

**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE**

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Title: USING VEHICLE SYSTEMS TO GENERATE A ROUTE  
DATABASE

Mail Stop *Ex Parte* Reexam  
Central Reexamination Unit  
Commissioner for Patents  
P.O. Box 1450  
Alexandria, VA 22313-1450

**DECLARATION OF VASSILIOS, MORELLAS, PH.D**

I currently hold the opinions set expressed in this declaration. But my analysis may continue, and I may acquire additional information and/or attain supplemental insights that may result in added observations.

I hereby declare that all statements made of my own knowledge are true and that all statements made on information and belief are believed to be true. I further declare 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 the Title 18 of the United States Code.

Date: 08/29/2024

By:   
Vassilios Morellas ☐

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## **I. QUALIFICATIONS AND BACKGROUND INFORMATION**

1. My education and experience are described more fully in the attached curriculum vitae. For ease of reference, I have highlighted certain information below.

2. I am currently employed as a Research Professor of Electrical and Computer Engineering at the University of Minnesota, Twin Cities, Minnesota. I am currently also the Director of the National Science Foundation (“NSF”) Center on Robots & Sensors for Human Well Being at the University of Minnesota.

3. I believe that I am well qualified to serve as a technical expert in this matter based upon my educational and work experience.

4. I have been involved with the design and evaluation of computer vision systems, sensors, lasers for various automation tasks, for approximately 30 years. My academic research has been in the areas of computer vision, robotics, intelligent transportation systems, sensor networks, object recognition, and sensor-based control in transportation systems. I have also been involved in work since 1995 involving computer algorithms for vehicle tracking, camera calibration, inspection, object recognition, vehicle monitoring systems, and motion control devices. I have authored or co-authored a book and book chapters and numerous peer-reviewed technical papers in these areas. My curriculum vitae details my

degrees, employment history, teaching experience, publication list, scholarly accomplishments, professional contributions, grants, honors, and awards.

5. I received my Diploma of Engineering in Mechanical Engineering from the National Technical University of Athens in Greece in 1983. I obtained my Master of Science degree in Mechanical Engineering from the Columbia University in New York, New York in 1989. In 1995, I received my Ph.D. in Mechanical Engineering from the University of Minnesota. My research at the time was in robotics, computer vision and control, computer integrated manufacturing, and software engineering, and my Ph.D. thesis was titled “A Neuro-computational Mobile Robot Architecture for Mapping Localization and Navigation.” The work revolved around the use of neural networks and a suite of ultrasonic sensors to accomplish place recognition and autonomous navigation for a mobile robot.

6. After receiving my Doctorate degree, from 1995-1998, I was employed as a Research Associate at the Department of Mechanical Engineering at the University of Minnesota. My work as a research associate concerned autonomous driving of a tractor trailer using a combination of cameras, Differential Geographic Position Systems (DGPS), and magnetometers along with speed and steering control algorithms to achieve autonomous navigation.

Autonomous driving of this vehicle was successfully demonstrated at a testing facility of the Minnesota Department of Transportation (MnDOT).

7. Starting in 2003, and until 2014, I was an instructor at the Department of Mechanical Engineering at the University of Minnesota. As an instructor, I taught classes related to robotics and computer vision. I also conducted research and oversaw projects directed to camera-based security and surveillance. Network camera surveillance and tracking was field deployed at Philadelphia's train station.

8. From 2019 until the present, I have served as a Research Professor of Electrical and Computer Engineering at the University of Minnesota. While in this role, I have advised and mentored students related to image-based cancer recognition, precision agriculture automation, and vision-based techniques for early detection of autism spectrum disorders. I have mentored and advised student research related to Computer Vision, Artificial Intelligence, Algorithms and Data Structures, and Readings in Computational Vision. These cover a variety of topics that include 3D reconstruction, extraction of depth, inspection, tracking, light striping, lasers, structured light, structure from motion, occlusions, edge detection, and basic image processing. My academic research has continued in the fields of computer vision systems, sensors, and lasers, with primary specialties in robotics, intelligent transportation systems, and sensor-based control in transportation applications.

9. From 2006-2019, I was the Program Director of the Computer Science & Engineering of the University of Minnesota. While in this role, I continued research on various types of automation involving the integration of sensors of different modalities with electro-mechanical platforms.

10. I have received research grants for various projects involving computer vision as applied to the transportation industry, including the development of a camera-based solution to the Truck Parking Availability problem that uses 3D reconstruction of truck park stops.

11. In terms of my industrial experience, from 1998-2005, I was employed as a Principal Research Scientist, in the Advanced Technology Labs of Honeywell International Inc. From 2005-2006, I was employed as a Senior Principal Research Scientist, also in the Advanced Technology Labs of Honeywell. During my time at Honeywell, my work was primarily concerned with systems that enhanced security and surveillance. The pinnacle of this work was a demonstration of secure gate access of vehicles at a naval base, using a custom developed multi-spectrum camera and face recognition technologies.

12. From 2007-2014, I served as a Co-PI for the NSF Research Center on Safety, Security and Rescue at the University of Minnesota. While there, I was tasked with directing the University of Minnesota site research on various research

topics of interest to industrial partners that chose to join our center paying an annual fee.

13. From 2014 until the present, I have acted as the Director of the NSF center on Robots & Sensors for Human Well Being at the University of Minnesota. In this role, my work concerns organizing the center's activities attracting industrial financial support and directing research in intelligent transportation, medical research (cancer recognition, mental health disorders), precision agriculture, and robotics.

14. I am listed as an inventor on numerous patents issued in the United States and foreign countries. My inventions concern technologies including computer and machine vision technologies. Examples of my issued U.S. patents include:

- US Pat. No. 9,858,816, titled "Determining Parking Space Occupancy Using a 3D Representation"
- US Pat. No. 7,907,750, titled "System and Method for Autonomous Object Tracking"
- US Pat. No. 7,602,942, titled "Infrared and Visible Fusion Face Recognition System"
- US Pat. No. 7,149,325, titled "Cooperative Camera Network"

- US Pat. No. 7,806,604, titled “Face Detection and Tracking in a Wide Field of View”
- US Pat. No. 7,606,425, titled “Unsupervised Learning of Events in a Video Sequence”

15. I have authored or co-authored over 130 articles or conference presentations, including numerous papers and presentations concerning computer or machine vision technologies. Of particular interest may be the following papers and presentations:

- Video Analytics for Security and Transportation Applications, Keynote talk at the 4th IEEE Computer Vision and Pattern Recognition Workshop on Object Tracking & Classification Beyond the Visible Spectrum (OTCBVS 2007), June 22, 2007
- Between the Lines: A Driver-Assistive Technology for Staying in the Lane, GPS World, Vol. 9, 1988
- Accurate 3D ground plane estimation from a single image, IEEE International Conference on Robotics and Automation, 2009

16. I have been actively involved in multiple technical communities, including the IEEE Society, and NSF Review panels. I have served in the organizing committee of many technical conferences, including, for example:

- Associate Editor, IEEE/RSJ International Conference on Intelligent Robots and Systems, 2019
- Technical Committee, 22nd International Conference on Pattern Recognition, ICPR 2014
- Program Area Chair, 5th IEEE International Conference on Advanced Video and Signal Based Surveillance, 2008

17. My research has been recognized by multiple organizations, universities, and institutions. The following is a small set of honors and awards that I have received:

- Center for Transportation Studies: CTS Research Partnership Award, 2016
- Best Student Paper Award, IEEE International Conference on Image Processing (ICIP), 2012
- Technical Achievement Award, for Technical Excellence in the area of “People Tracking in Camera Networks,” Highest Honorary Distinction from Automation and Control Solutions (ACS) of Honeywell International Inc., April 2003.

18. Overall, I have used my education, industry, teaching, writing, and membership and service experiences and my understanding of the knowledge, creativity, and experience of a person having ordinary skill in the art in forming the opinions.

19. I have been actively involved in multiple technical communities, including the IEEE Society, and NSF Review panels. I have served in the organizing committee of many technical conferences, including, for example:

20. My extensive experience in the transportation industry is applicable to analyzing the Asserted Patents.

21. I have been retained on behalf of Tesla, Inc. to offer technical opinions relating to U.S. Patent No. 10,850,616 (“the ’616 Patent”) and prior art references relating to its subject matter. I have reviewed the ’616 Patent, and relevant excerpts of the prosecution history of the ’616 Patent. I have also reviewed the following references:

- U.S. Pat. No. 10,850,616 (“the ’616 patent”) (Appendix A)
- Excerpts from the Prosecution History of the ’616 Patent (“the Prosecution History”) (Appendix B)
- U.S. Pat. App. Pub. No. 2005/0065711 (“Dahlgren”) (Appendix D)
- U.S. Pat. No. 6,314,347 (“Kuroda”) (Appendix E)
- Certified Translation of Japanese Pat. Pub. No. JP 2003-276472 (“Hongo”) (Appendix N)
- Translation Certification for Appendix N (Appendix O)
- Japanese Pat. Pub. No. JP 2003-276472 (“Hongo2”) (Appendix P)

- Mukhachev P. A. et al., “Modern Machine Learning Methods for Telemetry-Based Spacecraft Health Monitoring,” *Automation and Remote Control*, 2021, Vol. 82, No. 8, pp. 1293–1320 (2021) (Appendix Q)
- U.S. Pat. No. 7,433,889 (“Barton”) (Appendix R)
- U.S. Pat. No. 7,363,138 (“Scelers”) (Appendix S)
- U.S. Pat. App. No. 2008/0004783 (“Mizon”) (Appendix T)
- Schulz, Marcus, “Low-frequency Torsional Vibrations of a Power Split Hybrid Electric Vehicle Drive Train,” *Journal of Vibration and Control*, 11:749-780 (2005) (Appendix V)

22. I have also reviewed various supporting references and other documentation as further noted in my opinions below.

23. Counsel has informed me that I should consider these materials through the lens of one of ordinary skill in the art (POSITA) related to the ’616 patent, and I have done so during my review. The ’616 patent was filed on September 1, 2017 and claims the benefit of priority from a series of applications that includes U.S. Patent No. 11,065,977, U.S. Patent No. 9,682,624, U.S. Patent No. 8,972,162, U.S. Patent No. 8,712,650, and U.S. Pat. No. 7,925,426, with the ’426 patent having an earliest priority date of Nov. 17, 2005 (“Critical Date”).

Appx. A, cover.

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

25. In writing this Declaration, I have considered the following: my own knowledge and experience, including my work experience in the field of transportation systems; my experience in teaching those subjects; and my experience in working with others involved in those fields. In addition, I have analyzed various publications and materials, in addition to other materials I cite in my declaration. 26. My opinions, as explained below, are based on my education, experience, and expertise in the fields relating to the '616 Patent. Unless otherwise stated, my testimony below refers to the knowledge of a POSITA as of the Critical Date, or before. Any figures that appear within this document have been prepared with the assistance of Counsel and reflect my understanding of the '616 patent and the prior art discussed below.

## **II. OVERVIEW OF CONCLUSIONS FORMED**

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

- Claims 1-9, and 12-16 are made obvious by Dahlgren

- Claims 10 and 11 are made obvious by Kuroda and Dahlgren

27. As explained in Section V.D, the combination of Kuroda and Dahlgren incorporate the teachings of Dahlgren applied in Ground 1. Based on this, I understand that Kuroda-Dahlgren satisfies the requirements of claims 1-9, 12-16.

### **III. LEVEL OF ORDINARY SKILL IN THE ART**

28. In my opinion, one of ordinary skill in the art relating to, and at the time of, the invention of the '616 patent would have had a bachelor's degree in electrical engineering, computer engineering, mechanical engineering, civil engineering (transportation systems), physics, or a related field, and at least four years of experience (or the academic equivalent) in the field of transportation systems.

29. Based on my experiences, I have a good understanding of the capabilities of one of ordinary skill. Indeed, I have taught, participated in organizations, and worked closely with many such persons over the course of my career. Based on my knowledge, skill, and experience, I have an understanding of the capabilities of one of ordinary skill. Furthermore, I possess those capabilities myself.

#### **IV. THE '616 PATENT**

##### **A. The '616 Patent Family**

30. The '616 Patent, titled “Using Vehicle Systems To Generate A Route Database” was filed on September 1, 2017, and issued as a U.S. Patent on 10,850,616. I understand that:

- The '616 patent issued from U.S. Patent Application No. 15/693,899, and claims to be a continuation of U.S. Patent Application No. 15/626,676, filed on June 19, 2017, now U.S. Patent No. 11,065,977;
- U.S. Patent No. 11,065,977 is a continuation of U.S. Patent Application No. 14/566,848, filed on December 11, 2014, now U.S. Patent No. 9,862,624;
- U.S. Patent No. 9,682,624 is a continuation of U.S. Patent Application No. 14/206,138, filed on March 12, 2014, now U.S. Patent No. 8,972,162;
- U.S. Patent No. 8,972,162 is a continuation of U.S. Patent Application No. 13/066,189 filed on April 8, 2011, now U.S. Patent No. 8,712,650;
- U.S. Patent No. 8,712,650 is a continuation-in-part of U.S. Patent Application No. 11/283,137 filed November 17, 2005, now U.S. Pat. No. 7,925,426

##### **B. Brief Description**

31. Generally, the '616 patent purportedly provides “devices, systems, and methods for managing the power consumption of an automotive vehicle, and

thereby optimizing the power consumption of the vehicle.” Appx. A, 2:19-22.

The “devices and systems for managing the power consumption of the vehicle typically include power management logic that can calculate an applied power for the vehicle engine based on information provided from the external environment of the vehicle, the operational status of the vehicle, one or more command inputs from a driver, and one or more operational parameters of the vehicle.” Appx. A, 2:22-28.

32. The “information provided to the power management logic may come from data inputs (e.g., sensors, telemetries, etc.), memory, user commands, or it may be derived.” Appx. A, 2:28-31. The ’616 patent explains that “[a]ny appropriate sensors, detectors or data inputs may be used with the power management devices and systems described herein.” Appx. A, 21:65-67. The “sensors for detecting external environmental information may be used (e.g., optical, mechanical, electrical, or magnetic sensors).” *Id.*, 21:67-22:2.

33. The ’616 patent explains that these “[s]ensors may be monitored (e.g., polled) in real-time, as described above.” Appx. A, 22:2-3. In particular, the ’616 patent explains that:

...polling logic may coordinate continuous or periodic polling of Global Positioning System (GPS) information (e.g., giving information on the vehicle's current location, current elevation, upcoming elevations, upcoming terrain, vehicle's destination, etc.),

speedometer information (e.g., vehicle's current speed, motor speed), date and time information (e.g., the date and time may be used to determine personal driving habits and sun angle), gyroscope information (e.g., vehicle's current orientation, current slope/grade of road), RPM (e.g., motor and wheel rotations per minute), accelerator and brake pedal position (e.g., pressure applied and/or current angle of the pedals), the angle of sun (e.g., sensors may detect latitude, longitude, time of day, date), weather (e.g., wind direction and velocity, rain, sun, snow, etc.), battery state (e.g., voltage, amp hour meter, etc.), tire pressure (e.g., may be used to calculate the drag force due to rolling resistance), headway control information (e.g., the distance from a car in front of the vehicle), the weight of car (e.g., weight of cargo, passengers, driver), airflow (e.g., the amount of air going to the engine), gas flow sensor (e.g., the amount of gas going to engine of a hybrid or ICE car), weight of driver (e.g., may be used identify the driver and linked to personal driving habits). Different detectors or **sensors** may be polled at different intervals, including continuously, or only occasionally. Polling may also depend upon the availability of a resource. For example, information may be available only when a telecommunications network (e.g., satellite, cellular, etc.) is available.

Appx. A, 3-31; *see also id.*, 8:43-62, 8:23-30, 8:43-62.

The '616 patent purports to process data from the aforementioned **sensors** or detectors in order to determine one or more **current conditions**. *Id.*, 2:22-31, 7:42-55.

34. The current conditions can include:

... information about the external environment of the vehicle that is selected from the group consisting of: the current location of the vehicle, the elevation of the vehicle, upcoming elevations of the vehicle, the current slope/grade of the route, the predicted slope/grade of the next segments (or upcoming segments) of the route, speed limit information of the current route segment, speed limit information of upcoming route segments, the condition of the known or predicted route (or a portion thereof), traffic information or data, traffic surrounding the vehicle, the location of stoplights, the timing of stoplights, a map of the roadway, the present angle of the sun, the predicted angle of the sun for upcoming route segments, the weather around the vehicle, present wind direction, the predicted wind direction for upcoming route segments, present wind velocity, the predicted wind velocity for upcoming route segments, current temperature, the predicted temperature for upcoming route segments, current air pressure, predicted air pressure for upcoming route segments, time of day, date, day of week, visibility, present road conditions, predicted road conditions for upcoming route segments, and the distance to/from other vehicles.

Appx. A, 3:43-66.

35. Though the '616 patent describes obtaining certain types of **sensor data** from certain types of **sensors** (e.g., Appx. A, 3-31, 8:43-62, 8:23-30, 8:43-62) and determining certain types of **conditions** from the obtained sensor data (e.g.,

*id.*, 3:43-66), the '616 patent also explains that “in some variations, the power management system receives some of this information by telemetry with off-board information sources such as databases and the like.” Appx. A, 8:29-35. “For example, the power management system may communicate with a weather service, a map service, a traffic service, etc.” *Id.*

### **C. Prosecution History**

36. During prosecution, claims 1-19 were first filed as original claims of the '616 patent. Appx. B, 258-62. The Examiner rejected claims 1-19 as being anticipated by U.S. Pat. No. 6,169,495 to Koike in a first office action having notification date of Jan. 2, 2019.

37. In response to this first office action, applicant amended the claims to recite that the “current conditions associated with said route segment are uploaded to said remote database to *create* historical route information” and argued that Koike does not teach these claim features. (emphasis added). Appx. B, 108-16.

38. The Examiner disagreed and pointed out, for example, that Koike provides a remote Vehicle Information and Communications System (VICS). Appx. B, 97-103. Applicant clarified and reiterated the arguments from the previous response in more detail regarding the remote creation of historical route information. *Id.*, 69-87. An example of claim 1 is shown below:

1. (Previously presented) An apparatus comprising:

an interface configured to (a) receive (i) sensor data samples during operation of a vehicle and (ii) data from a telemetry system and (b) connect to a remote database;

a memory configured to store (a) said sensor data samples over a number of points in time and (b) said data from said telemetry system; and

a processor configured to (i) analyze said sensor data samples stored in said memory to determine current conditions and (ii) associate said current conditions with a route segment traveled by said vehicle, wherein (a) said route segment is identified according to said data from said telemetry system and (b) said current conditions associated with said route segment are uploaded to said remote database to create historical route information for a plurality of route segments.

Appx. B, 74

39. The Examiner was not persuaded by these arguments and discussed proposed amendments with the Patent Owner during an examiner interview.

Appx. B, 64. After the interview, applicant authorized an Examiner's amendment that led to the claims being amended into the form of the challenged claims. Appx. B, 28-34.

40. An example of claim 1, as amended by the Examiner's amendment, is shown below:

**As per Claim 1, the entire claim 1 has been replaced by the following**

**amended claim 1 :**

--1. An apparatus comprising:

an interface configured to (a) receive (i) sensor data samples during operation of a vehicle and (ii) data from a telemetry system and (b) connect to a remote database;

a memory configured to store (a) said sensor data samples for different points in time along a route segment travelled by said vehicle and (b) said data from said telemetry system; and

a processor configured to (i) analyze said sensor data samples stored in said memory to determine current conditions and (ii) associate said current conditions with said route segment, wherein (a) said route segment is identified according to said data from said telemetry system and (b) said current conditions associated with said route segment are uploaded to said remote database to create historical route information for a plurality of route segments;

wherein the sensor data samples are received from at least one of an optical sensor, a position sensor, a speed sensor, a gyroscopic sensor, a revolutions-per-minute sensor, an accelerator pedal position sensor, a brake pedal position sensor, a battery state sensor, a tire pressure sensor, a proximity sensor, a weight sensor, an airflow sensor, and a gas flow sensor; and

wherein said current conditions comprise at least one of: drag, wind resistance, tire resistance, a location relative to a destination, traffic patterns, an amount of light energy, a position of the sun, geographical information, an elevation of said vehicle, a grade of a road, a location of stoplights, a timing of stoplights, weather, a wind direction, a wind velocity, a temperature, air pressure, moisture, visibility, an amount of vibration, and traction.—

Appx. B, 33-34

These claims were then allowed after the Examiner's Amendment was entered.

Appx. B, 23.

**D. Claim Construction**

41. I understand that when considering the meaning of claims subject to this proceeding, one must consider the claim language. I understand that claim terms in this proceeding are generally interpreted under the broadest reasonable interpretation (BRI), as would be understood by a POSITA in the context of the specification, the prosecution history, and other claims. I have applied the above principles in forming my opinions provided in this declaration.

42. I also understand that formal claim constructions should be entered only to the extent necessary to resolve a controversy. Given this understanding, in my opinion, besides the claim terms discussed below, formal claim constructions are not required for any other claim term of the '616 patent. As discussed below, the independent claims of the '616 patent each require analyzing *sensor data samples*<sup>1</sup> to determine 21 enumerated *current conditions* (e.g., *traction*) ("Enumerated Current Conditions"). The *sensor data samples* are collected from 13 enumerated *sensor[s]* (e.g., *position sensor*) ("Enumerated Sensors").

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<sup>1</sup> Claim terms are bolded and italicized throughout.

**1. Relevant Limitations**

**(a) Interface Configuration (Claims 1, 15)**

43. Claims 1 and 15 include limitations ([1a-1], [1a-2], [15c-1], [15-2]) that recite a configuration of an *interface* that *receive[s] (i) sensor data samples during operation of a vehicle*. Appx. A, 27:33-36, 28:48-49. The *sensor data samples* recited in these limitations are later referenced in a first “wherein” clause of claims 1 and 15 ([1d], [15f]), which further requires that the *sensor data samples are received from at least one of* the Enumerated Sensors. Through antecedent basis, the wherein clause further limits the *interface* by requiring reception of *sensor data samples* that are *received from at least one of* several sensors enumerated in [1d] and [15f]. Appx. A, 27:33-56, 28:45-29:4.

44. The *interface* configuration for *receiv[ing] (i) sensor data samples during operation of a vehicle* should be construed to encompass “receiving sensor data samples from at least one of the sensors enumerated in [[1d]/[15f]] during operation of a vehicle.”

**(b) Memory/Storage Device Configuration (Claims 1, 15)**

45. Claims 1 and 15 include limitations ([1b], [15d]) that recite a configuration of a memory /storage device that store[s] (a) said sensor data samples for different points in time along a route segment travelled by said vehicle. Appx. A, 27:37-39, 28:48-49. The *sensor data samples* recited in these limitations are later referenced in a first “wherein” clause of claims 1 and 15 ([1d], [15f]),

which further requires that the *sensor data samples are received from at least one of* the Enumerated Sensors. Through antecedent basis, the use of said sensor data samples in these limitations ([1b], [15d]) references the requirements of sensor data samples in the first “wherein” clause of claims 1 and 15 ([1d], [15f]), which further requires that the sensor data samples are received from at least one of the Enumerated Sensors. Appx. A, 27:50-56, 28:65-29:4.

46. The memory/storage device configuration for stor[ing] (a) said sensor data samples for different points in time along a route segment travelled by said vehicle should be construed to encompass “storing sensor data samples, received via the interface, from at least one of the sensors enumerated in [[1d]/[15f]] for different points in time along a route segment travelled by said vehicle.”

**(c) Processor Configuration (Claims 1, 15)**

47. Claims 1 and 15 include limitations ([1c-1], [15e-1]) that recite a configuration of a *processor* that *analyze[s] said sensor data samples stored in said [memory/said storage device] to determine current conditions*. Appx. A, 27:41-43, 28:56-58. As discussed above for the *interface* and *memory* limitations, the reference to *sensor data samples* in several other limitations collectively require the *sensor data samples* to be (1) received via the *interface... during operation of a vehicle* (per [1a-1], [15c-1]), (2) received *from at least one of* several sensors enumerated in [1d] and [15f], and (3) *store[d]...for different points*

*in time along a route segment travelled by said vehicle* (per [1b], [15d]). Because the *processor* is recited to *analyze* the *sensor data samples*, the *processor* configuration of [1c-1]/[15e-1] subsumes these three requirements.

48. The *processor* configuration for *analyz[ing] said sensor data samples stored in said [memory/said storage device] to determine current conditions* should be construed to encompass “analyzing sensor data samples to determine at least one of the current conditions enumerated in [1e], where the sensor data samples are: (1) received via the interface during operation of a vehicle, (2) received from at least one of several sensors enumerated in [[1d]/[15f]], and (3) stored for different points in time along a route segment travelled by said vehicle.”

**(d) Monitoring Step (Claim 16)**

49. Claim 16 includes a limitation ([16a]) that recites the step of *monitoring a plurality of sensors to generate sensor data during operation of a vehicle*. Appx. A, 29:16-17. Limitation [16a] further recites that the *plurality of sensors comprises at least one of* the Enumerated Sensors. Because the *plurality of sensors* are *monitor[ed]* to *generate sensor data during operation of a vehicle*, the *monitoring* is limited by the *plurality of sensors*. The *monitoring* step should be construed to encompass “monitoring a plurality of sensors that comprise *at least one of* the sensors enumerated in [16a].”

(e) Analyzing Step (Claim 16)

50. This limitation interrelates *current conditions* and *sensor data samples*, and thus, the *at least one of* twenty-one enumerated *current conditions* ([16e]) are required to be determined based on analyzing *sensor data samples* from the *at least one of* the Enumerated Sensors ([16a]); Appx. C, XX. Claim 16 also includes a limitation ([16e]) that recites the step of *analyzing said sensor data to determine current conditions*. Appx. A, 30:6-7. Through antecedent basis, the use of *said sensor data* in [16e] references the requirements of *sensor data* in [16a], i.e., that the *sensor data* is *generate[d]* by a *plurality of sensors comprises at least one of* the several sensors enumerated in [16a]. Appx. A, 30:6-7, 29:16-24;

51. The *analyzing* step should be construed to encompass “analyzing sensor data generated by monitoring *at least one of* the sensors enumerated in [16a] to determine *at least one of* the current conditions enumerated in [16e].” Because this configuration interrelates *current conditions* and *sensor data samples*, the *at least one of* twenty-one enumerated *current conditions* ([16e]) are required to be determined based on analyzing *sensor data samples* from the *at least one of* the Enumerated Sensors ([16a]);

(f) At least One Of...And (Claims 1, 15, 16)

52. The phrase *at least one of . . . and* is included in two limitations of claims 1, 15, and 16. The first limitation ([1d], [15f], [16a])<sup>2</sup> is *sensor data samples are received from at least one of* 13 Enumerated Sensors. The second limitation ([1e], [15g], [16e]) is that *current conditions comprise at least one of* 21 Enumerated Current Conditions. The same interpretation should be applied for each limitation.

| Enumerated Sensors                       | Enumerated Current Conditions             |
|------------------------------------------|-------------------------------------------|
| <i>optical sensor</i>                    | <i>drag</i>                               |
| <i>position sensor</i>                   | <i>wind resistance</i>                    |
| <i>speed sensor</i>                      | <i>tire resistance</i>                    |
| <i>gyroscopic sensor</i>                 | <i>location relative to a destination</i> |
| <i>revolutions-per-minute sensor</i>     | <i>traffic patterns</i>                   |
| <i>accelerator pedal position sensor</i> | <i>amount of light energy</i>             |
| <i>brake pedal position sensor</i>       | <i>position of the sun</i>                |
| <i>battery state sensor</i>              | <i>geographical information</i>           |
| <i>tire pressure sensor</i>              | <i>elevation of said vehicle</i>          |

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<sup>2</sup> Claim 16 includes a similar limitation ([16a]), which recites a *plurality of sensors comprise at least one of* the same sensors enumerated in [1d] and [15f].

|                         |                               |
|-------------------------|-------------------------------|
| <i>proximity sensor</i> | <i>grade of a road</i>        |
| <i>weight sensor</i>    | <i>location of stoplights</i> |
| <i>airflow sensor</i>   | <i>timing of stoplights</i>   |
| <i>gas flow sensor</i>  | <i>weather</i>                |
|                         | <i>wind direction</i>         |
|                         | <i>wind velocity</i>          |
|                         | <i>temperature</i>            |
|                         | <i>air pressure</i>           |
|                         | <i>moisture</i>               |
|                         | <i>visibility</i>             |
|                         | <i>amount of vibration</i>    |
|                         | <i>traction</i>               |

53. As discussed in Section V below, the prior art analyzed in this Declaration satisfies the disjunctive read of the *at least one...and* phrases, which I understand is applicable under the BRI standard.

## **V. EXPLANATION OF MANNER OF APPLYING CITED PRIOR ART**

54. As detailed below, this declaration demonstrates how the Challenged Claims are unpatentable based on the prior art references discussed in this section.

**A. Overview of Prior Art**

**1. Dahlgren**

55. Dahlgren generally describes a system that integrates a “vehicle environment, central facility, and user environment.” Appx. D, [0026]. Specifically, “a vehicle on-board system” is “adapted to collect and analyze sensor data generating within the vehicle environment to determine event occurrence and to furnish such event information to end users for specialized purposes.” *Id.*, [0003]. Dahlgren expresses a concern that “[t]here are no current methodologies that are effective in dynamically monitoring roadway assets, roadway conditions, and traffic utilization in a manner that produces meaningful and reliable information useful in enabling users to optimally navigate the roadways, and in providing stewards of the roadway infrastructure the opportunity to determine the best manner to maintain, manage, design, enforce, and improve the roadways.” *Id.*, [0005]. To address this challenge, Dahlgren proposes a system that includes a “on-board vehicle system” for “collecting, analyzing and distributing information relating to transportation infrastructure and conditions” (*id.*, [0013]) and a “centralized facility for providing global management of event collection, analysis and reporting tasks in a distributed multi-vehicle environment” (*id.*, [0014]). An example of the Dahlgren system is shown in Figure 1:

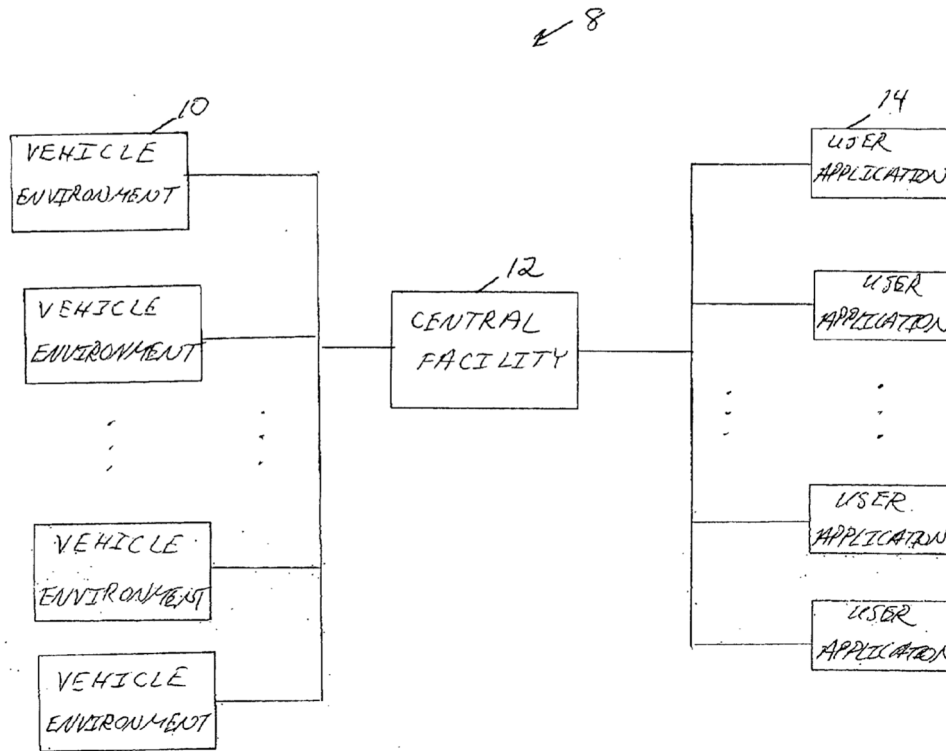
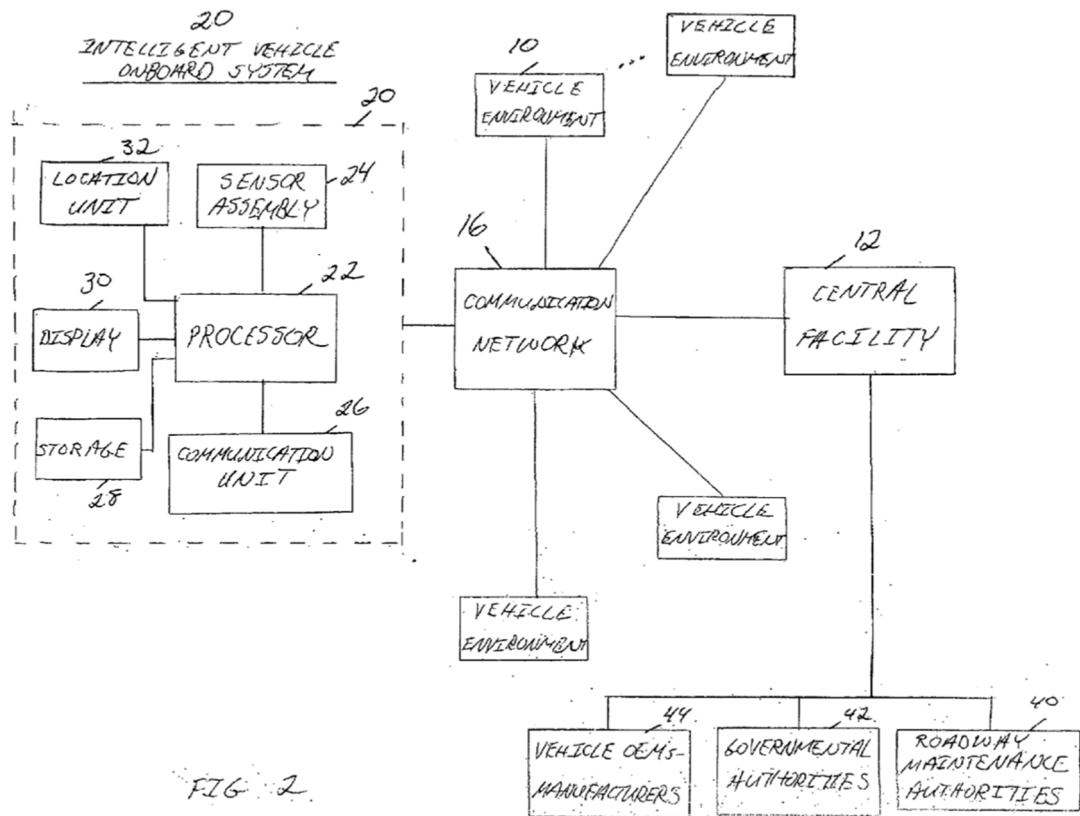


FIG. 1

Appx. D, FIG. 1

56. As shown above, system 8 integrates “a multi-vehicle population having a plurality of individual vehicle environments 10 traveling in a roadway network” (each of which includes a corresponding “intelligent vehicle on-board system 20”) and a “central facility 12” configured for “communication with the universe of vehicle environments 10 via a suitable communication network 16.” Appx. D, [0033].

57. The on-board intelligent vehicle system 20 is shown in FIG. 2:



Appx. D, FIG. 2

As shown above, on-board system 20 includes “a processor 22, a sensor assembly 24, a communication unit 26, a storage 28, a display 30, and a location unit 32.” *Id.*, [0034]. Sensor assembly 24 “collects data generated in the respective vehicle environment or platform,” which “may issue from standard equipment in the vehicle or be retrieved from the existing communication bus in the vehicle or be retrieved from added sensors and equipment.” *Id.*, [0035]. The “sensor data” “may relate to the status, operation, mode, performance, state, or any other measurable characteristic of any device, instrument, part, or component in the

vehicle.” *Id.* Further, “various sensor devices” may be used to collect sensor data. *See* Appx. D, [0047].

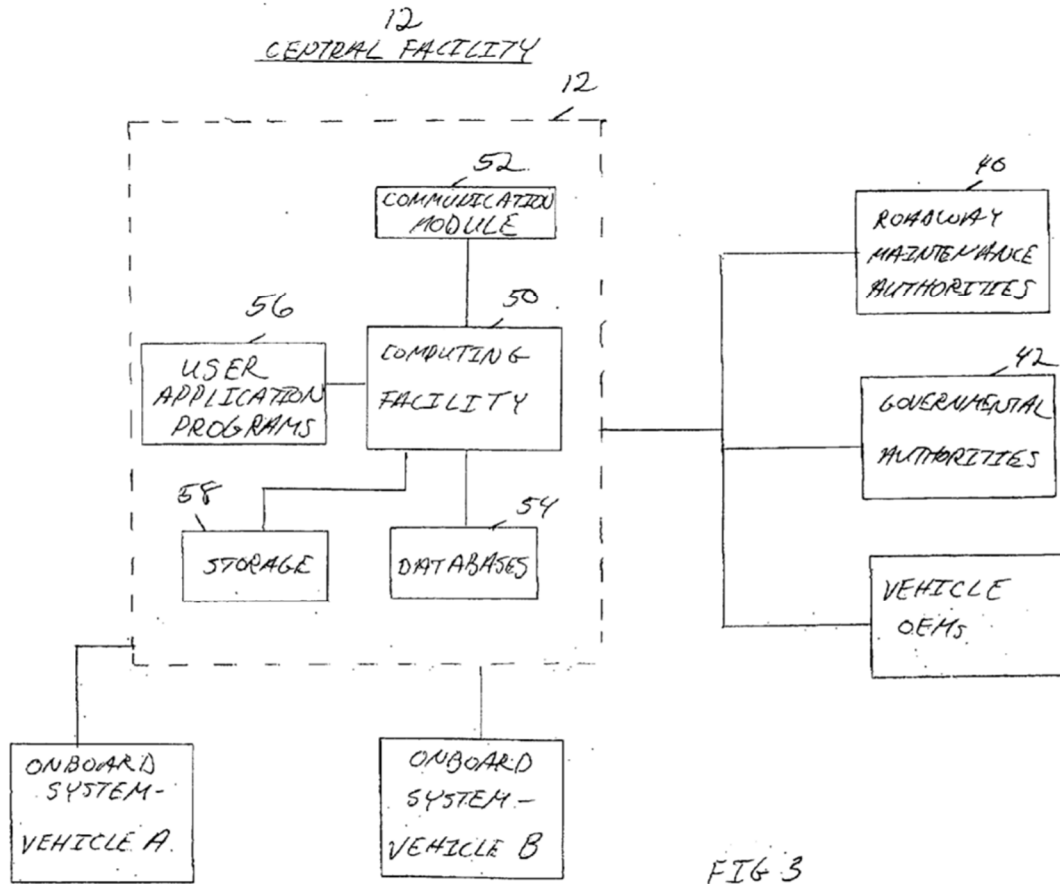
58. Processor 22 processes (i.e., analyzes) “sensor data collected by sensor assembly 24” to “determine whether the data indicates or otherwise signifies the occurrence of an event as represented by and correlated to the data.” Appx. D, [0036]. Processor 22 “generates an event indicator[]” when it “determines that an event has occurred” and the event indicator can be “formulated as any type of information or data set that provides some means of indicating the type of detected event.” *Id.* Further, event information also “include[s] or [is] associated with a location indicator (generated by location unit 32) that signifies the location of the vehicle at the time that the corresponding event was detected.” *Id.*, [0038]. Further, “the manner of detecting the occurrence of an event may be undertaken in any of various forms,” such as by “compar[ing] the sensed data to reference or benchmark data to determine if the sensor data falls within or without allowable tolerances, ranges, criteria, requirements or specifications.” *Id.*, [0039].

59. Upon generating event information, “on-board system 20 generates a communication...that transmits detected event information to central facility 12 via communication network 16.” Appx. D, [0040]. “Any suitable process or methodology may be used to facilitate the transfer of event information from each vehicle environment to central facility 12.” *Id.* As examples, “the event

information may be transmitted automatically in real-time as the event is detected,” “periodically at set intervals of time,” or “under specified conditions such as when the queue or backlog of events reaches a certain number...” *Id.*, [0040]. Further, “communication unit 26 may employ a wireless transceiver.” *Id.*, [0043].

60. Dahlgren further teaches that “during operation,” “regular streams of event-type information are being uploaded to central facility 12,” which then allows the central facility 12 to “provide centralized management, control, and dissemination of the event information on a universal, global scale.” Appx. D, [0044]. Functionality provided by “central facility 12” includes “evaluat[ing] the event information to determine whether the event information is relevant to any other user in the client population that is served by central facility 12.” *Id.* For example, upon receiving event information from one vehicle, central facility 12 “makes a decision or determination if such event indicators are relevant to any other vehicle in the network[,]” and “this relevant determination may involve comparing the location of the vehicle associated with [a] detected event with expected or projected travel routes of other vehicles.” *Id.*

61. The central facility 12 is shown in greater detail in Figure 3:



Appx. D, FIG. 3

As shown above, central facility 12 includes a computing or processing facility 50, a communication module 52, databases 54, user application programs 56, and storage 58.” Appx. D, [0060]. The “computing facility 50 performs the functions of processing the incoming communications from the various vehicle environments, namely, the event information.” *Id.*, [0061]. Specifically, “processing tasks will examine the event information to determine its relevance or relationship to the interests of any other user or party within the client or subscriber environment of the overall system.” *Id.* For example, “an event indicator

transmitted from the onboard system of exemplary vehicle A may be of interest to vehicle B based on a comparison of the location indicator correlated to the detected event from vehicle A relative to the planned or expected travel route of vehicle B.”

*Id.* “If the detected event is found to be relevant to another party, central facility 12 forwards the appropriate communication to the relevant destination (e.g., vehicle B).” *Id.*

62. Storage 58 is “used to store the information received from the various vehicle environments, in addition to the results of the relevance determinations carried out by central facility 12.” Appx. D, [0064]. Further, central facility 12 also “aggregate[s] the data for analysis and interpretation,” and “[d]epending upon the type of services provided and the content of the data received, status and information may be transferred back to individual vehicles and/or to the responsible agencies from the central information processing facility where it will be stored and maintained.” *Id.*, [0112]. Dahlgren also describes data aggregation systems and techniques that a POSITA would have understood to have been carried out at the central facility. *See id.*, [0084]-[0086]. Such centralization of data handling and processing would have been a well-understood concept for professionals familiar with the technology at the time.

63. As noted above, Dahlgren describes various examples of vehicle sensor information (collected by sensor assembly 24 of the on-board system 20)

and event information (analyzed by processor 22 of the on-board system 20 and/or the central facility 12). *See* Appx. D, [0047]. One example is vehicle sensor information relating to a traction control system of a vehicle. *Id.*; *see also id.*, [0052]. With this example, traction control system data (a type of vehicle sensor information) is analyzed to “detect events relating to the frictional interaction between the tires and the roadway[,]” such as “excessive slippage beyond a certain threshold” that “signif[ies] that the vehicle has encountered icy conditions on the roadway.” *Id.*, [0052]. Alternatively, “extended slippage measurements, when not otherwise attributable to weather conditions, may indicate degradation in the tires, e.g., worn treads.” *Id.* Through this disclosure, a POSITA would have understood that excessive slippage based on analyzing traction control system data may indicate attributes associated with road conditions (icy roads) and/or vehicle wear (worn treads).

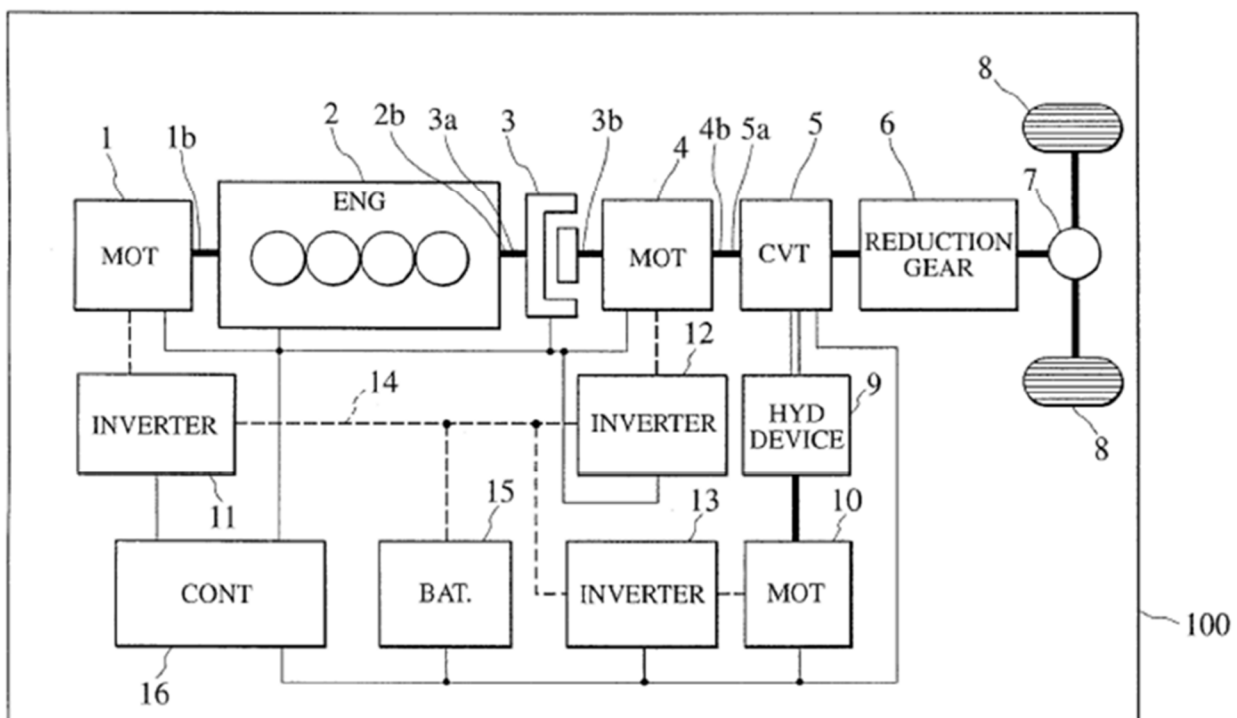
## **2. Kuroda**

64. Kuroda discloses a “driving control apparatus of a hybrid vehicle” that can “set an operating schedule of an engine and a motor so as to minimize fuel consumption in accordance with road conditions of a route to a destination.” Appx. E, 1:6-11. Kuroda’s vehicle includes a vehicle information communication system (VICS) for “receiv[ing] traffic information and road information by a beacon receiver, and a road map database.” *Id.*, 4:56- 67. Reception of

information from a road map database in Kuroda's vehicle is an example of techniques described in the '616 patent of communicating with a remote database. TESLA-1001, 8:7-22 (describing embodiments where "the power management device communicates with one or more such databases to identify the location and surrounding road features," including "traffic patterns").

65. Figure 1 shows an example of a driving control apparatus for a hybrid vehicle 100:

FIG. 1



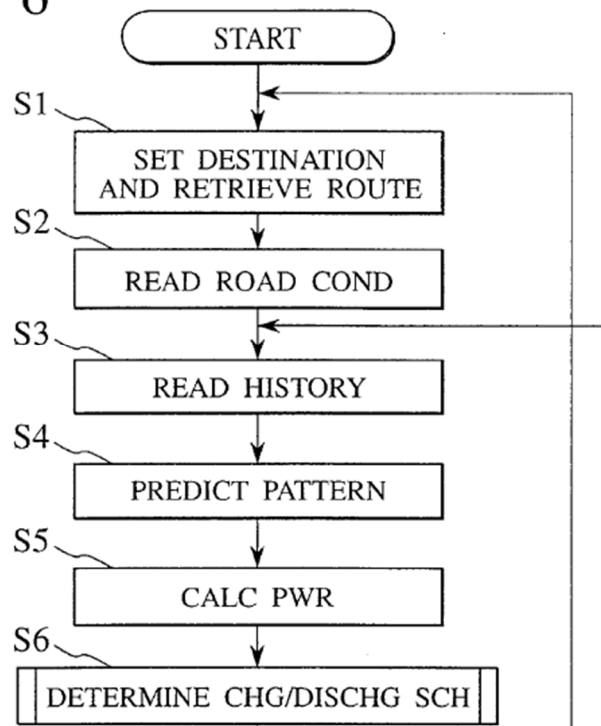
Appx. E, Figure 1

As shown above, power train of hybrid vehicle 100 includes "a motor 1, an engine 2, a clutch 3, a motor 4, a continuously variable transmission (CVT) 5, a reduction

gear 6, a differential gear 7, and driving wheels 8.” Appx. E, 3:32-42. Vehicle 100 also includes “controller 16,” which “has necessary parts such as a microcomputer and a memory and controls the rotational speed and output torque of the engine 2, the transmission torque of the clutch 3, the rotational speed and output torque of each of the motors 1, 4, and 10, the gear ratio of the CVT 5, and the like.” *Id.*, 4:15-19.

66. Kuroda further contemplates “scheduling methods” for “scheduling of storage and consumption of an energy to minimize the fuel consumption  $Q$ ” of hybrid vehicle 100. Appx. E, 5:1-3. One example is a technique of determining a charging/discharging schedule, which is shown in Figure 6 (excerpted below). *Id.*, 5:40-45.

FIG. 6



Appx. E, Figure 6 (excerpted)

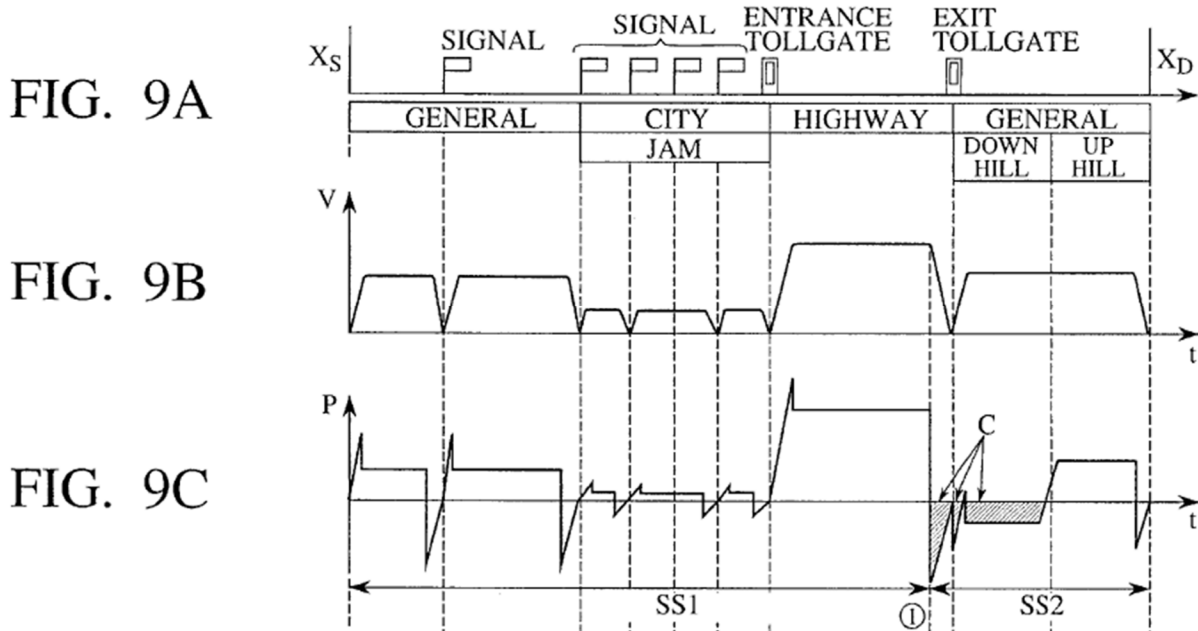
In the process shown above, “controller 16 executes the program every predetermined time.” Appx. E, 6:46-58. Reference to “every predetermined time” would have led a POSITA to understand and/or find obvious that controller 16 executes processing steps (e.g., steps S1, S2, S3, S4) at a specified time point in relation to the time period during which vehicle 100 travels along a particular route.

67. For example, Figure 6 depicts initially determining a charging/discharging schedule in step S6, and feedback loops to reflect updates to the initial charging/discharging schedule based on changes to the route or the road condition in steps S8 and S9, respectively, a POSITA would have understood that step S6 is performed at a specified time point, e.g., before the vehicle 100 begins traveling along a particular route to the destination. Further, the examples of scheduling methods and related power and fuel consumption calculations described in Kuroda further confirm a POSITA’s understanding that controller 16 would have been configured to determine an “operating schedule” at a specified time point. *See* Appx. E, 5:4-6:39.

68. In step S1, “the destination is set by the navigation system 34 and the optimum route to the destination is retrieved by a route retrieving unit 34a of the navigation system 34.” Appx. E, 6:46-58. In step S2, “information of the route to

the destination,” e.g., “the kinds of the roads, intersections, signals, and curvature and inclination of each road, traffic jam information,” is “read from a road condition sensor 34b of the navigation system 34.” *Id.*, 6:59-64. In step S3, “driving history is read from a driving history table 35a in the driving history recording device 35.” *Id.*, 6:65-7:9. In step S4, an “operating pattern on the route to the destination” is determined based on “the road conditions to the destination read in step S2 and the driving history of the occupant such as a driver read in step S3.” *Id.* The determination involves determining “the driving speed pattern,” which is “estimated to predict it.” *Id.* In step S5, “an output (power) P(w) necessary for the driving is calculated” using the “driving speed pattern of each section.” *Id.*, 7:48-50. In step S6, “a driving schedule setting unit 16C of the controller 16 executes a subroutine,” which includes determining a “charging/discharging schedule, that is, the operating schedule of the motor and the engine in the route to the destination.” *Id.*, 7:66-8:3.

69. Figures 9A, 9B, and 9C show an example of a route to a destination and an associated “operating schedule” determined for the route based on the process depicted in Figure 6. Appx. E, 7:35-36.



Appx. E, FIGS. 9A-9C

As shown in Figure 9A, “a vehicle is driven on a general road from a start point  $X_s$ , enters a city, drives on a highway and again a general road, and arrives at a destination  $X_D$ .” Appx. E, 7:37-47. Further, “the route is divided at points where stop and start of the vehicle are predicted and a driving speed  $V$  pattern shown in Figure 9B is [predicted] [*sic*] for each section on the basis of the road condition and the driving history data.” *Id.* Figure 9C shows “the calculation result of the output [power] based on the road condition of FIG. 9A and the driving speed pattern of FIG. 9B.” *Id.*, 7:48-65. Specifically, “a positive value of the output  $P$  necessary for driving the vehicle represents a driving power and a negative value shows a braking power.” *Id.*

70. Kuroda is analogous art to the '616 patent. Kuroda is from the same field of endeavor (e.g., vehicle power management) and is reasonably pertinent to the problem the '616 patent was trying to solve (e.g., optimizing fuel consumption challenges associated with vehicle operation). Appx. A, 8:7-22.

**B. Prior Art Combinations**

71. The prior combinations discussed below combine several conventional concepts that well-understood in display technologies by the Critical Date. A POSITA would have understood that features recited in individual claims of the '616 patent refer to obvious concepts, as demonstrated by the prior art teachings referenced in this declaration. While the '616 patent's claims combine several of these obvious concepts, a POSITA would have not have perceived the combination of concepts to be novel or non-obvious since the POSITA would have had a reasonable expectation of success in implementing the prior art combinations discussed in this declaration.

**1. Kuroda in view of Dahlgren**

72. The Kuroda-Dahlgren combination represents the predictable and expected result of applying in the context of Kuroda's system, Dahlgren's techniques for receiving, generating and disseminating roadway information, including roadway condition information. From a POSITA's perspective around the Critical Date, integrating the supplemental teachings of Dahlgren with

Kuroda's disclosure would involve nothing more than applying known solutions to known problems in the field of vehicle information processing and communications to achieve predictable outcomes. The fundamental aspects of Kuroda's disclosure would remain intact, bolstered by the well-known and beneficial teachings of Dahlgren to arrive at the '616 patent's purported inventions.

**(a) A POSITA Would Have Been Motivated to Seek Dahlgren's Teachings In Implementing Kuroda**

73. As discussed in Section VII.A.2, Kuroda is directed to techniques for determining and setting an "operating schedule" for a hybrid vehicle to "minimize fuel consumption in accordance with road conditions of a route to a destination." Appx. E, 1:6-11. These techniques may account for "traffic information" or "traffic jam information" in determining how to set the "operating schedule." *See id.*, 4:56-67, 6:59-64. This is because, as taught in Kuroda, traffic-related information impacts driving speed and vehicle spacing, each of which increase fuel consumption. *See id.*, 9:47-61, 10:46-65, FIGS. 9A-9E. Beyond these disclosures, however, Kuroda leaves open the possibility to consider various types of traffic information in determining an "operating schedule." *See id.* A POSITA looking to implement Kuroda's teachings would have therefore sought examples of traffic information known to be useful in predicting vehicle speed patterns (which are then used to determine an "operating schedule").

74. In my opinion, a POSITA would have recognized that techniques for monitoring traffic information were known to be useful in advancing Kuroda's objective to reducing fuel consumption, e.g., by enabling better route planning, avoiding congestion, and reducing idling times. For example, Kudo describes a system configured to analyze real-time traffic data to minimize stop-and-go driving, which is inefficient for fuel consumption. *See* Appx. M, [0202]. This is one example of the well-known use of traffic information to predict and/or adjust a vehicle destination. A POSITA would have recognized the monitoring of traffic information to be an important factor in reducing fuel consumption. For example, smoother traffic flow was known to help vehicles maintain optimal speeds associated with lower fuel consumption. Kuroda is broadly focused on reducing fuel consumption, a POSITA would have found it desirable to use sophisticated traffic flow information monitoring to further reduce fuel consumption.

75. A POSITA would have recognized that techniques for monitoring traffic information were known to be useful in advancing Kuroda's objective of reducing fuel consumption. Specifically, by integrating real-time traffic data, a system could dynamically adjust route planning to avoid congested areas, which would directly reduce unnecessary stop-and-go driving, a significant contributor to higher fuel consumption. Additionally, better route planning enabled by traffic monitoring would minimize idling times at intersections or in heavy traffic, further

conserving fuel. Such techniques would complement Kuroda's teachings by ensuring that the vehicle operates under more predictable and efficient driving conditions, thus maximizing the benefits of the system's power management strategies.

76. In seeking such techniques, a POSITA would have identified Dahlgren, which describes the collection of "traffic condition" information to determine fuel consumption parameters, including "average fuel economy." Appx. D, [0261]. Dahlgren also correlates traffic information and fuel consumption efficiency since "poor fuel economy may indicate stop-and-go travel patterns consistent with traffic jams and congestion." *Id.* Dahlgren also teaches monitoring "traffic flow," including the "expected average speed of flow," "activities such as unusual stop-and-go conditions or traffic jams," and "traffic statistics for roadway analysis." *See Id.*, [0086]. As explained above, a POSITA would have perceived these disclosures to be pertinent to Kuroda's overall objective of reducing fuel consumption.

**(b) A POSITA Would Have Been Motivated to Apply Dahlgren's Traffic Monitoring Techniques To The Kuroda System**

77. A POSITA would have been motivated to combine the teachings of Kuroda and Dahlgren because such a combination would have enabled the Kuroda system to leverage Dahlgren's sophisticated traffic information monitoring

capabilities to advance Kuroda's objective of reducing fuel consumption (e.g., by determining an "operating schedule" for a vehicle that factors in traffic flow information). Such a combination is already suggested within Kuroda, which contemplates obtaining "traffic information and road information" for use in determining the "operational schedule" and adjusting vehicle speed patterns based on the obtained traffic information. *See* Appx. E, 4:56-67, 6:59-64.

78. To implement the Kuroda-Dahlgren combination, a POSITA would have modified Kuroda's hybrid vehicle 100 to incorporate functionality described in Dahlgren relating to "discrete monitoring of interruptions to normal traffic flow," which are "analyzed in aggregate to determine the location of the possible obstruction to traffic," e.g., "a number of vehicle movement anomalies, speed changes, braking activity, and inertial measured movement including relative lane changes to and from the original lane at approximately the same location along roadway." Appx. D, [0220]. As suggested in Kuroda, this type of traffic information impacts "a driving load and an engine load" since it relates to "the time of constant of driving" (which increases fuel consumption). Appx. E, 1:23-30.

**(c) A POSITA Would Have Further Improved The  
Kuroda System Based on Dahlgren's Teachings**

79. In combining the teachings of Kuroda and Dahlgren in the manner discussed above, a POSITA would have identified opportunities to improve

various aspects of the Kuroda system. Specifically, Dahlgren teaches periodically updating data locally stored on a vehicle (e.g., “by downloads from [a] central facility”) and a POSITA would have recognized that this would have enabled Kuroda’s hybrid vehicle 100 to obtain up-to-date road condition information. Appx. D, [0050]. Using this information, the “driving control apparatus” could then determine an “operating schedule” that more accurately reflects predicted road conditions associated with a travel route. *See* Appx. E, 7:10-34. The information may reflect, for instance, road construction and/or transportation infrastructure, each of which impacts vehicle speed patterns and thereby affects associated fuel consumption. *See* Appx. D, [0096] (“An important aspect of the interpretative or translation functions” of a vehicle system that monitors road condition information is the “proper characterization of road conditions”); Appx. E, 1:23-30.

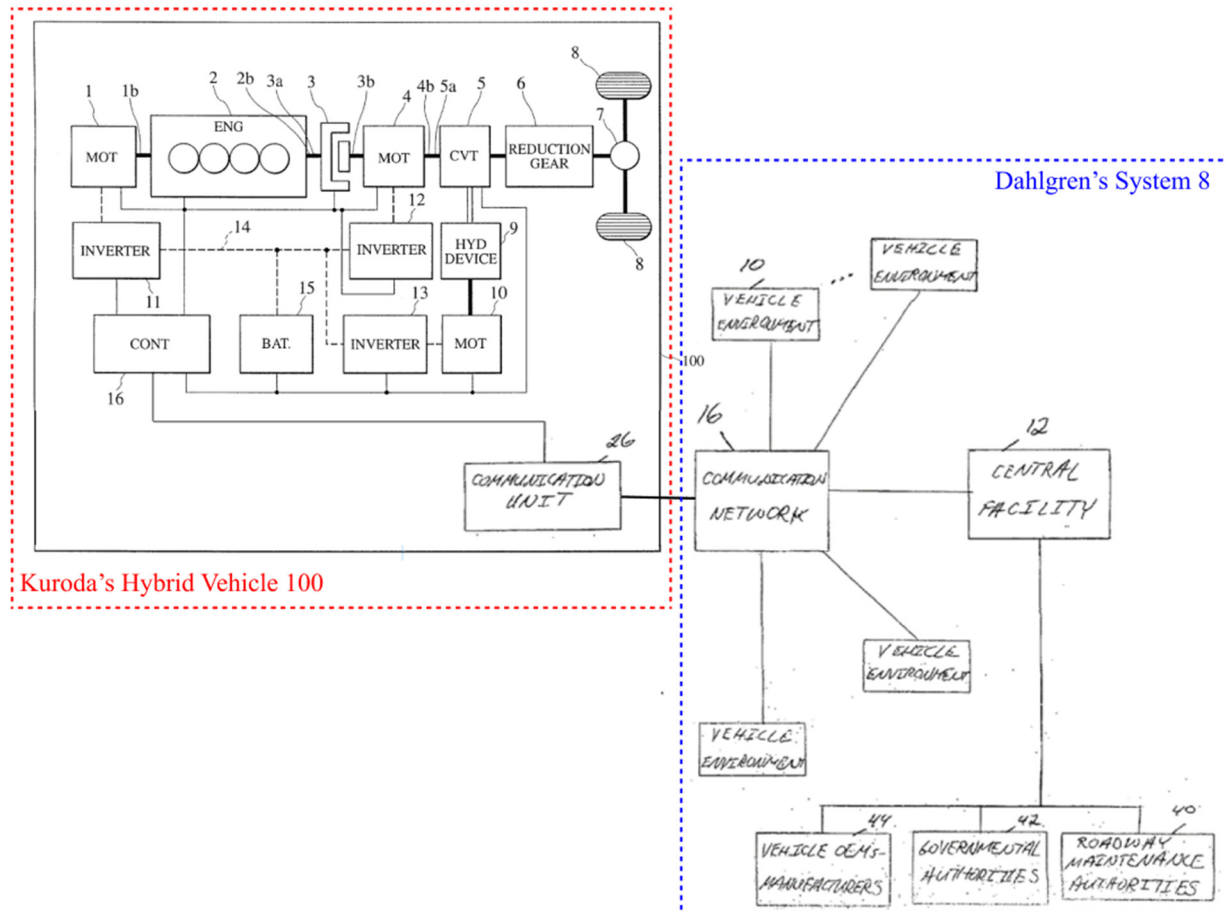
80. Dahlgren’s teachings would have also enabled the Kuroda vehicle to improve accuracy in assessing road condition and vehicle speed pattern information. Dahlgren describes that its technique “employs algorithms and other procedures adapted to determine from a vehicle, in real-time, the signature of distinct road conditions, traffic conditions, and road hazards based upon multiple in-vehicle sensor inputs.” Appx. D, [0097]. Further, the aggregation capabilities described in Dahlgren, when incorporated into Kuroda, would have enabled the combined system to “employ algorithms directed to predictive analyses and

reporting of road conditions based on integrated input” (as taught in Dahlgren).  
Appx. D, [0101].

81. Incorporation of Dahlgren’s teachings into Kuroda would have also enabled access to additional types of information stored in Dahlgren’s central facility 12 that would have been useful to provide further fuel consumption efficiencies. For example, in Dahlgren, “traffic condition” information is used to determine “average fuel economy for cars and render interpretations as to the efficiency of the vehicle consumption,” e.g., “poor fuel economy may indicate stop-and-go travel patterns consistent with traffic jams and congestion.” Appx. D, [0261]. This information would be useful, for instance, in relation to the process depicted in Kuroda’s Figure 6 relating to “determining and carrying out the charging and discharging schedule.” Appx. E, 6:40-45, FIG. 6.

82. As combined, Kuroda-Dahlgren would have provided a hybrid vehicle (e.g., Kuroda’s vehicle 100) that includes Dahlgren’s communication unit 26 to enable communications with Dahlgren’s central facility 12 over communication network 16. Appx. D, [0034], [0036], [0040], [0043]. A POSITA would have recognized that Dahlgren does not limit the applicability of its techniques to particular types of vehicles, and thus, Kuroda’s hybrid vehicle would be applicable as a vehicle type to be improved based on the teachings of Dahlgren discussed above. Thus, in Kuroda-Dahlgren, a hybrid vehicle with Kuroda’s “driving control

apparatus” would have been configured in a similar manner as Dahlgren’s  
“individual vehicle environment[] 10 traveling in a roadway network.” *Id.*, [0032],  
FIGS. 1, 2. An example of Kuroda-Dahlgren is shown below:



### Kuroda-Dahlgren

#### (d) A POSITA Would Have Had A Reasonable Expectation of Success in Combining Kuroda and Dahlgren

83. A POSITA would have had a reasonable expectation of success in combining the teachings of Kuroda and Dahlgren in the manner discussed above. Implementation of the combination would have required only routine knowledge

because Kuroda and Dahlgren relate to similar types of vehicle systems that monitor traffic information and road condition information. *Id.* Incorporation of remote server architecture (e.g., architecture of Dahlgren's system 8) into a vehicle (e.g., Kuroda's vehicle 100) also represented a well-known configuration by 5/16/2000 (i.e., Kuroda's filing date). For example, Kudo describes an example of a system in which components within a vehicle (e.g., car navigation system) are configured to communicate with a remote server over a network. Appx. M, [0005], [0019], [0074], [0075], [0215]. Implementation of Kuroda-Dahlgren would have been within the skill level of a POSITA without invention.

Fundamental aspects of Kuroda's disclosure would remain intact, bolstered by the well-known and beneficial teachings of Dahlgren related to traffic and road condition monitoring and dissemination via a central server.

84. A POSITA would have recognized that Kuroda and Dahlgren describe similar types of vehicle components such that the incorporation of Dahlgren's techniques into the standard hybrid vehicle described in Kuroda would not have involved invention. Both systems involve a control architecture where vehicle data is gathered, processed, and used to adjust vehicle operation. This similarity in architecture means that Dahlgren's components could be integrated into Kuroda's vehicle with minimal alteration. Additionally, since both systems rely on sensor data for decision-making, Dahlgren's sensors complement the data Kuroda's

system already uses to optimize vehicle performance. Dahlgren's in-vehicle processor components would have been easily integrated into Kuroda's control system, either by enhancing the existing controller or working alongside it. The compatibility stems from both systems' ability to process data and execute control logic. Dahlgren's processor could handle additional data inputs (e.g., aggregated traffic data from the central facility) that would enhance Kuroda's fuel optimization routines.

85. Further, a POSITA would have recognized that the proposed combination of the teachings of Kuroda and Dahlgren makes sense in the context of their respective disclosures. It would have been natural for Kuroda's hybrid vehicle to receive information from Dahlgren's server because Dahlgren's server aggregates real-time traffic and road condition data, which is critical for optimizing driving schedules and fuel efficiency in Kuroda's system. *Id.*; Appx. E, 11:31-49. By integrating this dynamic information, the Kuroda vehicle is able to adjust its powertrain operations more effectively, reducing fuel consumption and improving overall performance. Additionally, Dahlgren's predictive traffic flow data enables Kuroda's vehicle to anticipate and avoid congestion, leading to smoother driving patterns. *Id.* This combination allows Kuroda's hybrid vehicle to make more informed decisions, improving its ability to minimize fuel usage in various driving conditions. *Id.*

**C. GROUND 1—Dahlgren Makes Claims 1-9 and 12-16 Obvious**

**1. Analysis**

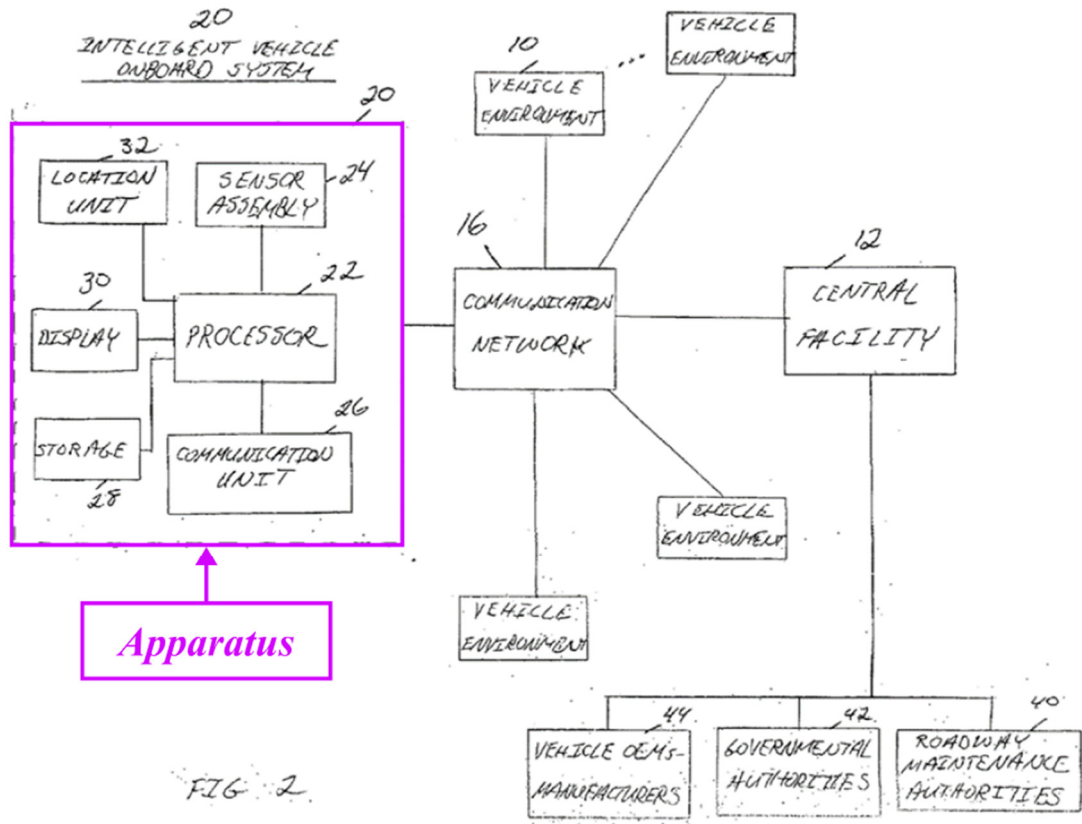
**(a) Claim 1**

*[1pre]An apparatus comprising:*<sup>3</sup>

86. To the extent the preamble is limiting, Dahlgren discloses the recited *apparatus* because an “on-board intelligent vehicle system” (hereinafter “Dahlgren Vehicle System”) (*apparatus*) “includes a sensor assembly to collect data and a processor to process the data to determine the occurrence of at least one event,” where the data may be “indicative of conditions relating to the vehicle, roadway infrastructure, and roadway utilization, such as vehicle performance, roadway design, roadway conditions, Vehicle weights, and traffic levels.” Appx. D, [0010]; *see id.*, [0033]-[0039], FIG. 2.

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<sup>3</sup> Claim language is referenced in this Request in bolded and italicized format.



Appx. D, FIG. 2 (annotated)

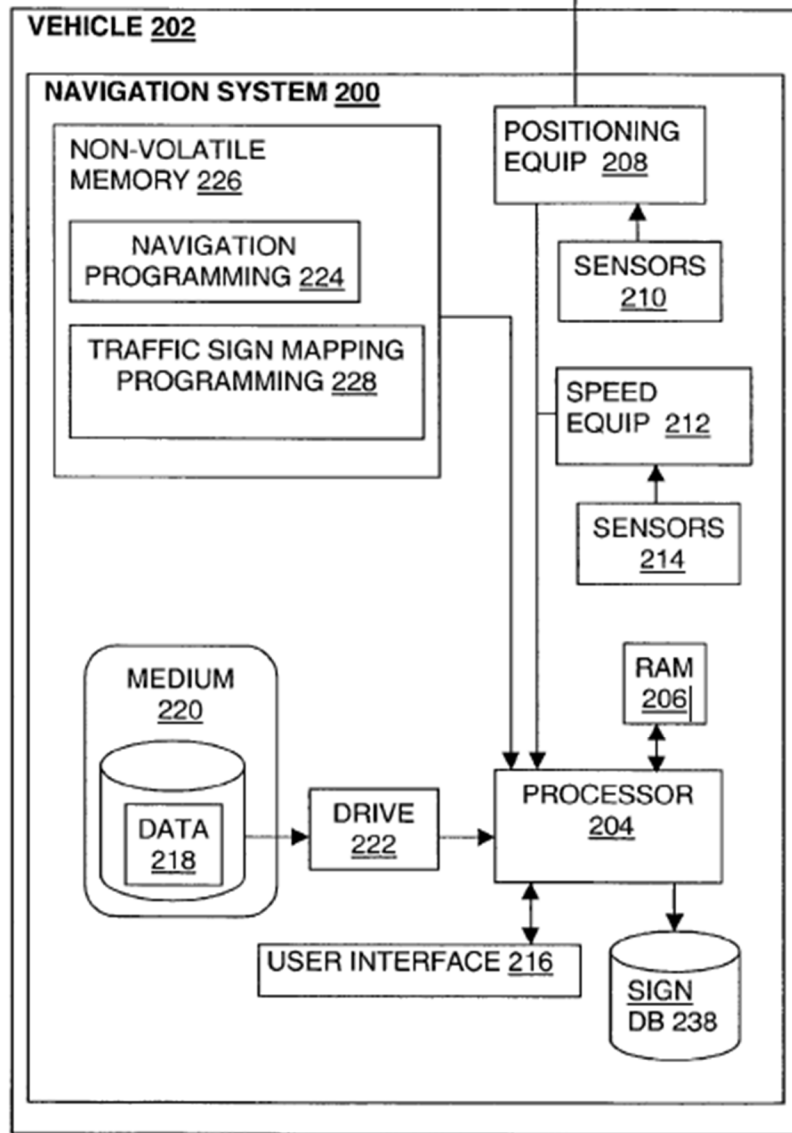
**[1a-1] an interface configured to (a) receive (i) sensor data samples during operation of a vehicle and (ii) data from a telemetry system and**

87. The Dahlgren Vehicle System includes “subsystems to gather, analyze and transmit vehicle sensor information.” Appx. D, [0083]. Because the “subsystems” are configured to “gather” (i.e., *receive*) various types of vehicle information (including those that represent *sensor data* and *data from a telemetry system*), a POSITA would have understood that the Dahlgren Vehicle System includes a communications interface (e.g., communications buses) to receive these various types of vehicle information (*interface*). See Appx. D, [0084], [0085]. As

discussed below, the Dahlgren Vehicle System provides functionality relating to gathering vehicle sensor information (*sensor data samples*) and measurement data from remote systems (*data from a telemetry system*), thereby satisfying the two sub-limitations of limitation [1a-1] (identified by *(i)* and *(ii)*). *Id.*

88. Further, interfaces for receiving both sensor data and data from a telemetry system were conventional as of the Critical Date. For example, as shown in Figure 7 of Barton, a vehicle 202 includes sensors 214 for collecting sensor data and positioning equipment 08 for obtaining GPS signals collected by satellites.

FIG. 7



Appx. R, FIG. 2

Specifically, “navigation system 200” is “located in a vehicle 202, such as an automobile, truck or bus” and is “a combination of hardware and software components.” Appx. R, 14:32-53. Additionally, “positioning equipment 208” may include “a GPS system[,]” which is configured to obtain GPS signals are

measurement data communicated wirelessly to vehicle 202. *Id.* Further, Barton describes a vehicle being capable of obtaining information from a “geographic database 30” (i.e., a database located remotely from a vehicle). *Id.*, 2:48-4:6, FIG.

2. For example, the vehicle can obtain “traffic sign data” for “all the roads represented in the geographic database” for use in providing navigation and map-related services. *Id.*

89. Indeed, Dahlgren teaches that “[d]ata from a number of sensors...is currently available on **standard in-vehicle communications buses.**” Appx. D, [0083] (emphasis added). Additionally, given the functionality described in Dahlgren, the Dahlgren Vehicle System would have included an interface that ensures seamless communication and data processing between the vehicle's electronic control unit (ECU) and external sources and this interface would have enabled the vehicle to utilize both local sensor inputs and remote updates or commands for improved performance and functionality.

a. *sensor data samples during operation of a vehicle*

90. As to sub-limitation **(a)**, the Dahlgren Vehicle System includes a “sensor assembly 24” that “collects data generated in the respective vehicle environment or platform.” Appx. D, [0035]. This data may “issue from standard equipment in the vehicle or be retrieved from the existing communication bus in the vehicle or be retrieved from added sensors and equipment.” *Id.* Further, “the

sensor data may relate to the status, operation, mode, performance, state, or any other measurable characteristic of any device, instrument, part, or component in the vehicle.” *Id.*

91. Dahlgren teaches that “[a]ny of various sensor devices may be used in the practice of the invention,” including “conventional sensors, instruments, and gauges currently existing as standard equipment on vehicles...” Appx. D, [0047]. Further, “[i]nformation from these sensors can be interpreted in various ways to arrive at the conclusion that certain events have occurred.” *Id.*

92. Additionally, “the sensor data may relate to the status, operation, mode, performance, state, or any other measurable characteristic of any device, instrument, part, or component in the vehicle.” Appx. D, [0035]. From these disclosures, a POSITA would have understood that the examples of sensor data described in Dahlgren are collected by the Dahlgren Vehicle System while a vehicle is travelling along a route (e.g., during operation of a vehicle). This is because the sensor data may relate to the “status” or “operation” of the vehicle, which indicates that the sensor data is collected during vehicle operation. The two examples of sensor data discussed below (e.g., slippage data, GPS data) are similarly collected during operation of a vehicle given Dahlgren’s disclosures of using information reflected by these examples in detecting events during vehicle operation (e.g., identifying a location where slippage occurs along a travel route).

Appx. D, [0052] (“traction data representing excessive slippage beyond a certain threshold may signify that the vehicle has encountered icy conditions on the roadway”).

93. As one example, with “traction control systems,” data is “used to detect events relating to the frictional interaction between the tires and the roadway.” *Id.*, [0052]. For instance, “traction data representing excessive slippage beyond a certain threshold may signify that the vehicle has encountered icy conditions on the roadway” and “extended slippage measurements” not attributable to weather conditions may “indicate degradation in the tires, e.g., worn treads.” *Id.* In these instances, “[t]raction data may be obtained from the limited slip differential, for example, to examine the usage history of the traction process.” *Id.* Based on this disclosure, one example of ***sensor data samples*** includes traction control system data collected during operation of the vehicle (e.g., while the vehicle is traveling on a road).

94. Another example is “GPS (for vehicle position).” Appx. D, [0047]. With this example, “a location indicator (generated by location unit 32) that signifies the location of the vehicle at the time that the corresponding event was detected.” *Id.*, [0038]. This enables “detected event” to be “correlated with positional information indicating the location of the vehicle where the event occurred.” *Id.* Based on this disclosure, another example of ***sensor data samples***

includes “a location of the vehicle at the time [a] corresponding event is detected,” such as the location of the vehicle while traveling (i.e., during operation of the vehicle).

b. *data from a telemetry system*

95. As to sub-limitation **(ii)**, the Dahlgren Vehicle System is configured to gather various types of information representing ***data from a telemetry system***. As one example, the Dahlgren Vehicle System monitors traffic-related information (***data from a telemetry system***) based on use of a “in-vehicle telematics unit” that wirelessly communicates with one or more systems external to the vehicle using a “communications network,” e.g., “existing and future cellular, radio and wide-area network communications.” Appx. D, [0111]; *see also id.*, [0091]-[0093], [0114]. Further, the telematics unit collects traffic information and “correlates it to fixed geographic coordinates (roadways),” confirming that this information is collected from a ***telemetry system*** because it represents measured data from a remote source. *Id.*, [0115]. Further, collection of traffic information by a vehicle from a remote source was well-known by the Critical Date, as demonstrated by Hongo (Appx. N).

96. For example, Hongo describes a vehicle including a “radio” that receives information that “relates to road conditions,” such as “traffic jams, traffic regulations, etc. during driving.” Appx. N, [0064]. Additionally, “natural traffic jams, traffic accidents, road construction, construction around roads, large events,

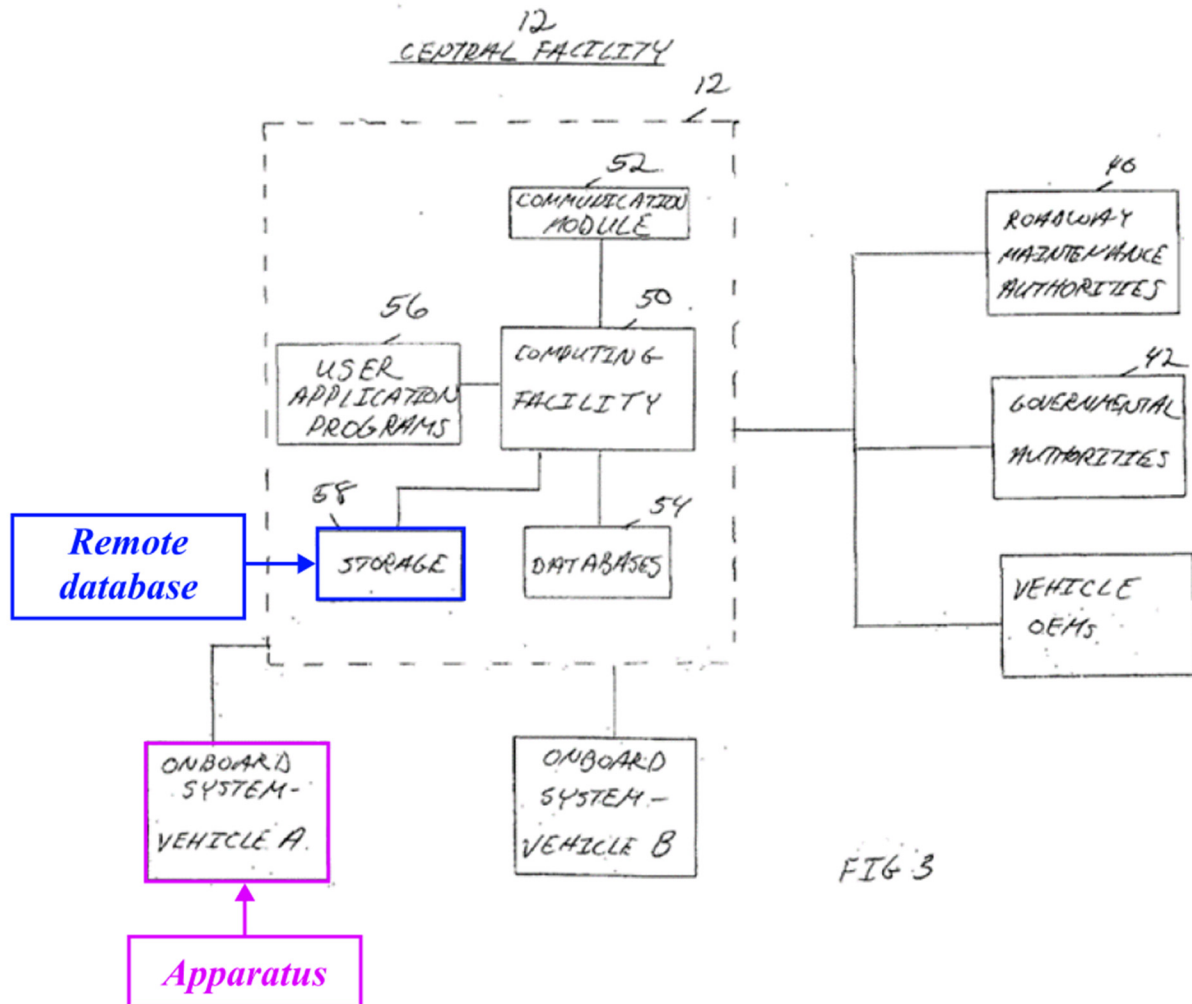
large holidays, etc. are factors that cause these changes[,]” and, “real-time received information from the radio is useful inappropriately dealing with these real-time changes.” *Id.* A POSITA would have found it obvious that the traffic information received by the “radio” corresponds to ***data from a telemetry system*** because the received information represents, for example, measurement data relating to traffic jams and traffic accidents, where the measurement data is communicated wirelessly to a vehicle. Appx. N, [0064].

97. As another example, the Dahlgren Vehicle System collects GPS signals (***data from a telemetry system***), e.g., wireless communications regarding a vehicle’s location sent by a satellite that is obtained by a GPS receiver, such as location unit 32. *See* Appx. D, [0038] (“location data may be provided by any means known to those skilled in the art, such as a GPS unit”), [0122] (describing “existing telematics in-vehicle hardware” as incorporating “standard GPS”). A POSITA would have understood that GPS signal data represents ***data from a telemetry system*** because, for example, they correspond to measurement data used to determine a current location of a vehicle, where the measurement data is communicated wirelessly to the vehicle.

***[1a-2][the interface configured to] (b) connect to a remote database;***

98. As discussed for [1a-1], a POSITA would have understood that the Dahlgren Vehicle System includes an interface (e.g., communications buses) to

receive various types of vehicle information (*interface*). See Appx. D, [0083]-[0085]. Further, in the Dahlgren Vehicle System, this interface is configured to communicate (i.e., *connect*) with storage 58 (*remote database*) of central facility 12. See Appx. D, [0060], [0064]. This is shown in FIG. 3 below:



Appx. D, FIG. 3 (annotated)

Specifically, storage 58 “store[s] the information received from the various vehicle environments, in addition to the results of the relevance determinations carried out by central facility 12.” Appx. D, [0064].

99. A POSITA would have understood that storage 58 is an example of a “database” because the ’616 patent specification references elements for storing information as, for instance, “a memory **or** other data structure that holds information on routes or segments...” Appx. A, 17:26-43 (emphasis added); *see also id.*, 8:7-22 (“...a memory or database of information, including information about maps and road information”). A POSITA would have understood that the **database** recited in this limitation includes a “memory or other data structure that holds information on routes or segments...” *Id.*, 17:26-43.

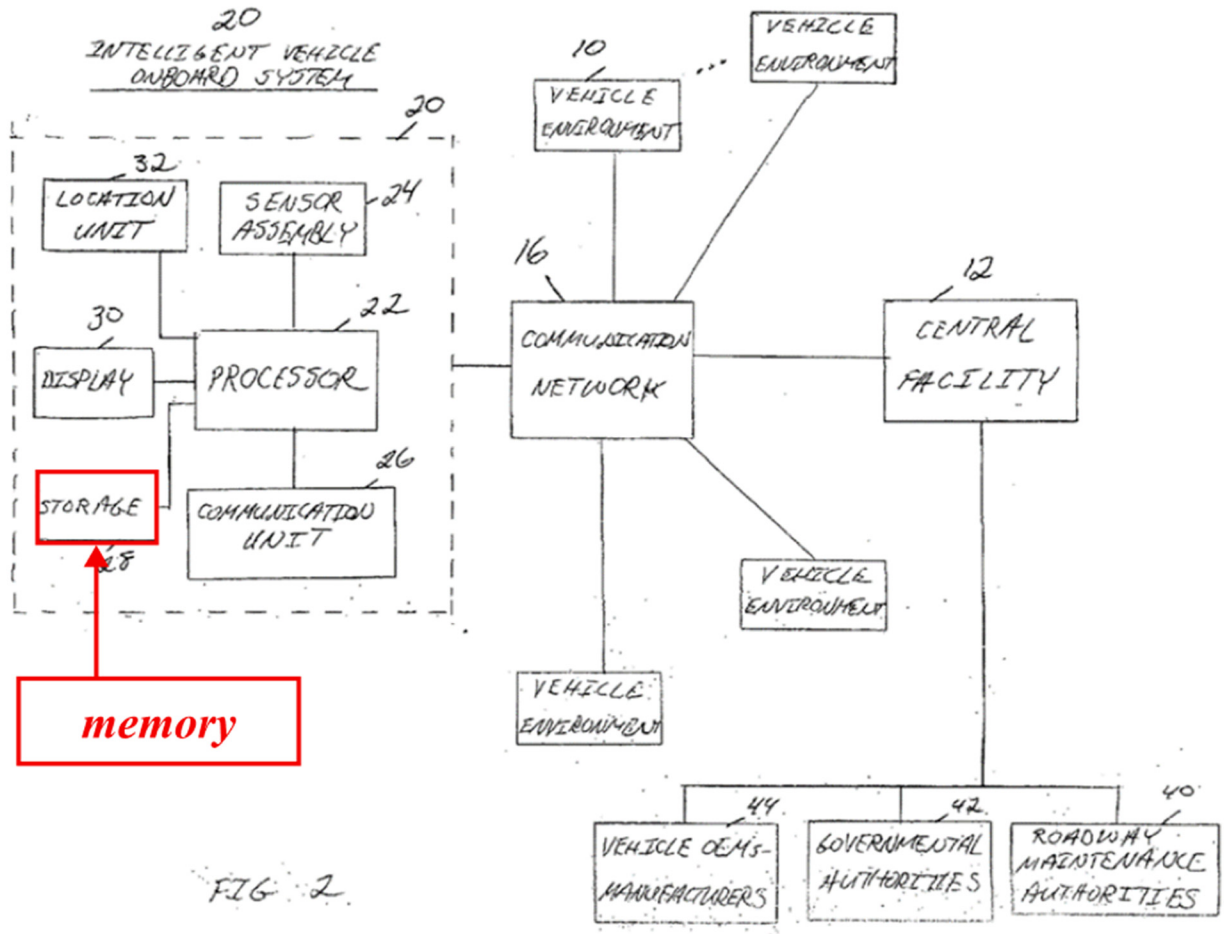
100. In my opinion, in the context of vehicle information systems, “storage” refers to the systematic collection and maintenance of information/data (e.g., sensor data, route data, location data) that is organized for easy retrieval and analysis. For instance, organized storage is an example of a “database” because the storage uses structured formats and database management systems (DBMS) to efficiently handle large volumes of information, ensuring data integrity and accessibility. Further, as to a **remote database**, the ’616 patent specification describes “a memory or other data structure that is located remotely.” Appx. A, 17:26-43.

101. In the Dahlgren Vehicle System, storage 58 is an example of a **remote database** because it represents a “memory or other data structure that holds information on routes or segments” and is “located remotely from” the Dahlgren

Vehicle System. Appx. A, 17:26-44. Indeed, like the storage elements described in the '616 patent specification, storage 58 is used to “store the information received from the various vehicle environments, in addition to the results of the relevant determinations carried out by central facility 12.” Appx. D, [0064]. A POSITA would have also understood that storage 58 represents an example of a “database” because it “systematically collects and maintains information/data relating to the vehicle on-board system 20 (e.g., vehicle sensor information, event information, location information, etc.) that is organized for easy retrieval and analysis by central facility 12.” Further, because the Dahlgren Vehicle System may upload information (e.g., vehicle sensor information, event information) to storage 58, the Dahlgren Vehicle System is *configured to...connect* to the storage 58.

***[1b] a memory configured to store (a) said sensor data samples for different points in time along a route segment travelled by said vehicle and (b) said data from said telemetry system; and***

102. The Dahlgren Vehicle System includes a storage 28 (*memory*) configured to store vehicle sensor information (*said data samples*) and information obtained from external sources (*said data from said telemetry system*). Storage 28 is shown in Figure 2 below:



Appx. D, FIG. 2 (annotated)

In particular, storage 28 is “used to record event information provided by processor 22. A display 30 may be used to display the results of processing operations to the driver, such as the details of an event once it is detected.” Appx. D, [0041]; *see id.*, [0039]. As discussed below, memory 28 provides functionality satisfying the two types of data recited in limitation [1a-1] (identified in [1b] by **(a)** and **(b)**). *Id.*

- a. *said sensor data samples for different points in time along a route segment travelled by said vehicle*

103. As to sub-limitation *(a)*, storage 28 is configured to store vehicle sensor information (*said sensor data samples*) (e.g., traction control system data). Appx. D, [0034], [0039], [0041]; *see id.*, [0035], [0038], [0047], [0052] (describing examples of vehicle sensor information). Specifically, “[t]he specifications for determining the event occurrence criteria (e.g., range of permissible values) may be stored locally in storage 28.” *Id.*, [0039]. Further, “storage 28 may be used to record event information provided by processor 22.” *Id.*, [0041].

104. A POSITA would have found it obvious that Dahlgren Vehicle System stores vehicle sensor information as a vehicle is travelling along a route (*different points in time along a route segment travelled by said vehicle*). For example, Dahlgren teaches that a vehicle can transmit event information “automatically in real-time as the event is detected,” represents ongoing collection and evaluation of sensor data. Appx. D, [0040].

105. Dahlgren also describes that an advantage of aspects of its disclosed invention is the processing of “real-time (or virtually real-time or near real-time) event indication information,” which implies and makes obvious, real-time collection of vehicle sensor information used for the event indication. Appx. D, [0020]; *see id.*, [0021] (describing that “users and applications can receive relevant event occurrence information in real-time (or near real-time) to enable timely and

useful response and reaction to the information”). Indeed, the Dahlgren Vehicle System, in some implementations, is configured to transmit event information “automatically in real-time as the event is detected” or “periodically at set intervals of time.” Appx. D, [0040].

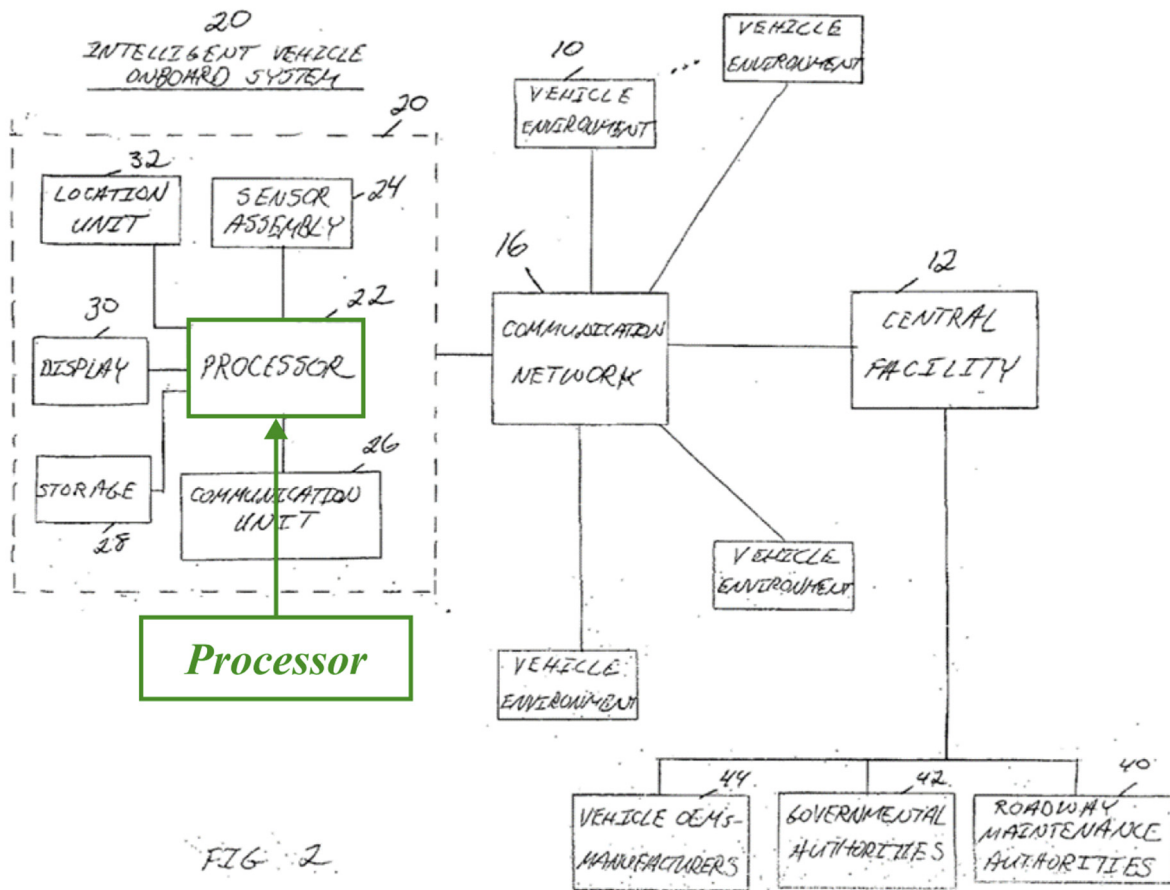
106. Further, “storage 28 may be used to record event information provided by processor 22 (*id.*, [0041]), including “sensor data collected by sensor assembly 24 [that] is processed by processor 22 to determine whether the data indicates or otherwise signifies the occurrence of an event as represented by and correlated to the data” (*id.*, [0036]). From these disclosures, a POSITA would have understood that, in some implementations, storage 28 is configured to store evaluations performed by the processor 22 in real-time (including the vehicle sensor information used for such evaluations) such that the storage 28 also stores vehicle sensor information collected in real-time at different time points of a vehicle route (*different points in time along a route segment travelled by said vehicle*). Further, local storage of sensor data on a vehicle as a vehicle is travelling along a route was a conventional vehicle system configuration by the Critical Date. *See* Appx. N, [0017], [0027], [0029], [0030], FIG. 3; *see also* Appx. R, 2:48-3:13, FIG. 3.

b. *said data from said telemetry system*

107. As to sub-limitation **(b)**, storage 28 is configured to store information obtained from external sources (*said data from said telemetry system*) (e.g., traffic flow information, GPS signals). Specifically, the Dahlgren Vehicle System monitors traffic flow information and “log[s] unexpected traffic flow as an event, including some information on the conditions, the time, and the coordinates of the event.” Appx. D, [0086]; *see id.*, [0091]-[0093], [0111], [0114]. “These events could either be dispatched to the call center immediately” or in other instances, “queued up and sent at a later time when it is more advantageous to do so (i.e., to collect traffic statistics for roadway analysis).” *Id.*, [0086]. As discussed above, because storage 28 records “event information provided by processor 22” (*id.*, [0041]), a POSITA would have understood that, in instances where event information based on traffic flow information is “queued up and sent at a later time,” the storage 28 stores traffic flow information associated with detected events. Appx. D, [0036], [0041]. Similarly, because event information is correlated with location information, storage 28 is configured to store, for example, GPS signal information associated with location information. Appx. D, [0011], [0036], [0038], [0056]; Appx.7 C, XX.

**[1c-1] a processor configured to (i) analyze said sensor data samples stored in said memory to determine current condition and (ii) associate said current conditions with said route segment**

108. The Dahlgren Vehicle System includes a processor 22 (**processor**) configured to analyze vehicle sensor information (**said sensor data samples**) to determine event information (**current condition[s]**), and correlate (**associate**) the event information with a vehicle position associated with a route segment (**said route segment**). Processor 22 is shown in Figure 2 below.



Appx. D, FIG. 2 (annotated)

Specifically, processor 22 processes “sensor data collected by sensor assembly 24”

to “determine whether the data indicates or otherwise signifies the occurrence of an event as represented by and correlated to the data.” Appx. D, [0036]. As discussed below, processor 22 provides functionality satisfying the two types of processing operations recited in limitation [1c-1] (identified in [1c-1] by **(a)** and **(b)**). *Id.*

- a. *analyze said sensor data samples stored in said memory to determine current condition*

109. As to sub-limitation **(a)**, processor 22 is configured to analyze vehicle sensor information (***said sensor data samples***) (e.g., traction control system data). Appx. D, [0034], [0039], [0041]; *see id.*, [0035], [0038], [0047], [0052] (describing examples of vehicle sensor information). Specifically, processor 22 may “analyze [] collected data in real-time as it is being acquired during use and transit of the vehicle, with a view towards determining whether the data signifies the occurrence of a specified event.” *Id.*, [0148]. This analysis “translates the otherwise raw sensor data into an interpretative outcome enabling one to understand the various driving dynamics, behaviors, mechanisms, and phenomena that are taking place interactively with one another and occurring rapidly during vehicle travel.” *Id.*, [0149].

110. As one example, traction control system data is analyzed to “detect events relating to the frictional interaction between the tires and the roadway,” such as “excessive slippage beyond a certain threshold” indicating that “the vehicle

has encountered icy conditions on the roadway.” *Id.*, [0052]. Based on this disclosure, one example of ***sensor data samples*** includes traction control system data (collected by a traction control system that includes an ***revolutions-per-minute sensor***), which, in this example, is analyzed to determine the ***current condition of traction***, e.g., “excessive slippage.” *Id.*; *see also id.*, [0047], [0154], [0167], [0266] (discussing traction control system data).

111. As another example, Dahlgren describes that “[a]s a driver travels along a particular segment, the vehicle would calculate average speed and also perform some simple statistical analysis on the speed samples, looking for activities such as unusual stop-and-go conditions or traffic jams.” Appx. D, [0086]. Based on this disclosure, one example of ***sensor data samples*** includes speed data (collected by a ***speed sensor***), which, in this example, is analyzed to determine the ***current condition of traffic patterns***, e.g., “unusual stop-and-go conditions or traffic jams.” *Id.*; *see also id.*, [0047], [0130], [0131], [0139] (discussing speed data).

b. *associate said current conditions with said route segment*

112. As to sub-limitation ***(b)***, processor 22 is configured to correlate (***associate***) event information with vehicle position information (e.g., a position of a vehicle within a segment of a travel route) (***said route segment***). Appx. D, [0011], [0036], [0038], [0053], [0056], [0061]. A POSITA would have understood

that such a correlation is performed by components of the vehicle on-board system 20 given various disclosures in Dahlgren. For example, Dahlgren teaches a computing configuration in which “[p]re-determined logic” is programmed into “the telematics unit to process sensor data, determine the vehicle location, and correlate it to previously stored **on-board databases**,” (*id.*, [0137] (emphasis added)), e.g., using “vehicle GPS” to locate [an] appropriate road segment” (*id.*, [0139]).

113. As another example, Dahlgren describes that “infrastructure data will be stored within the vehicle-processing unit to enable computation of safety incidents or out-of-bounds events[,]” and “[b]ased on the amount of stored knowledge at the vehicle level certain feedback will be immediately communicated to the driver[,]” e.g., “using map database information and current position data, a driver going down the wrong way on a one-way street can be alerted immediately.” *Id.*, [0113]. This disclosure teaches access by the Dahlgren Vehicle System to “map database information,” which can be analyzed using “current position data” to identify a vehicle’s location within a segment of a travel route.

114. Based on the examples discussed above, a POSITA perceived Dahlgren’s broader disclosure of “[t]he vehicle transmit[ting] an event indicator and correlated vehicle location data to a central facility for further management of the information” to include more than received GPS signals, e.g., processed vehicle

location information based on access to, for instance, “map database information.” *Id.* (citing Appx. D, [0011]). Given the capability of the Dahlgren Vehicle System to communicate with a map database and provide functionality relating to analyzing vehicle position in relation to map database information, a POSITA would have understood that computing elements of the Dahlgren Vehicle System (e.g., processor 22) would have been configured to associate vehicle position information with a corresponding route segment. Appx. D, [0139].

115. For instance, Dahlgren teaches an example where “[a]s a driver travels along a particular segment, the vehicle would calculate average speed and also perform some simple statistical analysis on the speed samples, looking for activities such as unusual stop-and-go conditions or traffic jams.” Appx. D, [0086]. From this description, processor 22 correlates (*associate[s]*) unusual speed data (*current condition* of *traffic patterns*) with a route segment associated with a vehicle position over which “unusual stop-and-go conditions or traffic jams” are detected (*said route segment*). *Id.*

116. Similarly, the Dahlgren Vehicle System may use monitoring techniques to identify traction control system data for a particular segment, which may be useful to indicate, for instance, “icy conditions on the roadway” (*id.*, [0052], or “degraded road conditions due to reduced traction and degraded ride quality of the road” (*id.*, [0093]). Indeed, because the traction control system of

the Dahlgren Vehicle System is used to “determine that a vehicle has encountered a road condition typically at an intersection with degraded vehicle motion starting ability,” correlation of traction system control data and route segment information is a natural implementation of Dahlgren’s teachings. Based on this disclosure, processor 22 correlates (*associate[s]*) traction control system data (*current condition of traction*) with a route segment associated with a vehicle position over which a traction-related event is detected (*said route segment*). *Id.*

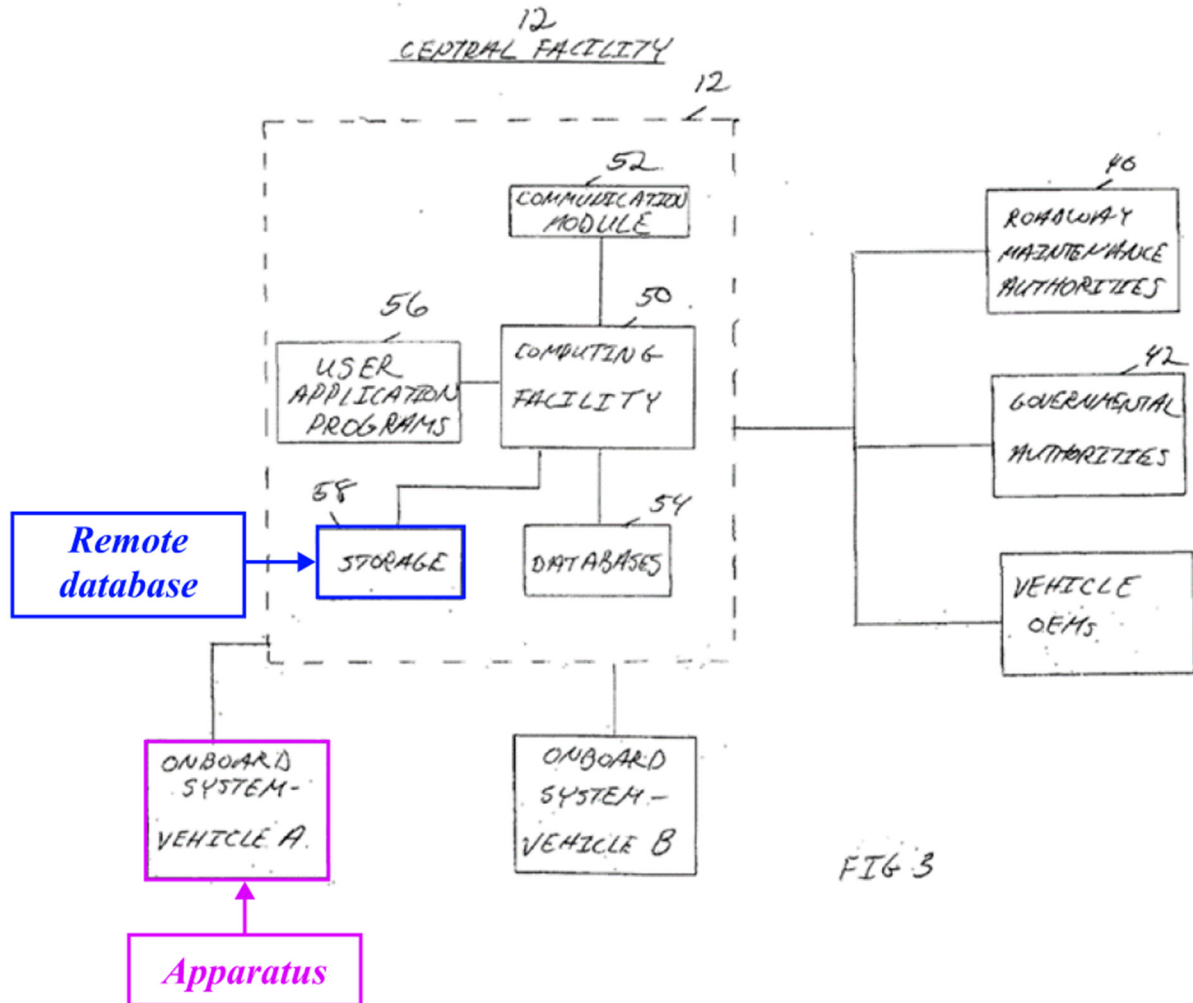
**[1c-2] wherein (a) said route segment is identified according to said data from said telemetry system and**

117. As discussed above, the Dahlgren Vehicle System is configured to obtain information from external sources (*data from said telemetry system*) (e.g., traffic flow information, GPS signals). Appx. D, [0038], [0122]; Appx. Q, 3. As one example, traffic information is “monitored” based on communications with external systems. Appx. D, [0091]-[0093], [0109].

118. Further, the Dahlgren Vehicle System is configured to determine vehicle position information (e.g., a position of a vehicle within a route segment (*said route segment*)). Appx. D, [0011], [0036], [0038], Appx. D, [0011], [0036], [0038], [0053], [0056], [0061]. Specifically, “vehicle GPS is used to locate [an] appropriate road segment.” Appx. D, [0139] (emphasis added). The appropriate road segment is *identified according to* GPS signal information representing GPS coordinates of a vehicle (i.e., vehicle position information). *Id.*

***[1c-3] (b) said current conditions associated with said route segment are uploaded to said remote database to create historical route information for a plurality of route segments;***

119. As discussed above, the Dahlgren Vehicle System is configured to determine event information as a vehicle is traveling along a route (***said current conditions associated with said route segment***) (e.g., excessive slippage detected based on analyzing traction control system data, traffic jams). Appx. D, [0052]; *see also id.*, [0047], [0154], [0167], [0266]. Further, as discussed for [1a-2], the Dahlgren Vehicle System is configured to communicate with storage 58 (***said remote database***), as shown in FIG. 3 below. Appx. D, [0060], [0064].



Appx. D, FIG. 3 (annotated)

120. Specifically, storage 58 is used to “store[s] the information received from the various vehicle environments, in addition to the results of the relevance determinations carried out by central facility 12.” Appx. D, [0064]. From this disclosure, a POSITA would have understood that information provided by the “various” vehicles of the Dahlgren system (including the Dahlgren Vehicle System within a particular vehicle) to the central facility 12 is collectively stored in storage 58. For instance, upon receiving information from the various vehicles, the central

facility 12 “will aggregate the data for analysis and interpretation,” and a POSITA would have understood that such aggregation involves storage, e.g., in storage 58. Appx. D, [0112].

121. In providing information to the central facility 12 (e.g., for storing in storage 58), the Dahlgren Vehicle System “generates a communication (such as with processor 22) that transmits detected event information to central facility 12 via communication network 16.” *Id.*, [0040]. This involves “[a]ny suitable process or methodology may be used to facilitate the transfer of event information from each vehicle environment to central facility 12.” *Id.* For example, “regular streams of event-type information are [] uploaded to central facility 12.” *Id.*, [0044].

122. In my opinion, because information stored in the storage 58 is received from various vehicles (including the Dahlgren Vehicle System in a particular vehicle), the Dahlgren Vehicle System is configured to ***upload[]*** information to the storage 58. Further, the uploaded information includes event information as a vehicle is traveling along a route (***said current conditions associated with said route segment***) (examples of which, as explained above, includes “excessive slippage” and “unusual stop-and-go conditions or traffic jams”). Appx. D, [0040], [0044]; *see also id.*, [0047], [0052], [0154], [0167], [0266] (discussing analysis of traction control system data); *see also id.*, [0047],

[0086], [0130], [0131], [0139] (discussing analysis of speed data). Where event information includes “excessive slippage” (*current condition of traction*) or “unusual stop-and-go conditions or traffic jams” (*current condition of traffic patterns*), the event information is uploaded to central facility 12 (and specifically stored in storage 58) (*uploaded to said remote database*).

123. Further, Dahlgren teaches the upload of event information including event indicators detected in the past because, in some instances, event information is transmitted to the central facility 12 “under specified conditions such as when the queue or backlog of events reaches a certain number...” Appx. D, [0040]; *see also id.*, [0086] (describing that event information can be “queued up and sent at a later time when it is more advantageous to do so...”). In such instances, the uploaded event information data includes event indicators that were detected in the past and are correlated with vehicle positions. The uploaded event information data represents *historical route information for a plurality of route segments*. Dahlgren also makes obvious that information uploaded to central facility 12 (and stored in storage 58) is an example of *historical route information for a plurality of route segments*. Given Dahlgren’s broad motivation to use information provided to central facility 12 to “send[] communications reflecting event occurrence to various relevant or interested users.” Appx. D, Abst., [0011]. A POSITA would have found it obvious that uploaded information is used to

establish reference data for subsequent analysis (i.e., historical data used for comparison relative to measured data). This enables the Dahlgren system to “provid[e] global management of event collection, analysis and reporting tasks in a distributed multi-vehicle environment.” *Id.*, [0014]. Such a configuration involved the application of a known technique (data storage techniques for periodically updating stored data) to a known device (the Dahlgren Vehicle System) ready for improvement to yield predictable results (benefits articulated above). A POSITA would have had a reasonable expectation of success in implementing such a configuration since the modifications would have amounted to a simple substitution of one data storage technique for another within the Dahlgren Vehicle System.

124. Enabling uploaded information to be used as historical data advances Dahlgren’s motivation for its disclosed solution to “a multi-vehicle environment employing intelligent vehicle platforms to facilitate the distributed exchange of event-type information between subscriber vehicles concerning roadway condition, capacity, and safety.” *Id.*, [0015]. Indeed, Dahlgren describes that even information uploaded by multiple vehicles can be used by “government and private agencies” to “more effectively manage [] infrastructure planning, design, maintenance, and conditions dissemination to the travelling public.” *Id.*, [0024]. In my opinion, use of the event information uploaded to central facility 12 as a

type of reference data (e.g., data used for comparison against monitored or sensed data by a particular entity or vehicle) that is maintained and updated periodically advances Dahlgren's broad objective to provide a "distributed multi-vehicle environment." Appx. D, [0014].

125. Additionally, Dahlgren makes such use of uploaded event information (e.g., as historical reference data) obvious insofar as it specifically teaches that "central information processing center will **aggregate** the data for analysis and interpretation," and that "the data received, status and information **may be transferred back** to individual vehicles and/or to the responsible agencies from the central information processing facility **where it will be stored and maintained.**" Appx. D, [0112] (emphasis added). Further, vehicle systems with centralized facilities for storing uploaded information as historical route information for a plurality of route segments were well-known by the Critical Date. Appx. R, 2:48-3:35.

126. For example, in Barton (Appx. R), a "geographic database 30 contain data 32 that represents some of the physical features in [a] geographic region," including "at least one database record 34...for each road segment 20 in the geographic region 12..." Appx. R, 2:48-63. Further, Barton establishes that it was well-known by the Critical Date to implement Dahlgren's storage 58 to be "updated on a regular basis" because "roads may be enhanced with information"

such that “there exists a need to continue to collect information for a geographic database.” *Id.*, 1:34-46. As another example, Hongo (Appx. N) establishes that databases for storing “past driving history,” including both “position” and “real-time road information” and associated techniques for comparing this information against measured speed data to determine a “target speed” were conventional.

Appx. N, [0017].

**[1d] wherein the sensor data samples are received from at least one of an optical sensor, a position sensor, a speed sensor, a gyroscopic sensor, a revolutions-per-minute sensor, an accelerator pedal position sensor, a brake pedal position sensor, a battery state sensor, a tire pressure sensor, a proximity sensor, a weight sensor, an airflow sensor, and a gas flow sensor; and**

127. As discussed in Section V.A.6, the *at least one...and* phrase within [1d] satisfied under BRI by receipt of *sensor data samples* from one of the Enumerated Sensors.

128. Dahlgren satisfies [1d] under BRI because it discloses at least four types of Enumerated Sensors (*revolutions-per-minute sensor, position sensor, speed sensor, gyroscopic sensor*) (and possibly more). As discussed above for [1a-1], the Dahlgren Vehicle System is configured to collect vehicle sensor information (*said sensor data samples*), which may generally “relate to the status, operation, mode, performance, state, or any other measurable characteristic of any device, instrument, part, or component in the vehicle.” Appx. D, [0035]. Dahlgren also teaches that “[a]ny of various sensor devices may be used in the practice of the

invention,” including “conventional sensors, instruments, and gauges currently existing as standard equipment on vehicles...” Appx. D, [0047].

129. As discussed above for [1a-1], examples of vehicle sensor information collected by the Dahlgren Vehicle System include traction control system data (*id.*, [0052]) and vehicle position information (*id.*, [0038], [0047]). With the first example, traction control system data is collected by “traction control systems (TCS)” (*see id.*, [0047], [0052], [0094], [0097], [0154], [0169]), which a POSITA would have understood to include a rotational speed sensor (*revolutions-per-minute sensor*). Specifically, controlling vehicle speed is important for detecting and preventing vehicle slippage (important functionality provided by a TCS), and such control would have involved monitoring data collected by a rotational speed sensor (e.g., wheel speed, rotational acceleration, rotational deceleration). *See* Appx. S, 1:12-24, 2:17-36, FIG. 1 and Appx. T, [0042].

130. Such configurations were well-known by the Critical Date, as demonstrated by Scelers (Appx. S). *See* Appx. S, 2:17-36 (describing “[a] vehicle having a traction control system” that includes “[o]ne or more wheel speed sensors 32 [that] transmit speed signal(s) to [a] controller 20”); *see also id.*, 1:12-24 (“wheel speed sensors may be used to provide information to a traction control system[.]”).

131. A POSITA would have also understood that a rotational speed sensor (e.g., wheel speed sensor) in a traction control system (TCS) of a vehicle is an example the *revolutions-per-minute sensor* because the sensor measures the rotational speed of the wheel in revolutions per minute (RPM), providing precise data on wheel speed. This data is crucial for the TCS to detect and correct wheel slip, ensuring optimal traction and vehicle stability. *See* Appx. S, 2:17-36; Appx. T, [0042]. For example, Mizon (Appx. T) describes a traction control system with “first and second wheel speed sensors 530 and 532” that “are employed to sense the rotational speeds of the front wheels 22” and “third and fourth wheel speed sensors 534 and 536” that “are employed to sense the rotational speeds of the rear wheels 32. Appx. T, [0042] (emphasis added). In my opinion, in the context of traction control systems, the unit of measurement for rotational speed is typically revolutions per minute (RPM) such that a speed sensor that measures rotational speed is a “revolutions-per-minute sensor.”

132. With the second example, vehicle position information is determined by processing GPS signals by a location unit 32 (*position sensor*) that “signifies the location of the vehicle at the time that [a] corresponding event was detected.” Appx. D, [0038] (“location data may be provided by any means known to those skilled in the art, such as a GPS unit”); *see id.*, [0034]. Further, in some instances, location information is further processed using additional sensor data, e.g., through

“interpolation of the position and trajectory of the vehicle” using an “Inertial Measurement Unit (IMU)[,]” and thereby determine “velocity and acceleration information along and about the pitch, roll, and yaw axes.” Appx. D, [0121]; *see also id.*, [0047], [0048], [0050], [0133]. For example, in “[o]ne typical configuration,” a vehicle includes “existing telematics in-vehicle hardware that incorporates standard GPS, and a low-resolution IMU that is constructed using micro-machined accelerometer and material layered technology[,],” which “has sufficient accuracy to note the location where vehicle events occur...” *Id.*, [0122]. In the Dahlgren Vehicle System, vehicle position information (*sensor data samples*) are received from a location unit 32 (*position sensor*), and optionally, an IMU (*gyroscopic sensor*). An IMU is an example of device that typically includes gyroscope sensors because it measures angular velocity, with accelerometers, which measure linear acceleration, to provide comprehensive data on an object’s motion and orientation.

133. As another example, Dahlgren describes that “[a]s a driver travels along a particular segment, the vehicle would calculate average speed and also perform some simple statistical analysis on the speed samples, looking for activities such as unusual stop-and-go conditions or traffic jams.” Appx. D, [0086]. The Dahlgren Vehicle System may include a “vehicle speed sensor” configured to “collect[] data every 0.5 seconds and calculates a running average

speed using the last 100 samples.” *Id.*, [0139]. In the Dahlgren Vehicle System, vehicle speed information (*sensor data samples*) are received from a vehicle speed sensor (*speed sensor*).

**[1e] wherein said current conditions comprise at least one of: drag, wind resistance, tire resistance, a location relative to a destination, traffic patterns, an amount of light energy, a position of the sun, geographical information, an elevation of said vehicle, a grade of a road, a location of stoplights, a timing of stoplights, weather, a wind direction, a wind velocity, a temperature, air pressure, moisture, visibility, an amount of vibration, and traction.**

134. As discussed in Section V.A.6, the *at least one...and* phrase within [1e] may be satisfied under BRI by determination of a *current condition* from one of the Enumerated Current Conditions.

135. Dahlgren satisfies [1e] under BRI. As discussed above for [1c-1], the Dahlgren Vehicle System is configured to generally determine event information (*current conditions*) based on analyzing vehicle sensor information (*said sensor data samples*). Appx. D, [0034], [0039], [0041]; *see id.*, [0035], [0038], [0047], [0052] (describing examples of vehicle sensor information). As one example, traction control system data is analyzed to “detect events relating to the frictional interaction between the tires and the roadway,” such as “excessive slippage beyond a certain threshold” indicating that “the vehicle has encountered icy conditions on the roadway.” *Id.*, [0052]. As another example, vehicle speed data is analyzed to

“look[] for activities such as unusual stop-and-go conditions or traffic jams.” *Id.*, [0086].

136. As discussed for [1d], the traction control system data is received from a rotational speed sensor of a TCS (*revolutions-per-minute sensor*). Appx., CC; Appx. S, 1:12-24, 2:17-36, FIG. 1; Appx. T, [0042]. In my opinion, “excessive slippage” (*current condition of traction*) is determined based on analyzing traction control system data (*sensor data samples*), which is received from a rotational speed sensor of a traction control system (*revolutions-per-minute sensor*). *Id.*; see also *id.*, [0047], [0154], [0167], [0266] (discussing traction control system data).

(b) **Claim 2**

[2] ***The apparatus according to claim 1, wherein said current conditions associated with said route segment are stored in said remote database with previously stored conditions associated with said route segment.***

137. As discussed for [1c-1], in the Dahlgren Vehicle System, processor 22 is configured to correlate event information with vehicle position information such that, in some instances, excessive slippage (*current condition of traction*) is associated with a vehicle position within a portion of a travel route (*route segment*). Appx. D, [0011], [0036], [0038], [0053], [0056], [0061], [0086], [0139]. Further, as discussed for [1c-3], the event information is stored in storage

58 (*remote database*). Appx. D, [0047], [0052], [0060], [0064], [0154], [0167], [0266].

138. A POSITA would have understood that the information uploaded to storage 58 is stored with previously uploaded event information (*previously stored conditions*) based on Dahlgren’s teachings regarding the functionality of storage 58 to “store the information received from the various vehicle environments, in addition to the results of the relevance determinations carried out by central facility 12.” Appx. D, [0064]. For instance, upon receiving information from the various vehicles, the central facility 12 “will aggregate the data for analysis and interpretation.” Appx. D, [0112]. Further, “during operation,” central facility 12 may receive “regular streams of event-type information” for collection in storage 58. *Id.*, [0044]. For example, “event information may be transmitted automatically in real-time as the event is detected” or “periodically at set intervals of time.” *Id.*, [0040]; *see id.*, [0147].

139. From disclosures above, a POSITA would have recognized certain implementations where the Dahlgren Vehicle System periodically uploads event information (including correlations with vehicle position within a travel route) the central facility 12 such storage 58 aggregates the periodically uploaded data. In my opinion, such a configuration would have allowed storage 58 to retain both new and previously uploaded information to facilitate aggregation and support

Dahlgren's contemplated functionality of the central facility 12 to provide comprehensive analysis and interpretation of event information. Appx. D, [0044]. Dahlgren explains that the central facility 12 "provide[s] centralized management, control, and dissemination of the event information on a universal, global scale." *Id.*

(c) **Claim 3**

**[3] The apparatus according to claim 2, wherein said historical route information comprises said current conditions and said previously stored conditions associated with said plurality of route segments.**

140. As discussed of [2], because the Dahlgren Vehicle System is configured to upload event information to central facility 12 "periodically at set intervals of time," a POSITA would have understood that, in some implementations, storage 58 of central facility 12 is configured to store uploaded data such that newly-uploaded event information is aggregated with previously-uploaded event information. Appx. D, [0040]; *see id.*, [0044], [0064], [0112], [0147]. In such implementations, event information stored in storage 58 (**said historical information**) includes the event information uploaded by the Dahlgren Vehicle System, including event information identify, for example, excessive slippage (**said current conditions**) and previously-uploaded event information by vehicle systems of other vehicles (**said previously stored conditions associated with said plurality of route segments**). *Id.* Indeed, Dahlgren teaches that the

“communications channel between the vehicle and the central facility will need to support high bandwidth, instantaneous connections with many nodes requiring asynchronous information” and further “processes data to/from a large number of vehicles simultaneously and autonomously in real-time.” Appx. D, [0089]. Based on this disclosure, a POSITA would have understood that event information may be uploaded from multiple vehicles such that information stored in storage 58 may be aggregated with respect to multiple uploads by the same vehicle and/or multiple uploads across multiple vehicles.

(d) **Claim 4**

**[4] *The apparatus according to claim 1, wherein said data from said telemetry system comprises a Global Positioning System (GPS) signal.***

141. As discussed for [1a-1], the Dahlgren Vehicle System collects GPS signals, e.g., wireless communications regarding a vehicle’s location sent by a satellite that is obtained by a GPS receiver. *See* Appx. D, [0038], [0122]. In some examples, the Dahlgren Vehicle System obtains GPS signal data (***Global Positioning System (GPS) signal***) corresponding to measurement data used to determine a current location of a vehicle, where the measurement data is communicated wirelessly to the vehicle. This technique was conventional by the Critical Date. *See, e.g.,* Appx. Q.

(e) **Claim 5**

**[5] The apparatus according to claim 1, wherein said data from said telemetry system comprises at least one of a map service and a traffic service.**

142. As discussed for [1a-1], the Dahlgren Vehicle System collects “traffic flow” information based on use of a “in-vehicle telematics unit” that wirelessly communicates with one or more systems external to the vehicle using a “communications network,” e.g., “existing and future cellular, radio and wide-area network communications.” Appx. D, [0111]; *see also id.*, [0086], [0114]. Further, the telematics unit “collect[s] traffic flow information and correlates it to fixed geographic coordinates (roadways),” confirming that the traffic flow information is collected from a **traffic service** because it represents measured data from a remote source. *Id.*, [0115]. Indeed, receipt of traffic-related information from an external system (e.g., through a “radio, beacon, etc.”) was well-known by the Critical Date. Appx. N, [0064]; *see also* Appx. E, 4:56-67 (describing a vehicle with a vehicle information communication system (VICS) for “receiv[ing] traffic information and road information by a beacon receiver, and a road map database”), 6:59-64 (describing information received by a vehicle sensor includes “traffic jam information provided by a VICS or the like”).

(f) **Claim 6**

**[6] The apparatus according to claim 1, wherein said current conditions comprise information about an environment (a) surrounding said vehicle and (b) acting on said vehicle.**

143. As discussed for [1a-1], the Dahlgren Vehicle System includes “sensor assembly 24,” which “collects data generated in the respective vehicle environment or platform.” Appx. D, [0035] (emphasis added). This data may “issue from standard equipment in the vehicle or be retrieved from the existing communication bus in the vehicle or be retrieved from added sensors and equipment.” *Id.* Further, “the sensor data may relate to the status, operation, mode, performance, state, or any other measurable characteristic of any device, instrument, part, or component in the vehicle.” *Id.* Further, as discussed for [1c-1], in the Dahlgren Vehicle system, processor 22 is configured to analyze the vehicle sensor information to determine event information (**current conditions**). *Id.*, [0034], [0039], [0041]. This analysis “translates the otherwise raw sensor data into an interpretative outcome enabling one to understand the various driving dynamics, behaviors, mechanisms, and phenomena that are taking place interactively with one another and occurring rapidly during vehicle travel.” *Id.*, [0149]. For example, traction control system data (**current condition of traction**) is analyzed to “detect events relating to the frictional interaction between the tires and the roadway,” such as “excessive slippage beyond a certain threshold”

indicating that “the vehicle has encountered icy conditions on the roadway.” *Id.*, [0052].

144. A POSITA would have understood that “frictional interaction between the tires and the roadway” is an example of *environment... surrounding said vehicle* because such interaction affects the vehicle’s traction, stability, and overall performance. For example, frictional interaction, as described in Dahlgren, is an important aspect of the surrounding environment of a vehicle that influences driving conditions. For example, as described in Dahlgren, icy road conditions impact how the vehicle maneuvers and responses while traveling on a road, which further emphasizes the role of frictional interaction in definitions the surroundings of a vehicle. *See* Appx. D, [0052], [0070], [0076], [0165].

145. A POSITA would have understood that “frictional interaction between the tires and the roadway” is also an example of *environment...acting on said vehicle* because such interaction affects a vehicle’s movement and control. In my opinion, frictional interaction, as described in Dahlgren, determines the level of traction and braking efficiency, thereby influencing the vehicle’s safety and performance. For example, a described in Dahlgren, icy road conditions alter frictional dynamics, which poses challenges to the vehicle’s stability and require adaptive driving responses. *See* Appx. D, [0052], [0070], [0076], [0165].

(g) **Claim 7**

**[7] The apparatus according to claim 1, wherein said current conditions are determined by deriving inferences from said sensor data samples.**

146. As discussed above for [1a-1], [1c-1], and [6], the Dahlgren Vehicle system is configured to analyze vehicle sensory information (*sensor data samples*) to determine environmental information (*current conditions*). Appx. D, [0034], [0035], [0039], [0041]. This analysis “translates the otherwise raw sensor data into an interpretative outcome enabling one to understand the various driving dynamics, behaviors, mechanisms, and phenomena that are taking place interactively with one another and occurring rapidly during vehicle travel.” *Id.*, [0149] (emphasis added). A POSITA would have understood the analysis of vehicle environment information to determine event information is an example of *deriving inferences from* the vehicle environment information because it involves an “interpretative outcome” (e.g., interpreting raw data to gain insights into driving dynamics and behaviors).

147. By translating complex data into understandable outcomes, the analysis by processor 22 of the Dahlgren Vehicle System to determine environment information identifies underlying patterns and relationships that inform how various mechanisms and phenomena interact during vehicle travel. This process of drawing conclusions from data enables a deeper understanding of the vehicle’s performance and safety in different driving conditions. *See* Appx. D,

[0047] (“[i]nformation from [vehicle] sensors can be interpreted in various ways to arrive at the conclusion that certain events have occurred”). For example, traction control system data (**current condition of traction**) is analyzed to “detect events relating to the frictional interaction between the tires and the roadway,” such as “excessive slippage beyond a certain threshold” indicating that “the vehicle has encountered icy conditions on the roadway.” *Id.*, [0052]. In this example, excessive slippage may be **determined by deriving inferences from** traction control system data.

(h) **Claim 8**

**[8] The apparatus according to claim 1, wherein said historical route information comprises said current conditions received from a plurality of vehicles each using one of said apparatuses.**

148. As discussed for [1c-3], Dahlgren makes obvious that information uploaded to central facility 12 (and stored in storage 58) is an example of **historical route information for a plurality of route segments**. Appx. R, 2:48-3:35; Appx. N, [0017]; Appx. D, Abst., [0011], [0014], [0015], [0024], [0112]. Further, in the Dahlgren system, central facility 12 receives data uploaded from “a large number of vehicles simultaneously and autonomously in real-time.” Appx. D, [0089]. Based on this disclosure, a POSITA would have understood that information stored in storage 58 (**said historical route information**) includes event information may be uploaded from multiple vehicles (**said current conditions**

*received from a plurality of vehicles*). Further, as shown in Figures 1 and 2, the Dahlgren system (system 8) integrates “a multi-vehicle population having a plurality of individual vehicle environments 10 travelling in a roadway network.” Appx. D, [0032]. FIGS 1, 2. Each of the multiple vehicles has a corresponding vehicle system (each vehicle *using one of said apparatuses*). *Id.*

(i) **Claim 9**

**[9]    *The apparatus according to claim 1, wherein said apparatus is configured to receive said historical route information for said plurality of route segments.***

149. As discussed for [1c-3], Dahlgren makes obvious that information uploaded to central facility 12 (and stored in storage 58) is an example of *historical route information for a plurality of route segments*. Appx. R, 2:48-3:35; Appx. N, [0017]; Appx. D, Abst., [0011], [0014], [0015], [0024], [0112]. Further, Dahlgren teaches that an advantage of its invention is that “road condition, traffic, hazard, and vehicle data will be collected using public vehicles and **provided** in real-time to city, county, state, federal and private agencies and even **back to the drivers themselves**.” *Id.*, [0023] (emphasis added); *see id.*, [0090] (“[t]he system also transmits critical information back to drivers as requested”), [0091]. Specifically, “[d]epending upon the type of services provided and the content of the data received, status and information may be transferred back to individual vehicles...from the central information processing facility where it will

be stored and maintained.” *Id.*, [0012]. In some implementations, the Dahlgren Vehicle System (*said apparatus*) is configured to receive information previously uploaded to central facility 12 (and stored in storage 58) (*historical route information for a plurality of route segments*).

(j) **Claim 12**

**[12] The apparatus according to claim 1, wherein said interface is configured to receive from a bus of said vehicle at least one of (a) said sensor data samples and (b) said data from said telemetry system.**

150. As discussed for [1a-1], in the Dahlgren Vehicle System includes an interface (*interface*) configured to receive vehicle sensor information (*said sensor data samples*) and measurement data from remote systems (*said data from said telemetry system*). Appx. D, [0035], [0038], [0047], [0052], [0083]-[0086], [0111], [0114], [0115]. Further, Dahlgren teaches that “[d]ata from a number of sensors...is currently available on standard in-vehicle communications buses.” Appx. D, [0083] (emphasis added). The Dahlgren Vehicle System would have been configured to receive at least vehicle sensor information (*said sensor data samples*) using one or more standard in-vehicle communications buses (*bus of said vehicle*).

(k) **Claim 13**

**[13] The apparatus according to claim 1, wherein said interface is configured to receive from an external device at least one of (a) said sensor data samples and (b) said data from said telemetry system.**

151. As discussed for [1a-1], in the Dahlgren Vehicle System includes an interface (*interface*) configured to receive vehicle sensor information (*said sensor data samples*) and measurement data from remote systems (*said data from said telemetry system*). Appx. D, [0035], [0038], [0047], [0052], [0083]-[0086], [0111], [0114], [0115]. For example, the Dahlgren Vehicle System monitors “traffic flow” based on use of a “in-vehicle telematics unit” that wirelessly communicates with one or more systems external to the vehicle using a “communications network,” e.g., “existing and future cellular, radio and wide-area network communications.” Appx. D, [0111]. The Dahlgren Vehicle System would have been configured to receive traffic flow information (*said data from said telemetry system*) from one or more external systems (*external device*). Indeed, receipt of traffic-related information from an external system (e.g., through a “radio, beacon, etc.”) was well-known by the Critical Date. See Appx. N, [0064]; see also Appx. E, 4:56-67 (describing a vehicle with a vehicle information communication system (VICS) for “receiv[ing] traffic information and road information by a beacon receiver, and a road map database”), 6:59-64 (describing

information received by a vehicle sensor includes “traffic jam information provided by a VICS or the like”).

(1) **Claim 14**

**[14] The apparatus according to claim 1, wherein said current conditions comprise at least one of: energy requirements, a speed of said vehicle, road conditions, and traffic.**

152. As discussed for [1c-1], processor 22 of the Dahlgren Vehicle System is configured to analyze vehicle sensor information (*said sensor data samples*) to determine environment information (*said current conditions*). Appx. D, [0034], [0039], [0041]; *see id.*, [0035], [0038], [0047], [0052] (describing examples of vehicle sensor information). One example of vehicle sensor information is data collected by a traction control system of the vehicle (i.e., traction control system data). *See id.*, [0052], [0047], [0154], [0167], [0266] (discussing traction control system data). Dahlgren further teaches that a “[t]raction control system” “[a]llows the system to indirectly determine that a vehicle has encountered a road condition typically at an intersection with degraded vehicle motion starting ability.” Appx. D, [0154]. In at least these implementations, traction control system data (*said sensor data samples*) is analyzed to determine an encountering of a road condition associated with degraded vehicle motion starting ability (*current condition of road conditions*). For example, “traction data representing excessive slippage beyond a certain threshold may signify that the vehicle has encountered icy conditions on the

roadway.” *Id.*, [0052]; *see also id.*, [0070], [0076], [0165] (describing icy road conditions).

(m) **Claim 15**

153. Dahlgren makes the following limitation of claim 15 obvious in the same manner as explained above with respect to the corresponding limitations of claim 1 identified in the table below.

| Claim 1 | Claim 15 |
|---------|----------|
| [1a-1]  | [15c-1]  |
| [1a-2]  | [15c-2]  |
| [1b]    | [15d]    |
| [1c-1]  | [15e-1]  |
| [1c-2]  | [15e-2]  |
| [1c-3]  | [15e-3]  |
| [1d]    | [15f]    |
| [1e]    | [15g]    |

***[15pre] A vehicle comprising:***

154. To the extent the preamble is limiting, the Dahlgren Vehicle System discloses [15pre] because it “resides in a vehicle...” (***vehicle***). Appx. D, [0034]; *see id.*, [0035]-[0040]; FIG. 2.

***[15a] a power train;***

155. A vehicle incorporating the Dahlgren Vehicle System includes “Engine/Transmission control system,” which “[a]llows the system to determine a whole host of potential road-condition situations...” Appx. D, [0158]; *see id.*, [0172], [0245], [0246]. For example, by the Critical Date, a vehicle with an engine control system (e.g., a vehicle incorporating the Dahlgren Vehicle System) would have been understood to include a powertrain because the powertrain encompasses the essential components that the engine control system manages, such as the engine, transmission, and drivetrain. The integration of these components is necessary to convert the engine's power into vehicle movement efficiently and the advancement of engine control systems required coordinated management of the powertrain components to meet performance, efficiency, and emissions standards. A POSITA would have understood that a vehicle incorporating the Dahlgren Vehicle System includes a ***power train*** and a ***drive train***. *See* Appx. V, 2 (describing vehicles including a drive train and power train before the Critical Date).

***[15b] a drive train;***

156. *See* [15a].

(n) **Claim 16**

157. Dahlgren makes the following limitation of claim 16 obvious in the same manner as explained above with respect to the corresponding limitations of claim 1 identified in the table below.

| Claim 1 | Claim 16 |
|---------|----------|
| [1a-1]  | [16b]    |
| [1a-2]  | [16c]    |
| [1b]    | [16d]    |
| [1c-1]  | [16f-1]  |
| [1c-2]  | [16f-2]  |
| [1c-3]  | [16f-3]  |

***[16a] (A) monitoring a plurality of sensors to generate sensor data during operation of a vehicle, wherein the plurality of sensors comprise at least one of an optical sensor, a position sensor, a speed sensor, a gyroscopic sensor, a revolutions-per-minute sensor, an accelerator pedal position sensor, a brake pedal position sensor, a battery state sensor, a tire pressure sensor, a proximity sensor, a weight sensor, an airflow sensor, and a gas flow sensor;***

158. See [1a-1], [1d]. Further, as discussed in Section V.A.6, [16a] may be satisfied under BRI by monitoring ***a plurality of sensors*** that includes one of the Enumerated Sensors. Dahlgren discloses the ***monitoring*** step under BRI through disclosure of monitoring various sensors (e.g., ***revolutions-per-minute sensor***,

*position sensor, gyroscopic sensor*). Appx. D, [0034], [0035], [0038], [0047], [0048], [0050], [0052], [0094], [0097], [0121], [0122], [0133], [0154], [0169].

**[16e] (E) analyzing said sensor data to determine current conditions, wherein said current conditions comprise at least one of: drag, wind resistance, tire resistance, a location relative to a destination, traffic patterns, an amount of light energy, a position of the sun, geographical information, an elevation of said vehicle, a grade of a road, a location of stoplights, a timing of stoplights, weather, a wind direction, a wind velocity, a temperature, air pressure, moisture, visibility, an amount of vibration, and traction; and**

159. See [1c-1], [1e]. Further, as discussed in Section V.A.6, [16e] may be satisfied under BRI by analyzing *sensor data samples* generated by monitoring one Enumerated Sensor to determine one *current condition*. Dahlgren discloses the *analyzing* step under BRI through disclosure of monitoring various sensors (e.g., *revolutions-per-minute sensor, position sensor, gyroscopic sensor*) to determine environment information (*current conditions*), for example, excessive slippage (*traction*). Appx. D, [0034], [0035], [0038], [0047], [0048], [0050], [0052], [0094], [0097], [0121], [0122], [0133], [0154], [0169].

**D. GROUND 2—Kuroda in view of Dahlgren Makes Claims 10 and 11 Obvious**

**1. Analysis**

160. This section addresses claims 10 and 11, but the combination of Kuroda and Dahlgren also satisfies the elements of claims 1-9 and 12-16. As explained in Section V.B.1, Kuroda-Dahlgren incorporates the teachings of Dahlgren that are discussed in reference to the elements recited by claims 1-9 and

12-16. *Compare* Section V.B.1 (discussing Kuroda-Dahlgren) and Section V.B.1 (addressing claim 1 based on Dahlgren). Specifically, Kuroda-Dahlgren would have provided a hybrid vehicle (e.g., Kuroda’s vehicle 100) that includes Dahlgren’s communication unit 26 to enable communications with Dahlgren’s central facility 12 over communication network 16. Appx. D, [0034], [0036], [0040], [0043]. The functionality associated with the Dahlgren Vehicle System and the central facility 12 discussed in Section V.C.1 would similarly be provided by Kuroda-Dahlgren. For this reason, Kuroda-Dahlgren satisfies the requirements of claims 1-9 and 12-16 for the same reasons discussed in Ground 1. *See, e.g.*, Section V.B.1 (addressing the requirements of claim 1).

**(a) Claim 10**

***[10] The apparatus according to claim 9, where operational parameters of said vehicle are adjusted for said route segment based on said historical route information.***

161. According to the ’616 patent specification, examples of “operational parameters” include “aerodynamic parameters (CDA), rolling resistance parameters (Crr1 and Crr2), drive train efficiency parameters, motor efficiency parameters, battery model parameters, battery charge and discharge relationships, type of battery.” Appx. A, 4:35-47. Further, “[m]any parameters may impact the optimal power consumption of a vehicle,” including “operational parameters of the vehicle (e.g., performance capabilities of the vehicle based on the make and model

and/or the component parts of the vehicle, as well as the historical performance of the vehicle).” Appx. A, 1:54-63. Based on these disclosures, the *operational parameters* recited in claim 10 encompass, for example, parameters relating to performance that impact the optimal power consumption of a vehicle.

162. As discussed in §VII.C.1, Kuroda-Dahlgren provides a vehicle configured to determine an “operating schedule” for a vehicle that adjusts vehicle speed patterns based on monitored traffic flow information. Appx. E, 4:56-67, 6:59-64, 7:10-34; see also Appx. D, [0050], [0220]. Kuroda explains that the “operating schedule” impacts operation of “an engine and a motor so as to minimize fuel consumption in accordance with road conditions of a route to a destination.” Appx, E, 1:6-11. For example, Kuroda teaches using the “operating schedule” to adapt an engine power “necessary to drive the vehicle” according to a specified pattern. *Id.*, 5:13-26 (“a positive value indicates a driving power and a negative value indicates a braking power”). Kuroda also describes adjusting “engine torque” when applying an “operating schedule” to adjust vehicle operation. See *id.*, 5:33-54. Other examples of adapted parameters include “engine speed (rpm),” “operating point,” “engine output” and “quantity of power generation.” *Id.*; Appx C, XX.

163. Thus, in Kuroda-Dahlgren, when an operating schedule is used to adapt vehicle operation, the vehicle monitors various engine parameters, e.g.,

engine power, engine torque (*operational parameters*), which may be adjusted based on a pattern specified for the operating schedule for a particular travel route (*adjusted for said route segment*). These parameters are examples of *operational parameters* because they relate to the “performance capabilities of the vehicle based on the make and model and/or the component parts of the vehicle,” as described in the ’619 patent specification. Appx. A, 1:54-63.

164. Further, as discussed for claim 9 in Ground 1A, Dahlgren renders obvious that information uploaded to central facility 12 (and stored in storage 58) is an example of *historical route information*. Appx. D, [0040], [0044], [0086], [0011]. And, as discussed in §VII.C.1, Kuroda-Dahlgren provides a hybrid vehicle incorporating Dahlgren’s teachings to access to additional types of information stored in Dahlgren’s central facility 12 to achieve further fuel consumption efficiencies. The accessed information (e.g., traffic condition information) would have enabled, for instance, improved accuracy in assessing road condition and vehicle speed pattern information when creating an “operating schedule” for a travel route. See Appx. D, [0097], [0101], [0261]; Appx. E, 6:40-45, FIG. 6. Thus, in Kuroda-Dahlgren, adjustment of various engine parameters, e.g., engine power, engine torque (*operational parameters*), based on a pattern specified for the operating schedule for a particular travel route (*adjusted for said route*

*segment*) may be based on information obtained from a central facility, such as traffic condition information (*based on said historical route information*).

165. In my opinion, a POSITA would have recognized that traffic condition information obtained from a central facility would have provided greater insights on portions of a travel route where a vehicle is expected to travel slower, which would then be reflected in the “operating schedule” by reducing engine power for those portions of the travel route, consistent with Kuroda’s teachings. *Id.*; see also Appx, E, 1:6-11, 7:35-8:3, FIGS. 9A-9E. This adjustment would then be reflected in the “operating schedule” by reducing engine power for those portions of the travel route, consistent with Kuroda’s teachings. Additionally, this approach would contribute to extending the vehicle’s range and improving overall system performance by reducing unnecessary acceleration in congested areas.

166. Further, Dahlgren suggests collecting and/or adjusting *operational parameters* through descriptions that “sensor data may relate to the status, operation, mode, **performance**, state, or any other measurable characteristic of any device, instrument, part, or component in the vehicle.” Appx. D, [0035] (emphasis added). For example, sensor data can be “collected from existing standard equipment such as the vehicle communication bus or add-on sensor[.]” so that the collected sensor data is indicative of “vehicle performance.” *Id.*, [0010]. For instance, the Dahlgren system enables collection of “data on the performance of

any component within the vehicle system,” e.g., “engine, [Anti-lock Braking System], airbag,” and “store that performance data for analysis by OEMs.” *Id.*, [0177].

167. From these disclosures, a POSITA would have further understood that performance data collected by the vehicle provided Kuroda-Dahlgren includes, for instance, data indicating motor efficiency parameters, and thereby includes ***operational parameters***. This is because Dahlgren identifies “engine” as a vehicle system from which performance data is collected, a POSITA would have understood that the performance data includes parameters relating to engine performance (e.g., fuel consumption, power output, and overall efficiency). Appx. D, [0177]; *see also* Appx. D, [0261] (“data may be collected to determine average fuel economy for cars and render interpretations as to the efficiency of the vehicle consumption”). The on-board vehicle system gathers various types of performance data, including parameters such as fuel consumption, power output, and overall efficiency. These parameters are crucial for understanding the performance characteristics of a vehicle's engine and are typically monitored using sensors integrated into the vehicle's systems. For example, high fuel consumption may indicate inefficiencies or mechanical issues within the engine or related systems. Monitoring the power output of the engine is essential to ensure that the engine performs optimally under different driving conditions.

**(b) Claim 11**

168. As described in the '616 patent specification, “determin[ing] an optimally efficient speed (or the optimal power to be supplied to the engine) may involve “optimiz[ing] the energy supplied to an engine so that the vehicle travels at a fuel-efficient speed.” Appx. A, 11:31-49; *see also id.*, 19:19-31 (“[a] efficient speed (or efficient speed output of the power management system) may also be expressed as the applied power that is provided to the engine to achieve the speed at which the fuel efficiency is optimal”). Indeed, given the '616 patent’s focus on improving fuel efficiency, a POSITA would have recognized that power adjustment to achieve fuel efficiency as an example of the adjustment of *operational parameters* for *optimiz[ing] power consumption of said vehicle*, as recited by claim 11.

169. As discussed for [10], in Kuroda-Dahlgren, when an operating schedule is used to adapt vehicle operation, the vehicle monitors various engine parameters, e.g., engine power, engine torque (*operational parameters*), which may be adjusted based on a pattern specified for the operating schedule for a particular travel route (*adjust[ed]*), and the adjustment may be based on information obtained from a central facility, such as traffic condition information (*based on said historical route information*). As described in Kuroda, the “operating schedule” is used to adjust vehicle operation “to minimize fuel

consumption in accordance with road conditions of a route to a destination.”

Appx. E, 1:6-11; *see also id.*, 5:1-39. Thus, in Kuroda-Dahlgren, various engine parameters, e.g., engine power, engine torque (*operational parameters*), may be adjusted to create an “operating schedule” that improve fuel efficiency (*is performed to optimize power consumption of said vehicle*). *See* [10], *supra*.

## **VI. LEGAL STANDARDS**

170. I am not a lawyer. I have relied on Requestor’s Counsel to inform me of the relevant legal principles for this analysis. That understanding is provided as follows.

### **A. Legal Standards for Prior Art**

171. I understand that a patent or other publication must first qualify as prior art before it can be used to invalidate a patent claim.

172. I understand that a U.S. or foreign patent qualifies as prior art to a patent if the date of issuance of the U.S. or foreign patent is prior to the invention of the patent. I further understand that a printed publication, such as an article published in a magazine or trade publication, qualifies as prior art to a patent if the date of publication is prior to the invention of the patent. My understanding is that, for such prior art references, a patentee may attempt to show that the claimed invention was conceived prior to the issuance of the U.S. foreign patent or publication of the printed materials. To do so, it is my understanding that patentee

must prove with corroborating evidence that the named inventors conceived of the complete claimed invention before the prior art and were diligent in reducing the claimed inventions to practice.

173. I understand that, regardless of the date of invention of the patent, a U.S. or foreign patent qualifies as prior art to the patent if the date of issuance of the U.S. or foreign patent is more than one year before the earliest effective filing date of the patent. I further understand that a printed publication, such as an article published in a magazine or trade publication, constitutes prior art to the patent if the publication occurs more than one year before the earliest effective filing date of the patent, again regardless of the date of invention of the patent.

174. I understand that a U.S. patent or published U.S. application qualifies as prior art to the patent if the application for that U.S. patent or published U.S. application was filed in the United States before the invention of the patent. My understanding is that, for such prior art references, a patentee may attempt to show that the claimed invention was conceived prior to the filing in the United States of the purported prior art U.S. patent or application. To do so, it is my understanding that patentee must prove with corroborating evidence that the named inventors conceived of the complete claimed invention before the prior art and were diligent in reducing the claimed inventions to practice.

175. I understand that documents and materials that qualify as prior art can be used to invalidate a patent claim as anticipated or as obvious.

**B. Legal Standard for Anticipation**

176. I have been informed by Counsel and understand that documents and materials that qualify as prior art can render a patent claim unpatentable as anticipated. I am informed by Counsel and understand that all prior art references are to be looked at from the viewpoint of a POSITA.

177. I am informed by Counsel and understand that a challenged claim is unpatentable as “anticipated” under 35 U.S.C. § 102 if it is determined that all the limitations of the claim are described in a single prior art reference. I am informed by Counsel and understand that, to anticipate a claim, a prior art reference must disclose, either expressly or inherently, each and every limitation of that claim and enable one of ordinary skill in the art to make and use the invention.

**C. Legal Standard for Obviousness**

178. I have been informed by Counsel and understand that documents and materials that qualify as prior art can render a patent claim unpatentable as obvious. I am informed by Counsel and understand that all prior art references are to be looked at from the viewpoint of a POSITA at the time of the invention, and that this viewpoint prevents one from using his or her own insight or hindsight in deciding whether a claim is obvious.

179. I have been informed by Counsel and understand that a claim is unpatentable for obviousness under 35 U.S.C. § 103 (in the pre-AIA form of that statute that applies to the '616 patent) “if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains.” I am informed by Counsel and understand that obviousness may be based upon a combination of references. I am informed by Counsel and understand that the combination of familiar elements according to known methods is likely to be obvious when it does no more than yield predictable results. However, I am informed by Counsel and understand that a patent claim composed of several elements is not proved obvious merely by demonstrating that each of its elements was, independently, known in the prior art.

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

181. I am informed by Counsel and understand that a patent claim composed of several limitations is not proved obvious merely by demonstrating that each of its limitations was independently known in the prior art. I am informed by counsel for the Patent Owner and understand that identifying a reason those elements would be combined can be important because inventions in many instances rely upon building blocks long since uncovered, and claimed discoveries almost of necessity will be combinations of what, in some sense, is already known. I am informed by Counsel and understand that it is improper to use hindsight in an obviousness analysis, and that a patent's claims should not be used as a "roadmap."

182. I am informed by Counsel and understand that an obviousness inquiry requires consideration of the following factors: (1) the scope and content of the prior art; (2) the differences between the claims and the prior art; (3) the level of ordinary skill in the pertinent art; and (4) any objective indicia of non-obviousness, such as commercial success, long-felt but unresolved need, failure of others, industry recognition, copying, and unexpected results. I understand that the foregoing factors are sometimes referred to as the "Graham factors."

183. I have been informed by Counsel and understand that an obviousness evaluation can be based on a combination of multiple prior art references. I understand that the prior art references themselves may provide a suggestion, motivation, or reason to combine, but that the nexus linking two or more prior art

references is sometimes simple common sense. I have been informed by Counsel and understand that obviousness analysis recognizes that market demand, rather than scientific literature, often drives innovation, and that a motivation to combine references may be supplied by the direction of the marketplace.

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

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

186. I have been informed by Counsel and understand that a proper obviousness analysis focuses on what was known or obvious to a POSITA at the time of invention, not just the patentee. Accordingly, I understand that any need or

problem known in the field of endeavor at the time of invention and addressed by the patent can provide a reason for combining the elements in the manner claimed.

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

188. I have been informed by Counsel and understand that secondary indicia of non-obviousness may include (1) a long felt but unmet need in the prior art that was satisfied by the invention of the patent; (2) commercial success of processes covered by the patent; (3) unexpected results achieved by the invention; (4) praise of the invention by others skilled in the art; (5) taking of licenses under the patent by others; (6) deliberate copying of the invention; (7) failure of others to find a solution to the long felt need; and (8) skepticism by experts. I understand that evidence of secondary indicia of non-obviousness, if available, should be considered as part of the obviousness analysis.

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

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