UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

APPLE INC.,
Petitioner

v.

LBT IP I LLC,
Patent Owner

Inter Partes Review Case No. IPR2020-01189

U.S. Patent No. 8,497,774

DECLARATION OF SCOTT ANDREWS

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I, Scott Andrews, declare as follows:

I. BACKGROUND AND QUALIFICATIONS

1. My name is Scott Andrews, and I am over 21 years of age and otherwise competent to make this Declaration. I make this Declaration based on facts and matters within my own knowledge and on information provided to me by others, and, if called as a witness, I could and would competently testify to the matters set forth herein.

2. I have been retained as a technical expert witness in this matter by Counsel for the Petitioner, Apple Inc. ("Petitioner") to provide my independent opinions on certain issues requested by Counsel for Petitioner relating to the accompanying Petition for Inter Partes Review of U.S. Patent No. 8,497,774 ("the '774 Patent"). I am being compensated at an hourly rate of $650.00. My compensation in this matter is not based on the substance of my opinions or on the outcome of this matter. I have been informed that LBT IP I LLC is the purported owner of the '774 Patent. I note that I have no financial interest in LBT IP I LLC or Petitioner, and I have no other interest in the outcome of this matter.

3. I have summarized in this section my educational background, career history, and other qualifications relevant to this matter. I have also included a current version of my curriculum vitae, attached as Ex. 1035.

4. I have over 30 years of professional experience in the field of mobile devices and technologies and systems, including handheld communications and navigation devices, vehicle information systems and vehicle safety and control systems, and the sensor system that are used in these devices. Further, I have authored numerous published technical papers and am a named inventor on 13 U.S. and foreign patents.

5. I received a Bachelor of Science degree in Electrical Engineering from University of California, Irvine in 1977 and a Master of Science degree in Electronic Engineering from Stanford University in 1982.

6. From 1977 to 1979, I worked at Ford Aerospace where I designed, tested and delivered microwave radar receiver systems.

7. From 1979 to 1983, I worked at Teledyne Microwave, where I developed high reliability microwave components and developed CAD tools.

8. From 1983 to 1996, I worked at TRW, Inc., having held various positions. From 1983 to 1985, I was a Member of the technical staff and a Department Manager in the Space Electronics sector. Between 1985 and 1990 I was a project manager working on various communications systems projects including the US DoD Advanced Research Projects Administration (ARPA) MIMIC Program. Between 1990 and 1993 I was the Manager of MMIC (monolithic-microwave-integrated-circuit) Products Organization. In this role, I developed business strategy and

managed customer and R&D programs. During this time, I also developed the first single chip 94 GHz Radar, used for automotive cruise control and anti-collision systems. In 1993, I transferred to the TRW Automotive Electronics Group, and managed about 30 engineers in the Systems Engineering and Advanced Product Development organization. In this role, I managed advanced development programs such as automotive radar, adaptive cruise control, occupant sensing, automatic crash notification systems, in-vehicle information systems, and other emerging transportation products.

9. During this time, I also worked with various types of accelerometers. For example, I developed a system that sampled the acceleration signal over time, and applied this time series of samples as inputs to a neural network. We then adjusted the weights of the neural network so that the system would correctly discriminate between crash events and the events, for airbag activation. We also used accelerometers to determine and control airbag deployment parameters and timing, and to provide information about the crash severity to first responders.

10. I was employed as a Project General Manager in the Electronics Division of Toyota Motor Corporation at Toyota headquarters in Toyota City, Japan from April 1996 to around April 2000. In this position, I was responsible for leading the development of vehicle telematics systems, infotainment systems, including on-board and off-board navigation systems, mobile device integration systems, traffic

information systems, vehicle communications systems, safety applications, and automated vehicle control systems. For example, while I was working at Toyota I was awarded a Japanese patent[1] related to determining the relative orientation of a user's eyepiece (i.e. glasses) relative to their eye axis and a display screen in order to determine where on the screen the user was looking.

11. I am currently a consultant for Cogenia Partners, LLC, focusing on systems engineering, business development and technical strategy supporting automotive and information technology. I have been in this position since 2001. In one of my active engagements, I served as the technical lead on a project funded by the National Highway Traffic Safety Administration (NHTSA) to develop requirements for connected vehicle safety systems in preparation for NHTSA regulations governing such systems. I also served as a technical consultant on multiple projects sponsored by the Federal Highway Administration (FHWA) related to connected vehicle technology research.

12. In the various positions mentioned above, I was responsible for research and development projects relating to numerous mobile information systems, user interface systems, sensory systems, control systems and safety systems, and also had the opportunity to collaborate with numerous researchers and suppliers to the auto industry. I therefore believe that I have a detailed understanding of the state of the

art during the relevant period, as well as a sound basis for opining how persons of skill in the art at that time would understand the technical issues in this case.

13. I am being compensated for my time spent in connection with this case. I have no financial interest in the outcome of this case. The opinions provided in this report are my own and my compensation does not depend in any way on the substance of my opinions.

14. As part of my work and in forming my opinions in connection with this proceeding, I have reviewed the following materials. For any prior art listed below, it is my opinion persons of ordinary skill in my field would reasonably rely upon such prior art in forming opinions regarding the subject matter of this proceeding:

- Petition for Inter Partes Review of U.S. Patent No. 8,497,774;
- U.S. Patent No. 8,497,774 (Ex. 1001);
- File History for U.S. Patent 8,497,774 (Ex. 1002);
- Certified English Translation of Japanese Patent Publication No. JP2004-37116 to Sakamoto (Ex. 1004);
- U.S. Patent No. 6,799,050 to Krasner ("*Krasner"*) (Ex. 1010);
- U.S. Patent No. 5,845,142 to Hayasaka et al ("*Hayasaka*") (Ex. 1011);
- U.S. Patent No. 5,902,347 to Backman et al. ("*Backman*") (Ex. 1013);
- U.S. Patent No. 6,308,134 to Croyle et al. ("*Croyle*") (Ex. 1015);
- U.S. Patent No. 7,024,321 to Deninger et al. ("*Deninger*") (Ex. 1016);
- U.S. Patent No. 7,196,661 to Harvey ("*Harvey*") (Ex. 1017);
- U.S. Patent Application Publication No. 2006/0167647A1 to Krumm et al. ("*Krumm*") (Ex. 1019);
- U.S. Patent No. 5,592,173 to Lau et al. ("*Lau*") (Ex. 1020);
- U.S. Patent No. 7,430,675 to Lee ("*Lee*") (Ex. 1021);
- U.S. Patent No. 8,467,804 to Lindquist ("*Lindquist*") (Ex. 1022);
- U.S. Patent No. 7,760,137 to Martucci et al. ("*Martucci*") (Ex. 1023);
- U.S. Patent No. 7,181,192 to Panasik et al. (Ex. 1024);
- U.S. Patent No. 7,126,536 to Rabinowitz et al. (Ex. 1025)
- U.S. Patent No. 8,797,214 to Taylor et al. ("*Taylor*") (Ex. 1026);

- U.S. Patent No. 7,239,271 to Vyas et al. ("*Vyas*") (Ex. 1027);
- U.S. Patent No. 6,850,844 to Walters et al. ("*Walters*") (Ex. 1028);
- U.S. Patent No. 7,439,907 to Wang et al. ("*Wang*") (Ex. 1029);
- U.S. Patent No. 5,491,486 to Welles, II et al. ("*Welles*") (Ex. 1030);
- Vehicle Location and Navigation Systems, pp. 43-81 ("*Zhao*") (Ex. 1032);
- *LBT IP I LLC v. Apple Inc.*, 1:19-cv-01245, No. 1 (D. Del. July 1, 2019) ("*LBT Complaint*") (Ex. 1036);
- U.S. Patent Application Publication No. 2007/005243A1 to Horvitz et al. ("*Horvitz*") (Ex. 1039);
- U.S. Patent Application Publication No. 2007/0005363A1 to Cucerzan et al. ("*Cucerzan*") (Ex. 1040);
- U.S. Patent No. 6,657,587 to Mohan et al. ("*Mohan*") (Ex. 1044);
- Any other materials I cite in support of this Declaration.

II. LEGAL FRAMEWORK

15. I am a technical expert and do not offer any legal opinions. However, I have been informed about certain legal principles regarding patentability and related matters under United States patent law, which I have applied in performing my analysis and arriving at my technical opinions in this matter.

A. ANALOGOUS ART

16. I have been informed by counsel that for prior art to be used to establish the unpatentability of a patent based on obviousness, the prior art must be "analogous art" to the claimed invention. I have also been informed by counsel that a prior art reference is analogous art to the claimed invention if: (1) the reference is from the same field of endeavor as the claimed invention, even if it addresses a different problem; or (2) the reference is reasonably pertinent to the problem faced by the invention, even if it is not in the same field of endeavor as the claimed invention.

B. OBVIOUSNESS

17. I have been informed that a person cannot obtain a patent on an invention if the differences between the invention and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art ("POSITA"). I have been informed that a conclusion of obviousness may be founded upon more than a single item of prior art. I have been further informed that obviousness is determined by evaluating the following factors: (1) the scope and content of the prior art, (2) the differences between the prior art and the claim at issue, (3) the level of ordinary skill in the pertinent art, and (4) secondary considerations of non-obviousness. In addition, the obviousness inquiry should not be done in hindsight. Instead, the obviousness inquiry should be done through the eyes of a POSITA at the time of the alleged invention.

18. In considering whether certain prior art renders a particular patent claim obvious, I have been informed that I can consider the scope and content of the prior art, including the fact that one of skill in the art would regularly look to the disclosures in patents, trade publications, journal articles, conference papers, industry standards, product literature and documentation, texts describing competitive technologies, requests for comment published by standard setting organizations, and materials from industry conferences, as examples. I have been

informed that for a prior art reference to be proper for use in an obviousness analysis, the reference must be "analogous art" to the claimed invention. I have been informed that a reference is analogous art to the claimed invention if: (1) the reference is from the same field of endeavor as the claimed invention (even if it addresses a different problem); or (2) the reference is reasonably pertinent to the problem faced by the inventor (even if it is not in the same field of endeavor as the claimed invention). In order for a reference to be "reasonably pertinent" to the problem, it must logically have commended itself to an inventor's attention in considering his problem. In determining whether a reference is reasonably pertinent, one should consider the problem faced by the inventor, as reflected either explicitly or implicitly, in the specification. I believe that all of the references I considered in forming my opinions in this IPR are well within the range of references a POSITA would have consulted to address the type of problems described in the Challenged Claims.

19. I have been informed that, in order to establish that a claimed invention was obvious based on a combination of prior art elements, a clear articulation of the reason(s) why a claimed invention would have been obvious must be provided. Specifically, I am informed that, under the U.S. Supreme Court's KSR decision, a combination of multiple items of prior art renders a patent claim obvious when there was an apparent reason for one of ordinary skill in the art, at the time of the invention, to combine the prior art, which can include, but is not limited to, any of the following

rationales: (A) combining prior art methods according to known methods to yield predictable results; (B) substituting one known element for another to obtain predictable results; (C) using a known technique to improve a similar device in the same way; (D) applying a known technique to a known device ready for improvement to yield predictable results; (E) trying a finite number of identified, predictable potential solutions, with a reasonable expectation of success; (F) identifying that known work in one field of endeavor may prompt variations of it for use in either the same field or a different one based on design incentives or other market forces if the variations are predictable to one of ordinary skill in the art; or (G) identifying an explicit teaching, suggestion, or motivation in the prior art that would have led one of ordinary skill to modify the prior art reference or to combine the prior art references to arrive at the claimed invention. I am also informed that where there is a motivation to combine, claims may be rejected as prima facie obvious provided a POSITA would have had a reasonable expectation of success regarding the proposed combination.

20. I am informed that the existence of an explicit teaching, suggestion, or motivation to combine known elements of the prior art is a sufficient, but not a necessary, condition to a finding of obviousness. This so-called "teaching-suggestion-motivation" test is not the exclusive test and is not to be applied rigidly in an obviousness analysis. In determining whether the subject matter of a patent

claim is obvious, neither the particular motivation nor the avowed purpose of the patentee controls. Instead, the important consideration is the objective reach of the claim. In other words, if the claim extends to what is obvious, then the claim is invalid. I am further informed that the obviousness analysis often necessitates consideration of the interrelated teachings of multiple patents, the effects of demands known to the technological community or present in the marketplace, and the background knowledge possessed by a person having ordinary skill in the art. All of these issues may be considered to determine whether there was an apparent reason to combine the known elements in the fashion claimed by the patent.

21. I also am informed that in conducting an obviousness analysis, a precise teaching directed to the specific subject matter of the challenged claim need not be sought out because it is appropriate to take account of the inferences and creative steps that a POSITA would employ. The prior art considered can be directed to any need or problem known in the field of endeavor at the time of invention and can provide a reason for combining the elements of the prior art in the manner claimed. In other words, the prior art need not be directed towards solving the same specific problem as the problem addressed by the patent. Further, the individual prior art references themselves need not all be directed towards solving the same problem. I am informed that, under the KSR obviousness standard, common sense is important

and should be considered. Common sense teaches that familiar items may have obvious uses beyond their primary purposes.

22. I also am informed that the fact that a particular combination of prior art elements was "obvious to try" may indicate that the combination was obvious even if no one attempted the combination. If the combination was obvious to try (regardless of whether it was actually tried) or leads to anticipated success, then it is likely the result of ordinary skill and common sense rather than innovation. I am further informed that in many fields it may be that there is little discussion of obvious techniques or combinations, and it often may be the case that market demand, rather than scientific literature or knowledge, will drive the design of an invention. I am informed that an invention that is a combination of prior art must do more than yield predictable results to be non-obvious.

23. I am informed that for a patent claim to be obvious, the claim must be obvious to a POSITA at the time of the alleged invention. I am informed that the factors to consider in determining the level of ordinary skill in the art include (1) the educational level and experience of people working in the field at the time the invention was made, (2) the types of problems faced in the art and the solutions found to those problems, and (3) the sophistication of the technology in the field.

24. I am informed that it is improper to combine references where the references teach away from their combination. I am informed that a reference may

be said to teach away when a POSITA, upon reading the reference, would be discouraged from following the path set out in the reference, or would be led in a direction divergent from the path that was taken by the patent applicant. In general, a reference will teach away if it suggests that the line of development flowing from the reference's disclosure is unlikely to be productive of the result sought by the patentee. I am informed that a reference teaches away, for example, if (1) the combination would produce a seemingly inoperative device, or (2) the references leave the impression that the product would not have the property sought by the patentee. I also am informed, however, that a reference does not teach away if it merely expresses a general preference for an alternative invention but does not criticize, discredit, or otherwise discourage investigation into the invention claimed.

C. SECONDARY CONSIDERATIONS OF NON-OBVIOUSNESS

25. I am informed that even if a prima facie case of obviousness is established, the final determination of obviousness must also consider "secondary considerations" if presented. In most instances, the patentee raises these secondary considerations of non-obviousness. In that context, the patentee argues an invention would not have been obvious in view of these considerations, which include: (a) commercial success of a product due to the merits of the claimed invention; (b) a long-felt, but unsatisfied need for the invention; (c) failure of others to find the solution provided by the claimed invention; (d) deliberate copying of the invention

by others; (e) unexpected results achieved by the invention; (f) praise of the invention by others skilled in the art; (g) lack of independent simultaneous invention within a comparatively short space of time; (h) teaching away from the invention in the prior art.

26. I am further informed that secondary-considerations evidence is only relevant if the offering party establishes a connection, or nexus, between the evidence and the claimed invention. The nexus cannot be based on prior art features. The establishment of a nexus is a question of fact. While I understand that the Patent Owner here has not offered any secondary considerations at this time, I will supplement my opinions in the event that the Patent Owner raises secondary considerations during the course of this proceeding.

D. CLAIM CONSTRUCTION

27. I have been informed by counsel that the first step in an unpatentability analysis involves construing the claims, as necessary, to determine their scope. Second, the construed claim language is then compared to the disclosures of the prior art. I am informed that claims are generally given their ordinary and custom meaning as understood by one of ordinary skill in the art at the time of the invention, in light of the patent specification.

28. For purposes of this proceeding, I have applied the claim constructions set forth in the claim construction section of the Petition for Inter Partes Review of U.S.

Patent No. 8,497,774 (the "Petition") that this declaration accompanies when analyzing the prior art and the claims. For any claim terms not construed, I have applied the meaning of the claim terms of the '774 Patent that are generally consistent with the terms' ordinary and customary meaning, as a person of ordinary skill in the art would have reasonably understood them at the time of the invention. I have been instructed to assume for purposes of this proceeding that the time of the invention is April 5, 2007.

III. OPINION REGARDING LEVEL OF SKILL OF A PERSON HAVING ORDINARY SKILL IN THE ART

29. I was asked to provide my opinion as to the level of skill of a person having ordinary skill in the art ("POSITA") of the '774 Patent at the time of the claimed invention, which I have been instructed to assume is April 5, 2007. In determining the characteristics of a hypothetical person of ordinary skill in the art of the '774 Patent at the time of the claimed invention, I was told to consider several factors, including the type of problems encountered in the art, the solutions to those problems, the rapidity with which innovations are made in the field, the sophistication of the technology, and the education level of active workers in the field. I also placed myself back in the time frame of the claimed invention and considered the colleagues with whom I had worked at that time.

30. In my opinion, a person having ordinary skill in the art of the ’774 Patent at the time of its filing would have been a person having, as of April 5, 2007, a Bachelor’s degree in Electrical Engineering, Mechanical Engineering, Computer Engineering, or Computer Science, or an equivalent degree with at least two years of experience in GPS navigation, dead reckoning, portable tracking devices, or related technologies. Additional education may substitute for lesser work experience and vice-versa. Such a person of ordinary skill in the art would have been capable of understanding the ’774 Patent and the prior art references discussed herein.

31. Based on my education, training, and professional experience in the field of the claimed invention, I am familiar with the level and abilities of a person of ordinary skill in the art at the time of the claimed invention. Additionally, I met at least these minimum qualifications to be a person having ordinary skill in the art at least as of April 5, 2007. Further, although my qualifications may exceed those of the hypothetical person having ordinary skill in the art defined above, my analysis and opinions regarding the ’774 Patent have been rendered from the perspective of a person having ordinary skill in the art at the time of the invention.

32. My opinions provided in this Declaration are made as of the priority date of the ’774 Patent (which counsel has informed me is April 5, 2007), unless expressly stated otherwise. To the extent that any verb tense used in this Declaration or any deposition or testimony provided in this matter is a present tense, e.g., “would

reasonably understand," such verb tense should be understood to be my opinion as of the '774 Patent's priority date (again, unless expressly stated otherwise). I merely use the present verb tense for ease of reading.

IV. BACKGROUND OF TECHNOLOGY

33. I was asked to briefly summarize the background of the technology from the standpoint of a POSITA prior to April 5, 2007.

A. GPS TECHNOLOGY

34. For decades, location tracking devices have utilized GPS technology to provide increasingly fast and accurate determination of a device's current and/or past location. NAVSTAR GPS was originally developed in the 1970s by the U.S. Department of Defense for military applications. *See, e.g., Vyas,* 1:36-51; *Zhao*, p. 63. Since that time, numerous advancements have taken place, such as the addition of satellites leading to 24 operational GPS satellites in orbit, and civilian use has been authorized by the United States government, within limitations. *Zhao*, pp. 63-64. Additionally, various components employed utilized for GPS-based location sensing have been manufactured to be smaller and less expensive, allowing GPS technology to be adapted into affordable portable hand-held devices at least as early as 1996. *Backman*, 2:17-20. By this time, various technical improvements were already being employed to overcome well-known issues associated with GPS

technology, such as low signal strength and the extensive power consumption of GPS receivers, as will be discussed in further detail below.

35. GPS satellites operate by transmitting a signal comprising almanac and time information, as well as clock and other correction coefficients to receiving devices on Earth. *Wang*, 2:1-4. Using this data received from each satellite signal collected over time by the GPS receiver, precise orbital coordinates of the each respective satellites are then determined by the device using "ephemeris data" corresponding to the expected general position of each satellite. *Wang*, 2:24-26; *Zhao*, pp. 64-65. This ephemeris data is embedded in the satellite signals, but it may also be, in some cases, received from a remote location such as a server over a communication network such as a mobile telephone network (an approach known as "assisted GPS", or AGPS). Thereafter, a "pseudorange" for the particular satellite is determined by exploiting the known invariance of the speed of light. *Croyle*, 3:24-31. Given the position of at least four satellites and the pseudorange from each of the satellites, a triangulation process may then be used to calculate the location coordinates of the GPS receiver by calculating the geometric intersection of the pseudoranges. *Id.*, 3:20-24.

36. Thus, GPS satellite signals do not and would not have comprised location coordinates of the tracking device directly, such as the longitudinal, latitudinal, and elevational positional coordinates. *See '774 Patent* at 5:22-25. Rather, a POSITA

would have recognized that the ephemeris data including orbital information of a plurality of satellites would have been used for locally determining longitudinal, latitudinal, and elevational coordinates of the satellite, and using this information together with the measured pseudoranges to determine the location coordinates of the receiver.

37. For example, as described by *Zhao,* a geodetic system for determining a user's location, such as WGS 84, defines points using three parameters: ellipsoidal height (elevation), geodetic latitude, and geodetic longitude. *Zhao,* p. 23, 64. These parameters are not directly transmitted by each satellite, but rather are determined based on location information(e.g. ephemeris data) transmitted from each satellite to a receiving device. *Id.* In the system described by *Zhao*, observation of at least four satellites with known coordinates at a given time permits determination of the 3D coordinates of the GPS receiver using a series of parametric equations. *Zhao*, pp. 64, 68. Thus, any GPS satellite signal would have comprised location coordinates information comprising the information *necessary to calculate* longitudinal, latitudinal, and elevational coordinates rather than containing the coordinates themselves.

38. A POSITA would have reasonably understood that location coordinate information would not necessarily comprise precise location *coordinates* but rather would comprise any information relating to location coordinates that would then be

subsequently used for determining location coordinates, such as time data and the ephemeris data used to precisely determine the position of the GPS satellite at a given time. *Wang*, 2:24-26; *Harvey*, 2:24-35.

B. COMMUNICATION WITH A MONITORING STATION

39. Prior to 2007, it was also well-known to rely on communication services to send location coordinates and monitor electronic tracking devices. Specifically, a base station including a cellular phone was known (*Martucci*, 5:25-29, 10:51-67, 15:4-6), as well as a communication channel for communicating navigational data between a remote server and a navigation device (*Walters*, 10:41-45). It was further established that one or more contact numbers may be inputted by a user to a handheld portable device as emergency contact information and that the device would automatically contact an emergency dispatcher based on one or more acceleration profiles. *Panasik*, 3:2-8, 6:52-54.

40. *Martucci* teaches a portable positioning determining device comprising a satellite navigation receiver (i.e., GPS receiver). *Martucci*, Abstract. The positioning determining device communicates location information with a base station via a two-way paging system. *Martucci*, 12:55-57. The base station is taught as including a cellular phone for communicating over a cellular network. *Martucci*, 15:4-6, 21:8-12.

41. *Panasik* teaches an automated emergency alert system including a handheld portable communication device, and a dynamic sensor, such as an accelerometer, to generate an acceleration profile of the device. *Panasik* teaches initiating communication over a network if it is determined that the acceleration profile matches a predefined acceleration profile. *Panasik*, Abstract, 3:2-8, 4:46-49. Further, *Panasik* teaches collecting user information, such as one or more contact numbers of persons associated with the user (e.g., an emergency contact person). *Panasik*, 6:50-61. Thus, as shown by these examples, it was well-known prior to April 5, 2007 to contact an individual on a contact list upon sensing an emergency event by an accelerometer.

C. RELIABILITY OF GPS SIGNALS

42. Prior to April 5, 2007 it was a known issue that GPS signals may be relatively weak, on the order of -160 dBW. *Rabinowitz*, 1:57-64. It had also been known that the already weak GPS signals may become degraded from interference with physical obstacles, such as buildings or indoor environments, further frustrating attempts to accurately determine a device's location. *See, e.g., Croyle*, 11:43-46; *Walters*, 9:23-29; *Krumm*, [0003]-[0004], [0042]; *Lau*, 4:10-13, 9:60-65. Thus, a variety of solutions have been developed to overcome the unreliability often experienced by devices sensing GPS signals.

43. *Croyle* teaches a preamplifier attached to a GPS antenna of the GPS receiver to amplify the GPS signal. *Croyle*, 3:16-18. *Croyle* also teaches using longitudinal and latitudinal acceleration information from the accelerometer to determine position if GPS is not available. *Croyle*, 5:39-45, 11:43-46. Thus, it was known prior to 2007 to (a) amplify received GPS signals and (b) include an accelerometer in a location tracking device to rely on when a GPS signal was unavailable.

44. *Taylor* teaches location tracking of a wireless communication device, such as a cell phone comprising a GPS and an event sensor, such as an accelerometer. *Taylor*, 2:7-9, 13:16-18, 13:22-24. *Taylor* teaches that the GPS provides an indication of reliability of the signal based on satellite acquisition, signal strength, and concordance of data received from multiple satellite signals. *Taylor*, 13:29-37. Similarly, *Lau* teaches measuring GPS satellite visibility of the GPS receiver and when no GPS signals are received the GPS receiver is set to a low power standby mode for a long time duration to avoid depleting batteries. *Lau*, 10:52-65. Thus, prior to April 5, 2007, it was well-known to measure a GPS signal level and to control GPS functionality based on its signal level to conserve battery power.

45. *Lindquist* teaches repetitively switching power-on to power-off to a GPS receiver circuit of a mobile terminal. *Lindquist*, Abstract. The power-on to power-off duty cycle can be regulated in response to identifying GPS isolation based on

insufficient signal strength. *Lindquist*, 3:62–4:7. Further, *Lindquist* expressly discloses that power may be conserved by powering down the GPS receiver circuit. *Lindquist*, 12:22-27. *Lindquist* also teaches determining acceleration-based location of the mobile device using acceleration information from an accelerometer during a power-off cycle of the GPS receiver circuit. *Lindquist*, 2:1-20.

46. *Krumm* teaches a system and method for determining if a device is inside or outside of a building to save power by suppressing services from certain devices. *Krumm*, Abstract. Specifically, *Krumm* teaches if it is determined the device is inside, the system turns off the GPS system to conserve battery. *Krumm*, [0003]. Thus, a POSITA would have been aware of the benefit of suppressing (i.e., powering down) GPS circuitry while inside (a location where GPS signal would have been known to be weak) to reduce power consumption of the GPS receiver (a well-known issue, as discussed below).

47. Further, it was known to measure a GPS signal strength (i.e., signal level) to detect indoor/outdoor conditions. Specifically, *Wang* teaches a mobile navigation receiver including a signal strength detector for testing the received signal strength to detect indoor/outdoor transitions of the receiver. *Wang*, 5:58-63.

D. POWER CONSUMPTION OF GPS RECEIVERS

48. In addition to the unreliability of GPS signals, another known significant obstacle to GPS technology was the high power consumption of the GPS receiver.

Specifically, it was established at least as early as 1994 that GPS receivers consumed a substantial amount of power. *Welles,* 4:1-22; *Martucci,* 1:62-2:3. As will be shown, power conservation for location tracking circuitry (specifically including GPS receivers within mobile devices) was a well-established solution used to reduce power consumption. Further, it was known that many mobile devices, such as location tracking units and cellular phones relied on battery power to operate. *See, e.g. Welles,* 4:67-5:1; *Martucci,* 11:43-52. Since battery conservation was a prevalent concern, many solutions have been developed relating to battery monitoring and battery conservation techniques. *See, e.g. Martucci*, 23:32-35; *Wang,* 11:11-14; *Lau*, 4:16-26.

49. *Welles* teaches a mobile tracking unit for a vehicle tracking system of a vehicle including a power source, such as a battery, and a navigation set, such as a GPS receiver, that reduces power consumption by selectively activating the navigation set. *Welles*, Abstract, 1:17-19, 4:67. Specifically, *Welles* teaches reducing an activation rate of the navigation set when it is determined that the vehicle is stationary, which is disclosed as substantially reducing the overall power consumption by a factor of at least 100. *Welles*, 4:18-22. Thus, it was known prior to 2007 that reducing the activation of a GPS receiver would have led to substantial power savings, which a POSITA would have recognized to have been especially beneficial to mobile systems relying on limited battery power.

50. *Mohan* teaches a tracking system that disabled a GPS receiver and a communications transceiver when not in use to conserve power. *Mohan*, Abstract, 2:14-22. *Mohan* further teaches a power management subsystem to monitor a battery of the tracking system and, if the battery capacity is low, transmit a signal to a low power alarm that causes the system to enter a low-power alarm mode. *Mohan*, 3:20-30, 6:14-18. *Mohan* also teaches sensing logic for interrogating the GPS signal strength, where the GPS signal is periodically polled until a sufficient level of GPS signal is determined and the system proceeds with normal operation. *Mohan*, 5:25-37.

51. *Horvitz* teaches a location-centric signal shadow mapping and storing architecture which stores information associated with the loss of location-identifying signals, such as GPS signals. *Horvitz*, Abstract. Here, the architecture stores information of GPS shadowed locations, where a GPS shadow is an area where a receiver cannot receive adequate GPS signals due to blockage or degradation from structures. *Horvitz*, [0025]. *Horvitz* further teaches turning off GPS until acceleration is detected by a less power hungry accelerometer to conserve power. *Horvitz*, [0040].

52. *Cucerzan* teaches a portable device capable of communicating with a position location system, such as GPS, to determine a physical location of the device. *Cucerzan*, [0045], [0047]. *Cucerzan* teaches that GPS location detection can be augmented with a movement detector, such as an accelerometer. *Cucerzan*, [0054].

53. In addition, some systems were known to include battery monitors to monitor battery conditions of portable electronic devices, such as available battery power. *See, e.g. Deninger*, 2:36-40; *Lee*, 5:28-33. Specifically, *Deninger* teaches a battery monitoring system comprising battery monitoring equipment that senses electrical charge of a battery and transmits a battery status message and powers down electrical components in response to a low-battery-charge condition. *Deninger*, Abstract, 9:48-56, 10:17-26. *Deninger* specifically discloses that a low battery charge routine, initiated when sampled battery voltage falls within a predetermined low-battery-charge range, involves powering down a GPS receiver. *Deninger*, 8:46-51, 10:26-33. Similarly, *Lee* teaches power management for a battery powered electronic device by reducing power consumption including a power manager and a battery monitor couple to a battery of the electronic device for providing battery conditions, such as charge level, temperature, voltage, and current. *Lee*, Abstract, 3:54–4:3.

54. Thus, it was known to include a battery monitoring component in an electronic tracking device to monitor battery conditions and manage power to electronic components according to the remaining battery level. Accordingly, the solutions of the prior art had already developed the various features discussed above prior to April 5, 2007, including primary GPS location tracking, communication with

a base station, and battery power monitors, to solve the well-known problems of unreliable GPS signals and the power consumption associated with GPS receivers.

V. OPINIONS REGARDING THE '774 PATENT AND ANALOGOUS ART

A. OVERVIEW OF THE ART

1. Sakamoto

55. I have been informed that Japanese Patent Publication No. JP2004-37116 to Sakamoto ("*Sakamoto*" or "Ex. 1004") is prior art to the '774 Patent. I have reviewed the certified translation of *Sakamoto* and provide herein my opinions on the teachings of *Sakamoto*. The opinions provided herein do not necessarily represent my entire understanding of *Sakamoto*.

56. *Sakamoto* generally relates to a GPS positioning system that includes a communication terminal and a GPS receiver. *Sakamoto*, Abstract, [0018-0019]. In its background section, *Sakamoto* recognizes that a "highly sensitive positioning" mode which maximizes GPS sensitivity (and which requires keeping the GPS receiver running at all times) consumes significant battery power. *Sakamoto* [0003], *Sakamoto* thus teaches that it is desirable to "flexibly control the operation of the GPS receiver" by only selectively using the high sensitivity positioning mode when needed and using a normal sensitivity positioning mode otherwise. *Id.*

57. *Sakamoto* teaches that the communication terminal or more specifically the GPS positioning system within the communication terminal may operate in

various modes depending on the signal level of the GPS signal from the GPS satellite. The three operating modes that *Sakamoto* teaches are: (1) the "normal sensitivity mode"; (2) the "high sensitivity mode"; and (3) a mode that I will call the stop-position searching mode[1]. *Sakamoto,* [0005], [0038].

58. With respect to the normal mode, *Sakamoto* discloses "when the satellite signal level is high, the normal sensitivity operation is automatically performed to

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[1] I recognize that when *Sakamoto's* GPS receiver stops position search, *Sakamoto* does not expressly refer to the stopping position searching as a "stop position" mode or an "off mode." However, for the reasons I provide below, it is my opinion that when the GPS receiver is not performing position searching because position searching was stopped due to a poor signal below a predetermined threshold value, or because the battery level is low, this is a third mode of operation or that a third "mode" would have otherwise been obvious. Regardless, my reference to the "stop position searching" state of operation as a "mode" is for ease of reference and is not inconsistent with *Sakamoto's* teachings of a distinct state of operation where position searching is stopped because position searching cannot be performed due to a signal level below a predetermined threshold level or because battery is low. *Sakamoto*, [0038], [0050].

reduce power consumption and to extend the operating time." *Sakamoto,* [0045]. *Sakamoto* further discloses "power consumption can be reduced by stopping the position search when positioning is not possible or by **switching to the positioning with normal sensitivity that consumes less battery for terminals** installed in positions with good positioning in order to extend the operating time." *Sakamoto,* [0050]. Thus, when the signal is high, the GPS receiver is switched to normal mode to conserve power. *Sakamoto* even provides an example of a situation where the level of the received GPS signal from the GPS satellite may be high and normal sensitivity mode is activated:

> **When the position of the position information communication terminal 1 is in an environment where it is easy to receive the GPS signal from the GPS satellite, the signal level received by the GPS receiver 10 becomes high.** Therefore, the man-machine interface control unit 14 is operated in advance to set a constant threshold value K1 in the positioning control unit 13 for each signal level of a plurality of GPS satellites. **The positioning control unit 13 compares the level of the GPS satellite signal detected by the satellite signal level detection unit 15 via the GPS receiver 10 and the GPS control unit 12 with the threshold value K1, and if the detection level is below the threshold K1,** the positioning control unit 13 automatically makes a transition to the high sensitivity positioning mode. **Further, a threshold value K2 different from the threshold value K1 is set in the positioning control unit 13, and when the detection level exceeds the threshold value K2, the positioning control unit 13 automatically makes a transition to the normal sensitivity positioning mode.**

Sakamoto, [0027] (emphasis added). Likewise when the GPS signal from the GPS satellite is low or below a predetermined threshold (i.e., below threshold value K1)

the GPS positioning system will automatically "transition to the high sensitivity positioning mode". *Id,* [0045] (teaching that the "high sensitivity positioning operation can be performed automatically to stabilize positioning ...").

59. With respect to the stop-position searching mode, *Sakamoto* teaches that when the GPS signal from the GPS satellite is so poor or weak that position determination cannot be performed, the position determination/searching is stopped:

> **If it is determined that the positioning cannot be performed when the signal level value is equal to or lower than a predetermined threshold value, the position search may be stopped.**

Sakamoto, [0038] (emphasis added), [0050] (teaching that "power consumption can be reduced by stopping the position search when positioning is not possible ...").

60. *Sakamoto* also teaches that the GPS receiver mode can be changed based on the battery level of the battery contained within the communication device. *Sakamoto* discloses a battery control unit 16 that "constantly monitors the remaining battery level." *Sakamoto,* [0028]. *Sakamoto* discloses "if the battery level becomes low and it becomes difficult to operate the GPS receiver 10, the positioning control unit 13 is notified." *Sakamoto,* [0028]. *Sakamoto* discloses setting a battery level threshold, below which a warning is issued. *Sakamoto,* [0029]. When the positioning control unit receives the battery level warning, it "automatically shift[s] the positioning mode to the normal sensitivity positioning mode." *Sakamoto,* [0029]. Thus, a measured low battery level prompts a shift to the normal mode to conserve

battery power. *Sakamoto* further teaches that, after the battery warning and switch to normal sensitivity mode, battery consumption may be reduced still further by switching to the stop-positioning mode. *Sakamoto,* [0039].

61. Because both *Sakamoto* and the ’774 Patent are directed to portable electronic tracking device employing a GPS receiver, *Sakamoto* is in the same field of endeavor as the ’774 Patent. Additionally, like the ’774 Patent, *Sakamoto* discloses a portable electronic tracking device that employs a GPS receiver and is concerned with trading off position sensitivity and battery life and with reducing the applied power to a GPS receiver when the battery power level is low in order to extend battery operating lifetime. ’774 Patent, 14:1-57, 11:58-67; *Sakamoto*, [0046], [0029]. Therefore, *Sakamoto* is in the same field of endeavor and is reasonably pertinent to a problem purportedly solved by the claimed invention in the ’774 Patent.

2. Hayasaka

62. I have been informed that U.S. Patent No. 5,845,142 to *Hayasaka* (“*Hayasaka*” or “Ex. 1011”) is prior art to the ’774 Patent. I have reviewed the *Hayasaka* and provide herein my opinions on the teachings of *Hayasaka*. The opinions provided herein do not necessarily represent my entire understanding of *Hayasaka*.

63. *Hayasaka* teaches a portable, battery-powered communication terminal. *Hayasaka,* Abst. In particular, *Hayasaka* discloses a system whereby communication is suppressed in response to a low battery capacity, and resumed once battery capacity is sufficient to support communication. *Hayasaka,* Abst.; 4:19-–27. Like the ’774 Patent, *Hayasaka* teaches monitoring the battery level of the portable communication terminal and putting the communication terminal into a sleep mode until the battery has sufficient power to process a communication. As such, *Hayasaka* is in the same field of endeavor and is pertinent to a problem to be solved by the claimed invention in the ’774 Patent.

B. DESCRIPTION OF THE ALLEGED INVENTION OF THE ’774 PATENT

64. The ’774 Patent describes a device and method to manage the electrical resource capability for an electronic tracking device. ’774 Patent, *Abst*. The tracking device generally contains: a battery, transceiver circuitry, processor circuitry, a battery power monitor, and a local battery power adjustment mechanism to update a cycle time of listening to GPS signals and generating position update packets by activating and deactivating at least one portion of the transceiver circuitry and location tracking circuitry in response to user input and the battery level of the tracking device. ’774 Patent, Abstract, 3:55-62, 4:17-22, 4:1-10.

65. DOP102 The ’774 Patent provides an exemplary embodiment of the electronic tracking device in Figure 5 depicted below which I have annotated.

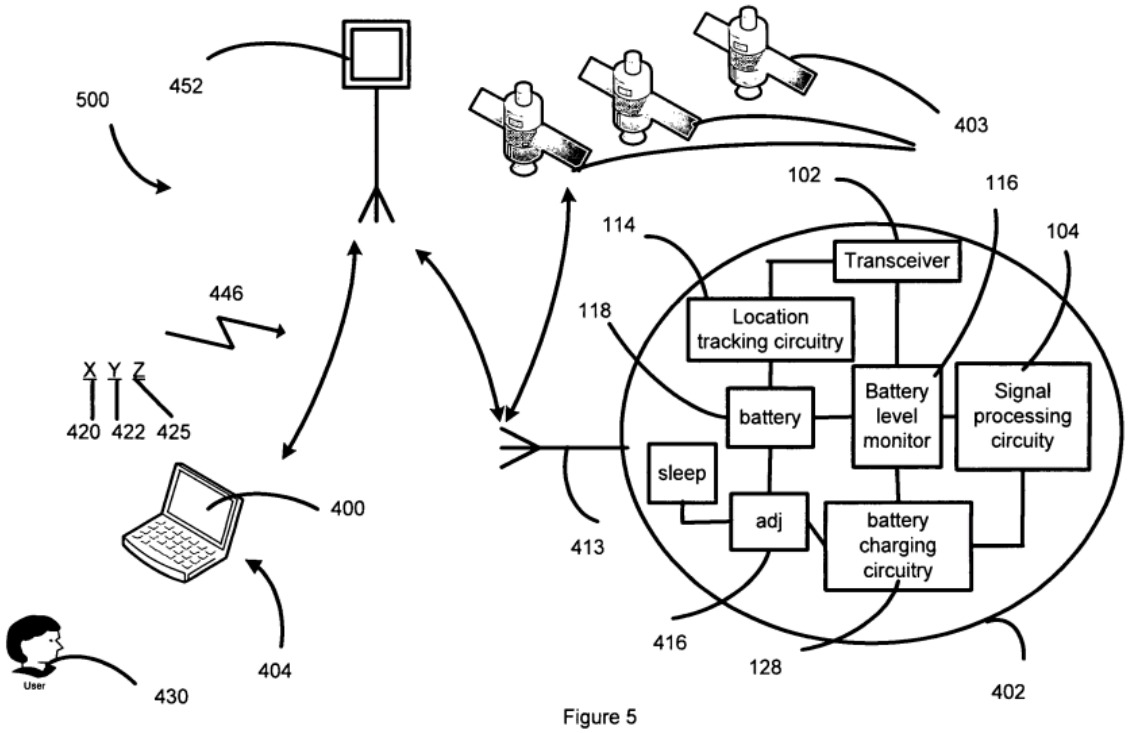

Figure 5

’774 Patent, Fig. 5, 11:9–21. (teaching that the “portable tracking device 402 includes battery 118 … transceiver 102, signal processing circuitry 104, battery level monitor 116, signal processing circuitry 104, location tracking circuitry 114, adj 416, and battery charging circuitry 128.”). The ’774 Patent describes that the location tracking circuitry 114 may be that of GPS logic circuitry. ’774 Patent, 7:21–22. The ’774 Patent teaches that, in some embodiments, the signal processing circuitry 104 “processes and measures signal power level.” ’774 Patent, 7:23–25 (teaching that the detecting circuitry 115 or the signal processing circuitry 104 may measure the signal power level). The ’774 Patent further teaches that the update rates of the system (including the rate at which the portable location tracking device listens to

GPS signals and the rate at which the server requests location updates) are adjusted responsive to user input ('774 Patent, 11:31–43) or responsive to a charge level of the battery ('774 Patent, 13:23–30).

C. GROUND 1: OPINIONS REGARDING SAKAMOTO AND OBVIOUS VARIATIONS THEREOF

1. Modifying Electronic Hardware and Software to Be Circuitry

66. A POSITA would have found it obvious to substitute any of the hardware or software components in the prior art that perform functions similar to those claimed by the '774 Patent as components with electronic circuitry.

67. The '774 Patent recognizes that the disclosed electronic tracking device is merely "various electronic components 101" disposed on a printed circuit board (PCB). '774 Patent, 6:64–60. The '774 Patent does not provide or otherwise indicate any specific details of the location tracking circuitry or other described circuitry, instead describing the circuitry primarily by its functionality.

> **The signal processing circuitry 104**, in one example, associated with the tracking device 100 **configured to store a first identification code, produce a second identification code, determine location coordinates, and generate a positioning signal that contains location data** (as described in more detail in incorporated by reference U.S. patent application Ser. No. 11/753,979 filed on May 25, 2007).

'774 Patent, 6:66–7:5,

> In one embodiment, **location tracking circuitry 114, calculates location data received and sends the data to signal processing circuitry 104. Memory 112 stores operating software and data, for instance, communicated to and from signal processing circuit 104**

> **and/or location tracking circuitry 114, e.g., GPS logic circuitry.** In one embodiment, **a signal detecting circuitry 115 detects and measures signal power level.** In another embodiment, the **signal processing circuitry 104 processes and measures signal power level. Battery level detection circuitry (e.g., battery level monitor 116) detects a battery level of battery 118,** which contains one or more individual units or a plurality of units grouped as a single unit.

'774 Patent, 7:17-28. The '774 Patent even describes the signal processing circuitry as a "microprocessor or other signal logic circuitry," thus indicating the term "circuitry" equates to electronic components performing the disclosed functionality. '774 Patent, 5:56-57. The '774 Patent also describes variations on the electronic tracking device, including electronic components mounted on the PCB versus "one integrated circuit." '774 Patent, 6:54-60, 7:13-16. PCBs were extremely well known for aggregating electronic components so that the components are electrically connected and/or electrically communicate with each other.

68. *Sakamoto* similarly provides figures with hardware components that are in communication with each other. For example *Sakamoto* depicts the communication terminal 1 in Fig. 1, as containing various components that are in communication with each other. The communication between components is indicated via the arrows disposed between the various components. *See Sakamoto's* Fig. 1 (reproduced below).

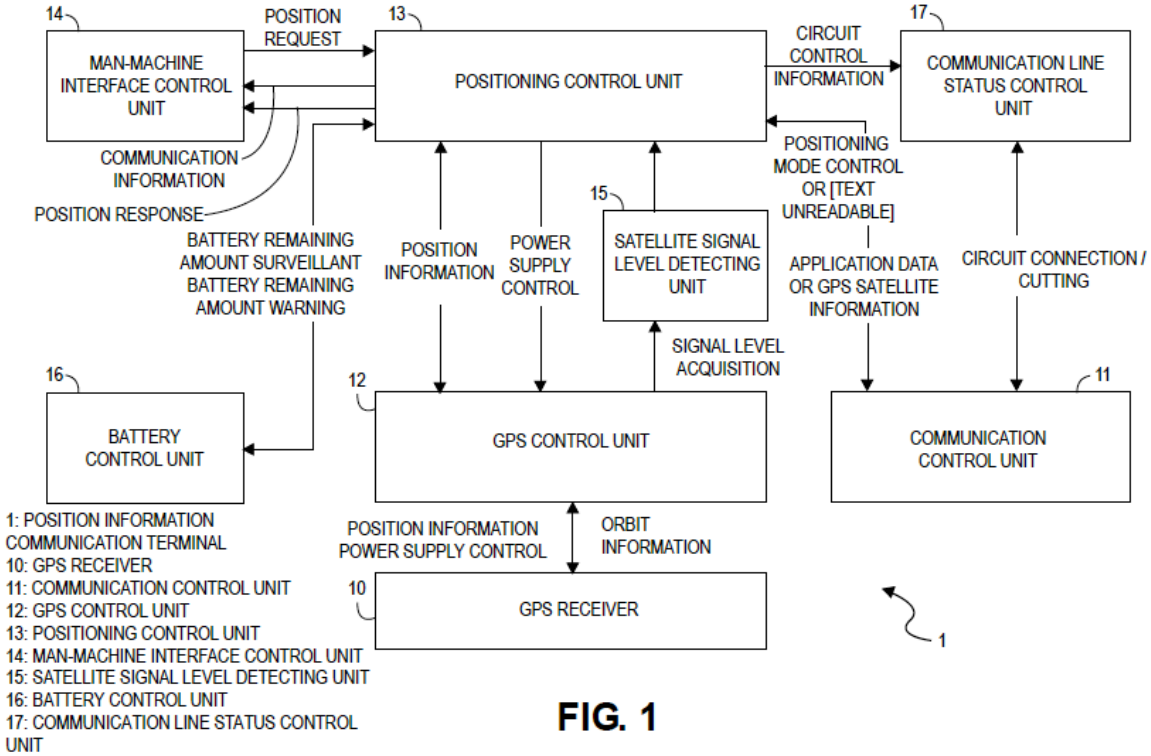

FIG. 1

Sakamoto, Fig. 1[1].

69. Furthermore, in order to achieve a functioning device that is also very compact (e.g., a cellular phone terminal), a POSITA would have found it obvious to combine such components on a PCB, as PCBs were extremely well known in the art and in common use. In fact, *Krasner* teaches that the functions of multiple microprocessors may be combined into a single processor/digital circuit, and that

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[1] The *Sakamoto* figures herein are reproductions of *Sakamoto's* figures prepared by Petitioner's counsel for clarity and are accurate representations of *Sakamoto's* translated figures. Affidavit for *Sakamoto* Figures Translation (Ex. 1004).

GPS signal processing circuitry and cell phone circuitry may be placed within the same integrated circuit. *Krasner*, 10:30-38.

70. A POSITA would have thus readily recognized that hardware, software, and/or firmware components for performing a particular function would have been easily substituted with that of circuitry for performing the same function. A POSITA would have also understood that those who design such components (e.g., electronic engineers/designers) would have found it obvious and a matter of design choice whether or not to obtain a desired functionality using circuitry, which commonly included hardware or firmware components, or utilize processors, controllers, integrated circuits, programmable logic devices, and/or other data and signal processing devices with the necessary memory and communication means (e.g., transmitters, receivers, and/or communication busses) for carrying out the same functions. In electronics design, utilizing hardware, software, firmware, and/or combinations thereof for achieving a desired functionality is very common and well known. Therefore, a POSITA would have found it obvious and been motivated to embody the various electronic components disclosed in *Sakamoto* as circuitry. In addition, I note that a processor is a circuit (circuitry) that can be dynamically configured into different states based on software instructions, and thus, when a processor is executing functions defined by software, the function is still being performed by circuitry.

71. Furthermore, Sakamoto and Hayasaka describe using processors. A POSITA would have reasonably understood that a processor is a circuit that can be dynamically reconfigured to perform different operations based on software instructions. At a low level, software instructions are converted into binary codes. These codes are then applied to the processor and it responds to the codes by performing the operation corresponding to the code. For example, within a processor is a circuit called an arithmetic logic unit, or ALU. The ALU circuit is configured with at least two data inputs and an instruction input. These inputs are represented by, for example 8 circuit lines each (for an 8-bit system). The codes and data can be applied to the ALU by changing the signal level on each circuit line to either a high level (representing a logic 1 value) or to zero (representing a logic 0 value). The ALU instructions may be, for example, ADD or SUBTRACT, or some logic operations such as AND, OR, XOR etc. When the instruction input lines are set to, for example the binary code corresponding to the ADD function, the ALU circuit will be configured internally to add the binary values of the two data inputs, and output the addition on another set of 8 circuit lines All of the operations inside the ALU are performed using logic circuits. All processors operate on this basic concept, so all software controlled systems (such as a GPS receiver) are implemented using circuitry, even if some of the processes are implemented using software.

2. Combining the Embodiments of Sakamoto

72. A POSITA would have reasonably understood that Sakamoto teaches at least two embodiments: "Embodiment 1"; and "Embodiment 2". Sakamoto, [0018], [0030] respectively. Referring to Embodiment 1, Sakamoto states: "In this embodiment, the position information communication terminal 1 will be described." Sakamoto, [0019]. Regarding Embodiment 2, Sakamoto states "the configurations of the position information communication terminal 1 and the GPS positioning system of the present embodiment are the same as those in FIGS. 1 and 2; the same configurations are denoted by the same reference numerals and the description thereof will be omitted." Sakamoto, [0030], [0034] (emphasis added). Both embodiments explicitly teach determining the level of a received satellite signal and specifying a positioning mode (e.g., high/normal sensitivity positioning mode) based on the determined level of the received satellite signal. Sakamoto, [0027] (describing Embodiment 1); [0037-0038], [0045], [0050] (describing Embodiment 2).

73. A POSITA, understanding that both embodiments are similar (e.g., both focusing on detecting a signal strength and setting a sensitivity positioning mode based on the detected signal strength), and further understanding that Embodiment 2 is expressly taught as including the same hardware as that of Embodiment 1 (e.g., the configurations of the terminal 1 and server 2), would have found it obvious and been motivated to combine both the embodiments or otherwise modify one

embodiment with teachings of the other. Furthermore, given the afore mentioned similarities between the embodiments and the express teaching regarding the inclusion of the same hardware in both embodiments, it would have been obvious to a POSITA to employ the methods and techniques described with respect to Embodiment 1 in the GPS system of Embodiment 2 and vice-versa. Such a modification would have entailed utilizing components from both embodiments to perform the disclosed methods and techniques of at least one of the embodiments. Sakamoto's disclosure regarding the GPS system that is taught for each of the embodiments is the same, and to the extent any modification would be necessary, it would require only routine programming of the GPS system to perform the disclosed methods of further reducing power usage. A POSITA would have reasonably understood that such a combination would have a reasonable expectation of success given Sakamoto's express teaching that the same hardware is used in both embodiments.

74. In Embodiment 1, Sakamoto teaches that the position information communication terminal 1, or more specifically the positioning control unit 13 is what sets the mode dependent on the detected level of the received satellite signal. Sakamoto, [0027]. In Embodiment 2, the positioning control unit 13 is what is taught as sending the position information to the position management server 2 ([0035]), the position management server 2 then uses the position control message (e.g.,

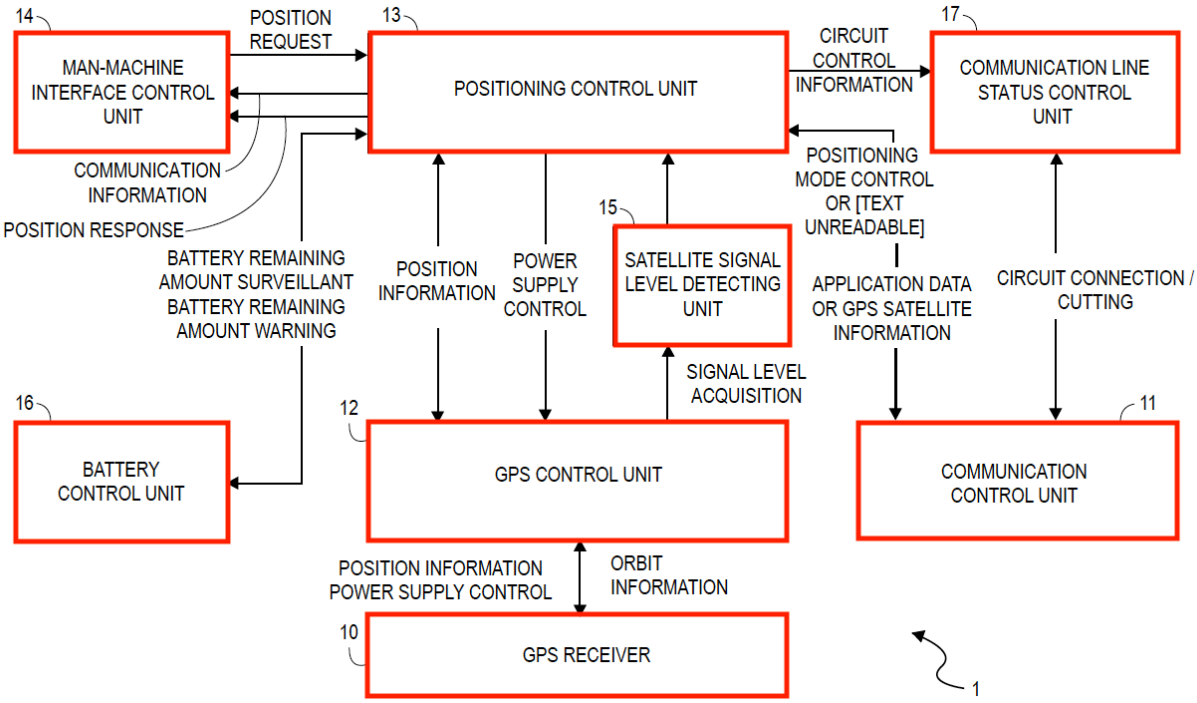
satellite signal level response message) to set the mode and instruct the terminal 1 as to the positioning mode. Sakamoto, [0037]–[0038]. Embodiment 2 expressly teaches that when the signal level value is equal to or lower than a predetermined threshold value, position searching may be stopped. Sakamoto, [0038], [0050]. It would have been obvious to a POSITA to perform position detection and satellite signal strength detection at the terminal, as taught for Embodiment 1, while still stopping position searching when the satellite signal level is equal to or lower than the predetermined threshold value, as taught for Embodiment 2. Such a modification would allow for the terminal to perform all position searching and mode setting without being instructed by the server 2, which would be advantageous in the event wireless communication with the server was limited through the mobile communication network. Sakamoto, [0005], Claims 7-8 (disclosing mobile communication network).

3. Claim 1

a) [1(pre]] A portable electronic tracking device to monitor location coordinates of one or more individuals and objects using a satellite navigation system, the portable electronic tracking device comprising:

75. I understand *Sakamoto's* "position information communication terminal 1" to comprise components that collectively act as an electronic tracking device. First, I understand the '774's description of an electronic tracking device to be a set of electronic components that collectively enable monitoring and/or tracking of an

object or individual. '774 Patent, 6:30–52, 5:26–44. *Sakamoto's* FIG. 1 shows electronic components that collectively perform such a function, as described below:



Sakamoto, FIG. 1 (red boxes added). These components (together with other components which are not displayed but which a POSITA would have reasonably understood to be present, such as a battery) enable monitoring and tracking of the terminal 1. I understand these components to be electronic components at least insofar as they rely on electric power provided by the battery and are interconnected to perform particular functions. For example, *Sakamoto's* GPS receiver determines position information for the terminal, and is therefore a location-determining electronic component. *Sakamoto*, [0005], [0019], [0030]. I also understand that *Sakamoto's* terminal is also a tracking device, because it allows a remote user,

position searcher B, to monitor (track) the location of the terminal. In particular, *Sakamoto* teaches an embodiment wherein the terminal transmits the position (as determined by the GPS unit) to the positioning management / positioning server 2 to be displayed (or otherwise provided) to position searcher B. *Sakamoto*, [0031]. A POSITA thus would have understood *Sakamoto's* position information communication terminal to be an electronic tracking device.

76. I understand *Sakamoto's* terminal to be portable for several reasons. First, I note that Sakamoto allows a position searcher B to repeatedly request the position of the terminal 1. If terminal 1 were not portable, there would not be any reason to have this functionality, because the location of terminal 1 would not change. The searcher would not have any reason to inquire about the location of the terminal, because it would never move. Further, I note that *Sakamoto* teaches that portable terminals have limited battery capacity (*Sakamoto*, [0003]), that mobile communication network [interface] is a mobile phone (*Sakamoto*, [0031]), and that the various components of terminal 1 (*Sakamoto*, [0019]) include a battery that is not shown. Furthermore, *Sakamoto* teaches that terminal 1 includes a mobile communication means, includes a battery that is monitored to reduce power consumption, and that terminal 1 communicates across a mobile communication network. *See Sakamoto*, [0018]–[0019], [0030]–[0031], [0050]–[0051]. *Sakamoto* further discloses that "flexibly controlling" the operation of the GPS receiver (as

Sakamoto teaches) is necessary "when applied to devices with limited battery capacity such as portable terminals." *Sakamoto*, [0003]. In my opinion, a POSITA would have reasonably understood from *Sakamoto* that terminal 1 (including the mapped *Sakamoto* Electronic Components and mapped as the claimed "electronic tracking device" of Claim 1(a)) is a *portable* terminal as well.

77. I understand that *Sakamoto's* terminal 1 is operable to monitor the location coordinates of an individual and/or object. As described above, *Sakamoto's* terminal is a portable electronic tracking device that allows a remote user to monitor the location of the terminal. As discussed above in the general discussion of GPS, GPS relies on pseudorange signals from a set of (at least four) GPS satellites to determine a latitude, longitude, and altitude for a GPS receiver. I note that this is wholly consistent with the definition of "location coordinates" in the '774 Patent as "any set or partial set of integer, real and/or complex location date or information such as longitudinal, latitudinal, and elevational positional coordinates." '774 Patent, 5:23–25. As such, I understand the position of the terminal in *Sakamoto* to include location coordinates as claimed. The obtained coordinates are the position of the GPS receiver, an object to which it is attached or a person carrying it (such as terminal user A). Thus understanding is further supported by the standard NMEA protocols used to interchange data between a GPS receiver and other components. For example, one typical data interchange format the NMEA Recommended Minimum

Sentence, which include fields corresponding to (1) the time of the location fix; (2) receiver active flag; (3) latitude of fix; (4) N/S flag; (5) longitude of fix; (6) E/W flag for longitude; (7) Speed of receiver in knots; (8) true course of receiver; (9) date stamp for position fix; (10) magnetic variation; (11) E/W flag for variation; and (12) sentence checksum. I note that this sentence include includes "real … location data such as longitudinal [and] latitudinal positional coordinates" and is thus location coordinates as in the terminology of the '774 Patent.

78. I understand that *Sakamoto's* terminal performs this location coordinate monitoring "using a satellite navigation system." In particular, I understand that GPS receiver 10 is one element of a complete GPS system that combines known orbit data (such as ephemeris data) with the pseudoranges from the GPS satellites (received via the GPS receiver) to determine the location coordinates (*i.e.*, position) discussed above. Thus, I understand the *Sakamoto* Electronic Components to determine the position (*i.e.*, "to monitor location coordinates") of terminal 1 and/or Terminal user A (*i.e.*, "one or more individuals or objects") using GPS satellites (*i.e.*, "a satellite navigation system").

b) [1(a)] a battery having a battery charge level;

79. I understand that *Sakamoto's* terminal includes a battery. *Sakamoto,* [0019]. A POSITA would have appreciated that a battery has a battery charge level corresponding to the amount of energy stored in the battery at a given point in time.

A battery charge level may be expressed in terms of an amount of stored charge (for example, as measured in milliAmp-hours) or in terms of a fraction of total capacity (for example as measured in a percentage). I note that the '774 Patent uses the terms "charge level" (of a "charging unit"), "battery charge level," "remaining battery charge level," "battery charge remaining," "power level" (of a charging unit) and "estimated charge level" interchangeably and synonymously to refer to this same concept. I also understand *Sakamoto's* use of the terms "remaining battery level," "remaining battery amount," and similar terms to refer to this same concept as well.

c) [1(b)] transceiver circuitry;

80. I understand *Sakamoto's* "communication control unit 11" to be or include transceiver circuitry. First, a POSITA would have reasonably understood transceiver circuitry to be circuitry that performs the function of *trans*mitting and re*ceiving*. *Sakamoto* teaches that communication control unit both transmits and receives data via "a mobile communication network." *Sakamoto*, [0007], [0048]. *Sakamoto* further gives a "mobile phone" as one example of a way terminal 1 is connected to server 2. I understand a mobile phone to be one example of a component that is or includes transceiver circuitry.

81. I also understand *Sakamoto's* GPS receiver 10 to be a receiver, at least because GPS receiver 10 receives GPS signals from GPS satellites. *Sakamoto*, [0005]. *Sakamoto* does not disclose that GPS receiver 10 transmits signals. However,

I note that the ’774 Patent uses the term “GPS transceiver” to refer to “conventional” GPS receivers. ’774 Patent, 2:57–3:41. A POSITA would have reasonably understood that such a “conventional” GPS device does not transmit. Accordingly, I also understand the ’774 Patent to use “transceiver” to encompass to encompass GPS receivers, either alone or in combination with other circuitry that performs transmission functions. As such, I understand *Sakamoto’s* GPS receiver 10 to be one portion of the collective transceiver circuitry taught by *Sakamoto*. I also note that some of the elements of the ’774 Patent’s claims share one or more components as they are mapped below and in the Petition. For example, the mapped “transceiver circuitry” comprises Sakamoto’s GPS receiver 10 and the communication control unit 11, whereas the mapped “processor circuitry” also comprises the GPS receiver 10 (in addition to other components). A POSITA would have understood and expected that a particular component would perform multiple functions. In portable (mobile) electronic devices, space is at a premium. A POSITA would not have expected each operational module to operate using completely dedicated hardware/circuitry, but rather to share particular hardware/circuitry as much as possible to conserve space. See Krasner, 10:16-51 (discussing various configurations of its components, including combining functions into a single processor). Similarly, a POSITA would have understood providing duplicate components for each subsystem of a consumer electronic device would have been

wasteful of production cost, materials cost, and/or power consumption. Instead, a POSITA would have understood that the claim elements, as mapped, would have been distinguishable by their distinct functions performed and the totality of their composition (i.e. the hardware/circuitry not shared between the claim elements). Thus, in my opinion, the mapping of the claim elements in the Petition, in which hardware/circuitry is shared amongst otherwise distinctly-operating elements, is appropriate and obvious. This is also appropriate in view of FIG. 5 of the '774 Patent (reproduced above) which shows only a single transceiver block to perform GPS functions and communications functions with the target host 452.

d) [1(c)] processor circuitry;

82. I understand *Sakamoto's* GPS receiver to include processing circuitry as well. In particular, as I discussed above, a POSITA would have appreciated that a GPS receiver includes the processing circuitry needed to calculate location coordinates from the received pseudorange signals. *See* § IV.A above. As such, I understand *Sakamoto's* depiction in FIG. 1 of a single box to be a shorthand, readily understandable by a POSITA, for the numerous electronic subcomponents that make up a GPS receiver, and I understand some of the these subcomponents to be or include processing circuitry in addition to the transceiver circuitry discussed above. *See also Sakamoto*, [0019] ("GPS receiver 10 which **receives GPS satellite signals** from GPS satellites and **performs positioning operations**.").

83. I further understand *Sakamoto's* satellite signal level detection unit 15 to be or include processor circuitry. In particular, *Sakamoto* describes the functions of satellite signal level detection unit 15 as including "monitor[ing] the signal level from the GPS satellite" for a specified time interval and providing a "calculation" of the "average value of the signal level." *Sakamoto,* [0037]. A POSITA would have reasonably understood that this monitoring and calculation would have been performed by processing circuitry so as to be able to begin and end monitoring responsive to instructions received (for example) from server 2, and calculate the average value in response. I further note that this is consistent with the description of the functionality of "signal processing circuitry 104" in one embodiment discussed in the '774 Patent. *See* '774 Patent, 7:23–25 ("In another embodiment, the signal processing circuitry 104 processes and measures signal power level."); 10:46–47 ("In step 306, processing unit 104 determines a power level of receive communication signal.").

e) [1(d)] a battery power monitor to measure in real-time the battery charge level and to make a prediction of an estimated remaining battery charge level in response to the battery charge level;

84. As described above, a POSITA reading the '774 Patent would have understood the terms "power level" (of a battery/charging unit) and "battery level" interchangeably. *See* § V.C.3.b) above. As such, I understand that the claimed "battery power monitor" monitors the previously claimed "battery charge level." I

further understand this monitored "battery charge level" to be the same concept as *Sakamoto's* "remaining battery amount" which is monitored by battery control unit 16.

85. I further understand the process of "mak[ing] a prediction" of an estimated remaining battery amount (either in terms of remaining charge level or in terms of remaining battery lifetime) to involve a step of measuring and a step of estimating or predicting. First, a measurement is taken from the battery being monitored. This may be, for example, a measurement of a voltage across the terminals, which a POSITA would have reasonably understood to decrease as the amount of energy remaining in the battery decreases. Based on this measurement, an estimation or prediction of the remaining capacity can be performed. For example, a lookup table of remaining charge indexed by battery voltage may be consulted to determine an estimated capacity. A predicted remaining life can also be calculated by dividing this remaining energy by a power draw rate (based, for example, on the battery voltage level across a known resistance of the circuit or a measured average current draw). Such a value (of remaining battery charge level or remaining battery charge life) is only an estimate (or a prediction) because the measured voltage for a particular remaining energy level may vary based on battery condition (such as battery age) and resistance or current draw may change based on changing ambient conditions (such as, for example temperature) and user actions (such as turning on the display).

For example *Lee,* discussed above, discloses how power consumption, power measurement and charging of a battery can vary depending on various "characteristics" including temperature and the age of the battery. *Lee,* 3:66–4:3; 8:39–39. I understand "monitoring" a battery charge level to be repeatedly performing this measurement and estimation process so as to update the estimate as the remaining energy and power consumption change. Performing such calculations is straightforward and a POSITA would have reasonably understood how a remaining battery charge level is monitored via measuring and estimating.

86. I note that *Sakamoto* discloses that that battery control unit "constantly" monitors the remaining battery level. I understand this to be consistent with the '774 claim limitation requiring that the battery level be measured "in real-time." In particular and as described above, measuring the battery charge level is a part of the process of monitoring the remaining battery amount. As such, "constantly" monitoring the remaining battery amount involves constantly measuring the battery charge level. While the '774 Patent does not provide parameters for what "real-time" measurement of a battery charge level requires, a POSITA would have reasonably understood that the battery charge level does not change appreciably over very short time intervals. This is the case at least because batteries provided for a device are selected to be of a capacity such that they can power the device for a length of time acceptable to a user (for example, for several hours). Thus, a measurement frequency

of even once per minute for a device with a battery lifetime of three hours would provide updates at a granularity level of less than one percent. Similarly, *Sakamoto's* battery control unit monitors the battery charge level in order to switch the device to a lower-power mode (for example, normal sensitivity mode) when the battery drops below a threshold. I understand that this would similarly be performed at a regular interval (in real-time) so that the trigger condition (dropping below the threshold) could be detected and power saving initiated promptly, thereby maximizing the battery-saving benefit (which I understand to be desirable). This is consistent with *Sakamoto's* teaching that the power is monitored "constantly." *Sakamoto*, [0028]. As such, I understand *Sakamoto's* "constantly" monitoring the battery level to be "in real time" for at least this reason.

f) [1(e)] local battery power adjustment mechanism to generate in substantially real-time an updated set of network communication signaling protocols associated with at least one of a request rate of location coordinate packets to be communicated to a target host and a listen rate of the location coordinate packets from a satellite navigation system, the updated set of network communication signaling protocols having a value that is responsive to a user input request;

87. I understand all of the *Sakamoto* Electronic Components depicts above in FIG. 1 to be "local" components to the terminal. In particular, I understand that positioning control unit 13 and man-machine interface 15, which act in concert to adjust the positioning mode, to be a part of terminal 1 and therefore "local"

components. Because the positioning control unit 13 powers on and off the GPS receiver via GPS control unit 12 (thereby adjusting the power draw of the GPS receiver from the battery) in response to the positioning mode, I understand them to be (alone or in combination) a "battery power adjustment mechanism" as well.

88. As discussed above, I understand *Sakamoto's* battery control unit to measure the remaining battery amount in real time in order to maximize the battery savings associated with switching to a lower-power mode upon detecting a low battery condition. I similarly understand that, in order to maximize the battery savings, the action responsive to the monitoring (here, switching to the lower power positioning mode) would also be performed in real time, or the benefit form "constantly" monitoring the remaining battery level would be lost. This is consistent with *Sakamoto's* disclosure that the mode switch occurs "when" the low battery level is detected and the warning issued and that the purpose of switching modes responsive to the low-battery condition is "to reduce the power consumption" so that "the operation time can be extended." *Sakamoto*, [0029]; [0046]. Because power consumption is not reduced until the mode switch occurs, I understand that the mode switch is performed in real time for this reason as well. I understand that the mode switches occur in real time (similar to the battery charge level monitoring). I understand that this is the case so as to avoid wasting battery power once it has been

determined (by terminal user A, position searcher B, or automatically based on a battery threshold) to switch to a positioning mode that consumes less battery charge.

89. A POSITA would have appreciated that switching the positioning modes (responsive to a low-power condition or to user command) changes the frequency with which *Sakamoto's* terminal transmits and receives data (*i.e.,* updates the communication signaling protocol of the terminal).

90. In particular, a continuously operating GPS receiver (such as *Sakamoto's* GPS receiver operating in high sensitivity positioning mode) has an associated update rate. For example, many GPS receivers generate a position update once per second (*i.e.*, at a rate of 1 Hz). Other GPS receivers may generate a position update more or less frequently, such as ten times per second or once every ten seconds (*i.e.*, 10 Hz or 0.1 Hz). A POSITA would have appreciated that a GPS receiver with an appropriate update rate can be selected based on the application. GPS satellites transmit position code signals at a higher rate than that at which a GPS receiver can update its position. Accordingly, the rate at which a GPS receiver listens for these signals (the claims "location coordinate packets") from GPS satellites is tied to its update rate.

91. Separately from the listen rate, *Sakamoto* teaches that the server may send "position search request messages." *Sakamoto*, [0032]–[0034]. *Sakamoto* teaches that these messages may be sent in response to a position search request from

position searcher B or in a "short cycle." *Sakamoto,* [0031]; [0040]. In the former case, the request rate is irregular (*i.e.*, it occurs at whatever interval position searcher B issues search requests), and in the latter case, it is at a regular (real-time, short cycle) rate.

92. In the normal sensitivity positioning mode, *Sakamoto's* GPS receiver is only powered up responsive to a request message from the server 2 (or a position search request form terminal user A). As such, I understand that the listen rate is decreased to the frequency of these requests. This is the case at least because the GPS receiver cannot listen for location coordinate packets while powered down. As discussed above with respect to the high sensitivity positioning mode, position search requests may be issued at an irregular rate specified by the position searcher B or a regular, real-time "short cycle." *Sakamoto* also discloses that (in both high sensitivity positioning mode and normal sensitivity positioning mode) the server periodically (at "the cycle set in advance in the position information database") sends a "satellite signal level request message." *Sakamoto*, [0037]. This causes the terminal to monitor the satellite signal level for a specified length of time and send a "satellite signal level response message" with signal strength data to the server. *Id.* I understand that monitoring the satellite signal level in this way would involve powering up the GPS receiver to listen for location coordinate packets such that their signal level can be measured. Thus I understand this to be a minimum listen rate in

normal sensitivity positioning mode even if no search request were made. Accordingly, in normal sensitivity positioning mode, the listen rate may be regular (in response to short cycle, real-time position searches or "cycle set in advance" satellite signal level request messages) or irregular (in response to individual position searches by position searcher B). The request rate, in normal sensitivity positioning mode, may likewise be regular (corresponding to the same short cycle, real-time position searches) or irregular (corresponding to the individual position searches by position searcher B). I understand that, where the GPS is powered on (to listen for location coordinates and generate a position search response message) responsive to a position search request from position searcher B, the listen rate and request rate are both responsive to user input (*i.e.*, the search request from position searcher B). I understand this at least because these rates are tied to the rate of user position search requests.

93. As discussed above, *Sakamoto* teaches that it may be "necessary to acquire the position in real time in a short cycle." *Sakamoto*, [0037]. I understand *Sakamoto* to indicate that this short cycle would be specified by the user. This is the case because the user will have the context necessary to (determine and specify) what a real-time, short cycle entails for a particular application. For example, tracking a package in a shipping container on a container ship requires significantly less frequent position updates that tracking that same package being carried by a

motorcycle courier. The user, having this context, would be able to set the cycle appropriately. This is also consistent with *Sakamoto's* teaching that the user can specify other "cycles" and other parameters used in the system, such as the "cycle set in advance in the position database" for updating the satellite signal levels. *Sakamoto*, [0037].

94. Finally *Sakamoto* teaches power-off modes for the GPS receiver and the terminal as a whole. *Sakamoto*, [0039], [0051]; [0028]. I understand that, in such a mode, the listen rate and the request rate would both be zero. I understand this to be the case at least because the GPS receiver cannot listen for location coordinate packets while powered off. Because the GPS receiver cannot listen for location coordinate packets, the GPS receiver cannot generate a position search response message with an updated position, and so the request rate would be zero for this reason as well. I understand these rates to be a "minimal level" at least because no lower level is possible.

g) [1(f)] wherein the local battery power adjustment mechanism actives or deactivates at least one portion of the transceiver circuitry or the processor circuitry to conserve the battery charge level in response to the value.

95. I understand that the GPS receiver is "deactivated" when it is powered off, and that the purpose (and effect) of this deactivation is to conserve the battery charge level by reducing the power consumption. *Sakamoto*, [0039]. I also understand that

the satellite signal level detecting unit 15 would also be deactivated when the GPS receiver 10 is deactivated, at least because (in the absence of a powered GPS receiver) no satellite signals are received for which to determine a signal level. Finally, a POSITA would have reasonably understood that the satellite signal level detecting unit 15 would also be powered down when GPS receiver is powered down (*i.e.,* when the power is cut off) so as to save the power consumed by the processing circuitry thereof.

4. Claim 4

a) The device of claim 1, wherein the local battery power adjustment mechanism comprises a user adjustable electronic display that indicates a current level of battery power and allows a user a capability to adjust power level thereof.

96. I understand that man-machine interface control unit 14 includes a display. I understand this at least because *Sakamoto* describes the terminal as showing the current position to terminal user A. I further understand that GPS receivers are commonly known to have displays to provide position and other data to users as well as (in the case of touch screens) to receive user input. I understand that *Sakamoto's* remaining battery amount warning would be "issue[d] to the user via this display. I understand this to be the case because GPS displays are commonly known to display battery information (such as, for example, charge level) as well as because *Sakamoto* does not disclose an alternative method (such as an audible alert) for issuing

warnings to a user. Furthermore, because the terminal user A can specify the threshold for the remaining battery amount warning notification, the notification indicates to user that the battery charge level has reached the value specified using man-machine interface control unit 14. I understand that, in order to set the threshold, the user interface would need to include some representation of the threshold battery level, for example a bar graph, or a slider, a numerical input, or some other way that the user could indicate the desired level.

5. Claim 5

a) The device of claim 4, wherein the local battery power adjustment mechanism comprises an automatic sleep mode to set at least one of the request rate of the location coordinate packets to the target host and the listen rate of the location coordinates from the satellite navigation system to a minimal level until the battery power monitor measures a sustainable battery charge level to process the at least one portion of an receive signal.

97. I understand *Sakamoto's* teachings of automatically entering a mode where the GPS receiver is completely powered off in response to a low battery level to be an "automatic sleep mode." I further understand *Sakamoto's* teaching that the terminal can "cope with charging" to indicate that the mode switches responsive to a low remaining battery amount are reversed once the battery level is no longer low (*i.e.,* once the battery has been at least partially recharged). Thus, for example, I understand that the terminal would exit the automatic sleep mode once the battery

was sufficiently recharged. I understand this to be the case at least because users generally expect changes made automatically (for example, in response to a low battery) to be reversed automatically once they are no longer needed (once the battery is recharged). This allows the device to continue operating as specified by the user once the conditions requiring the change no longer prevail. Thus, I would expect *Sakamoto's* terminal to revert back to normal sensitivity positioning mode from power-off mode and to high sensitivity positioning mode from normal sensitivity positioning mode (as appropriate for the signal level) as the battery is charged. This is further supported by the fact that Sakamoto does not describe the user changing the mode back once the GPS receiver has stopped position searching. This a POSITA would have understood that the GPS position searching resumes once the battery has been at least partially recharged.

6. Claim 6

a) The device of claim 4, wherein the local battery power adjustment mechanism comprises a charge control management of the portable electronic tracking device that estimates charge capability and adjusts cycling of the at least one of a request rate of location coordinate packets to a target host and a listen rate of the location coordinate packets from the satellite navigation system to maximize charge capability.

98. I understand that *Sakamoto's* terminal adjusts the cycling of the listen rate based on the positioning mode. In particular, as discussed above, in high sensitivity positioning mode, *Sakamoto's* listen rate governed by the update rate of the GPS

receiver. By contrast, in normal sensitivity positioning mode, *Sakamoto's* listen rate (in the absence of position searches) is governed by the "cycle set in advance" for updating the satellite signal levels. I understand the this cycle rate would be lower than the update rate of the GPS receiver (for example, once per minute as compared to once per second). Thus, the cycle (and, in particular, the cycle timing) for these positioning modes is different. Furthermore, the cycle for the power-off mode (*i.e.*, 0 Hz) is also different from the cycle timing for either the high sensitivity positioning mode or the normal sensitivity positioning mode. As described elsewhere, this mode is also switched to conserve battery power for when the user needs it (*i.e.,* to maximize charge capability). *Sakamoto*, [0046]. As such, when the positioning control unit adjusts the positioning mode in response to a battery charge level, thereby generating an updated set of communication protocols, it also adjusts the cycling of the listen rate, and it does so to conserve battery charge (maximize charge capability).

7. Claim 8

a) [8(pre)] A local charging management device to manage electrical resource capability for an electronic tracking device that is tracked by at least one other tracking device comprising:

99. See element [1(pre)], above.

b) [8(a)] a battery power level monitor;

100. See element [1(d)], above.

c) [8(b)] a charging unit; and

101. I understand *Sakamoto's* battery to be a "charging unit" as claimed. I understand this at least because the '774 Patent gives a battery as an example of a charging unit. '774 Patent, 13:52–55. Consistent with this, the '774 Patent also discusses the charging unit consistent with a battery. *See, e.g.,* '774 Patent, *Abst* ("The adjustment is responsive to an estimated charge level of the charging unit…"); 13:6–12 ("In one variant, electrical power resource management component adjusts cycle timing of request rate 420 of location coordinate packets 422 to target host 452 and listen rate 425 of location coordinate packets 422 from satellite navigation system 403 responsive to **estimated charge level of charging unit (e.g., battery charge level 406**)."). I further understand the "power level of the charging unit" to be the same as the "battery power level" and "battery charge level") (and the other terms used synonymously by the '774 Patent; *see* § V.C.3.b) above).

d) [8(c)] an electrical power resource management component to adjust cycle timing of at least one of a request rate of location coordinate packets to a target host and a listen rate of the location coordinate packets responsive to an estimated charge level of the charging unit,

102. I understand *Sakamoto's* teaching of a local battery power adjustment mechanism as discussed in elements [1(e)] and [1(f)] above to also be relevant to this claim limitation, at least because the '774 Patent gives a "local battery adjustment mechanism" as one example of an "electrical resource management

component." '774 Patent, 13:13–15. I also understand that Sakamoto's teachings of "adjust[ing] the cycling" of the listen rate as discussed in claim [6] above to be relevant to the function of "adjust[ing] cycle timing" as claimed here. Finally, I understand that *Sakamoto* teaches updating these cycle timings "responsive to an estimated charge level of the charging unit" at least because *Sakamoto* discloses adjusting the positioning mode in response to a determination that the remaining battery amount has fallen below a preset threshold. *Sakamoto,* [0028]–[0029].

e) [8(d)] wherein the battery power level monitor measures a power level of the charging unit and adjusts a power level applied to location tracking circuitry responsive to one or more signal levels, the power level comprising a multitude of threshold values determined by a user or system administrator to intermittently activate or deactivate the location tracking circuitry to conserve power of the charging unit in response to the estimated charge level of the charging unit.

103. I understand *Sakamoto's* disclosure that the terminal automatically switches to normal sensitivity positioning mode from high sensitivity mode in response to a battery warning message to teach a first threshold value. *Sakamoto*, [0029]. I further understand *Sakamoto's* disclosure that "man-machine interface control unit 14 is operated in advance to set the threshold" where this occurs to teach that this threshold is "determined by a user or system administrator." As discussed above, I understand *Sakamoto* to teach a still-lower power mode whereby the GPS receiver is powered off completely (rather than intermittently). I refer to this mode

below as power-off mode for brevity. I understand this at least because *Sakamoto* explicitly distinguishes a mode involving "cutting off the power of the GPS receiver" from normal sensitivity positioning mode. *Sakamoto*, [0051]. I understand that this power-off mode cannot be high sensitivity positioning mode at least because, in high sensitivity mode, the GPS receiver is "always operated." *Compare Sakamoto*, [0019] *with* [0051]. I understand that such a power-off mode has a separate threshold for switching from the normal sensitivity positioning mode to the power off mode. I understand this to be the case at least because, if the threshold for normal sensitivity positioning mode were the same as that for power-off mode, the device would switch into power off mode directly from high sensitivity positioning mode and normal sensitivity positioning mode would never be used, contrary to the teachings of *Sakamoto*. *Sakamoto*, [0029]. Furthermore, as described in my general discussion of *Sakamoto* above, a POSITA would have understood that a "predetermined threshold" for a signal level value "equal to or lower than a predetermined threshold" (e.g., K1) to select the high sensitivity mode would have been different from "the signal level value is equal to or lower than a predetermined threshold value" for selecting the stop-position searching mode (i.e., lower than the bottom threshold for the high sensitivity mode). A POSITA would have understood from the teachings of *Sakamoto* that "a predetermined threshold" for selecting the high sensitivity mode and "a predetermined threshold" for selecting the stop-position searching mode

would have been different; indeed, each threshold is for selecting a separate and distinct mode (e.g., transitioning from normal mode to high sensitivity mode vs. transitioning from high sensitivity mode to stop-position searching mode). Further, a POSITA would have recognized that *Sakamoto's* system would have been configured to transition from one of the modes to any other mode (including directly from stop-position searching mode to normal mode and/or vice-versa) when appropriate. Furthermore, *Sakamoto* teaches that the stop-position searching mode is selected when positioning cannot be performed. *Sakamoto*, [0038], 0050]. Therefore, a POSITA would have understood that "a predetermined threshold" for the stop-position searching mode would have been for a signal level lower (i.e., poorer) than the signal level range for the high sensitivity mode. For at least these reasons, a POSITA would have understood that *Sakamoto* teaches three distinct modes separated by distinct thresholds so that *Sakamoto's* system would have been operable and able to select the correct mode that corresponds to the signal level value (i.e., normal mode, high sensitivity mode, or stop-position searching mode). Therefore, I note that *Sakamoto's* "a predetermined threshold value" for the stop-positioning search mode meets the claimed "signal level" of the '774 Patent. See '774 Patent, at 8:7-10; Sakamoto, [0038], [0050].

104. Consistent with the teachings of *Sakamoto* regarding the first battery threshold, I understand that "man-machine interface control unit 14 is operated in

advance to set" this second battery threshold as well. I understand this to be the case because it is consistent with *Sakamoto's* teachings that the various thresholds (including the signal thresholds K1 and K2 and the first battery threshold) are configurable by the user using the man-machine interface.

105. To the extent that *Sakamoto* does not explicitly teach that this second threshold, it would have been obvious to modify *Sakamoto* to include such a second threshold. First, *Sakamoto* explicitly teaches that the user may want to power off the entire device in response to a sufficiently low power level. *Sakamoto,* [0028]. This might be desirable so as to conserve the small amount of remaining power for later use. However, a POSITA would have appreciated that the user might not notice a warning that the battery level was critically low, thereby leaving the device in normal-sensitivity positioning mode and wasting the small amount of power updating the satellite signal level in response to the satellite signal level requests from the server. As such it would have been obvious to a POSITA to modify Sakamoto to include a second, user-configurable battery threshold which causes the GPS receiver (and/or the terminal as a whole) to power off completely, in analogy to the first threshold that causes the device to switch to normal sensitivity positioning mode. Doing so would be a simple matter of programming, because *Sakamoto* already includes a battery power monitor component (*Sakamoto*, [0019]), and programming to power off the GPS receiver and/or device (*Sakamoto*, [0028]).

Given the simplicity of adding a second battery threshold using components and programming *Sakamoto* already includes, modifying Sakamoto to add this second threshold would have had a reasonable expectation of success, without undue experimentation.

106. To the extent that *Sakamoto* does not explicitly teach that this second threshold is user-configurable, in my opinion it would have been obvious to a POSITA to modify *Sakamoto* to make it user configurable. The user will have the best understanding of the likelihood of such a later use. For example, if the user was expecting to use the device later, but did not need to use it for some immediate interim period, then they might set the second threshold higher, to be sure they had power later. By contrast, if the user knew they would *not* be using it later, they might set the second threshold lower to allow longer use at the current time. Doing so would be also be a simple matter of programming, because *Sakamoto* already includes a first threshold for adjusting the power consumption and programming for allowing the user to specify that threshold. *Sakamoto*, [0029]. Given the simplicity of making the second battery threshold user-configurable using components and programming *Sakamoto* already includes, modifying Sakamoto to add this second threshold would have had a reasonable expectation of success, without undue experimentation.

8. Claim 10

a) 10. The apparatus of claim 8, wherein the local charging management device comprises a charge control management of the portable electronic tracking device that estimates charge capability and adjusts cycling of the at least one of a request rate of location coordinate packets to a host target and a listen rate of the location coordinate packets to maximize charge capability.

107. See Claim [6] above.

9. Claim 13

a) The apparatus of claim 8, wherein the listen rate of the location coordinates comprises a global positioning system (GPS) system refresh rate of the location coordinates.

108. As discussed above, I understand *Sakamoto's* disclosure of a listen rate to be taught by the refresh (or update) rate of the GPS receiver 10. *See* § V.C.3.f) above.

10. Claim 15

a) The apparatus of claim 8, wherein the battery power level monitor measures a power level of the charging unit and substantially automatically adjusts power usage responsive to available power of the charging unit to maximize power unit life.

109. I understand that *Sakamoto's* automatic mode switching is performed substantially automatically based on a measured battery level. *See* limitations [1(e)] and [1(f)] and claim 6 above. I further understand this adjustment to be performed (and to have the effect) of increasing power unit life thereby maximizing it consistent with the functioning of the device. *Sakamoto,* [0045], [0046], [0050].

D. GROUND 2: OPINIONS REGARDING *SAKAMOTO* AND APPLICANT ADMITTED PRIOR ART

1. Claim 1

a) [1(pre]] A portable electronic tracking device to monitor location coordinates of one or more individuals and objects using a satellite navigation system, the portable electronic tracking device comprising:

110. See Ground 1, [1(pre)] above.

b) [1(a)] a battery having a battery charge level;

111. See Ground 1, [1(a)] above.

c) [1(b)] transceiver circuitry;

112. See Ground 1, [1(b)] above.

d) [1(c)] processor circuitry;

113. See Ground 1, [1(c)] above.

e) [1(d)] a battery power monitor to measure in real-time the battery charge level and to make a prediction of an estimated remaining battery charge level in response to the battery charge level;

114. The ’774 Patent describes how battery life estimation techniques were known by one skilled in the art. I agree with this. Such techniques were well known and commonly used, as described in the background section above. In addition to the method disclosed in the ’774 Patent, a POSITA would have been aware of other estimation methods. For example, another approach would be to subtract the remaining battery level at the end of a measurement period from the remaining battery level at the beginning of the period and divide by the length of the period to

obtain a drain rate, and dividing the remaining battery level at the end of the period by the drain rate to predict the remaining battery charge life. To the extent that *Sakamoto* does not teach remaining battery charge life prediction, in my opinion it would have been obvious to a POSITA to incorporate these admittedly known teachings into the terminal of *Sakamoto*. The benefit of doing so would be to allow the user to make more informed decisions when manually switching the positioning mode of the device or when configuring the automatic battery level thresholds for switching the positioning mode. For example, it would be easier and more intuitive for a user to specify that the device should switch from high-sensitivity positioning mode to normal sensitivity positioning mode when one hour of battery remains as opposed to specifying that that switch should occur at a battery level of (for example) 18%. Furthermore, a user is likely to be setting the thresholds based on their own (less accurate) estimation of remaining device life, so predicting a remaining life and allowing the user to specify thresholds in terms of a remaining life would be simpler for the user as well as more accurate.

115. Adding the admittedly known functionality of predicting a remaining battery life to the terminal of *Sakamoto* would be a simple matter of programming. As discussed above, predicting remaining battery charge life is a simple matter of calculation. For example, the ’774 Patent discusses one approach: “measurement of time average amperage draw and voltage level (over a given period) to estimate

remaining battery charge life." Reviewing *Sakamoto's* disclosure of "constantly monitor[ing] the remaining battery level," (*Sakamoto*, [0028]), a POSITA would have reasonably understood that another approach is would be to subtract the remaining battery level at the end of the period from the remaining battery level at the beginning of the period and divide by the length of the period (which *Sakamoto* also measures; see [0037] (discussing monitoring a signal level "during the measurement time") to obtain a drain rate, and dividing the remaining battery level at the end of the period by the drain rate to predict the remaining battery charge life. Given the simplicity of implementing this calculation give data already monitored by *Sakamoto*, modifying *Sakamoto* to perform the calculation would have had a reasonable expectation of success, without undue experimentation.

f) [1(e)] local battery power adjustment mechanism to generate in substantially real-time an updated set of network communication signaling protocols associated with at least one of a request rate of location coordinate packets to be communicated to a target host and a listen rate of the location coordinate packets from a satellite navigation system, the updated set of network communication signaling protocols having a value that is responsive to a user input request;

116. See Ground 1, [1(e)] above.

g) [1(f)] wherein the local battery power adjustment mechanism actives or deactivates at least one portion of the transceiver circuitry or the processor circuitry to conserve the battery charge level in response to the value.

117. See Ground 1, [1(f)] above.

2. Claim 4

a) The device of claim 1, wherein the local battery power adjustment mechanism comprises a user adjustable electronic display that indicates a current level of battery power and allows a user a capability to adjust power level thereof.

118. See Ground 1, claim 4 above.

3. Claim 5

a) The device of claim 4, wherein the local battery power adjustment mechanism comprises an automatic sleep mode to set at least one of the request rate of the location coordinate packets to the target host and the listen rate of the location coordinates from the satellite navigation system to a minimal level until the battery power monitor measures a sustainable battery charge level to process the at least one portion of an receive signal.

119. See Ground 1, claim 5 above.

4. Claim 6

a) 6: The device of claim 4, wherein the local battery power adjustment mechanism comprises a charge control management of the portable electronic tracking device that estimates charge capability and adjusts cycling of the at least one of a request rate of location coordinate packets to a target host and a listen rate of the location coordinate packets from the satellite navigation system to maximize charge capability.

120. See Ground 1, claim 6 above; see also Ground 2, element [1(e)] above (estimating battery charge).

5. Claim 8

a) [8(pre)] A local charging management device to manage electrical resource capability for an electronic tracking device that is tracked by at least one other tracking device comprising:

121. See Ground 1, element [8(pre)] above.

b) [8(a)] a battery power level monitor;

122. See Ground 1, element [8(a)] above.

c) [8(b)] a charging unit; and

123. See Ground 1, element [8(b)] above.

d) [8(c)] an electrical power resource management component to adjust cycle timing of at least one of a request rate of location coordinate packets to a target host and a listen rate of the location coordinate packets responsive to an estimated charge level of the charging unit,

124. See Ground 1, element [8(c)] above, Ground 2, element [1(e)] above (estimating battery charge).

e) [8(d)] wherein the battery power level monitor measures a power level of the charging unit and adjusts a power level applied to location tracking circuitry responsive to one or more signal levels, the power level comprising a multitude of threshold values determined by a user or system administrator to intermittently activate or deactivate the location tracking circuitry to conserve power of the charging unit in response to the estimated charge level of the charging unit.

125. See Ground 1, element [8(d)] above.

6. Claim 10

a) The apparatus of claim 8, wherein the local charging management device comprises a charge control management of the portable electronic tracking device that estimates charge capability and adjusts cycling of the at least one of a request rate of location coordinate packets to a host target and a listen rate of the location coordinate packets to maximize charge capability.

126. See Ground 1, claim 10 above.

7. Claim 13

a) The apparatus of claim 8, wherein the listen rate of the location coordinates comprises a global positioning system (GPS) system refresh rate of the location coordinates.

127. See Ground 1, claim 13 above.

8. Claim 15

a) The apparatus of claim 8, wherein the battery power level monitor measures a power level of the charging unit and substantially automatically adjusts power usage responsive to available power of the charging unit to maximize power unit life.

128. See Ground 1, claim 15 above.

E. GROUND 3: OPINIONS REGARDING THE COMBINATION OF *SAKAMOTO* AND *HAYASAKA*

1. Claim 1

a) [1(pre]] A portable electronic tracking device to monitor location coordinates of one or more individuals and objects using a satellite navigation system, the portable electronic tracking device comprising:

129. See Ground 1, element [1(pre)] above.

b) [1(a)] a battery having a battery charge level;

130. See Ground 1, element [1(a)] above.

c) [1(b)] transceiver circuitry;

131. See Ground 1, element [1(b)] above.

d) [1(c)] processor circuitry;

132. See Ground 1, element [1(c)] above.

e) [1(d)] a battery power monitor to measure in real-time the battery charge level and to make a prediction of an estimated remaining battery charge level in response to the battery charge level;

133. I understand that *Hayasaka* teaches estimating a remaining battery level and predicting whether a remaining battery charge life was sufficient to send a packet. In particular, *Hayasaka* traches predicting whether an estimated battery charge life remaining is sufficient to process a communication (such as, for example, a position search request as received from server 2) based on factors such as a voltage across the terminals (which drops as the charge stored in the battery decreases). If the predicted power is sufficient to process the communication (for example, to determine a position and transmit a response message) the communication is allowed. Otherwise the communication is inhibited. *Hayasaka*, FIG. 3, 4:60-5:39.

134. In my opinion, it would have been obvious to a POSITA to combine the teachings of remaining battery charge level and/or remaining battery charge life prediction found in *Hayasaka* into *Sakamoto's* battery control unit (to the extent that

Sakamoto does not disclose it). In particular, as described above, it would have been beneficial to a user incorporate a predicted battery life into Sakamoto's terminal using the teachings of *Hayasaka*. For example, similar to providing user a warning based on remaining battery charge life as taught by AAPA, providing a warning based on a number of communications (*e.g.*, a number of position searches that can be performed with the remaining battery) would be useful to the user and would assist them in making informed decisions regarding whether and when to switch positioning modes. Furthermore, as described below with respect to claim 5, incorporating *Hayasaka's* teachings would allow *Sakamoto's* terminal to avoid wasting remaining battery power on messages when insufficient battery power remained to completely process the communication (position search request).

135. Adding the *Hayasaka's* functionality of predicting a remaining battery life to the terminal of *Sakamoto* would be a simple matter of programming. As discussed above, predicting remaining battery charge life is a simple matter of calculation. *Hayasaka* discloses another prediction algorithm based on continuously tracking the amount of battery charge consumed and subtracting it from the amount of energy the battery stores when it is full. *Hayasaka*, FIG. 3. *Hayasaka* then compares this to a lifetime by multiplying the power draw of the device by and time required to process the packet. *Id. Sakamoto* teaches continuously monitoring remaining battery amount. *Sakamoto* likewise teaches a powering on the GPS for a measured period to

time (for example, to measure a satellite signal level; *Sakamoto*, [0037]). Given the simplicity of implementing *Hayasaka's* calculation given data already monitored by *Sakamoto*, modifying *Sakamoto* to perform the calculation would have had a reasonable expectation of success, without undue experimentation.

f) [1(e)] local battery power adjustment mechanism to generate in substantially real-time an updated set of network communication signaling protocols associated with at least one of a request rate of location coordinate packets to be communicated to a target host and a listen rate of the location coordinate packets from a satellite navigation system, the updated set of network communication signaling protocols having a value that is responsive to a user input request;

136. See Ground 1, element [1(e)] above.

g) [1(f)] wherein the local battery power adjustment mechanism actives or deactivates at least one portion of the transceiver circuitry or the processor circuitry to conserve the battery charge level in response to the value.

137. See Ground 1, element [1(f)] above.

2. Claim 4

a) The device of claim 1, wherein the local battery power adjustment mechanism comprises a user adjustable electronic display that indicates a current level of battery power and allows a user a capability to adjust power level thereof.

138. See Ground 1, claim 4 above.

3. Claim 5

a) The device of claim 4, wherein the local battery power adjustment mechanism comprises an automatic sleep mode to set at least one of the request rate of the location coordinate packets to the target host and the listen rate of the location coordinates from the satellite navigation system to a minimal level until the battery power monitor measures a sustainable battery charge level to process the at least one portion of an receive signal.

139. I understand that *Sakamoto's* power-off mode, as augmented by *Hayasaka's* inhibition of communication (as discussed above with respect to element [1(d)] above) would be an automatic sleep mode as claimed. In particular, *Hayasaka* teaches "inhibit[ing]" a communication unless the battery stores sufficient energy to process the entire communication. *Hayasaka,* 3:53–57. Because *Hayasaka* compares the amount of energy currently stored in the battery to an amount required to process the communication (for example, to process a position search request message by receiving location coordinates from the satellite navigation system and sending location coordinate packets to the target host), I would understand that sending location coordinate packets to the target host and receiving location coordinates from the satellite navigation system are communication operations that would be inhibited in response to a low battery level in the combined system. I understand that communication inhibition is performed when insufficient energy is stored to process the communication, and I further understand that, once the battery

is sufficiently recharged and stores enough energy to process the communication (*i.e.* update a location and generate a position search response message), the combined system of *Sakamoto* and *Hayasaka* would no longer inhibit the communication (*i.e.*, would exit the automatic sleep mode).

140. In my opinion, it would have been obvious to a POSITA to combine the teachings of an automatic sleep mode found in *Hayasaka* into *Sakamoto's* local battery power adjustment mechanism. The motivation to do so would be to prevent wasting battery power by attempting to process communications when insufficient power remains. I understand that, absent such automatic sleep mode that inhibits communication, *Sakamoto's* terminal might send an incomplete, garbled, or erroneous position search response message when its battery charge level is critically low. This message would be worse than useless, as it could cause a "last observed position" of the terminal to be updated incorrectly. Adding *Hayasaka's* automatic sleep mode would therefore increase the accuracy of the device, which a POSITA would have reasonably understood to be desirable. Adding the automatic sleep mode would also remove the need for a user to specify a power-off threshold, which (as described above) might lead to incorrect positioning results. I also understand that *Hayasaka's* automatic sleep mode could also be combined with *Sakamoto's* second battery threshold such that communication is inhibited if either (1) the battery level is below a user-specified threshold (to preserve battery power for later use at the

user's discretion, as discussed above) *or* (2) the battery level is insufficient to process a communication (to prevent erroneous or garbled results). This would have the effect of maximizing the useable lifetime of the terminal (*i.e.* the time it could be used for tracking).

141. In my opinion, a POSITA would have had a reasonable expectation of success for adding *Hayasaka's* automatic sleep mode to the system of *Sakamoto*. As discussed above, predicting remaining battery charge level is a simple matter of calculation. Likewise, comparing the remaining amount of charge to an amount required to process a packet is a simple matter of calculation. Conditionally powering off the GPS receiver based on a signal from the battery power monitor and local battery adjustment mechanism is a function already provided for by *Sakamoto.* Given the simplicity of implementing an automatic sleep mode using data *Sakamoto* discloses collecting and hardware *Sakamoto* includes, modifying *Sakamoto* to include an automatic sleep mode would have had a reasonable expectation of success, without undue experimentation.

4. Claim 6

a) 6: The device of claim 4, wherein the local battery power adjustment mechanism comprises a charge control management of the portable electronic tracking device that estimates charge capability and adjusts cycling of the at least one of a request rate of location coordinate packets to a target host and a listen rate of the location coordinate packets from the

satellite navigation system to maximize charge capability.

142. See ground 1, claim 6 above; see also Ground 3, elements [1(d)] and claim 5 above (estimating battery charge level).

5. Claim 8

a) [8(pre)] A local charging management device to manage electrical resource capability for an electronic tracking device that is tracked by at least one other tracking device comprising:

143. See Ground 1, element [8(pre)] above.

b) [8(a)] a battery power level monitor;

144. See Ground 1, element [8(a)] above.

c) [8(b)] a charging unit; and

145. See Ground 1, element [8(b)] above.

d) [8(c)] an electrical power resource management component to adjust cycle timing of at least one of a request rate of location coordinate packets to a target host and a listen rate of the location coordinate packets responsive to an estimated charge level of the charging unit,

146. See Ground 1, element [8(c)] above. See also Ground 3, element [1(c)], and claim 5 above (predicting remaining battery charge level).

e) [8(d)] wherein the battery power level monitor measures a power level of the charging unit and adjusts a power level applied to location tracking circuitry responsive to one or more signal levels, the power level comprising a multitude of threshold values determined by a user or system administrator to intermittently

activate or deactivate the location tracking circuitry to conserve power of the charging unit in response to the estimated charge level of the charging unit.

147. See Ground 1, element [8(d)] above.

6. Claim 13

a) The apparatus of claim 8, wherein the listen rate of the location coordinates comprises a global positioning system (GPS) system refresh rate of the location coordinates.

148. See Ground 1, claim 13 above.

7. Claim 15

a) The apparatus of claim 8, wherein the battery power level monitor measures a power level of the charging unit and substantially automatically adjusts power usage responsive to available power of the charging unit to maximize power unit life.

149. See Ground 1, claim 15 above.

VI. CONCLUSION

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.

Date: 7/22/2020

By: _____

Scott Andrews