

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

ERICSSON INC. and VERIZON COMMUNICATIONS, INC.
Petitioners,

v.

PROCOMM INTERNATIONAL PTE. LTD
Patent Owner,

U.S. Patent No. 8,497,813
Issue Date: July 30, 2013

Title: PANEL ANTENNA HAVING SEALED RADIO
ENCLOSURE

Inter Partes Review No.: IPR2024-01455

**DECLARATION OF HENRY HOUH, PH.D. IN SUPPORT OF
PETITION FOR INTER PARTES REVIEW OF U.S. PATENT NO.
8,497,813**

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I. INTRODUCTION

1. I am over the age of eighteen (18) and otherwise competent to make this Declaration.

2. I have been retained by Ericsson, Inc. and Verizon Communications, Inc. (Petitioners) as an independent, technical expert consultant in this proceeding before the United States Patent and Trademark Office (USPTO). I am being compensated at my rate of \$820 per hour for my services. No part of my compensation is dependent on my opinions or on the outcome of this proceeding. I have no financial interest in any of the parties to this proceeding.

3. This Declaration is in support of the Petition for *inter partes* review involving U.S. Patent 8,497,813 (the “’813 Patent” or “the Patent”) (EX-1001), entitled “Panel Antenna Having Sealed Radio Enclosure ” and listing Derek Rodger and Matthew Ferris as the inventors.

4. For the purposes of this *inter partes* review as I discuss later, I have been instructed to assume that the effective filing date of the Claims of the ’813 Patent challenged by the Petitioners in this *inter partes* review is no earlier than Dec. 2, 2008.

5. I understand that, according to USPTO records, the ’813 Patent is currently assigned to Andrew LLC. I have been instructed to assume for

purposes of this proceeding that Procomm International Pte. Ltd is the patent owner.

6. The '813 Patent is titled "Panel Antenna Having Sealed Radio Enclosure" and particularly identifies the field of invention as relating to "arrangements of passive and active components in an [sic] multiple radiating element panel antenna." EX-1001 1:7-10. I am familiar with the technology described in the '813 Patent as of the earliest possible priority date of December 2008.

7. In preparing this Declaration, I have reviewed the '813 Patent (EX-1001) and its prosecution history (EX-1002), as well as the patents and documents cited herein, and I have considered these documents in light of the general knowledge in the art as of December 2008. In formulating my opinions, I have relied upon my experience in the relevant art. I have also considered the viewpoint of a person of ordinary skill in the art ("POSA") in the relevant field, as of December, 2008, who I describe below (§ V.D). For convenience, the materials I considered in arriving at my opinions are listed in Appendix A.

8. I have been asked to provide my technical expertise, analysis, insights and opinions regarding the '813 Patent and relevant references that form the basis of the arguments set forth in the accompanying Petition for

inter partes review of the '813 Patent. As described in detail below, I offer the following opinions in this Declaration:

- 1) A POSA would have found Claims 1, 2 and 4-7 of the '813 Patent to unpatentable over Bishop in view of Avramis, Lakoduc and/or Korte and a POSA would have been motivated to combine the teachings of these references;
- 2) A POSA would have found Claims 1, 2 and 7 of the '813 Patent to unpatentable Kelly alone or in combination with Avramis and a POSA would have been motivated to combine the teachings of these references.

9. Unless otherwise indicated, the emphasis in quotations has been added.

II. QUALIFICATIONS

10. My qualifications for forming the opinions set forth in this declaration are summarized here and explained in more detail in my *curriculum vitae*, which is included as Appendix B. Appendix B also includes a list of my publications and patents.

11. I received a Ph.D. in Electrical Engineering and Computer Science from the Massachusetts Institute of Technology ("MIT") in 1998. I also received a Master of Science degree in Electrical Engineering and Computer Science in 1991, a Bachelor of Science degree in Electrical

Engineering and Computer Science in 1989, and a Bachelor of Science Degree in Physics in 1990, all from MIT.

12. For the last 15 years I have been self-employed as an independent technical consultant which specializes in, among other things, in Web Site Development, Data Networking, Optical Networking, Telecommunications, and Media Streaming. My clients include almost every major law firm in the country.

13. My Career in the area of telecommunications began 1987 when I worked at AT&T Bell Laboratories as part of a five-year dual degree program at MIT. Later, as part of my doctoral research at MIT from 1991-1998, I was a research assistant in the Telemedia Network Systems (TNS) group at the Laboratory for Computer Science. The TNS group built a high-speed gigabit network and created applications that ran over the network. Example applications included ones for remote video capture, processing, and display of video on computer terminals. In addition to working on the design of core network components, designing and building the high speed links, and designing and writing the device drivers for the interface cards, I also set up the group's web server. Furthermore, because our group focused on real-time software processing of live streamed data, some members of our group focused on research in software

radios, which was thus commonly discussed in meetings and casual conversations. One of my labmates, Vanu Bose, went on to found Vanu, Inc., a software radio company focused on low cost base stations for rural cell carriers. Several members of our group joined Vanu's company and I continued to meet with Vanu and members of his company. Thus, I became aware of the architectures around software radios starting in the late 1990's.

14. I defended and submitted my Ph.D. thesis, titled "Designing Networks for Tomorrow's Traffic," in January 1998. As part of my thesis research, I analyzed local-area and wide-area flows to show a more efficient method for routing packets in a network, based on traffic patterns at the time.

15. From 1997 to 1999, I was a Senior Scientist and Engineer at NBX Corporation, a start-up that made business telephone systems for streaming packetized audio over data networks instead of using traditional telephone lines. NBX was later acquired by 3Com Corporation, and the phone system is still used today by numerous businesses. As part of my work at NBX, I designed the core audio reconstruction algorithms for the telephones, as well as the packet transmission algorithms. I also designed and validated the core packet transport protocol used by the phone system.

The protocol was used for all signaling in the phone system. The NBX system also featured a computer interface for initiating phone calls, which could also initiate conference calls. The NBX system also supported TAPI, the Telephony Application Programming Interface, thus allowing other computer programs to integrate with our system telephony features. We obtained U.S. Patent No. 6,697,963, entitled “Telecommunication method for ensuring on-time delivery of packets containing time-sensitive data,” as a result of part of this work.

16. From 1999-2004, I was employed by Empirix or its predecessor company, Teradyne. Empirix was a leader in test tools for telecommunications protocols and systems, providing functional testing tools as well as load testing tools. From 2000-2001, I conceived and built a test platform for testing Voice-over-IP (VoIP). The first application on this new test platform was a cloud emulator for simulating the effects of transmitting VoIP over a busy network.

17. In 2006, as part of my role at BBN Technologies, I helped found PodZinger Inc., now known as RAMP Inc. PodZinger utilized BBN’s speech recognition algorithms to search through the spoken words in audio and video segments. While I was Vice President of Operations

and Technology, PodZinger followed its initial prototype with a full streaming audio and video search solution.

18. Furthermore, I have served as expert witness in over 150 patent-related cases where I wrote expert reports and testified in over 100 depositions on topics such as network communications and telecommunications, including Internet protocols, streaming media, antenna design, and mobile wireless technologies. I have testified in Federal courts, the PTAB, and the ITC on behalf of leading companies such as Amazon, AT&T, Cisco Systems, Google, Microsoft, Comcast, Time Warner Cable, Samsung, Netflix, Disney, and Apple.

19. I have been awarded several United States patents, including the following examples:

U.S. Pat. No.	Title
7,975,296	Automated security threat testing of web pages
7,877,736	Computer language interpretation and optimization for server testing
7,801,910	Method and apparatus for timed tagging of media content
7,590,542	Method of Generating Test Scripts Using a Voice-Capable Markup Language
7,860,999	Distributed computation in network devices
6,967,963	Telecommunication method for ensuring on-time delivery of packets containing time-sensitive data
7,359,993	Method and apparatus for interfacing external resources with a network element

20. Based on my above-described over three decades of experience in network usage and resource allocation and the acceptance of my publications and professional recognition by societies in my field, I believe that I am qualified to be an expert in the field of wireless technology.

21. Based on my experience described above, and as indicated in my *curriculum vitae*, I am qualified to provide the following opinions with respect the patents in this case. Additionally, I am at least a person having ordinary skill in the art, as I have set forth in §IV.D below, as of the priority date of the '100 Patent.

III. RELEVANT LEGAL STANDARDS

22. I do not provide any legal opinions in this Declaration. I have been informed and understand that certain legal standards are to be applied by technical experts in forming opinions regarding the meaning and validity of patent claims. I have been asked to provide my opinions regarding whether the challenged claims of the '377 Patent would have been anticipated in light of the prior art to a person having ordinary skill in the art at the time of the alleged invention.

23. I have been informed and understand that, to anticipate a claim under 35 U.S.C. § 102, a reference must teach every element of the claim

either expressly or inherently to a person having ordinary skill in the relevant art.

24. I have also been informed and understand that in order to establish inherency, the extrinsic evidence must make clear that the missing descriptive matter is necessarily present in the thing described in the reference and that it would be so recognized by persons of ordinary skill. I further understand, inherency may not be established by probabilities or possibilities. The mere fact that a certain thing may result from a given set of circumstances is not sufficient.

25. I also have been informed and understand that a patent claim is not patentable as obvious (a requirement I understand to be governed by a statute, 35 U.S.C. § 103) if the differences between the patent claim and the prior art are such that the claimed subject matter as a whole would have been obvious at the time the claimed invention was made to a person having ordinary skill in the relevant art. Obviousness, as I have been informed and understand, is based on the scope and content of the prior art, the differences between the prior art and the claim, the level of ordinary skill in the art, and, to the extent that they exist, certain objective indicia of non-obviousness.

IV. OVERVIEW

26. The Challenged Claims are unpatentable as obvious over the prior art. The claims are directed to prior art systems and combinations of conventional components that perform conventional functions in panel antennas having an environmental enclosure for housing electronics for wireless communications. More specifically, the Challenged Claims are directed to a six-sided (boxlike) enclosure (**purple**) for housing radios (**blue**) wherein one of the sides (called the cover (**gold**)) has one or more RF radiating modules (**orange**) fastened to its exterior surface that are covered by a radome (**green**).

27. FIG. 6 illustrates the claimed embodiment:

RF Modules (mounted
Between Radome and
Cover)

Radome

Cover

Enclosure

Radios

Heat Sink

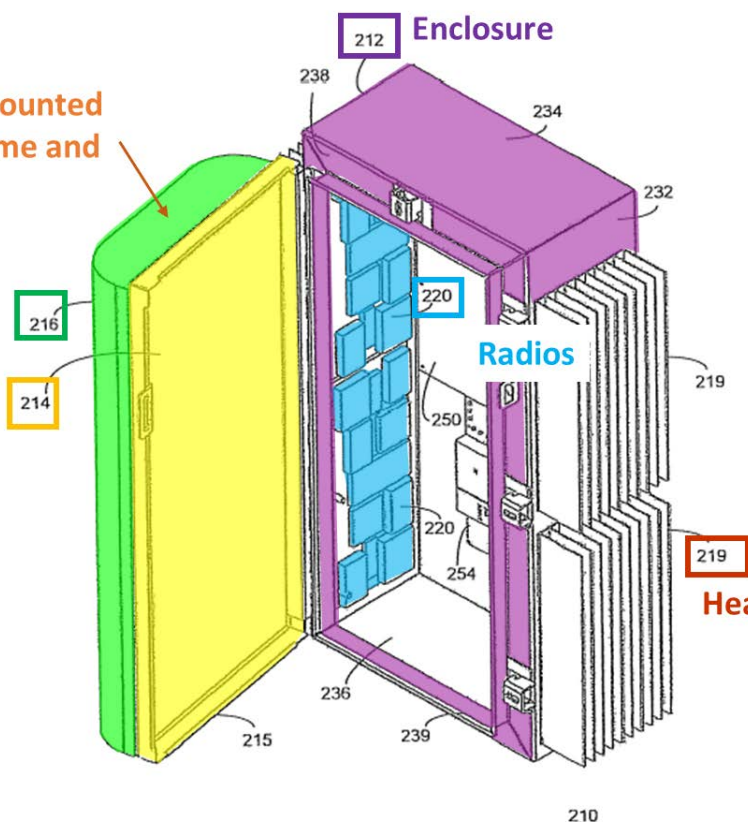


Figure 6

EX-1001 FIG. 6¹.

28. However, U.S. Patent Publication No. 2006/025311 (“Bishop”) (EX-1004) demonstrates that such a panel antenna having a six-sided (boxlike) enclosure for housing radios was known at the time of the ’813 Patent:

¹ My annotations are indicated in color on the Figs.

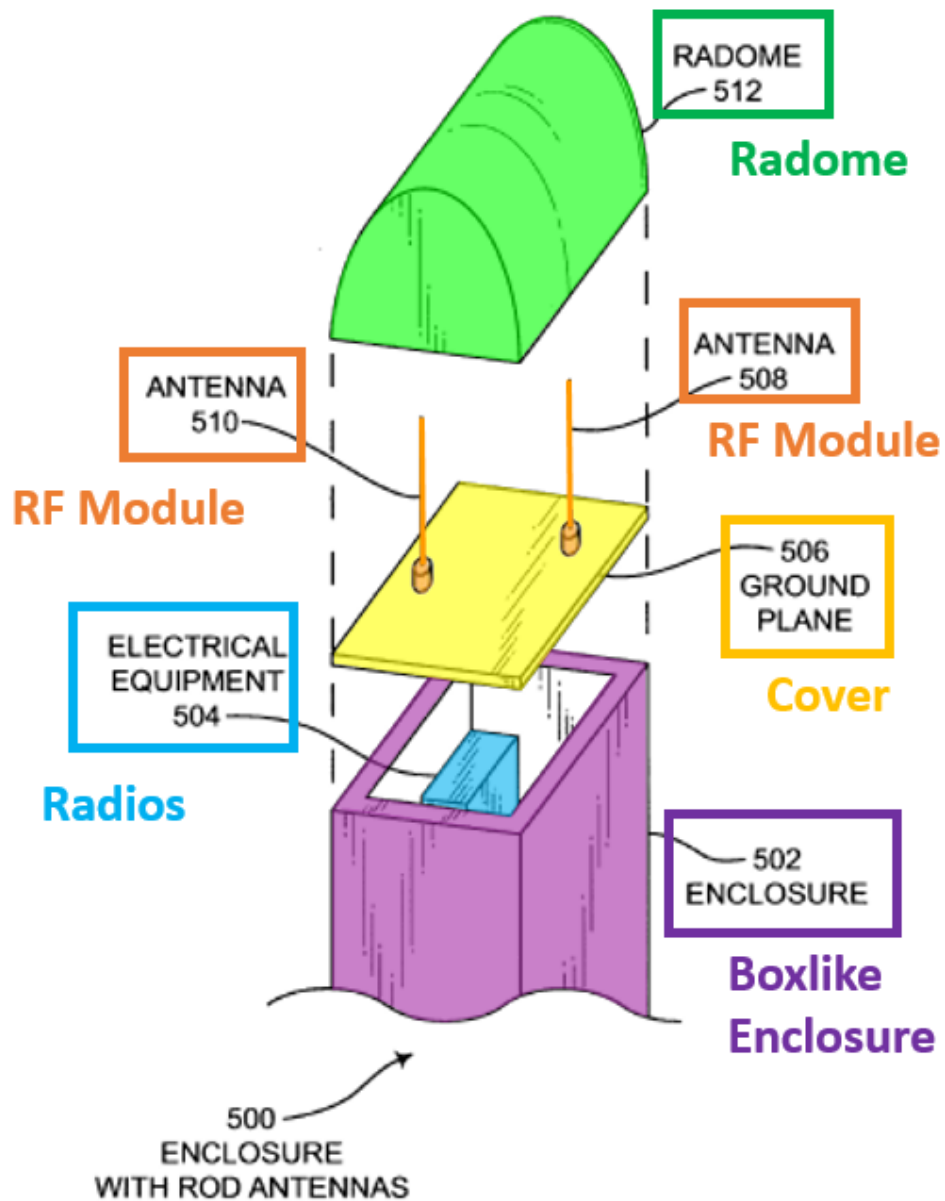


FIG. 5

EX-1004 FIG. 5

29. During prosecution, the applicant gained allowance of the Challenged Claims over a rejection based on Bishop by amending

Claim 1 to incorporate the limitations recited in original Claim 8, which the Office indicated would be allowable if rewritten in independent form.

EX-1002 36. Original Claim 8 read:

*8. The panel antenna of claim 1, wherein **a flange joins the first and second side walls and the top and bottom wall**, and **a lip extends from the flange**, further defining the aperture through which the cavity of the enclosure may be accessed, the lip being engaged by the internal cover to provide the environmental seal.*

EX-1002 249

30. The **flange/lip** feature recited in Claim 8 is illustrated in FIG. 6 below:

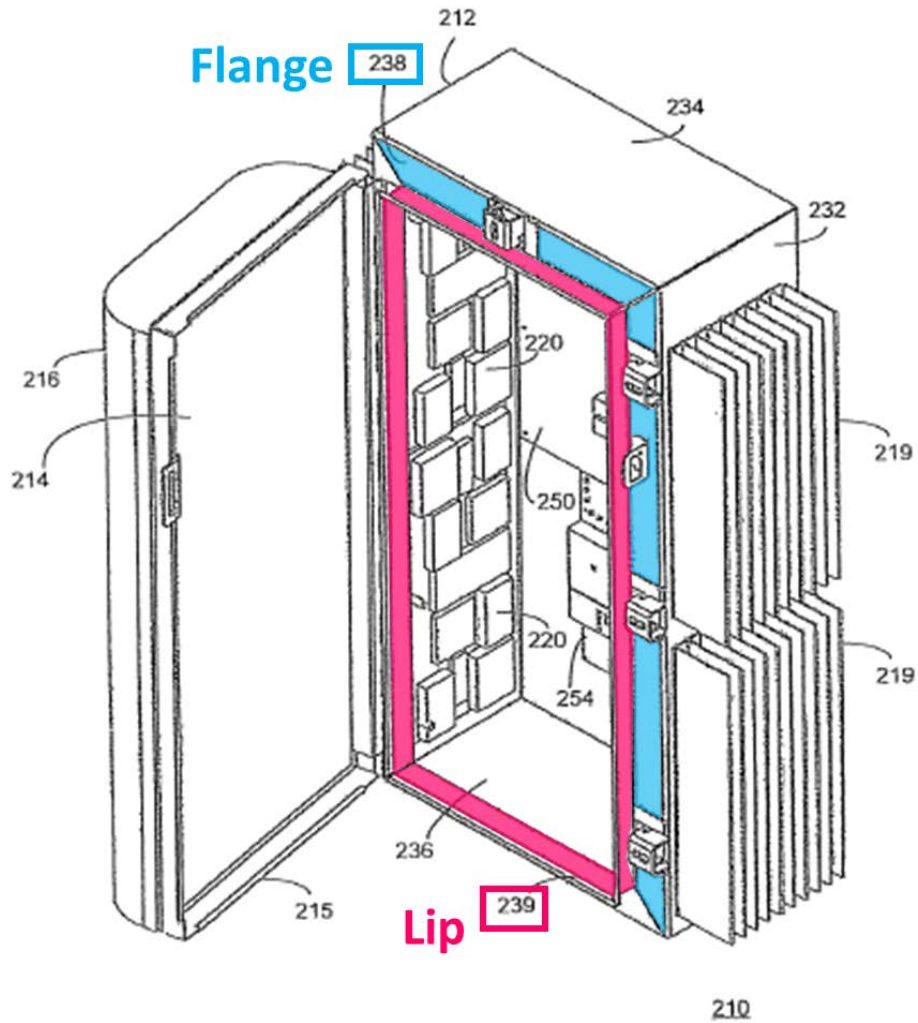


Figure 6

EX-1001 FIG 6

31. As illustrated below, Bishop embodies the recited **flange**, but not the **lip**:

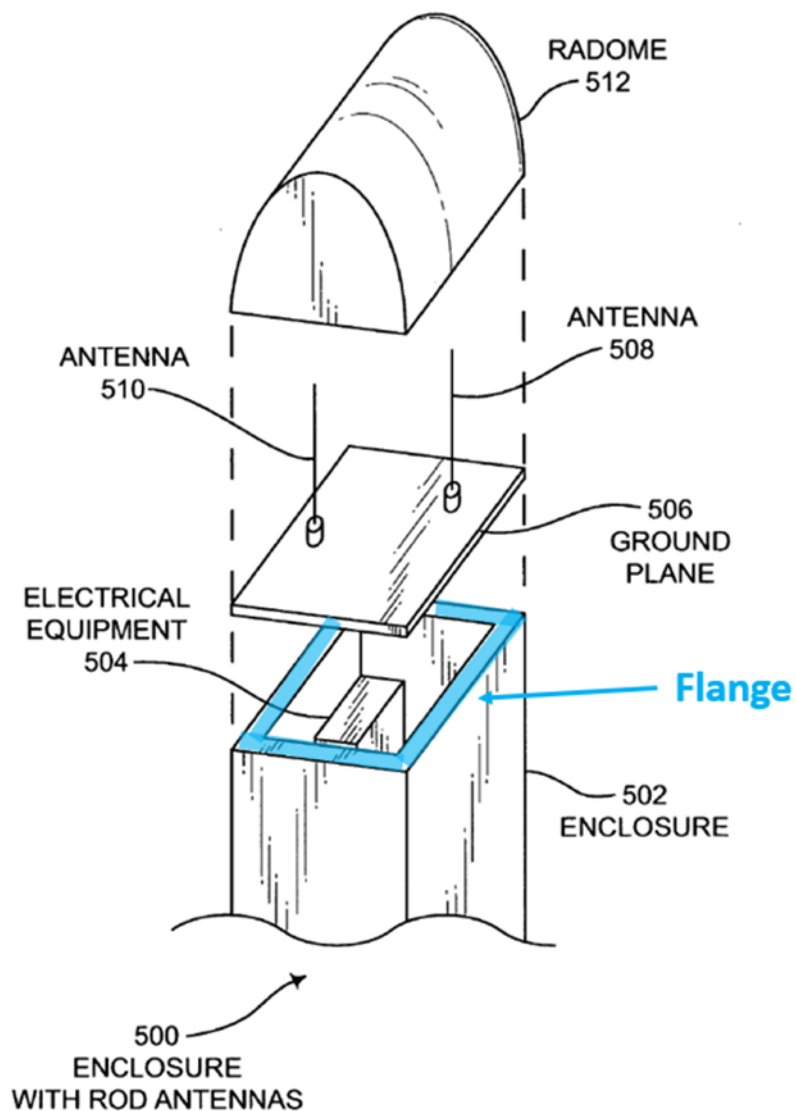
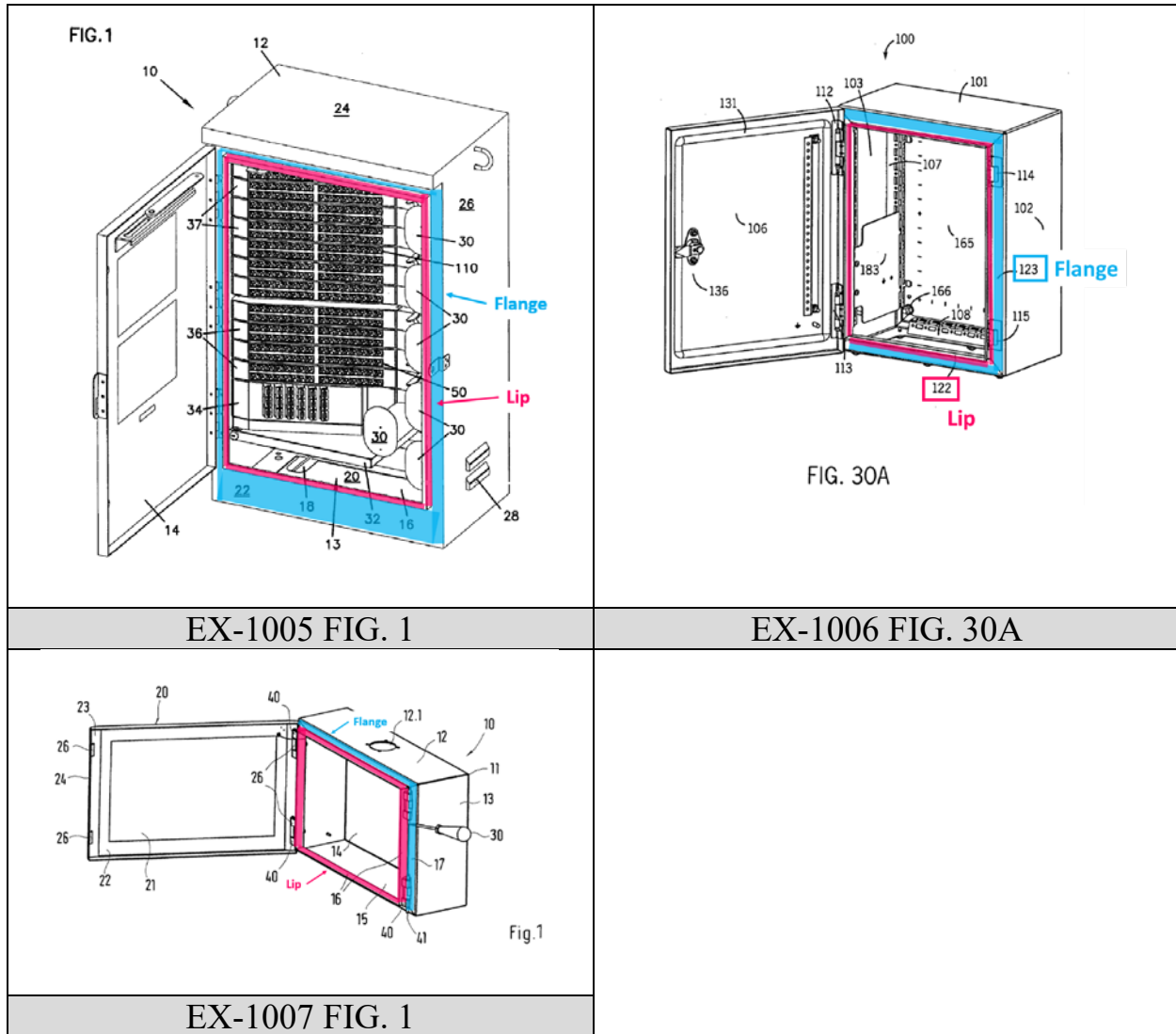


FIG. 5

EX-1004 FIG. 5

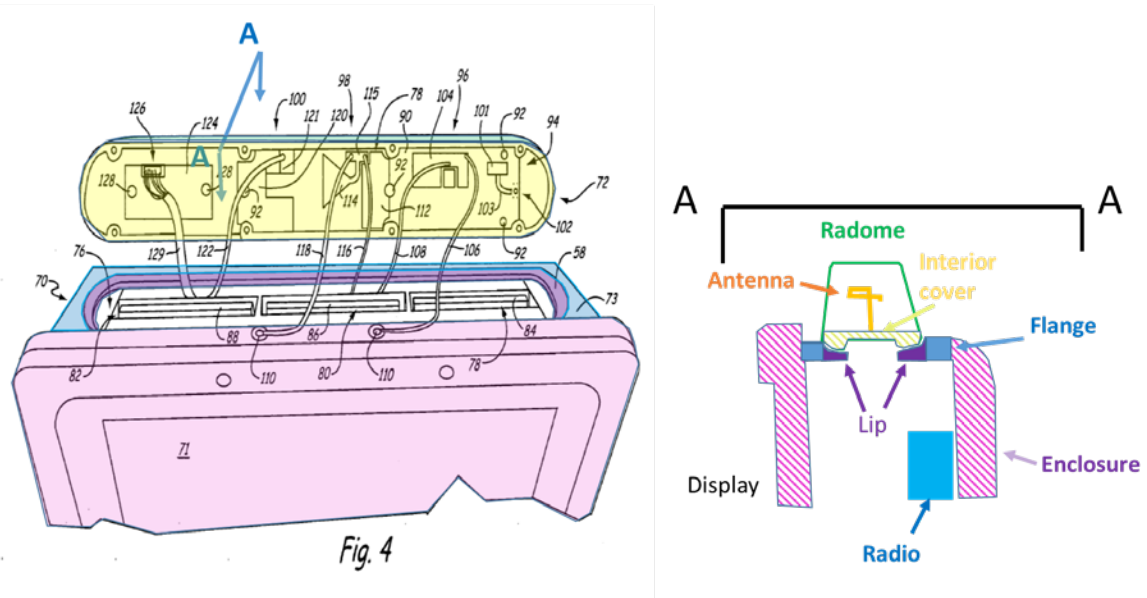
32. However, the flange/lip feature that formed the basis for allowance of the Challenged Claims was well known for engaging a panel to a boxlike enclosure to provide an environmental seal, and, specifically,

was well known in environmental enclosures housing communications equipment as demonstrated by the following examples:



33. In addition, U.S. Patent Publication No. 2006/0181462 (“Kelly”)(EX-1009), discloses the claimed panel antenna including the flange/ lip feature. Kelly discloses an enclosure with a hinged cover having external antennas covered by a radome that forms an environmental

seal with the enclosure by engaging the flange/lip feature formed by the enclosure.



EX-1009 Fig. 4.

34. As demonstrated by Bishop and Kelly, a panel antenna having a six-sided (boxlike) enclosure for housing radios was well known at the time of the purported invention. In addition, the flange/lip feature for providing an environmental seal was also well known as demonstrated by Kelly, and the other identified prior art enclosures that house communications equipment. These references are naturally combined together, and the combinations discloses each limitation recited in the Challenged Claims.

V. BACKGROUND

A. Summary of the '813 Patent

35. The '813 Patent is titled “Panel Antenna Having Sealed Radio Enclosure” and particularly identifies the field of invention as relating to “arrangements of passive and active components in an [sic] multiple radiating element panel antenna.” EX-1001 Title, 1:7-10.

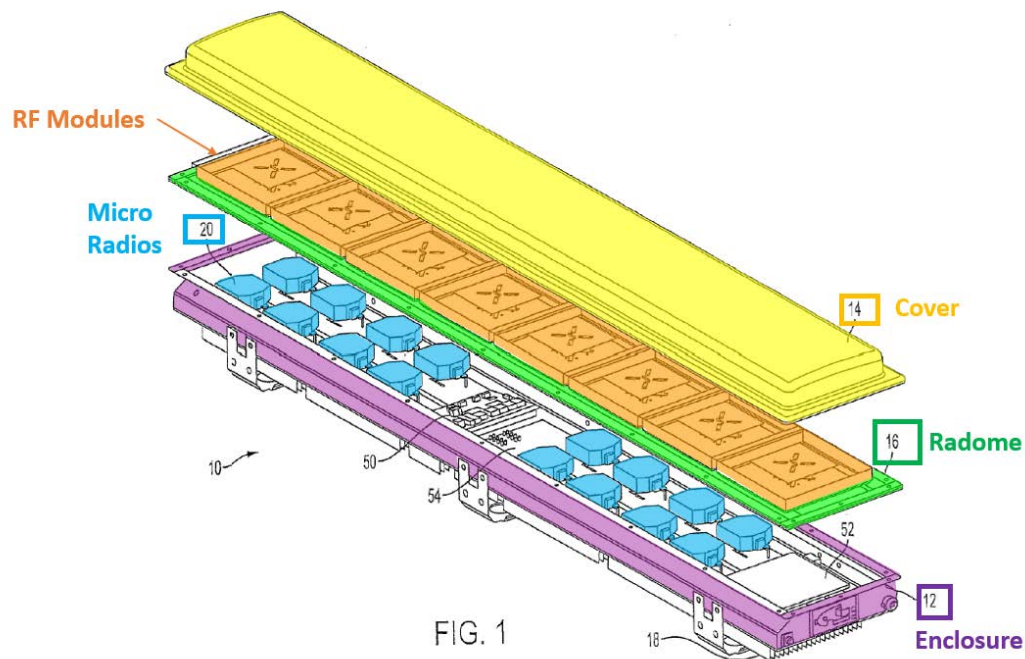
36. The '813 Patent summarizes the invention as a panel antenna including:

- (1) an enclosure defining a cavity and an aperture for accessing the cavity;
- (2) a cover dimensioned to overlap the aperture of the enclosure;
- (3) a radome;
- (4) a heat sink mounted to an external surface of the enclosure;
- (5) at least one active radio component (e.g., micro radio(s)) mounted inside the cavity of the enclosure; and
- (5) at least one passive radio element (e.g., RF radiating module(s)) mounted external to the cavity of the enclosure.

EX-1001 2:7-23.

37. The '813 Patent describes two embodiments differing in the positional relationship between the cover, radome, and the passive radio

element(s). In a first embodiment (“Embodiment I”), the cover is positioned exterior to the radome such that the passive radio element(s) are positioned between an interior surface of the cover and the radome. The ’813 Patent provides FIG. 1 as an illustration of Embodiment I:



EX-1001 FIG. 1.

38. With reference to FIG. 1, the ’813 Patent explains that panel antenna 10 comprises an enclosure 12 (**purple**), cover 14 (**gold**), and radome 16 (**green**). The panel antenna includes a plurality of micro radios 20 (**blue**) mounted within the enclosure 12 that may be thermally coupled to heat sinks 18. As illustrated in this embodiment (Embodiment I), a plurality of RF modules 24 (**orange**) are positioned between an internal

surface of cover 14 and radome 16 with the external surface of cover 14 forming an outer surface of panel antenna 10. EX-1001 3:51-59.

39. The '813 Patent also describes a second embodiment (“Embodiment II”) wherein the radome is positioned exterior to the cover such that the passive radio elements(s) (e.g., RF module(s)) are positioned between an exterior surface of the cover and the radome. The '813 Patent provides FIG. 6 as an illustration of Embodiment II:

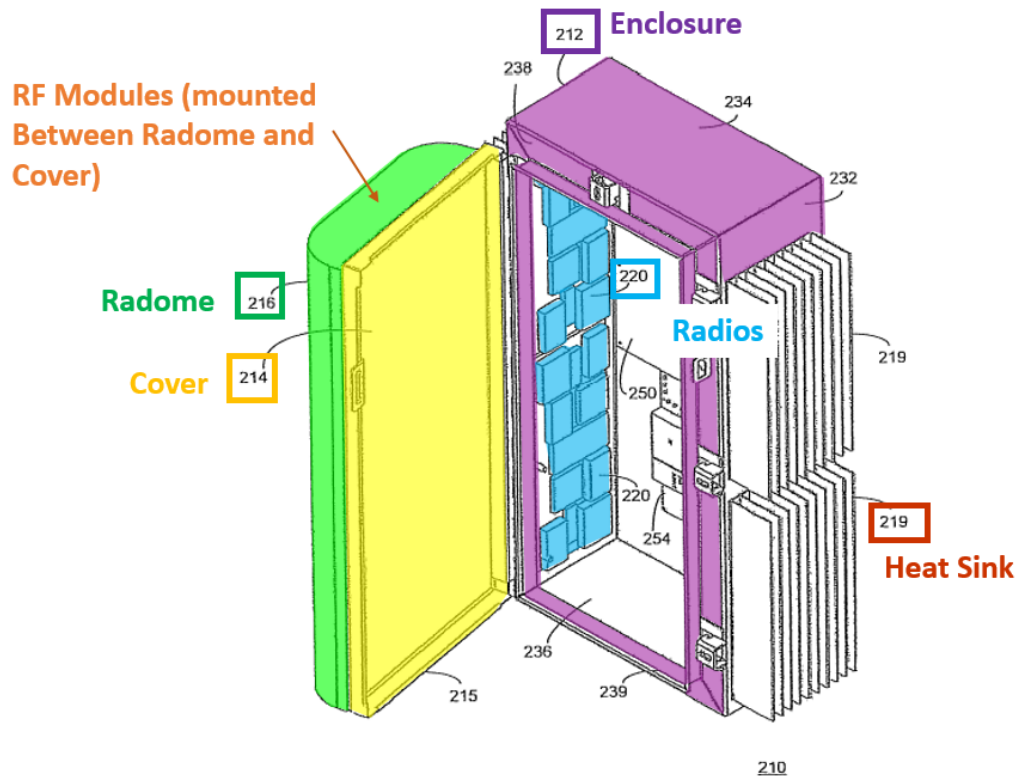
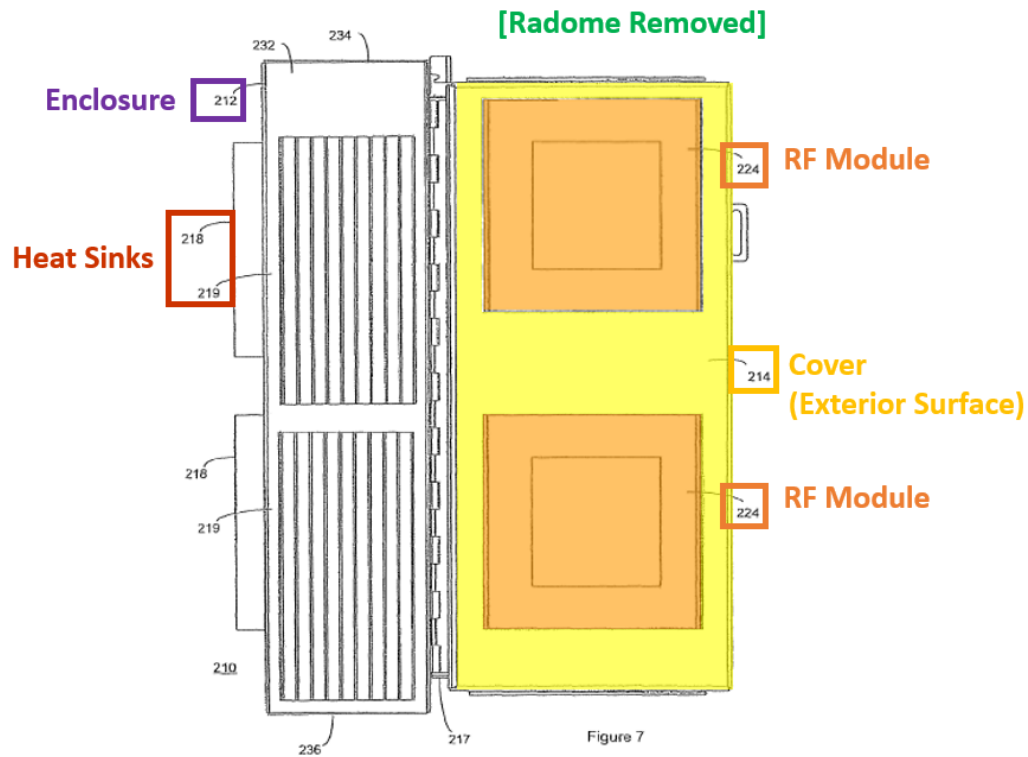


Figure 6

EX-1001 FIG. 6.

40. With reference to FIG. 6, the '813 Patent explains that panel antenna 210, like panel antenna 10 illustrated in FIG. 1 (Embodiment I), comprises an enclosure 212 (**purple**), cover 214 (**gold**), and radome 216 (**green**). The panel antenna includes a plurality of micro radios 220 (**blue**) mounted within the enclosure 212 that may be thermally coupled to heat sinks 219. As illustrated in this embodiment (Embodiment II), radome 216 (**green**) is positioned external to cover 214 (**gold**) such that the external surface of radome 216 forming an outer surface of panel antenna 210. EX-1001 6:65-7:7;

41. The '813 Patent provides FIG. 7 as a side view of panel antenna 210 with the radome 216 removed so that RF modules 224 are visible:



EX-1001 FIG. 7.

42. The '813 Patent explains that, with radome 216 removed, one or more RF modules 224 (**orange**) are visible and are mounted to an exterior surface of cover 214 (**gold**) such that when radome 216 is installed, the RF module(s) 224 are positioned within an enclosure formed by cover 214 and radome 216. EX-1001 7:6-9, 8:3640, 8:57.

43. The Challenged Claims are directed to Embodiment II of the panel antenna as described above wherein the RF module(s) are mounted to an exterior surface of the cover and enclosed by a radome (as indicated

by the bolded text), and also include the **flange/lip** feature. Specifically,

Claim 1 reads:

A panel antenna, comprising:

an enclosure, the enclosure including a rear panel, a first side wall, and a second side wall, a top wall and a bottom wall, the rear panel and the walls defining a cavity, the walls further defining an aperture through which the cavity of the enclosure may be accessed,

*an internal cover, the internal cover being dimensioned to overlap an area defined by the aperture of the enclosure and providing an environmental seal and electromagnetic shielding for the cavity, **the internal cover having at least one RF radiating module fastened to an exterior surface thereof,***

at least one micro radio mounted to an internal surface of the first side wall, the micro radio being coupled to the RF radiating module;

a first heat sink, mounted to an external surface of the first side wall, and

*a radome, **the radome mounting to the internal cover and enclosing the RF radiating module;***

wherein a flange joins the first and second side walls and the top and bottom wall, and a lip extends from the flange, further defining the aperture through which the cavity of the enclosure

may be accessed, the lip being engaged by the internal cover to provide the environmental seal.

B. Claim Construction

44. I have been informed to give each claim term in the Challenged Claims its plain and ordinary meaning in this proceeding. It is my opinion that no specific construction of any claim term is required because the prior art I have relied upon meets each of the claim terms under any reasonable construction.

C. Priority Date of the Challenged Claims

45. I understand the application from which the '813 Patent issued from U.S. Patent Application No. 12/792,367 was filed on Jun. 12, 2010 (the "CIP Application") as a continuation-in-part of application No. PCT/US2009/066345 filed on Dec. 2, 2009 (the "CIP Parent Application"), claiming priority to Provisional Application No. 61/119,114 filed on Dec. 2, 2008, and I have been instructed to assume the earliest possible priority date of the challenged claims is that of the provisional filing Dec. 2, 2008.

46. However, in the event the PO attempts to swear behind the references, I understand, the Challenged Claims are each directed to Embodiment II and thus recite new matter not disclosed in the CIP Parent Application that discloses only Embodiment I. Thus I understand that the

Petitioners have reserved the right to assert the Challenged Claims are entitled to a priority no earlier than the Jun. 2, 2010 filing date to the CIP Application that issued as the '813 Patent.

D. Person of Ordinary Skill in the Art

47. With respect to the '813 Patent, a POSA in late 2008 would have been familiar with electronic devices, radio communication, environmental enclosures, and heat management. A POSA would have a working knowledge of deleterious environmental effects on outdoor electronics and be aware of prophylactic measures routinely used against these effects.

48. A POSA would have gained knowledge of these concepts through a mixture of training and work experience, such as by having a Bachelor's degree in Electrical or Mechanical Engineering or equivalent and four years of experience; or by obtaining a Master's degree in Electrical or Mechanical Engineering or equivalent , but having only one to two years of experience; or by having no formal education but experience in radio communications and environmental enclosures of at least eight years.

E. State of the Art

49. The following section describes the state of the art in radio equipment enclosures as of late 2008. The prior art references, and the discussions of what was known to a POSA, provide the factual support for the general description of the state of the art at the time of the invention, provide additional motivation to modify or combine the reference Accordingly, these references should be considered by the Board.

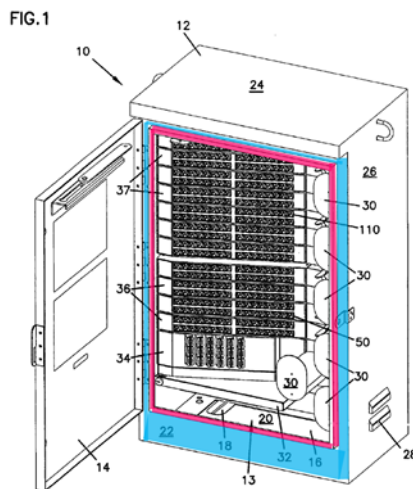
1. Radomes

50. It was well known in the art to protect antennas from environmental hazards with the use of radomes. Radomes are made of radar transparent materials as to not interfere with the operation of the transmission or reception of radio waves while protecting the antenna against rain, moisture and foreign objects. For example Aakula discloses the “antenna 20 is protected from the elements by the radome 30” and “is formed of non-conductive (i.e., insulative) material” so that the radio waves pass through the radome “without distortion or attenuation.” EX-1008 2:54-3:1.

2. Environmental Enclosures – flange/lip feature

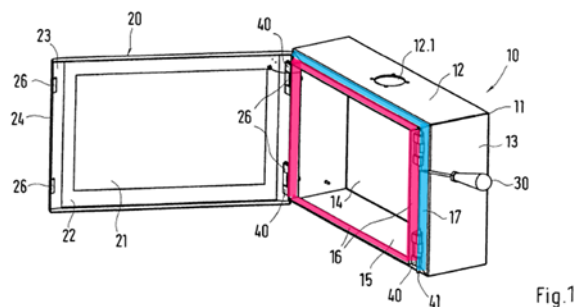
51. Environmental enclosures for electronics and radio communications are ubiquitous. A common focus for these environmental enclosures are integration of access panels/doors that allow for

maintenance/repair of the components inside while ensuring the access panels/doors do not compromise the protection from the elements. Many approaches rely upon the interaction of flanges and lips on the enclosure with the access panel/door to ensure an environmental seal. For example Solheid discloses a flange that forms a front wall (blue) with a lip (pink) extending therefrom as shown in Fig. 1. A cooperating lip on the door overlaps the enclosure lip to “seal interior from the elements when the door is closed.” EX-1005 5:3-13.



EX-1005 Fig. 1.

52. Similarly Neuhoff discloses a housing with a bending (flange) 17 (blue) from which an angular edge (lip) 16 (pink) extends and interacts with a cooperating overlapping edge of the door to form a retaining area as shown in Fig. 1.



EX-1007 Fig. 1.

VI. IDENTIFICATION OF CHALLENGES

A. Challenged Claims

Claims 1, 2, and 4-7 of the '813 Patent are challenged in this Petition.

B. Statutory Grounds for Challenges

The Challenges are set forth in detail below and summarized as follows:

Ground	Claims	Basis	Reference
1	1, 2, 4-7	§ 103	Bishop in view of Avramis, Lakoduc and/or Korte.
2	1, 2 and 7	§ 103	Kelly alone or in combination with Avramis

C. Prior Art Basis

53. I have been informed that U.S. Patent Publication No. 2006/0250311 ("Bishop") (EX-1004) and U.S. Patent Publication No. 2006/0181462 A1 ("Kelly") (EX-1009) qualify as prior art under §102(b) for purposes of this IPR. I have also been informed that U.S. Patent Publication No. 2007/0296518 ("Avramis") (EX-1010) qualifies as prior

art under §102(a) or (e). I have been further informed that U.S. Patent Publication No. 2009/0134755 (“Lakoduc”) (EX-1006) and International Publication Number WO 2008/009421 (“Korte”) (EX-1011) qualify as prior art under § 102(a).

VII. IDENTIFICATION OF HOW THE CHALLENGED CLAIMS ARE UNPATENTABLE

A. Challenge 1: Claims 1, 2, and 4-7 are obvious over Bishop in view of Avramis, Lakoduc and/or Korte.

1. The Bishop Reference

54. Bishop is titled “Enclosure With Ground Plane” and is generally directed to “[a] system and method for mounting one or more radio antennas in an outdoor enclosure” wherein the “outdoor enclosure may have a weather-proof radome mounted around the antennas” and may include “one or more radio transceivers in the enclosure 102.” EX-1004 Title, Abstract, [0031].

55. Like the ’813 Patent, Bishop discloses a boxlike enclosure for housing radios wherein one of the panels forms a multiple radiating element panel antenna having the same arrangements of passive and active components summarized by the ’813 Patent as its purported invention:

- (1) a boxlike enclosure (**purple**) defining a cavity;
- (2) a cover (**gold**) dimensioned to overlap an aperture of the enclosure;

- (3) a radome (**green**);
- (4) at least one active radio component (**blue**) (e.g., micro radio(s)) mounted within the enclosure; and
- (5) at least one passive radio element (**orange**) (e.g., RF radiating module(s)) mounted external to the enclosure.

56. FIGs. 1 and 5 illustrate embodiments:

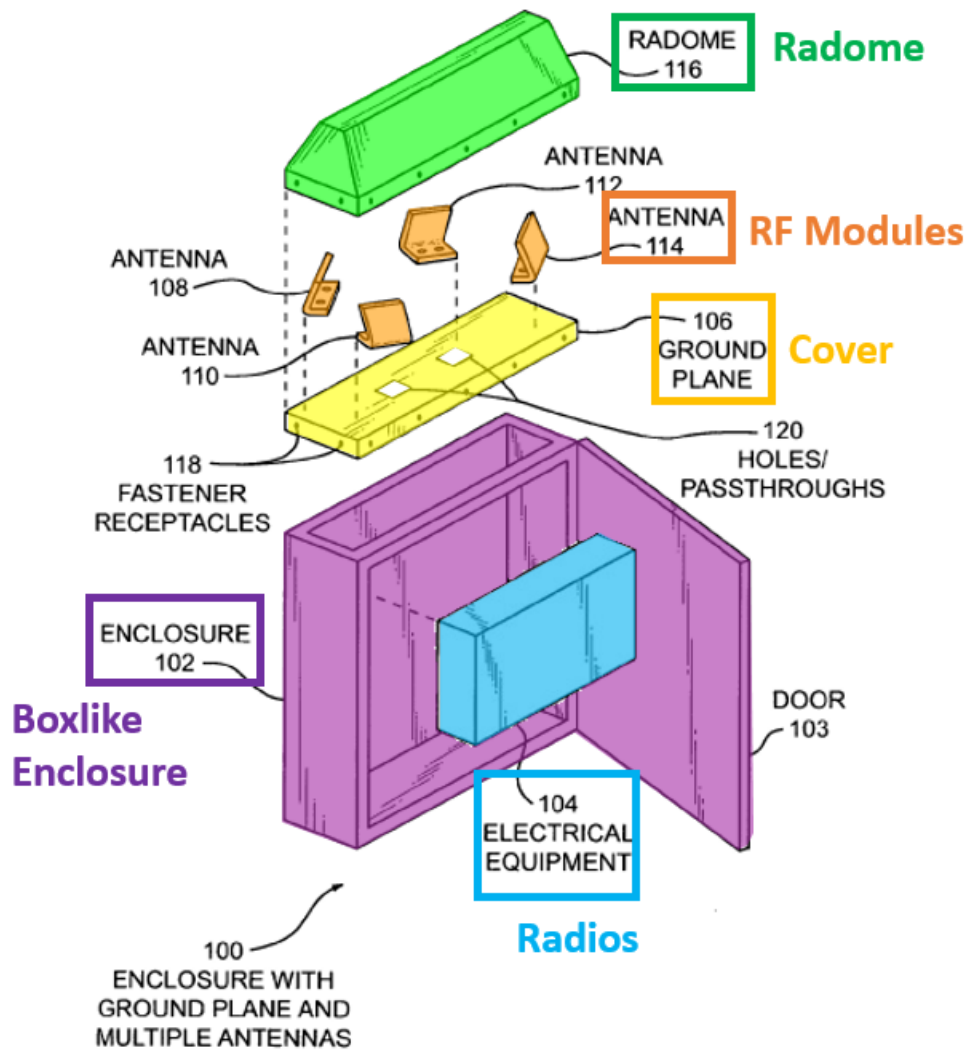


FIG. 1

EX-1004 FIG. 1.

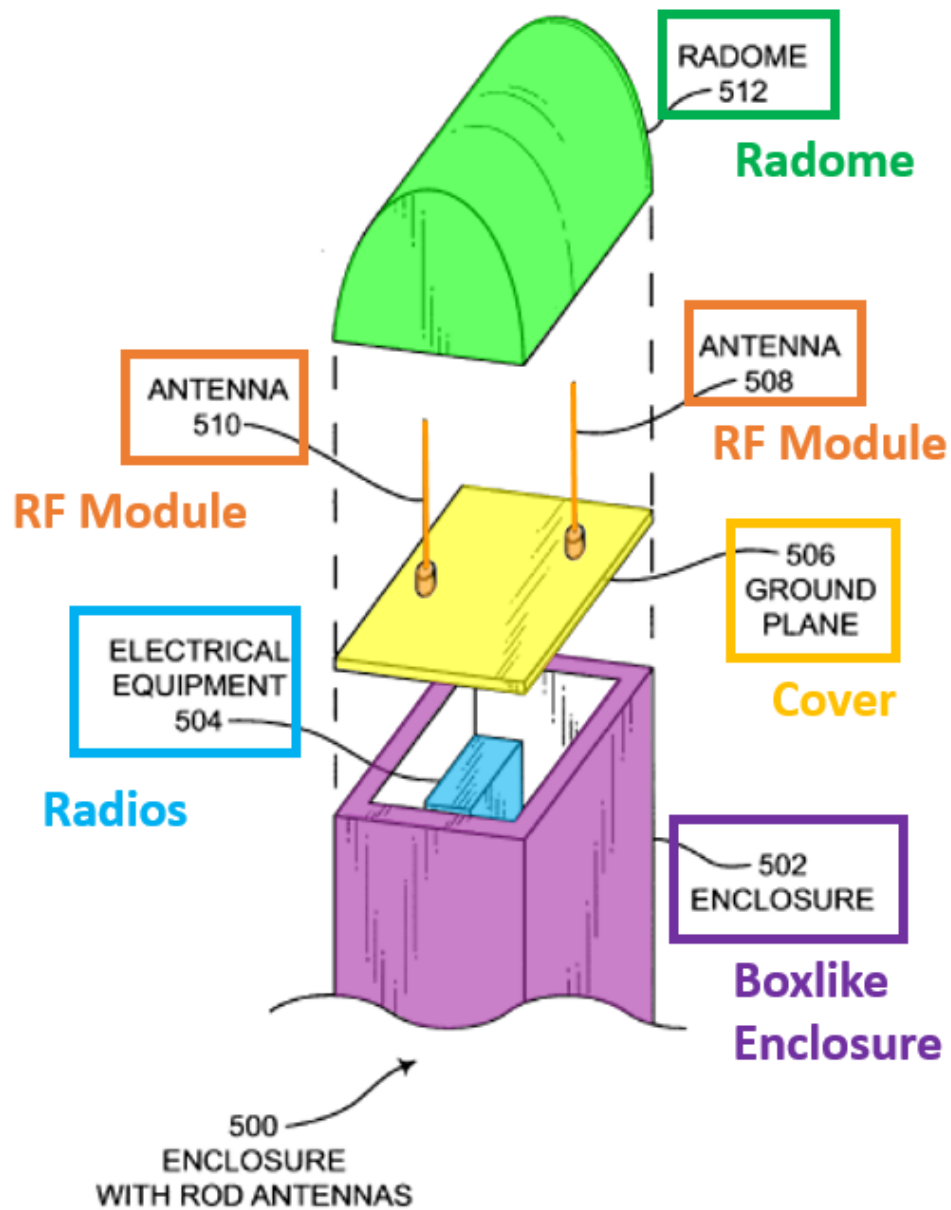


FIG. 5

EX-1004 FIG. 5.

57. Bishop explains that enclosure 102, (purple) may include door 103 as illustrated in FIG. 1 that may be of any type of access to electrical

equipment 104 (blue) housed within the enclosure. Door 103 may be hinged, or may be a removable panel. In some embodiments, enclosure 502 (purple) may not include a door as illustrated in FIG. 5, such that access to the interior of the enclosure would be by some other means. EX-1004 [0027], [0052].

58. Enclosure 102, 502 houses electrical equipment 104, 504 (blue) within an interior cavity. Bishop states “electrical equipment 104 may be any type of electrical equipment whatsoever” and that [i]n some cases, a transformer, power supply, or various radio frequency (RF) devices may be present either separately or as part of a single device.” EX-1004 [0029]. Bishop further states

In a typical enclosure used for wireless communications, a network signal may be transmitted through a cable or fiber optic connection into the enclosure. Power supplies, converters, modems, and various electrical devices may process incoming signals and connect to one or more radio transceivers. The transceiver may connect to one or more antennas located above the ground plane 106.

EX-1004 [0030].

59. Bishop explains that ground plane 106, 506 (gold) may be mounted to form a panel of enclosure 102, 502. Antenna 108-114, 508-510 (orange) are mounted to the exterior surface of ground plane 106, 506.

The antenna may be panel type antennae or any other type of antenna may be used, including dipole, rod, diversity, sectorized, parabolic, or any antenna imaginable. EX-1004 [0024, [0040].

60. Ground plane 106, 506 may shield the various antennae from interference from electrical equipment 104. Ground plane 106 may be manufactured from metal, including various steels, aluminum, brass, or other conductive metal, or ground plane 106 may be treated with a metallic or other conductive coating that may provide corrosion protection. EX-1004 [0032].

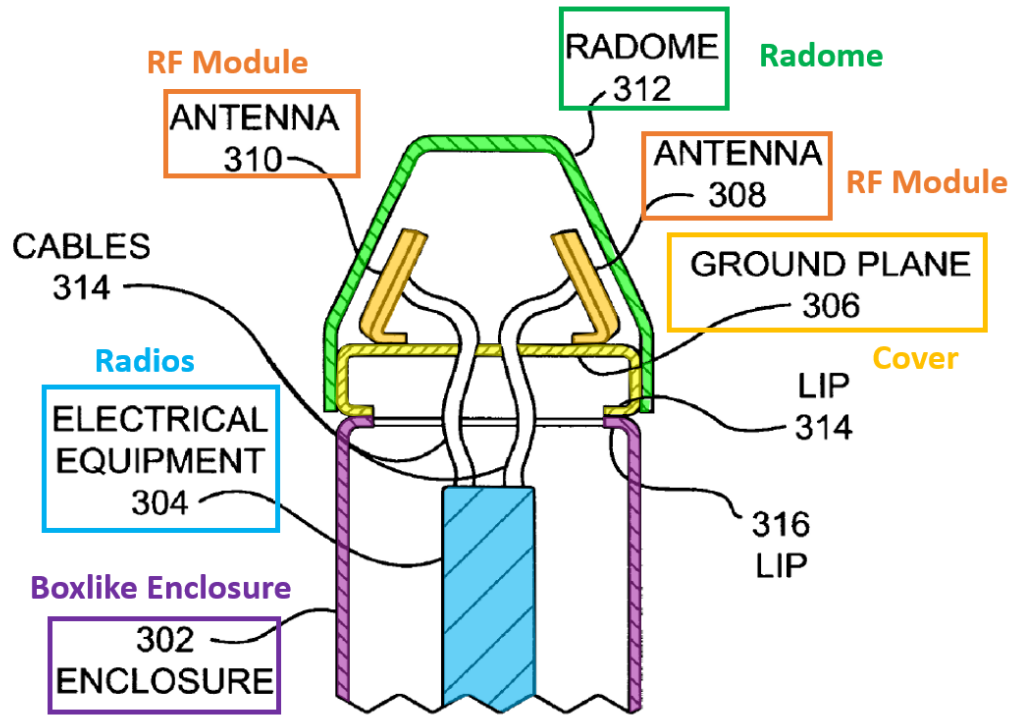
61. Ground plane 106 may prevent unwanted interference between noise or other energy generated within the enclosure 102 from interfering with or otherwise degrading the performance of signals transmitted or received on the antennae. EX-1004 [0037].

62. Ground plane 106, 506 may have several holes or pass throughs 120 so that connections between a radio transmitter within enclosure 104, 506 and the antennae may be made by passing a cable through the holes 120. EX-1004 [0036].

63. Radome 116, 516 (**green**) covers the antennae and may be a nonconductive cover that protects the antennae. The radome may be attached directly to the ground plane through the use of fastener holes 118

or by any other mechanical attachment. The radome may also be sealed in a weather-tight manner with gasketing to prevent water or dust infiltration. EX-1004 [0043].

64. FIG. 3 is a cross-sectional illustration of an embodiment 300:



EX-1004 FIG. 3.

65. Bishop explains that embodiment 300 includes enclosure 302 (purple) housing electrical equipment 304 (including radios) (blue) having ground plain 306 (gold) attached to enclosure 302 to thereby form the top panel of the boxlike enclosure. Ground plane 306 may be attached to

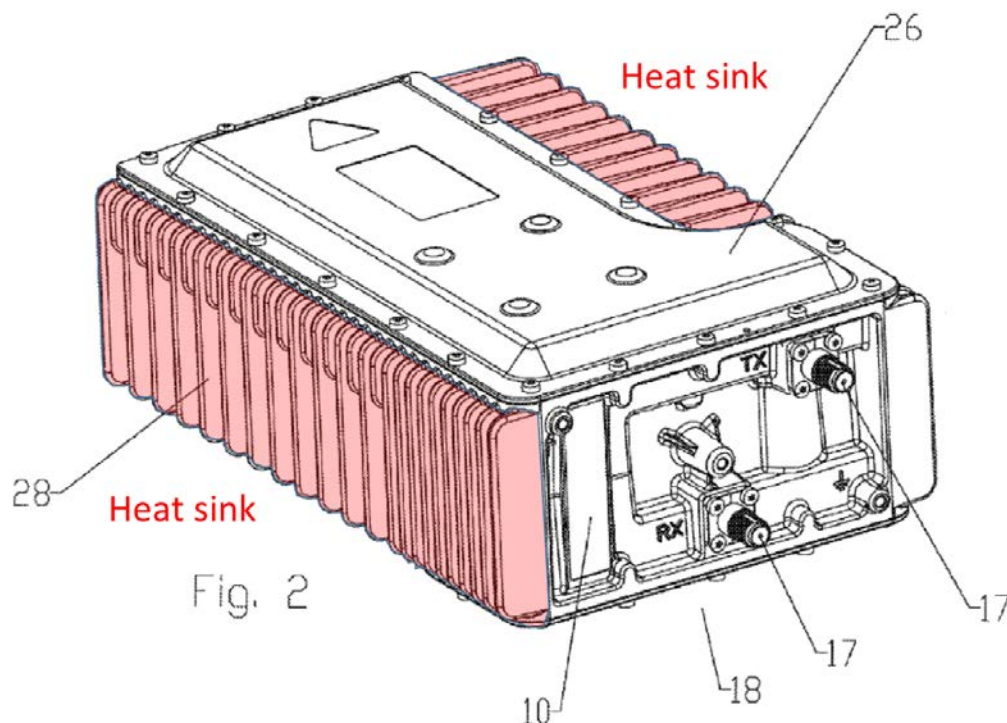
enclosure 302 by fastening through mated lips 314 and 316.² A gasket or sealant may also be used between lips 314 and 316. EX-1004 [0045-46].

66. Antennas 310 (**orange**) are mounted to the exterior surface of ground plane 306 and are covered by radome 312 (**green**), which may be fastened to ground plane 306. EX-1004 [0045], [0048].

2. The Avramis Reference

67. Avramis discloses a transceiver enclosure with heat sinks 28 arranged on the exterior sides of the enclosure for “the dissipation of heat generated by transceiver operation.” EX-1010 [0011], [0016], FIG. 2.

² In view of the unambiguous disclosure of FIG. 3, Bishop’s identification of radome 312 rather than ground plane 306 as being attached through lips 314 and 316 appears to be an error. EX-1004 [0046].



EX-1010 FIG. 2.

3. The Lakoduc Reference

68. Lakoduk (EX-1006) is titled “Configurable Enclosure For Electronics Components” and is generally directed to boxlike enclosures for housing electronic components. EX-1006 Title, Abstract.

69. Lakoduk summarizes the disclosure:

Described herein is technology for, among other things, enclosures for electronic components and methods for manufacturing the same. In one embodiment, the enclosure includes first and second sidewalls formed from a single elongated piece of sheet metal. The first sidewall, the second

sidewall, a third sidewall, and a fourth sidewall define an interior space of the enclosure. At least one of the first and second sidewalls includes an edge region folded inwardly relative to the interior space to form a mounting channel. The enclosure further includes a backwall coupled with first edges of the sidewalls and a door hingedly coupled with a second edge of at least one of the sidewalls.

EX-1006 [0007].

70. An embodiment of the enclosure is illustrated in FIG. 30A:

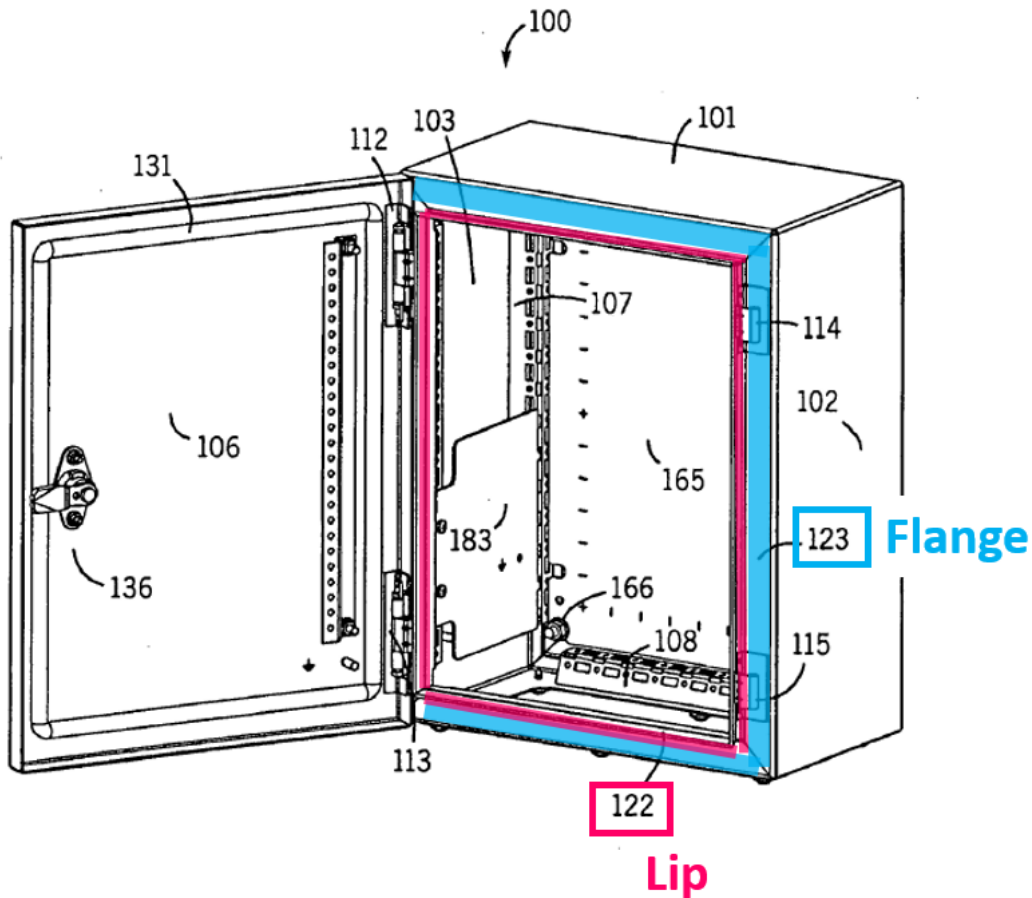


FIG. 30A

EX-1006 FIG. 30A.

71. Lakoduc explains that enclosure 100 includes four sidewalls 101-104 that are each turned inward to create a front perimeter 123 (blue) that is substantially parallel to the back wall 105 (shown in FIG. 8). The front perimeter may be folded outward to create flange 122 (pink) that may extend perpendicular or at an angle from the front perimeter 123. EX-1006 [0106].

72. Lakaoduk also explains that a gasket 131 positioned on the door 106 “engage[s] the front flanges 122 when the door is closed to help provide a substantially water-tight barrier to the inside of the enclosure 100.” EX-1006 [0110].

4. The Korte Reference

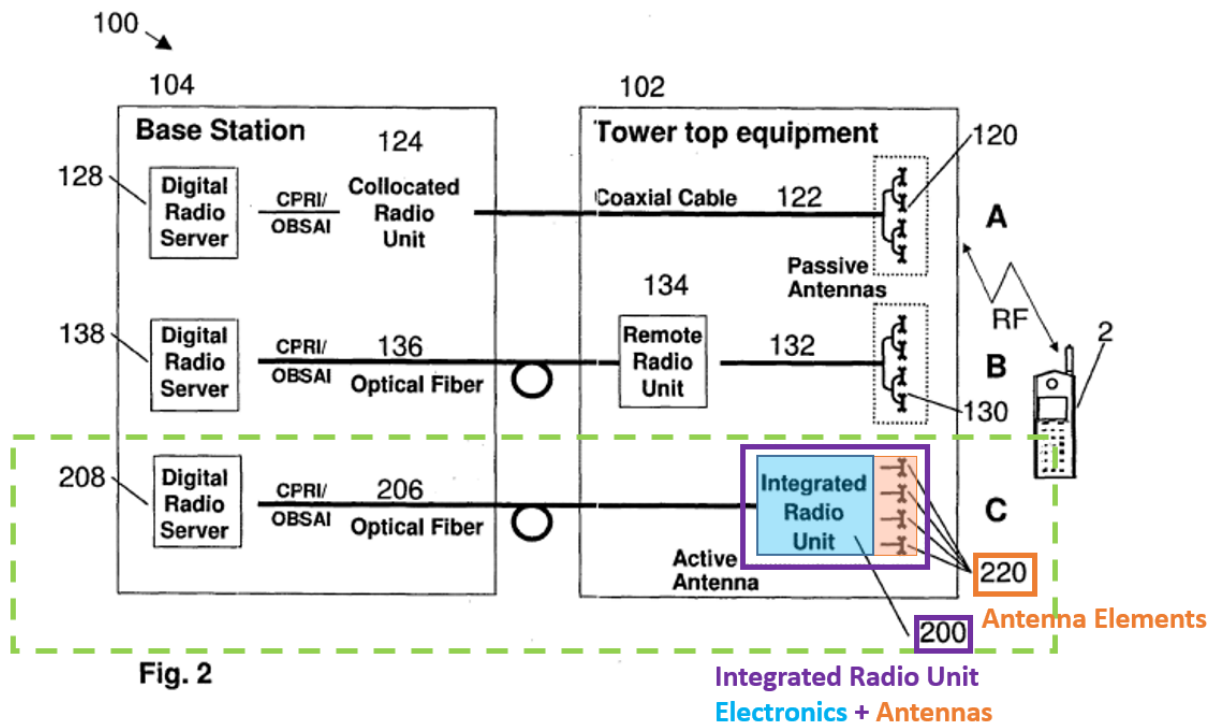
73. Korte is titled “Antenna Array System” and is generally directed to “base transceiver stations and antennas for mobile communication systems.” EX-1011 Title, 1:7-8. Korte summarizes an object of the invention as providing “a digital radio unit that can be installed at the tower top equipment of a BTS in close proximity of the antenna.” EX-1011 4:15-16. Korte further summarizes that invention:

The antenna system comprises a digital radio unit connectable to at least one antenna element, wherein the digital radio unit comprises: **at least one micro radio** for receiving and/or sending digital radio signals having a digital down-converter and/or a digital up-converter and a digital signal converter, whereby the at least one micro radio converts the digital radio signals to analogue RF (radio frequency) signals and vice versa; **at least one hub** for processing digital radio signals and control signals and for routing said digital radio signals and control signals via at least one digital link and at least one interface, the at least one digital link (260) being provided between the at least one hub and the at least one micro radio (230). The radio

communications stationary transmission/receiving apparatus can be used in mobile communications networks but can also be used in other communication networks.

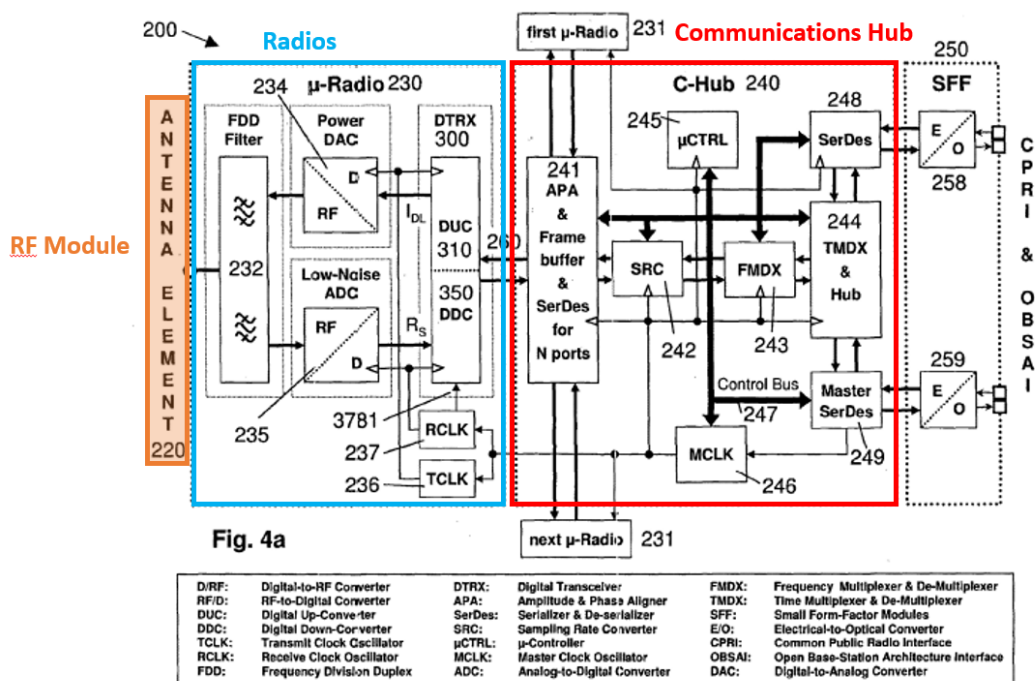
EX-1011 4:21-5:2 (emphasis added).

74. FIG. 2 illustrates three embodiments:



EX-1011 FIG. 2.

75. Korte explains that, in one embodiment (configuration (C) (green)), the integrated radio unit 200 (purple) is directly connected to the plurality of antenna elements 220 (orange) forming the antenna. EX-1011 11:7-8. This configuration is further illustrated in FIG. 4a:



EX-1011 FIG. 4a.

76. Korte explains that integrated radio unit 200 includes one or more micro radios 230 (blue) and a communications hub C-hub 240 (red) connected via a digital bi-directionally serial link (260). One or more antenna elements 220 (orange) are directly connected to the micro radios 230. The antenna element 220 may be mounted on an antenna board or another circuit board onto which the micro radio 230 is arranged or attached. EX-1011 13:6-10.

77. Korte further explains that a “micro-sniffer” (μS) 250 may be connected to one of the C-Hubs 240 for monitoring and calibrating purposes. The micro-sniffer 250 is a special micro radio having inverse

receive and transmit frequency band. The micro-sniffer 250 can be connected to the C-Hub 240 via the same or a similar interface. The micro-sniffer 250 additionally has an antenna 255 that may have the form of an antenna element or another form. The micro-sniffer 250 transmits pilot signals towards and detects the radiation emitted from the antenna elements 220, thus providing the C-Hubs 240 with feedback control information as required by the micro radios 230 for calibration purposes. EX-1011 12:29-13:4.

5. Detailed Application of the References to the Challenged Claims

Claim 1

[1.0] *A panel antenna, comprising:*

78. To the extent the preamble is limiting, Bishop discloses element [1.0]. Bishop is titled “Enclosure With Ground Plane” and is directed to “[a] system and method for mounting one or more radio antennas in an outdoor enclosure” wherein the “outdoor enclosure may have a weather-proof radome mounted around the antennas” and may include “one or more radio transceivers in the enclosure 102.” EX-1004 Title, Abstract, [0031].

79. Bishop provides FIGs. 1 and 5 as exploded perspective views of different embodiments of the enclosure with antennas:

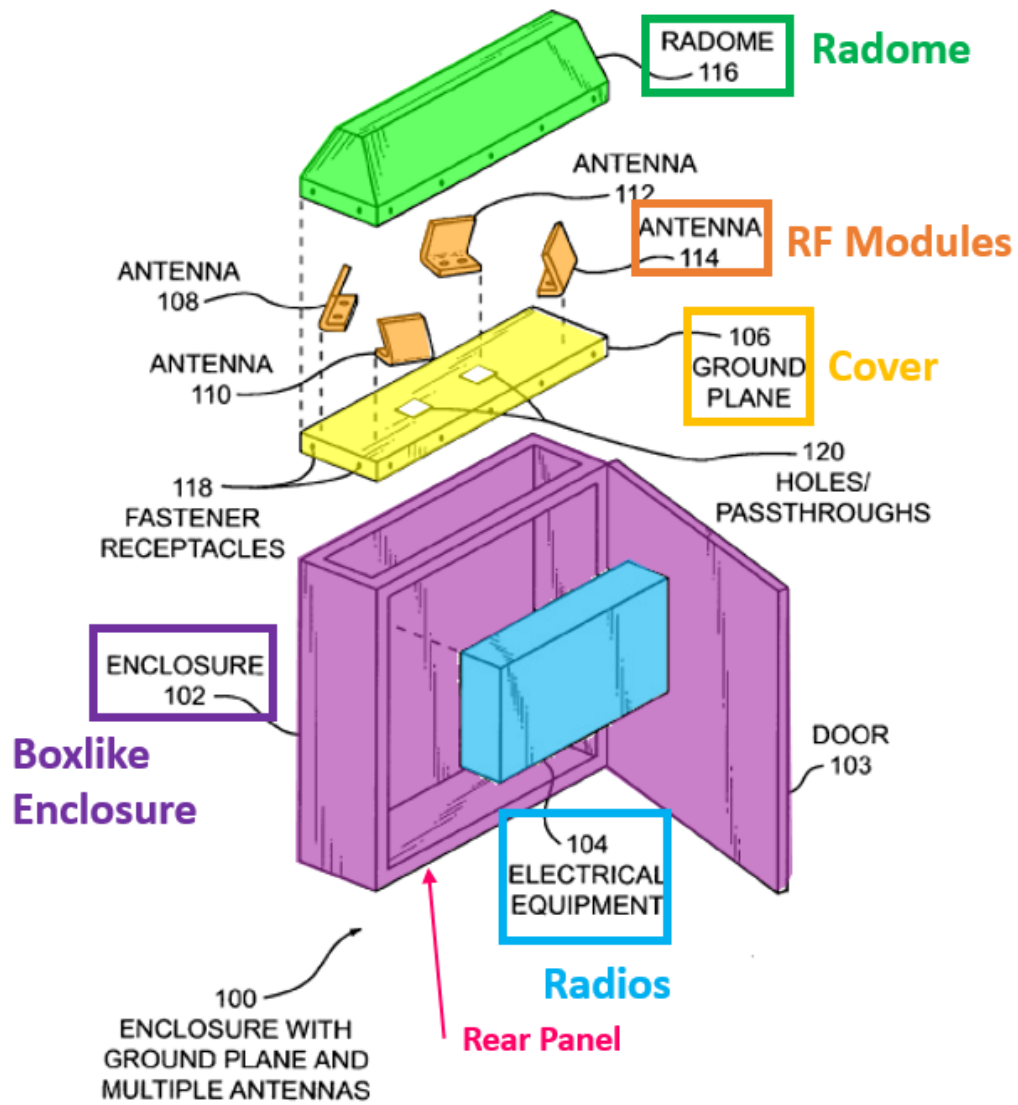
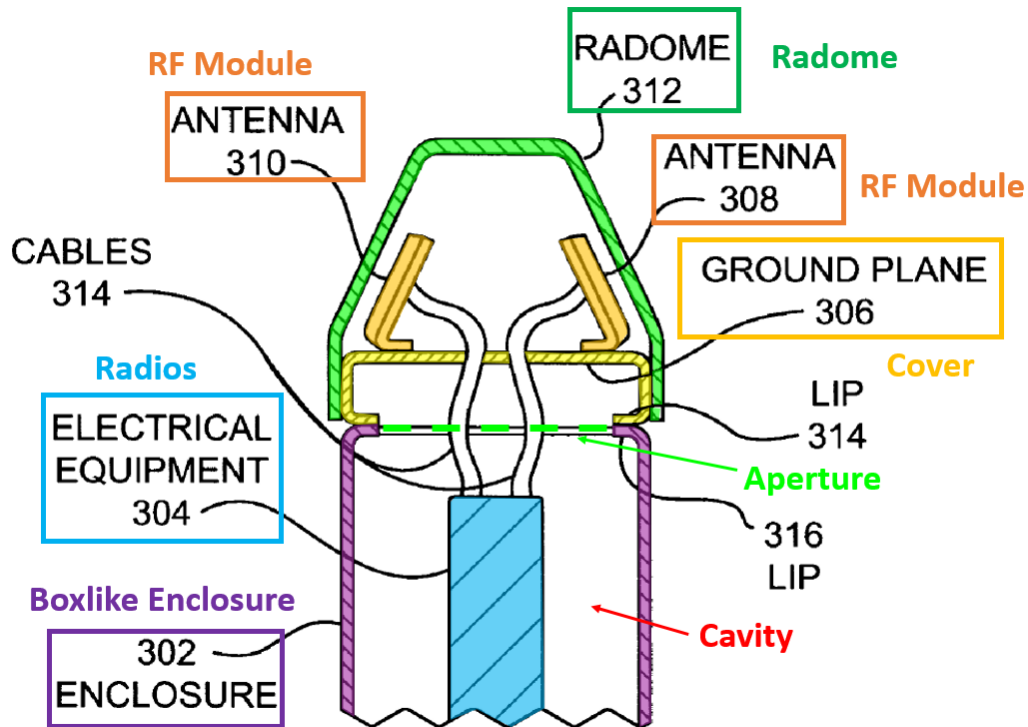


FIG. 1

EX-1004 FIG. 1("Annotated FIG. 1").



EX-1004 FIG. 3 (“Annotated FIG. 3”).

81. As illustrated in the annotated figures, Bishop discloses enclosure with ground plane and multiple antennas 100 and enclosure with rod antennas 500. Bishop explains that:

The antennae may be any type of radio frequency antenna. The antennae 108, 110, 112, and 114 **may be panel type antennae** that are configured to transmit in four separate quadrants. Any other type of antenna may be used, including dipole, rod, diversity, sectorized, parabolic, or any antenna imaginable.

EX-1004 [0040] (emphasis added).

82. Bishop also explains that “[e]mbodiment 500 illustrates that any type of antenna may be used in the present invention, including rod, dipole, parabolic, planar, or any type of antenna whatsoever.” EX-1004 [0053].

83. A POSA understood that Bishop discloses *a panel antenna* as recited in element [1.0].

[1.1] *an enclosure, the enclosure including a rear panel, a first side wall, and a second side wall, a top wall and a bottom wall, the rear panel and the walls defining a cavity, the walls further defining an aperture through which the cavity of the enclosure may be accessed,*

84. Bishop discloses element [1.1]. As illustrated in Annotated FIG. 1 and Annotated FIG. 5, Bishop discloses that enclosure 102, 502 (purple) [enclosure] includes a rear panel (pink) (illustrated in FIG. 1 but not in the partial view of FIG. 5) [rear panel] and four walls (pink) arranged as two pairs of opposing walls [first side wall, second side wall, top wall, bottom wall] that define a cavity (red) [defining a cavity]. The walls (pink) of the enclosure further define an aperture (green) [further defining an aperture].

85. In the embodiment of FIG. 1, Bishop discloses that one of the walls may be hinged to afford access to the electrical equipment housed

within the interior cavity of the enclosure. However, Bishop discloses that “[i]n some embodiments, an enclosure may not have a door and may afford access to the electrical equipment 104 by some other means.” EX-1004 [0027].

86. A POSA understood that the enclosure 502 illustrated in Annotated FIG. 5 includes no door, and that the aperture (green) defined by the four walls is one such other means for affording access to the interior cavity of the enclosure when ground plane 506 is removed. Thus a POSA understood that the aperture (green) constitutes *an aperture through which the cavity of the enclosure may be accessed* as recited in element [1.1].

87. Hence a POSA understood that Bishop discloses element [1.1].

[1.2] *an internal cover, the internal cover being dimensioned to overlap an area defined by the aperture of the enclosure and providing an environmental seal and electromagnetic shielding for the cavity,*

88. Bishop discloses element [1.2]. As set forth for element [1.2], the walls (pink) of the enclosure (purple) define an aperture (green). With reference to Annotated FIG. 3, Bishop discloses that ground plane 306 (gold) [*internal cover*] may be attached to enclosure 302, for example, by fastening means extending through mated lips 314 and 316. As

illustrated, by dimensioning the ground plane so that lip 314 of the ground plane mates with lip 316 of the enclosure the ground plane [*internal cover*] covers the entirety of the area of the aperture [*dimensioned to overlap an area defined by the aperture*]. Bishop further discloses that a gasket or sealant may be positioned between the lips to provide a seal [*providing an environmental seal*]. EX-1004 [0045-46].

89. Bishop further discloses that the ground plane may shield the various antennae from interference from electrical equipment housed within the enclosure and may prevent unwanted interference between noise or other energy generated within the enclosure from interfering with or otherwise degrading the performance of signals transmitted or received on the antennae [*providing electromagnetic shielding for the cavity*]. EX-1004 [0032], [0037].

90. The '813 Patent discloses that the internal cover may serve as a ground plane. EX-1001 8:46-47. Although the embodiment in Bishop is oriented such that the ground plane [*internal cover*] forms the top of the enclosure, consistent with the teaching of the '813 Patent, a POSA understood that the enclosure of Bishop may be oriented such that the ground plane forms the front cover of the enclosure.

91. Thus, a POSA understood that Bishop discloses element [1.2].

[1.3] *the internal cover having at least one RF radiating module fastened to an exterior surface thereof,*

92. Bishop discloses element [1.3]. With reference to the annotated figures, at least one antenna (**orange**) [*RF radiating module*] is attached to an exterior surface of the ground plane [*internal cover*] and that the antenna may be a panel type antenna or any other type of antenna may be used, including dipole, rod, diversity, sectorized, parabolic, or any antenna imaginable. EX-1004 [0024], [0040]. Thus a POSA understood that Bishop discloses element [1.3].

[1.4] *at least one micro radio mounted to an internal surface of the first side wall, the micro radio being coupled to the RF radiating module;*

93. Bishop discloses element [1.4]. As illustrated, the electrical equipment (**blue**) may be mounted to one of the walls (**pink**) [*first side wall*] of the enclosure (**purple**). For example, Annotated FIG. 1 shows electrical equipment 104 mounted a side wall of enclosure 102.

94. Bishop further discloses that the electrical equipment may be any type of electrical equipment whatsoever” and that [i]n some cases, a transformer, power supply, or various radio frequency (RF) devices may be present either separately or as part of a single device.” EX-1004 [0029].

Bishop further states

In a typical enclosure used for wireless communications, a network signal may be transmitted through a cable or fiber optic connection into the enclosure. Power supplies, converters, modems, and various electrical devices may process incoming signals and connect to **one or more radio transceivers** [*micro radios*]. **The transceiver may connect to one or more antennas located above the ground plane 106** [*micro radio being coupled to the RF radiating module*].

EX-1004 [0030] (emphasis added).

95. Bishop further discloses:

The enclosure 601 may contain **one or more radios**, each capable of one or more communication sessions. In the embodiment 600, directional antennas may be used to subdivide the total coverage area into several smaller sectors or coverage areas 616, 618, 620, and 622. Each coverage area may be covered by a separate radio.

EX-1004 [0056] (emphasis added)

96. Thus a POSA understood that Bishop discloses element [1.4].

[1.5] a first heat sink, mounted to an external surface of the first side wall, and

97. Bishop alone and/or in view of Avramis discloses element [1.5]. Bishop discloses that the enclosure houses active electronic components, including radios, and a POSA understood, as acknowledged

by the '813 Patent, that such an active component “generates a significant amount of heat that must be dealt with.” EX-1001 1:59-61. While Bishop does not address heat sinks specifically, or even heat management with respect to the active electronics housed within the enclosure generally, Bishop discloses that the enclosure may be formed from metal. A POSA understood that metal has excellent heat conductive and storage properties and thus inherently functions as a heat sink. EX-1004 [0027];

98. To the extent PO argues the enclosure of Bishop does not embody the recited heat sink, Avramis explicitly discloses heat sinks on enclosures housing electronics. Avramis discloses “heat sink(s) 28 may be arranged along the exterior sides of the enclosure 10 to assist with dissipation of heat generated by transceiver operation.” EX-1010 [0012].

99. Avramis discloses an enclosure for a transceiver in which the sides are provided with heat sinks and corrugations to cool the interior of the enclosure.

As shown in FIGS. 1-3 an enclosure 10 according to an exemplary embodiment of the invention has a feed flange 14 connection on a front end 16 and signal connection (s) 17 at the back end 18. The enclosure has a top side transmitter cavity 20 and a bottom side receiver cavity 22. A receiver cavity cover 24 and a transmitter cavity cover 26 enclose and environmentally seal the receiver cavity 22 and the transmitter cavity 20,

respectively. Heat sink(s) 28 may be arranged along the exterior sides of the enclosure 10 to assist with dissipation of heat generated by transceiver operation

EX-1010 [0012].

100. It would have been obvious to a POSA to provide heat sinks on the external surface of the enclosure of Bishop as taught by Avramis. A POSA would have been motivated to add the heat sinks of Avramis in order to dissipate the heat generated by the radio and other components within the enclosure to prevent over heating of the electronic components including the radios. A POSA understood that performance of electronic components were susceptible to degradation due to overheating. Moreover, a POSA would have been motivated to position the heat sink on an exterior surface of the housing wall upon which the heat generating component is mounted to minimize the conduction path and increase heat dissipation rate.

101. The disclosure of heat sinks in Avramis provides a teaching, suggestion, or motivation that would have led a POSA to combine Avramis' teaching of heat sinks with the enclosure of Bishop to arrive at the invention of Claim 1.

102. A POSA also understood that:

1. Combining the heat sinks of Avramis with the enclosure of Bishop would yield the predictable results of dissipating heat from heat generating components housed within enclosures;
2. Use of heat sinks as taught by Avramis to passively control heat buildup was a known technique to improve the heat management in heat sensitive electronic devices such as the electronic components of Bishop, by absorbing and dissipating heat into the surrounding environment.

103. Given the well-known and ubiquitous use of heat sinks in electronic device enclosures and otherwise, a POSA would have a high likelihood of success in implementing the heat sinks of Avramis with the enclosure of Bishop.

104. Thus, a POSA understood that Bishop alone and/or in view of Avramis discloses element [1.5].

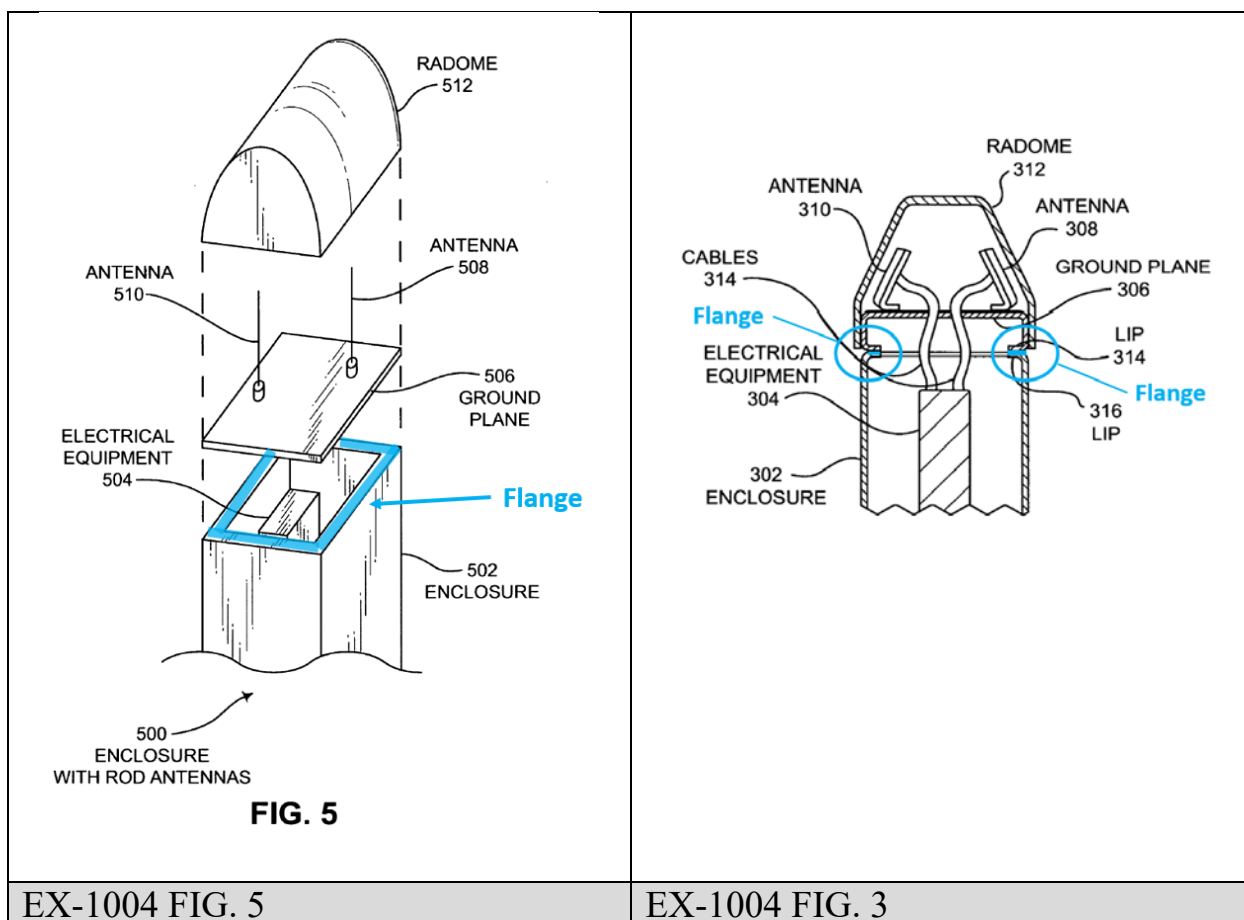
[1.6] *a radome, the radome mounting to the internal cover and enclosing the RF radiating module;*

105. Bishop discloses element [1.6]. As illustrated, Bishop discloses that the radome (**green**) covers and protects the antennae [*enclosing the RF radiating module*] and may be attached directly to the ground plane [*mounting to the internal cover*]. EX-1004 [0042-43].

106. Thus, a POSA understood that Bishop discloses element [1.6].

[1.7] wherein a flange joins the first and second side walls and the top and bottom wall, and a lip extends from the flange, further defining the aperture through which the cavity of the enclosure may be accessed, the lip being engaged by the internal cover to provide the environmental seal.

107. Bishop in view of Lakoduk discloses element [1.7]. As set forth for element [1.2], the enclosure includes a lip that mates with a lip on the ground plane [internal cover] when the ground plane is attached to the enclosure. FIGs. 3 and 5 are annotated below to identify the lip (blue) on the enclosure [flange further defining the aperture].



108. As illustrated, the flange extends along each of the four walls [*joins the first and second side walls and the top and bottom wall*]. Although Bishop discloses engaging the ground plane with the flange to provide an environmental seal, Bishop does not disclose that a lip extends from the flange. However, as set forth in the State of the Art, the **flange/lip** configuration recited in element [1.8] was well-known for engaging panels to enclosures housing electronic equipment. *See* Section IV.F.

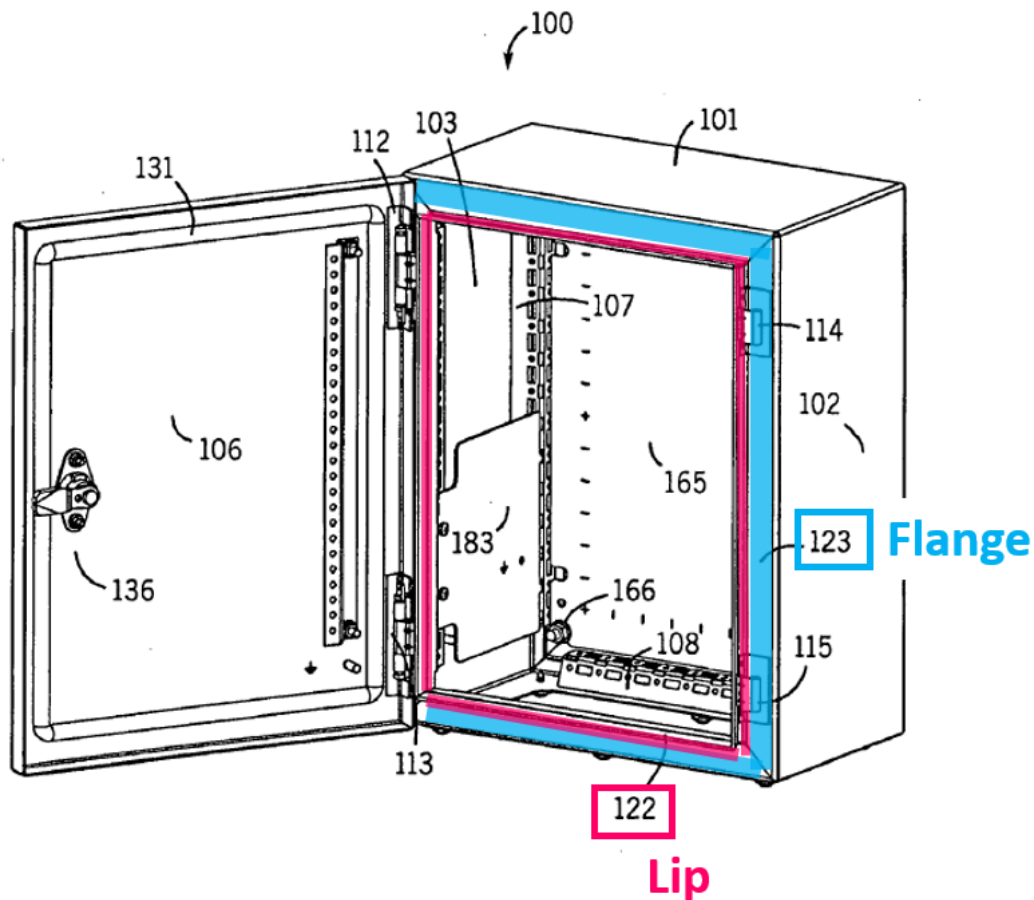
109. Lakoduk discloses an enclosure for electronics equipment have a rear panel and four sides defining a cavity and an aperture for accessing the cavity:

Described herein is technology for, among other things, enclosures for electronic components and methods for manufacturing the same. In one embodiment, the enclosure includes first and second sidewalls formed from a single elongated piece of sheet metal. The first sidewall, the second sidewall, a third sidewall, and a fourth sidewall define an interior space of the enclosure. At least one of the first and second sidewalls includes an edge region folded inwardly relative to the interior space to form a mounting channel. The enclosure further includes a backwall coupled with first edges of the sidewalls and a door hingedly coupled with a second edge of at least one of the sidewalls.

EX-1006 [0007]

110. An embodiment of the enclosure is illustrated in FIG.

30A:



EX-1006 FIG. 30A

111. Lakoduc discloses that enclosure 100 includes four sidewalls 101-104 that are each turned inward to create a front perimeter 123 (blue) that is substantially parallel to the back wall [flange joins the

first and second side walls and the top and bottom wall]. Lakoduc further discloses the front perimeter may be folded outward to create flange 122 (pink) that may extend perpendicular or at an angle from the front perimeter 123 [*lip extends from the flange, further defining the aperture through which the cavity of the enclosure may be accessed*]. EX-1006 [0106].

112. Lakoduc also explains that a gasket 131 positioned on the door 106 “engage[s] the front flanges 122 when the door is closed to help provide a substantially water-tight barrier to the inside of the enclosure 100” [*the lip being engaged by the internal cover to provide the environmental seal*]. EX-1006 [0110].

113. It would have been obvious to modify Bishop in view of the knowledge of a POSA and/or the teaching of Lakoduc to include the flange/lip configuration on the enclosure to engage the ground plane [*internal cover*] in order to provide an environmental seal.

114. Bishop discloses that, in some embodiments, the enclosure may not have a door and such that access to the interior of the enclosure would be by some other means. EX-1004 [0027], [0052]. A POSA understood that enclosure 502 illustrated in Annotated FIG. 5 includes no door, and that the aperture (green) defined by the four walls is

one such other means for affording access to the interior cavity of the enclosure when the ground plane is removed. Thus a POSA understood that the aperture (**green**) constitutes *an aperture through which the cavity of the enclosure may be accessed* as recited in element [1.1].

115. A POSA would have been motivated to provide an engagement between the ground plane and the enclosure in Bishop having the flange/lip configuration to “help provide a substantially water-tight barrier to the inside of the enclosure” as taught by Lakoduc. EX-1006 [0110].

116. Lakoduc and Bishop are each directed to boxlike enclosures formed from bending sheet metal and Lakoduc teaches that the flange/lip configuration may be implemented by adding a fold at the edge of the front perimeter 123 (**blue**) [*flange*] to create the flanges 122 (**pink**) [*lip*] extending perpendicular or at a slight angle from perpendicular away from the front perimeter. Implementing such a configuration in the enclosure of Bishop was well within the skill of a POSA, particularly since the claimed “flange” (i.e., lip 316 (**blue**)) was already implemented in the enclosure of Bishop.

117. As set forth above, Claim 1 is obvious over Bishop in view of Avramis and Lakoduc.

Claim 2

The panel antenna of claim 1,

- i. wherein the panel antenna further comprises: a second micro radio, the second micro radio mounted to an internal surface of the second side wall,***

118. Bishop discloses a plurality of radios (blue) [micro radios] housed within the enclosure and operatively connected to the antennas. See element [1.4].

119. Bishop is not specific regarding which wall a second of the plurality of radios is mounted on. However, the selection of a mounting position for the radio or other components is merely one of design choice and thus would have been obvious in view of the knowledge of a POSA.

120. A POSA would have been motivated to mount the radios to either of the side walls of the computer housing [first side wall] given:

- 1) these side walls provide mounting locations with advantageous proximity to the access door; and;
- 2) these side walls allow for dissipation of heat from the mounted radio to the environment (See claim limitation [1.5] above).

121. Further it would have been obvious to try mounting the radio on either of the side walls. A POSA understood that there are a

finite number (6) of interior surfaces on the housing of Bishop upon which to mount a radio and each of which provided predictable solutions, with a reasonable expectation of success.

ii. a plurality of RF radiating modules,

122. Bishop discloses a plurality of antennas (**orange**) [*RF radiating modules*] mounted to the exterior of the ground plane [*internal cover*] operatively connected to the plurality of radios (**blue**) [*micro radios*] housed within the enclosure. *See* element [1.3].

iii. a second heat sink mounted on an exterior surface of the second side wall.

123. Bishop alone or in view of Avramis discloses a second heat sink on an exterior surface of a second side wall of the radio enclosure. As described above, Bishop discloses the sidewalls of the enclosure may be formed of metal and thus function as a heat sink. To the extent PO argues that Bishop does not disclose a third heat sink on an exterior surface, Avramis discloses a heat sink on a second side wall. Thus it would have been obvious to modify Bishops enclosure to include the heat sinks of Avramis on the exterior side walls, for the same reasons discussed above with respect to limitation [1.5] above.

124. Bishop discloses and/or renders obvious Claim 2 for at least the reasons set forth for elements [1.3], [1.4], and [1.5].

Claim 4

The panel antenna of claim 1, further comprising a communications hub coupled to each micro radio.

125. Bishop alone or in view of Korte discloses Claim 4

126. Bishop discloses junction 624 [*communications hub*] connects multiple radios in the enclosure to the communications network 624 via network branch 626.

FIG. 6 illustrates a plan view of an embodiment 600 showing wireless access points deployed in a residential area. A road 602 is shown with houses 604, 606, 608, 610, 612, and 614. Enclosure 601 is mounted at a central point of the community and contains four different antennae. One antenna has coverage area 616 that encompasses house 608 and 610. A second antenna has coverage area 618 that encompasses house 606. A third antenna has coverage area 620 that encompasses houses 604 and 612. A fourth antenna has coverage area 622 that encompasses house 614. The enclosure 601 is connected to the network 624 through a network branch 626 and junction 628.

EX-1004 [0054].

The enclosure 601 may contain one or more radios, each capable of one or more communication sessions. In the embodiment 600, directional antennas may be used to sub

divide the total coverage area into several smaller sectors or coverage areas 616, 618, 620, and 622. Each coverage area may be covered by a separate radio.

EX-1004 [0056].

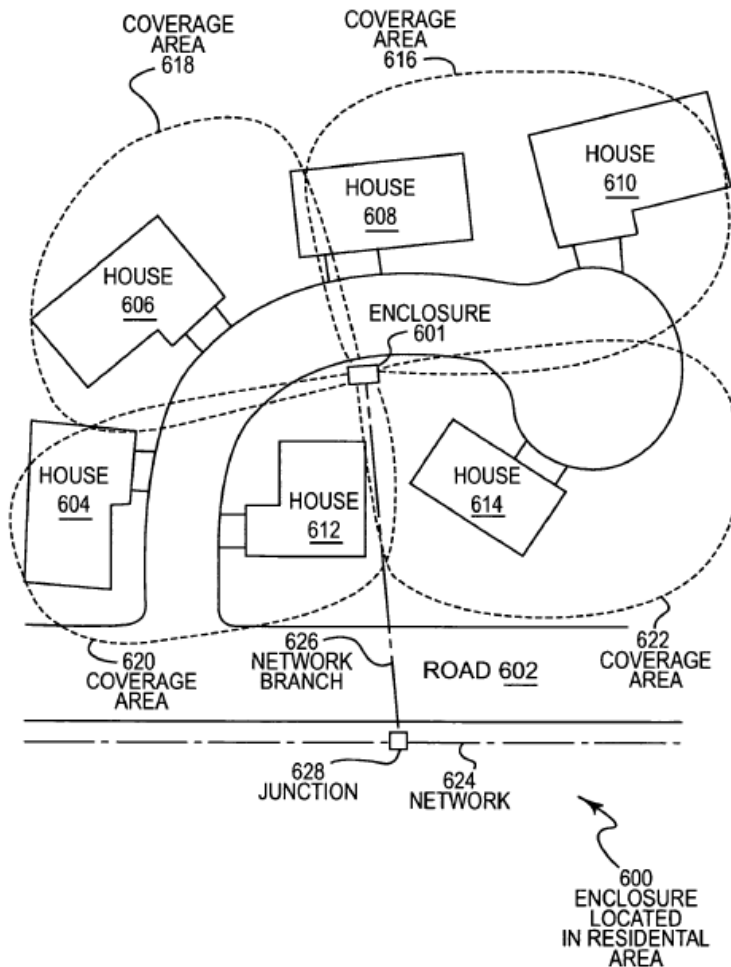


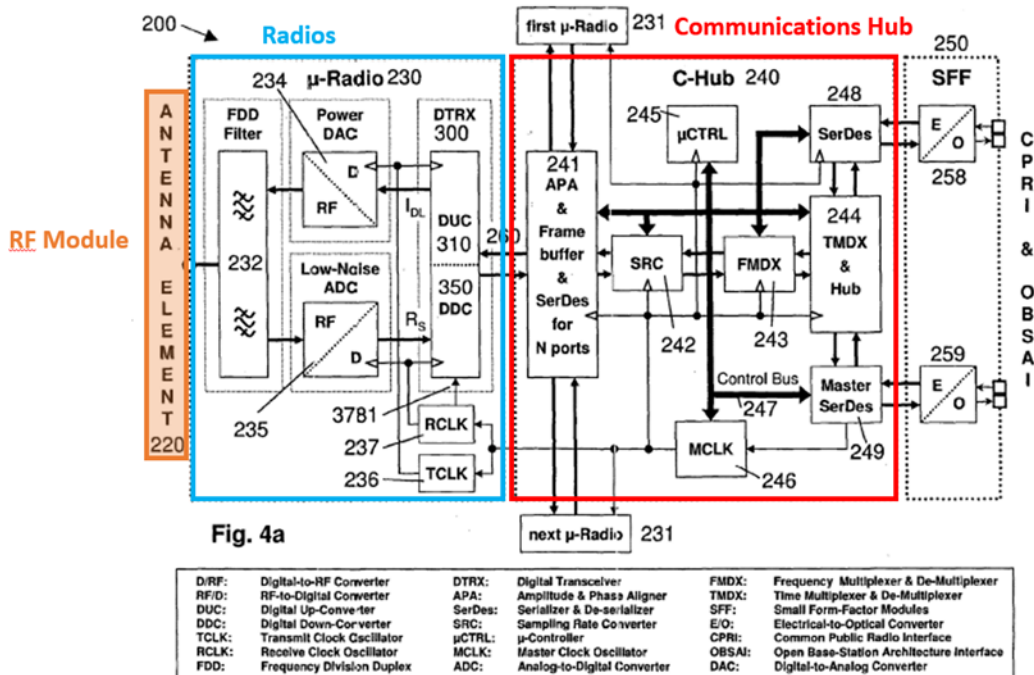
FIG. 6

EX-1004 Fig. 6.

127. A POSA understood the junction functions as a communication hub by connecting multiple radios to the communications network 624.

128. To the extent the PO argues Bishop's radios are not coupled to a communications hub, Korte, which is incorporated by reference in Bishop, discloses radios are connected to a communications hub.

129. Korte discloses that integrated radio unit 200 includes one or more micro radios 230 (blue) and a communications hub C-hub 240 (red) connected via a digital bi-directionally serial link (260). One or more antenna elements 220 (orange) are directly connected to the micro radios 230. The antenna element 220 may be mounted on an antenna board or another circuit board onto which the micro radio 230 is arranged or attached. EX-1011 13:6-10.



EX-1011 FIG. 4a.

130. It would have been obvious to a POSA to include a communication hub as described in Korte with the enclosure of Bishop to connect Bishop's radios to the communication network 624. A POSA would have been motivated to use a hub in order for "processing digital radio signals and control signals and for routing said :, digital radio signals and control signals via at least one serial link (260) and at least one interface (258, 259)" as taught in Korte. Such processing allows any number of micro radios to be connected to the network via the hub (EX-1011 12:21-27) and allow for the advantageous distribution of data via known standards such as CPRI (common public radio IP) or OBSAI. EX-1011 16:23-17:25. Thus a POSA would have been motivated to use a hub in the enclosure of Bishop in order in connect multiple radios to a communications network as desired in both Bishop and Korte as well as provide interoperability with the use of commonly used and known distribution standards as taught by Korte. A POSA would also be motivated to use the communication hub as described by Korte in Bishop's system given that Korte teaches the hub may be implemented with "commercially available components known to a person skilled in the art"

(EX-1011 17:17-18) and thus would be an economical and reliable system for connecting Bishop's radios to a communications network.

131. A POSA would be confident of success given the ubiquitous and well known use of hubs in connecting multiple radios to a network using known standards. Furthermore, a POSA would be able to implement the modification using commercial components as taught by Korte.

Claim 5

The panel antenna of claim 4, further comprising a calibration radio.

132. Bishop in view of Korte discloses Claim 5.

133. Korte further explains that a "micro-sniffer" (μS) 250 may be connected to one of the C-Hubs 240 for monitoring and calibrating purposes. The micro-sniffer 250 is a special micro radio having inverse receive and transmit frequency band. The micro-sniffer 250 can be connected to the C-Hub 240 via the same or a similar interface. The micro-sniffer 250 additionally has an antenna 255 that may have the form of an antenna element or another form. The micro-sniffer 250 transmits pilot signals towards and detects the radiation emitted from the antenna elements 220, thus providing the C-Hubs 240 with feedback control

information as required by the micro radios 230 for calibration purposes.

EX-1011 12:29-13:4.

134. It would have been obvious to a POSA to modify Bishops antenna panel to include a calibration radio as taught by Korte. A POSA would have been motivated to provide a calibration radio in Bishops antenna panel in order to provide “feedback control information as required by the micro radios 230 for calibration purposes.” (EX-1011 12:29-13:4). A POSA also understood the well-known benefits of calibrating radios, including improving reception and transmission of radio signals, minimizing interference from other radios and reducing interference on other network radios, and power level management.

135. A POSA would be confident of success given the ubiquitous and well known use of calibration devices and in particular calibration radios to tune/manage radios.

Claim 6

i. The panel antenna of claim 5, wherein the communications hub and calibration radio are mounted on an interior surface of the rear panel, and

136. Bishop in view of Avramis and Korte discloses Claim 6.

137. Bishop in view of Korte does not specifically describe the mounting location of the calibration radio or communication hub.

However, the selection of a mounting position for these components is merely one of design choice and thus would have been obvious in view of the knowledge of a POSA.

138. A POSA would have been motivated to mount the calibration radio or other components to an interior surface of the panel opposite the access aperture [*rear panel*] of Bishop given:

- 1) the rear panel provide mounting locations not used by other identified components (i.e. there is available space); and
- 2) the rear panel, like the other walls allow for dissipation of heat from the calibration radio or other components to the environment (See claim limitation [1.5] above).

139. Further it would have been obvious to try mounting the calibration radio on the rear panel. A POSA understood that there are a finite number (6) of interior surfaces on the housing of Bishop upon which to mount a radio and each of which provided predictable solutions, with a reasonable expectation of success. The rear panel being one of the finite mounting locations and thus would have been obvious to a POSA.

140. Korte further discloses the communication hub may be integrated with the radios via a “multi-chip module”. EX-1011 7:1-2.

Korte also discloses the communication hub be provided close to the radio

in that “cable length has the inherent disadvantages of energy and signal to noise loss.” EX-1011 3:1.)

141. Thus similar to the location and mounting of the calibration radio, it would also be obvious to a POSA to locate and mount the communication hub within the antenna enclosure and on the rear panel of Bishop.

142. A POSA would have been motivated to house the multi-chip module, or separate the communication hub in the same environmental enclosure as the radios in order to protect them from the elements and provide a location of the hub proximate to the radios to which its serves in order to reduce energy and SNR losses.

143. A POSA would have a reasonable likelihood of success given the location and selection of mounting positions are routine, involves no technological hurdles and requires no reconfiguration of Bishop’s radio system.

ii. a rear heat sink is mounted on an exterior surface of the rear panel.

144. Bishop alone or in view of Avramis discloses multiple heat sinks on an exterior surfaces of a radio enclosure. As described above, Bishop discloses the walls, including the rear panel of the enclosure may be formed of metal and thus each wall and portions thereof function

as a heat sink. To the extent PO argues that Bishop does not disclose a third heat sink on an exterior surface of the rear panel, Avramis discloses a multiple heat sinks on exterior walls. Thus it would have been obvious to modify Bishop's radio enclosure to include the heat sinks of Avramis on the exterior rear panel to transmit heat from the calibration radio and communication hub to the environment, for the same reasons discussed above with respect to limitation [1.5] above.

Claim 7

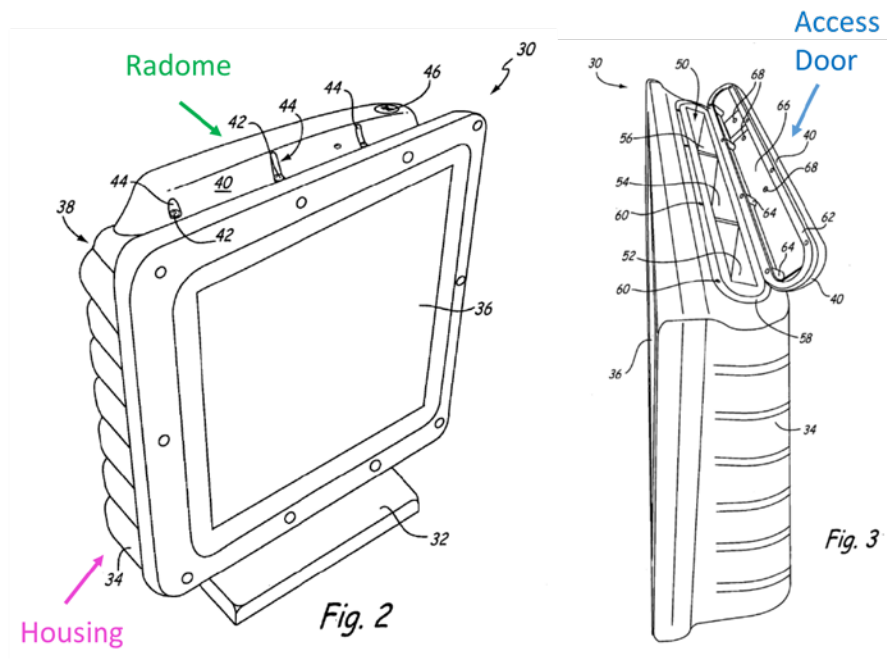
The panel antenna of claim 1, wherein a flange joins the first and second side walls and the top and bottom wall, further defining the aperture through which the cavity of the enclosure may be accessed.

145. Bishop discloses Claim 7 for at least the reasons set forth for element [1.7]. As set forth, a POSA understood that lip 316 (blue) constitutes a flange [that] joins the first and second side walls and the top and bottom wall, further defining the aperture through which the cavity of the enclosure may be accessed as recited in Claim 7. Thus, Bishop discloses Claim 7.

B. Challenge 2: Claims 1 and 2 are obvious over Kelly alone and/or in view of Avramis

1. The Kelly Reference

146. Kelly discloses an antenna for use with mobile computers which includes an antenna integrated into an access door of the mobile computer. The computer includes housing 34 containing radios and other components used for wireless communication and the access door including several antennas covered with a radome. EX-1009 FIGs. 1-6, [0034], [0040].



EX-1009 FIGs. 2, 3.

147. Kelly describes the access door improves servicing of the computer as well as general access, facilitating replacement, repair and upgrades of components.

Similarly, service is improved as well as basic access. Thus, even after manufacturing, a user can easily open the computer and replace, repair, or add any components as needed. Previous mobile computers were not as configurable, and often required the user to completely disassemble the computer to gain access to the motherboard or install additional radios or electronic components.

EX-1009 [0029].

148. Kelly describes the radome “protects the antennas from being damaged or broken, while still allowing the antennas to be placed on the computer in a location that ensures functionality” and the antenna plate shields the antenna from being interfered with or interfering with the electronics in computer cavity EX-1009 [0008], [0010]; [0050] .

149. Kelly describes the computer may be “tilted or rotated” with respect to the base. EX-1009 [0022], FIG. 1.

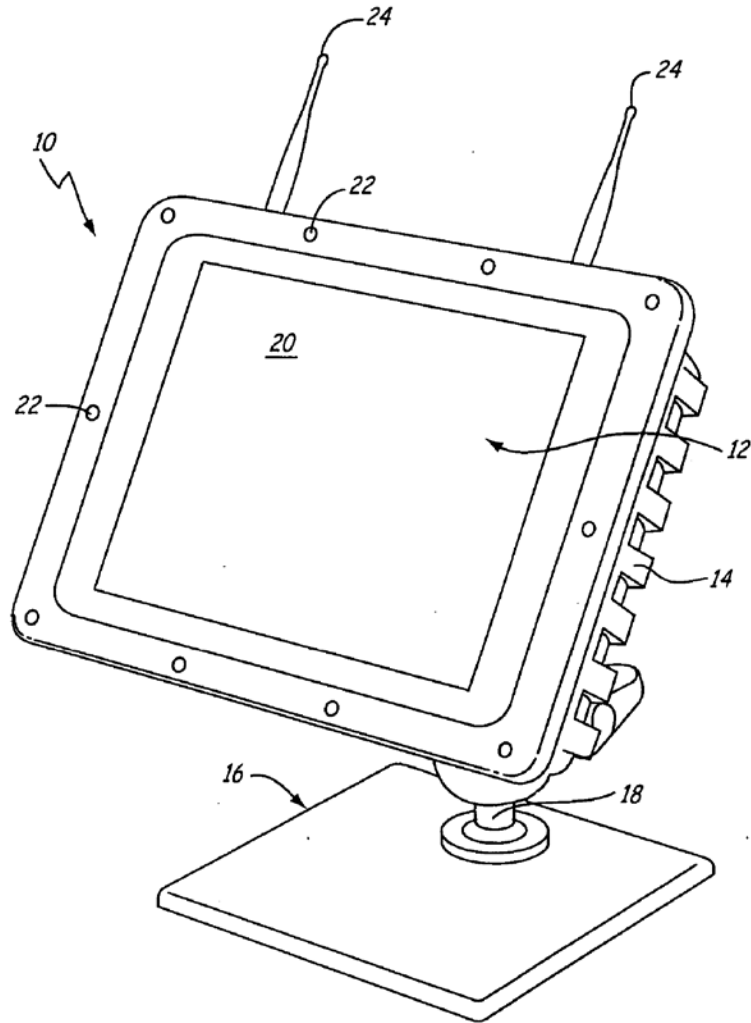


Fig. 1

EX-1009 FIG. 1.

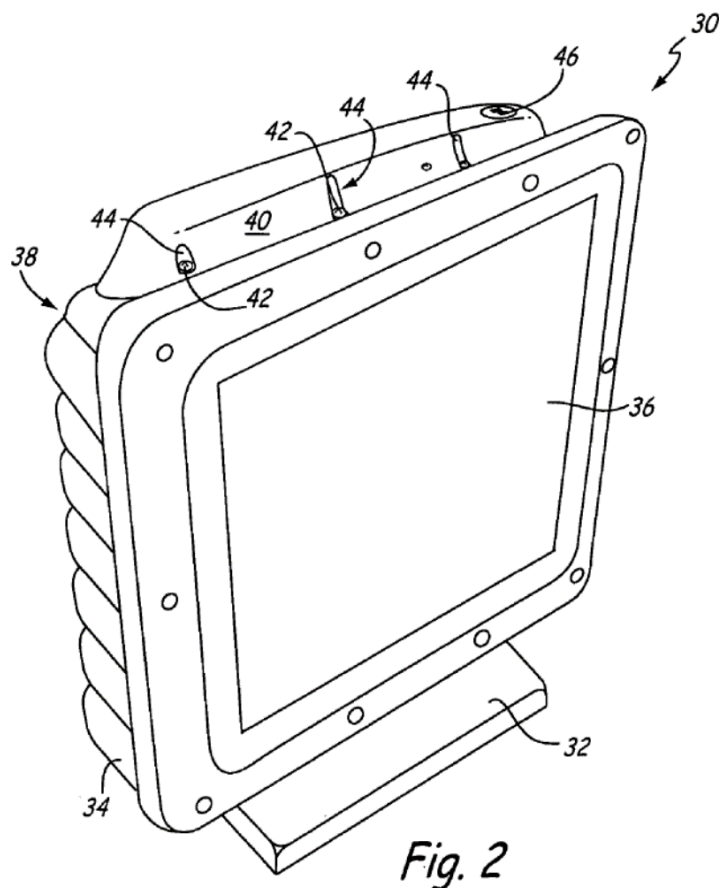
2. Detailed Application of Kelly and Avramis to the Challenged Claims

Claim 1

[1.0] *A panel antenna, comprising:*

150. Kelly discloses a computer with an integrated antenna door [*panel antenna*] which includes several antennas and other components used for wireless communications. The antennas are attached

to an antenna board and are covered by a radome. The radios are contained within the computer housing 34. EX-1009 FIGs. 1-6, [0034], [0040].



EX-1009 FIG. 2.

Located on the antenna board 90 is a remote antenna connection 94 and three antennas 96, 98, 100.

EX-1009 [0034].

The second antenna 98 comprises a generally rectangular grounding area 112, a triangular antenna 114, an antenna wire

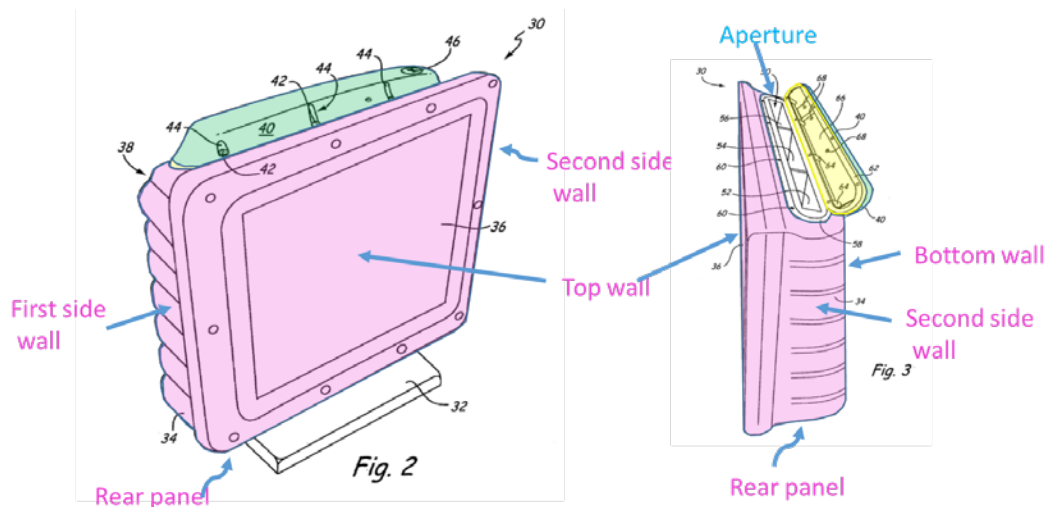
116, and a ground wire 118. The grounding area 112 provides a ground plane against which the second antenna 98 operates. The triangular antenna 114 comprises the antenna element which sends and receives data. The triangular antenna 114 and grounding area 112 may be formed of any suitable material. Such as a metal, and maybe affixed to the antenna board 90 using any suitable method.

EX-1009 [0040].

151. To the extent PO argues the preamble is limiting and must in addition to the claimed features, requires at least a radiating element to include a “panel antenna.” Kelly discloses a triangular antenna 114 which a POSA understands to be a “panel antenna.” EX-1009 FIG. 4, [0040].

[1.1] *an enclosure, the enclosure including a rear panel, a first side wall, and a second side wall, a top wall and a bottom wall, the rear panel and the walls defining a cavity, the walls further defining an aperture through which the cavity of the enclosure may be accessed,*

152. Kelly discloses a computer housing 34 [*enclosure*]. The housing includes a rear panel, a first side wall, a second side wall, a top wall and a bottom wall, defining an interior 50 [*cavity*] and an aperture the provides access to interior of the housing.

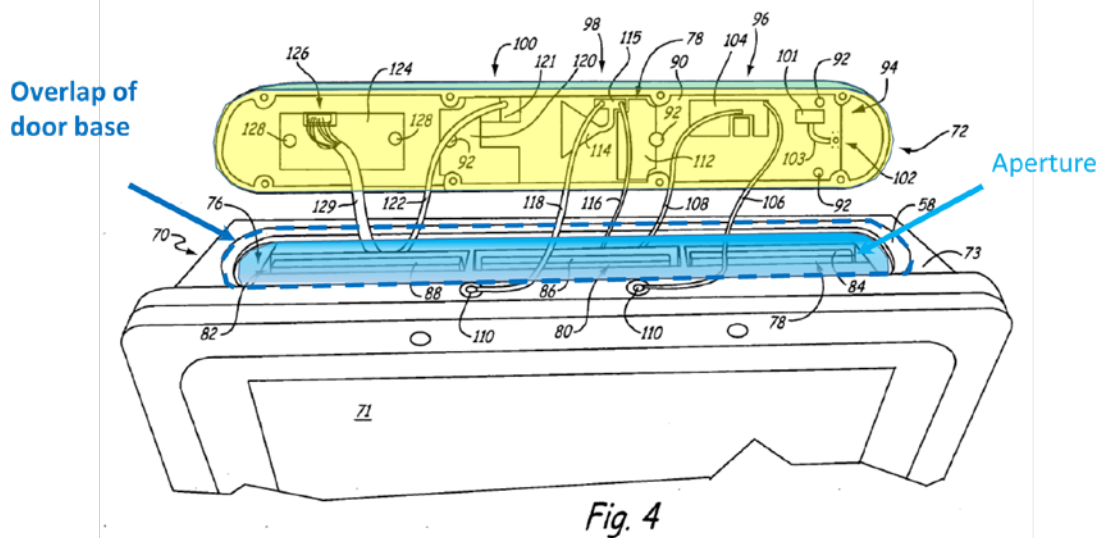


EX-1009 FIGs. 2 and 3.

153. Kelly describes the computer may be “tilted or rotated” with respect to the base and thus a POSA understood the Kelly describes the wall may be oriented in such that the screen may face upwards. EX-1009 [0022], FIG. 1.

[1.2] *an internal cover, the internal cover being dimensioned to overlap an area defined by the aperture of the enclosure and providing an environmental seal and electromagnetic shielding for the cavity,*

154. Kelly discloses a base portion of the door includes an antenna board 90 and seal (yellow) [internal cover] that overlaps (dashed blue line) the aperture (light blue) of the housing to environmentally seal the interior [environmental seal] and minimize interference [electromagnetic shielding].



EX-1009 FIG. 4.

Similarly, the magnesium housing must be sufficiently sealed, particularly at the access door, so that the computer can withstand the dust, dirt, moisture, or extreme temperatures of the environments in which the computer is used.

EX-1009 [0005].

The radome/access door 40 comprises a seal 62 and several cylindrical screw channels 64 through which screws can be inserted. The seal 62 corresponds in size to the groove 58 on the computer housing 34. In this way, the radome 40 can be affixed to the housing 34 by inserting screws through the screw channel 64 and screwing them into the screw holes 60 in the groove 58. The groove 58 and the corresponding seal 62 allow the radome 40 to be snugly affixed to the housing 34. The seal 62 serves to ensure that once the radome 40 is affixed to the housing 34, the

computer 30 is properly sealed so that no moisture, dirt, and dust enters the interior 50 of the computer 30.

EX-1009 [0025].

[I]t is preferable to locate the antennas such that they are separated from the wires and the PC board in the computer housing, to minimize interference from these and other electrical components in the computer and allow the best performance of the antenna array in the radome as possible.

EX-1009 [0049].

155. A POSA understood Kelly discloses that the location of the antenna board between the antennas and the cavity provided electromagnetic shielding from the “PC board” and “other electrical components” within the housing. EX-1009 [0049, 0050].

[1.3] *the internal cover having at least one RF radiating module fastened to an exterior surface thereof,*

156. Kelly discloses multiple RF antennas [*RF radiating modules*] fastened to the upper surface [*exterior surface*] of the antenna board [*portion of the internal cover*].

Located on the antenna board 90 is a remote antenna connection 94 and **three antennas 96, 98, 100.**

EX-1009 [0034] (emphasis added).

On the top of the first antenna board 90 are **a first antenna element 132 a second antenna element 134**, and external antenna port hardware 136.

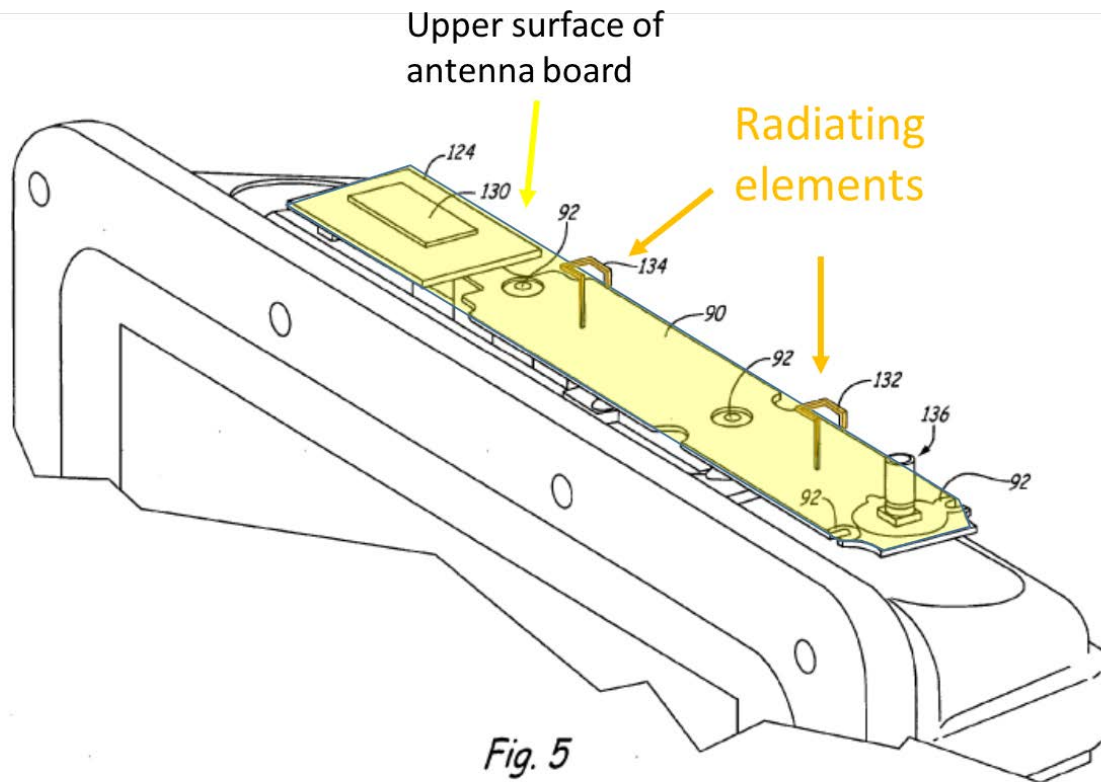
EX-1009 [0046](**emphasis added**).

The second antenna 98 comprises a generally rectangular grounding area 112, a triangular antenna 114, an antenna wire 116, and a ground wire 118. The grounding area 112 provides a ground plane against which the second antenna 98 operates. The triangular antenna 114 comprises the antenna element which sends and receives data. The triangular antenna 114 and grounding area 112 may be formed of any suitable material. Such as a metal, and maybe affixed to the antenna board 90 using any suitable method.

EX-1009 [0040].

The first antenna element 132 corresponds to the first antenna 96 of FIG. 4. The second antenna element 134 corresponds to the third antenna 100 of FIG. 4. The antenna elements 132 and 134 form a part of the antennas 96 and 100, and are used to send and receive data.

EX-1009 [0046].



EX-1009 FIG. 5.

[1.4] at least one micro radio mounted to an internal surface of the first side wall, the micro radio being coupled to the RF radiating module;

157. Kelly discloses at least one mini pci radio [*micro radio*] mounted internally in the computer housing.

The antenna wire 108 provides a connection between the first antenna 96 and the mini-PCI radio 86 located in the second expansion slot 80. As such, the antenna wire 108 operatively connects the mini-PCI radio 86 to the first antenna 96 so that the mini-PCI radio 86 can send or receive a signal

EX-1009 [0039].

The second antenna 98 may be used to provide a second antenna for the mini-PCI radio 86 located in the second expansion slot 80. As such, the second antenna wire 116 connects the second antenna 98 to the mini-PCI radio 86. Two antennas may be provided for the mini PCI radio 86 so that the radio 86 has a diversity of antennas, which improves coverage of the radio. For instance, the first antenna 96 may comprise a 2.4 giga Hertz (GHz) vertically polarized antenna, and the second antenna 98 may comprise a 2.4 GHz horizontally polarized antenna.

EX-1009 [0042].

The third expansion slot 82 maybe configured to accept any variety of radio module. One example of a radio module for use in the mobile computer 70 is a pico-link radio system 88, shown diagrammatically in FIG.4. The pico-link radio system 88 maybe any suitable type of radio configured for use in a pico-link wireless network.

EX-1009 [0031].

158. A POSA understood the radios of Kelly are attached to an interior surface of the computer housing “proximate the access door”, however Kelly does not specifically address to which interior wall surface the mini radio is mounted upon. However, the selection of a mounting

position for the radio or other components is merely one of design choice and thus would have been obvious in view of the knowledge of a POSA. EX-1009 [0033].

159. A POSA would have been motivated to mount the radios to either of the side walls of the computer housing [*first side wall*] given:

- 1) these side walls provide mounting locations with advantageous proximity to the access door, (EX-1009 [0033])
- 2) these side walls minimize potential interference from the display on the radios (EX-1009 [0008], [0050]), and
- 3) these side walls allow for dissipation of heat from the mounted radio to the environment (See claim limitation [1.5] below).

160. Further it would have been obvious to try mounting the radio on either of the side walls. A POSA understood that of the six (6) interior surfaces on the housing of Kelly, only the side walls and bottom panel of the housing offer the beneficial characteristics described above (e.g. the rear panel is furthest from the access panel, the top wall is most proximate the display and cannot dissipate heat directly to the environment, and the front surface is an access door) and thus a POSA would have understood there were only a finite number of surfaces upon

which to mount the radio which provided predictable solutions, with a reasonable expectation of success.

[1.5] *a first heat sink, mounted to an external surface of the first side wall, and*

161. Kelly does not explicitly describe the presence of heat sinks, yet discloses the computer housing may be formed of metal and may include corrugated sides. A POSA understood that metal has excellent heat conductive and storage properties and thus inherently functions as a heat sink. In addition, the housing includes corrugated sides (i.e., fins) that are common in increasing the surface area of heat sinks. EX-1009 FIGs. 1-3, [0022], Claims 2, 17.

162. To the extent PO argues Kelly's metal housing does not function as a heat sink, Avramis explicitly discloses heat sinks. Avramis discloses "heat sink(s) 28 may be arranged along the exterior sides of the enclosure 10 to assist with dissipation of heat generated by transceiver operation." EX-1010 [0012].

163. Avramis discloses an enclosure for a transceiver in which the sides are provided with heat sinks and corrugations to cool the interior of the enclosure.

As shown in FIGS. 1-3 an enclosure 10 according to an exemplary embodiment of the invention has a feed flange 14

connection on a front end 16 and signal connection (s) 17 at the back end 18. The enclosure has a top side transmitter cavity 20 and a bottom side receiver cavity 22. A receiver cavity cover 24 and a transmitter cavity cover 26 enclose and environmentally seal the receiver cavity 22 and the transmitter cavity 20, respectively. Heat sink(s) 28 may be arranged along the exterior sides of the enclosure 10 to assist with dissipation of heat generated by transceiver operation

EX-1010 [0012].

164. It would have been obvious to a POSA to provide heat sinks on the external surface of the housing of Kelly as taught by Avramis. A POSA would have been motivated to add the heat sinks of Avramis in order to dissipate the heat generated by the radio and other components within the enclosure to prevent over heating of the electronic components including the radio and PC board. A POSA understood that performance of electronic components were susceptible to degradation due to overheating. Moreover, a POSA would have been motivated to position the heat sink on an exterior surface of the housing [*side wall*] oppositely disposed from the interior surface upon which the heat generating component is mounted or proximate to, (i.e. on the same wall in which the radio or other electronics in order to minimize the conduction path and increase heat dissipation rate.

165. The disclosure of heat sinks in Avramis provides a teaching, suggestion, or motivation that would have led a POSA to combine Avramis' teaching of heat sinks with the computer housing of Kelly to arrive at the invention of Claim 1.

166. A POSA would also understand that:

1. Combining the heat sinks of Avramis with the computer housing of Kelly would yield the predictable results of dissipating heat from enclosures;
2. Use of heat sinks as taught by Avramis to passively control heat buildup was a known technique to improve the heat management in heat sensitive electronic devices such as the computer of Kelly, by absorbing and dissipating heat into the environment.

167. Given the well-known and ubiquitous use of heat sinks in electronic devices and otherwise, a POSA would have enjoyed a high likelihood of success in implementing the heat sinks of Avramis with the housing of Kelly.

[1.6] *a radome, the radome mounting to the internal cover and enclosing the RF radiating module;*

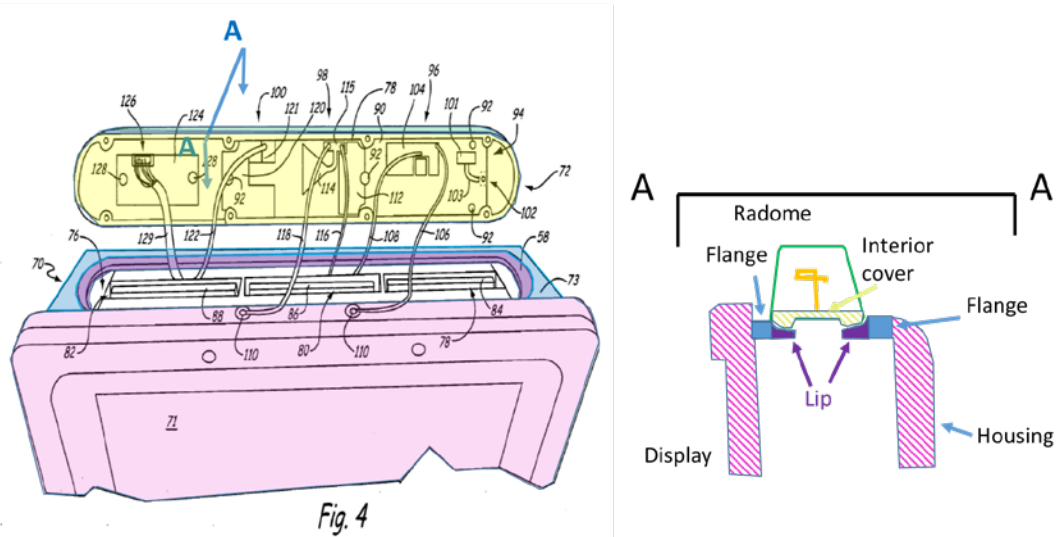
168. Kelly discloses a radome (green) extending from the internal cover (yellow) and enclosing the RF antennas.

[1.7] *wherein a flange joins the first and second side walls and the top and bottom wall, and a lip extends from the flange, further defining the aperture through which the cavity of the enclosure may be accessed, the lip being engaged by the internal cover to provide the environmental seal.*

169. Kelly discloses a flange (blue) that joins the first and second side walls and top and bottom wall. The flange includes a groove (purple) in the flange which forms a lip extending from the flange which defines the aperture, the lip cooperates with the seal to provide a seal [environmental seal].

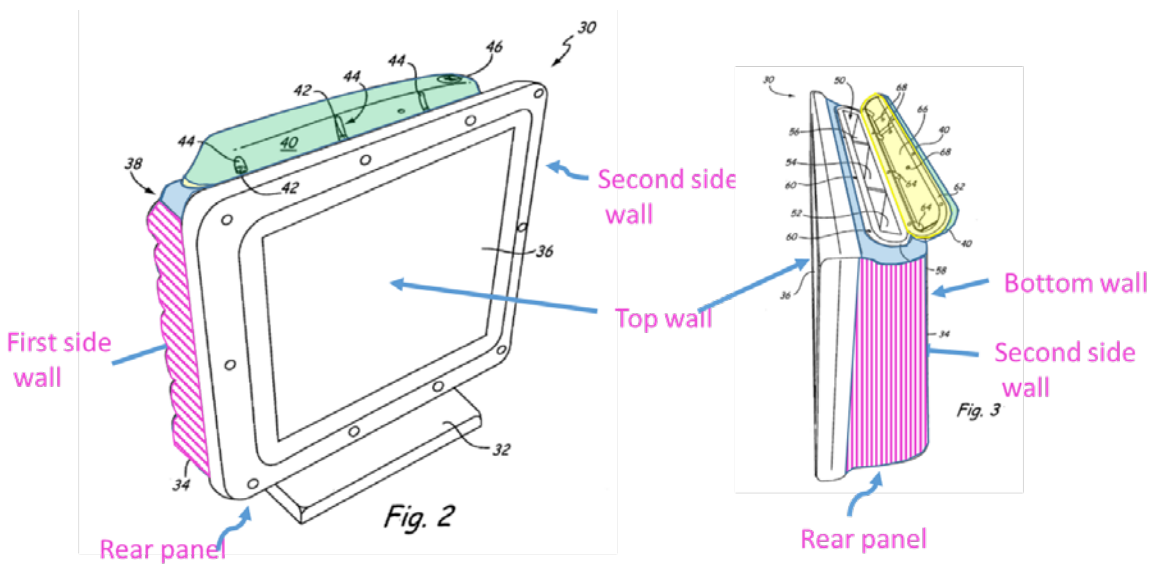
The radome/access door 40 comprises a seal 62 and several cylindrical screw channels 64 through which screws can be inserted. The seal 62 corresponds in size to the groove 58 on the computer housing 34. In this way, the radome 40 can be affixed to the housing 34 by inserting screws through the screw channel 64 and screwing them into the screw holes 60 in the groove 58. The groove 58 and the corresponding seal 62 allow the radome 40 to be snugly affixed to the housing 34. The seal 62 serves to ensure that once the radome 40 is affixed to the housing 34, the computer 30 is properly sealed so that no moisture, dirt, and dust enters the interior 50 of the computer 30.

EX-1009 [0025].



EX-1009 FIG. 4.

170. As shown below the flange joins the top, bottom and side walls.



EX-1009 FIGs. 2 and 3.

Claim 2

The panel antenna of claim 1, wherein the panel antenna further comprises:

- i. a second micro radio, the second micro radio mounted to an internal surface of the second side wall,*

171. Kelly discloses multiple micro PCI radios mounted internally to the computer housing. *See* Claim limitation [1.4] above.

- ii. a plurality of RF radiating modules,*

172. Kelly discloses multiple antennas. *See* Claim limitation [1.3] above.

- iii. a second heat sink mounted on an exterior surface of the second side wall.*

173. Kelly alone or in view of Avramis discloses a second heat sink on an exterior surface of a second side wall of the computer housing. As described above, Kelly discloses the sidewalls of the computer housing are formed of metal with corrugations and thus function as a heat sink. To the extent PO argues that Kelly does not disclose a second heat sink on an exterior surface, Avramis discloses a second heat sink on a second side wall. Thus it would have been obvious to modify Kelly's housing to include the heat sinks of Avramis on the exterior side walls, for the same reasons discussed above with respect to limitation [1.5] above.

Claim 7

The panel antenna of claim 1, wherein a flange joins the first and second side walls and the top and bottom wall, further defining the aperture through which the cavity of the enclosure may be accessed.

174. See Claim limitation [1.7].

CONCLUSION AND DECLARATION

My findings and opinions set forth in this Declaration are based on my work and examination to date. I may continue my examinations in view of additional documents or other factual evidence over the course of this proceeding that may necessitate supplementing and/or refining my opinions. I reserve the right to add to, alter, or delete my opinions and my Declaration upon discovery of additional information. I reserve the right to make such changes as necessary.

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 this 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.

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

[SIGNATURE ON FOLLOWING PAGE]

Date: 9/23/2024

By: Henry H. Houh.
Henry Houh Ph.D

Appendix A

<i>Exhibit No.</i>	<i>Description</i>
1001	U.S. Patent No. 8,497,813 (the “’813 Patent”)
1002	Portions of prosecution history of the ’813 Patent (“File History”)
1004	U.S. Patent Publication No. 2006/0250311 (“Bishop”)
1005	U.S. Patent No. 7,457,503 (“Solheid”)
1006	U.S. Patent Publication No. 2009/0134755 (“Lakoduc”)
1007	Foreign Publication DE102006020504A1 (“Neuhoff”)
1008	U.S. Patent No. 5,986,618 to (“Aakula”)
1009	U.S. Patent Publication No. 2006/0181462 (“Kelly”)
1010	U.S. Patent Publication No. 2007/0296518 A1 (“Avramis”)
1011	International Publication No. WO 2008/009421 (“Korte”)

APPENDIX B

Henry H. Houh

henry.houh@gmail.com

cell: 781-325-8273

Education

Massachusetts Institute of Technology, Cambridge, MA

- PhD in Electrical Engineering and Computer Science, February 1998. “Designing Networks for Tomorrow's Traffic,” thesis supervised by Professor David Tennenhouse and Professor John Guttag. GPA 4.7/5.0
- Master of Science in Electrical Engineering and Computer Science, February 1991. “Demonstration of a laser repetition rate multiplier,” thesis. GPA 4.5/5.0
- Bachelor of Science in Electrical Engineering and Computer Science, June 1989. “Boundary element analysis of arbitrarily shaped dielectric structures,” thesis. GPA 4.7/5.0
- Bachelor of Science in Physics, February 1990. GPA 4.7/5.0

MITx, Cambridge, MA

- September 2020 – present: Enrolled in Statistics and Data Science MicroMasters program, a sequence of five MIT-offered graduate-level courses in statistics and machine learning, culminating in a MicroMasters certificate. Have completed four of five required courses.

Experience

BlocksCAD Inc. (H3XL spin-out)

- 2014 - present: Founder and member of Board of Directors. BlocksCAD is a visual Computer-Aided Design (CAD) program, designed to teach children mathematics and geometric visualization. BlocksCAD is being used in U.S. schools and worldwide in maker spaces, with 350,000+ users. BlocksCAD was selected to be part of the LearnLaunch 2017 Boost Accelerator, the MIT Play Labs 2018 Summer Accelerator, and the MassChallenge 2018 Boston Cohort. Recipient of DARPA DSO grant in 2014, and SBIR grant from the USDA in 2019.

H3XL Inc. d/b/a Einstein's Workshop (formerly Lexington Robotics)

- 2009 - present: Founder and President. Started local league providing science and engineering education programs based on LEGO Mindstorms, LEGO WeDo, and FIRST LEGO League. In 2012, grew program into a full science, technology, engineering and math enrichment program and creative/maker space, in 7,000 square feet of space. Serve 2,000+ kids and families annually. As of end of 2021, have delivered an estimated 220,000 student-instruction-hours of STEM courses. Principle Investigator for 2-year DARPA grant to improve 3D Computer Aided Design tool developed in-house for the purposes of teaching 8 year olds and up 3D CAD.

Houh Consulting Inc. / Independent Consultant

- 2009 - present: Technical consultant specializing in Social Networking, Web 2.0, Web Site Development, Data Networking, Optical Networking, Telecommunications, Media Streaming and Voice Over IP. Clients include: Akin Gump Strauss Hauer & Feld LLP, Arnold & Porter Kaye Scholer LLP, BBN, Baker Botts LLP, Barnes & Thornburg LLP, BBN Technologies, Beus Gilbert McGroder PLLC, Bracewell LLP, Christensen O'Connor Johnson Kindness PLLC, Cooley LLP, Covington & Burling LLP, Cozen O'Connor P.C., DLA Piper, Davis Polk & Wardwell LLP, Desmarais LLP, Duane Morris LLP, Erise IP, P.A., Faegre Baker Daniels LLP, Finnegan, Henderson, Farabow, Garrett & Dunner, LLP, Fish & Richardson P.C., Goldman Ismail Tomaselli Brennan & Baum LLP, Haynes and Boone, LLP, Kaye Scholer, Kellogg Huber Hanson Todd Evans & Figel PLLC, Kirkland & Ellis LLP, Klarquist Sparkman, LLP, McCarthy Tetrault LLP, McGuireWoods LLP, Morgan, Lewis & Bockius LLP, Munger Tolles & Olson LLP, Orrick, Herrington & Sutcliffe LLP, O'Melveny & Myers LLP, Orrick, Herrington & Sutcliffe LLP, Paul Hastings LLP, Paul, Weiss, Rifkind, Wharton & Garrison LLP, Perkins Coie LLP, Quinn Emanuel Urquhart & Sullivan, LLP, Sidley Austin LLP, Smith Baluch LLP, Sterne, Kessler, Goldstein & Fox PLLC, Troutman Sanders LLP, Venable LLP, Weil, Gotshal & Manges LLP, Wiley Rein LLP, Wilmer Cutler Pickering Hale and Dorr LLP, and Winston & Strawn LLP.

Eons

- 2008 - 2009: Chief Technology Officer. Created product that Eons acquired from BBN Technologies. Integrated BBN product with Eons social networking platform and significantly increased the Eons group creation rate. Helped evaluate advertisement platform offerings and rolled out the "Boom Network" advertising network. Eons raised \$32 million from General Catalyst Partners, Charles River Ventures, Sequoia Capital, and Intel Capital.

BBN Technologies

- 2007 - 2008: Delta Division, Vice President of Technology. Grew "Boomerang" counter-sniper project engineering team and significantly de-risked \$10 million worth of product deliveries. Boomerang was a significant asset leading to the acquisition of BBN by Raytheon in 2009. Created new business plan and grew team; launched new fully-featured social networking web site in 5 months. Served as lead expert witness in patent

infringement lawsuit, resulting in \$58 million jury award to client; verdict for patents I testified on were upheld on appeal which resulted in a \$120 million settlement.

- 2004 - 2007: Delta Division, Director of Technology, responsible for commercializing IP and creating new businesses. Hired and grew division's initial engineering team. Wrote three business plans, two of which are funded and active. For call center business plan, acted as general manager, hiring and managing engineering team, inside sales team, and identifying and recruiting a new general manager. Identified and recruited other key employees to Delta Division, including senior members of team leading to successful internal sales growth and spin-outs of projects. Contracted by BBN to BBN spin-out PodZinger as VP of Operations and Technology. Identified sales team for counter-sniper system, leading to \$10 million dollars of new sales within 6 months and \$100+ million in additional orders in the following two years.

PodZinger Inc. (BBN spin-out, also known as EveryZing and now RAMP)

- 2006: Vice President of Operations and Technology. Significantly upgraded capability of consumer-facing search site and redeployed web site from company to co-location facility. Identified key portions of infrastructure for upgrading and cost reduction. Helped write business plan, evaluating advertisement models of revenue. Hired in operations replacement and phased back to BBN.

Commonwealth Capital

- 2004: Entrepreneur-in-residence (informally), performed technical due diligence on business plans, brainstormed ideas for new businesses with venture partner. With venture partner, left for portfolio company BBN to form core of commercialization team.

Empirix, Inc./Teradyne, Inc.

- 2001 - 2004: Chief Technologist, Engineering Manager, Web Application Test Group. Researched potential new product areas; developed product plan and prototype. Responsible for three new and existing products. Managed off-shore development team. Chief architect for all web testing products. Re-architected core testing product, helped write javascript interpreter. Provided technical vision for core product.
- 2000 - 2001: Chief Technologist, Communication Infrastructure Test Group. Responsible for incorporating new technology internally, tracking new technologies, technical evaluation of partnerships and potential acquisitions. Helped develop division strategy. Developed plans which formed core capabilities for successful new products introduced in 2004-5.
- 2000 - 2001: Engineering Manager, Communications Infrastructure Test Group. Execution of new product plan developed in prior role. Grew team from four existing engineers to team of over 30 on immediate team and over 40 on project. Delivered new platform in one year. Platform and derivatives accounted for large portion of booked products for the division within 2 years and is currently (2008) a key portion of new product offerings.

- 2000: Empirix was formed as a spin-out of Teradyne in January 2000. Reported to CEO in carve-out of Empirix from Teradyne.
- 1999: (Teradyne) Director of Business Development, Software Test Units. Reported directly to Chairman of the Board/Founder and then to general manager of software test unit (6 divisions of Teradyne). Evaluated and researched acquisition and partnership candidates. Internally assessed technology position in market and gaps in product lines. Worked with senior division staff to develop new product strategies. Attended internal Teradyne divisional board meetings. Chairman served as my mentor.

3Com Corporation/NBX Corporation

- 1999: Software Engineer 5. Continued work after 3Com acquisition of NBX. Built cross-division relationships for new products and research directions. NBX was acquired by 3Com in March 1999.
- 1997 - 1999: (NBX) Senior Scientist and Engineer. Work in IP Telephony. Architected next-generation product. Protocol design and validation for core protocol now used tens of millions of times daily. Led team in integration of IP protocols into current product. Designed audio reconstruction algorithms. Developed applications for bug analysis and diagnosis of system problems. Implementation of network simulator. Work on collaborative projects with external partners. Worked to identify gaps in product. Representative at numerous trade shows. Innovated novel methods of using product.

MIT Department of Electrical Engineering and Computer Science, Cambridge, MA

- 1991 - 1998: Research assistant, Telemedia Network Systems Group. Design, development, and implementation of Gigabit ATM network for distributed multimedia system. Studied host interface design issues. ATM network simulation.
- Spring 1989, Fall 1990, Spring 1995: Teaching assistant, Computation Structures digital systems course. (Spring 1995 Head TA)
- 1988 - 1989: Head laboratory teaching assistant for Computation Structures. Responsibilities included writing and revising lab assignments, and maintaining the lab.
- 1987: Laboratory teaching assistant for Computation Structures.
- 1987: Design, construction, and programming of 16-bit computer.

Agora Technology Group, Incorporated

- 1994 - 1996: Founder and CEO. Conceived and oversaw development of targeted advertising-supported Web sites. Responsible for company's vision and direction. Attended the first two WWW Conferences, presenting a workshop and paper at the first, and appearing on the "Commercialization and Economics of the Web" panel and chairing the "Where Commercial Services and the Web Are Headed" panel at the second. Sold company intact; is currently an operating stand-alone company.

AT&T Bell Laboratories, Holmdel, NJ

- 1989 - 1990: Implementation of cascadable all-optical fiber logic gate. Modelocking of all-fiber erbium laser. Construction of modelocked laser repetition rate booster. Strong optics laboratory and fiber optic experience.
- Summer 1988, 1987: Research in integrated optics. Analysis of rectangular waveguides using microwave modeling. Fabrication of integrated optical components.

Honors

- MIT Alumni Association Great Dome Award, 2010, Baker 60th Anniversary Reunion Co-Chair (highest group award given by MIT Alumni Association)
- MIT Alumni Association Presidential Citation Award (now known as Great Dome), 2008, Member of MIT Chairman's Salon committee
- MIT Alumni Association Bronze Beaver Award, 2007 (highest individual award given by MIT Alumni Association)
- MIT Alumni Association Volunteer Honor Roll, February 2004
- MIT Alumni Association Lobdell Award, 1999
- Boston Museum of Science Gold Pin for 1000 hours of Volunteer Service, April 1999
- MIT Alumni Association Presidential Citation Award (now known as Great Dome), 1997, Member of Alumni Online Communications Committee

Patents and Patent Publications

- U.S. Patent #9,697,231, H. Houh, J. Stern, R. Spina, M. Meter, "Methods and apparatus for providing virtual media channels based on media search," July 4, 2017.
- U.S. Patent #9,697,230, H. Houh, J. Stern, "Methods and apparatus for dynamic presentation of advertising, factual, and informational content using enhanced metadata in search-driven media applications," July 4, 2017. See also WO2007056485.
- U.S. Patent #7,975,296, L. Apfelbaum, H. Houh, T. Mayberry and G. Friedman, "Automated security threat testing of web pages," July 5, 2011. See also US20030159063, WO2003067405.
- U.S. Patent #7,877,736, H. Houh and J. N. Stern, "Computer language interpretation and optimization for server testing," January 25, 2011. See also US20050138104, WO2005043300.
- U.S. Patent #7,801,910, H. Houh and J. N. Stern, "Method and apparatus for timed tagging of media content," September 21, 2010. See also US20070112837, US20090222442, WO2007056535.
- U.S. Patent #7,590,542, D. C. Williams, W. C. Hand, H. Houh, A. R. Seeley, "Method of Generating Test Scripts Using a Voice-Capable Markup Language," September 15, 2009. See also EP1530869, US20030212561, WO2003096663.
- U.S. Patent #6,967,963, H. H. Houh, P. Anderson, C. Gadda, "Telecommunication method for ensuring on-time delivery of packets containing time-sensitive data," November 22, 2005. See also EP1060400, WO2000033092, CA2318774.

- U.S. Patent #5,144,375, M. C. Gabriel, H. H. Houh, N. A. Whitaker, “Sagnac Optical Logic Gate,” September 1, 1992. Also issued as European Patent # EP0456422, July 23, 1997, German Patent #DE69126913, August 28, 1997
- U.S. Patent Application Publication No. 20020015387, “Voice Traffic Packet Capture and Analysis Tool for a Data Network” (Abandoned in 2007)
- U.S. Patent Application Publication No. 20020016708, “Method and Apparatus for Utilizing a Network Processor as Part of a Test System” (Abandoned in 2007)
- U.S. Patent Application Publication No. 20020016937, “Method and Apparatus for Utilizing a Network Processor as Part of a Test System.” (Abandoned in 2007) See also WO2002011413.
- U.S. Patent Application Publication No. 20070106646, “User-directed navigation of multimedia search results” (Abandoned in 2009)
- U.S. Patent Application Publication No. 20070106660, “Method and apparatus for using confidence scores of enhanced metadata in search-driven media applications” (Abandoned in 2009)
- U.S. Patent Application Publication No. 20070106685, “Method and apparatus for updating speech recognition databases and reindexing audio and video content using the same” (Abandoned in 2015)
- U.S. Patent Application Publication No. 20070118873, “Methods and apparatus for merging media content” (Abandoned in 2015)
- U.S. Patent Application Publication No. 20090222442, “User-directed navigation of multimedia search results” (Abandoned in 2016)
- U.S. Patent Application 11/395,732, “Search snippet creation for audio and video data” (Abandoned in 2009)
- U.S. Patent Application 11/774,931, “Methods and apparatus for managing a social networking web site”
- U.S. Patent Application 11/774,947, “Methods and apparatus for organizing media files”
- U.S. Patent Application 11/774,956, “Methods and apparatus for managing an online event”
- U.S. Provisional Patent Application 61/086,909, “Measuring and ranking relationship activity”
- U.S. Provisional Patent Application 61/086,914, “Detecting media object commonality”
- U.S. Provisional Patent Application 61/086,904, “Message categorization based on message characteristics”
- U.S. Provisional Patent Application 61/086,905, “Photo tagging to request action”

Trials, Testimony and Depositions

- Case No. 1:06CV682 (CMH/BRP), Verizon vs. Vonage, U.S. District Court for the Eastern District of Virginia, filed expert report, was deposed and testified at trial.
- Case No. 1:08CV157 (CMH/TRJ), Verizon vs. Cox, U.S. District Court for the Eastern District of Virginia, was deposed and testified at trial.
- Case No. 5:09-cv-476, Two-Way Media vs. AT&T, U.S. District Court for the Western District of Texas, filed expert report, testified at trial.

- Case No. 2:10-cv-248 (RAJ/FBS), ActiveVideo Networks vs. Verizon, U.S. District Court for the Eastern District of Virginia, filed expert report and was deposed as an expert witness.
- Case No. 1:11-cv-00880-TSE-JFA, Bear Creek Technologies, Inc. vs. Verizon Services Corp., et al, U.S. District Court for the Eastern District of Virginia, was deposed as an expert witness.
- Case No. 3:10-CV-298-BBC, AlmondNet, Inc. vs. Microsoft Corp., U.S. District Court for the Western District of Wisconsin, filed expert report.
- Case No. 6:10-cv-00597, Guardian Media Technologies, Ltd. Vs. AT&T Operations, Inc. et al., U.S. District Court for the Eastern District of Texas, Tyler Division, filed expert report.
- Case No. ESCV2010-02282C, The Octopus Solution LLC v. Gary Brown et al., Essex, MA Superior Court, testified at trial.
- Investigation No. 337-TA-882, In the matter of Certain digital media devices, including televisions, Blu-ray disc players, home theater systems, tablets and mobile phones, components thereof and associated software, U.S. International Trade Commission, filed expert reports, was deposed and testified at hearing.
- Investigation No. 337-TA-995, In the matter of Certain communications or computing devices, and components thereof, U.S. International Trade Commission, filed expert reports, and was deposed.
- Case No. 8:12-cv-122-LES-TDT, Prism Technologies LLC v. AT&T Mobility LLC, U.S. District Court for the District of Nebraska, filed expert report, was deposed and testified at trial.
- Case No. 11-2684 (JWL), Sprint Communications Co., L.P., v. Comcast Cable Communications, LLC, et al., U.S. District Court for the District of Kansas, filed expert report and was deposed.
- Case No. 11-2686 (JWL), Sprint Communications Co., L.P., v. Time Warner Cable, Inc., et. al., LLC, et al., U.S. District Court for the District of Kansas, filed expert report, was deposed, and testified at trial.
- Case No. 12-487 (SLR), Cox Communications, Inc., et al., v. Sprint Communications Company L.P., et al., U.S. District Court for the District of Delaware, filed expert report and was deposed.
- Case IPR 2014-00039, Microsoft Corporation v. B.E. Technology LLC, U.S. Patent No. 6,628,314. Submitted declaration and cross-examined in deposition.
- Case IPR 2014-00086, Apple, Inc. v. Evolutionary Intelligence, LLC, U.S. Patent No. 7,010,536. Submitted declaration and cross-examined in deposition.
- Case No. 6:11-CV-421, Stragent, LLC v. Intel Corporation, U.S. District Court for the Eastern District of Texas, Tyler Division, deposed and testified at trial as a fact witness.
- IPR2014-01366, IPR2014-01367, IPR2014-01368, Samsung et al. v. Straight Path, submitted IPR declarations and was deposed.
- IPR2015-1006, IPR2015-1007, Cisco v. Straight Path, submitted IPR declarations.
- IPR2014-01457, IPR2014-01459, Microsoft v. Biscotti, submitted IPR declaration and was deposed.
- IPR2016-00302, Apple v. Nonend, submitted IPR declaration.
- IPR2014-00812, Yelp and Twitter v. Evolutionary Intelligence, submitted IPR declaration.

- IPR2015-00307, Cisco v. AIP, submitted IPR declaration.
- Microsoft v. Acacia, submitted IPR declaration.
- IPR2015-00342, AT&T Mobility LLC and Cellco Partnership d/b/a Verizon Wireless v. Solocron, submitted IPR declaration.
- Mediatube v. Bell Canada, Canadian Federal Court, submitted expert report and testified at trial.
- CBM2016-00036, Google v. At Home Bondholder's Liquidating Trust, submitted CBM declaration.
- IPR2016-01198, IPR2016-01201, Apple, Inc. v. VoIP-Pal.com, Inc., submitted IPR declaration and was deposed.
- Case No. 3:14-cv-2824-VC, Trend Micro Incorporated v. Rpost Holdings, Inc., et al, submitted expert report and was deposed
- Akamai v. Limelight Networks, IPR2016-01631, IPR2016-01711, IPR2017-00249, IPR2017-00349, submitted IPR declarations and was deposed
- Hyperlync Technologies v. Verizon Sourcing, No. 650151/2015 New York Supreme Court, submitted declaration and was deposed
- Cascades Streaming Technologies v. Big Ten Networks, submitted expert reports and was deposed
- Klaustech, Inc. v. Google LLC., Case No. 4:10-CV-05899-JSW (N.D. Cal.), submitted expert report and was deposed
- Cisco v. Uniloc, IPR2017-00198, IPR2017-00058, submitted IPR declarations and was deposed.
- Cisco v. Uniloc, IPR2017-00597, submitted IPR declaration and was deposed
- Twitter v. Youtoo Technologies, LLC, IPR2017-01133, IPR2017-01131, submitted IPR declarations and was deposed
- Taser International Inc. (now Axon Enterprise, Inc.) v. Digital Ally Inc., IPR2017-00375, submitted IPR declaration and was deposed
- Taser International Inc. (now Axon Enterprise, Inc.) v. Digital Ally Inc., IPR2017-00376, IPR2017-00515, IPR2017-00775, submitted IPR declarations
- HTC Corporation v. IPA Technologies, IPR2018-00306, IPR2018-00307, submitted IPR declaration
- Hulu v. Soundview, IPR2018-00864, IPR2018-01023, submitted IPR declarations and was deposed
- XpertUniverse v. Cisco, 3:17-cv-3848, U.S. District Court for Northern District of California, submitted declaration in support of claim construction and was deposed
- Improved Search v. Microsoft, C.A. No. 16-cv-650-JFB-SRF (Del.), submitted declaration in support of claim construction
- Apple v. Uniloc, IPR2018-00361, IPR2018-00394, IPR2018-00395, IPR2019-00700, IPR2019-00701, IPR2019-01667, submitted IPR declarations
- LG Electronics v. Uniloc, submitted IPR declaration
- SRC Labs and Saint Regis Mohawk Tribe v. Microsoft, 2:18-cv-00321-JLR, U.S. District Court for Western District of Washington at Seattle, submitted declaration in support of claim construction and was deposed
- Verizon Wireless v. Barkan Wireless IP Holdings LP, submitted IPR declarations

- Verizon Wireless and Samsung Electronics America Inc. v. Barkan Wireless IP Holdings LP, IPR2019-199, IPR2019-200, IPR2019-234, IPR2019-631, IPR2019-632, submitted IPR declarations
- Samsung Electronics America Inc. v. Barkan Wireless IP Holdings LP, IPR2019-100, submitted IPR declaration
- Cisco Systems Inc. v. Meetrix IP LLC, IPR2019-539, IPR2019-540, IPR2019-541, IPR2019-542, IPR2019-543, IPR2019-544, submitted IPR declarations
- GMG Products LLC v. Traeger Pellet Grills LLC, PGR2019-24, PGR2019-34, PGR2019-35, PGR2019-36, submitted PGR declaration and was deposed
- Uniloc 2017 LLC v. Google LLC, 2:18-cv-00502-JRG-RSP, U.S. District Court for the Eastern District of Texas, Marshall Division, submitted declaration in support of claim construction
- Microsoft Corporation v. Uniloc 2017 LLC, IPR2020-00102, IPR2020-00103, submitted IPR declarations
- Microsoft Corporation and HP Inc. v. Syncloud Technologies, LLC, IPR2020-00316, IPR2020-01031, IPR2020-01032, IPR2020-01269, IPR2020-01270, IPR2020-01271, submitted IPR declarations
- Seven Networks, LLC v. Apple Inc, 2:19-cv-115-JRG, U.S. District Court for the Eastern District of Texas, Marshall Division, submitted declaration in support of claim construction
- Unified Patents Inc. v. Ortiz & Associates Consulting, LLC, IPR2019-00743, submitted IPR declaration
- Uniloc 2017 LLC v. Apple Inc., 3:19-cv-01905-JD, U.S. District Court for the Northern District of California, San Francisco Division, submitted declaration in support of claim construction and was deposed
- ClearPlay Inc. v. Dish Network LLC et al.; 2:14-cv-00191, U.S. District Court for the District of Utah, Central Division, submitted expert report and re-examination declarations, was deposed, and testified at trial
- AMC Networks, Inc. et al v. Sound View Innovations, LLC, IPR2020-00482, submitted IPR declaration
- Case No. 1:17-cv-01734-RGA, Sprint Communications Co., L.P., v. Charter Communications, Inc., et al., U.S. District Court for the District of Delaware, filed expert report and was deposed.
- CommScope Technologies LLC et al. v. Barkan Wireless IP Holdings LP et al., IPR2020-00827, IPR2020-00829, IPR2020-00831, IPR2020-00833, IPR2020-00835, IPR2020-00838, submitted IPR declarations
- Cisco Systems Inc. v. Monarch Networking Solutions LLC, IPR2020-01226, submitted IPR declaration
- CoolTV Network.com v. Blackboard, Inc., Facebook, Inc., International Business Machines Corporation, Kaltura, Inc., Limelight Networks, Inc., Microsoft Corporation, Ooyala, Inc., Snap, Inc., and Trapelo Corp., submitted declaration in support of claim construction and was deposed
- Facebook, Inc. v. Onstream Media Corporation, IPR2020-01507, IPR2020-01508, IPR2020-01525, IPR2020-01527, IPR2020-01528, submitted IPR declarations
- Hisense Co LTD. v. Maxell, LTD, IPR2020-01598, IPR2020-01600, submitted IPR declarations

- Microsoft Corp. v. O'Brien, IPR2021-00015, submitted IPR declaration and was deposed
- Sable Networks Inc. v. Cisco Systems, Inc., WA:20-CV-00288-ADA, U.S. District Court for the Western District of Texas, Waco Division, submitted declaration in support of claim construction
- Peloton Interactive, Inc. v. Icon Health and Fitness Inc et al., IPR2021-00342, submitted IPR declaration
- Hulu, LLC v. SITO Mobile R&D IP, LLC et al., CBM2020-00028, IPR2020-00158, IPR2020-00206 , IPR2020-00219 , IPR2020-00265 , IPR2020-00298 , IPR2020-00304 , IPR2020-00308 , submitted CMB and IPR declarations and was deposed
- Twitter, Inc. and Google LLC v. B.E. Technology, LLC, IPR2021-00482, IPR2021-00483, IPR2021-00484, IPR2021-00485, submitted IPR declarations
- MG Freesites LTD v. ScorpCast, LLC, IPR2021-00511, submitted IPR declaration
- Avionte, LLC v. Sandeep Acharya, Samar Basnet, and Aqore LLC, Arbitration, Hon. Jeffrey Keyes (Ret.)
- Microsoft Corporation v. WSOU Investments, LLC d/b/a Brazos Licensing and Development, IPR2021-00751, submitted IPR declaration
- SAP America, Inc. v. Express Mobile, Inc., IPR2021-01144, IPR2021-01145, IPR2021-01146, submitted IPR declarations
- StratosAudio Inc. v. Hyundai Motor America, 6:20-cv-01125-ADA, U.S. District Court for the Western District of Texas, Waco Division, submitted claim construction declaration and was deposed Peloton Interactive, Inc. v. Ifit Health and Fitness Inc, IPR2022-00029, IPR2022-00030, submitted IPR declarations and was deposed
- Investigation No. 337-TA-1263, In the matter of Certain televisions, remote controls, and components thereof, U.S. International Trade Commission, filed expert reports, was deposed, and testified at hearing
- Alexander Stross v. Netease, Inc., et al., U.S. District Court (Central District of California), Case 2:20-cv-00861-AB(JC), filed expert reports, and was deposed
- Ralph Ledergerber v. Netease, Inc., et al., U.S. District Court (Central District of California), Case 2:20-cv-00862-AB(JC), filed expert reports and was deposed
- John Walmsley v. Netease, Inc., et al., U.S. District Court (Central District of California), Case 2:20-cv-00863-AB(JC), filed expert reports and was deposed
- Bernhard Kuhmstedt v. Netease, Inc., et al., U.S. District Court (Central District of California), Case 2:20-cv-02044-AB(JC), filed expert reports and was deposed
- Netflix, Inc. v. CA, Inc., IPR2021-01319, submitted IPR declaration and was deposed
- F45 Training Pty Ltd. v. Body Fit Training USA Inc., C.A. No. 20-1194 (LPS) (D. Del.), filed expert report
- Apple v. Fintiv, IPR2022-00976, IPR2022-01149, IPR2022-01150, IPR2023-00399, submitted IPR declarations and was deposed
- Estech Systems, Inc. v. Howard Midstream Energy Partners d/b/a Howard Energy Partners, C.A. No. 6:20-cv-777-ADA (Western District of Texas, Waco Division), filed expert reports and was deposed
- Echelon Fitness Multimedia, LLC. v. Peloton Interactive, Inc., IPR2020-01187, submitted IPR declaration and was deposed
- VIZIO. V. Maxell Ltd., IPR2022-01458, submitted IPR declaration
- Maxell, Ltd. et el. v. VIZIO, Inc., Case No. 2-21-cv-06758 (C.D. Cal.). filed declaration and was deposed

- Microsoft Corporation v. SurfCast, Inc., submitted IPR declarations
- MemoryWeb, LLC v. Samsung Electronics Co., LTD. and Samsung Electronics America, Inc., Case No. 6:21-cv-00411-ADA (Western District of Texas, Waco Division), filed declaration and was deposed
-
- The Walt Disney Company et al. v. WAG Acquisition LLC, IPR2022-01227, IPR2022-01228, IPR2022-01346, submitted IPR declarations and was deposed
- Rakuten Rewards et al. v. IBM, submitted IPR declarations and was deposed
- Fubotv Media Inc. v. Sito Mobile R&D IP, LLC et al., submitted IPR declarations
- Unified Patents, LLC v. Noblewood IP LLC, IPR2022-01111, submitted IPR declaration
- Unified Patents, LLC. v. Pedersen, Peter Henrik, IPR2023-00029, submitted IPR declaration
- Ericsson Inc v. Dali Wireless Inc., submitted IPR declarations
- Universal Electronics, Inc. et al. v. Roku, Inc., IPR2022-00818, submitted declarations and was deposed
- Google LLC. v. Wildseed Mobile LLC et al., IPR2023-00244, IPR2023-00245, IPR2023-00246, IPR2023-00247, IPR2023-00248, submitted declarations
- Lululemon Athletica Canada Inc. et al. v. Nike, Inc., IPR2023-00180, IPR2023-00424, submitted declarations
- Zoho Corporation, et al. v. Meetrix IP, LLC, IPR2023-00371, IPR2023-00377, IPR2023-00379, IPR2023-00380, IPR2023-00382, submitted declarations
- WSOU Investments, LLC d/b/a/ Brazos Licensing and Development v. Google LLC, 6:20-cv-572, U.S. District Court for the Western District of Texas, Waco Division, submitted reports and was deposed
- Google LLC v. Safecast Limited LLC, IPR2023-00652, submitted declaration
- Investigation No. 337-TA-1338, In the matter of Certain smart televisions, U.S. International Trade Commission, filed reports and was deposed
- Cisco Systems, Inc. v. Orckit IP LLC, IPR2023-00714, submitted declaration
- SupplyPro, Inc. v. Sandvik Machining Solutions AB, et al., AAA Case No. 01-22-000-7897. submitted declaration
- TrackThings LLC v. NETGEAR, Inc., Case No. 22-00981-RGA-JLH, U.S. District Court for the District of Delaware, submitted declaration
- Walt Disney Parks & Resorts US Inc. v. Agile Journeys LLC; IPR2024-00029, submitted declaration
- Aylo Freesites Ltd v. Dish Technologies LLC; IPR2024-00043, IPR2024-00044, IPR2024-00045, IPR2024-00046, IPR2024-00047, IPR2024-00048, IPR2024-00146, IPR2024-00147; submitted declarations
- Arm Inc. et al. v. Icpillar LLC; IPR2024-00476, IPR2024-00566; Retained by Arm; submitted declarations
- Microsoft Corp et al. v. Litl LLC, IPR2024-00454, IPR2024-00455, IPR2024-00456, IPR2024-00457, IPR2024-00458; submitted declarations
- Cisco Systems Inc et al. v. InfoExpress Inc, IPR2024-00539, IPR2024-00540, IPR2024-00677, IPR2024-00678; submitted declarations
- Vizio Inc v. Multimedia Technologies Pte Ltd; IPR2024-00722, IPR2024-00723; Retained by Vizio; submitted declarations

- Sap America Inc v. Isix IP LLC; IPR2024-00615; Retained by SAP; submitted declarations
- Cisco Systems Inc et al. v. Portsmouth Network Corp; IPR2024-00505, IPR2024-00506; submitted declarations
- Aylo Freesites Ltd v. Dish Technologies LLC; IPR2024-00512, IPR2024-00513, IPR2024-00514, IPR2024-00515, IPR2024-00516, IPR2024-00517, IPR2024-00518, IPR2024-00519, IPR2024-00940, IPR2024-00941; submitted declarations
- Verizon Corporate Service Group et al. v. Headwater Partners I LLC; IPR2024-00809, IPR2024-00945; Retained by Verizon; Technology: Mobile device management; Submitted declarations
- Microchip Technology Inc v. Aptiv Technologies Ltd et al.; IPR2024-00228; Retained by Aptiv; Technology: Universal Serial Bus; Submitted declaration, 2024
- Vusion Group SA v. Hanshow Technology Co Ltd; IPR2024-00963; Retained by VusionGroup; Technology: Video analysis; Submitted declaration
- Maxell, Ltd. v. TCL Electronic Holdings Ltd. et al.; Case No. 5:23-cv-00108-RWS-JBB; U.S. District Court for the Eastern District of Texas, Texarkana Division; Retained by TCL; submitted declaration and was deposed

Publications

- “IP switching: server driven flow classification,” H. H. Houh, *Proceedings of the Washington University Workshop on Integration of IP and ATM*, November 1996.
- “Aurora at MIT,” D. D. Clark, H. H. Houh, and D. L. Tennenhouse, Editors, *MIT Laboratory for Computer Science Technical Report 673*, December 1995.
- “ViewStation Applications: Implications for Network Traffic,” C. J. Lindblad, D. Wetherall, W. Stasior, J. F. Adam, H. H. Houh, M. Ismert, D. Bacher, B. Phillips, and D. L. Tennenhouse, *IEEE Journal of Selected Areas in Communications*, 1995.
- “The VuNet Desk Area Network: Architecture, Implementation, and Experience,” H. H. Houh, J. F. Adam, M. Ismert, C. J. Lindblad, and D. L. Tennenhouse, *IEEE Journal of Selected Areas in Communications*, 13 (4), May, 1995.
- “Reducing the Complexity of ATM Host Interfaces,” H. H. Houh and D. L. Tennenhouse, Hot Interconnects II Symposium Proceedings, Stanford, August 11-12, 1994.
- “Media-intensive data communications in a ‘desk-area’ network,” J. F. Adam, H. H. Houh, M. Ismert, and D. L. Tennenhouse, *IEEE Communications*, August 1994.
- “ViewStation Applications: Intelligent Video Processing Over A Broadband Local Area Network,” C. J. Lindblad, D. J. Wetherall, W. Stasior, B. Phillips, D. Bacher, J. Adam, H. Houh, M. Ismert, and D. L. Tennenhouse, Proceedings of the 1994 USENIX Symposium on High-Speed Networking, Oakland, CA, August 1994.
- “The Media Gateway: Live Video on the World Wide Web,” H. H. Houh, C. J. Lindblad, J. Soo, D. L. Tennenhouse, and D. J. Wetherall, Workshop at the 1994 World Wide Web Conference, Geneva, Switzerland, May 1994.
- “Active Pages: Intelligent Nodes on the World Wide Web,” H. H. Houh, C. J. Lindblad, and D. J. Wetherall, Proceedings of the 1994 World Wide Web Conference, Geneva, Switzerland, May 1994.

- “Wavelength Division vs. Code Division Access Methods for Optical Networks,” H. H. Houh, Area Exam Paper, May 1993.
- “Experience with the VuNet: A Network Architecture for a Distributed Multimedia System,” J. F. Adam, H. H. Houh, D. L. Tennenhouse, Proceedings of the 18th Conference on Local Computer Networks, pp. 70-76, September 1993
- “The VudBoard: A Simple DMA Interface,” H. H. Houh, Proceedings of the 4th Gigabit Minijam, January 1994.
- “A Software-Oriented Approach to the Design of Media Processing Environments,” D. L. Tennenhouse, J. Adam, D. Carver, H. Houh, M. Ismert, C. Lindblad, W. Stasior, D. Weatherall, D. Bacher, and T. Chang., submitted to the International Conference on Multimedia Computing and Systems, May 1994.
- “A Network Architecture for Distributed Multimedia Systems,” J. F. Adam, H. H. Houh, M. Ismert, and D. L. Tennenhouse, submitted to the International Conference on Multimedia Computing and Systems, May 1994.
- “The Viewstation Collected Papers,” D. L. Tennenhouse, J. Adam, C. Compton, A. Duda, D. Gifford, H. Houh, M. Ismert, C. Lindblad, W. Stasior, R. Weiss, D. Wetherall, D. Bacher, D. Carver, and T. Chang, MIT Laboratory for Computer Science Technical Report, MIT/LCS/TR-590, November 1993.
- “The Viewstation Collected Papers II,” W. F. Stasior, D. L. Tennenhouse, J. F. Adam, D. R. Bacher, H. H. Houh, M. Ismert, C. J. Lindblad, B. M. Phillips, D. J. Wetherall, MIT Laboratory for Computer Science Technical Report, MIT/LCS/TR-696, April 1996.
- “A System's Perspective of the Sagnac Fiber Logic Gates and Their Possible Applications,” A. Huang, N. Whitaker, C. Gabriel, H. Avramopoulos, P. M. W. French, H. H. Houh, and I. Chuang, Applied Optics, September 10, 1994
- “Complete Switching in a Three-Terminal Sagnac Switch,” H. Avramopoulos, P. M. W. French, M. C. Gabriel, H. H. Houh, N. A. Whitaker, T. Morse, IEEE Phot. Tech. Lett. **3** (3), 235
- “Complete Switching in a Three-Terminal Sagnac Switch,” H. Avramopoulos, P. M. W. French, M. C. Gabriel, H. H. Houh, N. A. Whitaker, IEEE/LEOS Annual Meeting, Paper PDP-13, November 1990
- “All-optical phase-locked oscillator,” N. A. Whitaker, Jr., H. H. Houh, H. Avramopoulos, T. F. Morse, IEEE/LEOS Annual Meeting, Paper ELT2.4/MOO3, November 1990
- “Passive modelocking of an all-fiber erbium laser,” H. Avramopoulos, H. H. Houh, N. A. Whitaker, M. C. Gabriel, T. F. Morse, IEEE/LEOS Conference on Optical Amplifiers and their Applications, Paper PDP-8, August 1990
- “Transverse modes, waveguide dispersion, and 30ps recovery in submicron GaAs/AlAs microresonators,” J. L. Jewell, S. L. McCall, A. Scherer, H. H. Houh, N. A. Whitaker, A. C. Gossard, and J. H. English, Appl. Phys. Lett. **55** (1), July 3, 1989

Leadership, Activities and Interests

- Leadership
 - Reading Symphony Orchestra
 - Board of Directors (Treasurer), 2022 – present
 - Discovery Museum (Acton, MA)
 - Board of Directors, 2023 – present

- Board of Directors, Development Committee, 2023 – present
- Science and Technology Advisory Council, 2012 - present
- The Discover Museum received the 2024 National Medal for Museum and Library Service, the nation's highest honor given to museums and libraries that make significant and exceptional contributions to their communities.
- MIT Alumni Association Board of Directors
 - MIT Annual Giving Board, 3 year term, 2024 – 2027
 - National Selection Committee, 3 year term, 2020 – 2023
 - K-12 STEM Initiatives Co-chair, 2013 – 2017
 - Awards Committee Chair, 2012 – 2014
 - Awards Committee, 3 year term, 2011 – 2014
 - Vice President, 2 year term, 2004 – 2006
 - Alumni Ad-Hoc Committee, Chair, 2005-2006
 - Board Member, 2 year term, 1997 – 1999
- MIT Club of Boston
 - Board of Directors, 2006 - 2011
 - K-12 Initiatives Chair, 2009 - 2012
 - VP of Communications, MIT Club of Boston, 2003 - 2006
 - Past-President, MIT Club of Boston, 2002 - 2003
 - President, MIT Club of Boston, 2001 - 2002
 - President-Elect, MIT Club of Boston, 2000 - 2001
 - VP of Programs, MIT Club of Boston, 1999 - 2000
 - Activities Super-Chair, MIT Club of Boston, 1998 - 1999
- MIT Enterprise Forum of Cambridge, Inc.
 - Past Chair, 2009 – 2011
 - In-NOW-vation Co-chair, 2010
 - Chair, 2007 - 2009
 - Vice Chair, 2005 - 2007
 - Executive Board Member, 2002 - 2011
 - Winter Workshop Co-Chair, February 2007 - conceived idea for conference, which sold-out and produced largest attendance numbers in recent memory
 - Spring Workshop Co-Chair, Spring 2004
 - Membership Committee Chair, Fall 2003 - 2006
 - 25th Anniversary Dinner Chair, Fall 2003
 - As Membership Chair and Board Member, started Special Interest Groups in 2004; a SIG won the MIT Presidential Citation award, the MIT Alumni Association's highest award for organizations, in 2006
- Estabrook Elementary School PTA
 - Advisory committee to the superintendent on PCB issue, 2010-2011
 - 4th Grade after-school science program co-organizer, 2010-2012
 - 4th and 5th Grade before-school Math Olympiad co-organizer, 2009-2013
 - 5th Grade BBQ and Yearbook Committee, 2011, 2013
 - Family Math Night volunteer, 2008-2012
- Tau Beta Pi National Engineering Honor Society
 - Executive Councilor and Secretary, 2024 – 2026

- Advisor, MA B Chapter at MIT, 2003 - present
 - District Director (National Officer), Tau Beta Pi, New England Area, 1991 - 2003
 - President, MA B Chapter at MIT, Fall 1988 - Spring 1989
 - Laureate award, 1989
- MIT Class of 1989
 - 35-year Reunion Gift Committee, Co-chair, 2024
 - Secretary, five consecutive 5 year terms, 1989 - 2014
 - 30-year Reunion Committee, 2019
 - 25-year Reunion Committee, 2014
 - 20-year Reunion Committee and Gift Committee, 2009
 - 15-year Reunion Committee and Gift Committee, 2004
 - 10-year Reunion Committee and Gift Committee, 1999
 - 5-year Reunion Committee, 1994
 - Interim Treasurer, 1993 - 1994
 - Instituted annual senior class career fair, now raising over \$100,000 annually for senior class activities, Fall 1988
- Strong, consistent record of leadership dating to high school
- Acting
 - ‘21’ (Sony Pictures), credited as “Chinatown Dealer,” 2007, Kevin Spacey's movie about the MIT Blackjack Team inspired by “Bringing Down the House” by Ben Mezrich, opened nationwide on March 28, 2008. 21 was the number one movie in US for two weeks and number one globally for one week. 21 also topped the DVD sales, Blu-ray sales and DVD rental charts.
 - Spring Lake Theater Company, first New York-area off-broadway production of “A Chorus Line,” played role of Mark, Summer 1990
- Former member of the MIT Blackjack team
- Producer for 10,000 Maniacs’ 2013 album “Music from the Motion Picture”
- Executive Producer for 10,000 Maniacs’ 2015 album “Twice Told Tales”
- Violist, violist, harpist, guitarist, singer, actor: played in many amateur/semi-professional groups including Firebird Pops Orchestra, Reading Symphony Orchestra, MIT Summer Philharmonic Orchestra, Carlisle Chamber Orchestra, Rivers Symphony Orchestra, Opera51 Orchestra, Freisinger Chamber Orchestra, Merrimack Valley Philharmonic, Longwood Symphony, MIT Symphony, and Somerville Community Chorus
- Violist, “Coming Home” album by Karen Phillips, 2014
- Google Scholar citations: 2224, h-index: 22, i10-index: 27 (since 2019: 539/12/12)
- Erdos-Bacon number of 7
- Erdos-Bacon-Sabbath number of 11