEE, CTIA, ANSI C63, and other international trade organizations. In addition, my team and I were closely aligned with regulatory agencies and certification bodies in the United States, European Union, and Asia.

12. In 2010, I led the formation of the Wireless Research Center of North Carolina (WRC) where I am currently the President. The WRC is an independent

non-profit, 501(c)(3), research organization with a unique mission to promote the advancement of wireless technologies and to foster innovation leading to economic development. The WRC provides engineering and testing services for a broad range of commercial and private wireless applications. These applications range from in-body, on-body through commercial mobile (LTE, pre-5G) to aviation and satellite networks.

13. In 2019, North Carolina State University and the WRC (along with Mississippi State University and other supporting organizations) were selected by the National Science Foundation to design, deploy, and maintain the third nationally-funded platform for advanced wireless research: AERPAW (Aerial Experimentation and Research Platform for Advanced Wireless). AERPAW was a five-year, \$24 million grant. AERPAW was designed to be a leader in aerial communications research, deployment, and commercialization. I served as a Co-PI to the AERPAW Investigator Team.

14. I have substantial research experience in wireless communication system design and assessment. Moreover, in my capacity as President of the WRC, I am often called upon by wireless communication companies to assist in the evaluation and development of wireless communication equipment. Notably during my time as President, the WRC has supported projects for both Petitioner and Patent Owner.

15. I have relied on my education, years of experience working in the area of research and design of wireless communication equipment, and my understanding of the knowledge, creativity, and experience of a person of skill in the art in forming the opinions expressed in this declaration.

16. Between now and such time that I may be asked to testify, I expect to continue my review, evaluation, and analysis of evidence presented before and/or at any hearing. I may review the declarations and other evidence submitted by Gogo. I reserve the right to amend or supplement this declaration, as appropriate, after considering any additional evidence or opinions set forth by Gogo. In the event that additional relevant information becomes available to me, I also reserve the right to review and consider that information in further developing or refining my opinions.

III. LEGAL PRINCIPLES

A. Person of Ordinary Skill in the Art

17. I am informed that a “person of ordinary skill in the art” (“POSA”) refers to a hypothetical person who is presumed to have known the relevant art at the time of the invention. Many factors may determine the level of ordinary skill in the art, including: (1) the type of problems encountered in the art, (2) prior art solutions to those problems, (3) the rapidity with which innovations are made, (4) the sophistication of the technology, (5) the educational level of active workers in the field, and (6) the educational level of the inventor. I understand that a POSA is a

person of ordinary creativity, meaning that a POSA may employ inferences and creative steps in their work.

18. A POSA for the '600 patent would have a degree in electrical engineering or computer science, or a similar discipline, along with 4-5 years of experience with real-time systems architecture, design, and implementation. This POSA would be aware and generally knowledgeable about the aviation and aerospace industry as it relates to telecommunication systems. I have used this definition in my analysis below.

B. Anticipation Invalidity

19. I understand that a patent claim is “anticipated,” and, therefore, invalid, if a single prior art reference discloses (expressly or inherently) each and every element of the claimed invention in a manner sufficient to enable a POSA to practice the invention, thus placing the invention in possession of the public.

C. Obviousness Invalidity

20. I understand that even if a prior art reference fails to anticipate a patent claim, the claim may nonetheless be invalid as “obvious,” if the differences between the subject matter claimed 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 POSA. I understand that several factual inquiries underlie a determination of obviousness. These inquiries include the scope and content of the prior art, the level of ordinary

skill in the art, the differences between the claimed invention and the prior art, and any objective “secondary considerations.” I understand that a combination of familiar elements according to known methods may be obvious when it does no more than yield predictable results. I also understand that common sense and ordinary creativity of one skilled in the art can be relevant to obviousness, and that a claim may be obvious if the elements of the claim are all known in the art, and if a POSA would have an apparent reason to combine those elements in the fashion claimed by the patent.

21. I have been informed that certain objective secondary considerations may be relevant to a determination of whether an invention was obvious. Such secondary considerations may include, e.g., (a) whether there was a long-felt and long-unmet need for the invention, (b) whether the invention achieved unexpected results, (c) the commercial success of the invention, and (d) whether the invention was copied or praised within the industry. I am not presently aware of any secondary considerations that impact my analysis of the challenged claims of the '600 Patent, but reserve the right to address any secondary considerations that may be raised by the Patent Owner in this proceeding.

D. Claim Construction

22. I have been informed that claim construction is a matter of law and that the final claim construction will ultimately be determined by the Board. For the

purposes of my invalidity analysis in this proceeding and with respect to the prior art, I have used the ordinary and customary meaning as understood by a POSA in question at the time of the invention.

23. I have been informed that, in general, a preamble limits the invention if it recites essential structure or steps, or if it is necessary to give life, meaning, and vitality to the claim. I have further been informed that a preamble is not limiting where a patentee defines a structurally complete invention in the claim body and uses the preamble only to state a purpose or intended use for the invention. I have further been informed that dependence on a particular disputed preamble phrase for antecedent basis may limit claim scope because it indicates a reliance on both the preamble and claim body to define the claimed invention. I have further been informed that clear reliance on the preamble during prosecution to distinguish the claimed invention from the prior art transforms the preamble into a claim limitation because such reliance indicates use of the preamble to define, in part, the claimed invention.

E. Effective Filing Date

24. I have been informed that in order for a claim in a later-filed application to be entitled to the benefit of the filing date of an earlier-filed application under 35 U.S.C. § 120, the earlier-filed application (as well as any intervening applications) must provide support for each limitation contained in the claim, as required by the

written description requirement of 35 U.S.C. § 112. I understand that it is not sufficient for an element or limitation to be obvious or apparent from the prior application. Instead, a prior application must describe an invention in sufficient detail that one skilled in the art can clearly conclude that the inventor invented the claimed invention as of the filing date sought. I also understand that claims containing any matter introduced in a continuation-in-part application are given the filing date of the continuation-in-part application.

25. I also understand that, though elements need not appear *in haec verba* in an earlier filed-application for claims with those elements to be entitled to earlier priority, there nonetheless needs to be language in the earlier-filed application that expresses the same meaning such that a POSA must immediately discern the limitation at issue.

IV. The ‘600 Patent

A. Background and Priority Claims

26. The ‘600 patent, entitled “Servicing cell selection in air to ground communication systems” relates to “select serving cells in air to ground communication systems.” In particular, the ‘600 patent discloses that the scarcity of air-to-ground (ATG) communication system resources (i.e., radio frequency spectrum) means that unlicensed bands may be used. However, given the noisy environment, which is full of interference, cell selection may make use of schemes

that select cells based on noise levels to maximize throughput. Ex. 1001, 1:23-62.

To select communication channels that maximize throughput, the '600 patent discloses the measurement of signal-to-noise ratios or noise power levels on various links, and the use of such measurements to calculate user capacity estimates or noise estimates that are placed in a user capacity matrix or noise matrix, respectively, to select channels based on the matrices. Ex. 1001, 1:66-2:62.

27. The '600 Patent issued April 24, 2018, from U.S. Patent Application No. 15/352,255, filed November 15, 2016. The '600 patent also claims the priority benefit of the provisional patent application, U.S. Patent Application No. 62/358,437 filed on July 5, 2016.

28. In my opinion, the challenged claims 1-19 of the '600 Patent are not entitled to a priority date earlier than July 5, 2016.

29. Unless another date is specified, my opinions in this declaration address what would be known and understood by POSA as of July 5, 2016.

B. Prosecution History

30. I have reviewed the file history of the '600 patent. The file history is briefly summarized below.

31. During prosecution of U.S. Patent Application No. 15/352,255, which issued as the '600 patent, there were no Office Actions rejecting any of the claims. However, a preliminary amendment was submitted on June 27, 2017 that, among

other things, added clarifications to the independent claims indicating that channels or links involved are between a ground station and aircraft, as well as adding the “forward-link user capacity matrix” to claim 1 and the “reverse-link noise matrix” to claim 7. Ex. 1004, pp. 64-73. An interview with the Examiner was conducted on December 7, 2017, and a Notice of Allowance was mailed on the same day. Ex. 1004, pp. 81-93. A minor amendment correcting issues of form was then submitted on January 11, 2018 prior to the ‘600 patent issuing. Ex. 1004, pp. 197-204.

C. Claims

32. As detailed above, the ‘600 patent was originally issued with 19 claims. Independent claims 1, 7, and 13 are challenged in this proceeding, as well as dependent claims 2-6, 8-12 and 14-19. The challenged claims are generally directed to selecting serving cells in air to ground communication systems.

33. Independent claim 1 recites a non-transitory computer readable medium; claim 7 recites a computer-implemented method, executed with a computer processor disposed within an air-to-ground communication ground station; and claim 13 recites a computer system comprising one or more processors and/or transceivers. These independent claims read as follows:

1. A non-transitory computer readable medium, comprising processor executable instructions that when executed by a computer processor disposed within an airborne aircraft cause the computer processor to:
command a directional antenna installed on the aircraft and a transceiver disposed within the aircraft to measure a first signal-to-noise ratio of a first communication channel corresponding to a first location on the ground,

the first communication channel configured to support transmissions to/from the airborne aircraft;

command the directional antenna and the transceiver to measure a second signal-to-noise ratio of a second communication channel corresponding to a second location on the ground, the second communication channel configured to support transmissions to/from the airborne aircraft;

calculate a first forward-link user capacity estimate using the first signal-to-noise ratio of the first communication channel;

calculate a second forward-link user capacity estimate using the second signal-to-noise ratio of the second communication channel; and

calculate a forward-link user capacity matrix using the first forward-link user capacity estimate and the second forward-link user capacity estimate,

wherein the forward-link user capacity matrix is utilized to select communication channels to utilize for transmissions between a plurality of ground stations disposed on the ground and the airborne aircraft.

7. A computer-implemented method, executed with a computer processor disposed within an air-to-ground communication ground station, comprising:

commanding, with the computer processor, a directional antenna installed at the ground station and a transceiver disposed within the ground station to measure a first noise power level of a first communication channel at a first elevation and a first azimuth from a current position of the ground station, the first communication channel configured to support transmissions between the ground station and airborne aircraft;

commanding, with the computer processor, the directional antenna and the transceiver to measure a second noise power level of a second communication channel at a second elevation and a second azimuth from the current position of the ground station, the second communication channel configured to support transmissions between the ground station and the airborne aircraft;

calculating, with the computer processor, a first reverse-link noise estimate using the first noise power level of the first communication channel;

calculating, with the computer processor, a second reverse-link noise estimate using the second noise power level of the second communication channel; and

calculating, with the computer processor, a reverse-link noise matrix using the first reverse-link noise estimate and the second reverse-link noise estimate,

wherein the reverse-link noise matrix is utilized to select communication channels to utilize for transmissions between a plurality of ground stations disposed on the ground and the airborne aircraft.

13. A computer system comprising one or more processors and/or transceivers configured to:

retrieve at least one of:

(i) a forward-link user capacity matrix comprising a plurality of forward-link user capacity estimates each associated with a respective signal-to-noise ratio measurement of a respective communication channel corresponding to a respective location on the ground; or

(ii) a return-link user capacity matrix comprising a plurality of return-link user capacity estimates each associated with a respective noise power level of a respective communication channel corresponding to a respective azimuth and a respective elevation from a current location of an airborne aircraft;

determine, using at least one of (i) the forward-link user capacity matrix or (ii) the return-link user capacity matrix, a candidate serving cell that is disposed on the ground; and

command a directional antenna and a particular transceiver to transmit or receive data between the airborne aircraft and the candidate serving cell.

Claims 2-6 depend from claim 1, claims 8-12 depend from claim 7, and claims 14-19 depend from claim 13.

V. PRIOR ART ANALYSIS

A. Brief Statement of Prior Art Relied Upon

1. de La Chapelle - U.S. Patent No. 9,306,657

34. De La Chapelle, entitled “Soft Handoff Method and Apparatus for Mobile Vehicles Using Directional Antennas,” was published October 12, 2006 from an application filed on December 21, 2005 that claims priority to a provisional application filed on April 8, 2005. de La Chapelle addresses a problem in connection with air-to-ground (ATG) communication services relating to the fact that there “is insufficient communication capacity in a single ATG channel to provide broadband service to the expected market of 10,000 or more aircraft using the exact communication method and apparatus used for standard terrestrial cellular communication.” Ex. 1005, 1:52-57. De La Chapelle explains that this problem exists “because a typical cell phone antenna is a monopole element that has an omnidirectional gain pattern in the plane perpendicular to the antenna element. This causes transmit power from the antenna to radiate in all directions, thus causing interference into all BTS sites within the radio horizon of its transmissions.” Ex. 1005, 1:64-2:2. To cure this problem, de La Chapelle refers to a “well known method for reducing interference on wireless networks is using directional antennas instead

of the omnidirectional antennas.” Ex. 1005, 2:9-11. But the problem remained in this ATG context as to how to handoff an aircraft between different ground stations when using these directional antennas to maintain the communication link between the aircraft and ground station through the handoff. Thus, de La Chapelle proposed multiple ways to conduct this handoff while maintaining the communication link that are ultimately aimed at providing “a higher quality communications link”. Ex. 1005, 4:20-23. Among the ways described to achieve the higher quality communications link in the context of the desire to increase capacity that is described in de La Chapelle, the use of a signal to interference ratio (S/I ratio) and the use of a signal to noise ratio (SNR) are both described. Ex. 1005, 8:57-9:7 and 17:48-53.

2. Jalali - U.S. Patent Application Publication No. 2014/0200045

35. Jalali, entitled “High Data Rate Aircraft to Ground Communication Antenna System,” was published July 17, 2014 from an application filed on March 17, 2014 that is a divisional of U.S. Patent No. 8,676,192 that claims priority to a provisional application filed on February 9, 2011. Jalali discloses air and ground communication utilizing multiple ground stations to switch data reception based on a number of different criteria. In this regard, for example, Jalali discloses that a handoff may be conducted based on signal strength measurements for pilot signals. Ex. 1006, [0008]-[0012]. However, Jalali also describes an example embodiment in which signal to noise plus interference (SINR) is measured, and the handoff is

controlled based on selecting beams that provide “improved performance.” Ex. 1006, [0059]-[0060]. The comparison of beams based on SINR allows an “optimal beam” to be selected. SINR values are indexed for comparison and considered relative to thresholds. Ex. 1006, [0067]. Moreover, Jalali describes the use of filtering and averaging of the values measured to account for variations. Ex. 1006, [0052] and [0057].

3. Nelson - U.S. Patent No. 7,177,939

36. Nelson, entitled “Aircraft Data Communications Services for Users,” was published February 27, 2003 from an application filed on June 19, 2001. Nelson discloses a communication system between a moving object and ground terminal. Ex. 1007, Abstract. Specifically, Nelson discloses a radio communication path between an aircraft and a ground terminal such that a “data communication server establishes the radio communication path over one of a plurality of wireless data networks including packet data networks and satellite data networks and preferably includes a pre-determined software architecture.” Ex. 1007, Abstract. Nelson also specifically mentions that data can flow through an air link using an “out-of-band” protocol. Ex. 1007, 10:23-27.

4. McGuffin - European Patent No. 2,207,275

37. McGuffin, entitled “Method and system for datalink ground station selection,” was published July 14, 2010 from an application filed on December 21,

2009. McGuffin discloses a selection method of a ground station for ground to air communication. Specifically, McGuffin discloses a selection method in which “the average of the signal strength values stored in each data structure is calculated to determine an average signal strength, and the average signal strength of each of the one or more ground stations is compared.” Ex. 1008, [0012]. The comparison of values is performed via storage of data in a data structure that is shown in various tables. Ex. 1008, [0034]-[0038].

5. Prior Art Status for Cited References

38. De La Chapelle was published October 12, 2006 (from an application filed on December 21, 2005 that claims priority to a provisional application filed on April 8, 2005), which is before the earliest effective filing date for the claims of the '600 patent. Accordingly, I understand that de La Chapelle is considered prior art to the claims of the '600 patent under the patent statute, 35 U.S.C. § 102(a)(1).

39. Jalali was published July 17, 2014 (from an application filed on March 17, 2014 that is a divisional of U.S. Patent No. 8,676,192 that claims priority to a provisional application filed on February 9, 2011), which is before the earliest the earliest effective filing date for the claims of the '600 patent. Accordingly, I understand that Jalali is considered prior art to the claims of the '600 patent under the patent statute, 35 U.S.C. § 102(a)(1).

40. Nelson was published February 27, 2003 from an application filed on June 19, 2001, which is before the earliest priority date for the '600 patent and over one year earlier than the earliest effective filing date for the claims of the '600 patent. Accordingly, I understand that Nelson is considered prior art to the claims of the '600 patent under the patent statute, 35 U.S.C. § 102(a)(1).

41. McGuffin was published July 14, 2010 from an application filed on December 21, 2009, which is before the earliest priority date for the '600 patent and over one year earlier than the earliest effective filing date for the claims of the '600 patent. Accordingly, I understand that McGuffin is considered prior art to the claims of the '600 patent under the patent statute, 35 U.S.C. § 102(a)(1).

VI. OPINIONS ON GROUNDS FOR INTER PARTES REVIEW

A. Disclosure of Claim Limitations in the Prior Art

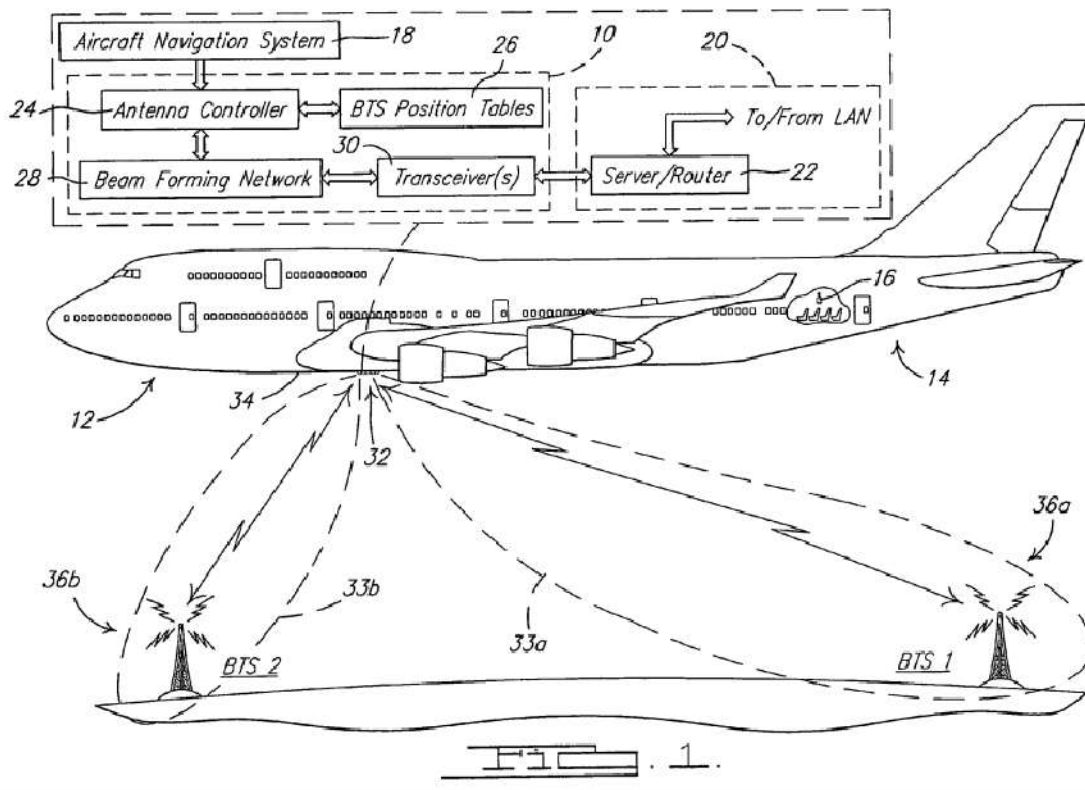
42. In my opinion, all elements of claims 1-19 of the '600 patent are known in the prior art, and these claims are anticipated by and/or obvious over various combinations of prior art, as explained below.

B. GROUND 1: de La Chapelle Discloses all Limitations of Claims 1-4, 6, 13-15, 17, and 19.

43. De La Chapelle (Ex. 1005) *addresses the same issue in the same manner* as the '600 patent. Specifically, the '600 patent and de La Chapelle each deal with the issue of providing air-to-ground (ATG) communication services to

airborne aircraft using directional beams that are handed off based on signal measurements of candidate cells. *Compare* Ex. 1001, 4:46-50 (“[b]y employing a high directivity antenna to measure the noise levels in many different possible directions of communication and refreshing such information periodically, the ATG supplementary IFC network may select serving cells that provide the best available SINR”), *with* Ex. 1005, 8:57 ([a] second method for determining when to initiate a hand off involves using a “best Signal/Interference (S/I) ratio” algorithm as part of periodic, real time calculation. For example, if the BTSs were uniformly distributed, the “nearest BTS” algorithm would work near-optimally. In practice there is typically clustering of BTSs in metropolitan areas, and in particular close to airports. If there are 2 BTSs close to each other, then during a receive operation, if the antenna system **32** steers its primary lobe to work with one of these BTSs, there may be strong interference coupled into the antenna system **32** from the other BTS, as both BTSs, may be within the relatively wide single lobe beam. In such situations, a higher S/I ratio and hence better system performance would be obtained by selecting and using another BTS which is actually not the next closest BTS to the aircraft. Preliminary testing has indicated that for realistic BTS locations (including some BTS clustering), using the “best S/I” approach increased the worst case S/I by around 5 dB”).

44. De La Chapelle teaches each and every limitation of claims 1-4 and 6 and therefore anticipates claims 1-4 and 6. The preamble of claim 1 recites “a non-transitory computer readable medium, comprising processor executable instructions that when executed by a computer processor disposed within an airborne aircraft cause the computer processor to” carry out various further claimed elements. To the extent the preamble of claim 1 is deemed a limitation, de La Chapelle discloses these features because de La Chapelle discloses “an antenna controller **24** that is in communication with a base transceiver station (BTS) position look-up table **26**.” Ex. 1005, 5:48-51. A POSA would understand that it is inherent that the BTS look-up table is stored in a non-transitory computer readable medium, and that the antenna controller **24** inherently possesses a processor capable of executing instructions. Moreover, the antenna controller **24** is clearly shown on the aircraft in FIG. 1.



45. With respect to claim 1, de La Chapelle teaches “command a directional antenna installed on the aircraft and a transceiver disposed within the aircraft.” Ex. 1005, 5:62-6:4. In particular, de La Chapelle discloses a beam forming network **28**, via which the antenna controller **24** controls an antenna system **32** to create a single beam that a POSA would clearly understand to correspond to a directional antenna and corresponding transceiver.

46. De La Chapelle also teaches that a directional antenna is commanded “to measure a first signal-to-noise ratio of a first communication channel corresponding to a first location on the ground, the first communication channel configured to support transmissions to/from the airborne aircraft.” Ex. 1005, 8:63 –

9:4 and 17:48-53. In this regard, de La Chapelle discloses that a signal to interference ratio, which a POSA would understand to be interchangeable with the signal-to-noise ratio mentioned in claim 1 of the '600 patent, is used in signal to interference analysis that is performed with respect to multiple base stations (i.e., BTSs). Notably, de La Chapelle is clear in indicating interchangeableness of signal-to-noise ratio (SNR) with the signal-to-interference ratio by virtue of the substitution of SNR in the description of 17:48-53 for the signal-to-interference ratio otherwise discussed in similar terms at 8:63-9:4 of Ex. 1005. Thus, a POSA would clearly understand that the signal to interference ratio measurements and SNR calculations of de La Chapelle must necessarily be made on the corresponding communication channels associated with each of the BTSs. Thus, for evaluation of any single potential handoff, de La Chapelle necessarily discloses measurements with respect to at least two BTSs, of which one of them would necessarily be considered to correspond to the "first communication channel" among the first and second communication channels of claim 1. The antenna controller **24** of de La Chapelle would also clearly be understood by a POSA as being the actor and commander of the directional antennas with respect to this instruction based on FIG. 1 and the descriptions of de La Chapelle. Ex. 1005, 5:27-6:60.

47. De La Chapelle also teaches a processor to "command the directional antenna and the transceiver to measure a second signal-to-noise ratio of a second

communication channel corresponding to a second location on the ground, the second communication channel configured to support transmissions to/from the airborne aircraft.” Ex. 1005, 8:63-9:4 and 17:48-53. As noted above, de La Chapelle discloses that a signal to interference ratio and SNR, which a POSA would understand to be the same as the signal-to-noise ratio mentioned in claim 1, is used in signal to interference/SNR analysis that is performed with respect to multiple base stations (i.e., BTSs). Notably, a POSA would clearly understand that the signal to interference ratio measurements and SNR calculations of de La Chapelle must necessarily be made on the corresponding communication channels associated with each of the BTSs. Thus, for evaluation of any single potential handoff, de La Chapelle necessarily discloses measurements with respect to at least two BTSs, of which one of them would necessarily be considered to correspond to the “second communication channel” among the first and second communication channels of claim 1. The antenna controller **24** of de La Chapelle would also clearly be understood by a POSA as being the actor and commander of the directional antennas with respect to this instruction.

48. De La Chapelle teaches “calculate a first forward-link user capacity estimate using the first signal-to-noise ratio of the first communication channel.” Ex. 1005, 1:52-2:19 and 8:63-9:4. As an initial matter, de La Chapelle specifically discusses interference experienced on the receive operation from the aircraft

perspective (see Ex. 1005, 8:63-67), which a POSA understands to be the forward link. A POSA would also very clearly understand that in order to determine the “best S/I” of de La Chapelle, a comparison of some estimate of the capacity of the network, which is defined by its channels, is necessary. In this regard, de La Chapelle expressly notes that communication capacity of networks, and thereby also their channels, is limited by interference. Ex. 1005, 2:4-8. This is an immutable characteristic of communication networks. Thus, capacity is well known by a POSA to be directly related to interference levels, and the signal to interference measurements and SNR calculations of de La Chapelle are therefore also directly associated with estimations of channel capacity. A POSA would appreciate that by virtue of de La Chapelle teaching the “best S/I” algorithm, de La Chapelle is teaching a particular way to employ a “best capacity” algorithm or “best quality” algorithm for BTS selection in handoff. Moreover, as noted above, de La Chapelle specifically discusses the focus on capacity in its background section. Ex. 1005, 1:47-2:21. de La Chapelle also specifically discloses conducting a handoff from one link to another when a second BTS is expected to provide a “higher quality communications link.” Ex. 1005, 4:20-27. de La Chapelle further describes this process with more specificity in connection with operation 110 of FIG. 16. Ex. 1005, 16:43-50. In this section, signal strength measurement is expressly disclosed in connection with quality determination. A POSA understands the term “quality” in wireless

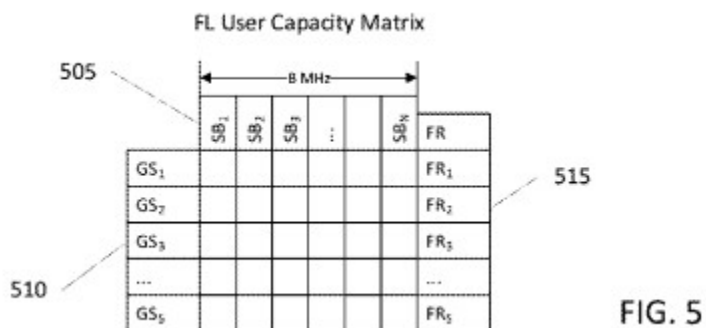
communication to mean colloquially, how “clean” or “clear” a signal is. This cleanliness or clarity is directly related to signal strength, interference, and noise and is also very well known to a POSA. The higher quality link in this regard, would be understood by a POSA to have a better combination of signal strength, interference and/or noise, and therefore also correspondingly higher capacity. Notably, the ‘600 patent does not expressly teach any formula or specific method for calculating a capacity estimate using a signal-to-noise ratio. To the contrary, the only detail provided for forward link capacity seems to be the provision of an exemplary system to collect and calculate the capacity. Ex. 1001, 8:46-9:56. Moreover, this section extols the virtue of a simple approach to estimating SINR based on noise plus interference measurements and power settings. Ex. 1001, 9:14-16. Therefore, a POSA would understand that the first forward-link user capacity estimate of claim 1 is therefore nothing more than a quality estimate based on signal to interference ratio and/or SNR, both of which are clearly disclosed by de La Chapelle. Although a POSA would easily appreciate the descriptions of de La Chapelle to be equivalent to that which is recited in claim 1, to the extent any distinction were to be maintained, the distinction would nevertheless be meaningless and at least define only a gap that would be obvious to traverse for a POSA. There would be no unexpected results, and the motivation is clear to obtain the most reliable communication links at all times.

49. De La Chapelle also discloses “calculate a second forward-link user capacity estimate using the second signal-to-noise ratio of the second communication channel.” Ex. 1005, 1:52-2:19 and 8:63-9:4. As noted above, de La Chapelle specifically discusses interference experienced on the receive operation from the aircraft perspective (see Ex. 1005, 8:63-67), which a POSA understands to be the forward link. de La Chapelle also necessarily discloses measurements with respect to at least two BTSs, of which one of them would necessarily be considered to correspond to the “second communication channel” among the first and second communication channels of claim 1. A POSA would also very clearly understand that in order to determine the “best S/I” of de La Chapelle, a comparison of some estimate of the capacity of the network, which is defined by its channels, is necessary. In this regard, de La Chapelle expressly notes that communication capacity of networks, and thereby also their channels, is limited by interference. Ex. 1005, 2:4-8. Thus, capacity is known by a POSA to be directly related to interference levels, and the signal to interference measurements and SNR calculations of de La Chapelle are therefore also directly associated with estimations of channel capacity. A POSA would appreciate that by virtue of de La Chapelle teaching the “best S/I” algorithm, de La Chapelle is teaching a particular way to employ a “best capacity” algorithm or “best quality” algorithm for BTS selection in handoff. Moreover, as noted above, de La Chapelle specifically discusses the focus on capacity in its

background section. Ex. 1005, 1:47-2:21. de La Chapelle also specifically discloses conducting a handoff from one link to another when a second BTS is expected to provide a “higher quality communications link.” Ex. 1005, 4:20-27. A POSA understands the term “quality” in wireless communication to mean colloquially, how “clean” or clear a signal is. This cleanliness or clarity is directly related to signal strength, interference, and noise and is also very well known to a POSA. The higher quality link in this regard, would be understood by a POSA to have a better combination of signal strength, interference and/or noise, and therefore also correspondingly higher capacity. Notably, the ‘600 patent does not expressly teach any formula or specific method for calculating a capacity estimate using a signal-to-noise ratio. To the contrary, the only detail provided for forward link capacity seems to be the provision of an exemplary system to collect and calculate the capacity. Ex. 1001, 8:46-9:56. Moreover, this section extols the virtue of a simple approach to estimating SINR based on noise plus interference measurements and power settings. Ex. 1001, 9:14-16. The first forward-link user capacity estimate of claim 1 would therefore be understood by a POSA to mean nothing more than a quality estimate based on signal to interference ratio and/or SNR, both of which are clearly disclosed by de La Chapelle.

50. De La Chapelle also teaches a processor to “calculate a forward-link user capacity matrix using the first forward-link user capacity estimate and the

second forward-link user capacity estimate.” Ex. 1005, 4:11-31. de La Chapelle describes a full process of handover involving “determining when a second BTS becomes available that is expected to provide a higher quality communications link with the terrestrial cellular network” (see Ex. 1005, 4:20-22), which a POSA understands to necessarily include a comparison of quality related parameters between two BTSs. The quality related parameters (e.g., signal strength, interference and noise) must be stored in a computer for comparison of the candidate BTSs for the forward link. This necessity for storage thereby inherently creates a matrix of parameters that can be compared. In this regard, FIG. 5 of the ‘600 patent (reproduced below for convenience) illustrates an example of the forward-link user capacity matrix.



It is evident from the depiction of FIG. 5 that the matrix of the ‘600 patent is indeed merely a collection of data in a common tabular form of columns and rows that is representative of how such data is stored in a computer conventionally to permit comparisons and/or decisions to be made with respect to the data of the matrix. For

the quality related parameters of de La Chapelle to be compared for its stated purpose of determining when a higher quality communications link is available, the computing device of de La Chapelle (i.e., the antenna controller **24**) would inherently employ a matrix of the quality related parameters in order to perform the task. As noted above, signal strength, interference and/or noise measurements or estimates are all expressly described as being made by de La Chapelle (see Ex 1005, 16:43-50, 9:16-21, and 17:48-53, respectively). The express description in de La Chapelle of determining when a higher quality communications link becomes available is therefore inherently performed using a matrix involving the two compared forward link collections of parameters that indicate quality (i.e., signal strength, interference and/or noise), which parameters are also directly related to channel capacity for reasons noted above, and easily substituted for or interchangeable in this context by a POSA.

51. De La Chapelle also discloses that “the forward-link user capacity matrix is utilized to select communication channels to utilize for transmissions between a plurality of ground stations disposed on the ground and the airborne aircraft.” Ex. 1005, 4:11-31. As noted above, de La Chapelle describes a full process of handover involving “determining when a second BTS becomes available that is expected to provide a higher quality communications link with the terrestrial cellular network” (see Ex. 1005, 4:20-22), which a POSA understands to necessarily include

a comparison of quality related parameters between two BTSs in the inherently stored user capacity matrix described above. In particular, the quality related parameters (e.g., signal strength, interference and noise) that are necessarily stored in a computer for comparison of the candidate BTSs for the forward link inherently define a matrix of parameters to permit the comparison. As noted above, signal strength, interference and/or noise measurements are all expressly described as being made by de La Chapelle (see Ex 1005, 16:43-50, 9:16-21, and 17:48-53, respectively). The express description in de La Chapelle of determining when a higher quality communications link becomes available inherently involves using a matrix involving the two compared forward link collections of parameters that indicate quality (i.e., signal strength, interference and/or noise), which parameters are also directly related to channel capacity, and easily substituted for or interchangeable in this context by a POSA.

52. De La Chapelle therefore expressly describes a handoff involving candidate forward link BTSs in a way that a POSA would understand to be merely restated in what can only generously be called different terms, but more fairly described as merely pedantic terms in claim 1. Thus, a POSA would easily appreciate the descriptions of de La Chapelle to be equivalent to that which is recited in claim 1. In this regard, claim 1 merely describes a conventional handoff in terms that are understood to be the same by a POSA in de La Chapelle, even though they may

appear to be different given only a cursory read. Parameters of candidate channels are compared to determine when to conduct the handoff using a common decision tool (i.e., a decision matrix) for common computers. To the extent any distinction were to be maintained, the distinction would nevertheless be insubstantial and define only a gap that would be obvious to traverse for a POSA. There would be no unexpected results, and the motivation is clear to use easily and well known substitutions of quality related parameters in comparison to obtain the most reliable communication links at all times.

53. With respect to claim 2, de La Chapelle teaches that “the first communication channel comprises a first center frequency and a first bandwidth, wherein the second communication channel comprises a second center frequency and a second bandwidth, and wherein the first communication channel does not overlap the second communication channel.” Ex 1005, 5:55-61 and 16:34-36. In this regard, de La Chapelle indicates that the communication links involve various RF frequency bands, each of which bands inherently has a center frequency and corresponding width. Moreover, a POSA clearly understands that channels must not interfere with each other, and therefore should not overlap. Moreover, de La Chapelle expressly notes that the beamformer includes a plurality of “distinct channels” (see Ex. 1005, 10:37-40), which a POSA would clearly understand to be non-overlapping.

54. With respect to claim 3, de La Chapelle teaches that “the processor executable instructions, when executed by the computer processor, cause the computer processor to: command the directional antenna and the transceiver to measure a short-term average of the first signal-to-noise ratio of the first communication channel.” Ex. 1005, 8:63 – 9:4, 17:48-53, and 9:13-21. This is effectively a restatement of one of the earlier recited passages of claim 1 (see ¶¶45 and 46 above) while incorporating short-term averaging for the signal-to-noise ratio involved. Thus, descriptions above regarding ¶¶45 and 46 apply except perhaps in relation to short-term averaging. Notably, the ‘600 patent does not provide any definition for what constitutes a “short-term” time frame. Thus, any averaging over a reasonably short time period would constitute a short-term average in the same terms provided by claim 3. Meanwhile, de La Chapelle describes real time performance, which is necessarily short-term, involving calculating the S/I ratio. This demonstrates a variable time frame for measurement, where the interference in the denominator is an “aggregate interference” that is aggregated over a selected time period (e.g., a short time suitable for real time application) among the variable time frames available to effectively define a short-term average. Ex. 1005, 9:13-21. Any suitable time frame that is usable in a real time context explained by de La Chapelle would be understood by a POSA to provide a short term averaging function for the performance of the ratio calculation.

55. de La Chapelle further discloses a processor to “command the directional antenna and the transceiver to measure a short-term average of the second signal-to-noise ratio of the second communication channel.” Ex. 1005, 8:63 – 9:4, 17:48-53, and 9:13-21. This is effectively a restatement of one of the earlier recited passages of claim 1 (see ¶47 above) while incorporating short-term averaging for the signal-to-noise ratio involved discussed in ¶54 above. Thus, descriptions above regarding ¶¶47 and 54 apply here as well and are incorporated by reference, and a POSA would appreciate this feature of claim 3 to be disclosed by de La Chapelle.

56. De La Chapelle also discloses “calculate the first forward-link user capacity estimate using the short-term average of the first signal-to-noise ratio of the first communication channel.” Ex. 1005, 8:63 – 9:4, 17:48-53, and 9:13-21. This is effectively a restatement of one of the earlier recited passages of claim 1 (see ¶48 above) while incorporating short-term averaging for the signal-to-noise ratio involved discussed in ¶54 above. Thus, descriptions above regarding ¶¶48 and 54 apply here as well and are incorporated by reference, and a POSA would appreciate this feature of claim 3 to be disclosed by de La Chapelle.

57. De La Chapelle also teaches to “calculate the second forward-link user capacity estimate using the short-term average of the second signal-to-noise ratio of the second communication channel.” Ex. 1005, 8:63 – 9:4, 17:48-53, and 9:13-21. This is effectively a restatement of one of the earlier recited passages of claim 1 (see

¶49 above) while incorporating short-term averaging for the signal-to-noise ratio involved discussed in ¶54 above. Thus, descriptions above regarding ¶¶49 and 54 apply here as well and are incorporated by reference, and a POSA would appreciate this feature of claim 3 to be disclosed by de La Chapelle.

58. With respect to claim 4, de La Chapelle teaches that “the processor executable instructions, when executed by the computer processor, cause the computer processor to: command the directional antenna and the transceiver to measure a long-term average of the first signal-to-noise ratio of the first communication channel.” Ex. 1005, 8:63-9:4, 17:48-53, and 9:13-21. This is effectively a restatement of one of the earlier recited passages of claim 1 (see ¶¶45 and 46 above) while incorporating long-term averaging for the signal-to-noise ratio involved. Thus, descriptions above regarding ¶¶45 and 46 apply except perhaps in relation to long-term averaging. Notably, the ‘600 patent does not provide any definition for what constitutes a “long-term” time frame. Thus, any averaging over a reasonably long time period would constitute a long-term average in the same terms provided by claim 4. Meanwhile, de La Chapelle describes a repeated cycle on the order every 30 seconds involving calculating the S/I ratio. Ex. 1005, 9:13-21. This demonstrates a variable time frame for measurement, where the interference in the denominator is an “aggregate interference” that is aggregated over a selected time period (e.g., 30 seconds) among the variable time frames available to

effectively define an averaging function. The time period of 30 seconds, or anything on the order of 30 seconds would be understood by a POSA to provide a long term averaging function for the performance of the ratio calculation.

59. De La Chapelle further discloses “command the directional antenna and the transceiver to measure a long-term average of the second signal-to-noise ratio of the second communication channel.” Ex. 1005, 8:63 – 9:4, 17:48-53, and 9:13-21. This is effectively a restatement of one of the earlier recited passages of claim 1 (see ¶47 above) while incorporating long-term averaging for the signal-to-noise ratio involved discussed in ¶58 above. Thus, descriptions above regarding ¶¶47 and 58 apply here as well and are incorporated by reference, and a POSA would appreciate this feature of claim 4 to be disclosed by de La Chapelle.

60. De La Chapelle also discloses “calculate the first forward-link user capacity estimate using the long-term average of the first signal-to-noise ratio of the first communication channel.” Ex. 1005, 8:63 – 9:4, 17:48-53, and 9:13-21. This is effectively a restatement of one of the earlier recited passages of claim 1 (see ¶48 above) while incorporating long-term averaging for the signal-to-noise ratio involved discussed in ¶58 above. Thus, descriptions above regarding ¶¶48 and 58 apply here as well and are incorporated by reference, and a POSA would appreciate this feature of claim 4 to be disclosed by de La Chapelle.

61. De La Chapelle also teaches to “calculate the second forward-link user capacity estimate using the long-term average of the second signal-to-noise ratio of the second communication channel.” Ex. 1005, 8:63 – 9:4, 17:48-53, and 9:13-21. This is effectively a restatement of one of the earlier recited passages of claim 1 (see ¶49 above) while incorporating long-term averaging for the signal-to-noise ratio involved discussed in ¶58 above. Thus, descriptions above regarding ¶¶49 and 58 apply here as well and are incorporated by reference, and a POSA would appreciate this feature of claim 4 to be disclosed by de La Chapelle.

62. With respect to claim 6, de La Chapelle teaches “additional processor executable instructions that when executed by the computer processor cause the computer processor to: command the directional antenna and the transceiver to measure a third signal-to-noise ratio of a third communication channel corresponding to a third location on the ground, the third communication channel configured to support transmissions to/from the airborne aircraft.” In particular, de La Chapelle discusses identifying which BTSs are above the horizon and visible, and then calculating the S/I ratio for each visible BTS. Ex. 1005, 9:13-21. Accordingly, de La Chapelle clearly contemplates the comparisons discussed above to be extended beyond two BTSs to at least a third BTS. Moreover, this requires the operations of commanding the directional antenna with respect to measurement discussed above in connection with ¶¶45 and 46 (which are incorporated herein by

reference) to be repeated for a third communication channel corresponding to a third location on the ground.

63. De La Chapelle also discloses “calculate a third forward-link user capacity estimate using the third signal-to-noise ratio of the third communication channel.” In this regard, de La Chapelle discusses identifying which BTSs are above the horizon and visible, and then calculating the S/I ratio for each visible BTS. Ex. 1005, 9:13-21. Accordingly, de La Chapelle clearly contemplates the comparisons discussed above to be extended beyond two BTSs to at least a third BTS. Moreover, this requires the operation of calculating a capacity estimate discussed above in connection with ¶48, which discussion is incorporated herein by reference, to be repeated for a third communication channel corresponding to a third location on the ground.

64. De La Chapelle also discloses “calculate the forward-link user capacity matrix using the first forward-link user capacity estimate, the second forward-link user capacity estimate, and the third forward-link user capacity estimate.” Ex. 1005, 9:13-21. In this regard, de La Chapelle discusses identifying which BTSs are above the horizon and visible, and then calculating the S/I ratio for each visible BTS. Accordingly, de La Chapelle clearly contemplates the comparisons discussed above to be extended beyond two BTSs to at least a third BTS. Moreover, this requires the operation of calculating the forward-link user capacity matrix discussed above in

connection with ¶50, which discussion is incorporated herein by reference, to be expanded to include a third column of the matrix thereby defining a third forward-link user capacity matrix. Accordingly, all of the features of claim 6 are disclosed in de La Chapelle, and claims 6 is anticipated by de La Chapelle.

65. The preamble of claim 13 recites “a computer system comprising one or more processors and/or transceivers” that carry out various further claimed elements. To the extent the preamble of claim 1 is deemed a limitation, de La Chapelle discloses these features because de La Chapelle discloses “a plurality of base transceiver stations (BTSs)” and that each BTS has “a radio transceiver.” Ex. 1005, 3:29-37.

66. De La Chapelle further teaches that the processors and/or transceivers are “configured to: retrieve at least one of: (i) a forward-link user capacity matrix comprising a plurality of forward-link user capacity estimates each associated with a respective signal-to-noise ratio measurement of a respective communication channel corresponding to a respective location on the ground. Ex. 1005, 4:11-31. de La Chapelle describes a full process of handover involving “determining when a second BTS becomes available that is expected to provide a higher quality communications link with the terrestrial cellular network” (see Ex. 1005, 4:20-22), which a POSA understands to necessarily include a comparison of quality related parameters between two BTSs. The quality related parameters (e.g., signal strength,

interference and noise) must be stored in a computer for comparison of the candidate BTSs for the forward link. This necessity for storage thereby inherently creates a matrix of parameters that can be compared. As noted above, signal strength, interference and/or noise measurements or estimates are all expressly described as being made by de La Chapelle (see Ex 1005, 16:43-50, 9:16-21, and 17:48-53, respectively). The express description in de La Chapelle of determining when a higher quality communications link becomes available is therefore inherently performed using a matrix involving the two compared forward link collections of parameters that indicate quality (i.e., signal strength, interference and/or noise), which parameters are also directly related to channel capacity (*see* ¶48), and easily substituted for or interchangeable in this context by a POSA.

67. Claim 13 recites that the processors and/or transceivers are alternatively configured to: retrieve “a return-link user capacity matrix comprising a plurality of return-link user capacity estimates each associated with a respective noise power level of a respective communication channel corresponding to a respective azimuth and a respective elevation from a current location of an airborne aircraft.” Notably, the recitation of this phrase as an alternative to the prior one means that anticipation is achieved without expressly showing this feature since the forward-link user capacity matrix is already shown by de La Chapelle in the manner recited in claim 13. Nevertheless, it is noteworthy that it would be well within the capability of a

POSA to perform the same operations described above for the forward-link on the return-link. Thus, this feature is at least readily apparent to be an obvious modification starting from de La Chapelle. Moreover, the motivation to make any such modification would be to advantageously determine serving cells for either forward or return links.

68. De La Chapelle also discloses to “determine, using at least one of (i) the forward-link user capacity matrix or (ii) the return-link user capacity matrix, a candidate serving cell that is disposed on the ground.” Ex. 1005, 4:11-31. As noted above, de La Chapelle describes a full process of handover involving “determining when a second BTS becomes available that is expected to provide a higher quality communications link with the terrestrial cellular network” (see Ex. 1005, 4:20-22), which a POSA understands to necessarily include a comparison of quality related parameters between two BTSs in the inherently stored user capacity matrix described above. In particular, the quality related parameters (e.g., signal strength, interference and noise) that are necessarily stored in a computer for comparison of the candidate BTSs for the forward link inherently define a matrix of parameters to permit the comparison. As noted above, signal strength, interference and/or noise measurements are all expressly described as being made by de La Chapelle (see Ex 1005, 16:43-50, 9:16-21, and 17:48-53, respectively). The express description in de La Chapelle of determining when a higher quality communications link becomes

available inherently involves using a matrix involving the two compared forward link collections of parameters that indicate quality (i.e., signal strength, interference and/or noise), which parameters are also directly related to channel capacity, and easily substituted for or interchangeable in this context by a POSA. For anticipation, claim 13 only requires that the forward link user capacity matrix be determined, and a POSA would understand that it is determined as part of the handoff process noted above. Nevertheless, the same process being performed for the reverse link would clearly also be within the capability of a POSA, and obvious in any case.

69. de La Chapelle also discloses “command a directional antenna and a particular transceiver to transmit or receive data between the airborne aircraft and the candidate serving cell. Ex. 1005, 4:23-31. This feature that concludes claim 13 merely describes the completion of a handoff of the aircraft to the candidate cell selected to maintain the communication link after completion of the handoff. de La Chapelle describes this feature in many places as it describes the different handoff strategies it teaches including explicit disclosure at 4:23-31 of Ex. 1005.

70. With respect to claim 14, de La Chapelle teaches that “the one or more processors and/or transceivers are configured to: retrieve the at least one of (i) the forward-link user capacity matrix or (ii) the return-link user capacity matrix from an air-to-ground network controller disposed on the ground and in communicative with a plurality of serving cells, the plurality of serving cells including the candidate

serving cell.” Notably, this passage again includes alternative language, and therefore anticipation only requires that one of the alternative passages be expressly or inherently disclosed in de La Chapelle. The first passage (i.e., relating to the forward-link user capacity matrix) is inherently disclosed by de La Chapelle. Ex. 1005, 4:11-31. In this regard, de La Chapelle describes a full process of handover involving “determining when a second BTS becomes available that is expected to provide a higher quality communications link with the terrestrial cellular network” (see Ex. 1005, 4:20-22), which a POSA understands to necessarily include a comparison of quality related parameters between two BTSs. The quality related parameters (e.g., signal strength, interference and noise) must be stored in a computer for comparison of the candidate BTSs for the forward link. This necessity for storage thereby inherently creates a matrix of parameters that can be compared, as described above. As also noted above, signal strength, interference and/or noise measurements or estimates are all expressly described as being made by de La Chapelle (see Ex 1005, 16:43-50, 9:16-21, and 17:48-53, respectively). The express description in de La Chapelle of determining when a higher quality communications link becomes available is therefore inherently performed using a matrix involving the two compared forward link collections of parameters that indicate quality (i.e., signal strength, interference and/or noise), which parameters are also directly related to channel capacity, and easily substituted for or interchangeable in this context by

a POSA. That matrix must be retrieved by the antenna controller **24** to permit the comparison. Thus, all of the features of claim 14 are expressly or inherently shown in de La Chapelle, and claim 14 is anticipated thereby.

71. With respect to claim 15, de La Chapelle teaches that “the candidate serving cell comprises a respective noise power level above a threshold.” Ex. 1005, 4:11-31 and 17:51-53. In this regard, de La Chapelle describes the handoff to the candidate cell based on higher quality, which directly takes accounting of noise power levels, as noted above at ¶48. de La Chapelle further expressly states that noise power levels are considered relative to “a predetermined threshold” in relation to this handoff process. Thus, a POSA would understand that all of the features of claim 15 are disclosed by de La Chapelle, and therefore also anticipated thereby.

72. With respect to claim 17, de La Chapelle teaches that “the forward-link user capacity matrix indicates a lower signal-to-noise ratio associated with the candidate serving cell than an alternative serving cell, and wherein the alternative serving cell is located at a distance from the airborne aircraft that is greater than a distance from the airborne aircraft of the candidate serving cell.” Ex. 1005, 4:11-31, 8:5-56, 8:57-9:27 and 17:51-53. The use of the antenna controller **24** to inherently employ a user capacity matrix for the full handoff described in de La Chapelle is described in detail above in ¶50 and incorporated by reference in this section. Claim 17 further adds the possibility that a more distant cell could be picked for handoff

among two candidate cells being considered for such handoff. However, this is a very conventional and well known result of employing handoffs in many contexts where signal quality (or S/I, SNR, etc.) is used as the basis for conducting handoffs instead of merely relying on distance. Moreover, de La Chapelle expressly describes the very basic “nearest BTS” algorithm as one option (see Ex. 1005, 8:5-56). However, de La Chapelle further expressly explains how real world interference renders the “nearest BTS” algorithm inferior in some contexts, and therefore further explains that using the best S/I ratio or using SNR can avoid this problem (see Ex. 1005, 8:57-9:27 and 17:51-53). Based on these disclosures a POSA would appreciate that claim 17 is also anticipated by de La Chapelle.

73. With respect to claim 19, de La Chapelle teaches that “the threshold comprises at least one of: a short-term noise threshold that enables a serving cell selection decision among a plurality of serving cells; or a long-term noise threshold that enables a future serving cell restriction decision.” Ex. 1005, 4:11-31, 8:14-19, 8:57-59 and 17:51-53. The correspondence of de La Chapelle to the application of a threshold for noise values is discussed above in relation to claim 15 at ¶70, and is incorporated herein also in this section. Claim 19 only adds the possibility that the noise thresholds can be either “short-term” or “long-term.” de La Chapelle discusses a variable time frame for operation, “which could typically be every 30 seconds or so.” This acknowledgement of variable timeframes would be understood by a POSA

to cover both short and long term time periods, particularly in a case where, as is the case here, no standard is provided for what constitutes short or long time frames. de La Chapelle also routinely discusses the real time applicability of its processes, which necessarily implies a short-term application of a noise threshold, or any other parameter involved in its comparisons and calculations. Moreover, since the short and long-term options are described in the alternative in claim 19, only one is required for anticipation. Thus, claim 19 is anticipated also by de La Chapelle.

C. GROUND 2: Claims 1-4, 6-15, and 17-19 are obvious in view of de La Chapelle and Jalali.

74. The combination of de La Chapelle and Jalali teaches each and every limitation of claims 1-4, 6-15, and 17-19 and therefore renders claims 1-4, 6-15, and 17-19 obvious. The preamble of claim 1 recites “a non-transitory computer readable medium comprising processor executable instructions that when executed by a computer processor disposed within an airborne aircraft cause the computer processor.” To the extent the preamble of claim 1 is deemed a limitation, de La Chapelle inherently teaches this feature by virtue of its disclosure of the antenna controller **24** and look-up table **26**. Ex. 1005, 5:48-51. However, to the extent de La Chapelle does not explicitly provide disclosure meeting this feature, Jalali expressly does via disclosure of a processor and memory on an aircraft. Ex. 1006, [0011].

75. With respect to the recited elements of claim 1, de La Chapelle teaches “command a directional antenna installed on the aircraft and a transceiver disposed

within the aircraft to measure a first signal-to-noise ratio of a first communication channel corresponding to a first location on the ground, the first communication channel configured to support transmissions to/from the airborne aircraft.” Ex. 1005, 5:62-6:4, 8:63-9:4 and 17:48-53. In particular, de La Chapelle discloses a beam forming network **28**, which controls an antenna system 32 to create a single beam that a POSA would clearly understand to correspond to a directional antenna and corresponding transceiver, and further teaches measurement of SNR for channels as further explained in ¶46 above, which is hereby incorporated in this section as well. To the extent any deficiency of de La Chapelle’s disclosure is argued relative to this feature, Jalali expressly teaches to “command a directional antenna installed on the aircraft and a transceiver disposed within the aircraft (see Ex. 1006, [0028]) to measure a first signal-to-noise ratio of a first communication channel corresponding to a first location on the ground (see Ex. 1006, [0059]), the first communication channel configured to support transmissions to/from the airborne aircraft (see Ex. 1006, [0061])”. In this regard, Jalali expressly describes both the aircraft and ground station adjusting their beams to increase or maximize Signal to Noise Plus Interference (SINR) received at the aircraft or ground station at [0059]. The measuring of SINR inherently includes the measurement of signal and noise, and placing such values in ratio. A POSA understands that the inclusion of interference in the ratio to the noise in the denominator simply involves adding another parameter

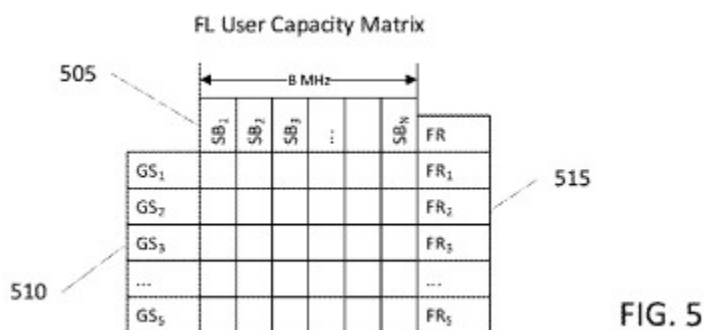
(i.e., interference), which in some cases may be zero, and therefore reduces to signal-to-noise ratio (SNR). Thus, measuring SINR necessarily includes measuring SNR, and also measuring interference, if it exists. Nevertheless, the measurement of SNR is expressly taught by de La Chapelle in connection with handoff at Ex. 1005, 17:48-53 and a POSA would find it obvious to substitute the SNR measurement of de La Chapelle for the SINR measurement of Jalali since both are used in the same conventional handoff procedure of directional antenna beams as common alternatives that do not produce any unexpected results when substituted for each other.

76. De La Chapelle also teaches “command the directional antenna and the transceiver to measure a second signal-to-noise ratio of a second communication channel corresponding to a second location on the ground, the second communication channel configured to support transmissions to/from the airborne aircraft.” Ex. 1005, 8:63 – 9:4 and 17:48-53. The discussion of de La Chapelle’s disclosure in this regard is provided in ¶47 above, and is hereby incorporated in this section as well. To the extent any deficiency of de La Chapelle’s disclosure is argued relative to this feature, Jalali also teaches to “command the directional antenna and the transceiver to measure a second signal-to-noise ratio (see Ex. 1006, [0059]) of a second communication channel corresponding to a second location on the ground, the second communication channel configured to support transmissions to/from the

airborne aircraft.” Ex. 1006, [0062]. In this regard, as noted above, measuring SINR, which is expressly described by Jalali, necessarily includes measuring SNR. Moreover, Jalali expressly notes that such measurements are performed for two grounds stations. A POSA would also consider the use of SNR and SINR as disclosed in de La Chapelle and Jalali to be obvious alternatives of one another for use in the same process described in each reference and in the ‘600 patent.

77. De La Chapelle also teaches “calculate a first forward-link user capacity estimate using the first signal-to-noise ratio of the first communication channel.” Ex. 1005, 1:52-2:19 and 8:63 – 9:4. The discussion of de La Chapelle’s disclosure in this regard is provided in ¶48 above, and is hereby incorporated in this section as well. To the extent any deficiency of de La Chapelle’s disclosure is argued relative to this feature, Jalali also discloses “calculate a first forward-link user capacity estimate using the first signal-to-noise ratio of the first communication channel.” Ex. 1006, [0069] and [0070]. In this regard, Jalali describes conventional handoff means in connection with a network that communicates with aircraft using beams (see [0069]) that involves comparing a signal strength of pilot signals from respective different ground base stations (see [0070]). A POSA understands the pilot signals to be synonymous with control channels, which is a specific type of communication channel. Control channels, like any communication channel, necessarily and inherently have a bandwidth defined by the frequency bounds that

possess particular signal power levels above a predefined threshold. Jalali does not use the word “capacity” in describing any aspect of the characteristics of the control channels mentioned in these paragraphs. However, the ‘600 patent also does not specifically define the term “capacity.” Nevertheless, a POSA reviewing in particular FIG. 5 of the ‘600 patent (reproduced below for convenience), can determine from the illustrated example of the forward-link user capacity matrix, some characteristics of channels or links that may be considered to correlate to or define “capacity.”



In this regard, it is evident from the depiction of FIG. 5 and its corresponding description (see Ex. 1001, 9:37-56) that “capacity” is effectively an estimate of an expected data rate for each ground station. For example, the ‘600 patent explains that “the matrix **500** depicts the case where expected data rate for S ground stations (e.g. GS1, GS2, GSS) **510** is characterized.” Ex. 1001, 9:45-47. The ‘600 patent also explains that “[u]sing the SINR at each sub-band and the spectral efficiency vs SINR for the air interface technology in use the UE can estimate the expected data rate for

each sub-band and the total expected data rate for each GS (e.g. FR1, FR2, FRS) **515.**” Ex. 1001, 9:47-51. Thus, while not specifically defined, a POSA would understand the ‘600 patent as relating the term “capacity” to various other terms that are very well known by a POSA including “quality,” and “expected data rate,” and various other terms that simply imply that one beam will provide a “better” communications link under prevailing conditions than another. Based on these explanations, a POSA would understand that the term “capacity,” as used in the ‘600 patent can be understood to be described also by, or be a synonym of, “expected data rate.” Accordingly, the “first forward-link user capacity estimate” is an estimate of the expected data rate provided by a ground base station whose channel characteristics are being evaluated. Furthermore, this feature of claim 1 dictates that the capacity estimate, i.e., the expected data rate, is determined based on SNR. Jalali is expressly concerned with providing a high data rate to aircraft as is clearly evident from the title of the published application and express statements at [0025] of Jalali. Moreover, the handoff means described by Jalali would be understood by a POSA as being aimed at being conducted with the goal of preserving a high data rate. In short, both de La Chapelle and Jalali describe the use of SNR or SINR or other similar parameters all well known by a POSA to be indicative of higher channel capacity, higher quality, or better communication link performance as a basis for determining when to conduct a handoff. The measurement of SINR or SNR as a

baseline parameter taught by both Jalali and de La Chapelle, which is then used to estimate data rate (Jalali) or quality (de La Chapelle). The estimate of quality or data rate must necessarily then be stored to enable a computer to compare the values, and a POSA would clearly understand that any data structure, table or other comparison tool involving a list of stored parameters is effectively a matrix for the parameter or parameters being compared. Thus, a POSA would find it obvious to combine the teachings of Jalali and de La Chapelle because doing so would merely combine known elements to yield predictable results, and would be advantageous in improving communication channel performance.

78. De La Chapelle also teaches “calculate a second forward-link user capacity estimate using the second signal-to-noise ratio of the second communication channel.” Ex. 1005, 1:52-2:19 and 8:63-9:4. The discussion of de La Chapelle’s disclosure in this regard is provided in ¶49 above, and is hereby incorporated in this section as well. To the extent any deficiency of de La Chapelle’s disclosure is argued relative to this feature, Jalali also discloses “calculate a second forward-link user capacity estimate using the second signal-to-noise ratio of the second communication channel.” Ex. 1006, [0069] and [0070]. As noted above, Jalali teaches calculation of estimates of parameters that are synonyms of “user capacity” by virtue of its measurement of parameters aimed at maximizing data rate across a handoff using SINR, which is an obvious substitute for SNR that is

specifically described in de La Chapelle. Jalali further explicitly uses such parameters in relation to a “second pilot signal” as described in [0070]. This feature would be considered obvious by a POSA in consideration of the teachings of both Jalali and de La Chapelle, which use obvious alternative parameters for the basis of conducting a beam handoff.

79. The feature “calculate a forward-link user capacity matrix using the first forward-link user capacity estimate and the second forward-link user capacity estimate” is taught or suggested by de La Chapelle. Ex. 1005, 4:11-31. In this regard, as noted above, de La Chapelle describes a full process of handover involving “determining when a second BTS becomes available that is expected to provide a higher quality communications link with the terrestrial cellular network” (see Ex. 1005, 4:20-22), which a POSA understands to necessarily include a comparison of quality related parameters between two BTSs as described at ¶48 above. The term “quality” in this context is used as an obvious substitute or synonym for the term “capacity” and a decision matrix on parameters used to pick the beam or link with the best capacity or quality would both be seen as obvious variants for handoff decision making as described above at ¶50, which is incorporated here also. To the extent any deficiency of de La Chapelle’s disclosure is argued relative to this feature, Jalali also discloses “calculate a forward-link user capacity matrix using the first forward-link user capacity estimate and the second forward-link user capacity

estimate.” Ex. 1006, [0034]. In this regard, Jalali describes a search for pilot signals that a POSA would clearly understand to be control channels that are used to evaluate different potential communication links on either side of a potential handoff (which is expressly the same context in which this feature of claim 1 is being described). This paragraph of Jalali then describes how the received pilot signals are “ranked to determine whether or not the aircraft modem should handoff to another ground base station.” Jalali mentions the station selected as being a station from which a stronger pilot signal is received as one example of a parameter that could be used in a decision matrix that must inherently be used in any computer that compares parameters to make a decision. As noted above, computers cannot make analog comparisons, and must instead store values in data structures (e.g., tables or matrices) for comparison of the values. The use of a matrix is an inherent feature of computer based comparison or decision tools based on lists of measured parameters. The only potential difference between claim 1 and Jalali is the parameter in the matrix, which is used to make the handoff decision. Both Jalali and de La Chapelle teach using various parameters as the basis for a handoff decision using a computer, which inherently does so with a matrix of stored parameter values. Moreover, both Jalali and de La Chapelle measure the same or similar parameters (e.g., SNR and SINR) that are the basis for values that can ultimately be used for comparison to decide when to handoff for the same reasons identified in the ‘600 patent. Whereas

claim 1 merely uses a different word (i.e., “user capacity matrix”) for what is compared than that which is expressly described in both Jalali and de La Chapelle, the terms used instead in Jalali and Chapelle are essentially equivalent or in any case obvious variants to a POSA.

80. The final feature of claim 1, i.e., that “the forward-link user capacity matrix is utilized to select communication channels to utilize for transmissions between a plurality of ground stations disposed on the ground and the airborne aircraft,” is disclosed in de La Chapelle (see Ex. 1005, 4:11-31). However, such feature is also disclosed by Jalali. Ex. 1006, [0025], [0034], [0059] and [0060]. In this regard, the ranking of pilot signals noted above represents the use of a decision matrix for parameters indicative of links having improved performance, which is ultimately estimated based on SINR (which is in obvious alternative for SNR expressly disclosed in de La Chapelle). Jalali discusses the reporting of SINR measurements and adjustment of beams based on SINR feedback to pick an “improved or optimal beam” if the beams provide “improved performance.” Ex. 1006, [0059]. Given the title of Jalali and various other explicit descriptions of the goal of having high data rate links (see Ex. 1006, [0025]), a POSA would clearly understand that Jalali teaches building a decision matrix for parameters indicative of high data rate from measured SINR. Calling the matrix a “user capacity matrix” is merely a choice of descriptive words that mean the same thing already described in

Jalali, or at least entirely obvious to a POSA based on the descriptions of Jalali and de La Chapelle. A POSA would be motivated to combine Jalali and de La Chapelle since they each provide similar solutions to the same problem, and would have had a reasonable expectation of success since there are a limited number of parameters of the directional beams that can be measured and estimated for consideration and comparison in making handoff decisions. The resulting combination also combines known prior art elements according to known methods to yield nothing more than predictable results.

81. With respect to claim 2, both de La Chapelle and Jalali teach that “the first communication channel comprises a first center frequency and a first bandwidth, wherein the second communication channel comprises a second center frequency and a second bandwidth, and wherein the first communication channel does not overlap the second communication channel.” Ex 1005, 5:55-61 and 16:34-36, and Ex. 1006, [0046], [0047], [0052] and [0053]. In this regard, de La Chapelle indicates that the communication links involve various RF frequency bands, each of which bands inherently has a center frequency and corresponding width. Moreover, a POSA clearly understands that channels must not interfere with each other, and therefore should not overlap. Moreover, de La Chapelle expressly notes that the beamformer includes a plurality of “distinct channels” (see Ex. 1005, 10:37-40), which a POSA would clearly understand to be non-overlapping. Jalali discusses

various narrow bandwidths or wide bandwidth that can be used to convert into baseband for analysis. Claim 2 effectively merely recites immutable characteristics of communication channels. Nevertheless, both Jalali and de La Chapelle disclose the same immutable characteristics of communication channels, and there is nothing in claim 2 that would not be obvious to a POSA.

82. With respect to claim 3, both de La Chapelle and Jalali teaches that “the processor executable instructions, when executed by the computer processor, cause the computer processor to: command the directional antenna and the transceiver to measure a short-term average of the first signal-to-noise ratio of the first communication channel.” Ex. 1005, 8:63-9:4, 17:48-53, and 9:13-21, and Ex. 1006, [0057], [0059] and [0061]. As noted above in ¶54, which is incorporated herein, de La Chapelle discusses real time performance, which necessarily would involve short term averaging of the SNR. Jalali expressly describes consideration of sufficient time to enable detection of pilot signals at Ex. 1006, [0057]. The sufficient time could be guaranteed via having enough data for calculating a short-term average, which would be obvious to a POSA in view of the related descriptions of Jalali and de La Chapelle, particularly in the absence of any clear definition provided by the ‘600 patent. Moreover, any time period can be considered to be short or long dependent on perspective, and a POSA would choose the perspective best suited to achieving the goals of improving handoff performance, which are the clear goals of

both Jalali and de La Chapelle. Jalali also expressly describes the use of filtering and/or averaging with respect to measured parameters to account for variations. Ex. 1006, [0052] and [0057]. Accordingly, a POSA would easily appreciate that the benefits of averaging described in Jalali would yield predictable and desirable results either alone or when combined with the teachings of de La Chapelle in relation to the measured parameters to be compared to improve the performance of handoff.

83. Both Jalali and de La Chapelle further teach or suggest “command the directional antenna and the transceiver to measure a short-term average of the second signal-to-noise ratio of the second communication channel.” Ex. 1005, 8:63-9:4, 17:48-53, and 9:13-21, and Ex. 1006, [0057], [0059] and [0061]. The teachings of both Jalali and de La Chapelle discussed above relative to measuring a short-term average of SNR or SINR for a first communication channel of ¶82 also apply to a second communication channel, since both references clearly evaluate SNR and SINR of two channels for evaluating a handoff.

84. Both Jalali and de La Chapelle teach or suggest “calculate the first forward-link user capacity estimate using the short-term average of the first signal-to-noise ratio of the first communication channel.” Ex. 1005, 8:63-9:4, 17:48-53, and 9:13-21, and Ex. 1006, [0057], [0059] and [0061]. In this regard, the descriptions above in ¶77 regarding using SINR and SNR for capacity estimates for a first channel in relation to claim 1 also apply here and are incorporated herein. These

descriptions would obviously apply to any short-term averaging of the SNR or SINR measurements made as discussed above in ¶82.

85. Jalali and de La Chapelle also teach or suggest “calculate the second forward-link user capacity estimate using the short-term average of the second signal-to-noise ratio of the second communication channel.” In this regard, the descriptions above in ¶78 regarding using SINR and SNR for capacity estimates in relation to claim 1 for a second channel also apply here and are incorporated herein. These descriptions would obviously apply to any short-term averaging of the SNR or SINR measurements made as discussed above in ¶82.

86. With respect to claim 4, de La Chapelle and Jalali teach “the processor executable instructions, when executed by the computer processor, cause the computer processor to: command the directional antenna and the transceiver to measure a long-term average of the first signal-to-noise ratio of the first communication channel.” Ex. 1005, 8:63-9:4, 17:48-53, and 9:13-21, and Ex. 1006, [0057], [0059] and [0061]. As noted above in ¶58, which is incorporated herein, de La Chapelle discusses a repeated cycle on the order every 30 seconds involving calculating the S/I ratio. Ex. 1005, 9:13-21. This demonstrates a variable time frame for measurement, where the interference in the denominator is an “aggregate interference” that is aggregated over a selected time period (e.g., 30 seconds) among the variable time frames available to effectively average the value over the variable

time frame. The time period of 30 seconds, or anything on the order of 30 seconds would be understood by a POSA to provide a long term averaging function for the performance of the ratio calculation. Jalali expressly describes consideration of sufficient time to enable detection of pilot signals at [0057]. The sufficient time could be guaranteed via having enough data for calculating a long-term average, which would be obvious to a POSA in view of the related descriptions of Jalali and de La Chapelle, particularly in the absence of any clear definition of “long-term” provided by the ‘600 patent. Moreover, any time period can be considered to be short or long dependent on perspective, and a POSA would choose the perspective best suited to achieving the goals of improving handoff performance, which are the clear goals of both Jalali and de La Chapelle. Jalali also expressly describes the use of filtering and/or averaging with respect to measured parameters to account for variations. Ex. 1006, [0052] and [0057]. Accordingly, a POSA would easily appreciate that the benefits of averaging described in Jalali would yield predictable and desirable results either alone or when combined with the teachings of de La Chapelle in relation to the measured parameters to be compared to improve the performance of handoff.

87. Both Jalali and de La Chapelle further teach or suggest “command the directional antenna and the transceiver to measure a long-term average of the second signal-to-noise ratio of the second communication channel.” Ex. 1005, 8:63-9:4,

17:48-53, and 9:13-21, and Ex. 1006, [0057], [0059] and [0061]. The teachings of both Jalali and de La Chapelle discussed above relative to measuring a long-term average of SNR or SINR for a first communication channel of ¶86 also apply to a second communication channel, since both references clearly evaluate SNR and SINR of two channels for evaluating a handoff.

88. Both Jalali and de La Chapelle teach or suggest “calculate the first forward-link user capacity estimate using the long-term average of the first signal-to-noise ratio of the first communication channel.” Ex. 1005, 8:63-9:4, 17:48-53, and 9:13-21, and Ex. 1006, [0057], [0059] and [0061]. In this regard, the descriptions above in ¶77 regarding using SINR and SNR for capacity estimates for a first channel in relation to claim 1 also apply here and are incorporated herein. These descriptions would obviously apply to any long-term averaging of the SNR or SINR measurements made as discussed above in ¶82.

89. Jalali and de La Chapelle also teach or suggest “calculate the second forward-link user capacity estimate using the long-term average of the second signal-to-noise ratio of the second communication channel.” In this regard, the descriptions above in ¶78 regarding using SINR and SNR for capacity estimates in relation to claim 1 for a second channel also apply here and are incorporated herein. These descriptions would obviously apply to any long-term averaging of the SNR or SINR measurements made as discussed above in ¶82.

90. With respect to claim 6, de La Chapelle and Jalali teach an “additional processor executable instructions that when executed by the computer processor cause the computer processor to: command the directional antenna and the transceiver to measure a third signal-to-noise ratio of a third communication channel corresponding to a third location on the ground, the third communication channel configured to support transmissions to/from the airborne aircraft.” Ex. 1005, 9:13-21, and Ex. 1006, [0062]. The disclosure of de La Chapelle relevant to the additional processor of claim 6 is described in detail above at ¶62, which is incorporated herein as well. Meanwhile, Jalali discloses “at least one second pilot signal” in [0062], which clearly implies more than just two pilot signals, and the addition of a processor would be obvious if not already taught by de La Chapelle.

91. The combination of Jalali and de La Chapelle also teaches “calculate a third forward-link user capacity estimate using the third signal-to-noise ratio of the third communication channel.” Ex. 1005, 9:13-21, and Ex 1006, [0062] and [0070]. The disclosure of de La Chapelle regarding this feature is discussed above in ¶63, which is incorporated here as well. Meanwhile, Jalali’s description of more than two channels from ¶90 and calculating user capacity estimates for the forward-link at ¶77 demonstrate Jalali’s disclosure of using SINR to estimate improved data rate performance for a capacity estimate. The combination of Jalali and de La Chapelle discloses this feature in its entirety and would be obvious to a POSA.

92. The combination of Jalali and de La Chapelle also teaches “calculate the forward-link user capacity matrix using the first forward-link user capacity estimate, the second forward-link user capacity estimate, and the third forward-link user capacity estimate.” Ex. 1005, 9:13-21, and Ex. 1006, [0034], [0062] and [0070]. The disclosure of de La Chapelle regarding this feature is discussed above in ¶64, which is incorporated here as well. Meanwhile, Jalali’s description of more than two channels from ¶90 and calculating a capacity matrix for the forward-link at ¶79 demonstrate Jalali’s disclosure of using a decision matrix based on data rate or capacity for multiple signals. The combination of Jalali and de La Chapelle discloses this feature in its entirety and would be obvious to a POSA.

93. Jalali and de La Chapelle combine to teach or suggest each and every feature of claim 7. The preamble of claim 7 recites “a computer-implemented method, executed with a computer processor disposed within an air-to-ground communication ground station.” To the extent the preamble of claim 7 is deemed a limitation, de La Chapelle discloses these features because de La Chapelle discloses “an antenna controller **24** that is in communication with a base transceiver station (BTS) position look-up table **26**.” Ex. 1005, 5:48-51. A POSA would understand that it is inherent that the BTS look-up table is stored in a non-transitory computer readable medium, and that the antenna controller **24** inherently possesses a processor capable of executing instructions. Moreover, the antenna controller **24** is clearly

shown on the aircraft in FIG. 1. Jalali also discloses computer hardware by virtue of discussing a controller/processor **440** at the ground base station **102**. Ex. 1006, [0040].

94. Jalali and de La Chapelle also teach or suggest features of the method including “commanding, with the computer processor, a directional antenna installed at the ground station and a transceiver disposed within the ground station.” Whereas de La Chapelle discloses a beam forming network **28**, which controls an antenna system **32** to create a single beam that a POSA would clearly understand to correspond to a directional antenna and corresponding transceiver, the antenna controller **24** is disposed at an aircraft. Ex. 1005, 5:62-6:4. Nevertheless, Jalali discloses ground station antenna arrays and that directional beams are generated using a beam steering computer. Ex. 1006, [0043] and [0046]. A POSA would clearly appreciate that the nature of wireless communication between a ground station and aircraft requires a two way link, and to the extent beam forming is performed at either end involving a transceiver, its duplication at the other end would be an obvious modification as using a known technique to improve similar devices in the same way, and would in any case yield nothing more than predictable results.

95. The combination of Jalali and de La Chapelle further teaches the commanding of a directional antenna and transceiver “to measure a first noise power level of a first communication channel at a first elevation and a first azimuth from a

current position of the ground station.” In this regard, de La Chapelle discusses that a signal-to-noise ratio (SNR) is calculated for a first communication channel. Ex 1005, 17:48-53. The calculation of SNR necessarily requires measurement of a first noise power level. A POSA understands that both signal power and noise power must be measured and put in ratio to arrive at any calculation of SNR, the calculation of SNR inherently involves measurement of a noise power level. Moreover, since de La Chapelle is explicit in stating that such calculation is for signals received by a first communication lobe, a POSA would clearly understand that the signals are directional antenna signals that are inherently formed at a given elevation and azimuth, which directly correlate to the first azimuth and first elevation recited in claim 7. Jalali also further explicitly mentions that ground base stations are enabled to search at different elevations, and that communication between air and ground assets can be supported “at any azimuth angle.” Ex. 1006, [0030] and [0028]. Jalali also describes adjustment of beams to increase or maximize signal to noise plus interference (SINR). Ex. 1006, [0059]. Increasing or maximizing SINR necessarily requires measurement of noise power and thus Jalali necessarily requires measurement of a first noise power level. A POSA would clearly appreciate that the nature of wireless communication between a ground station and aircraft requires a two way link, and to the extent beam forming is performed at either end involving certain capabilities for communicating at various azimuths and elevation angles, its

duplication at the other end would be an obvious modification as using a known technique to improve similar devices in the same way, if not otherwise necessary, and would in any case yield nothing more than predictable results.

96. The combination of Jalali and de La Chapelle further discloses “the first communication channel configured to support transmissions between the ground station and airborne aircraft.” Both Jalali and de La Chapelle are explicitly focused on handoffs of a first communication channel between ground stations and airborne aircraft and a second communication channel, and thus replete with descriptions of this feature. Ex. 1005, 2:63-4:31 and Ex. 1006, [0008]-[0012].

97. The combination of Jalali and de La Chapelle further discloses “commanding, with the computer processor, the directional antenna and the transceiver to measure a second noise power level of a second communication channel at a second elevation and a second azimuth from the current position of the ground station, the second communication channel configured to support transmissions between the ground station and the airborne aircraft.” This feature differs from the prior feature only by virtue of the fact that it repeats the same activities discussed above in ¶¶95 and 96 for a second channel. Those descriptions are incorporated herein as well. Moreover, as noted above, both Jalali and de La Chapelle are explicitly focused on handoffs of a first communication channel between ground stations and airborne aircraft and a second communication channel,

and thus replete with descriptions of the repeat of measurements on both communication channels to permit comparison to enable the handoff. Ex. 1005, 2:63-4:31 and Ex. 1006, [0008]- [0012].

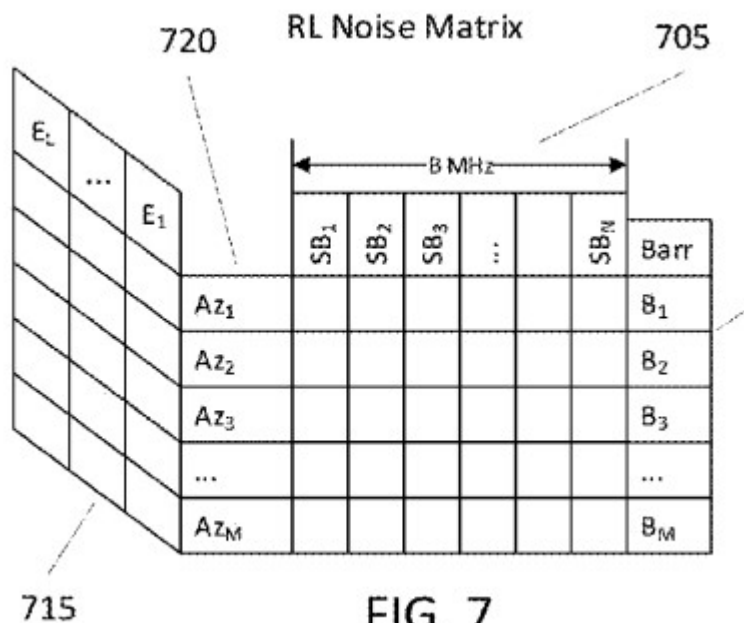
98. The combination of Jalali and de La Chapelle also discloses “calculating, with the computer processor, a first reverse-link noise estimate using the first noise power level of the first communication channel.” In this regard, de La Chapelle discloses that a signal-to-noise ratio (SNR) is calculated for a first communication channel. Ex 1005, 17:48-53. The calculation of SNR is understood by a POSA as a representation of estimated noise based on the noise power measurement inherently required to be employed to determine SNR. Notably, the calculation of SNR is not explicitly associated with either the forward or reverse link in de La Chapelle, and a POSA would understand that the method would apply equally to either direction of communication in any case. Jalali also describes adjustment of beams to increase or maximize signal to noise plus interference (SINR). Ex. 1006, [0059]. Increasing or maximizing SINR necessarily requires measurement of noise power, as noted above. Thus, Jalali is explicit in necessarily requiring measurement of a first noise power level, which is also used to estimate noise, since SINR necessarily includes an estimate of noise based on the measured noise power level. A POSA would find it obvious to combine Jalali and de La

Chapelle since the descriptions of both are known prior art elements that would be combinable to yield predictable results in this context.

99. The combination of Jalali and de La Chapelle also discloses “calculating, with the computer processor, a second reverse-link noise estimate using the second noise power level of the second communication channel.” This feature is merely a repeat of the operations discussed above in ¶98 for a second channel. The descriptions of ¶98 therefore apply here and are incorporated here as well. Moreover, as noted above, both Jalali and de La Chapelle are explicitly focused on handoffs of a first communication channel between ground stations and airborne aircraft and a second communication channel, and thus replete with descriptions of the repeat of measurements on both communication channels to permit comparison to enable the handoff. Ex. 1005, 2:63-4:31 and Ex. 1006, [0008]-[0012].

100. Jalali and de La Chapelle also combine to teach or suggest “calculating, with the computer processor, a reverse-link noise matrix using the first reverse-link noise estimate and the second reverse-link noise estimate.” The use of a matrix for making a decision involving comparing values is an inherent feature of a computer, and also the antenna controller **24** of de La Chapelle. In the context of describing a handoff, de La Chapelle describes a full process of handover involving “determining when a second BTS becomes available that is expected to provide a higher quality communications link with the terrestrial cellular network.” Ex. 1005, 4:20-22, which

a POSA understands to necessarily include a comparison of quality related parameters between two BTSs. The quality related parameters (e.g., signal strength, interference and noise) must be stored in a computer for comparison of the candidate BTSs for the forward link. This necessity for storage thereby inherently creates a matrix of parameters that can be compared. Moreover, for the comparison of SNR values that are used for one example handoff means described in de La Chapelle, the matrix would necessarily include noise estimates. Since the links are two directional between the ground station and the aircraft, noise on either link is highly relevant and of interest to a POSA to manage relative to conducting a successful handoff that maintains link quality. Thus, de La Chapelle inherently discloses calculation of a reverse link noise matrix to permit comparisons that will be used as the basis for handoff based on SNR. Also, notably FIG. 7 of the '600 patent (reproduced below for convenience) illustrates an example of the reverse link noise matrix.



It is evident from the depiction and description of FIG. 7 that the noise matrix of the ‘600 patent is defined by columns and rows of information that provide a characterization of noise plus interference. Ex 1001, 10:29-33. The collection of data in a common tabular form of columns and rows that is representative of how such data is stored in a computer conventionally to permit comparisons and/or decisions to be made with respect to the data of the matrix is also inherently included in the description of comparisons for quality related parameters of de La Chapelle as that how data is compared for its stated purpose of determining when a higher quality communications link is available using the computing device of de La Chapelle (i.e., the antenna controller **24**). As noted above, signal strength, interference and/or noise measurements or estimates are all expressly described as being made by de La Chapelle (see Ex 1005, 16:43-50, 9:16-21, and 17:48-53, respectively). The express

description in de La Chapelle of determining when a higher quality communications link becomes available is therefore inherently performed using a matrix involving the two compared forward link collections of parameters that indicate quality (i.e., noise). Jalali expressly states that channels for the forward link and reverse link are reciprocal. Ex. 1006, [0060]. Thus, a POSA would understand that calculations, estimates and/or processing techniques for forward and reverse links can also be identical. Moreover, Jalali also compares SINR from adjacent beams to manage handoff. *Id.* Thus, a POSA would clearly understand from the combination of Jalali and de La Chapelle that noise parameters can advantageously be used in a matrix form to enable a computer to manage handoff of beams of either or both of the forward and reverse link to maximize quality, data rate, or any other desirable parameter. Doing so would merely combine known elements to yield predictable results, and could be advantageous in improving communication channel performance.

101. The combination of Jalali and de La Chapelle further teaches “the reverse-link noise matrix is utilized to select communication channels to utilize for transmissions between a plurality of ground stations disposed on the ground and the airborne aircraft.” As noted above, de La Chapelle describes a full process of handover involving “determining when a second BTS becomes available that is expected to provide a higher quality communications link with the terrestrial cellular

network.” Ex. 1005, 4:11-31. A POSA understands this determination to necessarily include a comparison of quality related parameters between two BTSs in a matrix form within a computer. In particular, the quality related parameters (e.g., signal strength, interference and noise) that are necessarily stored in a computer for comparison of the candidate BTSs for the forward link or reverse inherently define a matrix of noise parameters to permit the comparison. As noted above, noise measurements are expressly described as being made by de La Chapelle. Ex 1005, 17:48-53. The express description in de La Chapelle of determining when a higher quality communications link becomes available inherently involves using a matrix involving the two compared noise parameters. Jalali also expressly describes using SINR from adjacent beams to manage handoff. Ex. 1006, [0060]. Thus, a POSA would clearly understand from the combination of Jalali and de La Chapelle that noise parameters can advantageously be used in a matrix form to enable a computer to manage handoff of beams of either or both of the forward and reverse link to maximize quality, data rate, or any other desirable parameter. Doing so would merely combine known elements to yield predictable results, and would be advantageous in improving communication channel performance.

102. With respect to claim 8, the combination of de La Chapelle and Jalali teaches that “the first communication channel comprises a first center frequency and a first bandwidth, wherein the second communication channel comprises a second

center frequency and a second bandwidth, and wherein the first communication channel does not overlap the second communication channel.” As noted above, these are immutable channel characteristics. In this regard, de La Chapelle indicates that the communication links involve various RF frequency bands, each of which bands inherently has a center frequency and corresponding width. Ex 1005, 5:55-61 and 16:34-36. Moreover, a POSA clearly understands that channels must not interfere with each other, and therefore should not overlap. Moreover, de La Chapelle expressly notes that the beamformer includes a plurality of “distinct channels” (see Ex. 1005, 10:37-40), which a POSA would clearly understand to be non-overlapping. Jalali discusses various narrow bandwidths or wide bandwidth that can be used to convert into baseband for analysis further indicating that the channels have basic and expected characteristics. Ex. 1006, [0046], [0047], [0052] and [0053]. Claim 8 effectively merely recites immutable characteristics of communication channels and both Jalali and de La Chapelle disclose the same immutable characteristics of communication channels such that there is nothing in claim 8 that would not be obvious to a POSA.

103. With respect to claim 9, the combination of de La Chapelle and Jalali teaches “the method further comprising: commanding, with the computer processor, the directional antenna and the transceiver to measure a short-term average of the first noise power level of the first communication channel at the first elevation and

the first azimuth; commanding, with the computer processor, the directional antenna and the transceiver to measure a short-term average of the second noise power level of the second communication channel at the second elevation and the second azimuth; calculating, with the computer processor, the first reverse-link noise estimate using the short-term average of the first noise power level of the first communication channel; and calculating, with the computer processor, the second reverse-link noise estimate using the short-term average of the second noise power level of the second communication channel.” Claim 9 merely adds the concept of short-term averaging of noise power levels to that which was already discussed above in relation to the contents of claim 7. However, averaging of values is well known, and provides no unexpected results. Ex. 1006, [0052] and [0057]. Moreover, the applicability of processing data in various time frames, including aggregation of data over such timeframes, is contemplated and described by de La Chapelle. Ex. 1005, 9:8-27. Meanwhile, Jalali expressly discusses filtering and averaging of values. Ex. 1006, [0052] and [0057]. A POSA would appreciate the advantage of using average values for the compared values being used to manage handoff. Moreover, in the context of managing handoff based on noise values, which is clearly discussed in both de La Chapelle and Jalali, averaging values over various timeframes that include short time frames would provide an obvious advantage of

optimizing link quality and data rate, which are stated goals of both de La Chapelle and Jalali.

104. With respect to claim 10, the combination of de La Chapelle and Jalali teaches “the method further comprising: commanding, with the computer processor, the directional antenna and the transceiver to measure a long-term average of the first noise power level of the first communication channel at the first elevation and the first azimuth; commanding, with the computer processor, the directional antenna and the transceiver to measure a long-term average of the second noise power level of the second communication channel at the second elevation and the second azimuth; calculating, with the computer processor, the first reverse-link noise estimate using the long-term average of the first noise power level of the first communication channel; and calculating, with the computer processor, the second reverse-link noise estimate using the long-term average of the second noise power level of the second communication channel.” Claim 10 merely adds the concept of long-term averaging of noise power levels to that which was already discussed above in relation to the contents of claim 7. However, averaging of values is well known, and provides no unexpected results. Moreover, the applicability of processing data in various time frames, including aggregation of data over such timeframes, is contemplated and described by de La Chapelle. Ex. 1005, 9:8-27. Meanwhile, Jalali expressly discusses filtering and averaging of values. Ex. 1006, [0052], [0057]. A

POSA would appreciate the advantage of using average values for the compared values being used to manage handoff. Moreover, in the context of managing handoff based on noise values, which is clearly discussed in both de La Chapelle and Jalali, averaging values over various timeframes including long time frames would provide an obvious advantage of optimizing link quality and data rate, which are stated goals of both de La Chapelle and Jalali.

105. With respect to claim 11, the combination of de La Chapelle and Jalali teaches the “method further comprising commanding, with the computer processor, the ground station to transmit the reverse-link noise matrix to a ground station controller, the ground station controller disposed on the ground and in communicative connection with the plurality of ground stations.” The disclosures of de La Chapelle and Jalali relative to calculation of a noise matrix is discussed above at ¶100 and is incorporated here. Jalali expressly describes that the ground stations have controllers. Ex. 1006, [0071]. Jalali further expressly notes that these ground stations are networked. Ex. 1006, [0061]. Jalali also notes that SINR measurements at the aircraft are sent to the ground station. Ex. 1006, [0059]. A POSA would understand that these values can either be formed into the matrix of noise measurements at the aircraft and sent in matrix form to the ground station, or may be sent for formation into the matrix of noise measurements to occur at the ground station. Either option is entirely possible, and both are obvious variants of the other.

Thus, a POSA would find it obvious from the descriptions of Jalali to transmit the reverse-link noise matrix to a ground station. Accordingly, all of the features of claim 11 are known from the combination of de La Chapelle and Jalali, and a POSA would find it obvious because the combination does no more than combine prior art elements to known methods to achieve predictable results.

106. With respect to claim 12, the combination of de La Chapelle and Jalali teaches “the method further comprising: commanding, with the computer processor, the directional antenna and the transceiver to measure a third noise power level of a third communication channel at a third elevation and a third azimuth from the current position of the ground station, the third communication channel configured to support transmissions between the ground station and airborne aircraft; calculating, with the computer processor, a third reverse-link noise estimate using the third noise power level of the third communication channel; and calculating, with the computer processor, the reverse-link noise matrix using the first reverse-link noise estimate, the second reverse-link noise estimate, and the third reverse-link noise matrix.” Thus, claim 12 merely repeats actions performed above in connection with claim 7 for a third ground station. All of the descriptions relating to the contents of claim 7 in ¶¶93 to 101 also apply and are incorporated here. As noted above, both de La Chapelle and Jalali describe a handoff between two ground stations or base stations. However, in both cases, the handoff is also performed in a context in which other

candidate ground stations or base stations are also considered and therefore have parameters measured. In particular, de La Chapelle discusses identifying which BTSs are above the horizon and visible, and then calculating the S/I ratio for each visible BTS. Ex. 1005, 9:13-21. Accordingly, de La Chapelle clearly contemplates the comparisons discussed above to be extended beyond two BTSs to at least a third BTS. Jalali also expressly notes that the ground stations are networked. Ex. 1006, [0061]. Thus, Jalali also describes an environment in which a third (or more) ground station and its interactions with the aircraft are considered for comparisons in connection with a handoff. Thus, all of the features of claim 12 are known from the combination of de La Chapelle and Jalali, and a POSA would find it obvious to combine the references because the combination does no more than combine prior art elements to known methods to achieve predictable results.

107. Jalali and de La Chapelle combine to teach or suggest each and every feature of claim 13. The preamble of claim 13 recites a “computer system comprising one or more processors and/or transceivers.” To the extent the preamble of claim 13 is deemed a limitation, de La Chapelle discloses these features because de La Chapelle discloses “an antenna controller **24**” and “at least one RF transceiver 30.” Ex. 1005, 5:48-54. Jalali also discloses computer hardware by virtue of discussing a controller/processor **440** at the ground base station **102**. Ex. 1006, [0040].

108. With respect to claim 13, the combination of de La Chapelle and Jalali teaches that the computer system is “configured to: retrieve at least one of: (i) a forward-link user capacity matrix comprising a plurality of forward-link user capacity estimates each associated with a respective signal-to-noise ratio measurement of a respective communication channel corresponding to a respective location on the ground.” The calculation of forward-link user capacity estimates based on SNR in relation is described in de La Chapelle in relation to paragraph 48 above, and that discussion is incorporated by reference here. The further calculation of forward-link user capacity matrix in de La Chapelle is discussed in detail at paragraph 50 above, and is incorporated by reference here as well. A POSA would understand that the antenna controller **24** of de La Chapelle would retrieve this information for different respective channels involved in potential handoffs for each ground location based on all of the visible stations mentioned for consideration by de La Chapelle. Ex 1005, 16:43-50, 9:16-21, and 17:48-53. Jalali similarly discusses searching “all pilot signals received from ground base stations” and ranking the pilot signals for handoff determination. Ex. 1006, [0034]. The ranking process necessarily includes the use of a matrix of values for SINR as discussed above in paragraph 79, which is incorporated by reference here. And a POSA would find the substitution of SNR matrix comparisons inherent in the description of de La Chapelle for the SINR ranking matrix operations of Jalali to be obvious as nothing more than a simple

substitution of one known element for another to obtain predictable results, or use of a known technique to improve similar devices in the same way.

109. Although claim 13 recites “(ii) a return-link user capacity matrix comprising a plurality of return-link user capacity estimates each associated with a respective noise power level of a respective communication channel corresponding to a respective azimuth and a respective elevation from a current location of an airborne aircraft” as an alternative such that only the feature (i) need be shown to demonstrate obviousness, it is nevertheless also stated by Jalali that that channels for the forward link and reverse link are reciprocal. Ex. 1006, [0060]. Thus, a POSA would understand that calculations, estimates and/or processing techniques for forward and reverse links can also be identical. Thus, a POSA would clearly understand from the combination of Jalali and de La Chapelle that both forward and reverse link measurements, estimates, matrices and comparisons of parameters in the matrices could be used for handoff decisions to define links that maintain high quality and data rate for the best user capacity that can be provided through handoff.

110. The combination of de La Chapelle and Jalali also teaches “determine, using at least one of (i) the forward-link user capacity matrix or (ii) the return-link user capacity matrix, a candidate serving cell that is disposed on the ground.” In particular, de La Chapelle describes a full process of handover involving “determining when a second BTS becomes available that is expected to provide a

higher quality communications link with the terrestrial cellular network.” Ex. 1005, 4:20-22. A POSA would understand this passage to necessarily include a comparison of quality related parameters between two BTSs in the inherently stored user capacity matrix described above in ¶50, which is incorporated by reference here. In particular, the quality related parameters (e.g., signal strength, interference and noise) that are necessarily stored in a computer for comparison of the candidate BTSs for the forward link inherently define a matrix of parameters to permit the comparison. As noted above, signal strength, interference and/or noise measurements are all expressly described as being made by de La Chapelle (see Ex 1005, 16:43-50, 9:16-21, and 17:48-53, respectively). The express description in de La Chapelle of determining when a higher quality communications link becomes available inherently involves using a matrix involving the two compared forward link collections of parameters that indicate quality (i.e., signal strength, interference and/or noise), which parameters are also directly related to channel capacity, and easily substituted for or interchangeable in this context by a POSA. Jalali similarly discusses searching “all pilot signals received from ground base stations” and ranking the pilot signals for handoff determination. Ex. 1006, [0034]. The ranking process necessarily includes the use of a matrix of values for SINR as discussed above in paragraph 79, which is incorporated by reference here. And a POSA would find the substitution of SNR matrix comparisons inherent in the description of de La

Chapelle for the SINR ranking matrix operations of Jalali to be to be obvious as nothing more than a simple substitution of one known element for another to obtain predictable results, or use of a known technique to improve similar devices in the same way.

111. The combination of de La Chapelle and Jalali also teaches “command a directional antenna and a particular transceiver to transmit or receive data between the airborne aircraft and the candidate serving cell.” As noted above, de La Chapelle describes a full process of handover involving “determining when a second BTS becomes available that is expected to provide a higher quality communications link with the terrestrial cellular network” and then “initiating a handoff of the first communications link from the first BTS to the second BTS by using a second, independently aimable lobe of the single antenna beam to establish a second communications link with the BTS while maintaining the first communications link with the first BTS; and gradually fading out the first communications link with the first BTS while simultaneously fading in the second communications link to complete the handoff of the cellular communications link from the first BTS to the second BTS.” Ex. 1005, 4:20-31. Jalali similarly describes completion of a handoff in many locations, and notes that “the ground base station repeatedly determines the desired or optimal receive beam and adjusts the transmit beam accordingly.” Ex. 1006, [0060]. Based on the descriptions in de La Chapelle and Jalali, a POSA would

understand completion of the handoff necessarily involves commanding a directional antenna to transmit or receive data between the airborne aircraft and the candidate serving cell to complete the handoff. Accordingly, a POSA would all of the features of claim 13 to be disclosed in the combination of de La Chapelle and Jalali.

112. With respect to claim 14, Jalali teaches wherein the one or more processors and/or transceivers are configured to retrieve the at least one of (i) the forward-link user capacity matrix or (ii) the return-link user capacity matrix from an air-to-ground network controller disposed on the ground and in communicative with a plurality of serving cells, the plurality of serving cells including the candidate serving cell.” As noted above, both de La Chapelle and Jalali describe a handoff between two ground stations or base stations where the handoff is performed to optimize quality or data rate using a comparison of measured or estimated parameters. The parameters are necessarily compared via a matrix, and the optimization of quality and data rate is in either case akin to managing the handoff based on capacity, and a capacity matrix. *See supra*, ¶¶ 50 and 108. Moreover, in both cases, the handoff is also performed in a context in which other candidate ground stations or base stations are also considered and therefore have parameters measured. In particular, de La Chapelle discusses identifying which BTSs are above the horizon and visible, and then calculating the S/I ratio for each visible BTS. Ex.

1005, 9:13-21. Accordingly, de La Chapelle clearly contemplates the comparisons discussed above to be extended beyond two BTSs to a plurality of BTSs that a POSA would expect to be in communication with each other. Jalali also expressly notes that the ground stations are networked. Ex. 1006, [0061]. Jalali further explains that the measurements made by aircraft are reported to a ground station. Ex. 1006, [0059]. Thus, Jalali describes an environment where the ground station receives the information used for the comparisons, and therefore receives the information that is either inherently inclusive of the user capacity matrix, or is at least obvious to a POSA in view of the teachings of Jalali and de La Chapelle. A POSA would appreciate the advantage of enabling both ground stations and aircraft transceivers to have the ability to select the best candidate beams. Moreover, Jalali has expressly indicated that channels for the forward link and reverse link are reciprocal. Ex. 1006, [0060]. Thus, a POSA would understand that calculations, estimates and/or processing techniques for forward and reverse links can also be identical and either end of the links must be equipped to access the user capacity matrix. Thus, all of the features of claim 14 are known from the combination of de La Chapelle and Jalali, and a POSA would find it obvious to combine the references because the combination does no more than combine prior art elements to known methods to achieve predictable results.

113. With respect to claim 15, the combination of de La Chapelle and Jalali teaches that “the candidate serving cell comprises a respective noise power level above a threshold.” In particular, de La Chapelle describes the handoff to the candidate cell based on higher quality, which directly takes accounting of noise power levels, which are considered relative to “a predetermined threshold” in relation to this handoff process. Ex. 1005, 17:51-53. Jalali also discloses maintaining SINR above a “target value.” Ex. 1006, [0067]. Thus, both de La Chapelle and Jalali expressly recite this feature of claim 15 and render it obvious alone or in combination.

114. With respect to claim 17, the combination of de La Chapelle and Jalali teaches that “the forward-link user capacity matrix indicates a lower signal-to-noise ratio associated with the candidate serving cell than an alternative serving cell, and wherein the alternative serving cell is located at a distance from the airborne aircraft that is greater than a distance from the airborne aircraft of the candidate serving cell.” Both de La Chapelle and Jalali clearly teach conducting handoff based on factors other than proximity, but instead based on measured parameters. In this regard, for example, Jalali ranks signals received (see Ex. 1006, [0034]) to conduct handoff and de La Chapelle manages handoff based on SNR (see Ex. 1005, 17:48-53), which could be higher or lower for any particular cell being compared. A POSA would clearly understand from both de La Chapelle and Jalali that when handoff is managed

based on measured parameters other than proximity, a more distant ground station may be selected as the serving cell as a necessary result. Thus, claim 17 is obvious in view of the combined teachings of de La Chapelle and Jalali.

115. With respect to claim 18, the combination of de La Chapelle and Jalali teaches that “the return-link user capacity matrix indicates a higher noise power level associated with the candidate serving cell than a noise power level associated with an alternative serving cell, and wherein the alternative serving cell is located at a distance from the airborne aircraft that is greater than a distance from the airborne aircraft of the candidate serving cell.” Similar to the discussion above, both de La Chapelle and Jalali clearly teach conducting handoff based on factors other than proximity, but instead based on measured parameters. In this regard, for example, Jalali ranks signals received (see Ex. 1006, [0034]) to conduct handoff and de La Chapelle manages handoff based on SNR (see Ex. 1005, 17:48-53), which could be higher or lower for any particular cell being compared. A POSA would clearly understand from both de La Chapelle and Jalali that when handoff is managed based on measured parameters other than proximity, a more distant ground station may be selected as the serving cell as a necessary result. Thus, claim 18 is obvious in view of the combined teachings of de La Chapelle and Jalali.

116. With respect to claim 19, the combination of de La Chapelle and Jalali teaches that “the threshold comprises at least one of: a short-term noise threshold

that enables a serving cell selection decision among a plurality of serving cells; or a long-term noise threshold that enables a future serving cell restriction decision.” Claim 19 merely indicates that the threshold of claim 15 could be a short-term or long-term threshold. This encompasses every possible threshold, and is therefore not a limitation at all on claim 19 from a logical perspective. Thus, for the same reasons discussed above at ¶113, claim 19 is obvious in view of de La Chapelle and Jalali.

D. GROUND 3: Jalali and de La Chapelle in view of Nelson et al. Discloses All Limitations of Claims 5 and 16

117. Claim 5, which depends directly from claim 1, recites “additional processor executable instructions that when executed by the computer processor cause the computer processor to command the directional antenna and the transceiver to transmit the forward-link user capacity matrix to a ground station controller using an out-of-band communication channel, the ground station controller disposed on the ground and in communicative connection with the plurality of ground stations.” It is noteworthy that de La Chapelle and Jalali teach all of the features of claim 5 relating to the forward-link user capacity matrix, directional antenna control, and ground station controllers, for the reasons noted above. In particular, the disclosures of de La Chapelle and Jalali relative to calculation of a noise matrix are discussed above at ¶100 and is incorporated here. Jalali also expressly describes that the ground stations have controllers. Ex. 1006, [0071]. Jalali further expressly notes that these ground stations are networked. Ex.

1006, [0061]. Jalali also notes that SINR measurements at the aircraft are sent to the ground station. Ex. 1006, [0059]. A POSA would understand that these values can either be formed into the matrix of noise measurements at the aircraft and sent in matrix form to the ground station, or may be sent for formation into the matrix of noise measurements to occur at the ground station. Either option is entirely possible, and both are obvious variants of the other. Thus, a POSA would find it obvious from the descriptions of Jalali to transmit the reverse-link noise matrix to a ground station. Accordingly, all of the features of claim 5 are known from the combination of de La Chapelle and Jalali, except perhaps that the forward-link user capacity matrix is transmitted to a ground station using an out-of-band communication channel. A POSA would understand that the provision of noise measurement information described in Jalali could be performed using out-of-band protocols. Moreover, Jalali expressly describes other bands (e.g., Ka and Ku bands). Ex. 1006, [0065]. It would be obvious to a POSA to provide the matrix information via out-of-band communications using the Ka or Ku band to avoid using bandwidth of the other channels (e.g., data channels associated with the directional beams). Nevertheless, to whatever extent Jalali's disclosure is not deemed specific enough to make this point, Nelson shows that it was well known to use out-of-band protocols for communication of data. Ex. 1007, [0069]. A POSA would find motivation from Nelson's discussion of the use of out-of-band protocols to employ the Ka and Ku

bands of Jalali to provide the forward-link user capacity matrix to a ground station controller. Doing so would merely combine known elements to yield predictable results, and would be advantageous in improving communication channel performance by not overburdening data channels.

118. Claim 16 recites “the one or more processors and/or transceivers are further configured to transmit the at least one of (i) the forward-link user capacity matrix or (ii) the return-link user capacity matrix using an out-of-band channel.” Thus, claim 16 adds, similar to claim 5, that a user capacity matrix for either the forward or reverse link is transmitted via an out-of-band channel. The disclosures of de La Chapelle and Jalali relative to calculation of a user capacity matrix are discussed above at ¶79 and are incorporated here. Jalali also notes that SINR measurements at the aircraft are sent to the ground station. Ex. 1006, [0059]. A POSA would understand that these values can either be formed into the matrix of noise measurements at the aircraft and sent in matrix form to the ground station, or may be sent for formation into the matrix of noise measurements to occur at the ground station. Either option is entirely possible, and both are obvious variants of the other. Thus, a POSA would find it obvious from the descriptions of Jalali to transmit the forward or reverse-link user capacity matrix to a ground station. Accordingly, all of the features of claim 16 are known from the combination of de La Chapelle and Jalali, except perhaps that the forward-link user capacity matrix is

transmitted using an out-of-band communication channel. A POSA would understand that the provision of noise measurement information described in Jalali could be performed using out-of-band protocols. Moreover, Jalali expressly describes other bands (e.g., Ka and Ku bands). Ex. 1006, [0065]. It would be obvious to a POSA to provide noise measurements or estimates in a matrix form that corresponds to the the user capacity matrix information via out-of-band communications using the Ka or Ku band to avoid using bandwidth of the other channels (e.g., data channels associated with the directional beams). Nevertheless, to whatever extent Jalali's disclosure is not deemed specific enough to make this point, Nelson shows that it was well known to use out-of-band protocols for communication of data. Ex. 1007, [0069]. A POSA would find motivation from Nelson's discussion of the use of out-of-band protocols to employ the Ka and Ku bands of Jalali to provide the forward-link user capacity matrix to a ground station controller. Doing so would merely combine known elements to yield predictable results, and would be advantageous in improving communication channel performance by not overburdening the data channels Jalali teaches.

E. GROUND 4: Jalali, de La Chapelle, Nelson and McGuffin Discloses All Limitations of Claims 1-19.

119. As noted above in connection with Grounds 2 and 3, it is my opinion that a POSA would find claims 1-19 to be obvious in view of the combination of de La Chapelle and Jalali as described in ¶¶74-116. However, to the extent the

combination is deemed lacking relative to the use of an out-of-band channel as provided in claims 5 and 16, those claims are also rendered obvious by adding Nelson and its corresponding express discussion of the use of out-of-band protocols to provide data as described in ¶¶117-118 above. This opinion is based on the above-explained further opinion that the uses of the term “matrix” in the ‘600 patent are met inherently within both de La Chapelle and Jalali by virtue of the fact that both de La Chapelle and Jalali specifically describe the comparison of measured or estimated parameters that include noise, and other indicators of channel quality, capacity and data rate by a computer. Computers cannot compare analog values, and therefore necessarily require a data structure in the form of a matrix (e.g., columns and rows of data) that provide a structure for comparison of the data therein by the computer. To the extent it is not considered inherent in the disclosures of de La Chapelle and Jalali that a matrix for noise as a basis for quality or other user capacity data is the means by which the comparisons described are accomplished, it would nevertheless be obvious to a POSA. Using a matrix for comparing this information would simply involve applying a known technique to a known device ready for improvement to yield predictable results, and would be an efficient alternative for transmitting, storing, and comparing data.

120. As clear evidence of the fact that a matrix is a known data structure for providing data in an efficient manner for storage, transmission and/or comparison,

Mcguffin can be seen to provide explicit disclosure of such a structure. In this regard, Mcguffin discloses multiple tables showing data structures for storing information used at ground stations to assist with handoff decisions that are made similar to those of de La Chapelle and Jalali. Ex. 1008, [0034]-[0038]. The data structures (shown in the example of Table 2 below) include message traffic density, signal strength and average (dB), which could easily be augmented or substituted with noise, capacity, data rate, or any other desired values.

TABLE 2

GROUND STATION	MESSAGE TRAFFIC DENSITY	SIGNAL STRENGTH DATA (dB)	AVERAGE (dB)
1	4	1, 1, 2, 2	1.5
2	3	0, 1, 0	0.3
3	5	6, 5, 3, 5, 4	4.6
4			
•	•	•	•
•	•	•	•
•	•	•	•
n			

121. The descriptions of applicability of de La Chapelle, Jalali and Nelson to claims 1-19 as described above in ¶¶74-118, apply equally to all of claims 1-19 and are incorporated here by reference. It would be obvious for a POSA to modify the storage and/or transmission of data at the aircraft controller and/or ground station of Jalali to include the data structure of Mcguffin for data defining a user capacity matrix or noise matrix to ensure the best communication link is available to the aircraft. Doing so would merely combine known elements to yield predictable results, and would be advantageous in improving communication channel

performance by providing a consistent format for storing, sharing and processing the information used to manage a handoff.

122. With respect to all of the obviousness rejections noted above in ¶¶74-120, it is noteworthy that all of de La Chapelle, Jalali, Nelson and McGuffin address the same issues that are addressed by the '600 patent, and do so in very similar ways. A POSA looking to conduct handoffs between beams does not wish to drop the connection, and therefore looks for the optimal or best performing handoff candidates available. The ways to select the best candidates for handoff are varied. However, whereas using distance or merely using signal strength represent relatively simple and well known alternatives, there are limited other options available, and those options are generally limited to the parameters that can be measured and used as a basis for comparison (e.g., SNR, SINR, noise, etc.). These measured values can be used to estimate further characteristics like quality, data rate, or capacity that might be achievable on candidate beams. The '600 patent generally uses noise, and does so with a matrix data structure for comparison. However, that same method was already known by de La Chapelle, and any small change apparent in the description of the '600 patent is only a different use of terminology, or at least obvious to a POSA based on the further descriptions of Jalali, Nelson and McGuffin.

123. A POSA would have been motivated to combine the teachings of Jalali and de La Chapelle (along with Nelson and McGuffin), since the references clearly

teach similar methods for solving the same problem. A POSA looking to improve capacity without interference would look to those other references that have dealt with the same problem to understand the state of the art, and would necessarily have also understood the contents of the '600 patent to merely restate that which was already known in the art.

124. A POSA would have had a reasonable expectation of success in combining the teachings of Jalali and de La Chapelle (along with Nelson and McGuffin), since the references clearly teach alternative methods for solving the same problem. In this regard, to the extent the processes differ in these references, they would be seen to provide alternatives that would be obvious to try to a POSA given the relatively limited number of parameters that can be measured in the handoff context.

VII. CONCLUSION

125. I understand that this declaration is being used to support an IPR petition challenging the '600 patent. I reserve the right to supplement my opinions in the future to respond to any arguments raised by the owner of the '600 patent and to take into account new information as it becomes available to me.

126. As discussed above, it is my opinion that claims 1-19 of the '600 Patent are anticipated and/or obvious and should be canceled as unpatentable over the prior art.

127. All statements made herein of my own knowledge are true; all statements made on information and belief are believed to be true; and these statements were made with the knowledge that willful false statements and the like are punishable by fine or imprisonment or both under 18 U.S.C. § 1001.