PTO/AIA/80 (07-12)
Approved for use through 11/30/2014. OMB 0651-0035
U.S. Patent and Trademark Office; U.S DEPARTMENT OF COMMERCE
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POWER OF ATTORNEY TO PROSECUTE APPLICATIONS BEFORE THE USPTO

I hereby revoke all previous powers of attorney given in the application identified in the attached statement under 37 CFR 3.73(c).

I hereby appoint:

☒ Practitioners associated with Customer Number: 145156

OR

☐ Practitioner(s) named below (if more than ten patent practitioners are to be named, then a customer number must be used):

Name	Registration Number	Name	Registration Number

As attorney(s) or agent(s) to represent the undersigned before the United States Patent and Trademark Office (USPTO) in connection with any and all patent applications assigned only to the undersigned according to the USPTO assignment records or assignments documents attached to this form in accordance with 37 CFR 3.73(c).

Please change the correspondence address for the application identified in the attached statement under 37 CFR 3.73(c) to:

☒ The address associated with Customer Number: 145156

OR

☐	Firm or Individual Name		
	Address		
	City	State	Zip
	Country		
	Telephone	Email	

Assignee Name and Address: Bell Textron Inc.
Mail Stop HQ 04415
Post Office Box 482
Fort Worth, Texas 76101

A copy of this form, together with a statement under 37 CFR 3.73(c) (Form PTO/AIA/96 or equivalent) is required to be Filed in each application in which this form is used. The statement under 37 CFR 3.73(c) may be completed by one of The practitioners appointed in this form, and must identify the application in which this Power of Attorney is to be filed.

SIGNATURE of Assignee of Record

The individual whose signature and title is supplied below is authorized to act on behalf of the assignee

Signature		Date	7-1-2019
Name	Rus Holloway	Telephone	817-280-2031
Title	Deputy General Counsel-Intellectual Property		

This collection of information is required by 37 CFR 1.31, 1.32 and 1.33. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 3 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

DJI-1002
IPR2023-01227

Privacy Act Statement

The **Privacy Act of 1974 (P.L. 93-579)** requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether disclosure of these records is required by the Freedom of Information Act.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (*i.e.*, GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspection or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

DECLARATION

Title of Invention: Fleet Controller

Attorney Docket No.: BEL-IN140-19.02

As the below named inventor, I hereby declare that:

This declaration is directed to:

- ☒ The attached application, or
- ☐ United States application number or PCT international application number _____ filed on _____.

The above-identified application was made or authorized to be made by me.

I believe that I am the original inventor or an original joint inventor of a claimed invention in the application.

I have reviewed and understand the contents of the application, including the claims.

I am aware of the duty to disclose to the U.S. Patent and Trademark Office all information known to me to be material to patentability as defined in 37 C.F.R. §1.56.

All statements made of my own knowledge are true and all statements made on information and belief are believed to be true.

I hereby acknowledge that any willful false statement made in this declaration may jeopardize the validity of the application or any patent issuing thereon and is punishable under 18 U.S.C. §1001 by fine or imprisonment of not more than five (5) years, or both.

Inventor Signature _____ Date 12/18/2019

Inventor Name: Grant Mark Bristow

DECLARATION

Title of Invention: Fleet Controller

Attorney Docket No.: BEL-IN140-19.02

As the below named inventor, I hereby declare that:

This declaration is directed to:

- ☒ The attached application, or
- ☐ United States application number or PCT international application number _____ filed on _____.

The above-identified application was made or authorized to be made by me.

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Inventor Signature _____ Date 12-18-19

Inventor Name: Matthew David Holvey

DECLARATION

Title of Invention: Fleet Controller

Attorney Docket No.: BEL-IN140-19.02

As the below named inventor, I hereby declare that:

This declaration is directed to:

- ☒ The attached application, or
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Inventor Signature _____ Date 12/18/19

Inventor Name: Naveed Ahmed Siddiqui

PTO/AIA/96 (08-12)
Approved for use through 01/31/2013. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

STATEMENT UNDER 37 CFR 3.73(c)

Applicant/Patent Owner: Bell Textron Inc.

Application No./Patent No.: TBD Filed/Issue Date: Herewith

Titled: Fleet Controller

Bell Textron Inc., a Corporation

(Name of Assignee) (Type of Assignee, e.g., corporation, partnership, university, government agency, etc.)

states that, for the patent application/patent identified above, it is (choose **one** of options 1, 2, 3 or 4 below):

1. ☑ The assignee of the entire right, title, and interest.

2. ☐ An assignee of less than the entire right, title, and interest (check applicable box):

   ☐ The extent (by percentage) of its ownership interest is _____%. Additional Statement(s) by the owners holding the balance of the interest must be submitted to account for 100% of the ownership interest.

   ☐ There are unspecified percentages of ownership. The other parties, including inventors, who together own the entire right, title and interest are:

   Additional Statement(s) by the owner(s) holding the balance of the interest must be submitted to account for the entire right, title, and interest.

3. ☐ The assignee of an undivided interest in the entirety (a complete assignment from one of the joint inventors was made). The other parties, including inventors, who together own the entire right, title, and interest are:

   Additional Statement(s) by the owner(s) holding the balance of the interest must be submitted to account for the entire right, title, and interest.

4. ☐ The recipient, via a court proceeding or the like (*e.g.*, bankruptcy, probate), of an undivided interest in the entirety (a complete transfer of ownership interest was made). The certified document(s) showing the transfer is attached.

The interest identified in option 1, 2 or 3 above (not option 4) is evidenced by either (choose **one** of options A or B below):

A. ☑ An assignment from the inventor(s) of the patent application/patent identified above. The assignment was recorded in the United States Patent and Trademark Office at Reel _____, Frame _____, or for which a copy thereof is attached.

B. ☐ A chain of title from the inventor(s), of the patent application/patent identified above, to the current assignee as follows:

1. From: _____ To: _____

   The document was recorded in the United States Patent and Trademark Office at

   Reel _____, Frame _____, or for which a copy thereof is attached.

2. From: _____ To: _____

   The document was recorded in the United States Patent and Trademark Office at

   Reel _____, Frame _____, or for which a copy thereof is attached.

This collection of information is required by 37 CFR 3.73(b). The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450**.

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PTO/AIA/96 (08-12)
Approved for use through 01/31/2013. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
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STATEMENT UNDER 37 CFR 3.73(c)

3. From: _____ To: _____

The document was recorded in the United States Patent and Trademark Office at

Reel _____, Frame _____, or for which a copy thereof is attached.

4. From: _____ To: _____

The document was recorded in the United States Patent and Trademark Office at

Reel _____, Frame _____, or for which a copy thereof is attached.

5. From: _____ To: _____

The document was recorded in the United States Patent and Trademark Office at

Reel _____, Frame _____, or for which a copy thereof is attached.

6. From: _____ To: _____

The document was recorded in the United States Patent and Trademark Office at

Reel _____, Frame _____, or for which a copy thereof is attached.

☐ Additional documents in the chain of title are listed on a supplemental sheet(s).

☑ As required by 37 CFR 3.73(c)(1)(i), the documentary evidence of the chain of title from the original owner to the assignee was, or concurrently is being, submitted for recordation pursuant to 37 CFR 3.11.

[NOTE: A separate copy (i.e., a true copy of the original assignment document(s)) must be submitted to Assignment Division in accordance with 37 CFR Part 3, to record the assignment in the records of the USPTO. See MPEP 302.08]

The undersigned (whose title is supplied below) is authorized to act on behalf of the assignee.

/Robert G. Graham/	December 19, 2019
Signature	Date
Robert G. Graham	58042
Printed or Typed Name	Title or Registration Number

[Page 2 of 2]

Privacy Act Statement

The **Privacy Act of 1974 (P.L. 93-579)** requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

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2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
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6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
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9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

ATTORNEY DOCKET NO.
BEL-IN140-19.02

ASSIGNMENT

WHEREAS, I, the undersigned inventor (or one of the undersigned joint inventors), of residence as listed, having invented certain new and useful improvements as below entitled, for which application for United States Letters Patent is made; and

WHEREAS, Bell Textron Inc. ("Assignee"), a corporation organized and existing under the laws of TX, with its principal office at Mail Stop HQ 04415 P.O. Box 482, Fort Worth, TX 76101, is desirous of acquiring my entire right, title and interest in and to said invention, and to said application and any Letters Patent that may issue thereon in the United States and all other countries throughout the world;

NOW, THEREFORE, for good and valuable consideration, the receipt of which is hereby acknowledged, I hereby sell and assign to said Assignee, its successors and assigns, my entire right, title and interest in and to said invention and in and to said application and all patents which may be granted therefor, and all future non-provisional applications including divisions, reissues, substitutions, continuations, and extensions thereof; and I hereby authorize and request the Commissioner for Patents to issue all patents for said invention, or patent resulting therefrom, insofar as my interest is concerned, to said Assignee, as assignee of my entire right, title and interest. I declare that I have not executed and will not execute any agreement in conflict herewith.

I also hereby sell and assign to Assignee, its successors and assigns, my foreign rights to the invention disclosed in said application, in all countries of the world, including, but not limited to, the right to file applications and obtain patents under the terms of the International Convention for the Protection of Industrial Property, and of the European Patent Convention, and further agree to execute any and all patent applications, assignments, affidavits, and any other papers in connection therewith necessary to perfect such patent rights.

I hereby further agree that I will communicate to said Assignee, or to its successors, assigns, and legal representatives, any facts known to me respecting said invention or the file history thereof, and at the expense of said Assignee, its legal representatives, successors, or assigns, will testify in any legal proceedings, sign all lawful papers, execute all divisional, continuation, reissue and substitute applications, make all lawful oaths, and generally do everything possible to aid said Assignee, its legal representatives, successors, and assigns, to obtain and enforce proper patent protection for said invention in all countries.

IN WITNESS WHEREOF, I hereunto set my hand and seal this day and year.

TITLE OF INVENTION	Fleet Controller			
SIGNATURE OF INVENTOR AND NAME	Grant Mark Bristow	Matthew David Holvey	Naveed Ahmed Siddiqui	
DATE	12/18/2019			
RESIDENCE	Benbrook, TX	North Richland Hills, TX	Dallas, TX	

ATTORNEY DOCKET NO.
BEL-IN140-19.02

ASSIGNMENT

WHEREAS, I, the undersigned inventor (or one of the undersigned joint inventors), of residence as listed, having invented certain new and useful improvements as below entitled, for which application for United States Letters Patent is made; and

WHEREAS, Bell Textron Inc. ("Assignee"), a corporation organized and existing under the laws of TX, with its principal office at Mail Stop HQ 04415 P.O. Box 482, Fort Worth, TX 76101, is desirous of acquiring my entire right, title and interest in and to said invention, and to said application and any Letters Patent that may issue thereon in the United States and all other countries throughout the world;

NOW, THEREFORE, for good and valuable consideration, the receipt of which is hereby acknowledged, I hereby sell and assign to said Assignee, its successors and assigns, my entire right, title and interest in and to said invention and in and to said application and all patents which may be granted therefor, and all future non-provisional applications including divisions, reissues, substitutions, continuations, and extensions thereof; and I hereby authorize and request the Commissioner for Patents to issue all patents for said invention, or patent resulting therefrom, insofar as my interest is concerned, to said Assignee, as assignee of my entire right, title and interest. I declare that I have not executed and will not execute any agreement in conflict herewith.

I also hereby sell and assign to Assignee, its successors and assigns, my foreign rights to the invention disclosed in said application, in all countries of the world, including, but not limited to, the right to file applications and obtain patents under the terms of the International Convention for the Protection of Industrial Property, and of the European Patent Convention, and further agree to execute any and all patent applications, assignments, affidavits, and any other papers in connection therewith necessary to perfect such patent rights.

I hereby further agree that I will communicate to said Assignee, or to its successors, assigns, and legal representatives, any facts known to me respecting said invention or the file history thereof, and at the expense of said Assignee, its legal representatives, successors, or assigns, will testify in any legal proceedings, sign all lawful papers, execute all divisional, continuation, reissue and substitute applications, make all lawful oaths, and generally do everything possible to aid said Assignee, its legal representatives, successors, and assigns, to obtain and enforce proper patent protection for said invention in all countries.

IN WITNESS WHEREOF, I hereunto set my hand and seal this day and year;

TITLE OF INVENTION	Fleet Controller			
SIGNATURE OF INVENTOR AND NAME	Grant Mark Bristow	 Matthew David Holvey	Naveed Ahmed Siddiqui	
DATE		12-18-19		
RESIDENCE	Benbrook, TX	North Richland Hills, TX	Dallas, TX	

ATTORNEY DOCKET NO.
BEL-IN140-19.02

ASSIGNMENT

WHEREAS, I, the undersigned inventor (or one of the undersigned joint inventors), of residence as listed, having invented certain new and useful improvements as below entitled, for which application for United States Letters Patent is made; and

WHEREAS, Bell Textron Inc. ("Assignee"), a corporation organized and existing under the laws of TX, with its principal office at Mail Stop HQ 04415 P.O. Box 482, Fort Worth, TX 76101, is desirous of acquiring my entire right, title and interest in and to said invention, and to said application and any Letters Patent that may issue thereon in the United States and all other countries throughout the world;

NOW, THEREFORE, for good and valuable consideration, the receipt of which is hereby acknowledged, I hereby sell and assign to said Assignee, its successors and assigns, my entire right, title and interest in and to said invention and in and to said application and all patents which may be granted therefor, and all future non-provisional applications including divisions, reissues, substitutions, continuations, and extensions thereof; and I hereby authorize and request the Commissioner for Patents to issue all patents for said invention, or patent resulting therefrom, insofar as my interest is concerned, to said Assignee, as assignee of my entire right, title and interest. I declare that I have not executed and will not execute any agreement in conflict herewith.

I also hereby sell and assign to Assignee, its successors and assigns, my foreign rights to the invention disclosed in said application, in all countries of the world, including, but not limited to, the right to file applications and obtain patents under the terms of the International Convention for the Protection of Industrial Property, and of the European Patent Convention, and further agree to execute any and all patent applications, assignments, affidavits, and any other papers in connection therewith necessary to perfect such patent rights.

I hereby further agree that I will communicate to said Assignee, or to its successors, assigns, and legal representatives, any facts known to me respecting said invention or the file history thereof, and at the expense of said Assignee, its legal representatives, successors, or assigns, will testify in any legal proceedings, sign all lawful papers, execute all divisional, continuation, reissue and substitute applications, make all lawful oaths, and generally do everything possible to aid said Assignee, its legal representatives, successors, and assigns, to obtain and enforce proper patent protection for said invention in all countries.

IN WITNESS WHEREOF, I hereunto set my hand and seal this day and year;

TITLE OF INVENTION	Fleet Controller			
SIGNATURE OF INVENTOR AND NAME	Grant Mark Bristow	Matthew David Holvey	 Naveed Ahmed Siddiqui	
DATE			12/18/19	
RESIDENCE	Benbrook, TX	North Richland Hills, TX	Dallas, TX	

Electronic Patent Application Fee Transmittal

Application Number:	
Filing Date:	
Title of Invention:	Fleet Controller
First Named Inventor/Applicant Name:	Grant Mark Bristow
Filer:	Robert G. Graham/Jennifer Rubio
Attorney Docket Number:	BEL-IN140-19.02

Filed as Large Entity

Filing Fees for Utility under 35 USC 111(a)

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
UTILITY APPLICATION FILING	1011	1	300	300
UTILITY SEARCH FEE	1111	1	660	660
UTILITY EXAMINATION FEE	1311	1	760	760
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				
Miscellaneous:				
			Total in USD ($)	**1720**

Electronic Acknowledgement Receipt

EFS ID:	38086699
Application Number:	16720543
International Application Number:	
Confirmation Number:	4655
Title of Invention:	Fleet Controller
First Named Inventor/Applicant Name:	Grant Mark Bristow
Customer Number:	145156
Filer:	Robert G. Graham/Jennifer Rubio
Filer Authorized By:	Robert G. Graham
Attorney Docket Number:	BEL-IN140-19.02
Receipt Date:	19-DEC-2019
Filing Date:	
Time Stamp:	13:42:39
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	CARD
Payment was successfully received in RAM	$1720
RAM confirmation Number	E2019BID43048274
Deposit Account	501065
Authorized User	Jennifer Rubio

The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows:

37 CFR 1.16 (National application filing, search, and examination fees)

37 CFR 1.17 (Patent application and reexamination processing fees)

37 CFR 1.19 (Document supply fees)

37 CFR 1.20 (Post Issuance fees)

37 CFR 1.21 (Miscellaneous fees and charges)

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Application Data Sheet	BELIN1401902_ADS.PDF	1228479 964a384975306886e74329d792b64989c50fbb3e	no	9
Warnings:					
Information:					
2		BEL-IN140-1902_Spec.pdf	158669 e465e5e837245742619eaccc9b86eb785e02855a	yes	30

	Multipart Description/PDF files in .zip description		
	Document Description	**Start**	**End**
	Abstract	30	30
	Claims	24	29
	Specification	1	23

Warnings:					
Information:					
3	Drawings-only black and white line drawings	BEL-IN140-1902_Drawings.PDF	139027 88f4729dc11da9688c4d46aed90388cbce28c3ba	no	4
Warnings:					
Information:					
4	Power of Attorney	BEL-IN140-1902_POA.PDF	2293528 839612781a27a611ecaa6b0226bb9e8c3e8d41a5	no	2
Warnings:					
Information:					
5	Oath or Declaration filed	BEL-IN140-1902_Declaration.PDF	286017 007a29e56e8b09a878da006764a6cef7261d48e7	no	3

Warnings:					
Information:					
6	Power of Attorney	BEL-IN140-1902_373.pdf	589841 a7e6d82ca60bc2144868e50c04526d02380ced31	no	6
Warnings:					
Information:					
7	Fee Worksheet (SB06)	fee-info.pdf	35111 d36ab8427968760f2109691ffe949780b8fe0525	no	2
Warnings:					
Information:					
			Total Files Size (in bytes):	4730672	

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

PTO/AIA/14 (02-18)
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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	BEL-IN140-19.02
	Application Number	
Title of Invention	Fleet Controller	

The application data sheet is part of the provisional or nonprovisional application for which it is being submitted. The following form contains the bibliographic data arranged in a format specified by the United States Patent and Trademark Office as outlined in 37 CFR 1.76.
This document may be completed electronically and submitted to the Office in electronic format using the Electronic Filing System (EFS) or the document may be printed and included in a paper filed application.

Secrecy Order 37 CFR 5.2:

☐ Portions or all of the application associated with this Application Data Sheet may fall under a Secrecy Order pursuant to 37 CFR 5.2 (Paper filers only. Applications that fall under Secrecy Order may not be filed electronically.)

Inventor Information:

Inventor 1 Remove

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	Grant	Mark	Bristow	

Residence Information (Select One) ● US Residency Non US Residency Active US Military Service

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Country	US

Inventor 3 Remove

Legal Name

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	Naveed	Ahmed	Siddiqui	

Residence Information (Select One) ◉ US Residency Non US Residency Active US Military Service

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	BEL-IN140-19.02
	Application Number	
Title of Invention	Fleet Controller	

City	Dallas	State/Province	TX	Country of Residence	US

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Postal Code	75201	**Country**	US

All Inventors Must Be Listed - Additional Inventor Information blocks may be generated within this form by selecting the **Add** button. Add

Correspondence Information:

Enter either Customer Number or complete the Correspondence Information section below.
For further information see 37 CFR 1.33(a).

☐ **An Address is being provided for the correspondence Information of this application.**

Customer Number	145156		
Email Address	docketing@slatermatsil.com	Add Email	Remove Email

Application Information:

Title of the Invention	Fleet Controller		
Attorney Docket Number	BEL-IN140-19.02	**Small Entity Status Claimed**	☐
Application Type	Nonprovisional		
Subject Matter	Utility		
Total Number of Drawing Sheets (if any)	4	**Suggested Figure for Publication (if any)**	

Filing By Reference:

Only complete this section when filing an application by reference under 35 U.S.C. 111(c) and 37 CFR 1.57(a). Do not complete this section if application papers including a specification and any drawings are being filed. Any domestic benefit or foreign priority information must be provided in the appropriate section(s) below (i.e., "Domestic Benefit/National Stage Information" and "Foreign Priority Information").

For the purposes of a filing date under 37 CFR 1.53(b), the description and any drawings of the present application are replaced by this reference to the previously filed application, subject to conditions and requirements of 37 CFR 1.57(a).

Application number of the previously filed application	Filing date (YYYY-MM-DD)	Intellectual Property Authority or Country

Publication Information:

☐ Request Early Publication (Fee required at time of Request 37 CFR 1.219)

☐ **Request Not to Publish.** I hereby request that the attached application not be published under 35 U.S.C. 122(b) and certify that the invention disclosed in the attached application **has not and will not** be the subject of an application filed in another country, or under a multilateral international agreement, that requires publication at eighteen months after filing.

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	BEL-IN140-19.02
	Application Number	
Title of Invention	Fleet Controller	

Representative Information:

Representative information should be provided for all practitioners having a power of attorney in the application. Providing this information in the Application Data Sheet does not constitute a power of attorney in the application (see 37 CFR 1.32).
Either enter Customer Number or complete the Representative Name section below. If both sections are completed the customer Number will be used for the Representative Information during processing.

Please Select One:	● Customer Number	US Patent Practitioner	◯ Limited Recognition (37 CFR 11.9)
Customer Number	145156		

Domestic Benefit/National Stage Information:

This section allows for the applicant to either claim benefit under 35 U.S.C. 119(e), 120, 121, 365(c), or 386(c) or indicate National Stage entry from a PCT application. Providing benefit claim information in the Application Data Sheet constitutes the specific reference required by 35 U.S.C. 119(e) or 120, and 37 CFR 1.78.
When referring to the current application, please leave the "Application Number" field blank.

Prior Application Status			Remove
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)

Additional Domestic Benefit/National Stage Data may be generated within this form by selecting the **Add** button. Add

Foreign Priority Information:

This section allows for the applicant to claim priority to a foreign application. Providing this information in the application data sheet constitutes the claim for priority as required by 35 U.S.C. 119(b) and 37 CFR 1.55. When priority is claimed to a foreign application that is eligible for retrieval under the priority document exchange program (PDX)[i] the information will be used by the Office to automatically attempt retrieval pursuant to 37 CFR 1.55(i)(1) and (2). Under the PDX program, applicant bears the ultimate responsibility for ensuring that a copy of the foreign application is received by the Office from the participating foreign intellectual property office, or a certified copy of the foreign priority application is filed, within the time period specified in 37 CFR 1.55(g)(1).

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Application Number	Country[i]	Filing Date (YYYY-MM-DD)	Access Code[i] (if applicable)

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	BEL-IN140-19.02
	Application Number	
Title of Invention	Fleet Controller	

Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications

☐ This application (1) claims priority to or the benefit of an application filed before March 16, 2013 and (2) also contains, or contained at any time, a claim to a claimed invention that has an effective filing date on or after March 16, 2013.
NOTE: By providing this statement under 37 CFR 1.55 or 1.78, this application, with a filing date on or after March 16, 2013, will be examined under the first inventor to file provisions of the AIA.

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	BEL-IN140-19.02
	Application Number	
Title of Invention	Fleet Controller	

Authorization or Opt-Out of Authorization to Permit Access:

When this Application Data Sheet is properly signed and filed with the application, applicant has provided written authority to permit a participating foreign intellectual property (IP) office access to the instant application-as-filed (see paragraph A in subsection 1 below) and the European Patent Office (EPO) access to any search results from the instant application (see paragraph B in subsection 1 below).

Should applicant choose not to provide an authorization identified in subsection 1 below, applicant **must opt-out** of the authorization by checking the corresponding box A or B or both in subsection 2 below.

NOTE: This section of the Application Data Sheet is **ONLY** reviewed and processed with the **INITIAL** filing of an application. After the initial filing of an application, an Application Data Sheet cannot be used to provide or rescind authorization for access by a foreign IP office(s). Instead, Form PTO/SB/39 or PTO/SB/69 must be used as appropriate.

1. Authorization to Permit Access by a Foreign Intellectual Property Office(s)

A. Priority Document Exchange (PDX) - Unless box A in subsection 2 (opt-out of authorization) is checked, the undersigned hereby **grants the USPTO authority** to provide the European Patent Office (EPO), the Japan Patent Office (JPO), the Korean Intellectual Property Office (KIPO), the State Intellectual Property Office of the People's Republic of China (SIPO), the World Intellectual Property Organization (WIPO), and any other foreign intellectual property office participating with the USPTO in a bilateral or multilateral priority document exchange agreement in which a foreign application claiming priority to the instant patent application is filed, access to: (1) the instant patent application-as-filed and its related bibliographic data, (2) any foreign or domestic application to which priority or benefit is claimed by the instant application and its related bibliographic data, and (3) the date of filing of this Authorization. See 37 CFR 1.14(h)(1).

B. Search Results from U.S. Application to EPO - Unless box B in subsection 2 (opt-out of authorization) is checked, the undersigned hereby **grants the USPTO authority** to provide the EPO access to the bibliographic data and search results from the instant patent application when a European patent application claiming priority to the instant patent application is filed. See 37 CFR 1.14(h)(2).

The applicant is reminded that the EPO's Rule 141(1) EPC (European Patent Convention) requires applicants to submit a copy of search results from the instant application without delay in a European patent application that claims priority to the instant application.

2. Opt-Out of Authorizations to Permit Access by a Foreign Intellectual Property Office(s)

☐ A. Applicant **DOES NOT** authorize the USPTO to permit a participating foreign IP office access to the instant application-as-filed. If this box is checked, the USPTO will not be providing a participating foreign IP office with any documents and information identified in subsection 1A above.

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NOTE: Once the application has published or is otherwise publicly available, the USPTO may provide access to the application in accordance with 37 CFR 1.14.

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	BEL-IN140-19.02
	Application Number	
Title of Invention	Fleet Controller	

Applicant Information:

Providing assignment information in this section does not substitute for compliance with any requirement of part 3 of Title 37 of CFR to have an assignment recorded by the Office.

Applicant 1 — Remove

If the applicant is the inventor (or the remaining joint inventor or inventors under 37 CFR 1.45), this section should not be completed. The information to be provided in this section is the name and address of the legal representative who is the applicant under 37 CFR 1.43; or the name and address of the assignee, person to whom the inventor is under an obligation to assign the invention, or person who otherwise shows sufficient proprietary interest in the matter who is the applicant under 37 CFR 1.46. If the applicant is an applicant under 37 CFR 1.46 (assignee, person to whom the inventor is obligated to assign, or person who otherwise shows sufficient proprietary interest) together with one or more joint inventors, then the joint inventor or inventors who are also the applicant should be identified in this section.

Clear

● Assignee	Legal Representative under 35 U.S.C. 117	Joint Inventor
Person to whom the inventor is obligated to assign.	Person who shows sufficient proprietary interest	

If applicant is the legal representative, indicate the authority to file the patent application, the inventor is:

Name of the Deceased or Legally Incapacitated Inventor:

If the Applicant is an Organization check here. ☒

Organization Name	Bell Textron Inc.		
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Address 2	P.O. Box 482		
City	Fort Worth	**State/Province**	TX
Country	US	Postal Code	76101
Phone Number		Fax Number	
Email Address			

Additional Applicant Data may be generated within this form by selecting the Add button. Add

Assignee Information including Non-Applicant Assignee Information:

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	BEL-IN140-19.02
	Application Number	
Title of Invention	Fleet Controller	

Assignee 1

Complete this section if assignee information, including non-applicant assignee information, is desired to be included on the patent application publication. An assignee-applicant identified in the "Applicant Information" section will appear on the patent application publication as an applicant. For an assignee-applicant, complete this section only if identification as an assignee is also desired on the patent application publication.

Remove

If the Assignee or Non-Applicant Assignee is an Organization check here. ☐

Prefix	**Given Name**	Middle Name	**Family Name**	Suffix

Mailing Address Information For Assignee including Non-Applicant Assignee:

Address 1			
Address 2			
City		**State/Province**	
Country i		Postal Code	
Phone Number		Fax Number	
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Signature:

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This Application Data Sheet **must** be signed by a patent practitioner if one or more of the applicants is a **juristic entity** (e.g., corporation or association). If the applicant is two or more joint inventors, this form must be signed by a patent practitioner, **all** joint inventors who are the applicant, or one or more joint inventor-applicants who have been given power of attorney (e.g., see USPTO Form PTO/AIA/81) on behalf of **all** joint inventor-applicants.

See 37 CFR 1.4(d) for the manner of making signatures and certifications.

Signature	/Robert G. Graham/			Date (YYYY-MM-DD)	2019-12-19
First Name	Robert G.	Last Name	Graham	Registration Number	58042

Additional Signature may be generated within this form by selecting the Add button. Add

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	BEL-IN140-19.02
	Application Number	
Title of Invention	Fleet Controller	

This collection of information is required by 37 CFR 1.76. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 23 minutes to complete, including gathering, preparing, and submitting the completed application data sheet form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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The information provided by you in this form will be subject to the following routine uses:

1 The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these records.

2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.

3 A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.

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5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent CooperationTreaty.

6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).

7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.

9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

ABSTRACT

FLEET CONTROLLER

An method for controlling an autonomous vehicle fleet, including obtaining, by a fleet controller, from a master schedule, a mission for a vehicle of a fleet of autonomous vehicles, where the mission is associated with a mission entry of the master schedule, generating vehicle commands according to mission parameters associated with the mission, maintaining a persistent connection with the vehicle, sending the vehicle commands to the vehicle using the connection, the vehicle commands causing the vehicle to execute the mission under control of the fleet controller, and monitoring operation of the vehicle during performance of the mission.

WHAT IS CLAIMED IS:

1. A method, comprising:

obtaining, by a fleet controller, from a master schedule, a mission for a vehicle of a fleet of autonomous vehicles, wherein the mission is associated with a mission entry of the master schedule;

generating vehicle commands according to mission parameters associated with the mission;

maintaining a persistent connection with the vehicle;

sending the vehicle commands to the vehicle using the connection, the vehicle commands causing the vehicle to execute the mission under control of the fleet controller; and

monitoring operation of the vehicle during performance of the mission.

2. The method according to Claim 1, wherein the generating the vehicle commands comprises:

identifying a flight path associated with the mission;

verifying a usability of the flight path with a traffic management system; and

generating the vehicle commands according to the flight path in response to verifying the usability of the flight path.

3. The method according to Claim 1, wherein the obtaining the mission comprises obtaining the mission from the master schedule according to a priority of mission entries in the master schedule.

4. The method according to Claim 1, wherein the monitoring operation of the vehicle comprises monitoring a connection of the vehicle to a communications network associated with the fleet controller.

5. The method according to Claim 4, wherein the monitoring the connection comprises:

monitoring, by an access point of the communications network, a connection between the vehicle and the access point; and

reporting, by the access point, a last vehicle status to the fleet controller.

6. The method according to Claim 1, wherein the monitoring operation of the vehicle comprises determining, during performance of the mission, whether the mission parameters associated with the mission are supported by mission impact data received at the fleet controller; and

wherein the method further comprises:

generating, in response to the mission parameters not being supported by the mission impact data, adjusted vehicle commands according to the mission impact data and the mission parameters; and

sending the adjusted vehicle commands to the vehicle using the connection, the adjusted vehicle commands causing the vehicle to execute the mission under control of the fleet controller according to the adjusted vehicle command.

7. The method according to Claim 1, wherein the sending the vehicle commands to the vehicle comprises determining whether the vehicle is subject to single source control; and

forwarding the vehicle commands to the vehicle in response the vehicle being subject to the single source control or a source of the vehicle commands being assigned an authority greater than any other set of vehicles commands associated with the vehicle.

8. A fleet controller, comprising:

a processor; and

a non-transitory computer-readable storage medium storing a program to be executed by the processor, the program including instructions for:

obtaining, from a master schedule, a mission for a vehicle of a fleet of autonomous vehicles, wherein the mission is associated with a mission entry of the master schedule;

generating vehicle commands according to mission parameters associated with the mission;

maintaining a persistent connection with the vehicle through a communications network;

sending the vehicle commands to the vehicle using the connection, the vehicle commands causing the vehicle to execute the mission under control of the fleet controller; and

monitoring operation of the vehicle during performance of the mission.

9. The fleet controller according to Claim 8, wherein the instructions for the generating the vehicle commands comprise:

identifying a flight path associated with the mission;

verifying a usability of the flight path with a traffic management system; and

generating the vehicle commands according to the flight path in response to verifying the usability of the flight path.

10. The fleet controller according to Claim 8, wherein the instructions for the obtaining the mission include instructions for obtaining the mission from the master schedule according to a priority of mission entries in the master schedule.

11. The fleet controller according to Claim 8, wherein the instructions for the monitoring operation of the vehicle include instructions for receiving, from an access point of the communications network, a last vehicle status in response to loss of a connection between the vehicle and the access point hosting the persistent connection.

12. The fleet controller according to Claim 8, wherein the instructions for the monitoring operation of the vehicle include instructions for determining, during performance of the

mission, whether the mission parameters associated with the mission are supported by mission impact data received at the fleet controller; and

wherein the program further includes instructions for:

generating, in response to the mission parameters not being supported by the mission impact data, adjusted vehicle commands according to the mission impact data and the mission parameters; and

sending the adjusted vehicle commands to the vehicle using the connection, the adjusted vehicle commands causing the vehicle to execute the mission under control of the fleet controller according to the adjusted vehicle command.

13. The fleet controller according to Claim 12, wherein the mission impact data comprises at least one of received event messages, traffic management system data, or exterior condition data.

14. The fleet controller according to Claim 8, wherein the instructions for the sending the vehicle commands to the vehicle comprises determining whether the vehicle is subject to single source control; and

forwarding the vehicle commands to the vehicle in response the vehicle being subject to the single source control or a source of the vehicle commands being assigned an authority greater than any other set of vehicles commands associated with the vehicle.

15. A system, comprising:

a vehicle;

a communications network; and

a fleet controller in communication with the vehicle by way of the communications network, the fleet controller configured to:

obtain, from a master schedule, a mission for a vehicle of a fleet of autonomous vehicles, wherein the mission is associated with a mission entry of the master schedule;

generate vehicle commands according to mission parameters associated with the mission;

maintain a persistent connection with the vehicle through the communications network;

send the vehicle commands to the vehicle using the connection, wherein the vehicle is configured to receive the vehicle command and execute the mission according to the vehicle commands; and

monitor operation of the vehicle during performance of the mission.

16. The system according to Claim 15, wherein the fleet controller is configured to:

identify a flight path associated with the mission;

verify a usability of the flight path with a traffic management system; and

generate the vehicle commands according to the flight path in response to verifying the usability of the flight path.

17. The system according to Claim 15, wherein the fleet controller is configured to obtain the mission from the master schedule according to a priority of mission entries in the master schedule.

18. The system according to Claim 15, wherein the fleet controller is configured to receive, from an access point of the communications network, a last vehicle status in response to loss of a connection between the vehicle and the access point hosting the persistent connection.

19. The system according to Claim 15, wherein the fleet controller is configured to:

determine, during performance of the mission, whether the mission parameters associated with the mission are supported by mission impact data received at the fleet controller;

generate, in response to the mission parameters not being supported by the mission impact data, adjusted vehicle commands according to the mission impact data and the mission parameters; and

send the adjusted vehicle commands to the vehicle using the connection, and wherein the vehicle is configured to execute the mission according to the adjusted vehicle command.

20. The system according to Claim 15, further comprising a control arbitrator configured to:

determine whether the vehicle is subject to single source control; and

forward the vehicle commands to the vehicle in response the vehicle being subject to the single source control or a source of the vehicle commands being assigned an authority greater than any other set of vehicles commands associated with the vehicle.

FLEET CONTROLLER

TECHNICAL FIELD

[0001] The present invention relates generally to a system and method for scheduling and controlling individual autonomous vehicles in a fleet, and, in particular embodiments, to a system and method for anticipating demand for cargo and passenger transportation by autonomous flying vehicles, and controlling the autonomous vehicles accordingly.

BACKGROUND

[0002] The increasing availability of electric-powered vehicles and improved remote vehicle control capabilities has recently led to increasing use of autonomous vehicles and development of autonomous vehicle fleets. The cost and complexity of autonomous vehicles, coupled with the increasing size of vehicle fleets calls for centralized fleet management systems.

SUMMARY

[0003] An embodiment method includes obtaining, by a fleet controller, from a master schedule, a mission for a vehicle of a fleet of autonomous vehicles, where the mission is associated with a mission entry of the master schedule, generating vehicle commands according to mission parameters associated with the mission, maintaining a persistent connection with the vehicle, sending the vehicle commands to the vehicle using the connection, the vehicle commands causing the vehicle to execute the mission under control of the fleet controller, and monitoring operation of the vehicle during performance of the mission.

[0004] An embodiment device may be a fleet controller, including a processor and a non-transitory computer-readable storage medium storing a program to be executed by the processor. The program may include instructions for obtaining, from a master schedule, a mission for a vehicle of a fleet of autonomous vehicles, where the mission is associated with a mission entry of the master schedule, generating vehicle commands according to mission parameters associated with the mission, maintaining a persistent connection with the vehicle

through a communications network, sending the vehicle commands to the vehicle using the connection, the vehicle commands causing the vehicle to execute the mission under control of the fleet controller, and monitoring operation of the vehicle during performance of the mission.

[0005] An embodiment system includes a vehicle, a communications network, and a fleet controller in communication with the vehicle by way of the communications network. The fleet controller may be configured to obtain, from a master schedule, a mission for a vehicle of a fleet of autonomous vehicles, where the mission is associated with a mission entry of the master schedule, generate vehicle commands according to mission parameters associated with the mission, maintain a persistent connection with the vehicle through the communications network, send the vehicle commands to the vehicle using the connection, with the vehicle being configured to receive the vehicle command and execute the mission according to the vehicle commands, and monitor operation of the vehicle during performance of the mission.

BRIEF DESCRIPTION OF THE DRAWINGS

[0006] For a more complete understanding of the present invention, and the advantages thereof, reference is now made to the following descriptions taken in conjunction with the accompanying drawings, in which:

[0007] Fig. 1 illustrates an arrangement of a fleet management system for command and monitoring of one or more vehicles according to some embodiments;

[0008] Fig. 2 illustrates operation of a fleet management system for control and monitoring of one or more vehicles according to some embodiments;

[0009] Fig. 3A illustrates an embodiment of a master schedule;

[0010] Fig. 3B illustrates an embodiment of a mission entry in the master schedule;

[0011] Fig. 4 illustrates operation of a system using the fleet controller according to some embodiments; and

[0012] Fig. 5 is a flow diagram illustrating a method for handling vehicles missions in a fleet management system according to some embodiments.

DETAILED DESCRIPTION OF ILLUSTRATIVE EMBODIMENTS

[0013] Embodiments of a fleet management system are described herein, with the fleet management system providing control and monitoring of autonomous vehicles to optimize the effective use of the vehicles, while maintaining safety and maintenance standards. While some embodiments of the fleet management system are described as being directed to control and monitoring of flying vehicles, such as drones, aircraft, rotorcraft, or the like, it should be understood that the principles described herein are equally applicable to watercraft, ground vehicles, or mixed fleets including any number or combination of flying vehicles, ground vehicles, and watercraft.

[0014] In some embodiments, the fleet management system provides a persistent connection with each vehicle, which may include real-time, near real-time, monitoring, or tracking last known statuses of vehicles for use in the case of a connection failure by the vehicle. The fleet management system may permit a user to control vehicles from various interaction mediums such as tablets, augmented reality (AR) headsets, laptops, desktops, control centers, or the like.

[0015] Some embodiments of the fleet management system permits assignment of role-based access for command and control of vehicles to segregate users into various roles and allow management of user access to vehicles controlled by the fleet management system. The fleet management system may also use a control arbitrator to ensure a single point of control of a vehicle at any one time to prevent contradictory command or control from different users or sources. Additionally, the fleet management system may permit role based access to command or control of vehicles, with different roles being permitted different levels of control or authority over the vehicles.

[0016] In some embodiments, the fleet management system provides for tracking, monitoring and management at the device level, with individual connected components on each vehicle being tracked and monitored to provide for part localization, tracking of component location (such as in vehicle, in repair, or the like), protection against fraudulent or counterfeit parts, lifecycle management of individual parts, or the like. These individual components may be connected components that self-identify on the vehicle and use the vehicle datalink to send component telemetry. In some embodiments, each of the connected components may include a unique device identity, which may be represented by an on-device certificate, such as an X.509 public key certificate or the like. The tracking of individual connected components and the reporting of connected component telemetry to the fleet management system permits the tracking of complete component histories for the lifetimes of each of the connected components, which may be made available via a cloud data storage system as a cloud-based component logbook.

[0017] Additionally, the tracking of individual connected components may include storing device performance, use or maintenance history, and the like, for use by prediction services such as a fleet scheduler, active connected component health monitoring, predictive maintenance, and the like. Tracking the histories of the connected components and having access to the connected component histories further permits software/firmware updates and the deployment and management of component-level systems.

[0018] Fig. 1 illustrates an arrangement 100 of a fleet management system 102 for command and monitoring of one or more vehicles 112 according to some embodiments. The fleet management system 102 is a system for launching and sustaining continuous operations for fleets of autonomous vehicles. The fleet management system 102 may include a fleet scheduler 104 that generates, or submits entries to, a master schedule 106. The master schedule 106 is used by a fleet controller 108 to control one or more vehicles through a communications system

such as an internet-of-things (IoT) backbone 110. The vehicles 112 may feed operational data back through the IoT backbone 110, which then delivers the operational data back to the fleet scheduler 104, or otherwise makes the operational data available to the fleet scheduler 104.

[0019] The fleet scheduler 104 monitors real-world data or mission impact data, including the operational data, and generates future-state predictions based on that data. The fleet scheduler 104 may then produce the optimized master schedule 106, which may include vehicle positions, mission timing, flight plans, maintenance and service (such as vehicle recharge/refuel) schedules, and the like, for fleet operations.

[0020] Additionally, the fleet scheduler 104 may include an API or other system for permitting third parties to submit third parties entries or requests to the master schedule, or requests for scheduling by the fleet scheduler 104. In some embodiments, third party requests 114 may be submitted directly to the master schedule 106, or may be submitted to the fleet scheduler 104 for verification or scheduling. For example, a third party cargo carrier may submit a request to the fleet scheduler 104 for carrying a particular class of cargo at a particular time and location, and the fleet scheduler 104 may determine a vehicle 112 suitable for the requested mission, assign the mission to the vehicle, and submit the scheduled mission to the master schedule 106. In other embodiments, a third party may perform the mission generation and scheduling, and submit a mission entry to the master schedule 106 for execution by the fleet controller 108.

[0021] In some embodiments, the fleet scheduler 104 analyzes historical demand, such as payload or passenger movement between identified points, demand input such as manual user entry or integration with planning systems, and environmental data such as weather, public transit, or ground traffic, air traffic, and then outputs recommendations for vehicle placement across a region's nodes in anticipation of upcoming demand. This predictive modeling allows for anticipatory vehicle placement to handle future demand, avoiding the need to assign vehicles

fixed, regular routes, which require a fixed schedule with a fixed number of vehicles. Such anticipatory positioning may also permit vehicles to be automatically prepositioned before an actual demand exists, rather than tasking vehicles to a particular site or assignment after demand occurs.

[0022] In some embodiments, the fleet scheduler 104 also monitors health characteristics of vehicle systems that are known to be associated with component degradation by analyzing real-time on-board sensor data in the operational data sent from the individual vehicles. The fleet scheduler 104 may apply machine learning to predict when the system or component is likely to fail or need maintenance, inspection or servicing. In such an embodiment, the fleet scheduler 104 uses predicted failure insights to determine when the vehicle 112 should be scheduled for maintenance or inspection in coordination with regular mission operations. Using data from operational vehicles permits the fleet scheduler 104 to correlate maintenance requirements for components/systems that follow similar maintenance cycles. This permits sequencing of vehicle maintenance downtime according to a predicted maintenance or servicing need at the fleet level, and the staggering or sequencing of scheduled maintenance activities ensures the fleet remains available to carry out daily mission operations.

[0023] The fleet controller 108 executes the master schedule 106, while also monitoring real-time air and ground conditions. The fleet controller 108 observes vehicles 112 of the fleet, weather conditions, and other operating factors or mission impact data, and will delay, redirect, or otherwise modify commands to the vehicles 112 if executing the master schedule 106 would result in unsafe or undesirable conditions. The fleet controller 108 executes the master schedule 106 by maintaining communication with the vehicles 112, monitoring the vehicles 112 in real-time or near real-time, and sending command instructions to the vehicles 112. The fleet controller 108 monitors real-time or near real-time fleet information regarding vehicle state, performance and health, progress of each flight, and the state of each vertiport or ground

location. The fleet controller 108 looks for conflicts during vehicle operations that result in unsafe or undesirable conditions and deviates from the master schedule 106 as necessary to enact contingencies that ensure safe and desirable fleet operations. In this way, the fleet controller 108 works independently from the fleet scheduler 104 to ensure a second layer of safe operation.

[0024] Fig. 2 illustrates operation of a fleet management system 102 for control and monitoring of one or more vehicles 112 according to some embodiments. The fleet management system 102 is in communication with one or more vehicles 112 via the IoT backbone 110. In some embodiments, the fleet scheduler 104 generates the master schedule 106 and the fleet controller 108 uses entries in the master schedule 106 to generate command instructions 202 which are sent to the vehicles 112. In some embodiments, the command instructions 202 are instructions to follow a particular flight path 216 to a destination, such as a maintenance facility 206, a service facility 208, a staging location 210 or a target origin 212, or for a mission between a target origin 212 and a target destination 214. For example, the fleet scheduler 104 may determine that a particular vehicle 112 has components in need of inspection or replacement, and may route the respective vehicle 112 to a maintenance facility 206. Similarly, the fleet scheduler 104 may determine from vehicle telemetry 204, or other data, that a battery of a vehicle 112 needs to be charged, that the vehicle 112 needs fuel, or the like, and may route the respective vehicle 112 to a service facility 208 or the like.

[0025] The fleet scheduler 104 may also provide entries in the master schedule 106 for missions such as passenger carriage, package or cargo pickup and delivery, and the like. In some embodiments, the fleet scheduler 104 may use predictive analytics to determine where potential demand exists. The fleet scheduler 104 may stage vehicles 112 at a staging location 210 associated with target origins 212 for missions between the target origins 212 and target destinations 214, or between the target origins 212 and target destinations 214 which are not

determined at the time of predicted demand. For example, the fleet scheduler 104 may use a transit schedule, such as a train schedule, to predict that demand for passenger carriage or taxi service will peak shortly after a train arrives at a train station, and may send vehicles 112 to a staging location 210 near the train station, with the train station being a target origin 212 for a potential passenger carriage mission. Thus, the fleet scheduler 104 may be able to have vehicles 112 ready to accept passengers at the anticipate demand time, reducing passenger wait times. The fleet scheduler 104 may also use a weather service or weather forecast to predict that adverse weather conditions will increase demand for passenger carriage service at the train station, and may task additional vehicles 112 to the staging location 210 prior to a train's arrival to handle the anticipated increase in passenger carriage mission demand. In such situations, the target destination 214 may be input by a passenger after the passenger requests carriage, or after the passenger enters the vehicle 112. The fleet scheduler 104 may receive a request for a passenger carriage mission, may determine one or more vehicles 112 closest to the passenger's target origin 212, and may provide an entry in the master schedule 106 assigning the vehicle 112 to the passenger carriage mission at the target origin 212.

[0026] Similarly, cargo handling may be scheduled by the fleet scheduler 104, with cargo vehicles 112 being sent to staging locations 210 near post offices, warehouses, distribution points, or the like according to predicted demand. The fleet scheduler 104 may be tied into data inputs such as retailers, distributors, package delivery logistic systems, third party request or scheduling systems, cargo terminal systems, or the like, and may use the data inputs, solely or in combination with, environmental monitoring, historical data, and the like to determine predicted and or actual package delivery demand. For example, cargo vehicles 112 may be staged near restaurants near meal times to handle food deliveries without requiring that the vehicles 112 be routed to the pickup point after the cargo mission is requested. In another example, cargo vehicles 112 may be sent to staging locations 210 near retail warehouses, package

delivery hubs, or the like, to handle delivery of cargo or packages, with the number of vehicles 112, staging locations 210 and arrival times determined by the fleet scheduler 104 according to anticipated and/or actual demand.

[0027] Figure 3A illustrates an embodiment of a master schedule 106. Figure 3B illustrates an embodiment of a mission entry 302 in the master schedule 106. The master schedule 106 may have one or more mission entries 302A . . . 302N set by the fleet scheduler 104. Each mission entry 302 may include data fields such as a mission identifier (ID) field 308, a vehicle ID field 310, a priority field 312, a flight origin field 314, a flight destination field 316, and one or more other data fields 318. The mission ID field 308 may uniquely identify a specific mission which is stored in the master schedule 106. The vehicle ID field 310 identifies a specific vehicle which will perform the specific mission. The vehicle ID field 310 may uniquely identify the specific vehicle 112 to allow the fleet controller 108 to control the specific vehicle 112 and permit the fleet scheduler 104 to track usage and anticipated location of the specific vehicle 112.

[0028] The priority field 312 may include data identifying a priority of the mission so that the fleet controller 108 handles mission entries 302 in the priority order. In some embodiments, the priority field 312 may indicate that the mission is an immediate mission instructing the fleet controller 108 to handle the mission entry 302 with the highest priority or immediately.

[0029] The mission entry 302 may also have locations in the flight origin field 314 identifying where the vehicle 112 should be sent for the mission. In some embodiments, the flight destination field 316 may also have a location for the end location of the mission. However, in further embodiments, the flight destination field 316 may be left blank at the beginning of the mission. Leaving the flight destination field 316 blank may indicate that the mission route or destination is to be determined on-the-fly. For example, in a passenger carriage mission, a passenger may identify a destination after the mission is scheduled, or after

the mission begins. The mission entry 302 may also include other data fields 318 with maybe used for supplemental data, or additional mission data such as data identifying mission start or end time, a particular flight route, account number for a particular mission, a mission identifier, requirements for the mission, or the like.

[0030] Fig. 4 illustrates operation of a system 400 using the fleet controller 108 according to some embodiments. The system 400 includes an IoT backbone 110 connecting one or more vehicles 112 to a control side subsystem that includes the fleet controller 108. In some embodiments, the vehicles 112 may be in communication with the IoT backbone 110 by way of a wireless connection to an access point 420 of the IoT backbone 110. The access point 420 may be a cellular system provided by a third party, may be a dedicated system for control of the vehicles 112, or may be a hybrid system, or another communications system. The access point 420 communicates with an IoT gateway 422 of the IoT backbone 110, which provides communication with the control side subsystem and routing of messages and commands to the appropriate destinations.

[0031] The vehicles 112 may include one or more connected components such as a motor 426 or a battery 424. In some embodiments, the connected components may have one or more sensors that measure operational parameters of the connected components. In other embodiments, a separate device, such as a monitoring circuit, may monitor the operational parameters of the connected components. For example, a vehicle may have an electric motor 426 and may also have current and revolutions per minute (RPM) monitoring circuits that are either disposed on the motor 426 or as part of one or more monitoring circuits separate from the motor 426. The current and RPM monitoring circuits may monitor the current and RPM operational parameters of the motor 426, and the vehicle 112 may report the operational parameter data as telemetry through the IoT gateway 422 back to the control side subsystem for storage and analysis. In other embodiments, the vehicles 112 may report operational

parameters such as location, altitude, airspeed, and the like, for use by the control side subsystem in tracking and verifying the location and control of the vehicles 112.

[0032] The vehicles 112 may generate event messages or request information from the control side subsystem. The vehicles 112 transmit reporting data such as the telemetry, events, and requests to the access point 420, which communicates the reporting data to the IoT gateway 422 for routing to the appropriate control side element. Events may include, for example, emergency events such as an unexpected lack of battery charge or component failure, an accident, an unexpected or uncontrollable deviation from the assigned flight path or mission, or the like. An event many also include mission related events such as reaching a designated start point, end point, or transit point in a mission, completion of a mission, acceptance of, or delivery of, a cargo package, loading or unloading of a passenger, a change to an anticipated or current mission such as a passenger changing a passenger carriage destination, or the like.

[0033] One or more vertiport sensors 460 may also be connected to the access point 420, and may report telemetry 204 and event data 402 through the IoT backbone 110 to the control side subsystem. For example, a vertiport, such as a storage facility, maintenance facility, service facility, regular staging location, or the like, may have sensors that detect and report the arrival of a vehicle 112 so that the control side subsystem may verify the arrival of a vehicle 112. In other embodiments, the vertiport may have weather monitoring equipment, and may report environmental conditions at the vertiport to provide finer grained weather reporting than may be available from third party services. In yet another embodiment, the vertiport may report on the conditions of vehicles 112 at the vertiport, demand for cargo or passenger missions at the vertiport, or the like. The IoT backbone 110 communicates telemetry, events and requests from the vertiport sensors 460 and the vehicles to the IoT gateway 422 for distribution to the relevant elements of the control side subsystem. The IoT backbone 110 also communicates command

and control instructions 202 received at the IoT gateway 422 to the relevant access point 420 for delivery to the appropriate vehicle 112.

[0034] In some embodiments, the IoT backbone 110 includes one or more access points 420 and one or more IoT gateways 422. The access points 420 may be, for example, cellular access points, micro, macro, or femto cell base stations, WiFi base stations, Bluetooth stations, or any other communications transmission system. Thus, an IoT gateway 422 may connect to one or more existing wireless communications networks, or may connect to a dedicated wireless network, or a combination of a dedicated wireless network and an existing wireless network to provide broad coverage and bandwidth capabilities for the system 400.

[0035] The access point 420 may, in some embodiments, provide edge decision making and edge services 430 such as offline services 432 for maintaining the vehicles in a safe state if the control side subsystem disconnects from the IoT backbone 110, telemetry analysis 440 to rapidly determine and address of emergencies with the vehicles 112, message routing 438 for directing messages to an appropriate IoT gateway 422 or vehicle 112, and connection management 436 for handling connections to the vehicles 112 or monitoring for loss of a connection to the vehicles 112. The access point 420 may analyze the classification of events and requests 402 to determine whether a priority of the event or request 402 is of a predetermined level, or whether the severity or type of event or request 402 falls into a category handled by the access point 420. For events handled by the access point 420, the access point 420 may apply a predetermined rule or procedure. Additionally, the access point 420 may hold or forward a message according to the classification of the event or request 402. For example, a vehicle 112 may detect that an assigned landing space at a target location is occupied or obscured, and may request permission to land at a different location. The access point 420 may determine that it has an assigned rule for handling such a request and may grant that request if the access point 420determines that the different location is available. The access point 420 may check with another element such as

a traffic management system, unmanned aircraft system (UAS) traffic management (UTM), or the like, and the permission or denial of the request to change the landing locations may be based on the access point check.

[0036] The IoT gateway 422 may, in some embodiments, provide gateway services 450 such as digital twin services 452 for recording the last state of a vehicle 112 and reporting the last state or status of the vehicle 112 back to the control side subsystem in the case of loss of a connection with the vehicle 112. In some embodiments, the last vehicle status is a most recent status of the vehicle, and may include one or more of a location, a speed, an altitude, a heading, or vehicle telemetry. The IoT gateway 422 may also provide other gateway services 450 such as access management services 454 for handling security and controlling access to the vehicles or control side subsystem.

[0037] The IoT gateway 422 routes messages sent by the vehicles 112 through the access point 420 to the relevant elements in the control side subsystem. In some embodiments, events and requests 402 may be routed to an event manager 406, and telemetry 204 data may be routed to a telemetry manager 404. The IoT gateway 422 may also route control message or command instructions 202 from a control arbitrator 414 through the IoT backbone 110 to the relevant vehicle 112.

[0038] The telemetry manager 404 and event manager 406 may each provide data to a dashboard 408 for presentation to a user monitoring the status of the system 400, including missions and vehicles 112. Thus, relevant events and requests 402 and telemetry 204 may be presented to a user at the dashboard 408 as a data visualization.

[0039] The telemetry manager 404 may also provide the telemetry 204 data to storage 444, where current telemetry 204 is stored with past telemetry to permit the fleet scheduler 104 to access historical data or operational history data in generating the master schedule 106. The operational history data may include flight duration, payload loading time, a history of on-time

or delayed flights, and the like. Additionally, the telemetry manager 404 may provide live, current telemetry 204 directly to the fleet scheduler 104 for generation of mission entries for the master schedule 106. In some embodiments, the event manager 406 provides event and request 402 data to the fleet controller 108.

[0040] The fleet controller 108 obtains entries from the master schedule 106 for execution as a next mission 428. In some embodiments, the fleet controller 108 executes missions in the master schedule 106 according to a priority of the missions, and may pre-empt lower priority missions for higher priority missions or directly submitted missions.

[0041] In some embodiments, the fleet controller may obtain the next mission 428 from the master schedule 106 through a fleet application programming interface (API) 410, and in other embodiments, may obtain the next mission 428 directly from the master schedule 106, or from another schedule or mission source such as a third party scheduling system or as a direct mission request from, for example, a control dashboard 418 or the like. The fleet controller 108 may generate a flight path for the next mission 428 according to information from a traffic management system 442, the control dashboard 418, historical mission information, and the like. For example, the fleet controller 108 may retrieve a next mission 428 entry indicating that a particular vehicle should move to arrive at a target location at a predetermined time. The fleet controller 108 may identify a particular flight path for the mission, and may verify the usability of the flight path with the traffic management system 442, such as a UTM. A UTM may provide data or flight path checking related to traffic in a flight path, availability of a flight path due to flight restrictions or the like, weather, requirements for a flight path such as weight or size, minimum or maximum altitude or airspeed, or the like. For example, the UTM may indicate that the flight path has an unexpected volume of traffic, and the fleet controller 108 may determine an alternative flight path using data from the UTM, historical flight data, predetermined flight paths, or the like, or a combination of any of the same. Alternatively, the

fleet controller 108 may determine that flight conditions, such as weather, wind, or the like, indicate that the flight path is unacceptable for flight operations, the fleet controller 108 may attempt to find a new, more acceptable flight path, may delay the mission, or may replace or cancel the mission.

[0042] In some embodiments, the control dashboard 418 may be an interface that permits a user to submit mission entries directly to the fleet controller 108, or to take manual control, through a manual control system 416, of a particular vehicle 112. The manual control system 416 permits operator-in-the-loop control, which may allow for precise control of a particular vehicle 112.

[0043] The fleet controller 108 may send command and control messages 202 to the IoT gateway 422 through a control arbitrator 414. The control arbitrator 414 may receive control messages or command instructions 202 from the manual control system 416 after receiving or executing an existing set of command instructions 202 from the fleet controller 108, or may receive command instructions 202 from the fleet controller 108 and manual control system 416 substantially simultaneously. The control arbitrator 414 determines which set of command instructions 202 has greater authority, and forwards the command instructions 202 with greater authority to the IoT gateway 422. In some embodiments, the control arbitrator 414 may use a predetermined set of rules to determine which command instructions 202 have greater authority. For example, in an embodiment, the control arbitrator 414 may use a predetermined rule that give any command instructions with an emergency priority the highest priority, any non-emergency manual command the next highest priority, and any scheduled control instruction the lowest priority.

[0044] The elements of the system 400 may, in some embodiments, be implemented by a computer system. The computer system may have one or more processors and a non-transitory computer readable medium having a program stored thereon. The program may include

instructions for performing the processes described herein. Additionally, one or more elements of the system 400 may be implemented as separate processes, programs or portions of one or more programs, or as separate programs on a computer or computer system having multiple computers. For example, the fleet controller 108 may be integrated with the control arbitrator 414, event manager 406, telemetry manager 404 or one or more other elements of the system 400. In another embodiment, the fleet controller 108 may be implemented on a first computer system, network, or in a first program, and any one or more of the control arbitrator 414, event manager 406, telemetry manager 404 may be disposed together, or separately on a second, separate computer system, network or in a second, separate program. Additionally, the fleet scheduler 104 and the fleet controller 108 may be integrated together, disposed on a same computer system in separate programs or processes, or disposed on separate computer systems or networks.

[0045] Fig. 5 is a flow diagram illustrating a method 500 for handling vehicles missions in a fleet management system according to some embodiments. Initially, in block 502, the fleet controller obtains a next mission. In some embodiments, the fleet controller retrieves, or receives, a next mission from a master schedule, either directly, through an API, or through another element. In some embodiments, the next mission is a mission having a highest priority in the master schedule, and in other embodiments, the next mission is a mission submitted directly to the fleet controller by a user through the control dashboard.

[0046] In block 504, the mission is verified against monitored parameters or mission impact data. In an embodiment, the fleet controller compares the requirements of the next mission against monitored parameters such as traffic in a potential travel path, weather, flight restrictions or requirements along the potential travel path, capabilities of the assigned vehicle, geographic restrictions, and the like. For example, the mission may be verified using a UTM to verify that the potential flight path for the next mission is available and safe for the assigned

vehicle. The fleet controller may attempt to modify the mission, select a new travel path that can be verified against the monitored parameters, reject the mission, reschedule the mission, or the like. The fleet controller may also apply geofencing restrictions on the vehicles using predetermined boundaries, using UTM data, or the like.

[0047] In block 506, vehicle commands are generated in response to the mission being verified against the monitored parameters. In some embodiments, generating the vehicle commands includes, but is not limited to, assigning one or more of a flight or travel path, speed, altitude, arrival or departure time, target origin or target destination, mission type, setting a flight path according to geofencing restrictions, or the like.

[0048] In block 508, the vehicle commands are sent to the vehicle. In some embodiments, the vehicle commands may be sent to a control arbitrator, and in block 510, the control arbitrator may verify that the vehicle associated with the vehicle commands is subject to single source control, and after verifying that the vehicle commands have proper authority, or are a single source of control for the relevant vehicle, may be forwarded to the vehicle, in block 530 to control the vehicle. In other embodiments, the vehicle commands may be sent or forwarded to the vehicle in block 530 without a control arbitrator to control the vehicle. The vehicle commands may be sent through the IoT backbone, which routes the vehicle commands to the relevant vehicle.

[0049] In block 512, the mission parameters are monitored by a monitoring element. In some embodiments, the fleet controller performs persistent monitoring of the operation of the individual vehicles and mission parameters during the mission to determine whether operation of a vehicle needs to be adjusted. The fleet controller performs persistent connection monitoring, and in block 514, detects connection loss to a particular vehicle by monitoring messaging to and from the vehicle. In block 516, the last vehicle status is reported when the connection is lost.

[0050] The fleet controller may use the connection management of the IoT backbone to detect the connection loss, or may use another connection monitoring technique. For example, the fleet controller may send a periodic message to each vehicle and monitor response messages, or may monitor for periodic message initiated by the vehicles. If a lost connection is detected, the last vehicle status reported status may be reported to, for example, the fleet controller, or the like. For example, the access point may perform connection monitoring, and report a lost connection with a last vehicle status, back to the fleet controller.

[0051] In some embodiments, when the connection between the vehicle and the IoT backbone is lost, the fleet controller may raise an exception, event or message, for example, at the dashboard, for investigation. In some embodiments, the fleet controller may assign a new vehicle to the mission of the vehicle associated with the lost connection, may request further instruction from a user, or the like.

[0052] In block 518, the monitoring element receives message events, in block 520, the monitoring element receives UTM data, and in block 522, the monitoring element receives exterior condition data. The event messages may include event messages or requests sent by a vehicle, or sent through the control dashboard or another system. The UTM data may include updates to flight paths or flight requirements for particular flight paths, traffic updates or data, and the like. The exterior condition data may include weather data and the like.

[0053] The monitoring element may verify that the mission parameters are supported during performance of the mission by mission impact data such as the received event messages, UTM data, and exterior condition data, and the like. In block 524, determines whether the vehicle operation adjustment is needed according to comparison between the mission parameters and the mission impact data. If vehicle operation adjustment is needed, then the fleet controller generates adjusted vehicle commands in block 528. In some embodiments, the fleet controller adjusts the vehicle commands according to at least one of the event messages,

UTM data or exterior condition data so that the vehicle commands reflect mission parameters that are supported by the received data. In some embodiments, the fleet controller performs vehicle deconfliction, for example, by providing control messaging to vehicles to avoid each other in transit.

[0054] In block 528, the adjusted vehicles commands are sent to the vehicles. In some embodiments, the adjusted vehicle commands are sent to the control arbitrator, which, in block 510, verifies that the vehicle is subject to single source control. Once the adjusted vehicle commands are confirmed to be a result of single source control, the adjusted vehicle commands are forwarded to the vehicle in block 530 to control the vehicle. In another embodiment where the control arbitrator is omitted, the adjusted vehicle commands are forwarded to the relevant vehicle in block 530 to control the vehicle. Once the vehicle receives the vehicle commands or adjusted vehicle commands, the vehicle executes the commands to perform the mission.

[0055] An embodiment method includes obtaining, by a fleet controller, from a master schedule, a mission for a vehicle of a fleet of autonomous vehicles, where the mission is associated with a mission entry of the master schedule, generating vehicle commands according to mission parameters associated with the mission, maintaining a persistent connection with the vehicle, sending the vehicle commands to the vehicle using the connection, the vehicle commands causing the vehicle to execute the mission under control of the fleet controller, and monitoring operation of the vehicle during performance of the mission.

[0056] In some embodiments, the generating the vehicle commands includes identifying a flight path associated with the mission, verifying a usability of the flight path with a traffic management system, and generating the vehicle commands according to the flight path in response to verifying the usability of the flight path. In some embodiments, the obtaining the mission includes obtaining the mission from the master schedule according to a priority of mission entries in the master schedule. In some embodiments, the monitoring operation of the

vehicle includes monitoring a connection of the vehicle to a communications network associated with the fleet controller. In some embodiments, the monitoring the connection includes monitoring, by an access point of the communications network, a connection between the vehicle and the access point, and reporting, by the access point, a last vehicle status to the fleet controller. In some embodiments, the monitoring operation of the vehicle includes determining, during performance of the mission, whether the mission parameters associated with the mission are supported by mission impact data received at the fleet controller, and the method further includes generating, in response to the mission parameters not being supported by the mission impact data, adjusted vehicle commands according to the mission impact data and the mission parameters, and sending the adjusted vehicle commands to the vehicle using the connection, the adjusted vehicle commands causing the vehicle to execute the mission under control of the fleet controller according to the adjusted vehicle command. In some embodiments, the sending the vehicle commands to the vehicle comprises determining whether the vehicle is subject to single source control, and forwarding the vehicle commands to the vehicle in response the vehicle being subject to the single source control or a source of the vehicle commands being assigned an authority greater than any other set of vehicles commands associated with the vehicle.

[0057] An embodiment device may be a fleet controller, including a processor and a non-transitory computer-readable storage medium storing a program to be executed by the processor. The program may include instructions for obtaining, from a master schedule, a mission for a vehicle of a fleet of autonomous vehicles, where the mission is associated with a mission entry of the master schedule, generating vehicle commands according to mission parameters associated with the mission, maintaining a persistent connection with the vehicle through a communications network, sending the vehicle commands to the vehicle using the

connection, the vehicle commands causing the vehicle to execute the mission under control of the fleet controller, and monitoring operation of the vehicle during performance of the mission.

[0058] In some embodiments, the instructions for the generating the vehicle commands include identifying a flight path associated with the mission, verifying a usability of the flight path with a traffic management system, and generating the vehicle commands according to the flight path in response to verifying the usability of the flight path. In some embodiments, the instructions for the obtaining the mission include instructions for obtaining the mission from the master schedule according to a priority of mission entries in the master schedule. In some embodiments, the instructions for the monitoring operation of the vehicle include instructions for receiving, from an access point of the communications network, a last vehicle status in response to loss of a connection between the vehicle and the access point hosting the persistent connection. In some embodiments, the instructions for the monitoring operation of the vehicle include instructions for determining, during performance of the mission, whether the mission parameters associated with the mission are supported by mission impact data received at the fleet controller, and the program further includes instructions for generating, in response to the mission parameters not being supported by the mission impact data, adjusted vehicle commands according to the mission impact data and the mission parameters, and sending the adjusted vehicle commands to the vehicle using the connection, the adjusted vehicle commands causing the vehicle to execute the mission under control of the fleet controller according to the adjusted vehicle command. In some embodiments, the mission impact data includes at least one of received event messages, traffic management system data, or exterior condition data. In some embodiments, the instructions for the sending the vehicle commands to the vehicle includes determining whether the vehicle is subject to single source control, and forwarding the vehicle commands to the vehicle in response the vehicle being subject to the single source

control or a source of the vehicle commands being assigned an authority greater than any other set of vehicles commands associated with the vehicle.

[0059] An embodiment system includes a vehicle, a communications network, and a fleet controller in communication with the vehicle by way of the communications network. The fleet controller may be configured to obtain, from a master schedule, a mission for a vehicle of a fleet of autonomous vehicles, where the mission is associated with a mission entry of the master schedule, generate vehicle commands according to mission parameters associated with the mission, maintain a persistent connection with the vehicle through the communications network, send the vehicle commands to the vehicle using the connection, with the vehicle being configured to receive the vehicle command and execute the mission according to the vehicle commands, and monitor operation of the vehicle during performance of the mission.

[0060] In some embodiments, the fleet controller is configured to identify a flight path associated with the mission, verify a usability of the flight path with a traffic management system, and generate the vehicle commands according to the flight path in response to verifying the usability of the flight path. In some embodiments, the fleet controller is configured to obtain the mission from the master schedule according to a priority of mission entries in the master schedule. In some embodiments, the fleet controller is configured to receive, from an access point of the communications network, a last vehicle status in response to loss of a connection between the vehicle and the access point hosting the persistent connection. In some embodiments, the fleet controller is configured to determine, during performance of the mission, whether the mission parameters associated with the mission are supported by mission impact data received at the fleet controller, generate, in response to the mission parameters not being supported by the mission impact data, adjusted vehicle commands according to the mission impact data and the mission parameters, and send the adjusted vehicle commands to the vehicle using the connection, with the vehicle being configured to execute the mission

according to the adjusted vehicle command. In some embodiments, the system further includes a control arbitrator configured to determine whether the vehicle is subject to single source control, and forward the vehicle commands to the vehicle in response the vehicle being subject to the single source control or a source of the vehicle commands being assigned an authority greater than any other set of vehicles commands associated with the vehicle.

[0061] While this invention has been described with reference to illustrative embodiments, this description is not intended to be construed in a limiting sense. Various modifications and combinations of the illustrative embodiments, as well as other embodiments of the invention, will be apparent to persons skilled in the art upon reference to the description. It is therefore intended that the appended claims encompass any such modifications or embodiments.

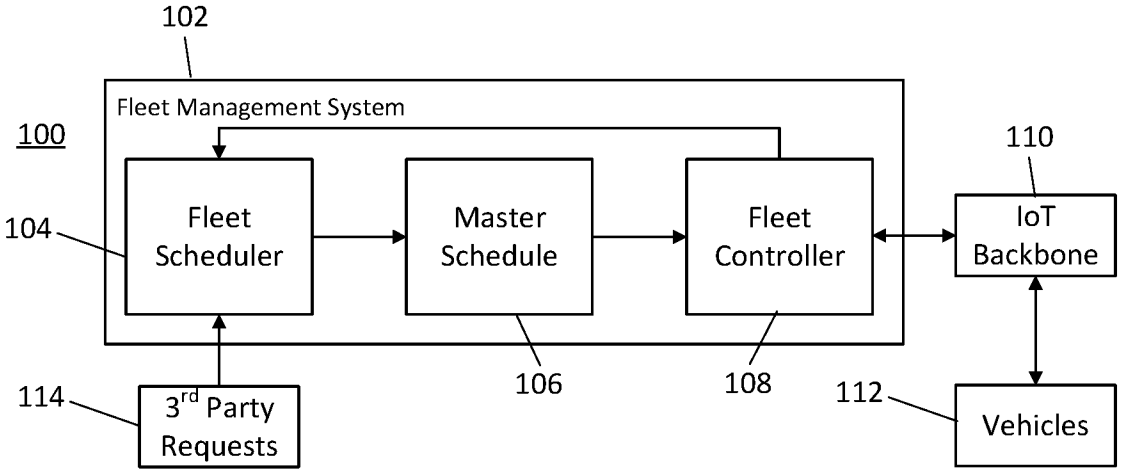

102
Fleet Management System
100
110
104
Fleet Scheduler
Master Schedule
Fleet Controller
IoT Backbone
106
108
114
3rd Party Requests
112
Vehicles

Fig. 1

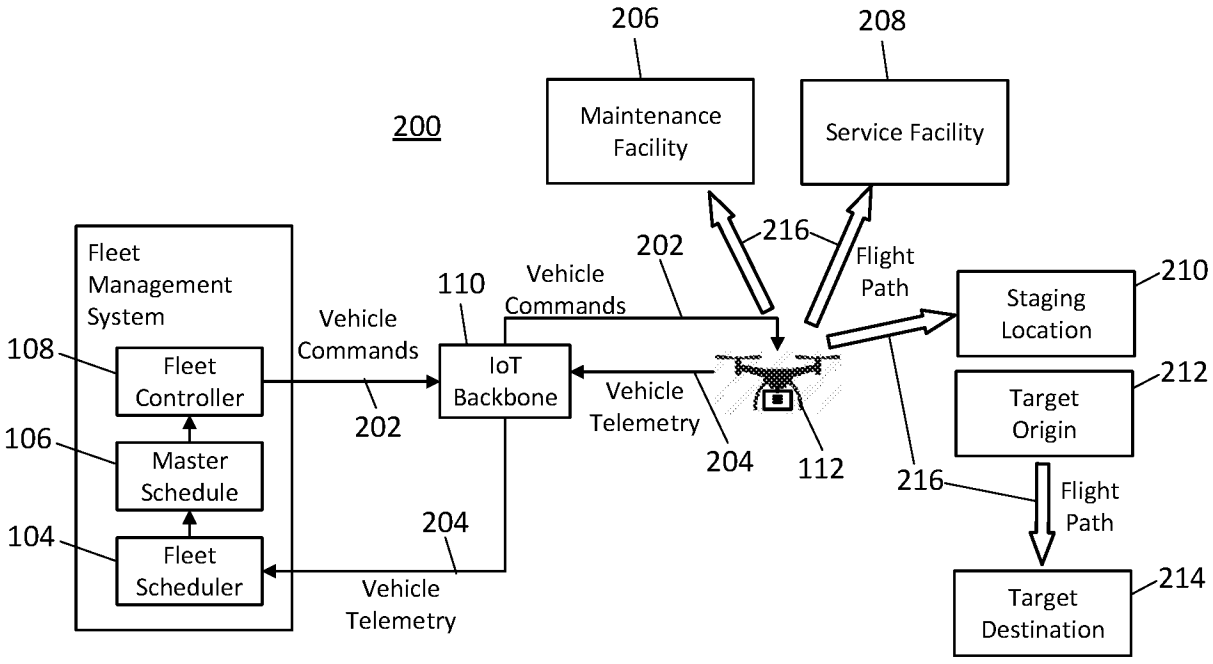

206
208
200
Maintenance Facility
Service Facility
216
202
Flight Path
Vehicle Commands
110
210
Staging Location
Fleet Management System
Vehicle Commands
108
Fleet Controller
IoT Backbone
Vehicle Telemetry
212
Target Origin
106
Master Schedule
202
204
112
216
Flight Path
104
204
Fleet Scheduler
Vehicle Telemetry
214
Target Destination

Fig. 2

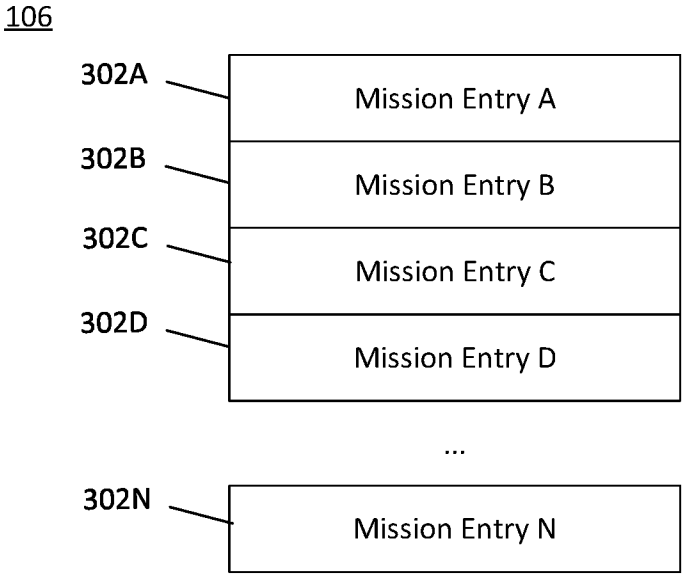

106
302A
Mission Entry A
302B
Mission Entry B
302C
Mission Entry C
302D
Mission Entry D
...
302N
Mission Entry N

Fig. 3A

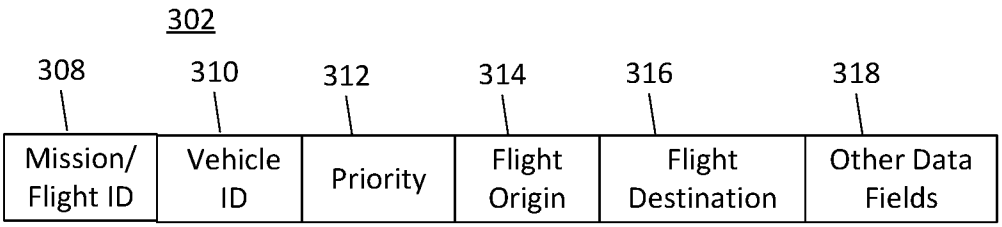

302
308
310
312
314
316
318
Mission/ Flight ID
Vehicle ID
Priority
Flight Origin
Flight Destination
Other Data Fields

Fig. 3B

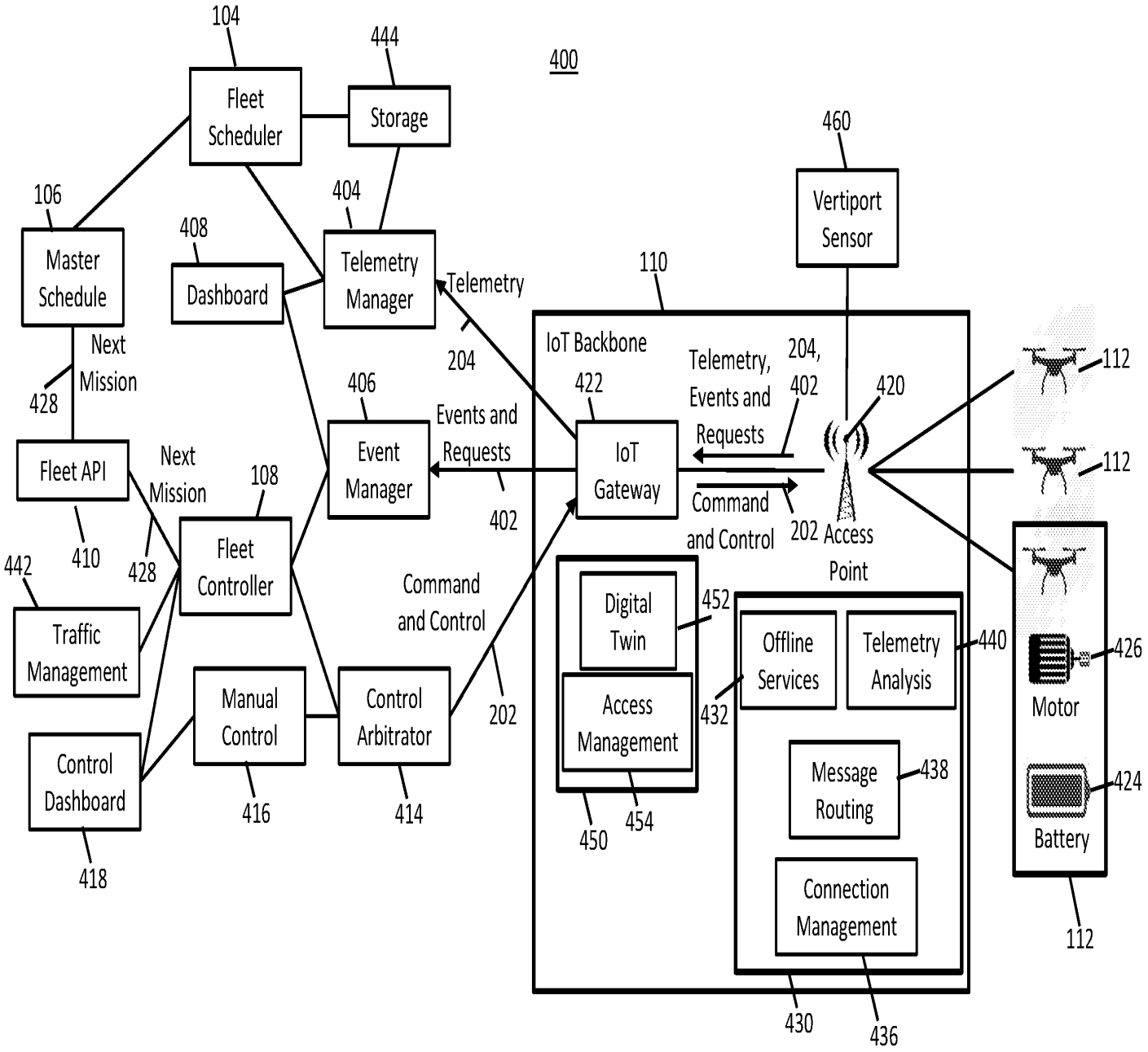

400
104
Fleet Scheduler
444
Storage
460
Vertiport Sensor
106
Master Schedule
404
Telemetry Manager
408
Dashboard
Telemetry
110
IoT Backbone
204
Next Mission
428
406
Event Manager
Events and Requests
402
422
IoT Gateway
Telemetry, Events and Requests
204, 402
420
Access Point
112
112
Fleet API
Next Mission
410
428
108
Fleet Controller
442
Traffic Management
Command and Control
202
Command and Control
Digital Twin
452
Offline Services
Telemetry Analysis
440
Access Management
432
Motor
426
Message Routing
438
Battery
424
Connection Management
Manual Control
Control Arbitrator
Control Dashboard
416
414
418
450
454
430
436
112

Fig. 4

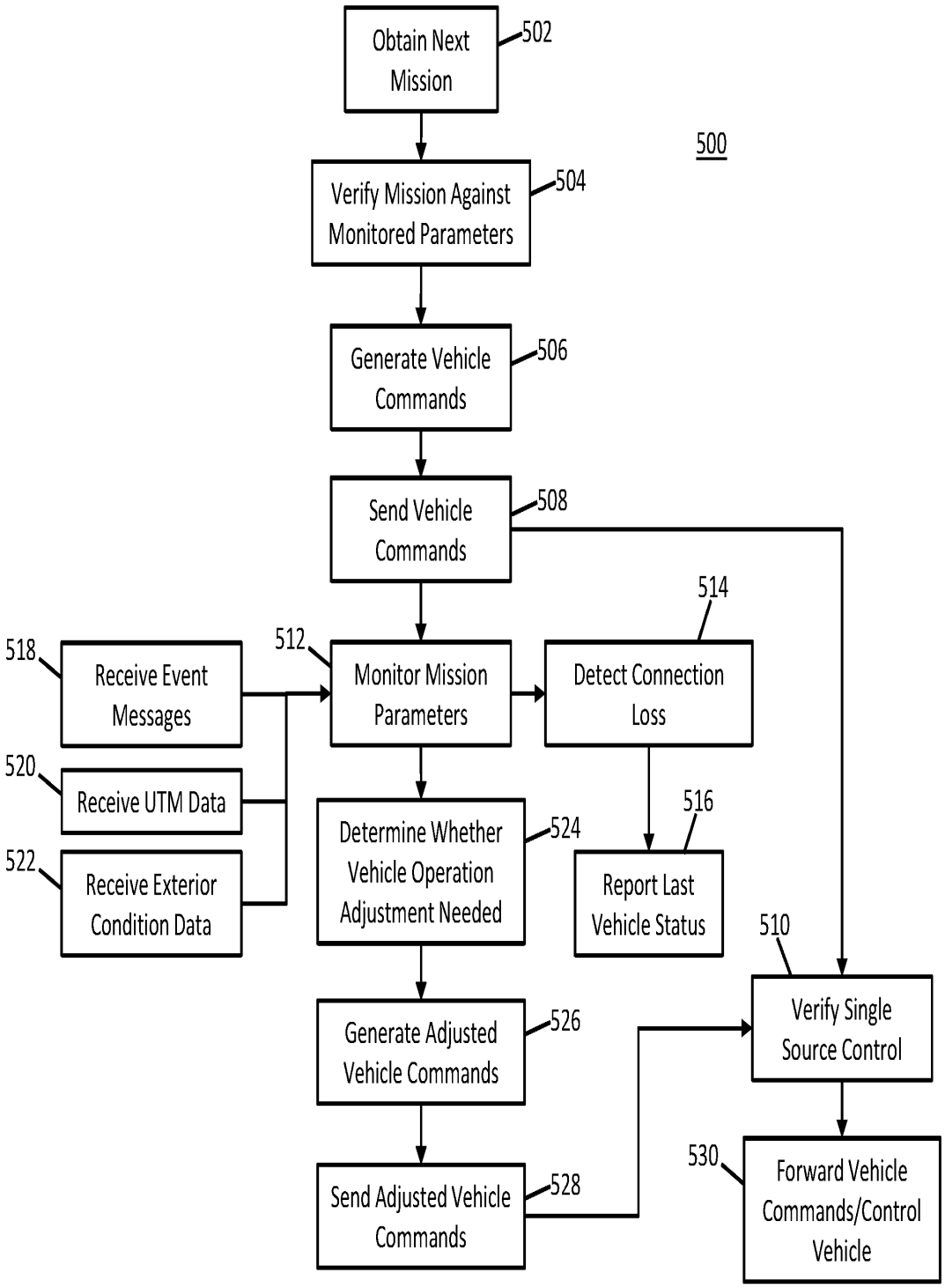

Obtain Next Mission
502
500
Verify Mission Against Monitored Parameters
504
Generate Vehicle Commands
506
Send Vehicle Commands
508
514
518
Receive Event Messages
512
Monitor Mission Parameters
Detect Connection Loss
520
Receive UTM Data
516
Determine Whether Vehicle Operation Adjustment Needed
524
522
Receive Exterior Condition Data
Report Last Vehicle Status
510
Verify Single Source Control
Generate Adjusted Vehicle Commands
526
530
Send Adjusted Vehicle Commands
528
Forward Vehicle Commands/Control Vehicle

Fig. 5

PATENT APPLICATION FEE DETERMINATION RECORD

Substitute for Form PTO-875

Application or Docket Number: 16/720,543

APPLICATION AS FILED - PART I

FOR	(Column 1) NUMBER FILED	(Column 2) NUMBER EXTRA	SMALL ENTITY RATE($)	SMALL ENTITY FEE($)	OR	OTHER THAN SMALL ENTITY RATE($)	OTHER THAN SMALL ENTITY FEE($)
BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A			N/A	300
SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A	N/A			N/A	660
EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A			N/A	760
TOTAL CLAIMS (37 CFR 1.16(i))	20 minus 20 =	*			OR	x 100 =	0.00
INDEPENDENT CLAIMS (37 CFR 1.16(h))	3 minus 3 =	*				x 460 =	0.00
APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $310 ($155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).						0.00
MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))							0.00
* If the difference in column 1 is less than zero, enter "0" in column 2.			TOTAL			TOTAL	1720

APPLICATION AS AMENDED - PART II

		(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	SMALL ENTITY RATE($)	SMALL ENTITY ADDITIONAL FEE($)	OR	OTHER THAN SMALL ENTITY RATE($)	OTHER THAN SMALL ENTITY ADDITIONAL FEE($)
AMENDMENT A	Total (37 CFR 1.16(i))	*	Minus	**	=	x =		OR	x =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=	x =		OR	x =	
	Application Size Fee (37 CFR 1.16(s))									
	FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
						TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	

		(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	RATE($)	ADDITIONAL FEE($)		RATE($)	ADDITIONAL FEE($)
AMENDMENT B	Total (37 CFR 1.16(i))	*	Minus	**	=	x =		OR	x =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=	x =		OR	x =	
	Application Size Fee (37 CFR 1.16(s))									
	FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
						TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".
*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".
The "Highest Number Previously Paid For" (Total or Independent) is the highest found in the appropriate box in column 1.

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APPLICATION NUMBER	FILING or 371(c) DATE	GRP ART UNIT	FIL FEE REC'D	ATTY.DOCKET.NO	TOT CLAIMS	IND CLAIMS
16/720,543	12/19/2019	3661	1720	BEL-IN140-19.02	20	3

CONFIRMATION NO. 4655

145156
SLATER MATSIL, LLP/Bell
17950 PRESTON RD, SUITE 1000
DALLAS, TX 75252-5793

FILING RECEIPT

OC000000114294581

Date Mailed: 01/30/2020

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Inventor(s)

Grant Mark Bristow, Benbrook, TX;
Matthew David Holvey, North Richland Hills, TX;
Naveed Ahmed Siddiqui, Dallas, TX;

Applicant(s)

Bell Textron Inc., Fort Worth, TX;

Power of Attorney: The patent practitioners associated with Customer Number 145156

Domestic Applications for which benefit is claimed - None.
A proper domestic benefit claim must be provided in an Application Data Sheet in order to constitute a claim for domestic benefit. See 37 CFR 1.76 and 1.78.

Foreign Applications for which priority is claimed (You may be eligible to benefit from the **Patent Prosecution Highway** program at the USPTO. Please see http://www.uspto.gov for more information.) - None.
Foreign application information must be provided in an Application Data Sheet in order to constitute a claim to foreign priority. See 37 CFR 1.55 and 1.76.

Permission to Access Application via Priority Document Exchange: Yes

Permission to Access Search Results: Yes

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If Required, Foreign Filing License Granted: 01/28/2020

The country code and number of your priority application, to be used for filing abroad under the Paris Convention, is **US 16/720,543**

Projected Publication Date: 06/24/2021

Non-Publication Request: No

Early Publication Request: No

Title

Fleet Controller

Preliminary Class

701

Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications: No

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(Not for submission under 37 CFR 1.99)

Application Number	16720543
Filing Date	2019-12-19
First Named Inventor	Grant Mark Bristow
Art Unit	3661
Examiner Name	TBD
Attorney Docket Number	BEL-IN140-19.02

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	2	20190339720		2019-11-07	Petersen et al.	
	3	21060364989		2016-12-15	Speasl et al.	

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	1	2019089677	WO	A1	2019-05-09	Shannon c/o The Marbury Law Group, PLLC.		

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	Application Number	16720543
	Filing Date	2019-12-19
	First Named Inventor	Grant Mark Bristow
	Art Unit	3661
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	Application Number	16720543
	Filing Date	2019-12-19
	First Named Inventor	Grant Mark Bristow
	Art Unit	3661
	Examiner Name	TBD
	Attorney Docket Number	BEL-IN140-19.02

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See attached certification statement.

The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

☒ A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Robert G. Graham/	Date (YYYY-MM-DD)	2021-04-13
Name/Print	Robert G. Graham	Registration Number	58042

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(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
09 May 2019 (09.05.2019)

WIPO | PCT

(10) International Publication Number
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G01S 19/15 (2010.01)

(21) International Application Number:
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(22) International Filing Date:
31 October 2018 (31.10.2018)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
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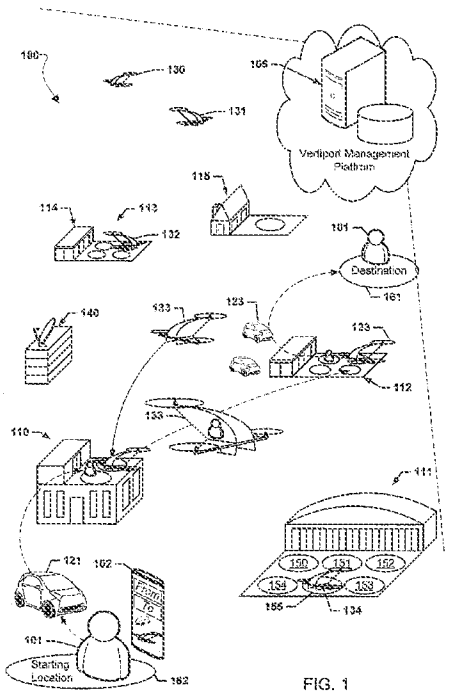


FIG. 1

(57) Abstract: Systems, methods, and devices of the various embodiments enable a vertiport management platform for various aerial on demand mobility (ODM) stakeholders, including vertiport owners/operators, mobility service providers, aircraft fleet operators (e.g., electric vertical takeoff and landing (eVTOL) fleet operators, etc.), etc., to coordinate activities related to vertiports. Various embodiments enable vertiport capacity and ground operation coordination among aerial ODM stakeholders. Vertiport management platforms according to the various embodiments may support all aspects of aerial ODM services. Vertiport management platforms according to the various embodiments may enable flight operations at and between vertiports regardless as to the mobility service provider and/or customer facing network under which a flight is provided to a customer.

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TITLE

Vertiport Management Platform

RELATED APPLICATIONS

[0001] This application claims the benefit of priority to U.S. Provisional Patent Application 62/580,833 entitled "Vertiport Management Platform," filed November 2, 2017, the entire contents of which are hereby incorporated by reference for all purposes.

BACKGROUND

[0002] The fundamentals of aerial on demand mobility (ODM) networks differ from existing terrestrial transportation networks (e.g., road based ODM networks operated by mobility service providers, such as Uber®, Lyft®, etc.) in several ways. Additionally, the fundamentals of aerial ODM networks differ from commercial airline transportation networks (e.g., services provided from metropolitan or regional airports, such as Delta® flights, JetBlue® flights, etc.) in several ways.

[0003] Aerial ODM flight schedules are by nature dynamic and evolve in real-time and the smaller scale of vertiports requires precise use of resources without high overhead. Additionally, aerial ODM may present challenges in that there can be both cooperative and competitive dynamics between the aerial ODM stakeholders, such as vertiport owner/operators, mobility service providers, and aircraft fleet operators (e.g., electric vertical takeoff and landing (eVTOL) fleet operators). For an aerial ODM network to work for aerial ODM stakeholders, coordination of capacity and ground operations at all vertiports that aircraft fly between is needed.

SUMMARY

[0004] The systems, methods, and devices of the various embodiments enable a vertiport management platform for various aerial on demand mobility (ODM) stakeholders, including vertiport owners/operators, mobility service providers, aircraft fleet operators (e.g., electric vertical takeoff and landing (eVTOL) fleet operators,

etc.), etc., to coordinate activities related to vertiports. Various embodiments enable vertiport capacity and ground operation coordination among aerial ODM stakeholders. Vertiport management platforms according to the various embodiments may support all aspects of aerial ODM services. Vertiport management platforms according to the various embodiments may enable flight operations at, and between, vertiports without regard to the mobility service provider and/or customer facing network under which a flight is provided to a customer.

BRIEF DESCRIPTION OF THE DRAWINGS

[0005] The accompanying drawings, which are incorporated herein and constitute part of this specification, illustrate exemplary embodiments of the invention, and together with the general description given above and the detailed description given below, serve to explain the features of the invention.

[0006] FIG. 1 is a system block diagram of an aerial ODM network supported by a vertiport management platform according to various embodiments.

[0007] FIG. 2 is a map of vertiports managed by a vertiport management platform according to various embodiments.

[0008] FIG. 3 is a block diagram of various interfaces to a vertiport management platform according to various embodiments.

[0009] FIG. 4 is process flow diagram illustrating an embodiment method for a vertiport management platform to provide aerial ODM scheduling.

[0010] FIG. 5 is process flow diagram illustrating an embodiment method for a vertiport management platform to manage the slack capacity at a vertiport.

[0011] FIG. 6 is a call flow diagram illustrating various embodiment operations performed by aerial ODM stakeholders to schedule a trip including a flight.

[0012] FIG. 7 is a component diagram of an example computing device suitable for use with the various embodiments.

[0013] FIG. 8 is a component diagram of an example server suitable for use with the various embodiments.

DETAILED DESCRIPTION

[0014] The various embodiments will be described in detail with reference to the accompanying drawings. Wherever possible, the same reference numbers will be used throughout the drawings to refer to the same or like parts. References made to particular examples and implementations are for illustrative purposes, and are not intended to limit the scope of the invention or the claims.

[0015] The word "exemplary" is used herein to mean "serving as an example, instance, or illustration." Any implementation described herein as "exemplary" is not necessarily to be construed as preferred or advantageous over other implementations.

[0016] As used herein, the term "vertiport" is used to refer to any location configured to provide landing and takeoff space to a vertical takeoff and landing (VTOL) aircraft, such as an electric VTOL (eVTOL) aircraft and to enable customers/passengers to embark and debark the VTOL aircraft. Vertiports may be structures or portions of structures entirely dedicated to flight operations, such as an airfield, an airport, a specifically built vertiport building including one or more VTOL aircraft landing spaces and a customer/passenger lounge area, etc., and/or vertiports may be structures or portions of structures only partially dedicated to flight operations, such as roof of a shopping center or parking garage including one or more VTOL aircraft landing spaces and a customer/passenger lounge area, a space within the loops of a highway cloverleaf, a converted parking lot, etc. Vertiports may be temporary, such as a structures or portions of structures used part of the time for flight operations and part of the time for non-flight operations. For example, vertiports may be implemented in dual-use structures (e.g., parking lots or parking garages) or real estate (e.g., baseball, soccer or football fields) that are used part of the time for flight operations and part of the time for their normal or designated purpose. Vertiports may be privately owned, developed, and/or managed locations. Vertiports may be publicly owned, developed, and/or managed locations, such as transit hubs, airports, etc. Vertiports may also be

public-private ventures. Vertiports may have a small scale and throughput when compared with regional airports. For example, some vertiports may have space for a limited number of VTOL aircraft to land and/or otherwise operate at a time, such as one, two, three, four, five, or six landing spots, and some vertiports may not provide hangar or other long term storage and maintenance space to VTOL aircraft. Vertiports may provide various support and maintenance services to VTOL aircraft, such as refueling services to combustion engine VTOL aircraft, re-charging services to eVTOL aircraft, etc.

[0017] As used herein, the term "computing device" is used to refer to any one or all of cellular telephones, smart phones, personal or mobile multi-media players, personal data assistants (PDAs), laptop computers, personal computers, tablet computers, smart books, palm-top computers, wireless electronic mail receivers, multimedia Internet enabled cellular telephones, wireless gaming controllers, satellite or cable set top boxes, streaming media players (such as, ROKU™ or CHROMECAST™ or FIRE TV™), smart televisions, digital video recorders (DVRs), and similar personal electronic devices which include a programmable processor and memory and circuitry to provide the functionality described herein.

[0018] The various embodiments are described herein using the term "server" to refer to any computing device capable of functioning as a server, such as a master exchange server, web server, mail server, document server, content server, or any other type of server. A server may be a dedicated computing device or a computing device including a server module (e.g., running an application which may cause the computing device to operate as a server). A server module (e.g., server application) may be a full function server module, or a light or secondary server module (e.g., light or secondary server application) that is configured to provide synchronization services among the dynamic databases on receiver devices. A light server or secondary server may be a slimmed-down version of server-type functionality that can be implemented on a receiver device thereby enabling it to function as an Internet server (e.g., an enterprise e-mail server) only to the extent necessary to provide the functionality described herein.

[0019] The fundamentals of aerial on demand mobility (ODM) networks differ from existing terrestrial transportation networks (e.g., road based ODM networks operated by mobility service providers, such as Uber®, Lyft®, etc.) in several ways. As an example, all that is typically needed for road based ODM passenger/customer pick-up/drop-off is curb space which is nearly everywhere a passenger/customer may be located and/or desires to travel to, is generally public property and free to use, and provides a high capacity for passenger/customer pick-ups/drop-offs. Conversely, aerial ODM may require vertiports for passenger/customer pick-up/drop-off which are generally in limited locations, may be on private property, and may have limited capacity for passenger/customer pick-ups/drop-offs.

[0020] Additionally, the fundamentals of aerial ODM networks differ from commercial airline transportation networks (e.g., services provided from metropolitan or regional airports, such as Delta® flights, JetBlue® flights, etc.) in several ways. As an example, commercial airline transportation networks typically fly from regional airports, which are typically in one or two locations in a metropolitan area, are expensive public infrastructure projects, have varying utilization rates, and have large scale passenger/customer and flight throughputs. Commercial airline transportation networks typically schedule flights months in advance and are supported by professional management and planning operations. Conversely, aerial ODM networks may fly from vertiports that are numerous throughout a metropolitan area, are generally private and inexpensive to build and operate, and require a high flight throughput to be economically viable. Aerial ODM flight schedules are by nature dynamic and evolve in real-time and the smaller scale of vertiports requires precise use of resources without high overhead.

[0021] Aerial ODM may present challenges in that there can be both cooperative and competitive dynamics between the aerial ODM stakeholders, such as vertiport owner/operators, mobility service providers, and aircraft fleet operators (e.g., electric vertical takeoff and landing (eVTOL) fleet operators). For example, vertiport owner/operators need to design and locate their vertiports to be desirable to mobility service providers and aircraft fleet operators so as to ensure usage of the vertiports by

both the customers/passengers of mobility service providers and pilots of aircraft fleet operators. As another example, mobility service providers need to schedule flights from vertiports that enable aircraft of aircraft fleet operators to receive necessary services (e.g., charging, etc.) at certain periodicities. As a further example, should fees for use of vertiports become too high, mobility service providers and/or aircraft fleet operators may be incentivized to build and operate their own vertiports. For an aerial ODM network to work for aerial ODM stakeholders, coordination of capacity and ground operations at all vertiports that VTOL aircraft fly between is needed.

[0022] The systems, methods, and devices of the various embodiments enable a vertiport management platform for various aerial ODM stakeholders, including vertiport owners/operators, mobility service providers, aircraft fleet operators (e.g., electric vertical takeoff and landing (eVTOL) fleet operators)(aircraft fleet operators may include organizations operating multiple aircraft or an individual operating a single aircraft), service providers (e.g., electric charging, maintenance, etc.), etc., to coordinate activities related to vertiports. Vertiport management platforms according to the various embodiments may both coordinate physical operations in aerial ODM networks (e.g., aircraft and passenger movement, etc.) and coordinate marketplace activities in aerial ODM networks (e.g., payments, bidding, etc.) Various embodiments enable vertiport capacity and ground operation coordination among aerial ODM stakeholders. Vertiport management platforms according to the various embodiments may support all aspects of aerial ODM services and vertiport management platforms according to the various embodiments may provide market-making functions and services for aerial ODM. Vertiport management platforms according to the various embodiments may enable flight operations at and between vertiports without regard to the mobility service provider and/or customer facing network under which a flight is provided to a customer.

[0023] The systems, methods, and devices of the various embodiments may provide a vertiport management platform that may autonomously manage capacity of take-off and landing spots across all vertiports in an area. The vertiport management platform may be a cloud based platform storing data associated with various aerial ODM

stakeholders in one or more database. For example, the vertiport management platform may include a database of vertiports including information on vertiport owners/operators, economic factors related to vertiports (e.g., rate of return goals, expected/actual usage rates, etc.), number of landing and take-off spots or pads at a vertiport, air traffic requirements or restrictions at a vertiport (e.g., egress/ingress flight directions, altitude ceilings, hover restrictions, etc.), maps of vertiports and their surrounding air traffic restrictions, etc. The vertiport management platform may apply algorithms, such as machine learning algorithms, to the data associated with aerial ODM stakeholders utilizing the vertiport management platform to manage the various aerial ODM processes associated with vertiports. For example, the vertiport management platform may apply machine learning algorithms to identify patterns in historical vertiport operations data and may use those patterns to predict future vertiport capacity in various scenarios. The vertiport management platform may enable vertiport owners/operators to maximize throughput and fee collection in the operation of vertiports. The vertiport management platform may alleviate the capacity bottleneck associated with the limited number of vertiports and take-off and landing spots at those vertiports in a given area, thereby supporting aerial ODM adoption. The vertiport management platform may track aircraft in-route and outbound from vertiports, link those aircraft to passenger demands, and dynamically assign aircraft, passengers, flight plans/routings, and vertiport take-off and landing spots (pads) together. The vertiport management platform may track interruptions and delays, such as passenger arrival delays, maintenance delays (e.g., electric charging delays, fueling delays, etc.), pre-flight check failures, weather delays, flight interruptions (e.g., emergency landings, etc.), and any other interruptions and/or delays impacting aerial ODM, and may dynamically adjust aircraft, passenger, and/or vertiport assignments. In various embodiments, the vertiport management platform may maintain a dynamic and experience based threshold level of slack (i.e., excess capacity) at a given vertiport to enable the vertiport management platform to account for and adjust to interruptions and/or delays impacting aerial ODM services.

[0024] In various embodiments, mobility service providers (e.g., aerial and aerial/road based ODM transportation network companies) may dynamically assemble flights from a marketplace of available vertiport timeslots, coupled with matching government airspace controller (e.g., U.S. Federal Aviation Administration (FAA), European Organization for the Safety of Air Navigation (Eurocontrol), etc.) flight plans and associated services (e.g., maintenance, electric charging, etc.). Access and pricing of timeslots may be determined in the free market as brokered on a vertiport management platform according to the various embodiments, and may include spot-market, pre-contracted, and other block-purchased or priority-based arrangements. A vertiport management platform according to the various embodiments may receive inputs from passengers/customers, mobility service providers (e.g., aerial and aerial/road based ODM transportation network companies), VTOL fleet operators, government airspace controllers (e.g., U.S. Federal Aviation Administration (FAA), European Organization for the Safety of Air Navigation (Eurocontrol), etc.) that may define available flights and/or demand for flights. A vertiport management platform according to the various embodiments may receive inputs from vertiport owner/operators (including inputs from equipment, systems, and personnel at the vertiports themselves) and definitions of various different requirements and constraints related to vertiport operations, such as electric charging, maintenance, billing, passenger/customer services, onward connections, etc., that may define both the available vertiports at any given time and the capacities of those vertiports. A vertiport management platform according to the various embodiments may use the knowledge of available flights and/or demand for flights and the knowledge of available vertiports at any given time and the capacities of those vertiports to perform various operations in support of aerial ODM, such as operations to maximize utilization of vertiports and/or flights, to create an efficient market for vertiports and/or flights, to enable seamless operations of vertiports and/or flights, to support a quality customer experience at vertiports and/or on flights, and to enable planning of future expansion of aerial ODM network capacity (e.g., placement of new vertiports, additions of aircraft, etc.).

[0025] A vertiport management platform according to the various embodiments may provide an interface to multiple different participants in aerial ODM, such as vertiport owner/operators, mobility service providers (e.g., aerial and aerial/road based ODM transportation network companies), service providers (e.g., electric charging, maintenance, fueling, passenger services (e.g., hospitality services, etc.), etc.), VTOL fleet operators, etc. A vertiport management platform according to the various embodiments may provide various tools for value creation in aerial ODM networks, such as route selection tools, flight scheduling tools, dynamic market pricing tools, service purchase tools, automated aviation compliance tools, streamlined administration tools, etc. A vertiport management platform according to the various embodiments may provide exchange operations, such as payment processing, contracted capacity services, performance ratings, etc. A vertiport management platform according to the various embodiments may provide a network of destinations, may leverage historical data on flights and/or vertiports to increase efficiency, may enable the selection of service providers, may support compliance requirements, and may streamline financial operations for aerial ODM participants. A vertiport management platform according to the various embodiments may implement contracts between the various aerial ODM participants and operate and schedule flights and other events in the aerial ODM network in compliance with those contracts. A vertiport management platform according to the various embodiments may recommend market terms for contracts between the various aerial ODM participants.

[0026] A vertiport management platform according to the various embodiments may receive routes, altitudes, and speed information for VTOL aircraft (e.g., eVTOL aircraft) from government airspace controllers (e.g., U.S. Federal Aviation Administration (FAA), European Organization for the Safety of Air Navigation (Eurocontrol), etc.) that monitor a given airspace and maintain the separation of aircraft traffic in that airspace. The vertiport management platform according to the various embodiments may coordinate and communicate upcoming ground operations at vertiports to aerial ODM participants and monitor ground operation performance.

The vertiport management platform according to the various embodiments may provide bi-direction updates between air and ground status of both VTOL aircraft and vertiports.

[0027] A vertiport management platform according to the various embodiments may provide a map of all vertiports available in a given region. The vertiport management platform may assign departure and landing slots at those vertiports based on availability. The vertiport management platform may manage the dynamic market for vertiport utilization and schedule aircraft services, such as maintenance, electric charging, etc. The vertiport management platform may schedule the arrival and/or departure of aircraft from a vertiport. The vertiport management platform may provide a benchmark of ground operations performance at a vertiport. The vertiport management platform may adjust operations at a vertiport based on weather. The vertiport management platform may provide a benchmark of flight on-time performance at a vertiport. The vertiport management platform may collect and distribute landing fees for a vertiport. The vertiport management platform may control electric charging services at a vertiport. The vertiport management platform may control maintenance services at a vertiport. The vertiport management platform may control passenger services at a vertiport. The vertiport management platform may support the provisioning of payables and receivables at a vertiport. The vertiport management platform may integrate with enterprise resource planning (ERP) systems, such as via application programming interfaces (APIs). The vertiport management platform may synchronize flight plans and vertiport operations. The vertiport management platform may document vertiport ground operations. The vertiport management platform may support emergency services, such as by reserving capacity at vertiports for emergencies and providing data links to first responders, etc.

[0028] A vertiport management platform according to the various embodiments may include interfaces for one or more aerial ODM participants and/or operations, including interfaces for air traffic control, interfaces for electric charging services, interfaces for mobility service providers (e.g., aerial and aerial/road based ODM transportation network companies), interfaces for vertiport onsite operations,

interfaces for hyper local airspace, interfaces for national weather service providers, interfaces for maintenance providers, interfaces for government airspace regulators and controllers (e.g., U.S. Federal Aviation Administration (FAA), European Organization for the Safety of Air Navigation (Eurocontrol), etc.), interfaces for VTOL fleet operators (e.g., eVTOL fleet operators), etc.

[0029] In various embodiments, interfaces for air traffic control may enable air traffic control to provide the inbound flight picture to a vertiport management platform. In various embodiments, interfaces for air traffic control may enable aircraft pilots (or autonomous aircraft) to utilize the vertiport management platform to file and/or update flight plans manually and/or automatically. In various embodiments, interfaces for air traffic control may enable flight plans to be filed synchronously with assignments of landing and takeoff timeslots and assignments of aircraft. In various embodiments, interfaces for air traffic control may enable temporary flight restrictions (TFRs), such as exclusion areas related to air shows, etc., to be created, updated, and/or canceled, as well as noticed to aircraft, vertiports, and any other aerial ODM participants. Additionally, the vertiport management platform may respond to the TFRs and adjust flight operations in the aerial ODM network accordingly. In various embodiments, interfaces for air traffic control may enable weather based routing changes to be indicated on an area wide and/or per aircraft basis from air traffic control to the various impacted aircraft, and the vertiport management platform may respond by updating estimated times of arrival/departure and rippling the resulting changes to flight plans throughout the aerial ODM network as needed. In various embodiments, interfaces for air traffic control may enable emergency divert updates from aircraft to be passed through the vertiport management platform to air traffic control. In various embodiments, the vertiport management platform and air traffic control may exchange data via a bi-directional interface. In various embodiments, a data feed from air traffic control may be provided to the vertiport management platform with the air traffic picture, flight plans, aircraft statuses, and any other information for a given area. The vertiport management platform may make the data feed available to other aerial ODM stakeholders, such as to vertiports for management of ground operations. The data

feed from air traffic control may enable the vertiport management platform to generate inbound and outbound flight pictures for vertiports and those inbound and outbound flight pictures may be provided to vertiport owner/operators and operations personnel of the takeoff and landing spots of the vertiports.

[0030] In various embodiments, a vertiport management platform may provide interfaces for electric charging services that may enable electric charging scheduling, operations status updates related to electric charging, billing and payment for electric charging services, and ERP integration for VTOL fleet operators and electric charging service providers. Vertiports may include electric charging equipment, such as electric charging charge points for one or more different electric charging services and/or one or more different aircraft configurations. In various embodiments, the vertiport management platform may store aircraft configuration data, such as make, model, fueling requirements, number of passengers, total useful load (i.e., carrying capacity), etc., and may provide that aircraft configuration data to electric charging services to enable the correct electric charging services to be prepared for and provisioned to aircraft at given vertiports. The vertiport management platform may enable VTOL fleet operators (e.g., eVTOL fleet operators) to interface with electric charging services to schedule and pay for electric charging services for aircraft.

[0031] In various embodiments, a vertiport management platform may provide interfaces for mobility service providers (e.g., aerial and aerial/road based ODM transportation network companies) that may enable flight creation, onward connection management, billing and payment for flights, and ERP integration for the mobility service providers.

[0032] In various embodiments, interfaces for vertiport onsite operations in a vertiport management platform may include interfaces to track the status of aircraft on the ground at the vertiport and the status of occupied landing/takeoff spaces at the vertiports. In various embodiments, interfaces for vertiport onsite operations may enable schedules of arrivals and departures to be generated and provided to the vertiports. In various embodiments, sensors at vertiports, such as radars, lidars,

cameras, or other sensors, may monitor the status of aircraft at the vertiport and/or the status of ground operations at the vertiport. Such sensors may use machine learning and/or computer analysis (e.g., machine vision, etc.) to interpret the sensor data and inform the vertiport management platform of the status of aircraft at the vertiport and/or the status of ground operations at the vertiport. The data from such sensors may be provided to the vertiport management platform and used by the vertiport management platform to track the status of aircraft on the ground at the vertiport and the status of occupied landing/takeoff spaces at the vertiports. Additionally, such data may be used to update flight plans and assignments. Further, data related to operations at the vertiport, such as maintenance (e.g., pre-flight check completion/passage/failure, etc.), electric charging (e.g., charge state, time to complete charging, etc.), passenger loading (e.g., loading complete, in process, passenger arrived, etc.), and any other vertiport operation, may be gathered by one or more sensors or input devices (e.g., vertiport staff user input terminal, etc.) and be provided to the vertiport management platform and used by the vertiport management platform. For example, the data related to operations at the vertiport may be used by the vertiport management platform to dynamically adjust flight assignments.

[0033] In various embodiments, interfaces for hyper local airspace information may enable situational awareness of each vertiports' local airspace to be monitored by a vertiport management platform. One or more sensor inputs at a vertiport, such as radars, Lidars, cameras, barometers, wind speed monitors, etc., may enable a situational awareness of the local airspace over the vertiport and safety and operations monitoring of each vertiport. Hyper local airspace information may include information about what aircraft are ascending, descending, landing, taking off, or otherwise operating in the vicinity of a vertiport, information about weather (e.g., cloud cover, barometer pressure readings, wind speed readings, etc.). Hyper local airspace information may be provided from sensors at the vertiport itself. For example, up-ward looking radars, lidars, and/or cameras at a vertiport may gather airspace information, such as aircraft information, weather information, etc.

[0034] In various embodiments, interfaces for national weather service providers may provide one or more weather feed to be provided to a vertiport management platform. The weather feed may provide a picture of the weather over one or more vertiport. The vertiport management platform may compare current weather patterns from the weather feed to previous weather patterns stored in a database. Based on the comparison, historical impacts of weather on vertiport operations may be modeled and current vertiport operations may be adjusted proactively to account for likely weather impacts. In this manner, the vertiport management platform may get ahead of weather impacts. Additionally, weather information may be provided by local weather stations, such as remote stations on buildings, weather stations at the vertiports themselves, miniature weather sensors located near a vertiport, aircraft pilots (e.g., weather observation logs, etc.), sensors on-board aircraft, etc.

[0035] In various embodiments, a vertiport management platform may provide interfaces for maintenance providers to advertise available services at various vertiports, schedule services, billing and payment for services, and ERP integration for maintenance service providers. Vertiports may include maintenance equipment, such as hangers, tools, lifts, etc., for one or more different maintenance providers and/or one or more different aircraft configurations. In various embodiments, the vertiport management platform may store aircraft configuration data, such as make, model, fueling requirements, etc., and may provide that aircraft configuration data to maintenance providers to enable the correct maintenance services to be prepared for and provisioned to aircraft at given vertiports. The vertiport management platform may enable VTOL fleet operators (e.g., eVTOL fleet operators) to interface with maintenance providers to schedule and pay for electric charging services for aircraft.

[0036] In various embodiments, a vertiport management platform may provide interfaces for government airspace regulators and controllers (e.g., U.S. Federal Aviation Administration (FAA), European Organization for the Safety of Air Navigation (Eurocontrol), etc.) that may provide operational accountability, compliance reporting, and safety monitoring. The vertiport management platform may capture data related to all activities of aerial ODM stakeholders using the

vertiport management platform and store such data. This stored data may serve effectively as a network wide "black box" enabling government airspace regulators and controllers to recreate the events before emergencies and other accidents and may provide aerial ODM stakeholders compliance and reporting services to such government airspace regulators and controllers using the stored data.

[0037] In various embodiments, a vertiport management platform may provide interfaces for VTOL fleet operators (e.g., eVTOL fleet operators) that may provide fleet status information, electric charging information, maintenance information, billing and payment processing, and ERP integration for VTOL fleet operators. In various embodiments, the vertiport management platform may receive and store aircraft configuration data, such as make, model, fueling requirements, charging requirements, etc., for aircraft from VTOL fleet operators. The vertiport management platform may provide interfaces for VTOL fleet operators to negotiate contracts with mobility service providers for use of aircraft and/or may enable VTOL fleet operators to receive spot bids for aircraft not currently under contract. The vertiport management platform may associate cost functions with aircraft of VTOL fleet operators, such as cost functions that account for aircraft operation costs, aircraft current location, flight time, VTOL fleet operator profit goals, etc., and may enable VTOL fleet operators to use such cost functions to automatically prepare bids for responding to flight requests on the spot flight request market. These cost functions may account for various VTOL fleet operator goals and may include price floors or other controls to ensure VTOL fleet operator profit needs are met. For example, the vertiport management platform may use VTOL fleet operator set cost functions to select from available aircraft and assign aircraft to flights to fill flight requests. Additionally, the vertiport management platform may execute contracts dynamically between vertiport operators, VTOL fleet operators, and mobility service providers to assign aircraft and vertiports to fill flight requests.

[0038] In various embodiments, a vertiport management platform may provide dynamic scheduling assignment of flights, across all sources of flights, including any and all consumer facing mobility service providers. The vertiport management

platform may provide a demand picture that is a forward looking list of all flights being requested from across all VTOL (e.g., eVTOL) fleet operators. Such dynamic scheduling and demand picture provisioning may enable VTOL (e.g., eVTOL) fleet operators to maximize their operating profit for air vehicles and/or may enable vertiport owner/operators to maximize their profit on vertiport operations. The vertiport management platform may enable market making for each requested flight based on various factors, such as contracts and/or spot market bids for aircraft service. The vertiport management platform may match flight requests to air vehicles based on one or more factors, such as price and/or response time, already scheduled flights with empty seats, etc. The vertiport management platform may track each aircraft and provide a real-time map of the location of each aircraft. The vertiport management platform may provide a predictive map of where all aircraft will be at times in the future to contribute to accurate and economically sound bidding for assignments of future flights. Such predictive services may enable VTOL (e.g., eVTOL) fleet operators to balance between maximizing pricing and maximizing utilization of their aircraft fleets. In various embodiments, VTOL (e.g., eVTOL) fleet operators may provide a forward view of the aircraft they will have operating at given times and in given areas to the vertiport management platform to enable a capacity picture to be generated by the platform. The operating plans for the VTOL (e.g., eVTOL) fleet operators may be both scheduled and dynamically changing, and the vertiport management platform may support both schedule types enabling VTOL (e.g., eVTOL) fleet operators to make rapid changes to the aircraft available.

[0039] In various embodiments, a vertiport management platform may provide pricing controls for VTOL (e.g., eVTOL) fleet operator flights. The vertiport management platform may set the pricing floor for aircraft to be assigned to a flight, for example based on aircraft type, operating cost structure, as well as deadhead distance for the aircraft to arrive at the pick-up vertiport. The vertiport management platform may set the pricing floors and/or bidding price functions used to dynamically match aircraft to needed flights. In various embodiments, a vertiport management platform may implement execution of contractual arrangements between fleet

operators and mobility service providers for air vehicle capacity. In various embodiments, a vertiport management platform may implement spot market pricing floors and bidding rules based on distance and/or response time from an air vehicle location to a pick-up (originating) vertiport. The vertiport management platform may monitor preferences for pricing and provide economic performance data of aircraft and fleet operators. The vertiport management platform may report on the revenue per day, revenue per aircraft, operating hours, bidding/pricing performance versus the market place, destinations frequented, and/or any other information of interest to the VTOL (e.g., eVTOL) fleet operators. This may enable VTOL (e.g., eVTOL) fleet operators to track the real-time status of their aircraft and gain a detailed picture of their operations to understand the utilization of the aircraft and vertiports, understand market reactions, and understand growth and usage trends. The vertiport management platform may increase market efficiency, increase utilization, increase speed and flexibility, and improve the customer experience of aerial ODM by dynamic matching of flights and aircraft. The vertiport management platform may aggregate flights and vertiport asset data and use that data to drive higher profits for VTOL (e.g., eVTOL) fleet operators. Fees for the vertiport management platform use by VTOL (e.g., eVTOL) fleet operators may be in the form of market spread fees, flat fees, or other type fees. The real-time and historical data accumulated by the vertiport management platform may be valuable to improve VTOL (e.g., eVTOL) fleet operator performance and help to deploy capital to efficient allocations of purchases of new aircraft, as well as construction of new vertiports.

[0040] In various embodiments, a vertiport management platform may enable vertiport owners/operators to maximize operating profit by providing passengers/customers and VTOL fleet operators a map or other indication of available vertiports and a directory of services available at those vertiports. The vertiport management platform may enable vertiport owners/operators to create flights from their vertiports on an on-demand basis and may provide precision predictions of arrival and departure times augmented by historical data. The vertiport management platform may enable aircraft to purchase services, such as electric charging or other

maintenance services, from vertiports. The vertiport management platform may support contracted capacity buys of vertiport landing/take-off spaces, spot market buys of landing/take-off spaces, and resale/transfer of landing/take-off spaces. In this manner, the vertiport management platform may enable vertiport owners/operators to maximize operating profit, attract flights and passengers, maximize utilization, up sell services, and/or adjust prices within the market. The vertiport management platform may charge a fee on service sales and landing/take-off space sales and the vertiport owners/operators may benefit from the dynamic market and historical data available on the vertiport management platform.

[0041] In various embodiments, a vertiport management platform may enable vertiport owners/operators to minimize the operational complexity of vertiport operations by maintaining a capacity buffer based on historical data, consolidating arrivals and departures on a single dashboard, and enabling flight plans to be filed. This may avoid overbooking, enable efficient operation management/staffing, enable regulation compliance, and enable system wide arrival and departure reporting. The vertiport management platform may tune the capacity buffer based on historical data. The vertiport management platform may provide a complete view of arriving and departing flights.

[0042] In various embodiments, a vertiport management platform may provide dynamic scheduling services to mobility service providers. The vertiport management platform may enable assignment of flights drawing from capacity across all vertiports and all VTOL fleet operators. The vertiport management platform may enable a market for each possible flight to be created, either through contracts and/or spot bids and clears the market by matching the flight request with an aircraft based on various factors including price and response time. The vertiport management platform may include all vertiports in an area, without restrictions as to ownership or network affiliation. The vertiport management platform may provide real-time departure and arrival information to mobility service providers for use in planning precise transfers and connections. The updates of real-time status on aircraft take-offs and landings may enable mobility service providers to predict actual arrival times to adjust their

transportation pickup times. The vertiport management platform may provide a demand picture of all flights requested by transport network companies and the demand picture may be analyzed on a time and/or geographic basis. This analysis may support vertiport expansion and capacity planning. Fees for the vertiport management platform use by the mobility service providers may be in the form of market spread fees, flat fees, or other type fees. The vertiport management platform may provide on-time service, maximized operating profits, and a full multi-modal mobility solution for mobility service providers. Through the vertiport management platform mobility service providers may meet customer/passenger needs, such as competitive pricing, fast response times with rapid pick-ups, and maximized destination service.

[0043] In various embodiments, a vertiport management platform may provide aerial ODM scheduling by dynamically assigning requested flights to vertiport spots and VTOL aircraft. The vertiport management platform may continually determine vertiport capacity, continually determine requested flights and their associated requirements, and continually determine available VTOL aircraft. Based on the capacity, requested flights, and available VTOL aircraft, the vertiport management platform may assign both take-off and landing vertiport spots and VTOL aircraft to requested flights. The vertiport management platform may send the assignments to the vertiports and VTOL aircraft and may dynamically update the assignments as the capacity, requested flights, and available VTOL aircraft change before a given requested flight is completed.

[0044] In various embodiments, a vertiport management platform may manage the slack capacity at a vertiport by dynamically updating the slack capacity setting for that vertiport. The vertiport management platform may determine the capacity threshold for a vertiport based at least in part on a selected vertiport's current status and historical performance data. In response to the slack capacity of the vertiport not being within the threshold, the vertiport management platform may update the selected vertiport's slack capacity setting. The vertiport's slack capacity setting may be used in determining the vertiport's capacity which may be used by the vertiport

management platform to assign both take-off and landing vertiport spots and VTOL aircraft to requested flights.

[0045] FIG. 1 is a system block diagram of an aerial ODM network 100 supported by a vertiport management platform 106 according to various embodiments. The vertiport management platform 106 may be an Internet connected (e.g., cloud based) platform tracking all operations in the aerial ODM network 100 and storing data related to all aspects of the aerial ODM network 100 operations in one or more databases.

[0046] The aerial ODM network 100 may include various vertiports 110, 111, 112, 114, and 115 all including one or more take-off and landing spots. Some vertiports may have a single take-off and landing spot, while other vertiports may have large numbers of take-off and landing spots. For example, vertiport 111 may have six spots, 105, 151, 152, 153, 154, 155, and 156. Aircraft, such as eVTOL aircraft 130, 131, 132, 133, and 134, may fly between the landing spots of the vertiports 110, 111, 112, 114, and 115 to move passengers/customers, such as passenger/customer 101 from various starting locations 162 to destinations 161 in the aerial ODM network 100. The vertiport management platform 106 may include the attributes of all vertiports in the aerial ODM network 100, such as the number of take-off and landing spots and the status of those spots. For example, the vertiport management platform 106 may track that eVTOL aircraft 134 is currently in spot 155 of vertiport 111.

[0047] Mobility service providers, such as mobility service provider 140, may interface with the vertiport management platform 106 to request and/or create flights from aircraft in the aerial ODM network 100 to enable flight legs between the transport provided by their ground vehicles 121 and 123 between vertiports. As an example, a passenger 101 at a starting location 162 may request transportation from the starting location 162 to a destination 161 from a mobility service provider 140 via the user's computing device 102. The mobility service provider 140 may request a flight from the vertiport management platform 106 and may provide the starting location 162 and destination 161. The vertiport management platform 106 may

review the airspace picture for the aerial ODM network 100 and based on multiple factors, such as economic factors, proximity of aircraft to vertiports, proximity of vertiports to starting location 162 and destination 161, vertiport capacity, etc., may assign aircraft 133 to fly from vertiport 110 to vertiport 112 to fulfill the flight request. The mobility service provider 140 may assign its vehicle 121 to drive the passenger/customer 101 from the starting location 162 to the vertiport 110. The aircraft 133 may arrive at the vertiport 110 to pick-up the passenger/customer 101 and fly to the vertiport 112 to disembark the passenger/customer 101. The passenger/customer 101 may be transported by the mobility service provider 140 vehicle 123 to the destination 161. The customer/passenger 101 may pay the mobility service provider 140 for the transport via vehicles 121 and 123 and aircraft 133 via his or her computing device 102. Then the mobility service provider 140 may pay the aircraft 133 and the vertiports 110 and 112 their respective fees for the flight via the vertiport management platform 106. The vertiport management platform 106 may track all such transactions and flights in the aerial ODM network 100. As another example, the mobility service provider 140 may request an overall trip from starting locations 162 to a destination 161, and the vertiport management platform 106 may optimize flight options from a variety of nearby vertiports, passing one or more options (e.g., the best option, top three options, etc.) back to the mobility service provider 140 for completion of the booking via ground transportation assignment and confirmation by the passenger/customer 101. Additionally, the passenger/customer 101 may be presented several options for vertiports and/or aircraft to use trading off between time, convenience, and/or price. Flight creation and scheduling may include reserving/holding several candidate flight plans with air traffic control until the passenger/customer 101 may be presented with and may select/confirm the flight to actually be used.

[0048] FIG. 2 is a map 200 of different type vertiports 202, 204, 206, and 208 managed by a vertiport management platform, such as vertiport management platform 106, that may be located in a given area. An area may include personal private vertiports 208 that are owned by individuals and intended only for that individual's

private use. These may for example be located at a passenger's home. Generally a personal private vertiport may only be for that passenger's personal travel. An area may include independent general use vertiports 202. These independent general use vertiports 202 may be established for use by all passengers and aircraft for a fee. The independent general use vertiports 202 may be developed by capital from landowners and/or investors and may be available to any mobility service provider to utilize. Example independent general use vertiports 202 may be located on top of buildings, in open lots, etc. An area may include closed network vertiports 204. These closed network vertiports 204 may be established for use exclusively by a single mobility service provider to support its flights. An area may include public vertiports 206. Public vertiports 206 may be available to all passengers and aircraft and may be developed by municipalities. Public vertiports 206 may be located at airports, at highway clover leafs, or on other public lands.

[0049] FIG. 3 is a block diagram of various interfaces to a vertiport management platform 106. The vertiport management platform 106 may include interfaces to one or more aerial ODM participants and/or operations, including interfaces for air traffic control 304, interfaces for support and service providers 310 (e.g., electric charging services, maintenance providers, etc.), interfaces for mobility service providers 302, interfaces for vertiports 305 and ground support personnel 314, interfaces for airspace monitoring systems 313, such as hyper local airspace monitoring systems, interfaces for weather service providers 303, interfaces for government compliance monitors 311 (e.g., government airspace regulators and controllers (e.g., U.S. Federal Aviation Administration (FAA), European Organization for the Safety of Air Navigation (Eurocontrol), etc.), interfaces for eVTOL fleet operators 308, interfaces for customers/passengers 307, and interface for emergency services 312 (e.g., fire, emergency management, etc.). The various interfaces to the vertiport management platform 106 may be provided by cloud computing interfaces, such as Internet connections via wired and/or wireless connections, direct connection interfaces, proprietary interfaces, and/or any other type interfaces. The various interfaces may be

unidirectional and/or bidirectional interfaces to the vertiport management platform 106.

[0050] In various embodiments, interfaces for air traffic control 304 may enable air traffic control 304 to provide the inbound flight picture to the vertiport management platform 106. In various embodiments, interfaces for air traffic control 304 may enable aircraft pilots (or autonomous aircraft control systems) to utilize the vertiport management platform 106 to file and/or update flight plans manually and/or automatically. In various embodiments, interfaces for air traffic control 304 may enable temporary flight restrictions (TFRs), such as exclusion areas related to air shows, etc., to be created, updated, and/or canceled, as well as noticed to aircraft, vertiports, and any other aerial ODM participants. In various embodiments, interfaces for air traffic control 304 may enable weather based routing changes to be indicated on an area wide and/or per aircraft basis. In various embodiments, interfaces for air traffic control 304 may enable emergency divert updates from aircraft to be passed through the vertiport management platform 106 to air traffic control 304. The vertiport management platform 106 may make the data feed from air traffic control 304 available to other aerial ODM stakeholders, such as to vertiports 305 for management of ground operations by support and service providers 310 and/or ground support personnel 314.

[0051] In various embodiments, the vertiport management platform 106 may provide interfaces for support and service providers 310, such as electric charging services that may enable electric charging scheduling, operations status updates related to electric charging, billing and payment for electric charging services, and ERP integration for VTOL fleet operators and electric charging service providers. In various embodiments, the vertiport management platform 106 may provide interfaces for support and service providers 310, such as maintenance providers (e.g., repair facilities, etc.)

[0052] In various embodiments, a vertiport management platform may provide interfaces for mobility service providers 302 that may enable flight creation, onward

connection management, billing and payment for flights, and ERP integration for the mobility service providers 302.

[0053] In various embodiments, interfaces for vertiports 305 may enable onsite operations to be reported to the vertiport management platform 106 to allow the tracking of the status of aircraft on the ground at the vertiport 305 and the status of occupied landing/takeoff spaces at the vertiport 305. In various embodiments, interfaces for vertiport onsite operations may enable schedules of arrivals and departures to be generated and provided to the vertiport 305. In various embodiments, sensors at the vertiport 305, such as radars, lidars, cameras, or other sensors, may monitor the status of aircraft at the vertiport 305 and/or the status of ground operations at the vertiport 305. One or more sensor inputs at a vertiport 305, such as radars, Lidars, cameras, barometers, wind speed monitors, etc., may enable a situational awareness of the local airspace over the vertiport 305 and safety and operations monitoring of each vertiport 305 to be reported to the vertiport management platform 106. Hyper local airspace information may include information about what aircraft are ascending, descending, landing, taking off, or otherwise operating in the vicinity of a vertiport 305, information about weather (e.g., cloud cover, barometer pressure readings, wind speed readings, etc.). Hyper local airspace information may be provided from sensors at the vertiport 305 itself. For example, up-ward looking radars, lidars, and/or cameras at a vertiport may gather airspace information, such as aircraft information, weather information, etc.

[0054] In various embodiments, interfaces for weather 303 may include hyper local airspace weather information and information from national weather service providers that may provide one or more weather feed to be provided to the vertiport management platform 106.

[0055] In various embodiments, the vertiport management platform 106 may capture data related to all activities of aerial ODM stakeholders using the vertiport management platform 106 and store such data. This stored data may serve effectively as a network wide "black box" enabling government airspace regulators and

controllers to recreate the events before emergencies and other accidents and may provide aerial ODM stakeholders compliance and reporting services to such government airspace regulators and controllers using the stored data. Such data may be retrieved via the government compliance interface 311.

[0056] In various embodiments, a vertiport management platform 106 may provide interfaces for eVTOL fleet operators 308 that may provide fleet status information, electric charging information, maintenance information, billing and payment processing, and ERP integration for eVTOL fleet operators 308. In various embodiments, the vertiport management platform 106 may receive and store aircraft configuration data, such as make, model, fueling requirements, passenger capability, weight carrying capacity, charging requirements, etc., for aircraft from eVTOL fleet operators 308. In various embodiments, the vertiport management platform may communicate with aircraft through the eVTOL fleet operators 308 or directly to the aircraft 309.

[0057] In various embodiments, the vertiport management platform 106 may include various databases and modules related to all aerial ODM operations. For example, the vertiport management platform 106 may include a routing and scheduling module 351, a monitoring and compliance module 352, a billing and payment module 353, an administration module 354, a pricing module 355, a logging and storage module 356, a rating and review module 357, a bidding and contracting module 358, a machine learning module 359, and historical modeling module 360, and well as various other modules to provide the functionality described herein.

[0058] FIG. 4 illustrates an embodiment method 400 for a vertiport management platform to provide aerial ODM scheduling. In various embodiments, the operations of method 400 may be performed by a processor of a vertiport management platform, such as vertiport management platform 106.

[0059] In block 402, the vertiport management platform may determine vertiport capacity. Vertiport capacity may be determined based on attributes of vertiports in a given area, such as the number of landing and take-off spots at the vertiports, the

current status of the vertiports and the landing and take-off spots at the vertiports (e.g., operational, off-line, in-use, reserved, etc.), the type of vertiport (e.g., private, public, etc.), or any other vertiport attributes. Additionally, the historical performance data for vertiports may be used to determine vertiport capacity. For example, a vertiport with historically high throughput may be determined to have a higher capacity than vertiports with lower throughput. Further, a vertiport slack capacity setting may be used to determine vertiport capacity. In various embodiments, the vertiport management platform may maintain a threshold level of slack (i.e., excess capacity) at a given vertiport to enable the vertiport management platform to account for and adjust to interruptions and/or delays impacting aerial ODM services. As an example, a vertiport slack capacity setting may be a number of vertiport spots that should remain unscheduled at a vertiport to support contingencies, such as emergency take-offs and landings, aircraft failures, passenger arrival delays at the vertiport, loading delays, etc. Vertiport capacity may be determined based on inputs from vertiport owner/operators and other aerial ODM stakeholders provided by one or more interfaces to the vertiport management platform.

[0060] In block 404, the vertiport management platform may determine requested flights. Requested flights may be flight requests for transportation of one or more passengers from a starting location, such as a starting vertiport, starting address, etc. to a destination location, such as an arrival vertiport, arrival address, etc. Requested flights may be received by a vertiport management platform from transport network companies and may be generated in response to passengers requesting transport. For example, a passenger may request transport between two locations from a mobility service provider, such as Uber ®, and the mobility service provider may select to use a flight for all or a portion of the transport. The mobility service provider may generate a flight request for all or portion of the transport requested by the passenger and may send the flight request to the vertiport management platform. The vertiport management platform may determine which vertiports (e.g., a starting vertiport and arrival vertiport) to use for the transport. Alternatively, the mobility service provider may select the starting vertiport and/or arrival vertiport.

[0061] In block 406, the vertiport management platform may determine available eVTOL aircraft. Available eVTOL aircraft may be determined based on eVTOL statuses and locations provided to the vertiport management system from eVTOL fleet operators. Available eVTOL aircraft may be aircraft currently in a certain geographic area or aircraft scheduled to be in a geographic area within a given time period.

[0062] In block 410, the vertiport management platform may assign requested flights to vertiport spots and eVTOL aircraft. The vertiport management platform may track aircraft in-route and outbound from vertiports, link those aircraft to passenger demands, and dynamically assign aircraft, passengers, and vertiport take-off and landing spots (pads) together. The vertiport management platform may track interruptions and delays, such as passenger arrival delays, maintenance delays, pre-flight check failures, weather delays, flight interruptions (e.g., emergency landings, etc.), and any other interruptions and/or delays impacting aerial ODM, and may dynamically adjust aircraft, passenger, and/or vertiport assignments. The vertiport management platform may assign departure and landing slots at those vertiports based on availability of aircraft and/or vertiport landing slots. In various embodiments, the vertiport management platform may use VTOL fleet operator set cost functions to select from available aircraft and assign aircraft to flights to fill flight requests. Additionally, the vertiport management platform may execute contracts dynamically between vertiport operators, VTOL fleet operators, and mobility service providers to assign aircraft and vertiports to fill flight requests. In various embodiments, the vertiport management system may use machine learning algorithms to assign aircraft and vertiport slots to flight requests based on historical performance data related to aircraft and/or vertiports. The vertiport management platform may assign aircraft and/or vertiports based at least in part on reputation related rankings, such as customer reviews. In various embodiments, the vertiport management platform may enable assignment of flights drawing from capacity across all vertiports and all VTOL fleet operators. In various embodiments, the vertiport management platform may report to and/or query air traffic control as part of assigning requested flights to vertiport spots and eVTOL aircraft. The reporting to/querying of air traffic control may enable flight

plans to be requested and/or approved for the assigned eVTOL aircraft and vertiport spots. As one example, the vertiport management platform may send a desired takeoff time and location and desired arrival location (and optionally arrival time) to air traffic control, and air traffic control may return possible flight plans/routings and estimated times of departure/arrival matching the vertiports and aircraft designated by the vertiport management platform.

[0063] In block 412, the vertiport management platform may send the assignments to the vertiports and eVTOL aircraft. For example, the vertiport management platform may send a notification to the mobility service provider originating a flight request including such information as the aircraft identifier of the aircraft assigned to make the flight, the identifiers of both the starting and ending vertiports to be used for the flight, estimates of the arrival and departure times for the aircraft assigned to the flight at the assigned take-off spot at the starting vertiport, estimates of the arrival times for the aircraft assigned to the flight at the assigned landing spot at the ending vertiport, estimated costs for the flight, etc. As an example, the vertiport management platform may send a notification to each of the starting and ending vertiports to be used for a flight including such information as the aircraft identifier of the aircraft assigned to make the flight, the identifiers of both the starting and ending vertiports to be used for the flight, estimates of the arrival and departure times for the aircraft assigned to the flight at the assigned take-off spot at the starting vertiport, estimates of the arrival times for the aircraft assigned to the flight at the assigned landing spot at the ending vertiport, identities of the passengers taking the flight, services to be rendered to the passengers and/or aircraft at the vertiports, fees to be earned for the flight, etc. As another example, the vertiport management platform may send a notification to the aircraft assigned for a flight including such information as the identifiers of both the starting and ending vertiports to be used for the flight, estimates of the arrival and departure times for the aircraft assigned to the flight at the assigned take-off sport at the starting vertiport, estimates of the arrival times for the aircraft assigned to the flight at the assigned landing spot at the ending vertiport, identities of the passengers

taking the flight, fees to be earned for the flight, a route map for the flight, approved flight plan for the flight, etc.

[0064] The operations of method 400 may be performed continually and dynamically by the vertiport management platform, and as assignments are generated and sent the method may proceed to block 402 and continually determine vertiport capacity to update and/or assign requested flights.

[0065] FIG. 5 illustrates an embodiment method 500 for a vertiport management platform to manage the slack capacity at a vertiport. In various embodiments, the operations of method 500 may be performed by a processor of a vertiport management platform, such as vertiport management platform 106. In various embodiments, the operations of method 500 may be performed in conjunction with the operations of method 400 described with reference to FIG. 4. In block 502, the vertiport management platform may select a vertiport. In block 504, the vertiport management platform may determine the selected vertiport current status. The current status of the vertiport may be determined based on one or more inputs from the vertiport, such as sensor inputs, aircraft reporting from the vertiport, vertiport staff inputs, electric charging equipment inputs, maintenance service inputs, weather inputs, etc. The current status of the vertiport may reflect various states of the vertiport and its associated take-off and landing spots, such as the number of functioning spots, the status of those spots (e.g., free, in-use, scheduled, etc.), etc.

[0066] In block 506, the vertiport management platform may determine a capacity threshold based at least in part on the selected vertiport current status and selected vertiport historical performance data. The capacity threshold may be threshold may be a window of slack (i.e., excess capacity) at the selected vertiport likely to enable the vertiport to handle interruptions and/or delays likely in aerial ODM services without impacting the ability to meet minimum throughput goals.

[0067] In determination block 508, the vertiport management platform may determine whether the selected vertiport slack capacity setting is within the determined capacity threshold. The vertiport management platform may compare a current vertiport slack

capacity setting for the vertiport to the determined threshold to determine whether the selected vertiport slack capacity setting is within the determined capacity threshold. In response to determining that the slack capacity setting is within the threshold (i.e., determination block 508 = "Yes"), the vertiport management platform may select a next vertiport in block 502.

[0068] In response to determining that the selected vertiport slack capacity setting is not within the determined capacity threshold (i.e., determination block 510 = "No"), the vertiport management platform may update the selected vertiport slack capacity setting in block 510. For example, the vertiport management platform may raise the slack capacity setting to a value above the threshold. The vertiport management platform may select a next vertiport in block 502.

[0069] The operations of method 500 may be performed continually and dynamically by the vertiport management platform, and slack capacity at vertiports may be continually and dynamically adjusted by updating the slack capacity setting as the vertiport current status and vertiport historical performance data change.

[0070] FIG. 6 is a call flow diagram illustrating various embodiment operations performed by a processor of a vertiport management platform and processors of devices of other aerial ODM stakeholders to schedule a trip including a flight. In various embodiments, the operations illustrated in FIG. 6 may be performed by processors of the vertiport management platform 106, the mobility service provider 140, the eVTOL aircraft 133, the user's computing device 102, the vertiport 112, and the vertiport 110 as described above with reference to FIG. 1.

[0071] A user may interact with an application running on the processor of the user's computing device 102 to request a trip from a starting destination to an arrival destination, such as a trip between two addresses, a trip between a user's current location and an address, etc. Based on the user inputs, the processor of the user's computing device 102 may generate a trip request and send the trip request to the processor of the mobility service provider 140 in block 602. The trip request may

indicate the user's desired starting and arrival destination, the user's current location, the number of passengers, estimated weights of passengers and bags or other gear, etc.

[0072] The processor of the mobility service provider 140 may determine that a flight portion may be suitable for use to fulfill all or a portion of the requested trip, and in block 604 the processor of the mobility service provider 140 may send a flight request to the processor of the vertiport management platform 106. The flight request may include information related to the requested trip, such as the desired starting and arrival destination, the user's current location, the number of passengers, estimated weights of passengers and bags or other gear, etc.

[0073] The processor of the vertiport management platform 106 may generate one or more flight plans based on the flight request in block 606. The processor of the vertiport management platform 106 may determine nearby vertiports to the desired starting destination and/or the desired arrival destination, may determine ground travel times from those vertiports to the user's current location, desired starting destination, and/or desired arrival destination, may determine the available aircraft and the attributes of those aircraft, may determine contract requirements between the vertiports, aircraft fleet operators, and/or vertiport owner/operators, and/or may determine other information enabling the processor of the vertiport management platform 106 to generate the one or more flight plans. Information considered by the processor of the vertiport management platform 106 may include departure point vertiport and arrival point vertiport locations, ground travel times, available timeslots at the vertiports, contracts between the departure point and/or arrival point vertiports and the mobility service provider, contracts between the mobility service provider and aircraft fleet operators, times until aircraft become available, distance between the aircraft and the departure point vertiports, aircraft specifications (e.g., type, carrying capacity, speed, etc.), etc. Additionally, the processor of the vertiport management platform 106 may determine dynamic spot pricing associated with the aircraft and vertiports in generating the flights.

[0074] The processor of the vertiport management platform 106 may generate one or more flight plans to fulfill the flight request and each flight plan may include an assigned departure point vertiport, an assigned arrival point vertiport, an assigned aircraft, estimated departure and arrival times for the aircraft, and a price for the flight (e.g., based on the aircraft and vertiport pricing determinations for that flight). In some embodiments, the processor of the vertiport management platform 106 may generate and send flight plan requests for all or a portion of the one or more generated flights to air traffic control and may receive routed flight plans for the one or more generated flights. In some embodiments, these flight plans may be place-holder flight plans or may be flight plans that may be canceled if not used.

[0075] In block 608 the processor of the vertiport management platform 106 may send one or more flight choices to the processor of the mobility service provider 140. The one or more flight choices may be indications of the one or more generated flight plans, and may indicate an assigned departure point vertiport, an assigned arrival point vertiport, an assigned aircraft, estimated departure and arrival times for the aircraft, and a price for each generated flight plan.

[0076] In block 610 the processor of the mobility service provider 140 may generate one or more trips based on all or a portion of the one or more flight plan choices. The one or more trips may be trips including at least a portion of the one or more flights used to get the user from his or her desired starting location to the desired arrival destination. The generated trips may include overall costs to the user, estimated total trip times, etc. In some embodiments, the trips may also include planning or coordination with other services for the ground segments (e.g., taxi or car services) from the desired starting location to the departure point vertiport and from the destination vertiport to the ultimate destination. The processor of the mobility service provider 140 may send the one or more trip choices to the processor of the user's computing device 102 in block 612, and the processor of the user's computing device 102 may display the trip choices in block 614.

[0077] The user may select one of the displayed trip choices and the processor of the user's computing device 102 may send the trip choice to the processor of the mobility service provider 140 in block 616. The processor of the mobility service provider 140 may determine the flight associated with the chosen trip and the processor of the mobility service provider 140 may send the flight choice to the processor of the vertiport management platform 106 in block 618.

[0078] In block 620 the processor of the mobility service provider 140 may send a trip confirmation to the processor of the user's computing device 102, and the processor of the user's computing device 102 may display the trip confirmation in block 622.

[0079] The processor of the vertiport management platform 106 may generate an operations plan based on the chosen flight in block 624. The operations plan may indicate the selected aircraft, the selected departure vertiport, the selected arrival vertiport, the number of passengers, the estimated weight of passengers and bags or other gear, the estimated departure time, the estimated arrival time, the air traffic control flight plan information, and/or any other information that may be appropriate to enable the aircraft and vertiports to support the chosen flight. For example, the eVTOL aircraft 133 may be selected for the chosen flight, the vertiport 112 may be the departure vertiport, and the vertiport 110 may be the arrival vertiport for the chosen flight that is all or a portion of the user's chosen trip. The operations plan may also include arrangements or coordination with other services for the ground travel segments (e.g., taxi or car services) at either end of the flight plan.

[0080] In block 626 the processor of the vertiport management platform 106 may send the operations plan to the processors of the eVTOL aircraft 133, the vertiport 112, and the vertiport 110. The operations plan may be the same for each of the eVTOL aircraft 133, the vertiport 112, and the vertiport 110 or may be tailored to the needs of each of the eVTOL aircraft 133, the vertiport 112, and the vertiport 110 based on the intended recipient. Upon receipt of the operations plan the eVTOL aircraft 133, the vertiport 112, and the vertiport 110 may execute the operations plan

to carry out the flight and trip for the user. In some embodiments, the processor of the vertiport management platform 106 may also send portions of the operations plan to service providers for the ground travel segments at either end of the flight plan.

[0081] The various embodiments (including, but not limited to, embodiments discussed above with reference to FIGs. 1-6) may be implemented in any of a variety of the computing devices (e.g., mobile devices), an example of which is illustrated in FIG. 7. For example, the mobile device 700 may include a processor 701 coupled to a touch screen controller 704 and an internal memory 702. The processor 701 may be one or more multicore integrated circuits (ICs) designated for general or specific processing tasks. The internal memory 702 may be volatile or non-volatile memory, and may also be secure and/or encrypted memory, or unsecure and/or unencrypted memory, or any combination thereof. The touch screen controller 704 and the processor 701 may also be coupled to a touch screen panel 712, such as a resistive-sensing touch screen, capacitive-sensing touch screen, infrared sensing touch screen, etc. The mobile device 700 may have one or more radio signal transceivers 708 (e.g., Peanut®, Bluetooth®, Zigbee®, Wi-Fi, RF, cellular (e.g., CDMA, TDMA, GSM, PCS, 3G, 4G, LTE, etc.), etc.) and antennae 710, for sending and receiving, coupled to each other and/or to the processor 701. The transceivers 708 and antennae 710 may be used with the above-mentioned circuitry to implement the various wireless transmission protocol stacks and interfaces. The mobile device 700 may include a cellular network wireless modem chip 716 that enables communication via a cellular network and is coupled to the processor. The mobile device 700 may include a peripheral device connection interface 718 coupled to the processor 701. The peripheral device connection interface 718 may be singularly configured to accept one type of connection, or multiply configured to accept various types of physical and communication connections, common or proprietary, such as USB, FireWire, Thunderbolt, or PCIe. The peripheral device connection interface 718 may also be coupled to a similarly configured peripheral device connection port (not shown). The mobile device 700 may also include speakers 714 for providing audio outputs. The mobile device 700 may also include a housing 720, constructed of a plastic, metal, or

a combination of materials, for containing all or some of the components discussed herein. The mobile device 700 may include a power source 722 coupled to the processor 701, such as a disposable or rechargeable battery. The rechargeable battery may also be coupled to the peripheral device connection port to receive a charging current from a source external to the mobile device 700.

[0082] The various embodiments (including, but not limited to, embodiments discussed above with reference to FIGs. 1-6) may also be implemented on any of a variety of commercially available server devices, such as the server 800 illustrated in FIG. 8. Such a server 800 typically includes a processor 801 coupled to volatile memory 802 and a large capacity nonvolatile memory, such as a disk drive 804. The server 800 may also include a floppy disc drive, compact disc (CD) or DVD disc drive 806 coupled to the processor 801. The server 800 may also include one or more network transceivers 803, such as a network access port, coupled to the processor 801 for establishing network interface connections with a communication network 807, such as a local area network coupled to other announcement system computers and servers, the Internet, the public switched telephone network, and/or a cellular network (e.g., CDMA, TDMA, GSM, PCS, 3G, 4G, LTE, or any other type of cellular network).

[0083] The processors 701 and 801 may be any programmable microprocessor, microcomputer or multiple processor chip or chips that can be configured by software instructions (applications) to perform a variety of functions, including the functions of the various embodiments described above. In some devices, multiple processors may be provided, such as one processor dedicated to wireless communication functions and one processor dedicated to running other applications. Typically, software applications may be stored in the internal memory before they are accessed and loaded into the processors 701 and 801. The processors 701 and 801 may include internal memory sufficient to store the application software instructions. In many devices the internal memory may be a volatile or nonvolatile memory, such as flash memory, or a mixture of both. For the purposes of this description, a general reference to memory refers to memory accessible by the processors 701 and 801 including internal memory

or removable memory plugged into the device and memory within the processors 701 and 801 themselves.

[0084] The foregoing method descriptions and the process flow diagrams are provided merely as illustrative examples and are not intended to require or imply that the steps of the various embodiments must be performed in the order presented. As will be appreciated by one of skill in the art the order of steps in the foregoing embodiments may be performed in any order. Words such as "thereafter," "then," "next," etc. are not intended to limit the order of the steps; these words are simply used to guide the reader through the description of the methods. Further, any reference to claim elements in the singular, for example, using the articles "a," "an" or "the" is not to be construed as limiting the element to the singular.

[0085] The various illustrative logical blocks, modules, circuits, and algorithm steps described in connection with the embodiments disclosed herein may be implemented as electronic hardware, computer software, or combinations of both. To clearly illustrate this interchangeability of hardware and software, various illustrative components, blocks, modules, circuits, and steps have been described above generally in terms of their functionality. Whether such functionality is implemented as hardware or software depends upon the particular application and design constraints imposed on the overall system. Skilled artisans may implement the described functionality in varying ways for each particular application, but such implementation decisions should not be interpreted as causing a departure from the scope of the present invention.

[0086] The hardware used to implement the various illustrative logics, logical blocks, modules, and circuits described in connection with the aspects disclosed herein may be implemented or performed with a general purpose processor, a digital signal processor (DSP), an application specific integrated circuit (ASIC), a field programmable gate array (FPGA) or other programmable logic device, discrete gate or transistor logic, discrete hardware components, or any combination thereof designed to perform the functions described herein. A general-purpose processor may be a

microprocessor, but, in the alternative, the processor may be any conventional processor, controller, microcontroller, or state machine. A processor may also be implemented as a combination of computing devices, e.g., a combination of a DSP and a microprocessor, a plurality of microprocessors, one or more microprocessors in conjunction with a DSP core, or any other such configuration. Alternatively, some steps or methods may be performed by circuitry that is specific to a given function.

[0087] In one or more exemplary aspects, the functions described may be implemented in hardware, software, firmware, or any combination thereof. If implemented in software, the functions may be stored as one or more instructions or code on a non-transitory computer-readable medium or non-transitory processor-readable medium. The steps of a method or algorithm disclosed herein may be embodied in a processor-executable software module, which may reside on a non-transitory computer-readable or processor-readable storage medium. Non-transitory server-readable, computer-readable or processor-readable storage media may be any storage media that may be accessed by a computer or a processor. By way of example but not limitation, such non-transitory server-readable, computer-readable or processor-readable media may include RAM, ROM, EEPROM, FLASH memory, CD-ROM or other optical disk storage, magnetic disk storage or other magnetic storage devices, or any other medium that may be used to store desired program code in the form of instructions or data structures and that may be accessed by a computer. Disk and disc, as used herein, includes compact disc (CD), laser disc, optical disc, digital versatile disc (DVD), floppy disk, and blu-ray disc where disks usually reproduce data magnetically, while discs reproduce data optically with lasers. Combinations of the above are also included within the scope of non-transitory server-readable, computer-readable and processor-readable media. Additionally, the operations of a method or algorithm may reside as one or any combination or set of codes and/or instructions on a non-transitory server-readable, processor-readable medium and/or computer-readable medium, which may be incorporated into a computer program product.

[0088] The preceding description of the disclosed embodiments is provided to enable any person skilled in the art to make or use the present invention. Various modifications to these embodiments will be readily apparent to those skilled in the art, and the generic principles defined herein may be applied to other embodiments without departing from the spirit or scope of the invention. Thus, the present invention is not intended to be limited to the embodiments shown herein but is to be accorded the widest scope consistent with the following claims and the principles and novel features disclosed herein.

CLAIMS

What is claimed is:

1. A method for aerial on-demand mobility (ODM) scheduling, comprising:

determining, in a vertiport management platform, vertiport capacity for one or more vertiport;

determining, in the vertiport management platform, one or more requested flights;

determining, in the vertiport management platform, one or more available aircraft;

assigning, in the vertiport management platform, the one or more requested flights to one or more vertiport spots of the one or more vertiports and selected ones of the one or more available aircraft; and

sending, by the vertiport management platform, the assignments to each respective one of the one or more vertiports and one or more available aircraft.

2. The method of claim 1, wherein the vertiport management platform determines the vertiport capacity based at least in part on a slack capacity setting for the vertiport.

3. The method of claim 2, wherein the slack capacity setting is updated based on a capacity threshold determined based at least in part on a vertiport current status and vertiport historical performance data.

4. The method of claim 3, wherein the vertiport current status is based on sensor data received by the vertiport management platform from the vertiport.

5. The method of claim 4, wherein the sensor data is generated by one or more of a radar, a lidar, a camera, a weather sensor, or an electric charging sensor.

6. The method of any of claims 1-5, wherein the vertiport management platform receives requested flight information from one or more mobility service providers.

7. The method of claim 6, wherein the vertiport management platform receives available aircraft information from aircraft fleet operators.

8. The method of claim 7, wherein the available aircraft are electric vertical take-off and landing (eVTOL) aircraft.

9. The method of claim 1, wherein the assigning is based at least in part on economic factors associated with vertiport operators, aircraft fleet operators, and mobility service providers.

10. The method of claim 9, wherein the economic factors include one or more of spot market bids and pre-contracted flight agreements.

11. The method of claim 1, wherein the assigning is based at least in part on information received from one or more of vertiport operators, mobility service providers, aircraft fleet operators, air traffic controllers, weather services, and passengers.

12. The method of claim 11, wherein the information from passengers includes vertiport reputation related rankings.

13. The method of claim 1, wherein the assigning is based at least in part on machine learning algorithms applied to historical vertiport operations data.

14. The method of claim 1, further comprising filing, by the vertiport management platform, flight plans with a government airspace controller reflecting the assignments to each respective one of the one or more vertiports and one or more available aircraft.

15. The method of claim 14, wherein the vertiport management platform tracks and stores all data for use in compliance with government airspace controller requirements.

16. The method of claim 1, wherein the assigning is based at least in part on real-time local airspace pictures at one or more vertiports.

17. The method of claim 16, wherein the assigning is based at least in part on predications of vertiport operations based on historical vertiport operations data and historical local airspace data.

18. The method of claim 1, wherein the vertiport management platform is a cloud based platform layer.

19. A vertiport management platform, comprising:

a processor configured with processor-executable instructions to perform operations comprising:

determining vertiport capacity for one or more vertiport;

determining one or more requested flights;

determining one or more available aircraft;

assigning the one or more requested flights to one or more vertiport spots of the one or more vertiports and selected ones of the one or more available aircraft; and

sending the assignments to each respective one of the one or more vertiports and one or more available aircraft.

20. The vertiport management platform of claim 19, wherein the processor is configured with processor-executable instructions to perform operations such that the vertiport capacity is determined based at least in part on a slack capacity setting for the vertiport.

21. The vertiport management platform of claim 20, wherein the processor is configured with processor-executable instructions to perform operations such that the slack capacity setting is updated based on a capacity threshold determined based at least in part on a vertiport current status and vertiport historical performance data.

22. The vertiport management platform of claim 21, wherein the processor is configured with processor-executable instructions to perform operations such that the vertiport current status is based on sensor data received by the vertiport management platform from the vertiport.

23. The vertiport management platform of claim 22, wherein the processor is configured with processor-executable instructions to perform operations such that the sensor data is generated by one or more of a radar, a lidar, a camera, a weather sensor, or an electric charging sensor.

24. The vertiport management platform of any of claims 19-23, wherein the processor is configured with processor-executable instructions to perform operations such that requested flight information is received from one or more mobility service providers.

25. The vertiport management platform of claim 24, wherein the processor is configured with processor-executable instructions to perform operations such that available aircraft information is received from aircraft fleet operators.

26. The vertiport management platform of claim 25, wherein the processor is configured with processor-executable instructions to perform operations such that the available aircraft are electric vertical take-off and landing (eVTOL) aircraft.

27. The vertiport management platform of claim 19, wherein the processor is configured with processor-executable instructions to perform operations such that the assigning is based at least in part on economic factors associated with vertiport operators, aircraft fleet operators, and mobility service providers.

28. The vertiport management platform of claim 27, wherein the processor is configured with processor-executable instructions to perform operations such that the economic factors include one or more of spot market bids and pre-contracted flight agreements.

29. The vertiport management platform of claim 19, wherein the processor is configured with processor-executable instructions to perform operations such that the assigning is based at least in part on information received from one or more of vertiport operators, mobility service providers, aircraft fleet operators, air traffic controllers, weather services, and passengers.

30. The vertiport management platform of claim 29, wherein the processor is configured with processor-executable instructions to perform operations such that the information from passengers includes vertiport reputation related rankings.

31. The vertiport management platform of claim 19, wherein the processor is configured with processor-executable instructions to perform operations such that the assigning is based at least in part on machine learning algorithms applied to historical vertiport operations data.

32. The vertiport management platform of claim 19, wherein the processor is configured with processor-executable instructions to perform operations further comprising filing flight plans with a government airspace controller reflecting the assignments to each respective one of the one or more vertiports and one or more available aircraft.

33. The vertiport management platform of claim 32, wherein the processor is configured with processor-executable instructions to perform operations such that all data is tracked and stored for use in compliance with government airspace controller requirements.

34. The vertiport management platform of claim 19, wherein the processor is configured with processor-executable instructions to perform operations such that the assigning is based at least in part on real-time local airspace pictures at one or more vertiports.

35. The vertiport management platform of claim 34, wherein the processor is configured with processor-executable instructions to perform operations such that the assigning is based at least in part on predications of vertiport operations based on historical vertiport operations data and historical local airspace data.

36. A non-transitory processor readable media having stored thereon processor-executable instructions configured to cause a processor to perform operations comprising:

determining vertiport capacity for one or more vertiport;

determining one or more requested flights;

determining one or more available aircraft;

assigning the one or more requested flights to one or more vertiport spots of the one or more vertiports and selected ones of the one or more available aircraft; and

sending the assignments to each respective one of the one or more vertiports and one or more available aircraft.

37. The non-transitory processor readable media of claim 36, wherein the stored processor-executable instructions are configured to cause a processor to perform operations such that the vertiport capacity is determined based at least in part on a slack capacity setting for the vertiport.

38. The non-transitory processor readable media of claim 37, wherein the stored processor-executable instructions are configured to cause a processor to perform operations such that the slack capacity setting is updated based on a capacity threshold

determined based at least in part on a vertiport current status and vertiport historical performance data.

39. The non-transitory processor readable media of claim 38, wherein the stored processor-executable instructions are configured to cause a processor to perform operations such that the vertiport current status is based on sensor data received by the vertiport management platform from the vertiport.

40. The non-transitory processor readable media of claim 39, wherein the stored processor-executable instructions are configured to cause a processor to perform operations such that the sensor data is generated by one or more of a radar, a lidar, a camera, a weather sensor, or an electric charging sensor.

41. The non-transitory processor readable media of any of claims 36-40, wherein the stored processor-executable instructions are configured to cause a processor to perform operations such that requested flight information is received from one or more mobility service providers.

42. The non-transitory processor readable media of claim 41, wherein the stored processor-executable instructions are configured to cause a processor to perform operations such that available aircraft information is received from aircraft fleet operators.

43. The non-transitory processor readable media of claim 42, wherein the stored processor-executable instructions are configured to cause a processor to perform operations such that the available aircraft are electric vertical take-off and landing (eVTOL) aircraft.

44. The non-transitory processor readable media of claim 36, wherein the stored processor-executable instructions are configured to cause a processor to perform operations such that the assigning is based at least in part on economic factors

associated with vertiport operators, aircraft fleet operators, and mobility service providers.

45. The non-transitory processor readable media of claim 44, wherein the stored processor-executable instructions are configured to cause a processor to perform operations such that the economic factors include one or more of spot market bids and pre-contracted flight agreements.

46. The non-transitory processor readable media of claim 36, wherein the stored processor-executable instructions are configured to cause a processor to perform operations such that the assigning is based at least in part on information received from one or more of vertiport operators, mobility service providers, aircraft fleet operators, air traffic controllers, weather services, and passengers.

47. The non-transitory processor readable media of claim 46, wherein the stored processor-executable instructions are configured to cause a processor to perform operations such that the information from passengers includes vertiport reputation related rankings.

48. The non-transitory processor readable media of claim 36, wherein the stored processor-executable instructions are configured to cause a processor to perform operations such that the assigning is based at least in part on machine learning algorithms applied to historical vertiport operations data.

49. The non-transitory processor readable media of claim 36, wherein the stored processor-executable instructions are configured to cause a processor to perform operations further comprising filing flight plans with a government airspace controller reflecting the assignments to each respective one of the one or more vertiports and one or more available aircraft.

50. The non-transitory processor readable media of claim 49, wherein the stored processor-executable instructions are configured to cause a processor to perform operations such that all data is tracked and stored for use in compliance with government airspace controller requirements.

51. The non-transitory processor readable media of claim 36, wherein the stored processor-executable instructions are configured to cause a processor to perform operations such that the assigning is based at least in part on real-time local airspace pictures at one or more vertiports.

52. The non-transitory processor readable media of claim 51, wherein the stored processor-executable instructions are configured to cause a processor to perform operations such that the assigning is based at least in part on predications of vertiport operations based on historical vertiport operations data and historical local airspace data.

53. An aerial on-demand mobility system, comprising:

one or more vertiport;

one or more aircraft; and

a vertiport management platform configured to perform operations comprising:

determining vertiport capacity for each of the one or more vertiports;

determining one or more requested flights;

determining one or more available aircraft from the one or more aircraft;

assigning the one or more requested flights to one or more vertiport spots of the one or more vertiports and selected ones of the one or more available aircraft; and

sending the assignments to each respective one of the one or more vertiports and one or more available aircraft.

54. The system of claim 53, wherein the vertiport management platform is configured such that the vertiport capacity is determined based at least in part on a slack capacity setting for the vertiport.

55. The system of claim 54, wherein the vertiport management platform is configured such that the slack capacity setting is updated based on a capacity threshold determined based at least in part on a vertiport current status and vertiport historical performance data.

56. The system of claim 55, wherein the vertiport management platform is configured such that the vertiport current status is based on sensor data received by the vertiport management platform from the vertiport.

57. The system of claim 56, wherein the vertiport management platform is configured such that the sensor data is generated by one or more of a radar, a lidar, a camera, a weather sensor, or an electric charging sensor.

58. The system of any of claims 53-57, further comprising one or more mobility service provider servers, wherein the vertiport management platform is configured such that requested flight information is received from at least one of the one or more mobility service provider servers.

59. The system of claim 56, further comprising one or more aircraft fleet operator servers, wherein the vertiport management platform is configured such that available aircraft information is received from at least one of the one or more aircraft fleet operator servers.

60. The system of claim 59, wherein the one or more aircraft are one or more electric vertical take-off and landing (eVTOL) aircraft.

61. The system of claim 53, further comprising a government airspace controller server, wherein the vertiport management platform is configured to perform operations further comprising filing flight plans with the government airspace controller server reflecting the assignments to each respective one of the one or more vertiports and one or more available aircraft.

62. The system of claim 53, wherein the vertiport management platform is a cloud based platform layer.

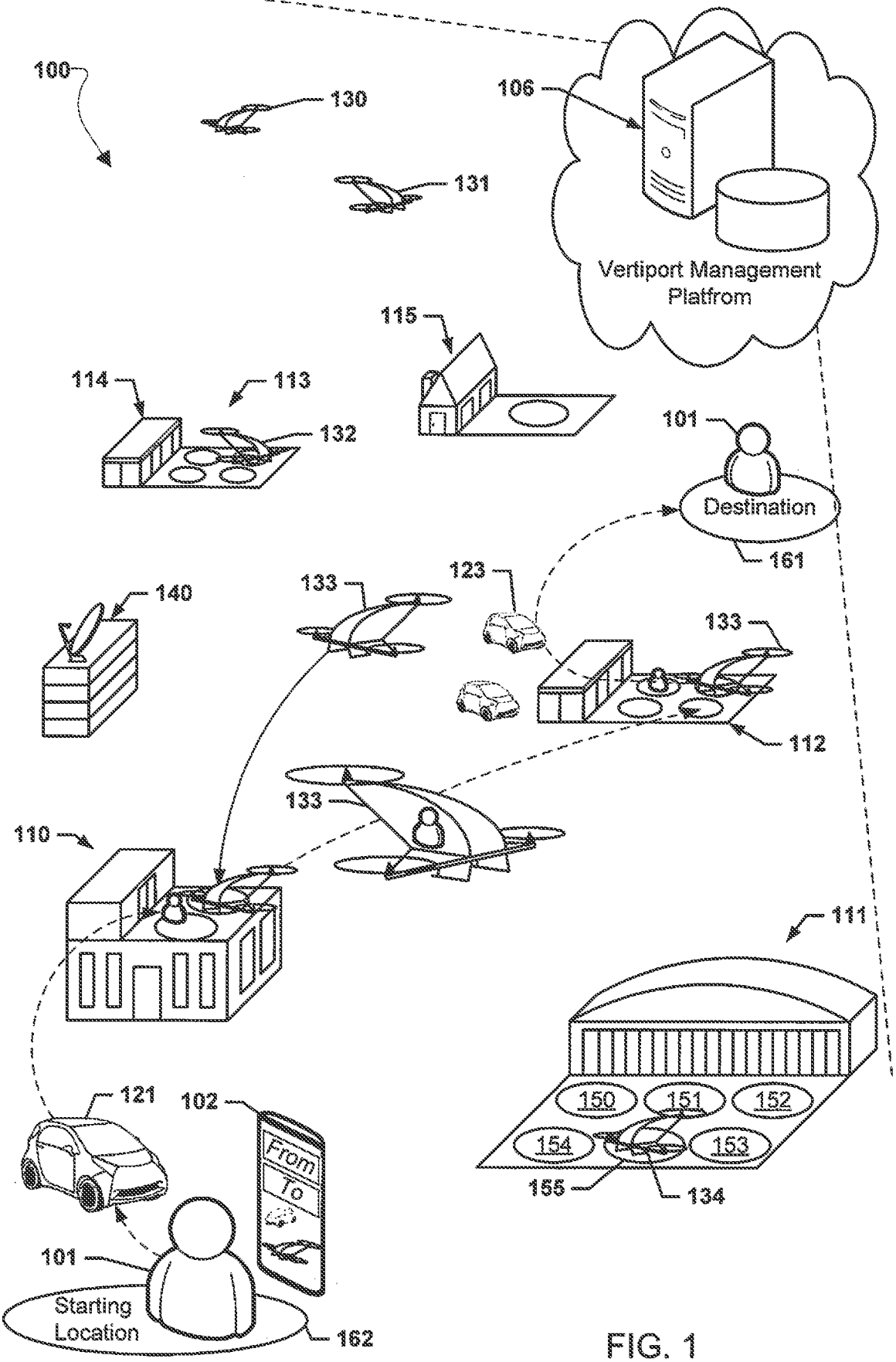

100
130
131
106
Vertiport Management Platfrom
115
114
113
132
101
Destination
161
140
133
123
133
112
133
110
111
150
151
152
154
153
155
134
121
102
From
To
101
Starting Location
162

FIG. 1

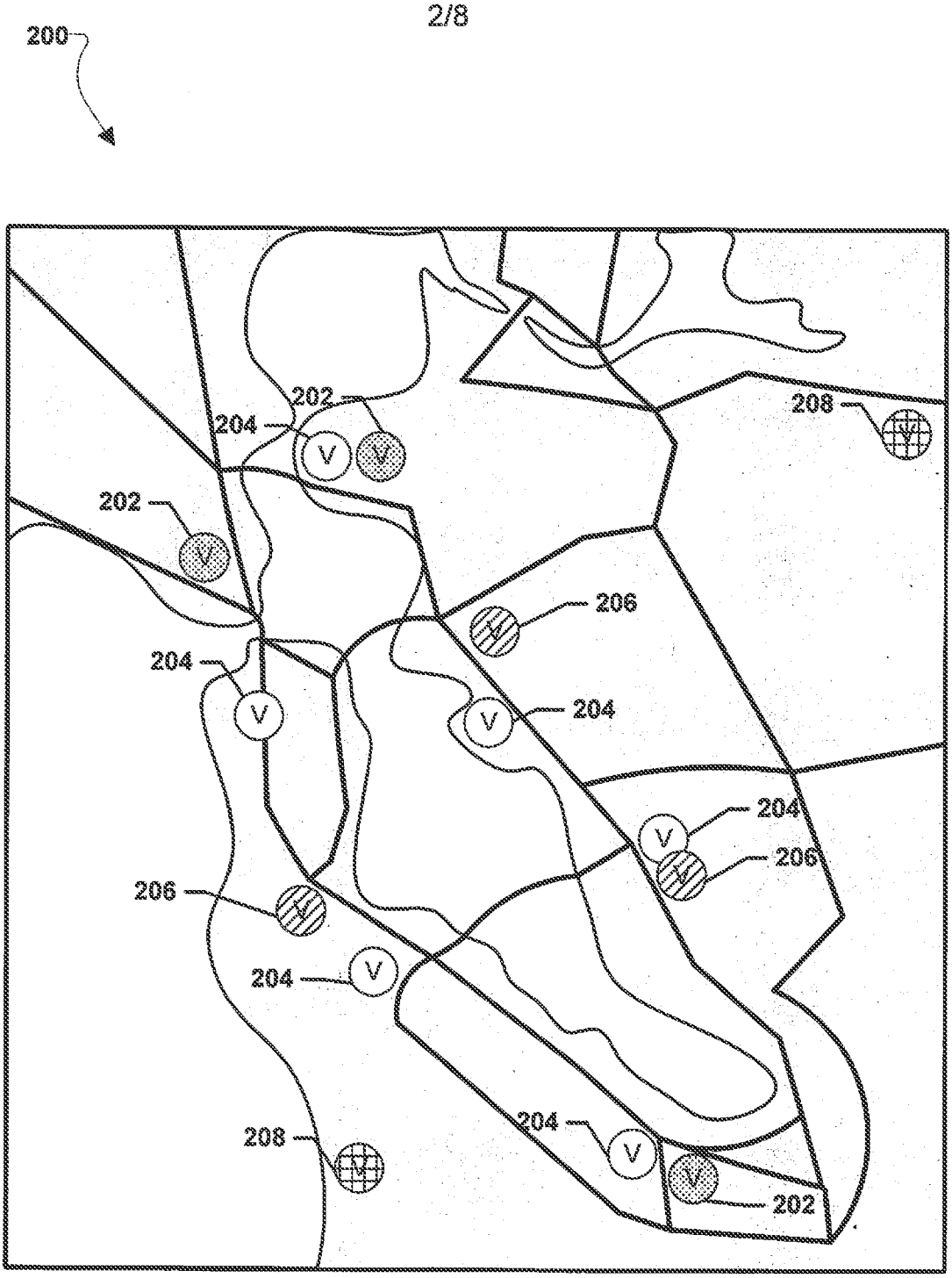


FIG. 2

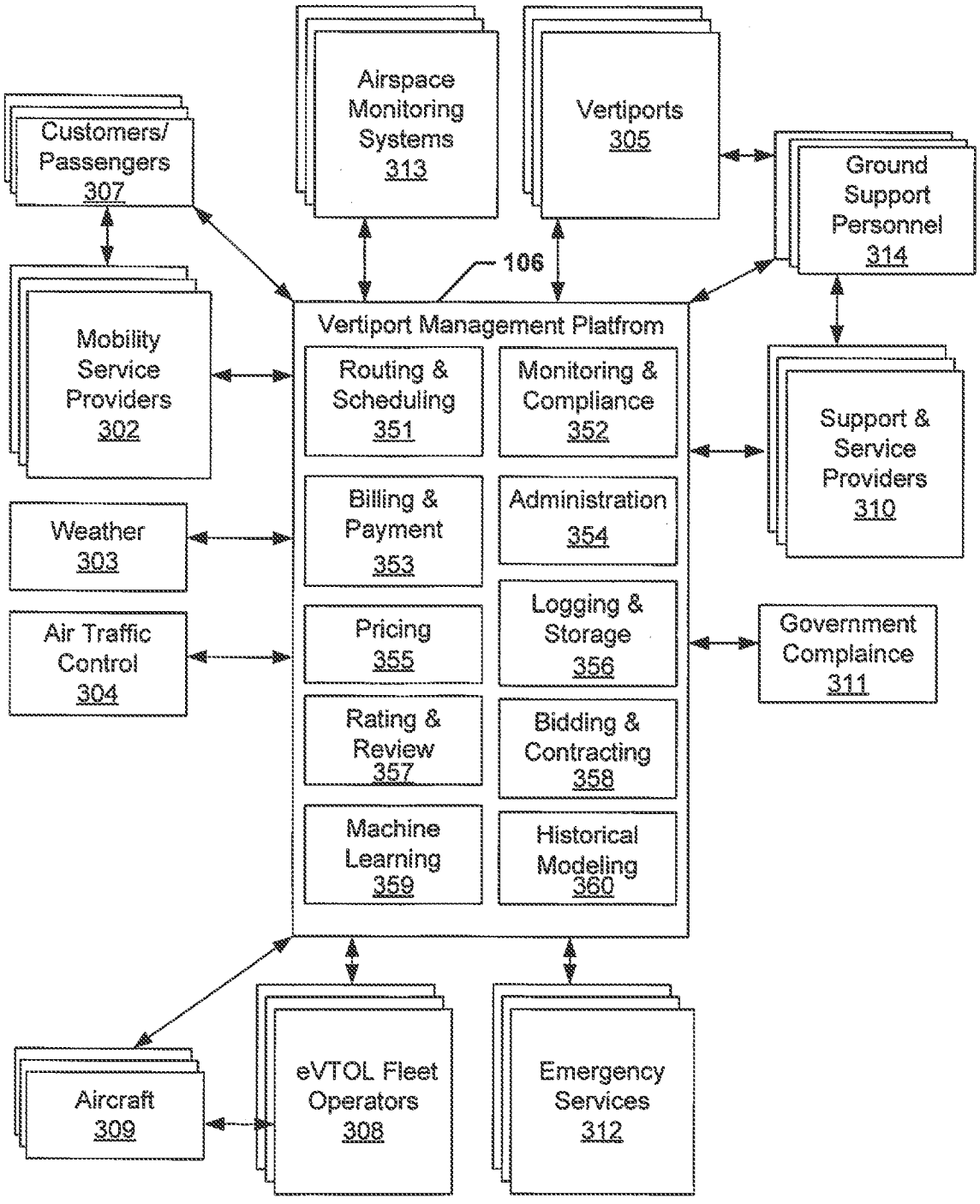

Airspace Monitoring Systems 313
Vertiports 305
Customers/ Passengers 307
Ground Support Personnel 314
106
Vertiport Management Platfrom
Mobility Service Providers 302
Routing & Scheduling 351
Monitoring & Compliance 352
Support & Service Providers 310
Weather 303
Billing & Payment 353
Administration 354
Air Traffic Control 304
Pricing 355
Logging & Storage 356
Government Complaince 311
Rating & Review 357
Bidding & Contracting 358
Machine Learning 359
Historical Modeling 360
Aircraft 309
eVTOL Fleet Operators 308
Emergency Services 312

FIG. 3

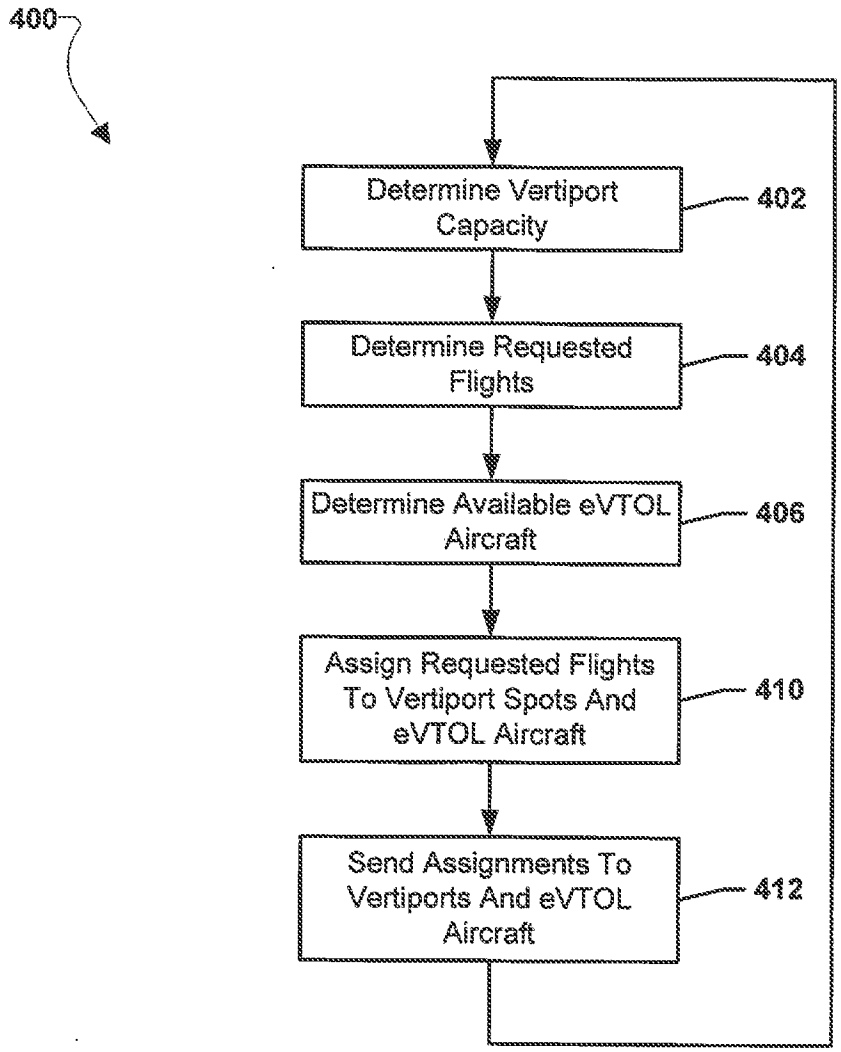

400
Determine Vertiport Capacity
402
Determine Requested Flights
404
Determine Available eVTOL Aircraft
406
Assign Requested Flights To Vertiport Spots And eVTOL Aircraft
410
Send Assignments To Vertiports And eVTOL Aircraft
412

FIG. 4

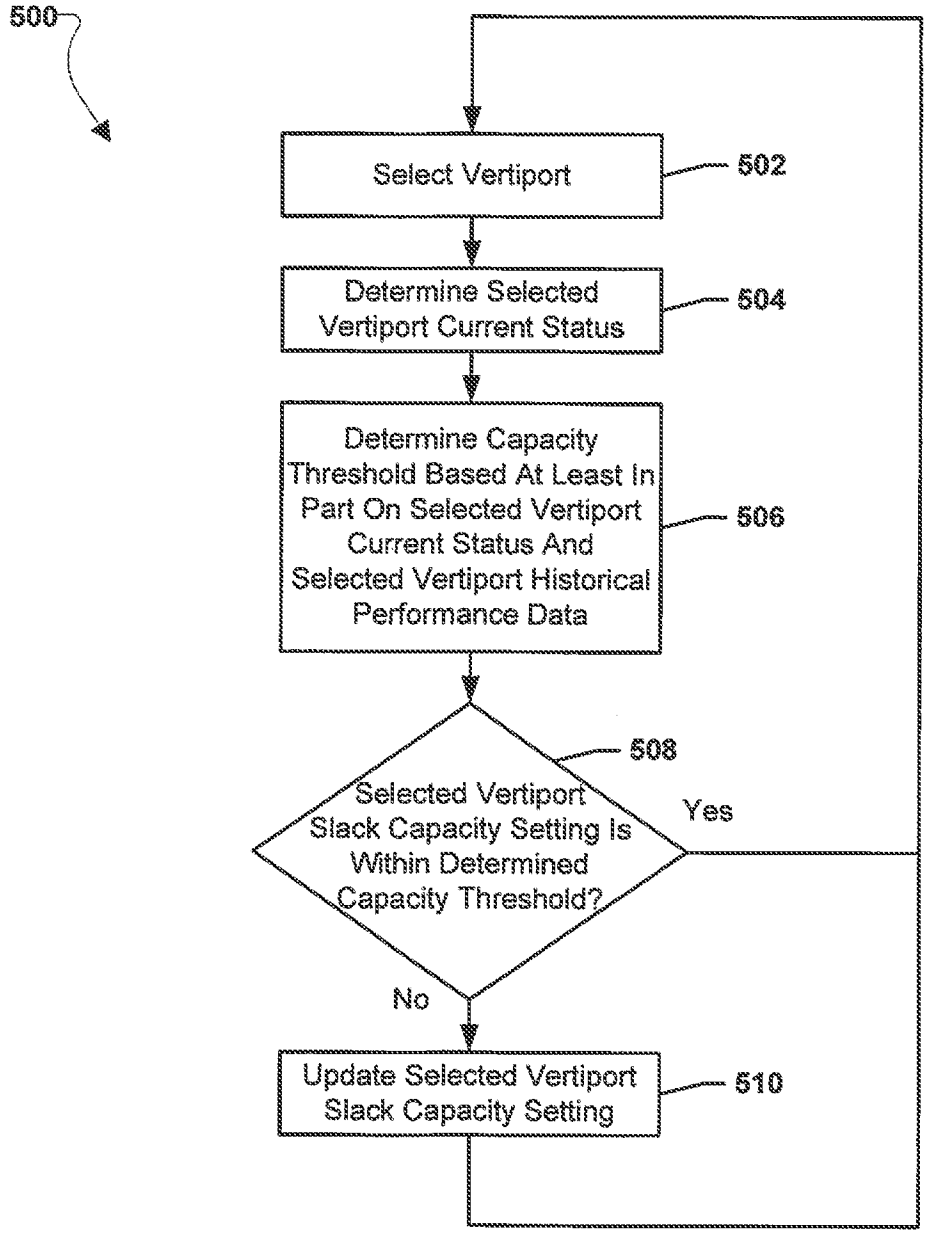

500
Select Vertiport
502
Determine Selected Vertiport Current Status
504
Determine Capacity Threshold Based At Least In Part On Selected Vertiport Current Status And Selected Vertiport Historical Performance Data
506
508
Selected Vertiport Slack Capacity Setting Is Within Determined Capacity Threshold?
Yes
No
Update Selected Vertiport Slack Capacity Setting
510

FIG. 5

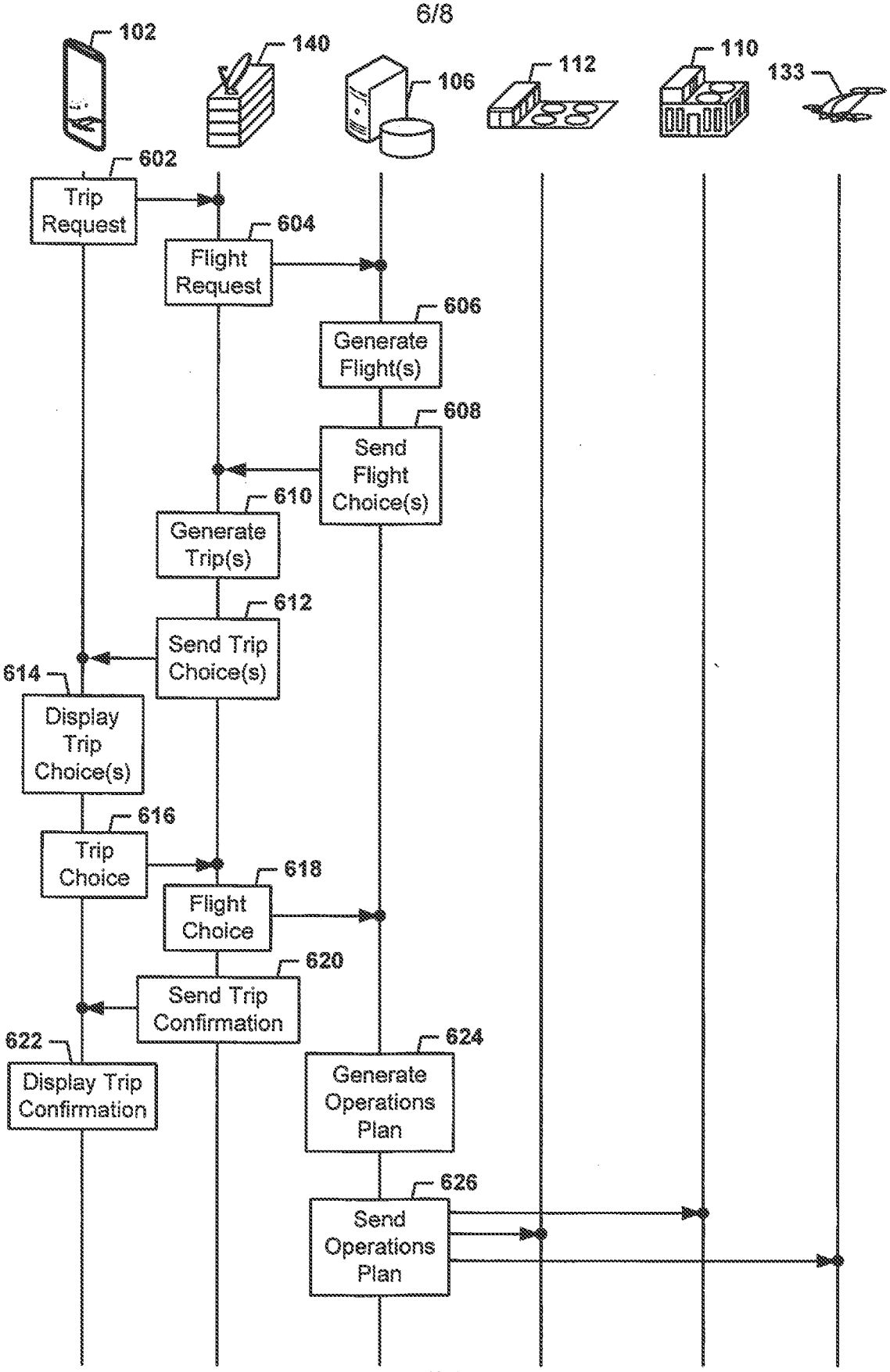

102
140
106
112
110
133
602
Trip Request
604
Flight Request
606
Generate Flight(s)
608
Send Flight Choice(s)
610
Generate Trip(s)
612
Send Trip Choice(s)
614
Display Trip Choice(s)
616
Trip Choice
618
Flight Choice
620
Send Trip Confirmation
622
Display Trip Confirmation
624
Generate Operations Plan
626
Send Operations Plan

FIG. 6

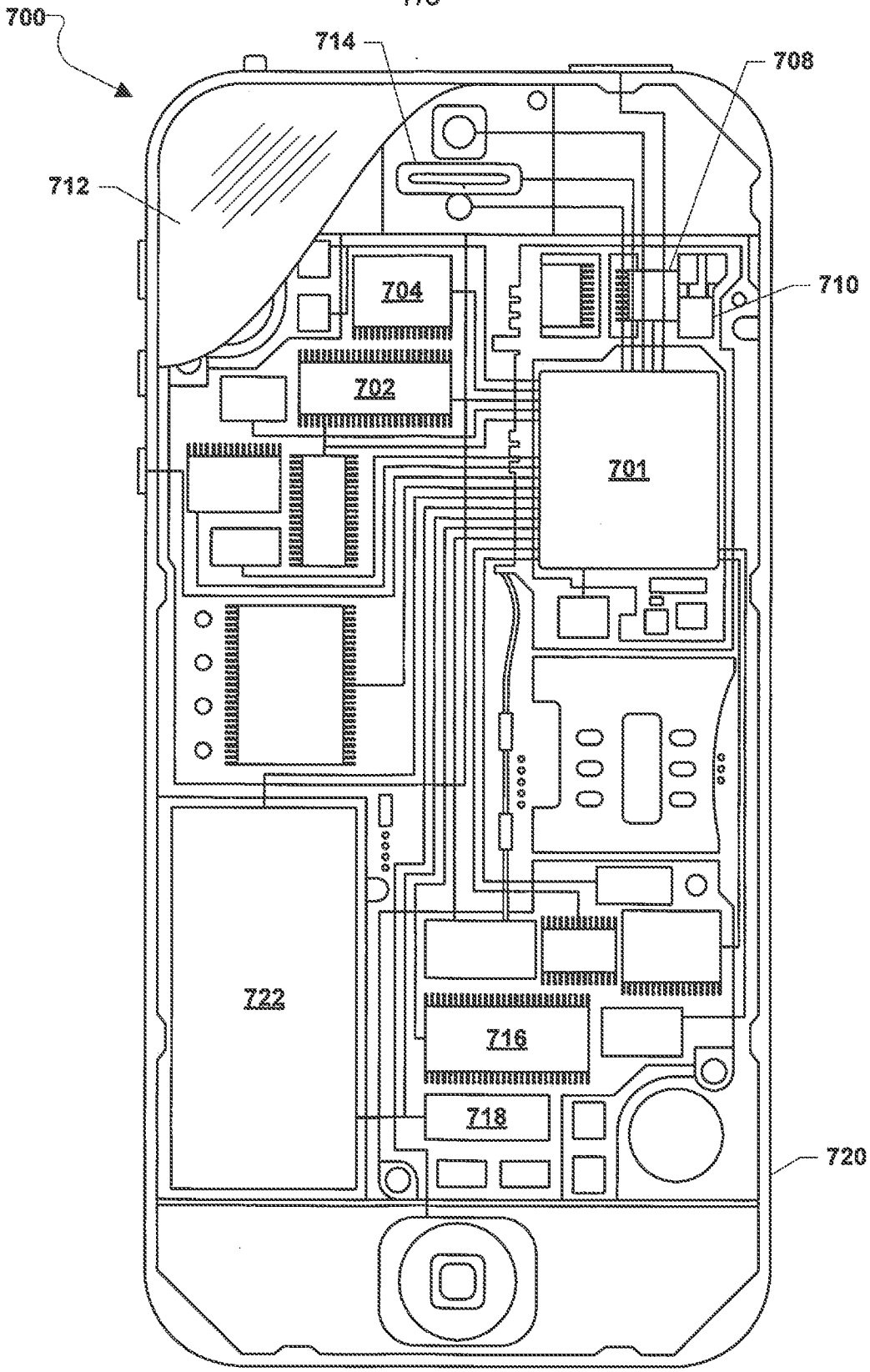


FIG. 7

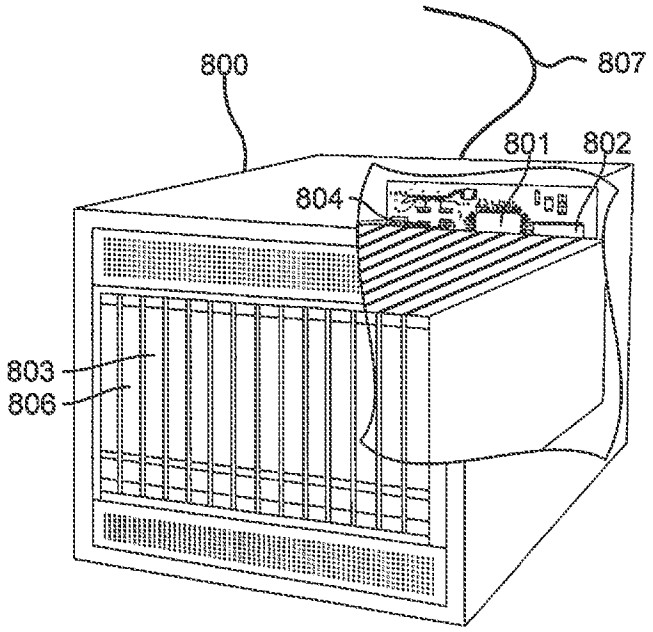


FIG. 8

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US18/58332

A. CLASSIFICATION OF SUBJECT MATTER

IPC - G08G 5/02; G01S 19/15; G06Q 10/08 (2018.01)

CPC - G08G 5/0013, 5/0026; G01S 19/15; G06Q 10/08

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

See Search History document

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

See Search History document

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

See Search History document

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X --- Y --- A	UBER "Fast-Forwarding to a Future of On-Demand Urban Air Transportation"; Publication [online]. 27 October 2016 [retrieved 6 December 2018]. Retrieved from the Internet: <URL: https://www.uber.com/elevate.pdf>; pp 1-97.	1, 6/1, 7/6/1, 8/7/6/1, 9, 11, 13, 18, 19, 24/19, 25/24/19, 26/25/24/19, 27, 29, 31, 36, 41/36, 42/41/36, 43/42/41/36, 44, 46, 48, 53, 58/53, 62 --- 10, 28, 45 --- 2-5, 6/2-6/5, 7/6/2-7/6/5, 8/7/6/2-8/7/6/5, 20-23, 24/20-24/23, 25/24/20-25/24/23, 26/25/24/20-26/25/24/23, 37-40, 41/37-41/40, 42/41/37-42/41/40, 43/42/41/37-43/42/41/40, 54-57, 58/54-58/57, 59, 60
Y	US 2002/0194113 A1 (LOF, P et al.) 19 December 2002; paragraph [0130]	10, 28, 45

☒ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
07 December 2018 (07.12.2018)	07 JAN 2019
Name and mailing address of the ISA/ Mail Stop PCT, Attn: ISA/US, Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-8300	Authorized officer Shane Thomas PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774

Form PCT/ISA/210 (second sheet) (January 2015)

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 2003/0139875 A1 (BAIADA, R et al.) 24 July 2003; entire document	1-62
A	US 2012/0233246A1 (GUEMEZ, E) 13 September 2012; entire document	1-62
A	US 2014/0018979 A1 (HONEYWELL INTERNATIONAL INC.) 16 January 2014; entire document	1-62
A	US 4989084 (WETZEL, D) 29 January 1991; entire document	1-62

Electronic Acknowledgement Receipt

EFS ID:	42438503
Application Number:	16720543
International Application Number:	
Confirmation Number:	4655
Title of Invention:	Fleet Controller
First Named Inventor/Applicant Name:	Grant Mark Bristow
Customer Number:	145156
Filer:	Robert G. Graham/Jennifer Rubio
Filer Authorized By:	Robert G. Graham
Attorney Docket Number:	BEL-IN140-19.02
Receipt Date:	13-APR-2021
Filing Date:	19-DEC-2019
Time Stamp:	12:28:22
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Information Disclosure Statement (IDS) Form (SB08)	BEL-IN140-1902_IDS1.PDF	1087729 161e3bc92da6a38b06a025625d7f62a68c5916f9	no	4

Warnings:

Information:					
2	Foreign Reference	WO2019089677A1_.PDF	6695693 fd3d7b15eb917ad1499d4ef4776db29cf7f7ecc3	no	60
Warnings:					
Information:					
			Total Files Size (in bytes):	7783422	

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

PTO/AIA/80 (07-17)
Approved for use through 03/31/2021. OMB 0651-0035
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no person is required to respond to a collection of information unless it displays a valid OMB control number

POWER OF ATTORNEY TO PROSECUTE APPLICATIONS BEFORE THE USPTO

I hereby revoke all previous powers of attorney given in the application identified in the attached statement under 37 CFR 3.73(c).

I hereby appoint:

[X] Practitioners associated with Customer Number:

OR

[ ] Practitioner(s) named below (if more than ten patent practitioners are to be named, then a customer number must be used):

Name	Registration Number	Name	Registration Number

As attorney(s) or agent(s) to represent the undersigned before the United States Patent and Trademark Office (USPTO) in connection with any and all patent applications assigned only to the undersigned according to the USPTO assignment records or assignment documents attached to this form in accordance with 37 CFR 3.73(c).

Please change the correspondence address for the application identified in the attached statement under 37 CFR 3.73(c) to:

[X] The address associated with Customer Number:

OR

[ ]

Firm or individual name		
Address		
City	State	Zip
Country		
Telephone	Email	

Assignee name and address: Textron Innovations Inc.
40 Westminster Street, Providence, Rhode Island 02903

A copy of this form, together with a statement under 37 CFR 3.73(c) (Form PTO/AIA/96 or equivalent) is required to be filed in each application in which this form is used. The statement under 37 CFR 3.73(c) may be completed by one of the practitioners appointed in this form, and must identify the application in which this Power of Attorney is to be filed.

SIGNATURE of Assignee of Record

The individual whose signature and title is supplied below is authorized to act on behalf of the assignee.

Signature	Date October 16, 2019
Name James Runstadler	Telephone 401-457-3577
Title President, Textron Innovations Inc.	

This collection of information is required by 37 CFR 1.31, 1.32, and 1.33. The information is required to obtain or retain a benefit by the public, which is to update (and by the USPTO to process) the file of a patent or reexamination proceeding. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 18 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

PTO/AIA/14 (02-18)
Approved for use through 11/30/2020. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

SUPPLEMENTAL **Application Data Sheet 37 CFR 1.76**	Attorney Docket Number	BEL-IN140-19.02
	Application Number	

Title of Invention	Fleet Controller

The application data sheet is part of the provisional or nonprovisional application for which it is being submitted. The following form contains the bibliographic data arranged in a format specified by the United States Patent and Trademark Office as outlined in 37 CFR 1.76
This document may be completed electronically and submitted to the Office in electronic format using the Electronic Filing System (EFS) or the document may be printed and included in a paper filed application.

Secrecy Order 37 CFR 5.2:

☐ Portions or all of the application associated with this Application Data Sheet may fall under a Secrecy Order pursuant to 37 CFR 5.2 (Paper filers only. Applications that fall under Secrecy Order may not be filed electronically.)

Inventor Information:

Inventor 1 Remove

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	Grant	Mark	Bristow	

Residence Information (Select One) ◉ US Residency ○ Non US Residency ○ Active US Military Service

City	Benbrook	State/Province	TX	Country of Residence	US

Mailing Address of Inventor:

Address 1	4382 Capra Way		
Address 2			
City	Benbrook	State/Province	TX
Postal Code	76126	Country	US

Inventor 2 Remove

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	Matthew	David	Holvey	

Residence Information (Select One) ◉ US Residency ○ Non US Residency ○ Active US Military Service

City	North Richland Hills	State/Province	TX	Country of Residence	US

Mailing Address of Inventor:

Address 1	6812 S. Fork Dr.		
Address 2			
City	North Richland Hills	State/Province	TX
Postal Code	76182	Country	US

Inventor 3 Remove

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	Naveed	Ahmed	Siddiqui	

Residence Information (Select One) ◉ US Residency ○ Non US Residency ○ Active US Military Service

SUPPLEMENTAL **Application Data Sheet 37 CFR 1.76**	Attorney Docket Number	BEL-IN140-19.02
	Application Number	
Title of Invention	Fleet Controller	

City	Dallas	State/Province	TX	Country of Residence	US

Mailing Address of Inventor:

Address 1	3033 Routh St. Apt 638		
Address 2			
City	Dallas	**State/Province**	TX
Postal Code	75201	**Country**	US

All Inventors Must Be Listed - Additional Inventor Information blocks may be generated within this form by selecting the **Add** button. Add

Correspondence Information:

Enter either Customer Number or complete the Correspondence Information section below.
For further information see 37 CFR 1.33(a).

☐ **An Address is being provided for the correspondence Information of this application.**

Customer Number	145156		
Email Address	docketing@slatermatsil.com	Add Email	Remove Email

Application Information:

Title of the Invention	Fleet Controller		
Attorney Docket Number	BEL-IN140-19.02	**Small Entity Status Claimed**	☐
Application Type	Nonprovisional		
Subject Matter	Utility		
Total Number of Drawing Sheets (if any)	4	**Suggested Figure for Publication (if any)**	

Filing By Reference:

Only complete this section when filing an application by reference under 35 U.S.C. 111(c) and 37 CFR 1.57(a). Do not complete this section if application papers including a specification and any drawings are being filed. Any domestic benefit or foreign priority information must be provided in the appropriate section(s) below (i.e., "Domestic Benefit/National Stage Information" and "Foreign Priority Information").

For the purposes of a filing date under 37 CFR 1.53(b), the description and any drawings of the present application are replaced by this reference to the previously filed application, subject to conditions and requirements of 37 CFR 1.57(a).

Application number of the previously filed application	Filing date (YYYY-MM-DD)	Intellectual Property Authority or Country

Publication Information:

☐ Request Early Publication (Fee required at time of Request 37 CFR 1.219)

☐ **Request Not to Publish.** I hereby request that the attached application not be published under 35 U.S.C. 122(b) and certify that the invention disclosed in the attached application **has not and will not** be the subject of an application filed in another country, or under a multilateral international agreement, that requires publication at eighteen months after filing.

SUPPLEMENTAL **Application Data Sheet 37 CFR 1.76**	Attorney Docket Number	BEL-IN140-19.02
	Application Number	
Title of Invention	Fleet Controller	

Representative Information:

Representative information should be provided for all practitioners having a power of attorney in the application. Providing this information in the Application Data Sheet does not constitute a power of attorney in the application (see 37 CFR 1.32).
Either enter Customer Number or complete the Representative Name section below. If both sections are completed the customer Number will be used for the Representative Information during processing.

Please Select One:	(●) Customer Number	( ) US Patent Practitioner	( ) Limited Recognition (37 CFR 11.9)
Customer Number	145156		

Domestic Benefit/National Stage Information:

This section allows for the applicant to either claim benefit under 35 U.S.C. 119(e), 120, 121, 365(c), or 386(c) or indicate National Stage entry from a PCT application. Providing benefit claim information in the Application Data Sheet constitutes the specific reference required by 35 U.S.C. 119(e) or 120, and 37 CFR 1.78.
When referring to the current application, please leave the "Application Number" field blank.

Prior Application Status			Remove
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)

Additional Domestic Benefit/National Stage Data may be generated within this form by selecting the **Add** button.

Foreign Priority Information:

This section allows for the applicant to claim priority to a foreign application. Providing this information in the application data sheet constitutes the claim for priority as required by 35 U.S.C. 119(b) and 37 CFR 1.55. When priority is claimed to a foreign application that is eligible for retrieval under the priority document exchange program (PDX)[i] the information will be used by the Office to automatically attempt retrieval pursuant to 37 CFR 1.55(i)(1) and (2). Under the PDX program, applicant bears the ultimate responsibility for ensuring that a copy of the foreign application is received by the Office from the participating foreign intellectual property office, or a certified copy of the foreign priority application is filed, within the time period specified in 37 CFR 1.55(g)(1).

			Remove
Application Number	Country[i]	Filing Date (YYYY-MM-DD)	Access Code[i] (if applicable)

Additional Foreign Priority Data may be generated within this form by selecting the **Add** button.

SUPPLEMENTAL **Application Data Sheet 37 CFR 1.76**	Attorney Docket Number	BEL-IN140-19.02
	Application Number	
Title of Invention	Fleet Controller	

Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications

☐ This application (1) claims priority to or the benefit of an application filed before March 16, 2013 and (2) also contains, or contained at any time, a claim to a claimed invention that has an effective filing date on or after March 16, 2013.
NOTE: By providing this statement under 37 CFR 1.55 or 1.78, this application, with a filing date on or after March 16, 2013, will be examined under the first inventor to file provisions of the AIA.

SUPPLEMENTAL **Application Data Sheet 37 CFR 1.76**	Attorney Docket Number	BEL-IN140-19.02
	Application Number	
Title of Invention	Fleet Controller	

Authorization or Opt-Out of Authorization to Permit Access:

When this Application Data Sheet is properly signed and filed with the application, applicant has provided written authority to permit a participating foreign intellectual property (IP) office access to the instant application-as-filed (see paragraph A in subsection 1 below) and the European Patent Office (EPO) access to any search results from the instant application (see paragraph B in subsection 1 below).

Should applicant choose not to provide an authorization identified in subsection 1 below, applicant **must opt-out** of the authorization by checking the corresponding box A or B or both in subsection 2 below.

NOTE: This section of the Application Data Sheet is **ONLY** reviewed and processed with the **INITIAL** filing of an application. After the initial filing of an application, an Application Data Sheet cannot be used to provide or rescind authorization for access by a foreign IP office(s). Instead, Form PTO/SB/39 or PTO/SB/69 must be used as appropriate.

1. Authorization to Permit Access by a Foreign Intellectual Property Office(s)

A. Priority Document Exchange (PDX) - Unless box A in subsection 2 (opt-out of authorization) is checked, the undersigned hereby **grants the USPTO authority** to provide the European Patent Office (EPO), the Japan Patent Office (JPO), the Korean Intellectual Property Office (KIPO), the State Intellectual Property Office of the People's Republic of China (SIPO), the World Intellectual Property Organization (WIPO), and any other foreign intellectual property office participating with the USPTO in a bilateral or multilateral priority document exchange agreement in which a foreign application claiming priority to the instant patent application is filed, access to: (1) the instant patent application-as-filed and its related bibliographic data, (2) any foreign or domestic application to which priority or benefit is claimed by the instant application and its related bibliographic data, and (3) the date of filing of this Authorization. See 37 CFR 1.14(h)(1).

B. Search Results from U.S. Application to EPO - Unless box B in subsection 2 (opt-out of authorization) is checked, the undersigned hereby **grants the USPTO authority** to provide the EPO access to the bibliographic data and search results from the instant patent application when a European patent application claiming priority to the instant patent application is filed. See 37 CFR 1.14(h)(2).

The applicant is reminded that the EPO's Rule 141(1) EPC (European Patent Convention) requires applicants to submit a copy of search results from the instant application without delay in a European patent application that claims priority to the instant application.

2. Opt-Out of Authorizations to Permit Access by a Foreign Intellectual Property Office(s)

☐ A. Applicant **DOES NOT** authorize the USPTO to permit a participating foreign IP office access to the instant application-as-filed. If this box is checked, the USPTO will not be providing a participating foreign IP office with any documents and information identified in subsection 1A above.

☐ B. Applicant **DOES NOT** authorize the USPTO to transmit to the EPO any search results from the instant patent application. If this box is checked, the USPTO will not be providing the EPO with search results from the instant application.

NOTE: Once the application has published or is otherwise publicly available, the USPTO may provide access to the application in accordance with 37 CFR 1.14.

SUPPLEMENTAL **Application Data Sheet 37 CFR 1.76**	Attorney Docket Number	BEL-IN140-19.02
	Application Number	
Title of Invention	Fleet Controller	

Applicant Information:

Providing assignment information in this section does not substitute for compliance with any requirement of part 3 of Title 37 of CFR to have an assignment recorded by the Office.

Applicant 1

If the applicant is the inventor (or the remaining joint inventor or inventors under 37 CFR 1.45), this section should not be completed. The information to be provided in this section is the name and address of the legal representative who is the applicant under 37 CFR 1.43; or the name and address of the assignee, person to whom the inventor is under an obligation to assign the invention, or person who otherwise shows sufficient proprietary interest in the matter who is the applicant under 37 CFR 1.46. If the applicant is an applicant under 37 CFR 1.46 (assignee, person to whom the inventor is obligated to assign, or person who otherwise shows sufficient proprietary interest) together with one or more joint inventors, then the joint inventor or inventors who are also the applicant should be identified in this section.

Clear

◉ Assignee	○ Legal Representative under 35 U.S.C. 117	○ Joint Inventor
○ Person to whom the inventor is obligated to assign.	○ Person who shows sufficient proprietary interest	

If applicant is the legal representative, indicate the authority to file the patent application, the inventor is:

Name of the Deceased or Legally Incapacitated Inventor:

If the Applicant is an Organization check here. ☒

Organization Name	~~Bell Textron Inc.~~ Textron Innovations Inc.		
Mailing Address Information For Applicant:			
Address 1	~~Mail Stop HQ 04445~~ 40 Westminster Street		
Address 2	~~P.O. Box 482~~		
City	~~Fort Worth~~ Providence	**State/Province**	~~TX~~ RI
Country US		Postal Code	~~76101~~ 02903
Phone Number		Fax Number	
Email Address			

Additional Applicant Data may be generated within this form by selecting the Add button.

Assignee Information including Non-Applicant Assignee Information:

Providing assignment information in this section does not substitute for compliance with any requirement of part 3 of Title 37 of CFR to have an assignment recorded by the Office.

SUPPLEMENTAL **Application Data Sheet 37 CFR 1.76**	Attorney Docket Number	BEL-IN140-19.02
	Application Number	
Title of Invention	Fleet Controller	

Assignee 1

Complete this section if assignee information, including non-applicant assignee information, is desired to be included on the patent application publication. An assignee-applicant identified in the "Applicant Information" section will appear on the patent application publication as an applicant. For an assignee-applicant, complete this section only if identification as an assignee is also desired on the patent application publication.

If the Assignee or Non-Applicant Assignee is an Organization check here. ☐

Prefix	**Given Name**	Middle Name	**Family Name**	Suffix

Mailing Address Information For Assignee including Non-Applicant Assignee:

Address 1			
Address 2			
City		**State/Province**	
Country i		Postal Code	
Phone Number		Fax Number	
Email Address			

Additional Assignee or Non-Applicant Assignee Data may be generated within this form by selecting the Add button.

Signature:

NOTE: This Application Data Sheet must be signed in accordance with 37 CFR 1.33(b). **However, if this Application Data Sheet is submitted with the INITIAL filing of the application and either box A or B is not checked in subsection 2 of the "Authorization or Opt-Out of Authorization to Permit Access" section, then this form must also be signed in accordance with 37 CFR 1.14(c).**

This Application Data Sheet **must** be signed by a patent practitioner if one or more of the applicants is a **juristic entity** (e.g., corporation or association). If the applicant is two or more joint inventors, this form must be signed by a patent practitioner, **all** joint inventors who are the applicant, or one or more joint inventor-applicants who have been given power of attorney (e.g., see USPTO Form PTO/AIA/81) on behalf of **all** joint inventor-applicants.

See 37 CFR 1.4(d) for the manner of making signatures and certifications.

Signature	/Robert G. Graham/			Date (YYYY-MM-DD)	2021-05-06
First Name	Robert G.	Last Name	Graham	Registration Number	58042

Additional Signature may be generated within this form by selecting the Add button.

SUPPLEMENTAL **Application Data Sheet 37 CFR 1.76**	Attorney Docket Number	BEL-IN140-19.02
	Application Number	
Title of Invention	Fleet Controller	

This collection of information is required by 37 CFR 1.76. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 23 minutes to complete, including gathering, preparing, and submitting the completed application data sheet form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these records.

2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.

3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.

4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).

5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent CooperationTreaty.

6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).

7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.

9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

Doc Code: R46C.REQ
Document Description: Request under 37 CFR 1.46(c) to correct, update or change the applicant.

PTO/AIA/41 (04-15)
Approved for use through 11/30/2020. OMB 0651-0031
U.S. Patent and Trademark Office, U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

REQUEST TO CORRECT OR UPDATE THE NAME OF THE APPLICANT UNDER 37 CFR 1.46(c)(1), OR CHANGE THE APPLICANT UNDER 37 CFR 1.46(c)(2)
(FOR USE ONLY IN APPLICATIONS FILED ON OR AFTER SEPTEMBER 16, 2012)

Application Number	16/720,543
Filing Date	12/19/2019
First Named Inventor	Grant Mark Bristow
Art Unit	3661
Examiner Name	TBD
Practitioner Docket Number	BEL-IN140-19.02

To: Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Applicant hereby **requests that the name of the applicant be corrected or updated under 37 CFR 1.46(c)(1), or that the applicant be changed under 37 CFR 1.46(c)(2),** in the above-identified application. **Requests under 37 CFR 1.46(c)(1) or (c)(2) cannot be submitted after payment of the issue fee or if the application has been patented.**

Please check the applicable box(es) below.

☐ 1. This request is to **correct or update the name of the applicant** (**under 37 CFR 1.46(c)(1)**) and includes:

☐ An application data sheet (ADS) in accordance with 37 CFR 1.76(c) with the corrected or updated information shown with markings (*e.g.*, underlining for insertions, strikethrough for deletions). A Corrected Web-based ADS may be used.

Note: Requests under 37 CFR 1.46(c)(1) may be filed to correct typographical errors in the name of the § 1.46 applicant, or for updating the name of the § 1.46 applicant (*i.e.*, where there is no change in the applicant itself but just in the applicant's name). See the Manual of Patent Examining Procedure (MPEP) section 605.01.

■ 2. This request is to **change the applicant** (**under 37 CFR 1.46(c)(2)**) and includes:

■ An application data sheet (ADS) in accordance with 37 CFR 1.76(c) that identifies the changes with proper markings (underlining for insertions and strikethrough for deletions). A Corrected Web-based ADS may be used.

■ A Statement Under 37 CFR 3.73(c) (Form PTO/AIA/96 or equivalent). See MPEP 325.

I am the

☐ applicant* ■ attorney or agent of record Registration number 58042 ☐ attorney or agent acting under 37 CFR 1.34 Registration number _____

Signature /Robert G. Graham/
Typed or printed name Robert G. Graham
Date May 6, 2021

NOTE: This form must be signed in accordance with 37 CFR 1.33. See 37 CFR 1.4 for signature requirements and certifications. *Juristic entities must be represented by a patent practitioner (See 37 CFR 1.31, applicable to any paper filed on or after September 16, 2012 that is presented on behalf of a juristic entity, regardless of application filing date). Submit multiple forms if more than one signature is required, see below**.

■ ** Total of 1 forms are submitted.

This collection of information is required by 37 CFR 1.36. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

Privacy Act Statement

The **Privacy Act of 1974 (P.L. 93-579)** requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether disclosure of these records is required by the Freedom of Information Act.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (*i.e.*, GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspection or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

PTO/AIA/96 (08-12)
Approved for use through 01/31/2013. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

STATEMENT UNDER 37 CFR 3.73(c)

Applicant/Patent Owner: Textron Innovations Inc.

Application No./Patent No.: 16/720,543 Filed/Issue Date: December 19, 2019

Titled: Fleet Controller

Textron Innovations Inc., a Corporation

(Name of Assignee) (Type of Assignee, e.g., corporation, partnership, university, government agency, etc.)

states that, for the patent application/patent identified above, it is (choose **one** of options 1, 2, 3 or 4 below):

1. ☑ The assignee of the entire right, title, and interest.

2. ☐ An assignee of less than the entire right, title, and interest (check applicable box):

   ☐ The extent (by percentage) of its ownership interest is _____%. Additional Statement(s) by the owners holding the balance of the interest must be submitted to account for 100% of the ownership interest.

   ☐ There are unspecified percentages of ownership. The other parties, including inventors, who together own the entire right, title and interest are:

   Additional Statement(s) by the owner(s) holding the balance of the interest must be submitted to account for the entire right, title, and interest.

3. ☐ The assignee of an undivided interest in the entirety (a complete assignment from one of the joint inventors was made). The other parties, including inventors, who together own the entire right, title, and interest are:

   Additional Statement(s) by the owner(s) holding the balance of the interest must be submitted to account for the entire right, title, and interest.

4. ☐ The recipient, via a court proceeding or the like (*e.g.*, bankruptcy, probate), of an undivided interest in the entirety (a complete transfer of ownership interest was made). The certified document(s) showing the transfer is attached.

The interest identified in option 1, 2 or 3 above (not option 4) is evidenced by either (choose **one** of options A or B below):

A. ☐ An assignment from the inventor(s) of the patent application/patent identified above. The assignment was recorded in the United States Patent and Trademark Office at Reel _____, Frame _____, or for which a copy thereof is attached.

B. ☑ A chain of title from the inventor(s), of the patent application/patent identified above, to the current assignee as follows:

1. From: GRANT MARK BRISTOW ET AL. To: BELL TEXTRON INC.

   The document was recorded in the United States Patent and Trademark Office at
   Reel 051376, Frame 0352, or for which a copy thereof is attached.

2. From: BELL TEXTRON INC. To: BELL TEXTRON RHODE ISLAND INC.

   The document was recorded in the United States Patent and Trademark Office at
   Reel 056129, Frame 0641, or for which a copy thereof is attached.

This collection of information is required by 37 CFR 3.73(b). The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

STATEMENT UNDER 37 CFR 3.73(c)

3. From: BELL TEXTRON RHODE ISLAND INC. To: TEXTRON INNOVATIONS INC.

The document was recorded in the United States Patent and Trademark Office at
Reel 056132, Frame 0469, or for which a copy thereof is attached.

4. From: _____ To: _____

The document was recorded in the United States Patent and Trademark Office at
Reel _____, Frame _____, or for which a copy thereof is attached.

5. From: _____ To: _____

The document was recorded in the United States Patent and Trademark Office at
Reel _____, Frame _____, or for which a copy thereof is attached.

6. From: _____ To: _____

The document was recorded in the United States Patent and Trademark Office at
Reel _____, Frame _____, or for which a copy thereof is attached.

☐ Additional documents in the chain of title are listed on a supplemental sheet(s).

☑ As required by 37 CFR 3.73(c)(1)(i), the documentary evidence of the chain of title from the original owner to the assignee was, or concurrently is being, submitted for recordation pursuant to 37 CFR 3.11.

[NOTE: A separate copy (i.e., a true copy of the original assignment document(s)) must be submitted to Assignment Division in accordance with 37 CFR Part 3, to record the assignment in the records of the USPTO. See MPEP 302.08]

The undersigned (whose title is supplied below) is authorized to act on behalf of the assignee.

/Robert G. Graham/	May 6, 2021
Signature	Date
Robert G. Graham	58042
Printed or Typed Name	Title or Registration Number

[Page 2 of 2]

Privacy Act Statement

The **Privacy Act of 1974 (P.L. 93-579)** requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

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6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
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9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

ATTORNEY DOCKET NO.
BEL-IN140-19.02

ASSIGNMENT

WHEREAS, I, the undersigned inventor (or one of the undersigned joint inventors), of residence as listed, having invented certain new and useful improvements as below entitled, for which application for United States Letters Patent is made; and

WHEREAS, Bell Textron Inc. ("Assignee"), a corporation organized and existing under the laws of TX, with its principal office at Mail Stop HQ 04415 P.O. Box 482, Fort Worth, TX 76101, is desirous of acquiring my entire right, title and interest in and to said invention, and to said application and any Letters Patent that may issue thereon in the United States and all other countries throughout the world;

NOW, THEREFORE, for good and valuable consideration, the receipt of which is hereby acknowledged, I hereby sell and assign to said Assignee, its successors and assigns, my entire right, title and interest in and to said invention and in and to said application and all patents which may be granted therefor, and all future non-provisional applications including divisions, reissues, substitutions, continuations, and extensions thereof; and I hereby authorize and request the Commissioner for Patents to issue all patents for said invention, or patent resulting therefrom, insofar as my interest is concerned, to said Assignee, as assignee of my entire right, title and interest. I declare that I have not executed and will not execute any agreement in conflict herewith.

I also hereby sell and assign to Assignee, its successors and assigns, my foreign rights to the invention disclosed in said application, in all countries of the world, including, but not limited to, the right to file applications and obtain patents under the terms of the International Convention for the Protection of Industrial Property, and of the European Patent Convention, and further agree to execute any and all patent applications, assignments, affidavits, and any other papers in connection therewith necessary to perfect such patent rights.

I hereby further agree that I will communicate to said Assignee, or to its successors, assigns, and legal representatives, any facts known to me respecting said invention or the file history thereof, and at the expense of said Assignee, its legal representatives, successors, or assigns, will testify in any legal proceedings, sign all lawful papers, execute all divisional, continuation, reissue and substitute applications, make all lawful oaths, and generally do everything possible to aid said Assignee, its legal representatives, successors, and assigns, to obtain and enforce proper patent protection for said invention in all countries.

IN WITNESS WHEREOF, I hereunto set my hand and seal this day and year;

TITLE OF INVENTION	Fleet Controller			
SIGNATURE OF INVENTOR AND NAME	Grant Mark Bristow	Matthew David Holvey	Naveed Ahmed Siddiqui	
DATE	12/18/2019			
RESIDENCE	Benbrook, TX	North Richland Hills, TX	Dallas, TX	

ATTORNEY DOCKET NO.
BEL-IN140-19.02

ASSIGNMENT

WHEREAS, I, the undersigned inventor (or one of the undersigned joint inventors), of residence as listed, having invented certain new and useful improvements as below entitled, for which application for United States Letters Patent is made; and

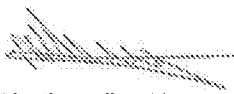
WHEREAS, Bell Textron Inc. ("Assignee"), a corporation organized and existing under the laws of TX, with its principal office at Mail Stop HQ 04415 P.O. Box 482, Fort Worth, TX 76101, is desirous of acquiring my entire right, title and interest in and to said invention, and to said application and any Letters Patent that may issue thereon in the United States and all other countries throughout the world;

NOW, THEREFORE, for good and valuable consideration, the receipt of which is hereby acknowledged, I hereby sell and assign to said Assignee, its successors and assigns, my entire right, title and interest in and to said invention and in and to said application and all patents which may be granted therefor, and all future non-provisional applications including divisions, reissues, substitutions, continuations, and extensions thereof; and I hereby authorize and request the Commissioner for Patents to issue all patents for said invention, or patent resulting therefrom, insofar as my interest is concerned, to said Assignee, as assignee of my entire right, title and interest. I declare that I have not executed and will not execute any agreement in conflict herewith.

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I hereby further agree that I will communicate to said Assignee, or to its successors, assigns, and legal representatives, any facts known to me respecting said invention or the file history thereof, and at the expense of said Assignee, its legal representatives, successors, or assigns, will testify in any legal proceedings, sign all lawful papers, execute all divisional, continuation, reissue and substitute applications, make all lawful oaths, and generally do everything possible to aid said Assignee, its legal representatives, successors, and assigns, to obtain and enforce proper patent protection for said invention in all countries.

IN WITNESS WHEREOF, I hereunto set my hand and seal this day and year;

TITLE OF INVENTION	Fleet Controller			
SIGNATURE OF INVENTOR AND NAME	Grant Mark Bristow	 Matthew David Holvey	Naveed Ahmed Siddiqui	
DATE		12-13-19		
RESIDENCE	Benbrook, TX	North Richland Hills, TX	Dallas, TX	

ATTORNEY DOCKET NO.
BEL-IN140-19.02

ASSIGNMENT

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WHEREAS, Bell Textron Inc. ("Assignee"), a corporation organized and existing under the laws of TX, with its principal office at Mail Stop HQ 04415 P.O. Box 482, Fort Worth, TX 76101, is desirous of acquiring my entire right, title and interest in and to said invention, and to said application and any Letters Patent that may issue thereon in the United States and all other countries throughout the world;

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I hereby further agree that I will communicate to said Assignee, or to its successors, assigns, and legal representatives, any facts known to me respecting said invention or the file history thereof, and at the expense of said Assignee, its legal representatives, successors, or assigns, will testify in any legal proceedings, sign all lawful papers, execute all divisional, continuation, reissue and substitute applications, make all lawful oaths, and generally do everything possible to aid said Assignee, its legal representatives, successors, and assigns, to obtain and enforce proper patent protection for said invention in all countries.

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TITLE OF INVENTION	Fleet Controller			
SIGNATURE OF INVENTOR AND NAME	Grant Mark Bristow	Matthew David Holvey	 Naveed Ahmed Siddiqui	
DATE			12/18/19	
RESIDENCE	Benbrook, TX	North Richland Hills, TX	Dallas, TX	

Electronic Acknowledgement Receipt

EFS ID:	42652605
Application Number:	16720543
International Application Number:	
Confirmation Number:	4655
Title of Invention:	Fleet Controller
First Named Inventor/Applicant Name:	Grant Mark Bristow
Customer Number:	145156
Filer:	Robert G. Graham/Jennifer Rubio
Filer Authorized By:	Robert G. Graham
Attorney Docket Number:	BEL-IN140-19.02
Receipt Date:	06-MAY-2021
Filing Date:	19-DEC-2019
Time Stamp:	12:05:08
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Power of Attorney	BEL-IN140-1902_POA.PDF	91633 8e16fb8db94bcb6d23510580ad4418ecf6c2af30	no	1

Warnings:

Information:					
2	Application Data Sheet	BEL-IN140-1902_Supplemental_ADS.PDF	143470 3a6ea1fd7a9887a901ca3ccdd6ee3f06f58a5a5c	no	9
Warnings:					
Information:					
This is not an USPTO supplied ADS fillable form					
3	Req to correct/update/change appl name until pay issue fee	BEL-IN140-1902_Request_Change_Applicant.PDF	219975 9dbd2a01b6bbf4dce0940f53f788f3c616da1d5a	no	2
Warnings:					
Information:					
4	Assignee showing of ownership per 37 CFR 3.73	BEL-IN140-1902_373_.pdf	601942 38df58d4f3acdc74ba5363c212c0e1a5ed7699ee	no	6
Warnings:					
Information:					
		Total Files Size (in bytes):	1057020		

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
16/720,543	12/19/2019	Grant Mark Bristow	BEL-IN140-19.02

CONFIRMATION NO. 4655

IMPROPER CPOA LETTER

145156
SLATER MATSIL, LLP/Bell
17950 PRESTON RD, SUITE 1000
DALLAS, TX 75252-5793

OC000000125440255

Date Mailed: 05/11/2021

NOTICE REGARDING POWER OF ATTORNEY

This is in response to the power of attorney filed 05/06/2021. The power of attorney in this application is not accepted for the reason(s) listed below:

- The person(s) appointed in the power of attorney is/are not registered to practice before the U.S. Patent and Trademark Office.

/mteklemichael/

Office of Data Management, Application Assistance Unit (571) 272-4000, or (571) 272-4200, or 1-888-786-0101

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NUMBER	FILING or 371(c) DATE	GRP ART UNIT	FIL FEE REC'D	ATTY.DOCKET.NO	TOT CLAIMS	IND CLAIMS
16/720,543	12/19/2019	3600	1720	BEL-IN140-19.02	20	3

CONFIRMATION NO. 4655

145156
SLATER MATSIL, LLP/Bell
17950 PRESTON RD, SUITE 1000
DALLAS, TX 75252-5793

REPLACEMENT FILING RECEIPT

OC000000125440260

Date Mailed: 05/11/2021

Receipt is acknowledged of this non-provisional utility patent application. The application will be taken up for examination in due course. Applicant will be notified as to the results of the examination. Any correspondence concerning the application must include the following identification information: the U.S. APPLICATION NUMBER, FILING DATE, NAME OF FIRST INVENTOR, and TITLE OF INVENTION. Fees transmitted by check or draft are subject to collection.

Please verify the accuracy of the data presented on this receipt. If an error is noted on this Filing Receipt, please submit a written request for a corrected Filing Receipt, including a properly marked-up ADS showing the changes with strike-through for deletions and underlining for additions. If you received a "Notice to File Missing Parts" or other Notice requiring a response for this application, please submit any request for correction to this Filing Receipt with your reply to the Notice. When the USPTO processes the reply to the Notice, the USPTO will generate another Filing Receipt incorporating the requested corrections provided that the request is grantable.

Inventor(s)

Grant Mark Bristow, Benbrook, TX;
Matthew David Holvey, North Richland Hills, TX;
Naveed Ahmed Siddiqui, Dallas, TX;

Applicant(s)

Textron Innovations Inc, Providence, RI;

Power of Attorney: The patent practitioners associated with Customer Number 145156

Domestic Applications for which benefit is claimed - None.
A proper domestic benefit claim must be provided in an Application Data Sheet in order to constitute a claim for domestic benefit. See 37 CFR 1.76 and 1.78.

Foreign Applications for which priority is claimed (You may be eligible to benefit from the **Patent Prosecution Highway** program at the USPTO. Please see http://www.uspto.gov for more information.) - None.
Foreign application information must be provided in an Application Data Sheet in order to constitute a claim to foreign priority. See 37 CFR 1.55 and 1.76.

Permission to Access Application via Priority Document Exchange: Yes

Permission to Access Search Results: Yes

Applicant may provide or rescind an authorization for access using Form PTO/SB/39 or Form PTO/SB/69 as appropriate.

If Required, Foreign Filing License Granted: 01/28/2020

The country code and number of your priority application, to be used for filing abroad under the Paris Convention, is **US 16/720,543**

Projected Publication Date: 06/24/2021

Non-Publication Request: No

Early Publication Request: No

Title

Fleet Controller

Preliminary Class

701

Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications: No

PROTECTING YOUR INVENTION OUTSIDE THE UNITED STATES

Since the rights granted by a U.S. patent extend only throughout the territory of the United States and have no effect in a foreign country, an inventor who wishes patent protection in another country must apply for a patent in a specific country or in regional patent offices. Applicants may wish to consider the filing of an international application under the Patent Cooperation Treaty (PCT). An international (PCT) application generally has the same effect as a regular national patent application in each PCT-member country. The PCT process **simplifies** the filing of patent applications on the same invention in member countries, but **does not result** in a grant of "an international patent" and does not eliminate the need of applicants to file additional documents and fees in countries where patent protection is desired.

Almost every country has its own patent law, and a person desiring a patent in a particular country must make an application for patent in that country in accordance with its particular laws. Since the laws of many countries differ in various respects from the patent law of the United States, applicants are advised to seek guidance from specific foreign countries to ensure that patent rights are not lost prematurely.

Applicants also are advised that in the case of inventions made in the United States, the Director of the USPTO must issue a license before applicants can apply for a patent in a foreign country. The filing of a U.S. patent application serves as a request for a foreign filing license. The application's filing receipt contains further information and guidance as to the status of applicant's license for foreign filing.

Applicants may wish to consult the USPTO booklet, "General Information Concerning Patents" (specifically, the section entitled "Treaties and Foreign Patents") for more information on timeframes and deadlines for filing foreign patent applications. The guide is available either by contacting the USPTO Contact Center at 800-786-9199, or it can be viewed on the USPTO website at http://www.uspto.gov/web/offices/pac/doc/general/index.html.

For information on preventing theft of your intellectual property (patents, trademarks and copyrights), you may wish to consult the U.S. Government website, http://www.stopfakes.gov. Part of a Department of Commerce initiative, this website includes self-help "toolkits" giving innovators guidance on how to protect intellectual property in specific

countries such as China, Korea and Mexico. For questions regarding patent enforcement issues, applicants may call the U.S. Government hotline at 1-866-999-HALT (1-866-999-4258).

LICENSE FOR FOREIGN FILING UNDER

Title 35, United States Code, Section 184

Title 37, Code of Federal Regulations, 5.11 & 5.15

GRANTED

The applicant has been granted a license under 35 U.S.C. 184, if the phrase "IF REQUIRED, FOREIGN FILING LICENSE GRANTED" followed by a date appears on this form. Such licenses are issued in all applications where the conditions for issuance of a license have been met, regardless of whether or not a license may be required as set forth in 37 CFR 5.15. The scope and limitations of this license are set forth in 37 CFR 5.15(a) unless an earlier license has been issued under 37 CFR 5.15(b). The license is subject to revocation upon written notification. The date indicated is the effective date of the license, unless an earlier license of similar scope has been granted under 37 CFR 5.13 or 5.14.

This license is to be retained by the licensee and may be used at any time on or after the effective date thereof unless it is revoked. This license is automatically transferred to any related applications(s) filed under 37 CFR 1.53(d). This license is not retroactive.

The grant of a license does not in any way lessen the responsibility of a licensee for the security of the subject matter as imposed by any Government contract or the provisions of existing laws relating to espionage and the national security or the export of technical data. Licensees should apprise themselves of current regulations especially with respect to certain countries, of other agencies, particularly the Office of Defense Trade Controls, Department of State (with respect to Arms, Munitions and Implements of War (22 CFR 121-128)); the Bureau of Industry and Security, Department of Commerce (15 CFR parts 730-774); the Office of Foreign AssetsControl, Department of Treasury (31 CFR Parts 500+) and the Department of Energy.

NOT GRANTED

No license under 35 U.S.C. 184 has been granted at this time, if the phrase "IF REQUIRED, FOREIGN FILING LICENSE GRANTED" DOES NOT appear on this form. Applicant may still petition for a license under 37 CFR 5.12, if a license is desired before the expiration of 6 months from the filing date of the application. If 6 months has lapsed from the filing date of this application and the licensee has not received any indication of a secrecy order under 35 U.S.C. 181, the licensee may foreign file the application pursuant to 37 CFR 5.15(b).

SelectUSA

The United States represents the largest, most dynamic marketplace in the world and is an unparalleled location for business investment, innovation, and commercialization of new technologies. The U.S. offers tremendous resources and advantages for those who invest and manufacture goods here. Through SelectUSA, our nation works to promote and facilitate business investment. SelectUSA provides information assistance to the international investor community; serves as an ombudsman for existing and potential investors; advocates on behalf of U.S. cities, states, and regions competing for global investment; and counsels U.S. economic development organizations on investment attraction best practices. To learn more about why the United States is the best country in the world to develop

technology, manufacture products, deliver services, and grow your business, visit http://www.SelectUSA.gov or call +1-202-482-6800.

PTO/AIA/80 (07-17)
Approved for use through 09/30/2021. OMB 0651-0035
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
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POWER OF ATTORNEY TO PROSECUTE APPLICATIONS BEFORE THE USPTO

I hereby revoke all previous powers of attorney given in the application identified in the attached statement under 37 CFR 3.73(c).

I hereby appoint:

[X] Practitioners associated with Customer Number: 145156

OR

[ ] Practitioner(s) named below (if more than ten patent practitioners are to be named, then a customer number must be used):

Name	Registration Number	Name	Registration Number

As attorney(s) or agent(s) to represent the undersigned before the United States Patent and Trademark Office (USPTO) in connection with any and all patent applications assigned only to the undersigned according to the USPTO assignment records or assignment documents attached to this form in accordance with 37 CFR 3.73(c).

Please change the correspondence address for the application identified in the attached statement under 37 CFR 3.73(c) to:

[X] The address associated with Customer Number: 145156

OR

[ ]

Firm or individual name		
Address		
City	State	Zip
Country		
Telephone	Email	

Assignee name and address: Textron Innovations Inc.
40 Westminster Street, Providence, Rhode Island 02903

A copy of this form, together with a statement under 37 CFR 3.73(c) (Form PTO/AIA/96 or equivalent) is required to be filed in each application in which this form is used. The statement under 37 CFR 3.73(c) may be completed by one of the practitioners appointed in this form, and must identify the application in which this Power of Attorney is to be filed.

SIGNATURE of Assignee of Record

The individual whose signature and title is supplied below is authorized to act on behalf of the assignee.

Signature	Date October 16, 2019
Name James Runstadler	Telephone 401-457-3577
Title President, Textron Innovations Inc.	

This collection of information is required by 37 CFR 1.31, 1.32, and 1.33. The information is required to obtain or retain a benefit by the public, which is to update (and by the USPTO to process) the file of a patent or reexamination proceeding. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 18 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

Electronic Acknowledgement Receipt

EFS ID:	42719804
Application Number:	16720543
International Application Number:	
Confirmation Number:	4655
Title of Invention:	Fleet Controller
First Named Inventor/Applicant Name:	Grant Mark Bristow
Customer Number:	145156
Filer:	Robert G. Graham/Jennifer Rubio
Filer Authorized By:	Robert G. Graham
Attorney Docket Number:	BEL-IN140-19.02
Receipt Date:	13-MAY-2021
Filing Date:	19-DEC-2019
Time Stamp:	18:35:39
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Assignee showing of ownership per 37 CFR 3.73	BEL-IN140-1902_373.pdf	602058 3da21d2e5c7bd8568943748008a445836baa3ce0	no	6

Warnings:

Information:					
2	Power of Attorney	BEL-IN140-1902_POA.PDF	195257 0cca45efc0413bef8d1800ccabd94e6fdce6a210	no	1
Warnings:					
Information:					
			Total Files Size (in bytes):	797315	

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

PTO/AIA/96 (08-12)
Approved for use through 01/31/2013. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
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STATEMENT UNDER 37 CFR 3.73(c)

Applicant/Patent Owner: Textron Innovations Inc.

Application No./Patent No.: 16/720,543 Filed/Issue Date: December 19, 2019

Titled: Fleet Controller

Textron Innovations Inc., a Corporation

(Name of Assignee) (Type of Assignee, e.g., corporation, partnership, university, government agency, etc.)

states that, for the patent application/patent identified above, it is (choose **one** of options 1, 2, 3 or 4 below):

1. ☑ The assignee of the entire right, title, and interest.

2. ☐ An assignee of less than the entire right, title, and interest (check applicable box):

   ☐ The extent (by percentage) of its ownership interest is _____%. Additional Statement(s) by the owners holding the balance of the interest must be submitted to account for 100% of the ownership interest.

   ☐ There are unspecified percentages of ownership. The other parties, including inventors, who together own the entire right, title and interest are:

   Additional Statement(s) by the owner(s) holding the balance of the interest must be submitted to account for the entire right, title, and interest.

3. ☐ The assignee of an undivided interest in the entirety (a complete assignment from one of the joint inventors was made). The other parties, including inventors, who together own the entire right, title, and interest are:

   Additional Statement(s) by the owner(s) holding the balance of the interest must be submitted to account for the entire right, title, and interest.

4. ☐ The recipient, via a court proceeding or the like (*e.g.*, bankruptcy, probate), of an undivided interest in the entirety (a complete transfer of ownership interest was made). The certified document(s) showing the transfer is attached.

The interest identified in option 1, 2 or 3 above (not option 4) is evidenced by either (choose **one** of options A or B below):

A. ☐ An assignment from the inventor(s) of the patent application/patent identified above. The assignment was recorded in the United States Patent and Trademark Office at Reel _____, Frame _____, or for which a copy thereof is attached.

B. ☑ A chain of title from the inventor(s), of the patent application/patent identified above, to the current assignee as follows:

1. From: GRANT MARK BRISTOW ET AL. To: BELL TEXTRON INC.

   The document was recorded in the United States Patent and Trademark Office at
   Reel 051376, Frame 0352, or for which a copy thereof is attached.

2. From: BELL TEXTRON INC. To: BELL TEXTRON RHODE ISLAND INC.

   The document was recorded in the United States Patent and Trademark Office at
   Reel 056129, Frame 0641, or for which a copy thereof is attached.

This collection of information is required by 37 CFR 3.73(b). The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

STATEMENT UNDER 37 CFR 3.73(c)

3. From: BELL TEXTRON RHODE ISLAND INC. To: TEXTRON INNOVATIONS INC.

The document was recorded in the United States Patent and Trademark Office at
Reel 056132, Frame 0469, or for which a copy thereof is attached.

4. From: _____ To: _____

The document was recorded in the United States Patent and Trademark Office at
Reel _____, Frame _____, or for which a copy thereof is attached.

5. From: _____ To: _____

The document was recorded in the United States Patent and Trademark Office at
Reel _____, Frame _____, or for which a copy thereof is attached.

6. From: _____ To: _____

The document was recorded in the United States Patent and Trademark Office at
Reel _____, Frame _____, or for which a copy thereof is attached.

☐ Additional documents in the chain of title are listed on a supplemental sheet(s).

☑ As required by 37 CFR 3.73(c)(1)(i), the documentary evidence of the chain of title from the original owner to the assignee was, or concurrently is being, submitted for recordation pursuant to 37 CFR 3.11.

[NOTE: A separate copy (i.e., a true copy of the original assignment document(s)) must be submitted to Assignment Division in accordance with 37 CFR Part 3, to record the assignment in the records of the USPTO. See MPEP 302.08]

The undersigned (whose title is supplied below) is authorized to act on behalf of the assignee.

/Robert G. Graham/	May 13, 2021
Signature	Date
Robert G. Graham	58042
Printed or Typed Name	Title or Registration Number

[Page 2 of 2]

Privacy Act Statement

The **Privacy Act of 1974 (P.L. 93-579)** requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether disclosure of these records is required by the Freedom of Information Act.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (*i.e.*, GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspection or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

ATTORNEY DOCKET NO.
BEL-IN140-19.02

ASSIGNMENT

WHEREAS, I, the undersigned inventor (or one of the undersigned joint inventors), of residence as listed, having invented certain new and useful improvements as below entitled, for which application for United States Letters Patent is made; and

WHEREAS, Bell Textron Inc. ("Assignee"), a corporation organized and existing under the laws of TX, with its principal office at Mail Stop HQ 04415 P.O. Box 482, Fort Worth, TX 76101, is desirous of acquiring my entire right, title and interest in and to said invention, and to said application and any Letters Patent that may issue thereon in the United States and all other countries throughout the world;

NOW, THEREFORE, for good and valuable consideration, the receipt of which is hereby acknowledged, I hereby sell and assign to said Assignee, its successors and assigns, my entire right, title and interest in and to said invention and in and to said application and all patents which may be granted therefor, and all future non-provisional applications including divisions, reissues, substitutions, continuations, and extensions thereof; and I hereby authorize and request the Commissioner for Patents to issue all patents for said invention, or patent resulting therefrom, insofar as my interest is concerned, to said Assignee, as assignee of my entire right, title and interest. I declare that I have not executed and will not execute any agreement in conflict herewith.

I also hereby sell and assign to Assignee, its successors and assigns, my foreign rights to the invention disclosed in said application, in all countries of the world, including, but not limited to, the right to file applications and obtain patents under the terms of the International Convention for the Protection of Industrial Property, and of the European Patent Convention, and further agree to execute any and all patent applications, assignments, affidavits, and any other papers in connection therewith necessary to perfect such patent rights.

I hereby further agree that I will communicate to said Assignee, or to its successors, assigns, and legal representatives, any facts known to me respecting said invention or the file history thereof, and at the expense of said Assignee, its legal representatives, successors, or assigns, will testify in any legal proceedings, sign all lawful papers, execute all divisional, continuation, reissue and substitute applications, make all lawful oaths, and generally do everything possible to aid said Assignee, its legal representatives, successors, and assigns, to obtain and enforce proper patent protection for said invention in all countries.

IN WITNESS WHEREOF, I hereunto set my hand and seal this day and year;

TITLE OF INVENTION	Fleet Controller			
SIGNATURE OF INVENTOR AND NAME	Grant Mark Bristow	Matthew David Holvey	Naveed Ahmed Siddiqui	
DATE	12/18/2019			
RESIDENCE	Benbrook, TX	North Richland Hills, TX	Dallas, TX	

ATTORNEY DOCKET NO.
BEL-IN140-19.02

ASSIGNMENT

WHEREAS, I, the undersigned inventor (or one of the undersigned joint inventors), of residence as listed, having invented certain new and useful improvements as below entitled, for which application for United States Letters Patent is made; and

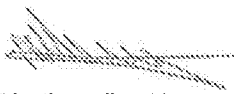
WHEREAS, Bell Textron Inc. ("Assignee"), a corporation organized and existing under the laws of TX, with its principal office at Mail Stop HQ 04415 P.O. Box 482, Fort Worth, TX 76101, is desirous of acquiring my entire right, title and interest in and to said invention, and to said application and any Letters Patent that may issue thereon in the United States and all other countries throughout the world;

NOW, THEREFORE, for good and valuable consideration, the receipt of which is hereby acknowledged, I hereby sell and assign to said Assignee, its successors and assigns, my entire right, title and interest in and to said invention and in and to said application and all patents which may be granted therefor, and all future non-provisional applications including divisions, reissues, substitutions, continuations, and extensions thereof; and I hereby authorize and request the Commissioner for Patents to issue all patents for said invention, or patent resulting therefrom, insofar as my interest is concerned, to said Assignee, as assignee of my entire right, title and interest. I declare that I have not executed and will not execute any agreement in conflict herewith.

I also hereby sell and assign to Assignee, its successors and assigns, my foreign rights to the invention disclosed in said application, in all countries of the world, including, but not limited to, the right to file applications and obtain patents under the terms of the International Convention for the Protection of Industrial Property, and of the European Patent Convention, and further agree to execute any and all patent applications, assignments, affidavits, and any other papers in connection therewith necessary to perfect such patent rights.

I hereby further agree that I will communicate to said Assignee, or to its successors, assigns, and legal representatives, any facts known to me respecting said invention or the file history thereof, and at the expense of said Assignee, its legal representatives, successors, or assigns, will testify in any legal proceedings, sign all lawful papers, execute all divisional, continuation, reissue and substitute applications, make all lawful oaths, and generally do everything possible to aid said Assignee, its legal representatives, successors, and assigns, to obtain and enforce proper patent protection for said invention in all countries.

IN WITNESS WHEREOF, I hereunto set my hand and seal this day and year;

TITLE OF INVENTION	Fleet Controller			
SIGNATURE OF INVENTOR AND NAME	Grant Mark Bristow	 Matthew David Holvey	Naveed Ahmed Siddiqui	
DATE		12-18-19		
RESIDENCE	Benbrook, TX	North Richland Hills, TX	Dallas, TX	

ATTORNEY DOCKET NO.
BEL-IN140-19.02

ASSIGNMENT

WHEREAS, I, the undersigned inventor (or one of the undersigned joint inventors), of residence as listed, having invented certain new and useful improvements as below entitled, for which application for United States Letters Patent is made; and

WHEREAS, Bell Textron Inc. ("Assignee"), a corporation organized and existing under the laws of TX, with its principal office at Mail Stop HQ 04415 P.O. Box 482, Fort Worth, TX 76101, is desirous of acquiring my entire right, title and interest in and to said invention, and to said application and any Letters Patent that may issue thereon in the United States and all other countries throughout the world;

NOW, THEREFORE, for good and valuable consideration, the receipt of which is hereby acknowledged, I hereby sell and assign to said Assignee, its successors and assigns, my entire right, title and interest in and to said invention and in and to said application and all patents which may be granted therefor, and all future non-provisional applications including divisions, reissues, substitutions, continuations, and extensions thereof; and I hereby authorize and request the Commissioner for Patents to issue all patents for said invention, or patent resulting therefrom, insofar as my interest is concerned, to said Assignee, as assignee of my entire right, title and interest. I declare that I have not executed and will not execute any agreement in conflict herewith.

I also hereby sell and assign to Assignee, its successors and assigns, my foreign rights to the invention disclosed in said application, in all countries of the world, including, but not limited to, the right to file applications and obtain patents under the terms of the International Convention for the Protection of Industrial Property, and of the European Patent Convention, and further agree to execute any and all patent applications, assignments, affidavits, and any other papers in connection therewith necessary to perfect such patent rights.

I hereby further agree that I will communicate to said Assignee, or to its successors, assigns, and legal representatives, any facts known to me respecting said invention or the file history thereof, and at the expense of said Assignee, its legal representatives, successors, or assigns, will testify in any legal proceedings, sign all lawful papers, execute all divisional, continuation, reissue and substitute applications, make all lawful oaths, and generally do everything possible to aid said Assignee, its legal representatives, successors, and assigns, to obtain and enforce proper patent protection for said invention in all countries.

IN WITNESS WHEREOF, I hereunto set my hand and seal this day and year;

TITLE OF INVENTION	Fleet Controller			
SIGNATURE OF INVENTOR AND NAME	Grant Mark Bristow	Matthew David Holvey	 Naveed Ahmed Siddiqui	
DATE			12/18/19	
RESIDENCE	Benbrook, TX	North Richland Hills, TX	Dallas, TX	

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
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Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
16/720,543	12/19/2019	Grant Mark Bristow	BEL-IN140-19.02

CONFIRMATION NO. 4655

145156
SLATER MATSIL, LLP/Bell
17950 PRESTON RD, SUITE 1000
DALLAS, TX 75252-5793

POA ACCEPTANCE LETTER

OC000000125612911

Date Mailed: 05/17/2021

NOTICE OF ACCEPTANCE OF POWER OF ATTORNEY

This is in response to the Power of Attorney filed 05/13/2021.

The Power of Attorney in this application is accepted. Correspondence in this application will be mailed to the above address as provided by 37 CFR 1.33.

Questions about the contents of this notice and the requirements it sets forth should be directed to the Office of Data Management, Application Assistance Unit, at **(571) 272-4000** or **(571) 272-4200** or **1-888-786-0101**.

/rnegga/

PTO/SB/08a (02-18)
Approved for use through 11/30/2020. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Not for submission under 37 CFR 1.99)

Application Number	16720543
Filing Date	2019-12-19
First Named Inventor	Grant Mark Bristow
Art Unit	3661
Examiner Name	Tyler D. Paige
Attorney Docket Number	BEL-IN140-19.02

U.S.PATENTS Remove

Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
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U.S.PATENT APPLICATION PUBLICATIONS Remove

Examiner Initial*	Cite No	Publication Number	Kind Code[1]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	20080125933		2008-05-29	Williams et al.	
	2	20160209220		2016-07-21	Laetz	
	3	20160247404		2016-08-25	Srivastava et al.	
	4	20190197798		2019-06-27	Abari et al.	

If you wish to add additional U.S. Published Application citation information please click the Add button. Add

FOREIGN PATENT DOCUMENTS Remove

Examiner Initial*	Cite No	Foreign Document Number[3]	Country Code[2] i	Kind Code[4]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear	T[5]

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	16720543
	Filing Date	2019-12-19
	First Named Inventor	Grant Mark Bristow
	Art Unit	3661
	Examiner Name	Tyler D. Paige
	Attorney Docket Number	BEL-IN140-19.02

	1						

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EXAMINER SIGNATURE

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[1] See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. [2] Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). [3] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [4] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [5] Applicant is to place a check mark here if English language translation is attached.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	16720543
	Filing Date	2019-12-19
	First Named Inventor	Grant Mark Bristow
	Art Unit	3661
	Examiner Name	Tyler D. Paige
	Attorney Docket Number	BEL-IN140-19.02

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

See attached certification statement.

The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

☒ A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Robert G. Graham/	Date (YYYY-MM-DD)	2021-06-09
Name/Print	Robert G. Graham	Registration Number	58042

This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 1 hour to complete, including gathering, preparing and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

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9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

Electronic Acknowledgement Receipt

EFS ID:	42939328
Application Number:	16720543
International Application Number:	
Confirmation Number:	4655
Title of Invention:	Fleet Controller
First Named Inventor/Applicant Name:	Grant Mark Bristow
Customer Number:	145156
Filer:	Robert G. Graham/Jennifer Rubio
Filer Authorized By:	Robert G. Graham
Attorney Docket Number:	BEL-IN140-19.02
Receipt Date:	09-JUN-2021
Filing Date:	19-DEC-2019
Time Stamp:	12:54:23
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Information Disclosure Statement (IDS) Form (SB08)	BEL-IN140-1902_IDS2.PDF	1087809 f1a9b945bce72310f755dbf295ed82e9bfa30029	no	4

Warnings:

Information:	
Total Files Size (in bytes):	1087809

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If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

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APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
16/720,543	12/19/2019	Grant Mark Bristow	BEL-IN140-19.02

CONFIRMATION NO. 4655

145156
SLATER MATSIL, LLP/Bell
17950 PRESTON RD, SUITE 1000
DALLAS, TX 75252-5793

PUBLICATION NOTICE

OC000000126526534

Title: Fleet Controller

Publication No.US-2021-0192962-A1
Publication Date:06/24/2021

NOTICE OF PUBLICATION OF APPLICATION

The above-identified application will be electronically published as a patent application publication pursuant to 37 CFR 1.211, et seq. The patent application publication number and publication date are set forth above.

The publication may be accessed through the USPTO's publically available Searchable Databases via the Internet at www.uspto.gov. The direct link to access the publication is currently http://www.uspto.gov/patft/.

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In addition, information on the status of the application, including the mailing date of Office actions and the dates of receipt of correspondence filed in the Office, may also be accessed via the Internet through the Patent Electronic Business Center at www.uspto.gov using the public side of the Patent Application Information and Retrieval (PAIR) system. The direct link to access this status information is currently https://portal.uspto.gov/pair/PublicPair. Prior to publication, such status information is confidential and may only be obtained by applicant using the private side of PAIR.

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
16/720,543	12/19/2019	Grant Mark Bristow	BEL-IN140-19.02	4655

145156 7590 08/18/2021

SLATER MATSIL, LLP/Bell
17950 PRESTON RD, SUITE 1000
DALLAS, TX 75252-5793

EXAMINER
PAIGE, TYLER D

ART UNIT	PAPER NUMBER
3661	

NOTIFICATION DATE	DELIVERY MODE
08/18/2021	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

docketing@slatermatsil.com

Office Action Summary	Application No. 16/720,543	Applicant(s) Bristow et al.	
	Examiner TYLER D PAIGE	Art Unit 3661	AIA (FITF) Status Yes

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTHS FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☑ Responsive to communication(s) filed on 12/19/2019.

☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

2a)☐ This action is **FINAL.** 2b) ☑ This action is non-final.

3)☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.

4)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims*

5) ☑ Claim(s) 1-20 is/are pending in the application.

5a) Of the above claim(s) _____ is/are withdrawn from consideration.

6) ☐ Claim(s) _____ is/are allowed.

7) ☑ Claim(s) 1-20 is/are rejected.

8) ☐ Claim(s) _____ is/are objected to.

9) ☐ Claim(s) _____ are subject to restriction and/or election requirement

* If any claims have been determined allowable, you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see http://www.uspto.gov/patents/init_events/pph/index.jsp or send an inquiry to **PPHfeedback@uspto.gov.**

Application Papers

10)☐ The specification is objected to by the Examiner.

11)☑ The drawing(s) filed on 12/19/2019 is/are: a)☑ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

Certified copies:

a)☐ All b)☐ Some** c)☐ None of the:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

** See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☑ Notice of References Cited (PTO-892)

2) ☑ Information Disclosure Statement(s) (PTO/SB/08a and/or PTO/SB/08b) Paper No(s)/Mail Date 04/13/2021;06/09/2021.

3) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date _____.

4) ☐ Other: _____.

DETAILED ACTION

Notice of Pre-AIA or AIA Status

The present application, filed on or after March 16, 2013, is being examined under the first inventor to file provisions of the AIA. This office action is in response to an application filed on 12/19/2019. The applicant submits Information Disclosure Statements dated 04/13/2021 and 06/09/2021. The applicant does not claim Domestic or Foreign priority.

Claim Objections

1. Claims 1, 8 and 15 are objected to because of the following informalities: The claims do not have a descriptive preamble describing the inventive concept of the invention pursuant to MPEP 2111.02. The MPEP states the preamble may be used to interpret the claimed invention. However, such a direction presupposes the preamble is descriptive, therefore, it is highly encouraged the applicant amend the preamble to describe the invention. Applicant does not have to include features that limit the scope of the claim. Just as the abstract describes the invention without limiting the invention. The preamble should describe the invention. Appropriate correction is required.

Claim Rejections - 35 USC § 102

In the event the determination of the status of the application as subject to AIA 35 U.S.C. 102 and 103 (or as subject to pre-AIA 35 U.S.C. 102 and 103) is incorrect, any correction of the statutory basis for the rejection will not be considered a new ground of rejection if the prior art relied upon, and the rationale supporting the rejection, would be the same under either status.

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (a)(2) the claimed invention was described in a patent issued under section 151, or in an application for patent published or deemed published under section 122(b), in which the patent or application, as the case may be, names another inventor and was effectively filed before the effective filing date of the claimed invention.

Claims 1 - 20 are rejected under 35 U.S.C. 102(a)(2) as being anticipated by Mullan US 2015/0234387.

2. As per claim 1, A method, comprising: (Mullan paragraphs 0086, 88, and 89 discloses the method)

obtaining, by a fleet controller, from a master schedule, a mission for a vehicle of a fleet of autonomous vehicles, wherein the mission is associated with a mission entry of the master schedule; (Mullan paragraph 0023 discloses, "The fleet and mission operations controller may receive a work order related to UV mission. According to an example, work orders may be received from various enterprises and cover a variety of applications of UVs. The fleet and mission operations controller may operate in conjunction with the mission manager to translate a work order into a mission request. A mission request may identify, for example, an operation for a UV, a type of a UV to complete the operation, at least one type of sensor to be mounted on the UV, a UV operation crew, a movement plan, and/or an objective for the mission. For example, a mission request may indicate that a fixed wing UAV or quadcopter (i.e., types of UAVs) may be equipped with a video camera, a gas detector, an infrared (IR) camera, and/or a pressure sensor to detect leaks in an oil pipeline.")

generating vehicle commands according to mission parameters associated with the mission; (Mullan paragraph 0024 discloses, "After launching the mission, the UV may follow

the movement plan autonomously, or with varying degrees of remote operator guidance from a hardware implemented movement planning controller operated by an operations crew. Sensors mounted onto the UV may transmit data in real-time to a ground station on the field, such as a portable device with a hardware implemented UV data receiver, and the ground station may transmit the data to the event detector, which may be disposed off-site. The event detector may process the data to identify an event. When an event is identified, the event detector may transmit an alarm to the fleet and mission operations controller for further review by a mission operator. The alarm may include information such as an identification of the event, data associated with the event, a location of the event, etc. After reviewing the event, the mission manager may operate in conjunction with the fleet and mission operations controller to generate instructions in real-time with an updated movement plan for a UV operator.")

maintaining a persistent connection with the vehicle; (Mullan paragraph 0043 discloses, "According to an example, the hardware implemented mission controller that is executed by the at least one hardware processor may control the assigned UV according to the assigned first movement plan, and receive communication data from the assigned sensor." And paragraph 0068 discloses, "At 314, communication data including telemetry data 132 and video stream data 134 may be received at the mission controller 102 from the UV 104. The telemetry data 132 and the video stream data 134 may include a video feed or other real-time data depending on the mission and data collected.")

sending the vehicle commands to the vehicle using the connection, the vehicle commands causing the vehicle to execute the mission under control of the fleet controller; (Mullan paragraph 0070 discloses, "At 322, if deemed appropriate, the fleet and mission operations controller 110 may send instructions to the mission controller 102 to change a movement path

while the mission is in progress. Any change to a movement path (or other mission aspects generally) may be re-verified for compliance by the compliance evaluator 114.") and

monitoring operation of the vehicle during performance of the mission. (Mullan paragraph 0095 discloses, "At block 1006, the method 1000 may include analyzing, by a hardware implemented event detector that is executed by the at least one hardware processor, communication data from the assigned sensor to identify an event related to the mission. For example, referring to FIGS. 1, 3A-3C, and 11, the hardware implemented event detector 116 may analyze communication data from the assigned sensor to identify an event related to the mission.")

3. As per claim 2, The method according to Claim 1, wherein the generating the vehicle commands comprises:

identifying a flight path associated with the mission; (Mullan paragraph 0050 discloses, "The movement planning controller 122 may be used to launch the UV 104, and control the UV flight path (e.g., for an aerial UV) and associated sensors. Once the UV 104 begins its movement plan from the launch point, the mission planning controller 120 may communicate with the mission manager 112 to indicate the beginning of the mission.")

verifying a usability of the flight path with a traffic management system; (Mullan paragraph 0054 discloses, "The compliance evaluator 114 may confirm whether the mission request complies with regulations (e.g., government regulations) governing the use of UVs, as well as with other policies related to UVs.") and

generating the vehicle commands according to the flight path in response to verifying the usability of the flight path. (Mullan paragraph 0024)

4. As per claim 3, The method according to Claim 1, wherein the obtaining the mission comprises obtaining the mission from the master schedule according to a priority of mission entries in the master schedule. (Mullan paragraph 0035 discloses, "According to an example, the mission request may include an identification of an objective of a mission, an assignment of a UV and a sensor to the mission from a fleet of UVs and sensors, and an assignment of a first movement plan to the mission based on the identified objective of the mission.")

5. As per claim 4, The method according to Claim 1, wherein the monitoring operation of the vehicle comprises monitoring a connection of the vehicle to a communications network associated with the fleet controller. (Mullan paragraph 0079 discloses, "Upon the launch of the UV 104 by the movement planning controller 122, a mission planner may initiate a request for a mission session with the event detector 116. An example of a mission planner may include MAVLINK Shim. The mission planning controller 120 may receive the request from the mission planner, and generate a request for the initiation of a session at the event orchestrator 604. Session initiation may include allocation of a data integrator and multiple data analyzers, and connecting the data integrator and the data analyzers to a receiver for data capture. The event orchestrator 604 may receive the events and publish the events for use at a dashboard for the mission controller 102.")

6. As per claim 5, The method according to Claim 4, wherein the monitoring the connection comprises: monitoring, by an access point of the communications network, a connection between the vehicle and the access point; (Mullan paragraph 0079) and reporting, by the access point, a last vehicle status to the fleet controller. (Mullan paragraph 0079)

7. As per claim 6, The method according to Claim 1, wherein the monitoring operation of the vehicle comprises determining, during performance of the mission, whether the mission

parameters associated with the mission are supported by mission impact data received at the fleet controller; (Mullan paragraph 0074 discloses, "According to an example, analytics may be performed on the source video by the event detector 116 and displayed as an analytics processing video. For example, an analytics processing video may include voice over describing the analytics performed on source video. The event detector 116 may generate a notification that is sent to the fleet and mission operations controller 110, where the fleet and mission operations controller 110 may perform actions such as changing the movement plan in real-time to make further observations related to the potential threat.") and

wherein the method further comprises:

generating, in response to the mission parameters not being supported by the mission impact data, adjusted vehicle commands according to the mission impact data and the mission parameters; (Mullan paragraph 0024) and

sending the adjusted vehicle commands to the vehicle using the connection, the adjusted vehicle commands causing the vehicle to execute the mission under control of the fleet controller according to the adjusted vehicle command. (Mullan paragraph 0070)

8. As per claim 7, The method according to Claim 1, wherein the sending the vehicle commands to the vehicle comprises determining whether the vehicle is subject to single source control; (Mullan paragraph 0076) and forwarding the vehicle commands to the vehicle in response the vehicle being subject to the single source control or a source of the vehicle commands being assigned an authority greater than any other set of vehicles commands associated with the vehicle. (Mullan paragraph 0076)

9. As per claim 8, A fleet controller, comprising:

a processor; (Mullan paragraph 0035 discloses, "According to examples disclosed herein, the UV control system may include the hardware implemented fleet and mission operations controller that is executed by at least one hardware processor to receive a UV work order and to generate a mission request based on the UV work order.") and

a non-transitory computer-readable storage medium storing a program to be executed by the processor, the program including instructions for: (Mullan paragraph 0085 discloses, "The elements of the UV control system 100 described herein may be machine readable instructions stored on a non-transitory computer readable medium.")

obtaining, from a master schedule, a mission for a vehicle of a fleet of autonomous vehicles, wherein the mission is associated with a mission entry of the master schedule; (Mullan paragraph 0023 discloses, "The fleet and mission operations controller may receive a work order related to UV mission. According to an example, work orders may be received from various enterprises and cover a variety of applications of UVs. The fleet and mission operations controller may operate in conjunction with the mission manager to translate a work order into a mission request. A mission request may identify, for example, an operation for a UV, a type of a UV to complete the operation, at least one type of sensor to be mounted on the UV, a UV operation crew, a movement plan, and/or an objective for the mission. For example, a mission request may indicate that a fixed wing UAV or quadcopter (i.e., types of UAVs) may be equipped with a video camera, a gas detector, an infrared (IR) camera, and/or a pressure sensor to detect leaks in an oil pipeline.")

generating vehicle commands according to mission parameters associated with the mission; (Mullan paragraph 0024 discloses, "After launching the mission, the UV may follow the movement plan autonomously, or with varying degrees of remote operator guidance from a

hardware implemented movement planning controller operated by an operations crew. Sensors mounted onto the UV may transmit data in real-time to a ground station on the field, such as a portable device with a hardware implemented UV data receiver, and the ground station may transmit the data to the event detector, which may be disposed off-site. The event detector may process the data to identify an event. When an event is identified, the event detector may transmit an alarm to the fleet and mission operations controller for further review by a mission operator. The alarm may include information such as an identification of the event, data associated with the event, a location of the event, etc. After reviewing the event, the mission manager may operate in conjunction with the fleet and mission operations controller to generate instructions in real-time with an updated movement plan for a UV operator.")

maintaining a persistent connection with the vehicle through a communications network; (Mullan paragraph 0043 discloses, "According to an example, the hardware implemented mission controller that is executed by the at least one hardware processor may control the assigned UV according to the assigned first movement plan, and receive communication data from the assigned sensor." And paragraph 0068 discloses, "At 314, communication data including telemetry data 132 and video stream data 134 may be received at the mission controller 102 from the UV 104. The telemetry data 132 and the video stream data 134 may include a video feed or other real-time data depending on the mission and data collected.")

sending the vehicle commands to the vehicle using the connection, the vehicle commands causing the vehicle to execute the mission under control of the fleet controller; (Mullan paragraph 0070 discloses, "At 322, if deemed appropriate, the fleet and mission operations controller 110 may send instructions to the mission controller 102 to change a movement path

while the mission is in progress. Any change to a movement path (or other mission aspects generally) may be re-verified for compliance by the compliance evaluator 114.") and

monitoring operation of the vehicle during performance of the mission. (Mullan paragraph 0095 discloses, "At block 1006, the method 1000 may include analyzing, by a hardware implemented event detector that is executed by the at least one hardware processor, communication data from the assigned sensor to identify an event related to the mission. For example, referring to FIGS. 1, 3A-3C, and 11, the hardware implemented event detector 116 may analyze communication data from the assigned sensor to identify an event related to the mission.")

10. As per claim 9, The fleet controller according to Claim 8, wherein the instructions for the generating the vehicle commands comprise:

identifying a flight path associated with the mission; (Mullan paragraph 0050 discloses, "The movement planning controller 122 may be used to launch the UV 104, and control the UV flight path (e.g., for an aerial UV) and associated sensors. Once the UV 104 begins its movement plan from the launch point, the mission planning controller 120 may communicate with the mission manager 112 to indicate the beginning of the mission.")

verifying a usability of the flight path with a traffic management system; (Mullan paragraph 0054 discloses, "The compliance evaluator 114 may confirm whether the mission request complies with regulations (e.g., government regulations) governing the use of UVs, as well as with other policies related to UVs.") and

generating the vehicle commands according to the flight path in response to verifying the usability of the flight path. (Mullan paragraph 0024)

11. As per claim 10, The fleet controller according to Claim 8, wherein the instructions for the obtaining the mission include instructions for obtaining the mission from the master schedule according to a priority of mission entries in the master schedule. (Mullan paragraph 0035 discloses, "According to an example, the mission request may include an identification of an objective of a mission, an assignment of a UV and a sensor to the mission from a fleet of UVs and sensors, and an assignment of a first movement plan to the mission based on the identified objective of the mission.")

12. As per claim 11, The fleet controller according to Claim 8, wherein the instructions for the monitoring operation of the vehicle include instructions for receiving, from an access point of the communications network, a last vehicle status in response to loss of a connection between the vehicle and the access point hosting the persistent connection. (Mullan paragraph 0079)

13. As per claim 12, The fleet controller according to Claim 8, wherein the instructions for the monitoring operation of the vehicle include instructions for determining, during performance of the mission, whether the mission parameters associated with the mission are supported by mission impact data received at the fleet controller; (Mullan paragraph 0074 discloses, "According to an example, analytics may be performed on the source video by the event detector 116 and displayed as an analytics processing video. For example, an analytics processing video may include voice over describing the analytics performed on source video. The event detector 116 may generate a notification that is sent to the fleet and mission operations controller 110, where the fleet and mission operations controller 110 may perform actions such as changing the movement plan in real-time to make further observations related to the potential threat.") and

wherein the program further includes instructions for:

generating, in response to the mission parameters not being supported by the mission impact data, adjusted vehicle commands according to the mission impact data and the mission parameters; (Mullan paragraph 0024) and

sending the adjusted vehicle commands to the vehicle using the connection, the adjusted vehicle commands causing the vehicle to execute the mission under control of the fleet controller according to the adjusted vehicle command. (Mullan paragraph 0070)

14. As per claim 13, The fleet controller according to Claim 12, wherein the mission impact data comprises at least one of received event messages, traffic management system data, or exterior condition data.(Mullan paragraph 0021 discloses, "The system and method disclosed herein may generally utilize a hardware implemented mission manager and a hardware implemented event detector to assign and manage a mission upon receipt of a work order." And paragraph 0026 discloses, "The system and method disclosed herein may be used in package delivery (e.g., food, medicine, equipment, etc.), aerial surveillance (e.g., police/fire department, cartography, photography, film, journalism, real estate, etc.), exploration (e.g., mine detection, site survey, etc.), research (e.g., wildlife, atmosphere, ocean, etc.), remote sensing (e.g., telecommunications, weather, maritime, construction, etc.), disaster relief (e.g., survivors, explore contaminated areas, etc.), environment (e.g., forest fires, threats, etc.), and agriculture (e.g., spray pesticides, crop growth, disease, irrigation level, wild animals, etc.).")

15. As per claim 14, The fleet controller according to Claim 8, wherein the instructions for the sending the vehicle commands to the vehicle comprises determining whether the vehicle is subject to single source control; (Mullan paragraph 0076) and forwarding the vehicle commands to the vehicle in response the vehicle being subject to the single source control or a source of the

vehicle commands being assigned an authority greater than any other set of vehicles commands associated with the vehicle. (Mullan paragraph 0076)

16. As per claim 15, A system, comprising:

a vehicle; (Mullan paragraph 0020 discloses, "Unmanned vehicles (UVs) such as aerial vehicles (e.g., Unmanned aerial vehicles (UAVs), or drones), land vehicles, or even collaborative robots are typically operated without a human aboard.")

a communications network; (Mullan paragraph 0076 discloses, "Referring to FIG. 5, micro air vehicle link (MAVLINK) may represent an open source communications protocol used for telemetry communications between open source ground stations and UV flight controllers (e.g., the mission controller 102).") and

a fleet controller in communication with the vehicle by way of the communications network, the fleet controller configured to:

obtain, from a master schedule, a mission for a vehicle of a fleet of autonomous vehicles, wherein the mission is associated with a mission entry of the master schedule; (Mullan paragraph 0023 discloses, "The fleet and mission operations controller may receive a work order related to UV mission. According to an example, work orders may be received from various enterprises and cover a variety of applications of UVs. The fleet and mission operations controller may operate in conjunction with the mission manager to translate a work order into a mission request. A mission request may identify, for example, an operation for a UV, a type of a UV to complete the operation, at least one type of sensor to be mounted on the UV, a UV operation crew, a movement plan, and/or an objective for the mission. For example, a mission request may indicate that a fixed wing UAV or quadcopter (i.e., types of UAVs) may be equipped with a

video camera, a gas detector, an infrared (IR) camera, and/or a pressure sensor to detect leaks in an oil pipeline.")

generate vehicle commands according to mission parameters associated with the mission; (Mullan paragraph 0024 discloses, "After launching the mission, the UV may follow the movement plan autonomously, or with varying degrees of remote operator guidance from a hardware implemented movement planning controller operated by an operations crew. Sensors mounted onto the UV may transmit data in real-time to a ground station on the field, such as a portable device with a hardware implemented UV data receiver, and the ground station may transmit the data to the event detector, which may be disposed off-site. The event detector may process the data to identify an event. When an event is identified, the event detector may transmit an alarm to the fleet and mission operations controller for further review by a mission operator. The alarm may include information such as an identification of the event, data associated with the event, a location of the event, etc. After reviewing the event, the mission manager may operate in conjunction with the fleet and mission operations controller to generate instructions in real-time with an updated movement plan for a UV operator.")

maintain a persistent connection with the vehicle through the communications network; (Mullan paragraph 0043 discloses, "According to an example, the hardware implemented mission controller that is executed by the at least one hardware processor may control the assigned UV according to the assigned first movement plan, and receive communication data from the assigned sensor." And paragraph 0068 discloses, "At 314, communication data including telemetry data 132 and video stream data 134 may be received at the mission controller 102 from the UV 104. The telemetry data 132 and the video stream data 134 may include a video feed or other real-time data depending on the mission and data collected.")

send the vehicle commands to the vehicle using the connection, wherein the vehicle is configured to receive the vehicle command and execute the mission according to the vehicle commands; (Mullan paragraph 0070 discloses, "At 322, if deemed appropriate, the fleet and mission operations controller 110 may send instructions to the mission controller 102 to change a movement path while the mission is in progress. Any change to a movement path (or other mission aspects generally) may be re-verified for compliance by the compliance evaluator 114.") and

monitor operation of the vehicle during performance of the mission. (Mullan paragraph 0095 discloses, "At block 1006, the method 1000 may include analyzing, by a hardware implemented event detector that is executed by the at least one hardware processor, communication data from the assigned sensor to identify an event related to the mission. For example, referring to FIGS. 1, 3A-3C, and 11, the hardware implemented event detector 116 may analyze communication data from the assigned sensor to identify an event related to the mission.")

17. As per claim 16, The system according to Claim 15, wherein the fleet controller is configured to:

identify a flight path associated with the mission; (Mullan paragraph 0050 discloses, "The movement planning controller 122 may be used to launch the UV 104, and control the UV flight path (e.g., for an aerial UV) and associated sensors. Once the UV 104 begins its movement plan from the launch point, the mission planning controller 120 may communicate with the mission manager 112 to indicate the beginning of the mission.")

verify a usability of the flight path with a traffic management system; (Mullan paragraph 0054 discloses, "The compliance evaluator 114 may confirm whether the mission request

complies with regulations (e.g., government regulations) governing the use of UVs, as well as with other policies related to UVs.") and

generate the vehicle commands according to the flight path in response to verifying the usability of the flight path. (Mullan paragraph 0024)

18. As per claim 17, The system according to Claim 15, wherein the fleet controller is configured to obtain the mission from the master schedule according to a priority of mission entries in the master schedule. (Mullan paragraph 0035 discloses, "According to an example, the mission request may include an identification of an objective of a mission, an assignment of a UV and a sensor to the mission from a fleet of UVs and sensors, and an assignment of a first movement plan to the mission based on the identified objective of the mission.")

19. As per claim 18, The system according to Claim 15, wherein the fleet controller is configured to receive, from an access point of the communications network, a last vehicle status in response to loss of a connection between the vehicle and the access point hosting the persistent connection. (Mullan paragraph 0079)

20. As per claim 19, The system according to Claim 15, wherein the fleet controller is configured to: determine, during performance of the mission, whether the mission parameters associated with the mission are supported by mission impact data received at the fleet controller; (Mullan paragraph 0074 discloses, "According to an example, analytics may be performed on the source video by the event detector 116 and displayed as an analytics processing video. For example, an analytics processing video may include voice over describing the analytics performed on source video. The event detector 116 may generate a notification that is sent to the fleet and mission operations controller 110, where the fleet and mission operations controller 110

may perform actions such as changing the movement plan in real-time to make further observations related to the potential threat.")

generate, in response to the mission parameters not being supported by the mission impact data, adjusted vehicle commands according to the mission impact data and the mission parameters; (Mullan paragraph 0024) and

send the adjusted vehicle commands to the vehicle using the connection, and wherein the vehicle is configured to execute the mission according to the adjusted vehicle command. (Mullan paragraph 0070)

21. As per claim 20, The system according to Claim 15, further comprising a control arbitrator configured to: determine whether the vehicle is subject to single source control; (Mullan paragraph 0076) and forward the vehicle commands to the vehicle in response the vehicle being subject to the single source control or a source of the vehicle commands being assigned an authority greater than any other set of vehicles commands associated with the vehicle. (Mullan paragraph 0076)

Examiner Request

The examiner requests, in response to this office action, support must be shown for language added to any original claims on amendment and any new claims. That is, indicate support for newly added claim language by specifically pointing to page(s) and line number(s) in the specification and/or drawing figure(s). This will assist the examiner in prosecuting the application. When responding to this office action, applicant is advised to clearly point out the patentable novelty which he or she thinks the claims present, in view of the state of art disclosed by the references cited or the objections made. He or she must also show how the amendments

avoid such references or objections. In amending in reply to a rejection of claims in an application or patent under reexamination, the applicant or patent owner must clearly point out the patentable novelty which he or she thinks the claims present in view the state of the art disclosed by the references cited or the objections made. The applicant or patent owner must also show how the amendments avoid such references or objections.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to TYLER D PAIGE whose telephone number is (571)270-5425. The examiner can normally be reached on M-F 7:00am - 6:00pm (mst).

Examiner interviews are available via telephone, in-person, and video conferencing using a USPTO supplied web-based collaboration tool. To schedule an interview, applicant is encouraged to use the USPTO Automated Interview Request (AIR) at http://www.uspto.gov/interviewpractice.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Thomas Black can be reached on 571-272-6956. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see https://ppair-my.uspto.gov/pair/PrivatePair. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-

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/TYLER D PAIGE/
Examiner, Art Unit 3661

Notice of References Cited	Application/Control No. 16/720,543	Applicant(s)/Patent Under Reexamination Bristow et al.	
	Examiner TYLER D PAIGE	Art Unit 3661	Page 1 of 1

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	CPC Classification	US Classification
*	A	US-20210192962-A1	06-2021	Bristow; Grant Mark	G08G5/006	1/1
*	B	US-20140316616-A1	10-2014	Kugelmass; Bret	G06T11/206	701/8
*	C	US-20110029804-A1	02-2011	HADDEN; George Daniel	G05D1/0088	714/1
*	D	US-20150234387-A1	08-2015	MULLAN; Pramila	G05D1/104	701/3
*	E	US-20170168480-A1	06-2017	WANSTEDT; Stefan	G07C5/008	1/1
*	F	US-20190235488-A1	08-2019	Beth; Dirk Karsten	G08G5/0013	1/1
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Index of Claims	Application/Control No.	Applicant(s)/Patent Under Reexamination
	16/720,543	Bristow et al.
	Examiner	Art Unit
	TYLER D PAIGE	3661

✓	Rejected	-	Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

CLAIMS

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

CLAIM		DATE								
Final	Original	08/13/2021								
	1	✓								
	2	✓								
	3	✓								
	4	✓								
	5	✓								
	6	✓								
	7	✓								
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	17	✓								
	18	✓								
	19	✓								
	20	✓								

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	16/720,543	Bristow et al.
	Examiner	Art Unit
	TYLER D PAIGE	3661

CPC - Searched*		
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CPC Combination Sets - Searched*		
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G08G5/0069 or G05D1/101 or G07C5/02 or G08G5/0013 or H04W24/08 or G08G5/006 or G08G5/0091 or G08G5/0056 or G08G5/0034 or G08G5/0043 or G08G5/0026 or G05D1/104	08/13/2021	tdp

US Classification - Searched*			
Class	Subclass	Date	Examiner
701	3	08/13/2021	tdp

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Search Notes		
Search Notes	Date	Examiner
Inventor Search	08/13/2021	tdp
NPL Search	08/13/2021	tdp
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/TYLER D PAIGE/ Examiner, Art Unit 3661	

Doc code: IDS
Doc description: Information Disclosure Statement (IDS) Filed

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Not for submission under 37 CFR 1.99)

Application Number	16720543
Filing Date	2019-12-19
First Named Inventor	Grant Mark Bristow
Art Unit	3661
Examiner Name	TBD
Attorney Docket Number	BEL-IN140-19.02

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	1	20190235488		2019-08-01	Beth et al.	
	2	20190339720		2019-11-07	Petersen et al.	
	3	21060364989		2016-12-15	Speasl et al.	

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	1	2019089677	WO	A1	2019-05-09	Shannon c/o The Marbury Law Group, PLLC.		

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT

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Attorney Docket Number	BEL-IN140-19.02

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First Named Inventor	Grant Mark Bristow
Art Unit	3661
Examiner Name	TBD
Attorney Docket Number	BEL-IN140-19.02

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

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SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Robert G. Graham/	Date (YYYY-MM-DD)	2021-04-13
Name/Print	Robert G. Graham	Registration Number	58042

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8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.

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Bibliographic Data

Application No: 16/720,543

Foreign Priority claimed: ○ Yes ◉ No

35 USC 119 (a-d) conditions met: ☐ Yes ☑ No ☐ Met After Allowance

Verified and Acknowledged: /TYLER D PAIGE/ (Examiner's Signature) (Initials)

Title: Fleet Controller

FILING or 371(c) DATE	CLASS	GROUP ART UNIT	ATTORNEY DOCKET NO.
12/19/2019	701	3661	BEL-IN140-19.02
RULE			

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Matthew David Holvey, North Richland Hills, TX, UNITED STATES

Naveed Ahmed Siddiqui, Dallas, TX, UNITED STATES

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UNITED STATES

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Application Number	16720543
Filing Date	2019-12-19
First Named Inventor	Grant Mark Bristow
Art Unit	3661
Examiner Name	Tyler D. Paige
Attorney Docket Number	BEL-IN140-19.02

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	1	20080125933		2008-05-29	Williams et al.	
	2	20160209220		2016-07-21	Laetz	
	3	20160247404		2016-08-25	Srivastava et al.	
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	First Named Inventor	Grant Mark Bristow
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Examiner Signature	/TYLER D PAIGE/ (08/13/2021)	Date Considered	08/13/2021

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through a citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

[1] See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. [2] Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). [3] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [4] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [5] Applicant is to place a check mark here if English language translation is attached.

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /T.D.P/

INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Not for submission under 37 CFR 1.99)

Application Number	16720543
Filing Date	2019-12-19
First Named Inventor	Grant Mark Bristow
Art Unit	3661
Examiner Name	Tyler D. Paige
Attorney Docket Number	BEL-IN140-19.02

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

See attached certification statement.

The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

☒ A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Robert G. Graham/	Date (YYYY-MM-DD)	2021-06-09
Name/Print	Robert G. Graham	Registration Number	58042

This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 1 hour to complete, including gathering, preparing and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

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ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /T.D.P/

EAST Search History

EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L1	2	("20190235488" | "20190339720" | "21060364989").PN.	US-PGPUB; USPAT	OR	OFF	2021/08/13 17:09
L2	4	("20080125933" | "20160209220" | "20160247404" | "20190197798").PN.	US-PGPUB; USPAT	OR	OFF	2021/08/13 17:09
S1	3	((("BRISTOW") near3 ("Grant")) OR (("HOLVEY") near3 ("Matthew")) OR (("SIDDIQUI") near3 ("Naveed"))).INV.	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT	OR	OFF	2021/08/13 11:21
S2	3,617	701/3.ccls.	US-PGPUB; USPAT; USOCR; IBM_TDB	OR	ON	2021/08/13 11:21
S3	27,918	(G08G5/0069 or G05D1/101 or G07C5/02 or G08G5/0013 or H04W24/08 or G08G5/006 or G08G5/0091 or G08G5/0056 or G08G5/0034 or G08G5/0043 or G08G5/0026 or G05D1/104).cpc.	US-PGPUB; USPAT; USOCR; IBM_TDB	OR	ON	2021/08/13 11:22
S4	22	(autonomous adj vehicle or uav or drone) with fleet same schedule same mission	US-PGPUB; USPAT; USOCR; IBM_TDB	OR	ON	2021/08/13 11:37
S5	23	(autonomous adj vehicle or uav or drone) same fleet same schedule same mission	US-PGPUB; USPAT; USOCR; IBM_TDB	OR	ON	2021/08/13 11:39
S6	5	(autonomous adj vehicle or uav or drone) same fleet same schedule same mission and maintenance	US-PGPUB; USPAT; USOCR; IBM_TDB	OR	ON	2021/08/13 11:41
S7	53	(autonomous adj vehicle or uav or drone) same fleet same mission and maintenance and schedule	US-PGPUB; USPAT; USOCR; IBM_TDB	OR	ON	2021/08/13 11:44
S8	90	(autonomous adj vehicle or uav or drone) same fleet same mission and (maintenance or service) and schedule	US-PGPUB; USPAT; USOCR; IBM_TDB	OR	ON	2021/08/13 11:44
S9	1	(autonomous adj vehicle or uav or drone) same fleet same mission same	US-PGPUB; USPAT;	OR	ON	2021/08/13 11:45

		priority and (maintenance or service) and schedule	USOCR; IBM_TDB			
S10	42	(autonomous adj vehicle or uav or drone) same fleet same mission and priority and (maintenance or service) and schedule	US-PGPUB; USPAT; USOCR; IBM_TDB	OR	ON	2021/08/13 11:46
S11	13	(autonomous adj vehicle or uav or drone) same fleet same mission and priority and (maintenance or service) and schedule and communication with connection and commands	US-PGPUB; USPAT; USOCR; IBM_TDB	OR	ON	2021/08/13 12:19
S12	13	(autonomous adj vehicle or uav or drone) same fleet same mission and priority and (maintenance or service) and schedule and communication same connection and commands	US-PGPUB; USPAT; USOCR; IBM_TDB	OR	ON	2021/08/13 12:20
S13	30	(autonomous adj vehicle or uav or drone) same fleet same mission and priority and (maintenance or service) and schedule and communication and commands	US-PGPUB; USPAT; USOCR; IBM_TDB	OR	ON	2021/08/13 12:20
S14	1	(autonomous adj vehicle or uav or drone) same fleet same mission and (maintenance or service) and schedule and communication and commands same priority	US-PGPUB; USPAT; USOCR; IBM_TDB	OR	ON	2021/08/13 12:21
S15	1	(autonomous adj vehicle or uav or drone) same fleet same mission and schedule and communication and commands same priority	US-PGPUB; USPAT; USOCR; IBM_TDB	OR	ON	2021/08/13 12:21
S16	19	(autonomous adj vehicle or uav or drone) same fleet same mission and schedule and communication and (commands or order or program$) same priority	US-PGPUB; USPAT; USOCR; IBM_TDB	OR	ON	2021/08/13 12:21

8/13/2021 5:11:22 PM
C:\Users\tpaige\Documents\EAST\Workspaces\16720543_uav_communication.wsp

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

First Inventor:	Bristow	Docket No.:	BEL-IN140-19.02
Application No.:	16/720,543	Conf. No.:	4655
Art Unit:	3661	Examiner:	Tyler D Paige
Filed:	12/19/2019		
Title:	Fleet Controller		

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

AMENDMENT

Dear Sir:

The following amendments and remarks are presented in response to the Examiner's Office Action dated August 18, 2021. Please amend the above-referenced application as follows.

IN THE CLAIMS:

1. (Currently Amended) [[A]] An autonomous vehicle fleet control method, comprising:

obtaining, by a fleet controller, from a master schedule, a mission for a vehicle of a fleet of autonomous vehicles, wherein the mission is associated with a mission entry of the master schedule;

identifying a flight path associated with the mission;

verifying a usability of the flight path with a unmanned aircraft system (UAS) traffic management (UTM), wherein the UTM performs checking on the flight path for traffic in the flight path, availability of the flight path due to flight restrictions and requirements for use of the flight path;

modifying the flight path according to data from the UTM in response to the UTM indicating that the usability of the flight path is not verified;

generating vehicle commands according to mission parameters associated with the mission based on the flight path;

maintaining a persistent connection with the vehicle;

sending the vehicle commands to the vehicle using the connection, the vehicle commands causing the vehicle to execute the mission under control of the fleet controller; and

monitoring operation of the vehicle during performance of the mission.

2. (Cancelled).

3. (Original) The method according to Claim 1, wherein the obtaining the mission comprises obtaining the mission from the master schedule according to a priority of mission entries in the master schedule.

4. (Original) The method according to Claim 1, wherein the monitoring operation of the vehicle comprises monitoring a connection of the vehicle to a communications network associated with the fleet controller.

5. (Original) The method according to Claim 4, wherein the monitoring the connection comprises:

monitoring, by an access point of the communications network, a connection between the vehicle and the access point; and

reporting, by the access point, a last vehicle status to the fleet controller.

6. (Original) The method according to Claim 1, wherein the monitoring operation of the vehicle comprises determining, during performance of the mission, whether the mission parameters associated with the mission are supported by mission impact data received at the fleet controller; and

wherein the method further comprises:

generating, in response to the mission parameters not being supported by the mission impact data, adjusted vehicle commands according to the mission impact data and the mission parameters; and

sending the adjusted vehicle commands to the vehicle using the connection, the adjusted vehicle commands causing the vehicle to execute the mission under control of the fleet controller according to the adjusted vehicle command.

7. (Currently Amended) The method according to Claim 1, wherein the sending the vehicle commands to the vehicle comprises determining whether the vehicle is subject to single source control, wherein the determining whether the vehicle is subject to single source control comprises ensuring that the vehicle is subject to a single point of control at any one time; and

forwarding the vehicle commands to the vehicle in response the vehicle being subject to

the single source control or a source of the vehicle commands being assigned an authority greater than any other set of vehicles commands associated with the vehicle.

8. (Currently Amended) A fleet controller for controlling an autonomous vehicle fleet, comprising:

a processor; and

a non-transitory computer-readable storage medium storing a program to be executed by the processor, the program including instructions for:

obtaining, from a master schedule, a mission for a vehicle of a fleet of autonomous vehicles, wherein the mission is associated with a mission entry of the master schedule;

identifying a flight path associated with the mission;

verifying a usability of the flight path with a unmanned aircraft system (UAS) traffic management (UTM), wherein the UTM performs checking on the flight path for traffic in the flight path, availability of the flight path due to flight restrictions and requirements for use of the flight path;

modifying the flight path according to data from the UTM in response to the UTM indicating that the usability of the flight path is not verified;

generating vehicle commands according to mission parameters associated with the mission based on the flight path;

maintaining a persistent connection with the vehicle through a communications network;

sending the vehicle commands to the vehicle using the connection, the vehicle commands causing the vehicle to execute the mission under control of the fleet controller; and

monitoring operation of the vehicle during performance of the mission.

9. (Cancelled).

10. (Original) The fleet controller according to Claim 8, wherein the instructions for the obtaining the mission include instructions for obtaining the mission from the master schedule according to a priority of mission entries in the master schedule.

11. (Original) The fleet controller according to Claim 8, wherein the instructions for the monitoring operation of the vehicle include instructions for receiving, from an access point of the communications network, a last vehicle status in response to loss of a connection between the vehicle and the access point hosting the persistent connection.

12. (Original) The fleet controller according to Claim 8, wherein the instructions for the monitoring operation of the vehicle include instructions for determining, during performance of the mission, whether the mission parameters associated with the mission are supported by mission impact data received at the fleet controller; and

wherein the program further includes instructions for:

generating, in response to the mission parameters not being supported by the mission impact data, adjusted vehicle commands according to the mission impact data and the mission parameters; and

sending the adjusted vehicle commands to the vehicle using the connection, the adjusted vehicle commands causing the vehicle to execute the mission under control of the fleet controller according to the adjusted vehicle command.

13. (Original) The fleet controller according to Claim 12, wherein the mission impact data comprises at least one of received event messages, traffic management system data, or exterior condition data.

14. (Currently Amended) The fleet controller according to Claim 8, wherein the instructions for the sending the vehicle commands to the vehicle comprises instructions for determining whether the vehicle is subject to single source control, wherein the determining whether the vehicle is subject to single source control comprises ensuring that the vehicle is subject to a

single point of control at any one time; and

forwarding the vehicle commands to the vehicle in response the vehicle being subject to the single source control or a source of the vehicle commands being assigned an authority greater than any other set of vehicles commands associated with the vehicle.

15. (Currently Amended) [[A]] An autonomous vehicle fleet control system, comprising:

a vehicle;

a communications network; and

a fleet controller in communication with the vehicle by way of the communications network, the fleet controller configured to:

obtain, from a master schedule, a mission for a vehicle of a fleet of autonomous vehicles, wherein the mission is associated with a mission entry of the master schedule;

identify a flight path associated with the mission;

verify a usability of the flight path with a unmanned aircraft system (UAS) traffic management (UTM), wherein the UTM performs checking on the flight path for traffic in the flight path, availability of the flight path due to flight restrictions and requirements for use of the flight path;

modify the flight path according to data from the UTM in response to the UTM indicating that the usability of the flight path is not verified;

generate vehicle commands according to mission parameters associated with the mission based on the flight path;

maintain a persistent connection with the vehicle through the communications network;

send the vehicle commands to the vehicle using the connection, wherein the vehicle is configured to receive the vehicle command and execute the mission according to the vehicle

commands; and

monitor operation of the vehicle during performance of the mission.

16. (Cancelled).

17. (Original) The system according to Claim 15, wherein the fleet controller is configured to obtain the mission from the master schedule according to a priority of mission entries in the master schedule.

18. (Original) The system according to Claim 15, wherein the fleet controller is configured to receive, from an access point of the communications network, a last vehicle status in response to loss of a connection between the vehicle and the access point hosting the persistent connection.

19. (Original) The system according to Claim 15, wherein the fleet controller is configured to:

determine, during performance of the mission, whether the mission parameters associated with the mission are supported by mission impact data received at the fleet controller;

generate, in response to the mission parameters not being supported by the mission impact data, adjusted vehicle commands according to the mission impact data and the mission parameters; and

send the adjusted vehicle commands to the vehicle using the connection, and wherein the vehicle is configured to execute the mission according to the adjusted vehicle command.

20. (Currently Amended) The system according to Claim 15, further comprising a control arbitrator configured to:

determine whether the vehicle is subject to single source control, wherein determining whether the vehicle is subject to single source control comprises ensuring that the vehicle is subject to a single point of control at any one time; and

forward the vehicle commands to the vehicle in response the vehicle being subject to the

single source control or a source of the vehicle commands being assigned an authority greater than any other set of vehicles commands associated with the vehicle.

21. (New) The method according to Claim 1, wherein the requirements for use of the flight path comprise at least one of weight, size, minimum or maximum altitude, or airspeed.

22. (New) The fleet controller according to Claim 8, wherein the requirements for use of the flight path comprise at least one of weight, size, minimum or maximum altitude, or airspeed.

23. (New) The system according to Claim 15, wherein the requirements for use of the flight path comprise at least one of weight, size, minimum or maximum altitude, or airspeed.

REMARKS

Claims 1, 3-8, 10-15, and 17-23 are pending, with claims 1, 8, and 15 being independent. Claims 2, 9, and 16 have been cancelled. Claims 1, 7, 8, 14, 15, and 20 have been amended. Claims 21-23 have been added. No new subject matter has been added.

Claim Objections

Claims 1, 8 and 15 have been objected to because of minor informalities. Applicant has amended the claims in accordance with the Examiner's suggestion. Hence, Applicant respectfully requests withdrawal of the objection.

Prior Art Rejections

Claims 1-20 have been rejected under 35 U.S.C. § 102(a)(2) as assertedly being anticipated by U.S. Patent Publication No. 2015/0234387 ("Mullan"). Applicant respectfully traverses the rejections.

Claim 1, as amended, recites "identifying a flight path associated with the mission," "verifying a usability of the flight path with a unmanned aircraft system (UAS) traffic management (UTM), wherein the UTM performs checking on the flight path for traffic in the flight path, availability of the flight path due to flight restrictions and requirements for use of the flight path," and "modifying the flight path according to data from the UTM in response to the UTM indicating that the usability of the flight path is not verified." Applicant respectfully asserts that portions of these features were taken from Claim 2 as originally filed, and are further supported by discussed at paragraphs [0041] and [0046] of the specification.

In addressing Claim 2, the Office Action asserts that Mullan teaches a compliance evaluator confirms that a mission request complies with government regulations or other policies related to UVs. Office Action, p. 5.

However, Applicant respectfully asserts that Mulan is directed to verifying the mission's compliance with government regulations and policies, but fails to teach or suggest that the

compliance evaluator checks for "traffic in the flight path, availability of the flight path due to flight restrictions and requirements for use of the flight path" or "modifying the flight path according to data from the UTM in response to the UTM indicating that the usability of the flight path is not verified." Indeed, nothing in Mullan teaches or suggests any modification of the flight path if the UTM fails to verify the flight path, or that any modification to the flight path "according to data from the UTM."

In view of the foregoing, Applicant respectfully asserts that Mullan fails to teach or render obvious each element of Claim 1. Additionally, none of the remaining cited references cure the deficiencies of Mullan. Accordingly, the cited references, taken singly, or in combination, fail to teach, suggest, or in any way render obvious the features of Claim 1. Thus, Claim 1 as a whole is patentable over the cited references. Applicant further asserts that Claims 8 and 15 recite features similar to those discussed above with respect to Claim 1 and are therefore patentable over the cited references for similar reasons.

The remaining claims depend from and add further features to one of the independent claims. It is respectfully submitted that these dependent claims are allowable by reason of depending from an allowable claim, as well as for adding new features, and that it is not necessary to separately address these dependent claims. This should not be construed as an acquiescence to Examiner's interpretation of those claims, or reading of those claim elements on the prior art, and Applicant expressly reserves the right to establish the patentability of those additional claim limitations, should the need arise.

Conclusion

Applicant has made a diligent effort to place the claims in condition for allowance. However, should there remain unresolved issues that require adverse action, it is respectfully requested that the Examiner telephone Applicant's Attorney at the number listed below so that such issues may be resolved as expeditiously as possible. The Commissioner is hereby authorized to charge any fees that are due, or credit any overpayment, to Deposit Account No. 50-1065.

Respectfully submitted,

October 4, 2021
Date

/Robert G. Graham/
Robert G. Graham
Attorney for Applicant
Reg. No. 58,042

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Electronic Acknowledgement Receipt

EFS ID:	43935412
Application Number:	16720543
International Application Number:	
Confirmation Number:	4655
Title of Invention:	Fleet Controller
First Named Inventor/Applicant Name:	Grant Mark Bristow
Customer Number:	145156
Filer:	Robert G. Graham/Jennifer Rubio
Filer Authorized By:	Robert G. Graham
Attorney Docket Number:	BEL-IN140-19.02
Receipt Date:	04-OCT-2021
Filing Date:	19-DEC-2019
Time Stamp:	10:48:00
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1		BEL-IN140-1902_Amendment.pdf	81480 2060367967ce9128fbea9ef56d4ea4f1707ba3b6	yes	11

	Multipart Description/PDF files in .zip description		
	Document Description	**Start**	**End**
	Amendment/Req. Reconsideration-After Non-Final Reject	1	1
	Claims	2	8
	Applicant Arguments/Remarks Made in an Amendment	9	11
Warnings:			
Information:			
	Total Files Size (in bytes):	81480	

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New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

PTO/SB/06 (09-11)
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PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875	Application or Docket Number 16/720,543	Filing Date 12/19/2019	☐ To be Mailed

ENTITY: ☑ LARGE ☐ SMALL ☐ MICRO

APPLICATION AS FILED - PART I

FOR	(Column 1) NUMBER FILED	(Column 2) NUMBER EXTRA		RATE ($)	FEE ($)
☐ BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A		N/A	
☐ SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A		N/A	
☐ EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A		N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	minus 20 =	*		x $100 =	
INDEPENDENT CLAIMS (37 CFR 1.16(h))	minus 3 =	*		x $460 =	
☐ APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $310 ($155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).				
☐ MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))					
* If the difference in column 1 is less than zero, enter "0" in column 2.				TOTAL	

APPLICATION AS AMENDED - PART II

		(Column 1)		(Column 2)	(Column 3)			
AMENDMENT	10/04/2021	CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA		RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	* 20	Minus	** 20	= 0		x $100 =	0
	Independent (37 CFR 1.16(h))	* 3	Minus	*** 3	= 0		x $480 =	0
	☐ Application Size Fee (37 CFR 1.16(s))							
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							
							TOTAL ADD'L FEE	0

		(Column 1)		(Column 2)	(Column 3)			
AMENDMENT		CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA		RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	*	Minus	**	=		x $0 =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=		x $0 =	
	☐ Application Size Fee (37 CFR 1.16(s))							
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							
							TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.	LIE
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".	/TERRY BRYANT/
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First Named Inventor	Grant Mark Bristow
Art Unit	3661
Examiner Name	Tyler D. Paige
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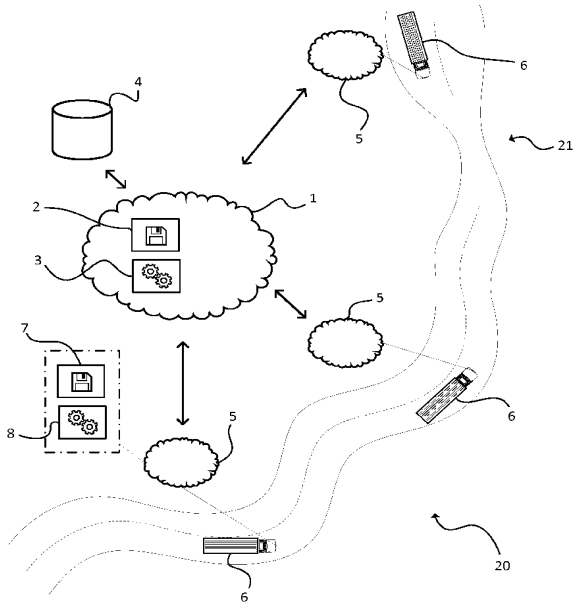


Fig. 3

(57) **Abstract:** A method for operating a plurality of vehicles is disclosed. The method comprises receiving (101) a first set of vehicle data and a second set of vehicle data, the vehicle data comprising information about each vehicle of the plurality of vehicles, each vehicle operating along at least one fixed route, receiving (102) a first set of environmental data and a second set of environmental data, the environmental data comprising information about each fixed route, and estimating (103), by means of the global self-learning model and each local-self learning model, a schedule parameter for each vehicle of the plurality of vehicles based on the received first set of vehicle data, the received first set of environmental data, the received second set of vehicle data, the received second set of environmental data, and a predefined interaction model between the global self-learning model and each local-self learning model. The method further comprises receiving (104) a measured schedule parameter for each vehicle, comparing (105) the estimated schedule parameter with the received measured schedule parameter, and updating (106) the global self-learning model and each local self-learning model based on the comparison of the estimated schedule parameter with the received measured schedule parameter.

WO 2020/160778 A1

Title

METHOD AND SYSTEM FOR OPERATING A FLEET OF VEHICLES

TECHNICAL FIELD

The present invention relates to a system and method for operating a fleet of vehicles and a corresponding non-transitory computer-readable storage medium. The fleet of vehicles may for example comprise buses, cars, trucks, construction vehicles, or the like.

BACKGROUND ART

It is common for commercial companies and government institutions to maintain a fleet of vehicles and therefore to have an interest in keeping track of the vehicles and shipments, as well as the performance and well-being of their drivers. Moreover, the vehicles are frequently equipped with apparatuses arranged to track the vehicles' geographic locations, speeds, headings, cargo temperature, engine performance parameters, and other data. This information is then used, for example, to maintain the vehicles, estimate delivery/arrival times, provide warning of possible damage to cargo, and to evaluate driver performance.

A typical segment, in which arrival time is of particular importance is public transport. One of the most, if not the most, complained of problem associated with public transportation is time wasted waiting for public transit vehicles to arrive at a passenger's particular transit stop, and uncertainty as to service and/or arrival time at transit connections or destinations. However, estimation of arrival times is an important aspect in other type of segments utilizing vehicle fleets, such as e.g. shipping and logistics, where delivery times are of critical importance for consumers.

Thus, accurate predictions or estimations of arrival time is not only an important aspect for the users/consumers of the service, but also for the system owner/operator in order to be able to efficiently plan resource, schedule routes, broadcasting of information, planning charging of Electric Vehicles (EVs), warehouse preparations, etc.

To this end, static methods are often used based on basic estimations, e.g. calculating distances and assuming speed profiles, albeit simple such methods are often not adequately accurate. Especially when vehicles or routes deviate from generalized models. As a remedy to

this, some systems use real-time data based on a current geographical position of the vehicles, assumed speed profiles of the route, temporary route obstacles, etc. However, even though such solutions display an improved accuracy as compared to the static methods, they are still based on generalized assumptions which are not applicable for all situations.

Accordingly, there is a need for a new and improved method and system for managing a fleet of vehicles whereby more accurate estimations of arrival times, fuel/energy consumptions, and such can be made.

SUMMARY OF THE INVENTION

It is therefore an object of the present invention to provide a method, a non-transitory computer-readable storage medium, and a system for operating a fleet of vehicles, which can be used to predict a schedule parameter for each vehicle, such as e.g. arrival time, more accurately than presently known systems.

The term exemplary is in the present context to be understood as serving as an instance, example or illustration.

According to a first aspect of the invention, the object is achieved by a method according to claim 1. The method comprises receiving a first set of vehicle data and a second set of vehicle data, the vehicle data comprising information about each vehicle of the plurality of vehicles, each vehicle operating along at least one fixed route, receiving a first set of environmental data and a second set of environmental data, the environmental data comprising information about each fixed route, and estimating, by means of the global self-learning model and each local-self learning model, a schedule parameter for each vehicle of the plurality of vehicles based on the received first set of vehicle data, the received first set of environmental data, the received second set of vehicle data, the received second set of environmental data, and a predefined interaction model between the global self-learning model and each local-self learning model. The method further comprises receiving a measured schedule parameter for each vehicle, comparing the estimated schedule parameter with the received measured schedule parameter, and updating the global self-learning model and each local self-learning model based on the comparison of the estimated schedule parameter with the received measured schedule parameter.

The adaption of a global self-learning model and a plurality of local self-learning models (e.g. machine learning algorithms) in vehicle fleet management systems allows for improved predictability for a variety of desirable schedule parameters (e.g. arrival time, fuel consumption, energy consumption) which will consequently facilitate future system planning. In particular, the utilization of an interaction between a common "global" self-learning model and several local self-learning models, renders the whole management system more versatile and dynamic. Moreover, this allows for a type of plug-and-play functionality, where new vehicles may be added to an operational site or route without a need for reconfiguration of the whole prediction model.

Moreover, by for example being able to more accurately predicting arrival times it is possible to more accurately manage resources at the point of arrival (e.g. warehouse) in order to improve operational efficiency. In another example scenario, improved arrival time prediction will lead to a greater customer/passenger satisfaction for public transport operators/owners. In terms of energy consumption predictions it may result in facilitated resource allocation in terms of re-charging facilities in order to avoid idle times in the vehicle fleet or being able to efficiently schedule recharging at non-peak hours of the electric grid, thereby increasing operational efficiency and reducing costs. The arrival time may be in reference to any defined destination, and may accordingly be an intermediate check point or final destination.

The first set of vehicle data and the second set of data may comprise the same information, or various subsets of available data based on the specific application and desired specifications.

Further, according to an exemplary embodiment of the present invention, the predefined interaction model comprises making a first estimation of the schedule parameter for each vehicle by means of the global self-learning model based on the received first set of vehicle data and the received first set of environmental data, and making a second estimation of the schedule parameter by means of each local self-learning model for each corresponding vehicle based on the received second set of vehicle data and the received second set of environmental data, and the first estimation of the schedule parameter for each vehicle, the second estimation being the estimated schedule parameter.

Stated differently, the local self-learning models make an initial estimation of the schedule parameter (e.g. arrival time) for the associated vehicle, whereafter this first estimation is used

as an input to the global self-learning model in order to further improve the accuracy of the estimation by accounting for “global parameters” and interactions between the vehicles on a system level.

According to a second aspect of the invention, the object is achieved by a non-transitory computer-readable storage medium according to claim 10. The non-transitory computer-readable storage medium storing one or more programs configured to be executed by one or more processors of a vehicle fleet management system, the one or more programs comprising instructions for performing the method according to any one of the embodiments disclosed herein. With this aspect of the invention, similar advantages and preferred features are present as in the previously discussed first aspect of the invention, and vice versa.

Further, according to a third aspect of the invention, the object is achieved by a system according to claim 11. The system comprises a first module comprising control circuitry configured to receive a first set of vehicle data and a second set of vehicle data, the vehicle data comprising information about each vehicle of the plurality of vehicles, each vehicle operating along at least one fixed route, and receive a first set of environmental data and a second set of environmental data, the environmental data comprising information about each fixed route. Moreover, the control circuitry is configured to estimate, by means of the global self-learning model and each local-self learning model, a schedule parameter for each vehicle of the plurality of vehicles based on the received first set of vehicle data, the received first set of environmental data, the received second set of vehicle data, the received second set of environmental data, and a predefined interaction model between the global self-learning model and each local-self learning model. Further, the system comprises a second module comprising a control unit to receive the estimated schedule parameter from the first module, receive a measured schedule parameter for each vehicle, compare each estimated schedule parameter with each corresponding received measured schedule parameter, and send a command signal in order to update the global self-learning model and each local self-learning model based on the comparison. With this aspect of the invention, similar advantages and preferred features are present as in the previously discussed first aspect of the invention, and vice versa.

Further embodiments of the invention are defined in the dependent claims. It should be emphasized that the term "comprises/comprising" when used in this specification is taken to specify the presence of stated features, integers, steps, or components. It does not preclude the presence or addition of one or more other features, integers, steps, components, or groups thereof.

These and other features and advantages of the present invention will in the following be further clarified with reference to the embodiments described hereinafter.

BRIEF DESCRIPTION OF THE DRAWINGS

With references to the appended drawings, below follows are more detailed description of example embodiments of the invention, in which:

Fig. 1 is a schematic flow-chart representation of a method for operating a fleet of vehicles according to an embodiment of the present invention.

Fig. 2 is a schematic overview illustration of a system for operating a fleet of vehicles according to an embodiment of the present invention.

Fig. 3 is a schematic block diagram representation of a system for operating a fleet of vehicles according to an embodiment of the present invention.

DETAILED DESCRIPTION

Those skilled in the art will appreciate that the steps, services and functions explained herein may be implemented using individual hardware circuitry, using software functioning in conjunction with a programmed microprocessor or general purpose computer, using one or more Application Specific Integrated Circuits (ASICs) and/or using one or more Digital Signal Processors (DSPs). It will also be appreciated that when the present disclosure is described in terms of a method, it may also be embodied in one or more processors and one or more memories coupled to the one or more processors, wherein the one or more memories store one or more programs that perform the steps, services and functions disclosed herein when executed by the one or more processors.

In the following description of exemplary embodiments, the same reference numerals denote the same or similar components.

Fig. 1 shows a flow-chart representation of a method 100 for operating a fleet of vehicles according to an exemplary embodiment of the present invention. In more detail, each vehicle vehicles comprises an associated local self-learning model and the plurality of vehicles are connected to a global self-learning model The method is particularly suitable for operating a fleet of surface vehicles such as e.g. buses, cars, trucks, construction vehicles, and any other vehicles operating along one or more fixed and recurring routes. An example is buses used in public transportation.

The method comprises receiving 101, a first set of vehicle data and a second set of vehicle data, the vehicle data comprising information about each vehicle of the plurality of vehicles, each vehicle operating along at least one fixed route. The global self-learning model, may also be referred to as a global Artificial Intelligence (global AI) or a shared AI, can for example be a machine-learning model based on e.g. reinforcement learning. The term global is to be understood as that the self-learning model is at a system level, i.e. common to or shared by a plurality of individual vehicles in the fleet. Further, each vehicle of the plurality of vehicles is provided with a local self-learning model. In other words, each vehicle of the plurality of vehicles has a corresponding “local AI”, such that an AI network or AI system is formed.

The vehicle data may for example comprise one or more of a geographical position of each vehicle, an acceleration request of each vehicle, a brake request of each vehicle, a cargo load of each vehicle, a transmission type of each vehicle, a state of charge of a traction battery of each vehicle, a state of health of the traction battery of each vehicle, and an axle load of each vehicle.

Further, the method 100 comprises receiving 102 a first set of environmental data and a second set of environmental data, the environmental data comprising information about each fixed route. In other words, the global AI and local AIs are used to also account for various environmental factors. In more detail, the environmental data one or more of weather along each fixed route, route data (traffic, congestion, speed limits, friction level, etc.) of each fixed route, a road curvature of each fixed route, an inclination profile of each fixed route, operational data (loading or unloading of cargo or passengers, number of mandatory stops, etc.) for each fixed route, infrastructural data (number of traffic lights, constructional work,

number of gates to pass, single lane traffic areas, etc.) for each fixed route, a time of day, and calendar data (day of the week, month, etc.).

Next, a schedule parameter is estimated 103 (by the AI system comprising the interacting global AI and local AIs) for each vehicle based on the received first set of vehicle data, the received first set of environmental data, the received second set of vehicle data, the received second set of environmental data, and a predefined interaction model between the global self-learning model and each local-self learning model. In other words, the self-learning models make a best guess of a selected schedule parameter (e.g. arrival time, fuel consumption, energy consumption, etc.) for each vehicle of the plurality of vehicles, based on the received information and some predefined interaction model. Naturally, in the example of the schedule parameter being an arrival time, it is assumed that the global self-learning model has access to a start time and start position of each vehicle (may be comprised in the received 101 first set of vehicle data).

Further, the method 100 comprises a step of receiving 104 a measured schedule parameter for each vehicle. In other words, an external sensor system measures the sought after schedule parameter (e.g. arrival time or energy consumption for electric vehicles), which will be forming the ground truth for the self-learning model. Then, the estimated schedule parameter and the received measured schedule parameter are compared 105 to each other. In other words, the method comprises an evaluation step 105 in which the global self-learning model is evaluated based on the accuracy of the performed estimation 103.

Still further, the method 100 comprises a step of updating 106 the global self-learning model and each local self-learning model based on the preceding comparison 105 between the estimated schedule parameter and the received measured schedule parameter (ground truth). In the exemplary embodiment, where the self-learning models are based on reinforcement learning, each model is accordingly rewarded or penalized based on the quality/accuracy of the estimation.

The predefined interaction model, i.e. the relationship between the global self-learning model and each local self-learning in the estimation 103 step may be defined in alternative ways. For example, the predefined interaction model may comprise making a first estimation of the schedule parameter for each vehicle by means of the global self-learning model based on the

received first set of vehicle data and the received first set of environmental data. Next, a second estimation of the schedule parameter by means of each local self-learning model for each corresponding vehicle is made based on the received second set of vehicle data and the received second set of environmental data, and the first estimation of the schedule parameter for each vehicle, the second estimation being the estimated schedule parameter. Stated differently, the AI system is configured to first estimate the schedule parameter for each vehicle by the global AI and use this first estimation as input for each local AI in order to make a second estimation which will be the final estimation/prediction of the schedule parameter for each vehicle.

However, alternatively the roles of the self-learning models may be reversed such that the first estimation is made locally in each vehicle and these first estimations are used as input to the global self-learning model to provide the final estimation/prediction of the schedule parameter for each vehicle.

Fig. 2 is a schematic block diagram representation of a system 10 for operating a fleet of vehicles in accordance with an embodiment of the present invention. In particular, each vehicle comprises an associated local self-learning model and the plurality of vehicles are connected to a global self-learning model. Moreover, the system 10 is particularly suitable for estimating schedule parameters associated with a mission of the fleet of vehicles, such as e.g. arrival times, fuel consumptions and so on. The system 10 has a first module 11 comprising control circuitry (not shown). The control circuitry may be provided by means of appropriate software, hardware or a combination thereof.

Moving on, the control circuitry is configured to receive a first set of vehicle data and a second set of vehicle data, the vehicle data comprising information about each vehicle of the plurality of vehicles, each vehicle operating along at least one fixed route. Further the control circuitry is configured to receive a first set of environmental data and a second set of environmental data, the environmental data comprising information about each fixed route. The vehicle data and the environmental data may for example be retrieved from a database/data storage unit 4 which includes different groups of data, amongst other vehicle/agent specific data such as e.g. load, cargo, axle load, transmission type, fuel levels, state of charge of batteries, state of health of batteries, etc. The data storage unit 4 may be a remote unit that is communicatively

connected to each vehicle, meaning that it is accessible to each local self-learning model (via e.g. an external network). An advantage of using a remote database 4 is that data from perception systems of a plurality of vehicles can be accessed and stored thereby increasing the reliability in for example the environmental data.

The control circuitry is further configured to estimate a schedule parameter 14, by means of the global self-learning model and each local-self learning model, a schedule parameter for each vehicle of the plurality of vehicles based on the received first set of vehicle data, the received first set of environmental data, the received second set of vehicle data, the received second set of environmental data, and a predefined interaction model between the global self-learning model and each local-self learning model.

The system 10 further comprises a second module 13 having a control unit (not shown) configured to receive the estimated schedule parameter 14 from the first module 11, receive a measured schedule parameter for each vehicle. The measured schedule parameter may for example be provided by one or more sensor systems 12 associated with the operational site(s). Further, the second control unit is configured to compare each estimated schedule parameter with each corresponding received measured schedule parameter, and to send a command signal to update the global self-learning model and the local self-learning model based on this comparison.

The second module 13 may further be provided with a validation feature. In more detail, the second module 13 may comprise another control unit, or the same control unit may be configured to validate the environmental data or vehicle data, and to update the database 4 based on this validation. The data validation may for example be based on input from the sensor systems (in-vehicle or infrastructure) which may measure a variety of parameters from the database. Such as for example, weather conditions, axle loads, tire pressure, etc.

The system 10 may further comprise a third module 15, which may be referred to as an integration module or extension module. The third module 15 comprises control circuitry configured to compare vehicle data of a new vehicle to be added to the fleet of vehicles with the data of each vehicle of the plurality of vehicles. The vehicle data may for example be included in the associated database 4 of the system 10. Further, the control circuitry of the third module 15 is configured to select a local self-learning model of at least one vehicle of the

plurality of vehicle based on the comparison and at least one predefined constraint, and to implement a new local self-learning model into the new vehicle based on the selection.

In more detail, the control circuitry of the third module 15 can be configured to form a local self-learning model by utilizing fuzzy logic/analysis based on the local self-learning models of the plurality of vehicles. Thereby the new vehicle will be provided with a self-learning model having a larger share of the most similar vehicle's local self-learning model and a smaller share of the less similar vehicles' local self-learning models. The fuzzy analysis may be based on a plurality of parameters of the vehicle data such as e.g. transmission system, battery type, vehicle type, tire pressure, etc.

In more detail, the implementation of an AI module 11 having a combination of a global self-learning model and a plurality of local self-learning models, each associated with a specific vehicles, allows for a very scalable and versatile fleet management system 20. For example, adding and removing vehicles is facilitated since a type of plug-and-play feature is available, so that additions and removals of vehicles from/to the fleet at the operational site has little to no effect on the system since the various "AIs" are independent. Moreover, it provides for efficient utilization of already trained local self-learning models in that a new vehicle is cross-checked against already existing vehicles in order to find a suitable combination of one or more already running local self-learning models to be implemented into the new vehicle.

Fig. 3 shows an overview illustration of a system for operating a fleet of vehicles according to an embodiment of the present invention. In particular, Fig. 3 illustrates how the local 5 and global/shared 1 parts of the self-learning model (AI) work together at an operational site 20. The global self-learning model 1 could be realized in a control tower (not shown) provided at the site 20, as a cloud-based solution accessible via an external wireless network (e.g. cellular network), or a distributed solution based on a Vehicle-to-Vehicle (V2V) communication protocol.

Each of the self-learning models 1, 5 can be realized by means of appropriate software, hardware or a combination thereof as indicated by the processors 3, 8 and associated memories 2, 7. The operational site 20 has a single lane traffic area (SLTA) 21, thus by accurately estimating or predicting arrival times for the vehicles 6, it is possible for a site

operator to schedule departures in order to avoid queues forming at the SLTA 21, and thereby avoiding unnecessary idling.

Further, each vehicle 6 is connected to external network(s) via for instance a wireless link. The same or some other wireless link may be used to communicate with other vehicles in the vicinity of the vehicle or with local infrastructure elements. Cellular communication technologies may be used for long range communication such as to external networks and if the cellular communication technology used have low latency it may also be used for communication between vehicles, V2V, and/or vehicle to infrastructure, V2X. Examples of cellular radio technologies are GSM, GPRS, EDGE, LTE, 5G NR, and so on, also including future cellular solutions. However, in some solutions mid to short range communication technologies are used such as Wireless Local Area (LAN), e.g. IEEE 802.11 based solutions. ETSI is working on cellular standards for vehicle communication and for instance 5G is considered as a suitable solution due to the low latency and efficient handling of high bandwidths and communication channels.

The present disclosure has been presented above with reference to specific embodiments. However, other embodiments than the above described are possible and within the scope of the disclosure. Different method steps than those described above, performing the method by hardware or software, may be provided within the scope of the disclosure. Thus, according to an exemplary embodiment, there is provided a non-transitory computer-readable storage medium storing one or more programs configured to be executed by one or more processors of system for emulating remote control of a physical robot via a wireless network, the one or more programs comprising instructions for performing the method according to any one of the above-discussed embodiments. Alternatively, according to another exemplary embodiment a cloud computing system can be configured to perform any of the method aspects presented herein. The cloud computing system may comprise distributed cloud computing resources that jointly perform the method aspects presented herein under control of one or more computer program products.

The control unit(s) and control circuitry (associated with the fleet management system 10) may be or include any number of hardware components for conducting data or signal processing or for executing computer code stored in memory. The system may have an

associated memory, and the memory may be one or more devices for storing data and/or computer code for completing or facilitating the various methods described in the present description. The memory may include volatile memory or non-volatile memory. The memory may include database components, object code components, script components, or any other type of information structure for supporting the various activities of the present description. According to an exemplary embodiment, any distributed or local memory device may be utilized with the systems and methods of this description. According to an exemplary embodiment the memory is communicably connected to the processor (e.g., via a circuit or any other wired, wireless, or network connection) and includes computer code for executing one or more processes described herein.

The different features and steps of the embodiments may be combined in other combinations than those described.

CLAIMS

1. A method for operating a plurality of vehicles, each vehicle comprising an associated local self-learning model and wherein the plurality of vehicles are connected to a global self-learning model, said method comprising:

receiving (101) a first set of vehicle data and a second set of vehicle data, the vehicle data comprising information about each vehicle of the plurality of vehicles, each vehicle operating along at least one fixed route;

receiving (102) a first set of environmental data and a second set of environmental data, the environmental data comprising information about each fixed route;

estimating (103), by means of the global self-learning model and each local-self learning model, a schedule parameter for each vehicle of the plurality of vehicles based on the received first set of vehicle data, the received first set of environmental data, the received second set of vehicle data, the received second set of environmental data, and a predefined interaction model between the global self-learning model and each local-self learning model;

receiving (104) a measured schedule parameter for each vehicle;

comparing (105) the estimated schedule parameter with the received measured schedule parameter; and

updating (106) the global self-learning model and each local self-learning model based on the comparison of the estimated schedule parameter with the received measured schedule parameter.

2. The method according to claim 1, wherein the predefined interaction model comprises:

making a first estimation of the schedule parameter for each vehicle by means of the global self-learning model based on the received first set of vehicle data and the received first set of environmental data;

making a second estimation of the schedule parameter by means of each local self-learning model for each corresponding vehicle based on the received second set of vehicle data and the received second set of environmental data, and the first estimation of the schedule parameter for each vehicle, the second estimation being the estimated schedule parameter.

3. The method according to claim 1, wherein the predefined interaction model comprises:

making a first estimation of the schedule parameter for each vehicle by means of the associated local self-learning model based on the received second set of vehicle data and the received second set of environmental data;

making a second estimation of the schedule parameter by means of means of the global self-learning model based on the received first set of vehicle data and the received first set of environmental data, and the first estimation of the schedule parameter for each vehicle, the second estimation being the estimated schedule parameter.

4. The method according to any one of the preceding claims, further comprising:

comparing vehicle data of the new vehicle with the vehicle data of each vehicle of the plurality of vehicles;

selecting a local-self learning model of one of the vehicles of the plurality of based on the comparison and at least one predefined constraint; and

implementing the selected local self-learning model into a new vehicle to be added to the plurality of vehicles.

5. The method according to any one of the preceding claims, wherein the vehicle data comprises at least one of a geographical position of each vehicle, an acceleration request of each vehicle, a brake request of each vehicle, a cargo load of each vehicle, a transmission type of each vehicle, a state of charge of a traction battery of each vehicle, a state of health of the traction battery of each vehicle, and an axle load of each vehicle.

6. The method according to any one of the preceding claims, wherein the environmental data comprises at least one of weather along each fixed route, route data of each fixed route, a road curvature of each fixed route, an inclination profile of each fixed route, operational data for each fixed route, infrastructural data for each fixed route, a time of day, and calendar data.

7. The method according to any one of the preceding claims, wherein the schedule parameter is an arrival time to a destination, a fuel consumption, or a power consumption.

8. The method according to any one of the preceding claims, wherein the vehicle data and/or the environmental data is retrieved from each vehicle of the plurality of vehicles.

9. The method according to any one of the preceding claims, wherein the vehicle data and/or the environmental data is retrieved from a data storage unit connected to the plurality of vehicles.

10. A non-transitory computer-readable storage medium storing one or more programs configured to be executed by one or more processors of a vehicle fleet management system, the one or more programs comprising instructions for performing the method according to any one of claims 1 – 9.

11. A system for operating a plurality of vehicles, each vehicle comprising an associated local self-learning model and wherein the plurality of vehicles are connected to a global self-learning model, the system comprising:

a first module comprising control circuitry configured to:

receive a first set of vehicle data and a second set of vehicle data, the vehicle data comprising information about each vehicle of the plurality of vehicles, each vehicle operating along at least one fixed route;

receive a first set of environmental data and a second set of environmental data, the environmental data comprising information about each fixed route;

estimate, by means of the global self-learning model and each local-self learning model, a schedule parameter for each vehicle of the plurality of vehicles based on the received first set of vehicle data, the received first set of environmental data, the received second set of vehicle data, the received second set of environmental data, and a predefined interaction model between the global self-learning model and each local-self learning model;

a second module comprising a control unit to:

receive the estimated schedule parameter from the first module;

receive a measured schedule parameter for each vehicle;

compare each estimated schedule parameter with each corresponding received measured schedule parameter;

send a command signal in order to update the global self-learning model and each local self-learning model based on the comparison.

12. The system according to claim 11, wherein the predefined interaction model comprises:

making a first estimation of the schedule parameter for each vehicle by means of the global self-learning model based on the received first set of vehicle data and the received first set of environmental data;

making a second estimation of the schedule parameter by means of each local self-learning model for each corresponding vehicle based on the received second set of vehicle data and the received second set of environmental data, and the first estimation of the schedule parameter for each vehicle, the second estimation being the estimated schedule parameter.

13. The system according to claim 11, wherein the predefined interaction model comprises:

making a first estimation of the schedule parameter for each vehicle by means of the associated local self-learning model based on the received second set of vehicle data and the received second set of environmental data;

making a second estimation of the schedule parameter by means of means of the global self-learning model based on the received first set of vehicle data and the received first set of environmental data, and the first estimation of the schedule parameter for each vehicle, the second estimation being the estimated schedule parameter.

14. The system according to claim 12 or 13, further comprising a third module comprising a control circuitry configured to:

compare vehicle data of a new vehicle to be added to the fleet of vehicles with the vehicle data of each vehicle of the plurality of vehicles;

selecting a local self-learning model of at least one vehicle of the plurality of vehicles based on the comparison and at least one predefined constraint; and

implement a local self-learning model into the new vehicle based on the selection.

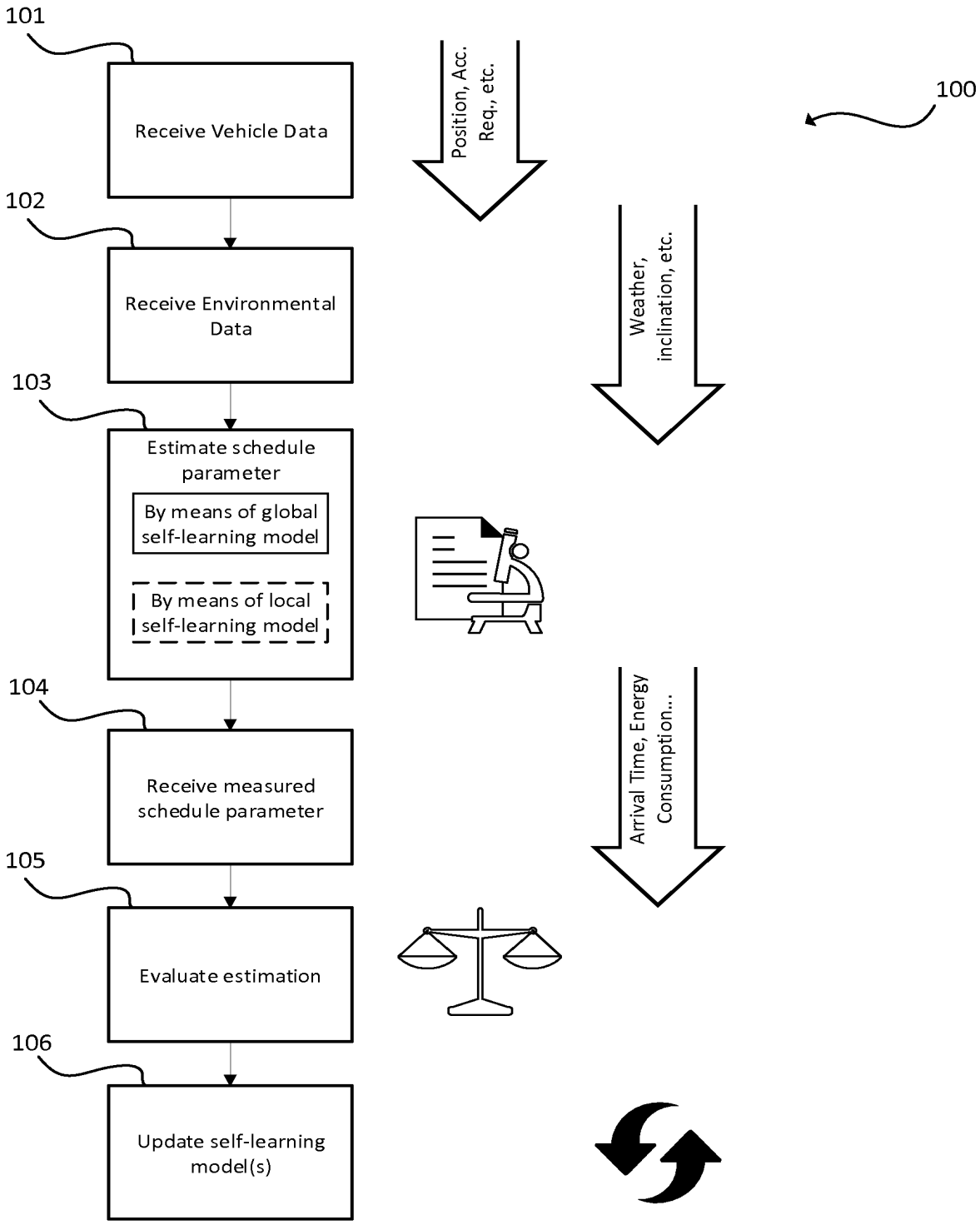

101
Receive Vehicle Data
102
Receive Environmental Data
103
Estimate schedule parameter
By means of global self-learning model
By means of local self-learning model
104
Receive measured schedule parameter
105
Evaluate estimation
106
Update self-learning model(s)
Position, Acc. Req., etc.
Weather, inclination, etc.
Arrival Time, Energy Consumption...
100

Fig. 1

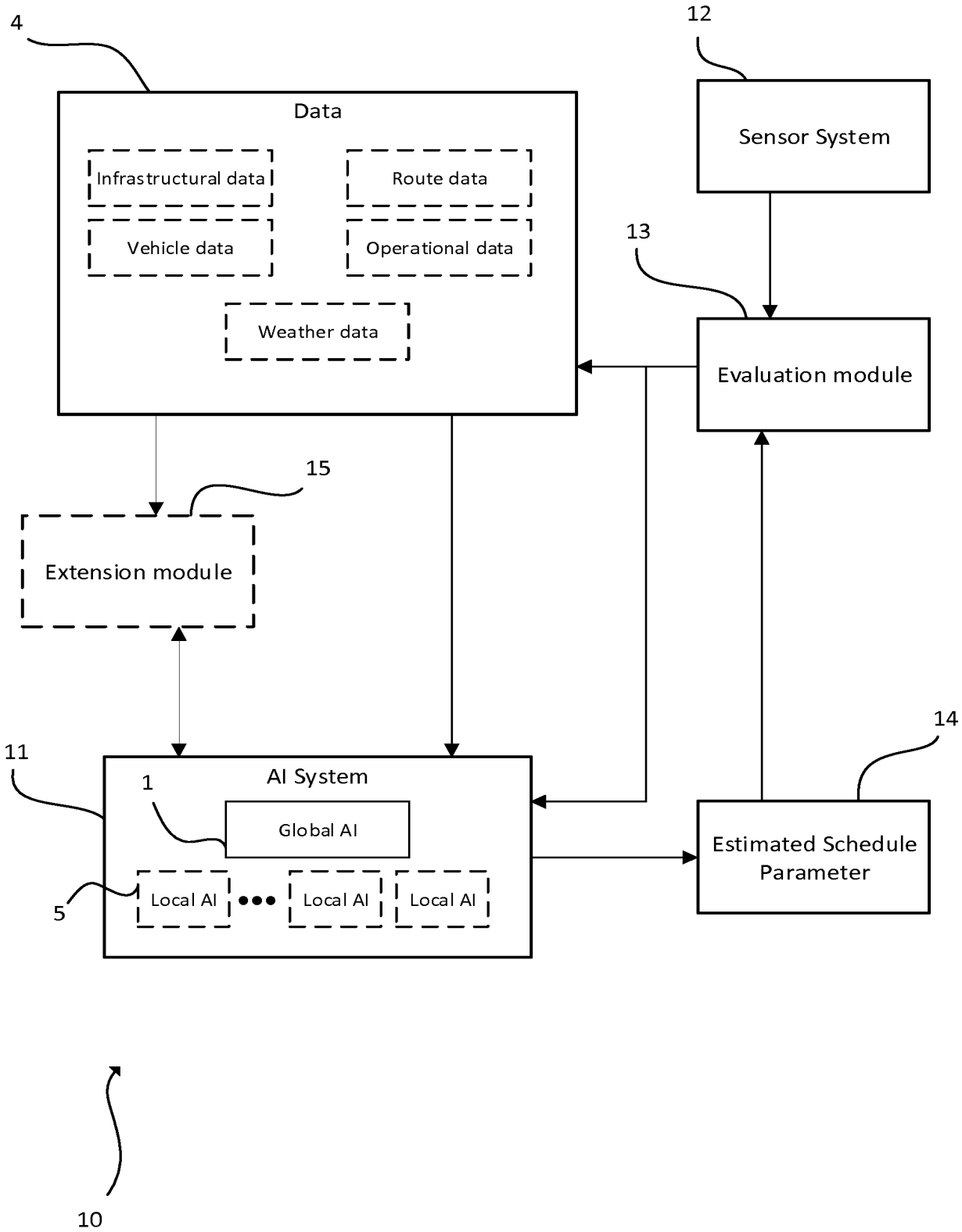

4
Data
Infrastructural data
Route data
Vehicle data
Operational data
Weather data
12
Sensor System
13
Evaluation module
15
Extension module
11
AI System
1
Global AI
5
Local AI
Local AI
Local AI
14
Estimated Schedule Parameter
10

Fig. 2

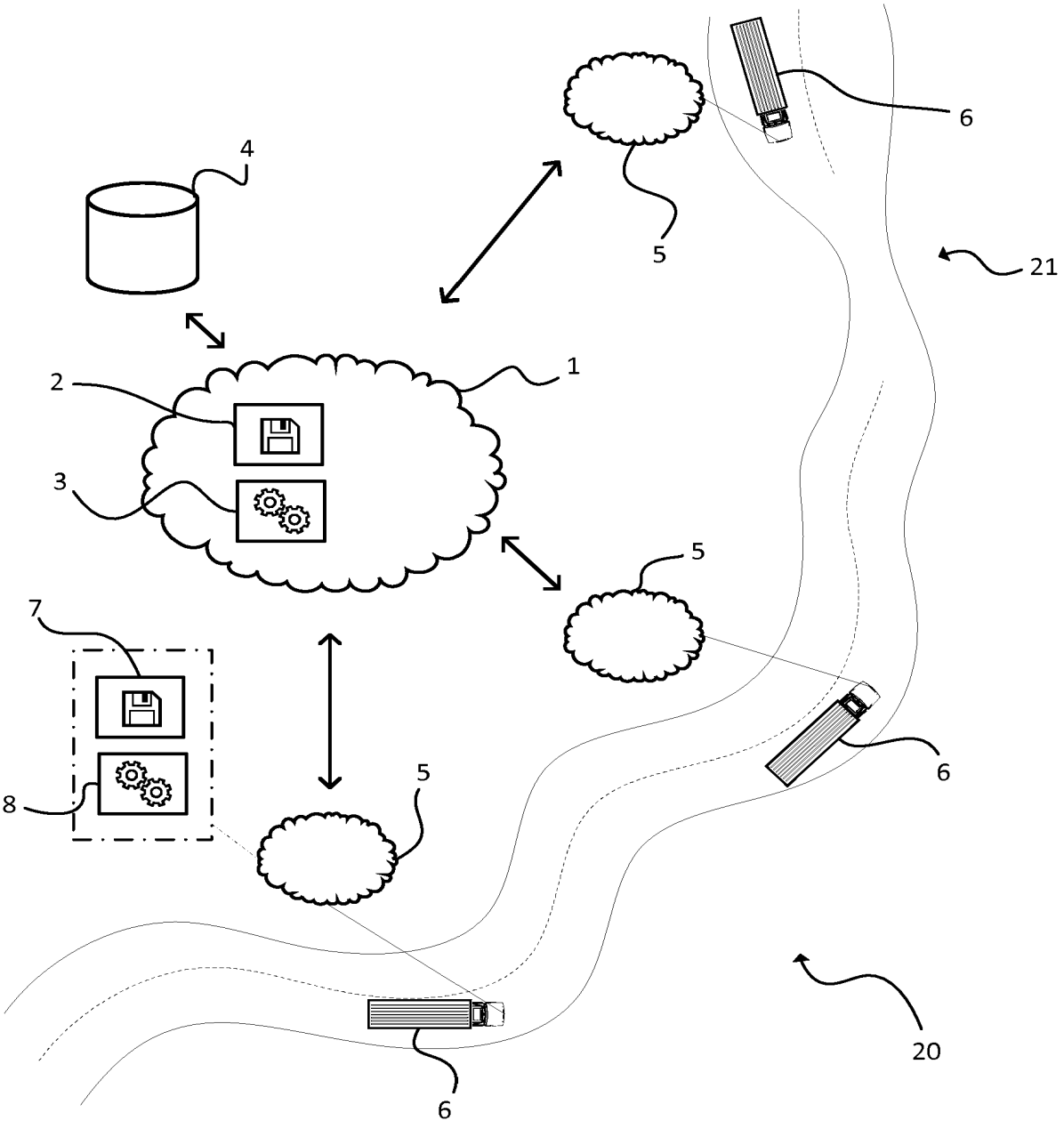


Fig. 3

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2019/053050

A. CLASSIFICATION OF SUBJECT MATTER
INV. G06Q10/04 G06Q10/06 G06Q50/28 G06Q50/30 G08G1/00 G08G1/123
ADD.
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
G06Q G08G

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2018/247207 A1 (RISTOVSKI KOSTA [US] ET AL) 30 August 2018 (2018-08-30) abstract paragraphs [0001], [0005] - [0009], [0021] - [0026], [0029], [0032] - [0034], [0036], [0040] - [0044], [0046] - [0049], [0051], [0053] - [0055], [0058] - [0064] figure 1	1-14
X	US 2018/170349 A1 (JOBSON EDWARD [SE] ET AL) 21 June 2018 (2018-06-21) abstract paragraphs [0001] - [0004], [0013] - [0031], [0037] - [0044], [0057] - [0059], [0061] - [0073], [0077] - [0093]	1-14

-/--

[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
9 October 2019	18/10/2019

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Thareau-Berthet, N

2

Form PCT/ISA/210 (second sheet) (April 2005)

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2018/357736 A1 (SUN SHUJUAN [CN] ET AL) 13 December 2018 (2018-12-13) abstract paragraphs [0002] - [0018], [0041] - [0042], [0054], [0065] - [0095], [0097], [0103] - [0121] -----	1-14
A	US 2018/349785 A1 (ZHENG HAO [US] ET AL) 6 December 2018 (2018-12-06) the whole document -----	1-14

2

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2018247207 A1	30-08-2018	AU 2018200496 A1	09-08-2018
		CA 2992053 A1	24-08-2018
		JP 2018142308 A	13-09-2018
		US 2018247207 A1	30-08-2018
US 2018170349 A1	21-06-2018	EP 3307596 A1	18-04-2018
		JP 2018524715 A	30-08-2018
		US 2018170349 A1	21-06-2018
		WO 2016202360 A1	22-12-2016
US 2018357736 A1	13-12-2018	TW 201903659 A	16-01-2019
		US 2018357736 A1	13-12-2018
		WO 2018227325 A1	20-12-2018
US 2018349785 A1	06-12-2018	US 2018349782 A1	06-12-2018
		US 2018349784 A1	06-12-2018
		US 2018349785 A1	06-12-2018
		WO 2018224873 A1	13-12-2018
		WO 2018224879 A1	13-12-2018
		WO 2018224880 A1	13-12-2018

Electronic Acknowledgement Receipt

EFS ID:	44151993
Application Number:	16720543
International Application Number:	
Confirmation Number:	4655
Title of Invention:	Fleet Controller
First Named Inventor/Applicant Name:	Grant Mark Bristow
Customer Number:	145156
Filer:	Robert G. Graham/Jennifer Rubio
Filer Authorized By:	Robert G. Graham
Attorney Docket Number:	BEL-IN140-19.02
Receipt Date:	28-OCT-2021
Filing Date:	19-DEC-2019
Time Stamp:	17:27:46
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Information Disclosure Statement (IDS) Form (SB08)	BEL-IN1401902_IDS3.PDF	1088985 8dbf7528366b86f44d1370b407536e8bac182c59	no	5

Warnings:

Information:					
2	Foreign Reference	WO2020160778A1.PDF	906197 55b48d1f76429e5f5269f783236c56e143242304	no	24
Warnings:					
Information:					
			Total Files Size (in bytes):	1995182	

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Electronic Patent Application Fee Transmittal

Application Number:	16720543
Filing Date:	19-Dec-2019
Title of Invention:	Fleet Controller
First Named Inventor/Applicant Name:	Grant Mark Bristow
Filer:	Robert G. Graham/Jennifer Rubio
Attorney Docket Number:	BEL-IN140-19.02

Filed as Large Entity

Filing Fees for Utility under 35 USC 111(a)

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Miscellaneous:				
SUBMISSION- INFORMATION DISCLOSURE STMT	1806	1	260	260
		Total in USD ($)		**260**

Electronic Acknowledgement Receipt

EFS ID:	44152035
Application Number:	16720543
International Application Number:	
Confirmation Number:	4655
Title of Invention:	Fleet Controller
First Named Inventor/Applicant Name:	Grant Mark Bristow
Customer Number:	145156
Filer:	Robert G. Graham/Jennifer Rubio
Filer Authorized By:	Robert G. Graham
Attorney Docket Number:	BEL-IN140-19.02
Receipt Date:	28-OCT-2021
Filing Date:	19-DEC-2019
Time Stamp:	17:31:01
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	DA
Payment was successfully received in RAM	$260
RAM confirmation Number	E20210RH31260371
Deposit Account	501065
Authorized User	Jennifer Rubio

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37 CFR 1.17 (Patent application and reexamination processing fees)

37 CFR 1.19 (Document supply fees)

37 CFR 1.20 (Post Issuance fees)

37 CFR 1.21 (Miscellaneous fees and charges)

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Fee Worksheet (SB06)	fee-info.pdf	38288 d5af63ac9201bb84ebbe8bec70d136c8d02f266e	no	2

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EXAMINER	
PAIGE, TYLER D	
ART UNIT	PAPER NUMBER
3666	

DATE MAILED: 11/23/2021

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
16/720,543	12/19/2019	Grant Mark Bristow	BEL-IN140-19.02	4655

TITLE OF INVENTION: Fleet Controller

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	UNDISCOUNTED	$1200	$0.00	$0.00	$1200	02/23/2022

THE APPLICATION IDENTIFIED ABOVE HAS BEEN EXAMINED AND IS ALLOWED FOR ISSUANCE AS A PATENT. PROSECUTION ON THE MERITS IS CLOSED. THIS NOTICE OF ALLOWANCE IS NOT A GRANT OF PATENT RIGHTS. THIS APPLICATION IS SUBJECT TO WITHDRAWAL FROM ISSUE AT THE INITIATIVE OF THE OFFICE OR UPON PETITION BY THE APPLICANT. SEE 37 CFR 1.313 AND MPEP 1308.

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PTOL-85 (Rev. 02/11)

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INSTRUCTIONS: This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 5 should be completed where appropriate. All further correspondence including the Patent, advance orders and notification of maintenance fees will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications.

CURRENT CORRESPONDENCE ADDRESS (Note: Use Block 1 for any change of address)

145156 7590 11/23/2021

SLATER MATSIL, LLP/Bell
17950 PRESTON RD, SUITE 1000
DALLAS, TX 75252-5793

Note: A certificate of mailing can only be used for domestic mailings of the Fee(s) Transmittal. This certificate cannot be used for any other accompanying papers. Each additional paper, such as an assignment or formal drawing, must have its own certificate of mailing or transmission.

Certificate of Mailing or Transmission

I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being transmitted to the USPTO via EFS-Web or by facsimile to (571) 273-2885, on the date below.

(Typed or printed name)
(Signature)
(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
16/720,543	12/19/2019	Grant Mark Bristow	BEL-IN140-19.02	4655

TITLE OF INVENTION: Fleet Controller

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	UNDISCOUNTED	$1200	$0.00	$0.00	$1200	02/23/2022

EXAMINER	ART UNIT	CLASS-SUBCLASS
PAIGE, TYLER D	3666	701-003000

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).

❑ Change of correspondence address (or Change of Correspondence Address form PTO/SB/122) attached.

❑ "Fee Address" indication (or "Fee Address" Indication form PTO/SB/47; Rev 03-09 or more recent) attached. **Use of a Customer Number is required.**

2. For printing on the patent front page, list

(1) The names of up to 3 registered patent attorneys or agents OR, alternatively,

(2) The name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.

1 _____

2 _____

3 _____

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document must have been previously recorded, or filed for recordation, as set forth in 37 CFR 3.11 and 37 CFR 3.81(a). Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE

(B) RESIDENCE: (CITY and STATE OR COUNTRY)

Please check the appropriate assignee category or categories (will not be printed on the patent) : ❑ Individual ❑ Corporation or other private group entity ❑ Government

4a. Fees submitted: ❑ Issue Fee ❑ Publication Fee (if required) ❑ Advance Order - # of Copies _____

4b. Method of Payment: *(Please first reapply any previously paid fee shown above)*

❑ Electronic Payment via EFS-Web ❑ Enclosed check ❑ Non-electronic payment by credit card (Attach form PTO-2038)

❑ The Director is hereby authorized to charge the required fee(s), any deficiency, or credit any overpayment to Deposit Account No. _____

5. **Change in Entity Status** (from status indicated above)

❑ Applicant certifying micro entity status. See 37 CFR 1.29

❑ Applicant asserting small entity status. See 37 CFR 1.27

❑ Applicant changing to regular undiscounted fee status.

NOTE: Absent a valid certification of Micro Entity Status (see forms PTO/SB/15A and 15B), issue fee payment in the micro entity amount will not be accepted at the risk of application abandonment.
NOTE: If the application was previously under micro entity status, checking this box will be taken to be a notification of loss of entitlement to micro entity status.
NOTE: Checking this box will be taken to be a notification of loss of entitlement to small or micro entity status, as applicable.

NOTE: This form must be signed in accordance with 37 CFR 1.31 and 1.33. See 37 CFR 1.4 for signature requirements and certifications.

Authorized Signature _____ Date _____

Typed or printed name _____ Registration No. _____

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
16/720,543	12/19/2019	Grant Mark Bristow	BEL-IN140-19.02	4655

145156 7590 11/23/2021

SLATER MATSIL, LLP/Bell
17950 PRESTON RD, SUITE 1000
DALLAS, TX 75252-5793

EXAMINER	
PAIGE, TYLER D	
ART UNIT	PAPER NUMBER
3666	

DATE MAILED: 11/23/2021

Determination of Patent Term Adjustment under 35 U.S.C. 154 (b)
(Applications filed on or after May 29, 2000)

The Office has discontinued providing a Patent Term Adjustment (PTA) calculation with the Notice of Allowance.

Section 1(h)(2) of the AIA Technical Corrections Act amended 35 U.S.C. 154(b)(3)(B)(i) to eliminate the requirement that the Office provide a patent term adjustment determination with the notice of allowance. See Revisions to Patent Term Adjustment, 78 Fed. Reg. 19416, 19417 (Apr. 1, 2013). Therefore, the Office is no longer providing an initial patent term adjustment determination with the notice of allowance. The Office will continue to provide a patent term adjustment determination with the Issue Notification Letter that is mailed to applicant approximately three weeks prior to the issue date of the patent, and will include the patent term adjustment on the patent. Any request for reconsideration of the patent term adjustment determination (or reinstatement of patent term adjustment) should follow the process outlined in 37 CFR 1.705.

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Customer Service Center of the Office of Patent Publication at 1-(888)-786-0101 or (571)-272-4200.

OMB Clearance and PRA Burden Statement for PTOL-85 Part B

The Paperwork Reduction Act (PRA) of 1995 requires Federal agencies to obtain Office of Management and Budget approval before requesting most types of information from the public. When OMB approves an agency request to collect information from the public, OMB (i) provides a valid OMB Control Number and expiration date for the agency to display on the instrument that will be used to collect the information and (ii) requires the agency to inform the public about the OMB Control Number's legal significance in accordance with 5 CFR 1320.5(b).

The information collected by PTOL-85 Part B is required by 37 CFR 1.311. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 30 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, Virginia 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, Virginia 22313-1450. Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether disclosure of these records is required by the Freedom of Information Act.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspection or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

Notice of Allowability	Application No. 16/720,543	Applicant(s) Bristow et al.	
	Examiner TYLER D PAIGE	Art Unit 3666	AIA (FITF) Status Yes

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☑ This communication is responsive to 10/04/2021.
   ☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

2. ☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.

3. ☑ The allowed claim(s) is/are See Continuation Sheet . As a result of the allowed claim(s), you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see **http://www.uspto.gov/patents/init_events/pph/index.jsp** or send an inquiry to **PPHfeedback@uspto.gov.**

4. ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

   Certified copies:

   a) ☐ All b) ☐ Some* c) ☐ None of the:

   1. ☐ Certified copies of the priority documents have been received.
   2. ☐ Certified copies of the priority documents have been received in Application No. _____ .
   3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

   * Certified copies not received: _____ .

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.
THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.

5. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
   ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date _____ .

   Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).

6. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Attachment(s)

1. ☐ Notice of References Cited (PTO-892)
2. ☑ Information Disclosure Statements (PTO/SB/08), Paper No./Mail Date 10/28/2021.
3. ☐ Examiner's Comment Regarding Requirement for Deposit of Biological Material _____.
4. ☐ Interview Summary (PTO-413), Paper No./Mail Date. _____.
5. ☐ Examiner's Amendment/Comment
6. ☑ Examiner's Statement of Reasons for Allowance
7. ☐ Other _____.

/TYLER D PAIGE/
Examiner, Art Unit 3666

Continuation of 3. The allowed claim(s) is/are: 1,3-8,10-15 and 17-23

DETAILED ACTION

Notice of Pre-AIA or AIA Status

The present application, filed on or after March 16, 2013, is being examined under the first inventor to file provisions of the AIA.

Allowable Subject Matter

1. Claims 1, 3 – 8, 10 – 15, 17 – 23 are allowed. Claims 2, 9, and 16 are canceled.

2. The following is an Examiner's Statement for reasons for allowance. None of the references of record either alone or in combination teaches or suggest the following limitations as claimed in claim 1, An autonomous vehicle fleet control method, comprising: obtaining, by a fleet controller, from a master schedule, a mission for a vehicle of a fleet of autonomous vehicles, wherein the mission is associated with a mission entry of the master schedule; identifying a flight path associated with the mission; verifying a usability of the flight path with a unmanned aircraft system (UAS) traffic management (UTM), wherein the UTM performs checking on the flight path for traffic in the flight path, availability of the flight path due to flight restrictions and requirements for use of the flight path; modifying the flight path according to data from the UTM in response to the UTM indicating that the usability of the flight path is not verified; generating vehicle commands according to mission parameters associated with the mission based on the flight path; maintaining a persistent connection with the vehicle; sending the vehicle commands to the vehicle using the connection, the vehicle commands causing the vehicle to execute the mission under control of the fleet controller; and monitoring operation of the vehicle during performance of the mission. This limitation, in combination with the other elements of the claim, is not shown or suggested in the prior art of record.

3. None of the references of record either alone or in combination teaches or suggest the following limitations as claimed in claim 8, A fleet controller for controlling an autonomous vehicle fleet, comprising: a processor; and a non-transitory computer-readable storage medium storing a program to be executed by the processor, the program including instructions for: obtaining, from a master schedule, a mission for a vehicle of a fleet of autonomous vehicles, wherein the mission is associated with a mission entry of the master schedule; identifying a flight path associated with the mission; verifying a usability of the flight path with a unmanned aircraft system (UAS) traffic management (UTM), wherein the UTM performs checking on the flight path for traffic in the flight path, availability of the flight path due to flight restrictions and requirements for use of the flight path; modifying the flight path according to data from the UTM in response to the UTM indicating that the usability of the flight path is not verified; generating vehicle commands according to mission parameters associated with the mission based on the flight path; maintaining a persistent connection with the vehicle through a communications network; sending the vehicle commands to the vehicle using the connection, the vehicle commands causing the vehicle to execute the mission under control of the fleet controller; and monitoring operation of the vehicle during performance of the mission. This limitation, in combination with the other elements of the claim, is not shown or suggested in the prior art of record.

4. None of the references of record either alone or in combination teaches or suggest the following limitations as claimed in claim 15, An autonomous vehicle fleet control system, comprising: a vehicle; a communications network; and a fleet controller in communication with the vehicle by way of the communications network, the fleet controller configured to: obtain, from a master schedule, a mission for a vehicle of a fleet of autonomous vehicles, wherein the

mission is associated with a mission entry of the master schedule; identify a flight path associated with the mission; verify a usability of the flight path with a unmanned aircraft system (UAS) traffic management (UTM), wherein the UTM performs checking on the flight path for traffic in the flight path, availability of the flight path due to flight restrictions and requirements for use of the flight path; modify the flight path according to data from the UTM in response to the UTM indicating that the usability of the flight path is not verified; generate vehicle commands according to mission parameters associated with the mission based on the flight path; maintain a persistent connection with the vehicle through the communications network; send the vehicle commands to the vehicle using the connection, wherein the vehicle is configured to receive the vehicle command and execute the mission according to the vehicle commands; and monitor operation of the vehicle during performance of the mission. This limitation, in combination with the other elements of the claim, is not shown or suggested in the prior art of record.

5. Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submission should be clearly labeled, "Comments on Statement of Reasons for Allowance."

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to TYLER D PAIGE whose telephone number is (571)270-5425. The examiner can normally be reached M-F 7:00am - 6:00pm (mst).

Examiner interviews are available via telephone, in-person, and video conferencing using a USPTO supplied web-based collaboration tool. To schedule an interview, applicant is encouraged to use the USPTO Automated Interview Request (AIR) at http://www.uspto.gov/interviewpractice.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Thomas Black can be reached on 571-272-6956. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of published or unpublished applications may be obtained from Patent Center. Unpublished application information in Patent Center is available to registered users. To file and manage patent submissions in Patent Center, visit: https://patentcenter.uspto.gov. Visit https://www.uspto.gov/patents/apply/patent-center for more information about Patent Center and https://www.uspto.gov/patents/docx for information about filing in DOCX format. For additional questions, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/TYLER D PAIGE/
Examiner, Art Unit 3666

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	16/720,543	Bristow et al.
	Examiner	**Art Unit**
	TYLER D PAIGE	3666

CPC						
Symbol					**Type**	**Version**
G08G	/	5	/	0069	F	2013-01-01
G05D	/	1	/	101	I	2013-01-01
G07C	/	5	/	02	I	2013-01-01
G08G	/	5	/	0013	I	2013-01-01
H04W	/	24	/	08	A	2013-01-01

CPC Combination Sets							
Symbol					**Type**	**Set**	**Ranking**	**Version**
	/		/					

NONE		Total Claims Allowed:	
(Assistant Examiner)	(Date)	20	
/TYLER D PAIGE/ Examiner, Art Unit 3666	07 November 2021	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	1

U.S. Patent and Trademark Office — Part of Paper No.: 20211107

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	16/720,543	Bristow et al.
	Examiner	**Art Unit**
	TYLER D PAIGE	3666

INTERNATIONAL CLASSIFICATION				
CLAIMED				
G08G	/	5	/	00
G05D	/	1	/	10
G07C	/	5	/	02
H04W	/	24	/	08

NON-CLAIMED				
	/		/	

US ORIGINAL CLASSIFICATION	
CLASS	**SUBCLASS**
701	3

CROSS REFERENCES(S)						
CLASS	**SUBCLASS (ONE SUBCLASS PER BLOCK)**					

NONE (Assistant Examiner)	(Date)	**Total Claims Allowed:** 20	
/TYLER D PAIGE/ Examiner, Art Unit 3666 (Primary Examiner)	07 November 2021 (Date)	O.G. Print Claim(s) 1	O.G. Print Figure 1

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	16/720,543	Bristow et al.
	Examiner	**Art Unit**
	TYLER D PAIGE	3666

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

CLAIMS

Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original
1	1	9	10	18	19										
-	2	10	11	19	20										
2	3	11	12	7	21										
3	4	12	13	14	22										
4	5	13	14	20	23										
5	6	-	15												
6	7	15	16												
8	8	16	17												
-	9	17	18												

NONE		**Total Claims Allowed:**	
(Assistant Examiner)	(Date)	20	
/TYLER D PAIGE/ Examiner, Art Unit 3666	07 November 2021	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	1

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	16/720,543	Bristow et al.
	Examiner	Art Unit
	TYLER D PAIGE	3666

CPC - Searched*		
Symbol	Date	Examiner

CPC Combination Sets - Searched*		
Symbol	Date	Examiner
G08G5/0069 or G05D1/101 or G07C5/02 or G08G5/0013 or H04W24/08 or G08G5/006 or G08G5/0091 or G08G5/0056 or G08G5/0034 or G08G5/0043 or G08G5/0026 or G05D1/104	08/13/2021	tdp

US Classification - Searched*			
Class	Subclass	Date	Examiner
701	3	08/13/2021	tdp

* See search history printout included with this form or the SEARCH NOTES box below to determine the scope of the search.

Search Notes		
Search Notes	Date	Examiner
Inventor Search	08/13/2021	tdp
NPL Search	08/13/2021	tdp
East Search	08/13/2021	tdp

Interference Search			
US Class/CPC Symbol	US Subclass/CPC Group	Date	Examiner
701	3	11/07/2021	tdp

/TYLER D PAIGE/ Examiner, Art Unit 3661	

Index of Claims	Application/Control No.	Applicant(s)/Patent Under Reexamination
	16/720,543	Bristow et al.
	Examiner	Art Unit
	TYLER D PAIGE	3666

✓	Rejected	-	Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

CLAIMS

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

CLAIM		DATE								
Final	Original	08/13/2021	11/07/2021							
1	1	✓	=							
-	2	✓	-							
2	3	✓	=							
3	4	✓	=							
4	5	✓	=							
5	6	✓	=							
6	7	✓	=							
8	8	✓	=							
-	9	✓	-							
9	10	✓	=							
10	11	✓	=							
11	12	✓	=							
12	13	✓	=							
13	14	✓	=							
15	15	✓	=							
-	16	✓	-							
16	17	✓	=							
17	18	✓	=							
18	19	✓	=							
19	20	✓	=							
7	21		=							
14	22		=							
20	23		=							

Bibliographic Data

Application No: 16/720,543

Foreign Priority claimed: ○ Yes ◉ No

35 USC 119 (a-d) conditions met: ☐ Yes ☑ No ☐ Met After Allowance

Verified and Acknowledged: /TYLER D PAIGE/ Examiner's Signature | Initials

Title: Fleet Controller

FILING or 371(c) DATE	CLASS	GROUP ART UNIT	ATTORNEY DOCKET NO.
12/19/2019	701	3666	BEL-IN140-19.02
RULE			

APPLICANTS

Textron Innovations Inc, Providence, RI, UNITED STATES

INVENTORS

Grant Mark Bristow, Benbrook, TX, UNITED STATES

Matthew David Holvey, North Richland Hills, TX, UNITED STATES

Naveed Ahmed Siddiqui, Dallas, TX, UNITED STATES

CONTINUING DATA

FOREIGN APPLICATIONS

IF REQUIRED, FOREIGN LICENSE GRANTED**

01/28/2020

STATE OR COUNTRY

UNITED STATES

ADDRESS

SLATER MATSIL, LLP/Bell
17950 PRESTON RD, SUITE 1000
DALLAS, TX 75252-5793
UNITED STATES

FILING FEE RECEIVED

$1,720

Doc code: IDS
Doc description: Information Disclosure Statement (IDS) Filed

PTO/SB/08a (02-18)
Approved for use through 11/30/2020. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT
(Not for submission under 37 CFR 1.99)

Application Number	16720543
Filing Date	2019-12-19
First Named Inventor	Grant Mark Bristow
Art Unit	3661
Examiner Name	Tyler D. Paige
Attorney Docket Number	BEL-IN140-19.02

U.S.PATENTS Remove

Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	10217066		2019-02-26	Margherio et al.	
	2	10956855		2021-03-23	Coughran et al.	
	3	8340948		2012-12-25	Song et al.	

If you wish to add additional U.S. Patent citation information please click the Add button. Add

U.S.PATENT APPLICATION PUBLICATIONS Remove

Examiner Initial*	Cite No	Publication Number	Kind Code[1]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	20160147404		2016-05-26	Keune	
	2	20160364989		2016-12-15	Speasl et al.	
	3	20170166328		2017-06-15	Ethington et al.	

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /T.D.P/

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	16720543
	Filing Date	2019-12-19
	First Named Inventor	Grant Mark Bristow
	Art Unit	3661
	Examiner Name	Tyler D. Paige
	Attorney Docket Number	BEL-IN140-19.02

	4	20190130515		2019-05-02	Haggiag	
	5	20190188581		2019-06-20	Chabin et al.	
	6	20200075027		2020-03-05	Arantes et al.	

If you wish to add additional U.S. Published Application citation information please click the Add button. Add

FOREIGN PATENT DOCUMENTS Remove

Examiner Initial*	Cite No	Foreign Document Number[3]	Country Code[2]	Kind Code[4]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear	T[5]
	1	2020160778	WO	A1	2020-08-13	Volvo Truck Corporation		

If you wish to add additional Foreign Patent Document citation information please click the Add button Add

NON-PATENT LITERATURE DOCUMENTS Remove

Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T[5]
	1		

If you wish to add additional non-patent literature document citation information please click the Add button Add

EXAMINER SIGNATURE

Examiner Signature	/TYLER D PAIGE/ (11/07/2021)	Date Considered	11/07/2021

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through a citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /T.D.P/

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	16720543
	Filing Date	2019-12-19
	First Named Inventor	Grant Mark Bristow
	Art Unit	3661
	Examiner Name	Tyler D. Paige
	Attorney Docket Number	BEL-IN140-19.02

[1] See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. [2] Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). [3] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [4] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [5] Applicant is to place a check mark here if English language translation is attached.

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /T.D.P/

INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Not for submission under 37 CFR 1.99)

Application Number	16720543
Filing Date	2019-12-19
First Named Inventor	Grant Mark Bristow
Art Unit	3661
Examiner Name	Tyler D. Paige
Attorney Docket Number	BEL-IN140-19.02

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

See attached certification statement.

☒ The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Robert G. Graham/	Date (YYYY-MM-DD)	2021-10-28
Name/Print	Robert G. Graham	Registration Number	58042

This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 1 hour to complete, including gathering, preparing and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /T.D.P/

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these record s.

2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.

3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.

4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).

5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.

6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).

7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.

9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

EFS Web 2.1.18

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /T.D.P/

PE2E SEARCH - Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	British Equivalents	Time Stamp
L1	9	("10217066" OR "10956855" OR "20160147404" OR "20160364989" OR "20170166328" OR "20190130515" OR "20190188581" OR "20200075027" OR "8340948").pn.	(US-PGPUB; USPAT)	OR	ON	ON	2021/11/07 11:57 AM

PE2E SEARCH - Search History (Interference)

There are no Interference searches to show.

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
16/720,543	12/19/2019	Grant Mark Bristow	BEL-IN140-19.02	4655

145156 7590 01/18/2022

SLATER MATSIL, LLP/Bell
17950 PRESTON RD, SUITE 1000
DALLAS, TX 75252-5793

EXAMINER
PAIGE, TYLER D

ART UNIT	PAPER NUMBER
3666	

NOTIFICATION DATE	DELIVERY MODE
01/18/2022	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

docketing@slatermatsil.com

Corrected ***Notice of Allowability***	**Application No.** 16/720,543	**Applicant(s)** Bristow et al.	
	Examiner TYLER D PAIGE	**Art Unit** 3666	**AIA (FITF) Status** Yes

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☑ This communication is responsive to 12/07/2021.
   ☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

2. ☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.

3. ☑ The allowed claim(s) is/are See Continuation Sheet . As a result of the allowed claim(s), you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see **http://www.uspto.gov/patents/init_events/pph/index.jsp** or send an inquiry to **PPHfeedback@uspto.gov.**

4. ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

   Certified copies:

   a) ☐ All b) ☐ Some* c) ☐ None of the:

   1. ☐ Certified copies of the priority documents have been received.
   2. ☐ Certified copies of the priority documents have been received in Application No. _____ .
   3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

   * Certified copies not received: _____ .

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.
THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.

5. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
   ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date _____ .

   Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).

6. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Attachment(s)

1. ☑ Notice of References Cited (PTO-892)
2. ☐ Information Disclosure Statements (PTO/SB/08), Paper No./Mail Date _____.
3. ☐ Examiner's Comment Regarding Requirement for Deposit of Biological Material _____.
4. ☐ Interview Summary (PTO-413), Paper No./Mail Date. _____.
5. ☐ Examiner's Amendment/Comment
6. ☐ Examiner's Statement of Reasons for Allowance
7. ☐ Other _____.

/TYLER D PAIGE/
Examiner, Art Unit 3666

Continuation of 3. The allowed claim(s) is/are: 1,3-8,10-15 and 17-23

Notice of References Cited	Application/Control No. 16/720,543	Applicant(s)/Patent Under Reexamination Bristow et al.	
	Examiner TYLER D PAIGE	Art Unit 3666	Page 1 of 1

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	CPC Classification	US Classification
*	A	US-20200075027-A1	03-2020	ARANTES; Adriano Siqueira	G10L25/48	1/1
*	B	US-20190188581-A1	06-2019	Chabin; Guillaume	G06Q10/04	1/1
*	C	US-20160364989-A1	12-2016	Speasl; Jerry	G08G5/0082	1/1
*	D	US-20160147404-A1	05-2016	Keune; Dirk	G09B17/003	715/784
*	E	US-20170166328-A1	06-2017	Ethington; James M.	G06Q10/06311	1/1
	F					
	G					
	H					
	I					
	J					
	K					
	L					
	M					

FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	CPC Classification
	N					
	O					
	P					
	Q					
	R					
	S					
	T					

NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
	U	
	V	
	W	
	X	

*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.

PART B - FEE(S) TRANSMITTAL

Complete and send this form, together with applicable fee(s), by mail or fax, or via EFS-Web.

By mail, send to: Mail Stop ISSUE FEE
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450

By fax, send to: (571)-273-2885

INSTRUCTIONS: This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 5 should be completed where appropriate. All further correspondence including the Patent, advance orders and notification of maintenance fees will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications.

CURRENT CORRESPONDENCE ADDRESS (Note: Use Block 1 for any change of address)

145156 7590 11/23/2021
SLATER MATSIL, LLP/Bell
17950 PRESTON RD, SUITE 1000
DALLAS, TX 75252-5793

Note: A certificate of mailing can only be used for domestic mailings of the Fee(s) Transmittal. This certificate cannot be used for any other accompanying papers. Each additional paper, such as an assignment or formal drawing, must have its own certificate of mailing or transmission.

Certificate of Mailing or Transmission

I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being transmitted to the USPTO via EFS-Web or by facsimile to (571) 273-2885, on the date below.

Jennifer Rubio	(Typed or printed name)
/Jennifer Rubio/	(Signature)
2/22/22	(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
16/720,543	12/19/2019	Grant Mark Bristow	BEL-IN140-19.02	4655

TITLE OF INVENTION: Fleet Controller

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	UNDISCOUNTED	$1200	$0.00	$0.00	$1200	02/23/2022

EXAMINER	ART UNIT	CLASS-SUBCLASS
PAIGE, TYLER D	3666	701-003000

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).

☐ Change of correspondence address (or Change of Correspondence Address form PTO/SB/122) attached.

☐ "Fee Address" indication (or "Fee Address" Indication form PTO/SB/47; Rev 03-09 or more recent) attached. **Use of a Customer Number is required.**

2. For printing on the patent front page, list
(1) The names of up to 3 registered patent attorneys or agents OR, alternatively,
(2) The name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.

1 Slater Matsil, LLP
2
3

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document must have been previously recorded, or filed for recordation, as set forth in 37 CFR 3.11 and 37 CFR 3.81(a). Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE: TEXTRON INNOVATIONS INC.

(B) RESIDENCE: (CITY and STATE OR COUNTRY): PROVIDENCE, RHODE ISLAND

Please check the appropriate assignee category or categories (will not be printed on the patent) : ☐ Individual ☒ Corporation or other private group entity ☐ Government

4a. Fees submitted: ☒ Issue Fee ☐ Publication Fee (if required) ☐ Advance Order - # of Copies _____

4b. Method of Payment: *(Please first reapply any previously paid fee shown above)*

☒ Electronic Payment via EFS-Web ☐ Enclosed check ☐ Non-electronic payment by credit card (Attach form PTO-2038)

☒ The Director is hereby authorized to charge the required fee(s), any deficiency, or credit any overpayment to Deposit Account No. 50-1065

5. **Change in Entity Status** (from status indicated above)

☐ Applicant certifying micro entity status. See 37 CFR 1.29

☐ Applicant asserting small entity status. See 37 CFR 1.27

☐ Applicant changing to regular undiscounted fee status.

NOTE: Absent a valid certification of Micro Entity Status (see forms PTO/SB/15A and 15B), issue fee payment in the micro entity amount will not be accepted at the risk of application abandonment.
NOTE: If the application was previously under micro entity status, checking this box will be taken to be a notification of loss of entitlement to micro entity status.
NOTE: Checking this box will be taken to be a notification of loss of entitlement to small or micro entity status, as applicable.

NOTE: This form must be signed in accordance with 37 CFR 1.31 and 1.33. See 37 CFR 1.4 for signature requirements and certifications.

Authorized Signature /Robert G. Graham/ Date February 22, 2022

Typed or printed name Robert G. Graham Registration No. 58,042

Electronic Patent Application Fee Transmittal

Application Number:	16720543
Filing Date:	19-Dec-2019
Title of Invention:	Fleet Controller
First Named Inventor/Applicant Name:	Grant Mark Bristow
Filer:	Robert G. Graham/Jennifer Rubio
Attorney Docket Number:	BEL-IN140-19.02

Filed as Large Entity

Filing Fees for Utility under 35 USC 111(a)

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
UTILITY APPL ISSUE FEE	1501	1	1200	1200

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Extension-of-Time:				
Miscellaneous:				
			Total in USD ($)	**1200**

Electronic Acknowledgement Receipt

EFS ID:	45051910
Application Number:	16720543
International Application Number:	
Confirmation Number:	4655
Title of Invention:	Fleet Controller
First Named Inventor/Applicant Name:	Grant Mark Bristow
Customer Number:	145156
Filer:	Robert G. Graham/Jennifer Rubio
Filer Authorized By:	Robert G. Graham
Attorney Docket Number:	BEL-IN140-19.02
Receipt Date:	22-FEB-2022
Filing Date:	19-DEC-2019
Time Stamp:	13:47:23
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	DA
Payment was successfully received in RAM	$1200
RAM confirmation Number	E20222LD47550274
Deposit Account	501065
Authorized User	Jennifer Rubio

The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows:

37 CFR 1.21 (Miscellaneous fees and charges)

37 CFR 1.20 (Post Issuance fees)

37 CFR 1.19 (Document supply fees)

37 CFR 1.17 (Patent application and reexamination processing fees)

37 CFR 1.16 (National application filing, search, and examination fees)

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Issue Fee Payment (PTO-85B)	BEL-IN140-1902_Issue_Fee.PDF	155381 dfeee7f4a99d281fcfad5189268f572477b21539	no	1
Warnings:					
Information:					
2	Fee Worksheet (SB06)	fee-info.pdf	38101 d688f2a93d95407fb0210ebb2108982dedbad717	no	2
Warnings:					
Information:					
		Total Files Size (in bytes):	193482		

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

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United States Patent and Trademark Office
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APPLICATION NO.	ISSUE DATE	PATENT NO.	ATTORNEY DOCKET NO.	CONFIRMATION NO.
16/720,543	03/29/2022	11288972	BEL-IN140-19.02	4655

145156 7590 03/09/2022

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17950 PRESTON RD, SUITE 1000
DALLAS, TX 75252-5793

ISSUE NOTIFICATION

The projected patent number and issue date are specified above.

Determination of Patent Term Adjustment under 35 U.S.C. 154 (b)
(application filed on or after May 29, 2000)

The Patent Term Adjustment is 156 day(s). Any patent to issue from the above-identified application will include an indication of the adjustment on the front page.

If a Continued Prosecution Application (CPA) was filed in the above-identified application, the filing date that determines Patent Term Adjustment is the filing date of the most recent CPA.

Applicant will be able to obtain more detailed information by accessing the Patent Application Information Retrieval (PAIR) WEB site (http://pair.uspto.gov).

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Application Assistance Unit (AAU) of the Office of Data Management (ODM) at (571)-272-4200.

INVENTOR(s) (Please see PAIR WEB site http://pair.uspto.gov for additional inventors):

Grant Mark Bristow, Benbrook, TX;
Matthew David Holvey, North Richland Hills, TX;
Naveed Ahmed Siddiqui, Dallas, TX;

APPLICANT(s) (Please see PAIR WEB site http://pair.uspto.gov for additional applicants):

Textron Innovations Inc, Providence, RI;

The United States represents the largest, most dynamic marketplace in the world and is an unparalleled location for business investment, innovation, and commercialization of new technologies. The USA offers tremendous resources and advantages for those who invest and manufacture goods here. Through SelectUSA, our nation works to encourage and facilitate business investment. To learn more about why the USA is the best country in the world to develop technology, manufacture products, and grow your business, visit SelectUSA.gov.

PTO/SB/08a (01-22)
Approved for use through 05/31/2024. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Not for submission under 37 CFR 1.99)

Application Number	16720543
Filing Date	2019-12-19
First Named Inventor	Grant Mark Bristow
Art Unit	3666
Examiner Name	Tyler D. Paige
Attorney Docket Number	BEL-IN140-19.02

U.S.PATENTS Remove

Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	10692053		2020-06-23	Viswanath et al.	
	2	6609051		2003-08-19	Fiechter et al.	

If you wish to add additional U.S. Patent citation information please click the Add button. Add

U.S.PATENT APPLICATION PUBLICATIONS Remove

Examiner Initial*	Cite No	Publication Number	Kind Code[1]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	20190220036		2019-07-18	Weslosky et al.	
	2	20200126326		2020-04-23	Lavie	

If you wish to add additional U.S. Published Application citation information please click the Add button. Add

FOREIGN PATENT DOCUMENTS Remove

Examiner Initial*	Cite No	Foreign Document Number[3]	Country Code[2] i	Kind Code[4]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear	T[5]
	1	2019143752	WO	A1	2019-07-25	Uber Technologies, Inc.		

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	16720543
	Filing Date	2019-12-19
	First Named Inventor	Grant Mark Bristow
	Art Unit	3666
	Examiner Name	Tyler D. Paige
	Attorney Docket Number	BEL-IN140-19.02

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Signature	/Robert G. Graham/	Date (YYYY-MM-DD)	2022-03-15
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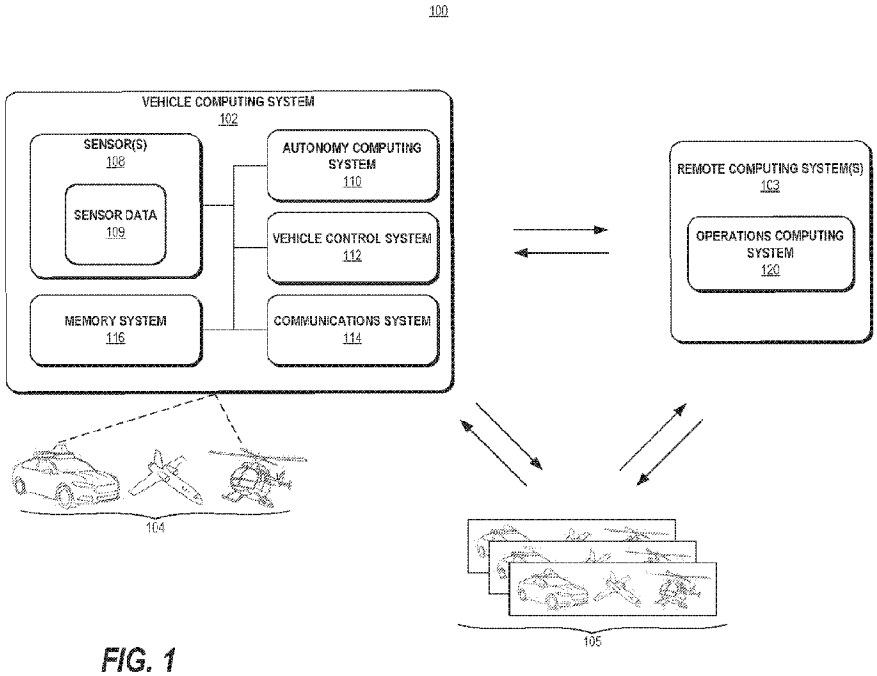


FIG. 1

(57) Abstract: Systems and methods for managing a fleet of vehicles are provided. In one example embodiment, a computer-implemented method includes obtaining data representing vehicle state information associated with one or more vehicles among a fleet of vehicles at one or more times. The method includes predicting a future vehicle state associated with the one or more vehicles at one or more future times. The method includes scheduling a vehicle assignment in a predetermined set of vehicle assignments for a selected vehicle among the one or more vehicles before a first future time among the one or more future times. The method includes transmitting a command signal to a computing system associated with the selected vehicle based at least in part on the scheduled vehicle assignment.

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[Continued on next page]

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SYSTEMS AND METHODS FOR IMPLEMENTING VEHICLE ASSIGNMENTS USING VEHICLE STATE INFORMATION

PRIORITY CLAIM

[0001] The present application claims the benefit of priority of U.S. Provisional Patent Application No. 62/618,383 filed January 17, 2018, entitled "Systems and Methods for Implementing Vehicle Assignments Using Vehicle State Information," and U.S. Patent Application No. 15/898,960 filed February 19, 2018, entitled "Systems and Methods for Implementing Vehicle Assignments using Vehicle State Information." The above-referenced patent applications are incorporated herein by reference.

FIELD

[0002] The present disclosure relates generally to managing a fleet of vehicles, and in particular, scheduling vehicle assignments using vehicle state information and controlling the vehicles to implement the vehicle assignments.

BACKGROUND

[0003] An autonomous vehicle is a vehicle that is capable of sensing its environment and navigating without human input. In particular, an autonomous vehicle can observe its surrounding environment using a variety of sensors and can attempt to comprehend the environment by performing various processing techniques on data collected by the sensors. Given knowledge of its surrounding environment, the autonomous vehicle can identify an appropriate motion plan through such surrounding environment.

SUMMARY

[0004] Aspects and advantages of the present disclosure will be set forth in part in the following description, or may be learned from the description, or may be learned through practice of the embodiments.

[0005] One example aspect of the present disclosure is directed to a computer-implemented method for managing a fleet of vehicles. The method includes obtaining data representing vehicle state information associated with one or more vehicles among a fleet of vehicles at one or more times. The method includes predicting a future vehicle state associated with the one or more vehicles at one or more future times based at least in part on the vehicle state information. The method includes scheduling a vehicle assignment in a predetermined set of vehicle assignments for a selected vehicle among the one or more

vehicles before a first future time among the one or more future times based at least in part on a future vehicle state associated with the selected vehicle at the first future time. The method includes transmitting a command signal to a computing system associated with the selected vehicle based at least in part on the scheduled vehicle assignment.

[0006] Another example aspect of the present disclosure is directed to a computer-implemented method for implementing a vehicle assignment. The method includes obtaining data representing vehicle state information associated with a vehicle at one or more collection times. The method includes transmitting the vehicle state information to one or more remote computing systems at one or more transmission times. The method includes receiving a command signal from the one or more remote computing systems, the command signal indicative of a scheduled vehicle assignment for the vehicle based at least in part on the vehicle state information. The method includes controlling, in response to the command signal, the vehicle to implement the scheduled vehicle assignment based at least in part on the command signal.

[0007] Yet another example aspect of the present disclosure is directed to a computing system for managing a fleet of vehicles. The computing system includes a fleet of vehicles, a fleet manager that manages the fleet of vehicles, one or more processors and one or more tangible, non-transitory, computer readable media that collectively store instructions that when executed by the one or more processors cause the computing system to perform operations. The operations include collecting, by one or more vehicle in the fleet, data representing vehicle state information associated with the one or more vehicles at one or more collection times. The operations include transmitting, by the one or more vehicles, data representing the vehicle state information associated with the one or more vehicles, to the fleet manager at one or more transmission times. The operations include obtaining, by the fleet manager, data representing the vehicle state information. The operations include predicting, by the fleet manager, a future vehicle state associated with the one or more vehicles at one or more future times based at least in part on the vehicle state information. The operations include scheduling, by the fleet manager, a vehicle assignment in a predetermined set of vehicle assignments for a selected vehicle among the one or more vehicles before a first future time among the one or more future times based at least in part on a future vehicle state associated with the selected vehicle at the first future time. The operations include transmitting, by the fleet manager, a command signal to the selected vehicle based at least in part on the scheduled vehicle assignment, the command signal indicative of the scheduled vehicle assignment for the selected vehicle. The operations

include receiving, by the selected vehicle, a command signal from the one or more remote computing systems, the command signal indicative of a scheduled vehicle assignment for the vehicle based at least in part on the vehicle state information. The operations include implementing, by the selected vehicle, the scheduled vehicle assignment in response to the command signal.

[0008] Other example aspects of the present disclosure are directed to systems, methods, vehicles, apparatuses, tangible, non-transitory computer-readable media, and memory devices for controlling an autonomous vehicle.

[0009] These and other features, aspects, and advantages of various embodiments will become better understood with reference to the following description and appended claims. The accompanying drawings, which are incorporated in and constitute a part of this specification, illustrate embodiments of the present disclosure and, together with the description, serve to explain the related principles.

BRIEF DESCRIPTION OF THE DRAWINGS

[00010] Detailed discussion of embodiments directed to one of ordinary skill in the art are set forth below, which make reference to the appended figures, in which:

[00011] FIG. 1 depicts a block diagram of an example system overview according to example embodiments of the present disclosure;

[00012] FIG. 2 depicts a block diagram of an example vehicle computing system according to example embodiments of the present disclosure;

[00013] FIG. 3 depicts a block diagram of an example vehicle operations system interface according to example embodiments of the present disclosure;

[00014] FIG. 4 depicts example vehicle state information according to example embodiments of the present disclosure;

[00015] FIG. 5 depicts example vehicle state information according to example embodiments of the present disclosure;

[00016] FIGS. 6A-6C depict example vehicle state information according to example embodiments of the present disclosure;

[00017] FIG. 7 depicts example vehicle assignment information according to example embodiments of the present disclosure;

[00018] FIG. 8 depicts a flow diagram of managing a fleet of vehicles according to example embodiments of the present disclosure;

[00019] FIG. 9 depicts a flow diagram of implementing a vehicle assignment according to example embodiments of the present disclosure; and

[00020] FIG. 10 depicts example system components according to example embodiments of the present disclosure.

[00021] Reference numerals that are repeated across plural figures are intended to identify the same components or features in various implementations.

DETAILED DESCRIPTION

[00022] Example aspects of the present disclosure are directed to communication between vehicles in a fleet and an entity infrastructure, for example, a service provider's operations or control center. In particular, the systems and methods of the present disclosure can facilitate secure, bidirectional communications between one or more vehicles in a service provider's fleet and the service provider's operations or control center. The systems and methods of the present disclosure can provide for accessing vehicle state information associated with the vehicles in the fleet, and scheduling vehicle assignments for the vehicles based on the vehicle state information. In this fashion, systems and methods can be provided that advantageously implement dynamic control of vehicle state monitoring and assignment scheduling across an entire fleet of vehicles.

[00023] In particular, according to aspects of the present disclosure, a vehicle application programming interface (Vehicle API) platform can provide for a translation/transport layer as an interface between vehicle computing systems onboard vehicles within an entity's fleet and one or more remote clients and/or applications operating within the entity's operations/control center. For example, the Vehicle API platform can receive data from a vehicle over a communications pipeline established with the Vehicle API. The Vehicle API platform can provide for communicating vehicle data to the operations/control center in a secure manner that allows for expanded processing of vehicle data off the vehicle, analyzing such data in real time, and/or the like. According to example aspects of the present disclosure, a Vehicle API platform can be vehicle agnostic, allowing for any autonomous vehicle and/or computer-capable vehicle to interact with an entity's operations/control center by providing a consistent communication pipeline that any vehicle computing system would be able to use to report vehicle data (e.g., vehicle state information, etc.) and/or receive messages (e.g., command/control messages, configuration messages, etc.) from an entity's operations system.

[00024] More particularly, an entity (e.g., service provider, owner, manager) can use one or more vehicles (e.g., ground-based vehicles) to perform one or more tasks in a predetermined set of tasks. The predetermined set of tasks can include, for example, providing a vehicle service such as a transportation service (e.g., rideshare service), a courier service, a delivery service, etc., collecting vehicle state information, collecting map data associated with an environment, collecting sensor data associated with one or more vehicle components onboard the one or more vehicle. The one or more vehicles can be autonomous vehicles that include various systems and devices configured to control the operation of the vehicle. For example, an autonomous vehicle can include an onboard vehicle computing system for operating the autonomous vehicle (e.g., located on or within the autonomous vehicle). The vehicle computing system can receive sensor data from sensor(s) onboard the vehicle (e.g., cameras, LIDAR, RADAR), attempt to comprehend the vehicle's surrounding environment by performing various processing techniques on the sensor data, and generate an appropriate motion plan through the vehicle's surrounding environment. Moreover, the autonomous vehicle can be configured to communicate with one or more computing devices that are remote from the vehicle. For example, the autonomous vehicle can communicate with an operations computing system that can be associated with the entity. The operations computing system can help the entity monitor, communicate with, manage, etc. the fleet of vehicles.

[00025] In some implementations, the Vehicle API platform can provide for a vehicle to send multiple types of data to the service provider system over the established connections between the vehicle and the service provider system. For example, in some implementations, the Vehicle API platform can provide for a vehicle to send vehicle state information to the service provider system. In some implementations, the Vehicle API platform can provide for a vehicle to send low resolution perception data, such as labels and/or geometries, to the service provider system, allowing for processing the data offboard the vehicle and developing better understanding of the world. In some implementations, the Vehicle API platform can provide for a vehicle to send data such as current vehicle pose (e.g., global and relative to map), vehicle trajectory, onboard diagnostics, and/or the like, to the service provider system.

[00026] In some implementations, the Vehicle API platform can provide for aggregating data from multiple vehicles allowing for an understanding of what the vehicles are doing in that particular moment in time. For example, in some implementations, the Vehicle API platform can provide for aggregating data from a vehicle to allow for determining what a particular vehicle is doing, to allow for tracking vehicle in real time, and/or the like. In some

implementations, the Vehicle API platform can provide for streaming real time data from a vehicle, for example, providing a live stream of telemetry data from a vehicle to an operations system to allow for providing assistance to the vehicle. In some implementations, by providing for aggregating vehicle data, the Vehicle API platform can facilitate understanding of what all the vehicles are in a fleet, who they belong to, what they are doing, providing a history for some time window into the behavior of a vehicle, providing moving snapshots of vehicle data over time, and/or the like.

[00027] In some implementations, the Vehicle API platform can provide for a vehicle to send data including vehicle state information associated with the vehicle. The vehicle state information can include, for example, one or more vehicle attributes associated with the vehicle at any given time. The Vehicle API platform can provide for the vehicle to send data including one or more vehicle attributes associated with the vehicle at one or more times. The vehicle attributes can include, for example, vehicle activity information, vehicle schedule information, trip availability information, and/or vehicle readiness information.

[00028] In some implementations, the vehicle attributes associated with a vehicle can include vehicle activity information.

[00029] The vehicle attributes can include "autonomous mode", for example, when the vehicle is operating autonomously and navigating to a destination, when the vehicle is operating autonomously and is stationary, etc.

[00030] The vehicle attributes can include "manual mode", for example, when a vehicle operator is manually operating the vehicle to navigate to a destination, when a vehicle operator is manually operating the vehicle and the vehicle is stationary, etc.

[00031] The vehicle attributes can include "deploying", for example, when the vehicle is deploying, etc.

[00032] The vehicle attributes can include "parked", for example, when a transmission of the vehicle set to "park", etc.

[00033] The vehicle attributes can include "keyed-off", for example, when the last known vehicle attribute associated with the vehicle indicates that the vehicle is parked and a predetermined amount of time has since elapsed, etc.

[00034] The vehicle attributes can include "no-signal", for example, when the vehicle is not associated with one of autonomous mode, manual mode, deploying, parked, or keyed-off.

[00035] In some implementations, the vehicle attributes associated with a vehicle can include vehicle schedule information.

[00036] The vehicle attributes can include "scheduled", for example, when the vehicle is scheduled for operation, etc.

[00037] The vehicle attributes can include "not scheduled", for example, when the vehicle is not scheduled for operation, etc.

[00038] The vehicle attributes can include "assigned", for example, when a vehicle operator is assigned to operate the vehicle, etc.

[00039] The vehicle attributes can include "not assigned", for example, when a vehicle operator is not assigned to operate the vehicle, etc. The vehicle attributes can further include, for example, whether a vehicle operator is available to operate the vehicle, etc.

[00040] The vehicle attributes can include "logged-in", for example, when a vehicle operator is logged-in to the vehicle, etc.

[00041] The vehicle attributes can include "not logged-in", for example, when a vehicle operator is not logged-in to the vehicle, etc. The vehicle attributes can further include, for example, whether the vehicle operator is not logged-in because the vehicle operator is taking a break, the vehicle operator has scheduled down-time, etc.

[00042] The vehicle attributes can include "operational", for example, when the vehicle is scheduled for operation, a vehicle operator is assigned to operate the vehicle, and the assigned vehicle operator is logged-in to the vehicle.

[00043] The vehicle attributes can include "non-operational", for example, when the vehicle is not scheduled for operation, when a vehicle operator is not assigned to operate the vehicle, when a vehicle operator is not logged-in to the vehicle, when a vehicle operator that is not assigned to operate the vehicle is logged-in to the vehicle, etc.

[00044] In some implementations, the vehicle attributes associated with a vehicle can include trip availability information.

[00045] The vehicle attributes can include "available", for example, when a vehicle operator is scheduled to operate the vehicle, the vehicle operator is logged-in to the vehicle, and the vehicle is available to perform one or more tasks in the predetermined set of tasks; etc.

[00046] The vehicle attributes can include "not available", for example, when a vehicle operator is scheduled to operate the vehicle, the vehicle operator is logged-in to the vehicle, and the vehicle is not available to perform one or more tasks in the predetermined set of tasks; etc. The vehicle attributes can further include, for example, whether the vehicle is not available because the vehicle operator is cleaning the vehicle, the vehicle operator is refueling the vehicle, the vehicle operator is returning the vehicle to a vehicle base, etc.

[00047] In some implementations, the vehicle attributes associated with a vehicle can include vehicle readiness information.

[00048] The vehicle attributes can include "ready", for example, when the vehicle is ready to perform one or more tasks in the predetermined set of tasks, etc.

[00049] The vehicle attributes can include "troubleshooting", for example, when an entity is troubleshooting the vehicle. The vehicle attributes can further include, for example, an identification of the entity troubleshooting the vehicle, whether the troubleshooting is tier 1 (e.g., remote troubleshooting), whether the troubleshooting is tier 2 (e.g., hand-on trouble shooting by a vehicle reliability team), etc.

[00050] The vehicle attributes can include "grounded", for example, when the vehicle cannot perform one or more tasks in the predetermined set of tasks. The vehicle attributes can further include, for example, whether the vehicle cannot perform one or more tasks because of maintenance (e.g., oil change, engine service, brake replacement, etc.), fleet rollout (e.g., vehicle software updates, vehicle hardware upgrades, etc.), etc.

[00051] In some implementations, the Vehicle API platform can provide for a service provider system to receive data including vehicle state information associated with one or more vehicle in the fleet at a given time. The Vehicle API platform can provide for the service provider system to receive the data from one or more sources (e.g., from one or more vehicles in the fleet, one or more remote computing systems, etc.). The Vehicle API platform can provide for the service provider system to aggregate data including vehicle state information associated with a vehicle from the one or more sources. The service provider system can, for example, analyze the data to determine a vehicle state associated with the one or more vehicles at the given time. A vehicle state for a vehicle at the given time can indicate, for example, one or more vehicle attributes associated with the vehicle at the given time. The service provider system can, for example, determine a vehicle utility score associated with the one or more vehicles at the given time. Each of the one or more vehicle attributes associated with the vehicle can be associated with a predetermined utility value. The vehicle utility score for a vehicle at the given time can be determined, for example, based on a vehicle utility score function that outputs the vehicle utility score based on the predetermined utility values associated with the one or more vehicle attributes associated with the vehicle at the given time. Additionally, the service provider system can, for example, determine a fleet utility score associated with the fleet at the given time. The fleet utility score can be determined, for example, based on a fleet utility function that outputs the

fleet utility score based on the vehicle utility scores associated with the one or more vehicles in the fleet.

[00052] In some implementations, the Vehicle API platform can provide for a service provider system to aggregate data (e.g., vehicle state information) associated with one or more vehicles in the fleet at one or more times. The service provider system can, for example, analyze the data to determine a vehicle state associated with the one or more vehicles at the one or more times, and determine a vehicle utilization score associated with the one or more vehicles over a predetermined duration (e.g., a previous hour, day, week, month, year, etc.). A vehicle utilization score for a vehicle can indicate, for example, a fraction of the predetermined duration that the vehicle is associated with vehicle attributes such as autonomous mode, manual mode, offloading, or deploying. In some implementations, the vehicle utilization score for the vehicle can be based on a vehicle utility score associated with the vehicle at one or more times within the predetermined duration. In some implementations, the vehicle utilization score can be determined based on a vehicle utilization function that outputs the vehicle utilization score based on the vehicle utility scores associated with the one or more vehicles in the fleet. Additionally, the service provider system can, for example, determine a fleet utilization score associated with the fleet over the predetermined duration. The fleet utilization score can be determined, for example, based on a fleet utilization function that outputs the fleet utilization score based on vehicle utilization scores associated with the one or more vehicles in the fleet.

[00053] In some implementations, the Vehicle API platform can provide for a service provider system to determine one or more utilization patterns associated with one or more vehicles in the fleet. The one or more utilization patterns associated with a vehicle can indicate, for example, one or more times that the vehicle is associated with a particular vehicle attribute or set of vehicle attributes. The one or more utilization patterns can include, for example, a pattern corresponding to when a vehicle is performing one or more tasks in the predetermined set of tasks, a pattern corresponding to when a vehicle is not performing one or more tasks in the predetermined set of tasks, a pattern corresponding to when a vehicle is operating in autonomous mode, a pattern corresponding to when a vehicle is operating in manual mode, a pattern corresponding to when a vehicle is offloading, a pattern corresponding to when a vehicle is deploying, a pattern corresponding to when a vehicle is parked, a pattern corresponding to when a vehicle is keyed off, a pattern corresponding to when a vehicle is associated with no signal, a pattern corresponding to when a vehicle is scheduled for operation, a pattern corresponding to when a vehicle is not scheduled for

operation, a pattern corresponding to when a vehicle operator is signed in to the vehicle, a pattern corresponding to when a vehicle operator is not signed in to the vehicle, a pattern corresponding to when no vehicle operator is available to be scheduled for the vehicle, a pattern corresponding to when a vehicle is scheduled for down time, a pattern corresponding to when a vehicle is not available for a trip because the vehicle is being cleaned, a pattern corresponding to when a vehicle is not available for a trip because the vehicle is being returned to a vehicle base, a pattern corresponding to when a vehicle is not available for a trip because the vehicle is being refueled, a pattern corresponding to when a vehicle is ready, a pattern corresponding to when an entity is troubleshooting a vehicle, a pattern corresponding to when a vehicle is grounded because of routine maintenance, a pattern corresponding to when a vehicle is grounded because of a fleet rollout, etc.

[00054] In some implementations, the Vehicle API platform can provide for a service provider system to extrapolate one or more utilization patterns associated with a vehicle to one or more future times to predict one or more vehicle attributes associated with the vehicle at the one or more future times. In some implementations, the service provider system can, for example, extrapolate the one or more utilization patterns to predict a future vehicle state associated with the vehicle at a future time, and predict a future vehicle utility score associated with the vehicle at the future time. Additionally, the service provider system can, for example, predict a future fleet utility score associated with the fleet at the future time. In some implementations, the service provider system can, for example, extrapolate the one or more utilization patterns to predict a future vehicle state associated with the vehicle at the one or more future times, and predict a future vehicle utilization score associated with the vehicle over a predetermined duration (e.g., a future hour, day, week, month, year, etc.). Additionally, the service provider system can, for example, predict a future fleet utilization score associated with fleet over the predetermined duration.

[00055] In some implementations, the Vehicle API platform can provide for the service provider system to send multiple types of data to a vehicle over the established connections to the vehicle. For example, in some implementations, the Vehicle API platform can provide for sending vehicle assignment data to a vehicle, such as instructions for a vehicle to offload the data from its computing system, instructions for a vehicle to report for maintenance, instructions for a vehicle to procure fuel, and/or the like. In some implementations, the Vehicle API platform can provide for sending command signals to a vehicle, such as, for example, sending specific control messages to a vehicle, sending advisories to vehicles, etc. The specific control messages can, for example, instruct the vehicle to go to certain

coordinates. The advisories can, for example, notify a vehicle operator associated with the vehicle about scheduled vehicle assignments, flagged geo regions (e.g., areas to avoid, areas to spend more time in to acquire passengers, areas under construction that should be routed around, etc.), etc.

[00056] In some implementations, the Vehicle API platform can provide for a service provider system to schedule a vehicle assignment in a predetermined set of vehicle assignments. A vehicle assignment can include instructions for a vehicle to perform one or more actions. The service provider system can schedule a vehicle assignment for a vehicle at one or more future times for the vehicle to implement the vehicle assignment at the one or more future times by performing the one or more actions. In some implementations, the predetermined set of vehicle assignments can include, for example, maintenance assignments, fleet rollout assignments, trade dressing assignments, event assignments, etc. In some implementations, a vehicle assignment can be associated with one or more assignment attributes, such as, for example, scheduled times, locations, expected durations, required preconditions, contact information, notes, etc.

[00057] In some implementations, a maintenance assignment can include, for example, instructions for a vehicle to refuel, obtain an oil change, repair broken components, replace worn components (e.g., tires, brake pads, etc.), etc. The maintenance assignment can be associated with assignment attributes including, for example, a maintenance type (e.g., oil change, repair, etc.), maintenance time, maintenance location (e.g., commercial gas station, maintenance garage, etc.), expected maintenance duration (e.g., expected duration for an oil change, expected duration for tire replacement, etc.), maintenance preconditions (e.g., threshold fuel level remaining before refueling, threshold distance traveled before an oil change, threshold redundancy loss before repairing broken components, threshold performance degradation before repairing worn components, etc.), etc.

[00058] In some implementations, a fleet rollout assignment can include, for example, instructions for a vehicle to update one or more components (e.g., software components), replace one or more components (e.g., hardware components), add one or more components (e.g., software and/or hardware components), etc., as part of a rollout to one or more vehicles in the fleet. The fleet rollout assignment can be associated with assignment attributes including, for example, a start date/time to begin a rollout to vehicles in a fleet, a completion date/deadline to finish the rollout, locations (e.g., one or more maintenance garages that a vehicle can access to implement a fleet rollout assignment), expected durations (e.g., expected duration to update, replace, and/or add one or more components associated with the

fleet rollout), required preconditions (e.g., availability of a maintenance garage to receive a vehicle at a future time, inventory at a maintenance garage of one or more vehicle components associated with the fleet rollout, bandwidth and resource availability restrictions on data associated with the fleet rollout, etc.), etc.

[00059] In some implementations, a trade dressing assignment can include, for example, instructions for a vehicle to perform an action associated with a trade dress. The trade dress assignment can be associated with one or more corresponding assignment attributes.

[00060] In some implementations, an event assignment can include, for example, instructions for a vehicle to perform an event at a predetermined future time. The service provider system can obtain event data including one or more events to be performed at one or more future times, and schedule one or more event assignments for a vehicle to perform the one or more events at the one or more future times. The service provider system can obtain the event data, for example, from a calendar of events that is maintained and/or updated by one or more remote clients and/or applications operating within the service provider system, and/or from one or more remote computing devices. The event assignment can be associated with assignment attributes including, for example, a scheduled time of an event associated with the event assignment, location associated with the event, expected duration of the event, notes that describe the event, etc.

[00061] In some implementations, the Vehicle API platform can allow for a service provider system to select a vehicle to implement a vehicle assignment at a future time based on a future vehicle state associated with the selected vehicle.

[00062] As an example, the service provider system can determine that a future vehicle state predicted for a vehicle at a first future time will indicate that the vehicle will have traveled a distance that exceeds an oil change threshold distance. The service provider system can select the vehicle to implement a maintenance assignment (e.g., for the selected vehicle to obtain an oil change) at the first future time, and schedule the maintenance assignment for the selected vehicle at the first future time. Maintenance assignments for other maintenance events than oil changes can be determined in a similar fashion.

[00063] As another example, the service provider system can predict a future vehicle utility score associated with a selected vehicle at two or more future times. The service provider system can compare the future vehicle utility scores to determine a future time when the vehicle utility score is lowest. The service provider system can schedule a vehicle assignment for the selected vehicle at the future time when the vehicle utility score is lowest.

[00064] As another example, the service provider system can select a vehicle to implement a vehicle assignment associated with a an expected duration. The service provider system can predict a future vehicle utilization score associated with the selected vehicle over two or more future durations. Each of the future durations can be associated with a future start time for the duration, and extend at least as long as the expected duration. The service provider system can compare the future vehicle utilization scores to determine a future duration when the vehicle utilization score is lowest. The service provider system can schedule the vehicle assignment for the selected vehicle at the future start time when the vehicle utilization score is lowest.

[00065] In some implementations, the Vehicle API platform can allow for a service provider system to select a vehicle to implement a vehicle assignment at a future time based on a future vehicle state associated with a plurality of vehicles in the fleet at the future time.

[00066] As an example, the service provider system can select a vehicle to implement an event assignment associated with a first future time. The service provider system can predict a future vehicle state associated with a plurality of vehicles in the fleet at the first future time, and predict a future vehicle utility score associated with each of the plurality of vehicles at the first future time. The service provider system can determine a vehicle among the plurality of vehicles that is associated with a lowest future vehicle utility score, and select the vehicle to implement the event assignment at the first future time. Alternatively, the service provider system can determine one or more vehicles among the plurality of vehicles that are associated with a vehicle utility score below a predetermined threshold score, and select a vehicle to implement the event assignment from among the one or more determined vehicles. Alternatively, the service provider system can predict a fleet utility score at the first future time, and select a vehicle to implement the event assignment such that the fleet utility score is maximized or otherwise increased. The service provider system can schedule the event assignment for the selected vehicle at the first future time.

[00067] As another example, the service provider system can select a vehicle to implement an assignment associated with a first future time and an expected duration. The service provider system can predict a future vehicle state associated with a plurality of vehicles in the fleet at one or more future times proximate to the first future time, and predict a future vehicle utilization score associated with each of the plurality of vehicles over the expected duration starting at the first future time. The service provider system can determine a vehicle among the plurality of vehicles that is associated with a lowest future vehicle utilization score, and select the vehicle to implement the vehicle assignment at the first future time.

Alternatively, the service provider system can determine one or more vehicles among the plurality of vehicles that are associated with a vehicle utilization score below a predetermined threshold score, and select a vehicle to implement the vehicle assignment from among the one or more determined vehicles. Alternatively, the service provider system can predict a fleet utilization score over the expected duration starting at the first future time, and select a vehicle to implement the vehicle assignment such that the fleet utilization score is maximized or otherwise increased. The service provider system can schedule the vehicle assignment for the selected vehicle at the first future time.

[00068] In some implementations, the Vehicle API platform can allow for a service provider system to determine one or more preconditions associated with a vehicle assignment. The service provider system can schedule the vehicle assignment based on the one or more preconditions.

[00069] As an example, a maintenance assignment to refuel can be associated with a precondition that a vehicle's fuel tank is less than a quarter full. The service provider system can determine that a future vehicle state predicted for the vehicle at a first future time will indicate that the vehicle's fuel tank will be less than a quarter full. The service provider system can schedule the maintenance assignment for the vehicle in proximity to the first future time.

[00070] As another example, a fleet rollout assignment to install a new hardware component can be associated with a first precondition that a maintenance location is able to accommodate the vehicle, and a second precondition that the maintenance location has an inventory of the new hardware component. The service provider system can schedule the fleet rollout assignment for the vehicle at a first future time when the first and second preconditions are met.

[00071] In some implementations, the Vehicle API platform can provide for a service provider system to edit a scheduled vehicle assignment. The service provider system can edit a scheduled vehicle assignment, for example, in response to determining updated vehicle state information and/or updated vehicle assignment information.

[00072] As an example, the service provider system can predict that a vehicle's fuel tank will be less than a quarter full at a first future time, and schedule a maintenance assignment to refuel the vehicle at the first future time. The service provider system can receive data including updated vehicle state information from the vehicle at one or more times before the first future time, and predict an updated future vehicle state associated with the vehicle. The updated future vehicle state can indicate, for example, that the vehicle's fuel tank will be less

than a quarter full at a second future time before/after the first future time. The service provider can reschedule the maintenance assignment for the vehicle at the second future time, based on the updated vehicle state information.

[00073] As another example, the service provider system can schedule a fleet rollout assignment to install a new hardware component for a vehicle at a first future time based on a vehicle utilization score associated with the vehicle for an expected duration of the fleet rollout assignment starting at the first future time. The service provider system can later determine an updated expected duration associated with the fleet rollout assignment that is shorter. The service provider system can update the scheduled vehicle assignment to reflect the shorter expected duration. Additionally, if the service provider system predicts that the vehicle will be associated with a lower vehicle utilization score over the updated expected duration starting at a second future time, then the service provider system can reschedule the fleet rollout assignment at the second future time.

[00074] In some implementations, Vehicle API platform can provide for a service provider system to send a control message to a vehicle instructing the vehicle to implement a scheduled vehicle assignment. For example, the service provider system can provide a control message instructing the vehicle to autonomously travel to a location associated with the vehicle assignment at a scheduled time associated with the vehicle service.

[00075] In some implementations, the Vehicle API platform can provide for a service provider system to send an advisory to a vehicle to notify a vehicle operator associated with the vehicle of a vehicle assignment scheduled for the vehicle. The advisory can include one or more attributes associated with the vehicle assignment, such as for example, a scheduled time, location, expected duration, etc. In some implementations, the service provider system can provide one or more advisories at one or more times ahead of a scheduled time associated with the vehicle assignment.

[00076] In some implementations, the Vehicle API platform can provide for a service provider system to send an advisory to a vehicle based on vehicle state information associated with the vehicle. The service provider system can provide the advisory based on a predetermined set of rules corresponding to the vehicle state information. For example, the service provider system can provide an advisory to a vehicle to notify a vehicle operator associated with the vehicle that a vehicle attribute associated with the vehicle has changed, indicating that the vehicle's activity has changed from being grounded to being ready.

[00077] The systems and methods described herein provide a number of technical effects and benefits. Systems and methods for accessing vehicle state information associated with

the vehicles can have a technical effect of improving efficiency in fleet resource management. By enabling access, collection, and analysis of the vehicle state information, a future vehicle utility/utilization and a future fleet utility/utilization can be predicted. In this way, vehicle assignments can be scheduled for vehicles so that the utility/utilization can be improved. Additionally, the systems and methods can enable dynamic control of vehicle state monitoring and assignment scheduling across the fleet of vehicles.

[00078] The systems and methods of the present disclosure also provide an improvement to vehicle computing technology, such as autonomous vehicle computing technology. For instance, the systems and methods herein enable the vehicle technology to collect and provide detailed vehicle state information. For example, the systems and methods can allow one or more computing system(s) on-board an autonomous vehicle (and/or off-board a vehicle) to collect vehicle state information, determine utilization patterns, and predict future utility/utilization.

EXAMPLE EMBODIMENTS

[00079] Reference now will be made in detail to embodiments, one or more example(s) of which are illustrated in the drawings. Each example is provided by way of explanation of the embodiments, not limitation of the present disclosure. In fact, it will be apparent to those skilled in the art that various modifications and variations can be made to the embodiments without departing from the scope or spirit of the present disclosure. For instance, features illustrated or described as part of one embodiment can be used with another embodiment to yield a still further embodiment. Thus, it is intended that aspects of the present disclosure cover such modifications and variations.

[00080] With reference now to the FIGS., example embodiments of the present disclosure will be discussed in further detail. FIG. 1 depicts an example system 100 according to example embodiments of the present disclosure. The system 100 can include a vehicle computing system 102 associated with a vehicle 104. The system 100 can also include one or more additional vehicle(s) 105, each including a respective vehicle computing system (not shown).

[00081] In some implementations, the system 100 can include one or more remote computing system(s) 103 that are remote from the vehicle 104 and the additional vehicle(s) 105. The remote computing system(s) 103 can include an operations computing system 120.

The remote computing system(s) 103 can be separate from one another or share computing device(s). The operations computing system 120 can remotely manage the vehicle 104.

[00082] In some implementations, the vehicle 104 can be part of a fleet of vehicles managed by the operations computing system 120. Additionally, the one or more additional vehicle(s) 105 can be part of the fleet of vehicles managed by the operations computing system 120.

[00083] The vehicle computing system 102 can include one or more computing device(s) located on-board the vehicle 104 (e.g., located on and/or within the vehicle 104). The computing device(s) can include various components for performing various operations and functions. For instance, the computing device(s) can include one or more processor(s) and one or more tangible, non-transitory, computer readable media. The one or more tangible, non-transitory, computer readable media can store instructions that when executed by the one or more processor(s) cause the vehicle 104 (e.g., its computing system, one or more processors, etc.) to perform operations and functions, such as those described herein.

[00084] In some implementations, the vehicle computing system 102 can include a Vehicle API client that can enable bidirectional communication with a service provider's system (e.g., an operations computing system) through a Vehicle API Platform operating on the service provider's system. For example, the Vehicle API Platform and the Vehicle API client can provide for establishing communication tunnels between the vehicle computing system and the service provider system. In some implementations, the Vehicle API client can provide for communicating data using intelligent quality of service (QoS), multiplexing data over different communication streams, prioritizing and/or de-prioritizing data traffic dynamically, for example, based on link conditions and/or the like.

[00085] In some implementations, the operations computing system 120 can include a Vehicle API platform that can provide for a translation/transport layer as an interface between vehicle computing systems onboard vehicles within an entity's fleet and one or more remote clients and/or applications operating within the entity's operations/control center. For example, the Vehicle API platform can receive data from a vehicle over a communications pipeline established between the Vehicle API and the vehicle (e.g., the vehicle computing system) and provide for different means of classifying the data, writing the data consistently on different messaging protocols, and providing a platform that can aggregate data for other clients/applications in consistent ways. The Vehicle API platform can provide for communicating vehicle data to the operations/control center in a secure manner that allows

for expanded processing of vehicle data off the vehicle, analyzing such data in real time, and/or the like.

[00086] As shown in FIG. 1, the vehicle 104 can include one or more sensors 108, an autonomy computing system 110, a vehicle control system 112, a communications system 114, and a memory system 116. One or more of these systems can be configured to communicate with one another via a communication channel. The communication channel can include one or more data buses (e.g., controller area network (CAN)), on-board diagnostics connector (e.g., OBD-II), and/or a combination of wired and/or wireless communication links. The on-board systems can send and/or receive data, messages, signals, etc. amongst one another via the communication channel.

[00087] The sensor(s) 108 can be configured to acquire sensor data 109 associated with one or more objects that are proximate to the vehicle 104 (e.g., within a field of view of one or more of the sensor(s) 108). As shown in FIG. 2, the sensor(s) 108 can include one or more cameras 230 (e.g., visible spectrum cameras, infrared cameras, etc.), a Light Detection and Ranging (LIDAR) system 232, a Radio Detection and Ranging (RADAR) system 234, motion sensors, and/or other types of imaging capture devices and/or sensors. The sensor data 109 can include image data, radar data, LIDAR data, and/or other data acquired by the sensor(s) 108. The object(s) can include, for example, pedestrians, vehicles, bicycles, and/or other objects. The object(s) can be located in front of, to the rear of, and/or to the side of the vehicle 104. The sensor data 109 can be indicative of locations associated with the object(s) within the surrounding environment of the vehicle 104 at one or more times. The sensor(s) 108 can provide the sensor data 109 to the autonomy computing system 110.

[00088] As shown in FIG. 2, the autonomy computing system 110 can include a perception system 202, a prediction system 204, a motion planning system 206, and/or other systems that cooperate to perceive the surrounding environment of the vehicle 104 and determine a motion plan for controlling the motion of the vehicle 104 accordingly. For example, the autonomy computing system 110 can receive the sensor data 109 from the sensor(s) 108, attempt to comprehend the surrounding environment by performing various processing techniques on the sensor data 109 (and/or other data), and generate an appropriate motion plan through such surrounding environment. The autonomy computing system 110 can control one or more components of the vehicle control system 112 to operate the vehicle 104 according to the motion plan.

[00089] The autonomy computing system 110 can identify one or more objects that are proximate to the vehicle 104 based at least in part on the sensor data 109. For instance, the

perception system 202 can perform various processing techniques on the sensor data 109 to determine perception data 262 that is descriptive of a current state of one or more object(s) that are proximate to the vehicle 104. The prediction system 204 can create prediction data 264 associated with each of the respective one or more object(s) proximate to the vehicle 104. The prediction data 264 can be indicative of one or more predicted future locations of each respective object. The motion planning system 206 can determine a motion plan for the vehicle 104 based at least in part on the prediction data 264 (and/or other data), and save the motion plan as motion plan data 266. The motion plan data 266 can include vehicle actions with respect to the object(s) proximate to the vehicle 104 as well as the predicted movements. The motion plan data 266 can include a planned trajectory, speed, acceleration, etc. of the vehicle 104.

[00090] The motion planning system 206 can provide at least a portion of the motion plan data 266 that indicates one or more vehicle actions, a planned trajectory, and/or other operating parameters to the vehicle control system 112 to implement the motion plan for the vehicle 104. For instance, the vehicle 104 can include a mobility controller configured to translate the motion plan data 266 into instructions. By way of example, the mobility controller can translate the motion plan data 266 into instructions to adjust the steering of the vehicle 104 "X" degrees, apply a certain magnitude of braking force, etc. The mobility controller can send one or more control signals to one or more responsible system(s) included in the vehicle control system (e.g., powertrain control system 220, steering control system 222, braking control system 224) to execute the instructions and implement the motion plan.

[00091] The communications system 114 can allow the vehicle computing system 102 (and its computing system(s), additional vehicle(s) 105) to communicate with other computing systems (e.g., remote computing system(s) 103). For example, the vehicle computing system 102 can use the communications system 114 to communicate with the operations computing system 120 over one or more networks (e.g., via one or more wireless signal connections). In some implementations, the communications system 114 can allow communication among one or more of the system(s) on-board the vehicle 104. The communications system 114 can include any suitable sub-systems for interfacing with one or more network(s), including, for example, transmitters, receivers, ports, controllers, antennas, and/or other suitable sub-systems that can help facilitate communication.

[00092] The memory system 116 of the vehicle 104 can include one or more memory devices located at the same or different locations (e.g., on-board the vehicle 104, distributed throughout the vehicle 104, off-board the vehicle 104, etc.). The vehicle computing system

102 can use the memory system 116 to store and retrieve data/information. For instance, the memory system 116 can store map data 260, perception data 262, prediction data 264, motion plan data 266, and vehicle state data 270.

[00093] The map data 260 can include information regarding: an identity and location of different roadways, road segments, buildings, or other items or objects (e.g., lampposts, crosswalks, curbing, etc.); a location and direction of traffic lanes (e.g., the location and direction of a parking lane, a turning lane, a bicycle lane, or other lanes within a particular roadway or other travel way and/or one or more boundary markings associated therewith); and/or any other data that assists the vehicle computing system 102 in comprehending and perceiving its surrounding environment and its relationship thereto.

[00094] The vehicle state data 270 can include information regarding vehicle state information associated with the vehicle 104. The vehicle computing system 102 can obtain the vehicle state information from one or more sources. For example, the vehicle computing system 102 can monitor the vehicle 104 to determine one or more vehicle attributes (e.g., vehicle activity information) associated with the vehicle 104, and store information indicative of the determination in the vehicle state data 270 as the vehicle state information. As another example, the vehicle computing system 102 can obtain data indicative of one or more vehicle attributes (e.g., vehicle schedule information) associated with the vehicle 104 from the operations computing system 120. Additionally, the vehicle computing system 102 can send the vehicle state data 270, or at least a part thereof, to the operations computing system 120 at one or more times (e.g., via the Vehicle API platform). In some implementations, the vehicle state information can include other data relating to the collection, analysis, and transmission of the vehicle state information. In some implementations, the vehicle state data 270 can include vehicle assignment information regarding one or more vehicle assignments scheduled for the vehicle 104. The vehicle computing system 102 can obtain the vehicle assignment information from one or more sources. For example, the vehicle computing system 102 can obtain data indicative of vehicle assignment information associated with the vehicle 104 from the operations computing system 120.

[00095] FIG. 3 depicts a block diagram of an example vehicle-operations system interface 300 according to example embodiments of the present disclosure. The systems and methods of the present disclosure can provide for secure, bidirectional communications between one or more vehicles in a service provider's fleet, such as the vehicle 104 and the service provider's operations or control center, such as an operations system 302 associated with the operations computing system 120.

[00096] As illustrated in FIG. 3, the vehicle-operations system interface 300 can include a Vehicle API 304 associated with an operations system 302. The Vehicle API 304 can provide for a translation/transport layer as an interface between vehicle computing systems onboard vehicles within an entity's fleet (e.g., vehicle 104, additional vehicle(s) 105, and/or the like) and one or more remote clients and/or applications operating within the entity's operations/control center (e.g., operations system 302).

[00097] The Vehicle API 304 can include an offboard gateway 306 which can provide for establishing one or more communication channels between the Vehicle API 304 and a vehicle, such as vehicle 104 (e.g., via vehicle computing system 102, etc.). The offboard gateway 306 can establish multiplexing connections between the vehicle 104 and the Vehicle API 304 that can be used to send arbitrary communications through the same connections.

[00098] In some implementations, the Vehicle API 304, through offboard gateway 306, can provide for establishing multiple hypertext transfer protocol (or other suitable protocol) connections, for example, using HTTP/2, between a Vehicle API relay/client 308 and the offboard gateway 306, allowing the ability to parallelize and assert traffic priority within a connection. In some implementations, the offboard gateway 306 of Vehicle API 304 can establish at least two hypertext transfer protocol (or other suitable protocol) connections, such as HTTP/2 connections, to the operations computing system from a vehicle, where at least one connection can be dedicated to high reliability, high deliverability traffic and at least one connection can be dedicated to best-effort, unguaranteed traffic. In some implementations, the use of multiple connections can allow for the underlying transport to be controlled in terms of different connections having different weights such that data can be identified as more important.

[00099] The vehicle 104 can include a Vehicle API relay/client 308, for example, associated with a vehicle computing system 102, which can provide for establishing the one or more communication channels between the offboard gateway 306 of the Vehicle API 304 and the vehicle 104. In some implementations, the Vehicle API relay/client 308 onboard the vehicle 104 can provide for communicating data using intelligent quality of service (QoS), multiplexing data over different communication streams, prioritizing and/or de-prioritizing data traffic dynamically, for example, based on link conditions and/or the like. In some implementations, the Vehicle API relay/client 308 can provide for making determinations about what data it thinks is more important and handling the communication of that data as appropriate.

[000100] In some implementations, the Vehicle API 304, through offboard gateway 306 and Vehicle API relay/client 308, can provide for communicating onboard data traffic 310 (e.g., telemetry, vehicle state information, etc.) from the vehicle 104 to the operations system 302. For example, the offboard gateway 306 can receive the onboard data traffic 310 from the Vehicle API relay/client 308 and the Vehicle API 304 can provide for handling the onboard data traffic 310 and providing the onboard data traffic 310 to one or more clients and/or application associated with the operations system 302 in client messages 314.

[000101] In some implementations, the Vehicle API 304, through offboard gateway 306 and Vehicle API relay/client 308, can provide for communicating authenticated vehicle messages 312 from the operations system 302 to the vehicle 104 (e.g., to a vehicle computing system, etc.). For example, the offboard gateway 306 can receive vehicle messages 316 from one or more clients/applications associated with the operations system 302 (e.g., messages signed by the client to allow for authenticating the messages before sending to a vehicle) and the Vehicle API 304 can provide for communicating the vehicle messages 316 to the vehicle 104, through offboard gateway 306 and Vehicle API relay/client 308, as authenticated vehicle messages 312 (e.g., once the Vehicle API 304 has authenticated the signed vehicle messages 316).

[000102] In some implementations, the Vehicle API 304 can allow for a vehicle 104 to send multiple types of data to the operations system 302 over the established connections with the vehicle 104. For instance, in some implementations, the Vehicle API 304 can provide for a vehicle 104 sending vehicle state data 270 to the operations system 302. In some implementations, the Vehicle API 304 can provide for a vehicle 104 to send low resolution perception data, such as labels and/or geometries, to the operations system, allowing for processing the data offboard the vehicle 104 by one or more clients/applications associated with the operations system 302 and allowing for developing a better understanding of the world. In some implementations, the Vehicle API 304 can provide for a vehicle to send data such as current vehicle pose (e.g., global and relative to map), vehicle trajectory, onboard diagnostics, and/or the like, to the operations system 302 to be processed by one or more clients/applications associated with the operations system 302, for example.

[000103] In some implementations, the Vehicle API 304 can provide for the operations system 302 to receive multiple types of data from the vehicle 104 and/or additional vehicle(s) 105. For example, the Vehicle API 304 can provide for the operations system 302 to receive multiple types of data from the vehicle 104 over the established connections with the vehicle 104. In some implementations, the Vehicle API 304 can provide for receiving vehicle state

data 270 from the vehicle 104 at one or more times, and analyzing the vehicle state data 270 to determine a vehicle state associated with the vehicle 104.

[000104] In some implementations, the Vehicle API 304 can provide for the operations system 302 to aggregate data (e.g., vehicle state information) associated with the vehicle 104 and/or additional vehicle(s) 105. The operations system 302 can, for example, analyze the aggregated data to determine a vehicle utility and/or utilization score associated with the vehicle 104 and/or additional vehicle(s) 105. Additionally, the operations system 302 can, for example, determine a fleet utility and/or utilization score associated with fleet.

[000105] In some implementations, the Vehicle API 304 can provide for the operations system 302 to determine one or more utilization patterns associated with the vehicle 104 and/or additional vehicle(s) 105.

[000106] In some implementations, the Vehicle API 304 can provide for the operations system 302 to extrapolate the one or more utilization patterns associated with the vehicle 104 and/or additional vehicle(s) 105 to one or more future times to predict one or more vehicle attributes associated with the vehicle 104 and/or additional vehicle(s) 105 at the one or more future times. In some implementations, the operations system 302 can, for example, extrapolate the one or more utilization patterns to predict a future vehicle state associated with the vehicle 104 and/or additional vehicle(s) 105 at a future time, and predict a future vehicle utility and/or utilization associated with the vehicle 104 and/or additional vehicle(s) 105 at the future time. Additionally, the operations system 302 can, for example, predict a future fleet utility and/or utilization associated with the fleet at the future time.

[000107] In some implementations, the Vehicle API 304 can provide for the operations system 302 to send multiple types of data to the vehicle 104 and/or additional vehicle(s) 105. For example, the Vehicle API 304 can provide for the operations system 302 to send multiple types of data to the vehicle 104 over the established connections to the vehicle 104. For example, in some implementations, the Vehicle API 304 can provide for sending vehicle assignment data to the vehicle 104, such as instructions for the vehicle 104 to offload the data from its computing system, instructions for the vehicle 104 to report for maintenance, instructions for a vehicle to procure fuel, and/or the like. In some implementations, the Vehicle API 304 can provide for sending command signals to the vehicle 104, such as, for example, sending specific control messages to the vehicle 104, sending advisories to the vehicle 104, etc. The specific control messages can, for example, instruct the vehicle 104 to go to certain geographic coordinates. The advisories can, for example, notify a vehicle operator associated with the vehicle 104 about scheduled vehicle assignments, flagged geo

regions (e.g., areas to avoid, areas to spend more time in to acquire passengers, areas under construction that should be routed around, etc.), etc.

[000108] In some implementations, the Vehicle API 304 can provide for the operations system 302 to schedule a vehicle assignment for the vehicle 104 and/or additional vehicle(s) 105. The operations system 302 can schedule a vehicle assignment for the vehicle 104 and/or additional vehicle(s) 105 at one or more future times.

[000109] In some implementations, the Vehicle API 304 can allow for the operations system 302 to select the vehicle 104 to implement a vehicle assignment at a future time based on a future vehicle state associated with the vehicle 104.

[000110] In some implementations, the Vehicle API 304 can allow for the operations system 302 to select vehicle 104 to implement a vehicle assignment at a future time based on a future vehicle state associated with the vehicle 104 and a future vehicle state associated with the additional vehicle(s) in the fleet at the future time.

[000111] In some implementations, the Vehicle API 304 can allow for the operations system 302 to determine one or more preconditions associated with a vehicle assignment. The operations system 302 can schedule the vehicle assignment based on the one or more preconditions.

[000112] In some implementations, the Vehicle API 304 can provide for the operations system 302 to edit a scheduled vehicle assignment. The operations system 302 can edit a scheduled vehicle assignment, for example, in response to determining updated vehicle state information and/or updated vehicle assignment information.

[000113] In some implementations, Vehicle API 304 can provide for the operations system 302 to send a control message to the vehicle 104 instructing the vehicle 104 to implement a scheduled vehicle assignment. For example, the operations system 302 can provide a control message instructing the vehicle 104 to autonomously travel to a location associated with the vehicle assignment at a scheduled time associated with the vehicle service.

[000114] In some implementations, the Vehicle API 304 can provide for the operations system 302 to send an advisory to the vehicle 104 to notify a vehicle operator associated with the vehicle 104 of a vehicle assignment scheduled for the vehicle 104. In some implementations, the operations system 302 can provide one or more advisories at one or more times ahead of a scheduled time associated with the vehicle assignment.

[000115] In some implementations, the Vehicle API 304 platform can provide for the operations system 302 to send an advisory to the vehicle 104 based on vehicle state information associated with the vehicle 104.

[000116] FIG. 4 depicts example vehicle state information according to example embodiments of the present disclosure. In some implementations, the vehicle state information depicted in FIG. 4 or variations thereof can be provided as part of a graphical user interface available at one or more computing systems, such as vehicle computing system 102 and/or operations computing system 120 or other remote computing system 103. As shown in FIG. 4, the vehicle state information can include vehicle activity information, vehicle schedule information, trip availability information, and vehicle readiness information. In particular, the vehicle sate information can include one or more vehicle attributes that are associated with the vehicle 104 at one or more times.

[000117] FIG. 5 depicts example aggregated vehicle state information according to example embodiments of the present disclosure. In some implementations, the aggregated vehicle state information depicted in FIG. 5 or variations thereof can be provided as part of a graphical user interface available at one or more computing systems, such as vehicle computing system 102 and/or operations computing system 120 or other remote computing system 103. As shown in FIG. 5, the aggregated vehicle state information can include vehicle activity information associated with a plurality of vehicles in the fleet at one or more times. FIG. 5 depicts a percentage of vehicles in the fleet that are associated with vehicle attributes indicative of vehicle activity information (e.g., autonomous mode, manual mode, deploying, parked, keyed-off, and no-signal) at a present time and one or more past times. FIG. 5 also depicts a prediction of what percentage of the vehicles in the fleet will be associated with each of the vehicle attributes one or more future times.

[000118] FIGS. 6A-6C depict example aggregated vehicle state information according to example embodiments of the present disclosure. In some implementations, the aggregated vehicle state information depicted in FIGS. 6A-6C or variations thereof can be provided as part of a graphical user interface available at one or more computing systems, such as vehicle computing system 102 and/or operations computing system 120 or other remote computing system 103. As shown in FIGS. 6A-6C, the aggregated vehicle state information can include vehicle readiness information, vehicle schedule information, and vehicle activity information associated with a plurality of vehicles in the fleet at a particular moment. FIGS. 6A-6C depict a graphical representation of vehicles in the fleet that are associated with vehicle attributes indicative of vehicle readiness information, vehicle schedule information, or vehicle activity information.

[000119] FIG. 6A depicts a first graphical representation of a distribution of the vehicles in the fleet based on an association of the vehicles with vehicle attributes indicative of

troubleshooting, grounded, and ready. FIG. 6A additionally depicts a distribution of the vehicles associated with troubleshooting, based on an association of the vehicles with vehicle attributes indicative of tier 1 and tier 2. FIG. 6A additionally depicts a distribution of the vehicles associated with grounded, based on an association of the vehicles with vehicle attributes indicative of maintenance and fleet rollout. FIG. 6A additionally depicts a distribution of the vehicles associated with ready, based on an association of the vehicles with vehicle attributes indicative of a vehicle operator being assigned to the vehicles.

[000120] FIG. 6B depicts a second graphical representation of a distribution of the vehicles in the fleet based on an association of the vehicles with vehicle attributes indicative of troubleshooting, grounded, and ready.

[000121] FIG. 6C depicts a third graphical representation of a distribution of the vehicles in the fleet based on an association of the vehicles with vehicle attributes indicative of troubleshooting, grounded, and ready. FIG. 6C additionally depicts a distribution of the vehicles associated with troubleshooting and tier 2, based on an association of the vehicles with vehicle attributes indicative of remote troubleshooting and hand-on troubleshooting. FIG. 6C additionally depicts a distribution of the vehicles associated with ready, based on an association of the vehicles with vehicle attributes indicative of an autonomous mode and manual mode.

[000122] FIG. 7 depicts example vehicle assignment information according to example embodiments of the present disclosure. In some implementations, the vehicle assignment information depicted in FIG. 7 or variations thereof can be provided as part of a graphical user interface available at one or more computing systems, such as vehicle computing system 102 and/or operations computing system 120 or other remote computing system 103. As shown in FIG. 7, the vehicle assignment information can include a vehicle task during which the vehicle assignment is to be implemented, a type of the vehicle assignment (e.g., maintenance assignment, fleet rollout assignment, trade dressing assignment, or event assignment), assignment attributes (e.g., time, location, expected duration, contact, and notes).

[000123] FIGS. 8 and 9 depict flow diagrams of example methods 800 and 900 according to example embodiments of the present disclosure. One or more portion(s) of the methods 800 and 900 can be implemented as operations by one or more computing system(s) such as, for example, the computing system(s) 102, 120, 1001, and 1010 shown in FIGS. 1 and 10. Moreover, one or more portion(s) of the methods 800 and 900 can be implemented as an algorithm on the hardware components of the system(s) described herein (e.g., as in FIGS. 1,

2, and 10) to, for example, manage a fleet of vehicles, or implement a vehicle assignment. FIGS. 8 and 9 depict elements performed in a particular order for purposes of illustration and discussion. Those of ordinary skill in the art, using the disclosures provided herein, will understand that the elements of any of the methods (e.g., of FIGS. 8 or 9) discussed herein can be adapted, rearranged, expanded, omitted, combined, and/or modified in various ways without deviating from the scope of the present disclosure.

[000124] FIG. 8 depicts a diagram of a method 800 for managing a fleet of vehicles. At (802), the method 800 can include obtaining vehicle state information. For example, the operations computing system 120 can obtain data representing vehicle state information associated with the vehicle 104 and/or the additional vehicles 105 at one or more times. The vehicle state information can include one or more vehicle attributes associated with the vehicle 104 and/or the additional vehicles 105, the one or more vehicle attributes indicating one or more of a vehicle activity, vehicle schedule, trip availability, and vehicle readiness.

[000125] At (804), the method 800 can include predicting a future vehicle state. For example, the operations computing system 120 can predict a future vehicle state associated with the vehicle 104 and/or the additional vehicles 105 at one or more future times based at least in part on the vehicle state information. The operations computing system 120 can aggregate the vehicle state information associated with the vehicle 104 and/or the additional vehicles 105 at one or more times. The operations computing system 120 can analyze the aggregated vehicle state information to determine one or more utilization patterns associated with the vehicle 104 and/or the additional vehicles 105. In some implementations, the operations computing system 120 can determine one or more times when the vehicle 104 and/or the additional vehicles 105 are associated with one or more vehicle attributes, and determine a utilization pattern for each of the one or more vehicle attributes over a duration corresponding to the one or more times when the vehicle 104 and/or the additional vehicles 105 are associated with the one or more vehicle attributes. The operations computing system 120 can predict the future vehicle state associated with the vehicle 104 and/or the additional vehicles 105 at one or more future times based at least in part on the one or more utilization patterns. In some implementations, the operations computing system 120 can determine one or more vehicle utilization scores, each vehicle utilization score associated with the vehicle 104 and/or the additional vehicles 105 and based at least in part on a future vehicle state associated with the vehicle 104 and/or the additional vehicles 105 at the one or more future times; and determine a fleet utilization score associated with the fleet of vehicles, based at least in part on the one or more vehicle utilization scores. In some implementations, the

operations computing system 120 can update the predicted future vehicle state associated with the vehicle 104 and/or the additional vehicles 105 at the first future time, and select a vehicle to implement the vehicle assignment among the vehicle 104 and/or the additional vehicles 105 based at least in part on the updated future vehicle state associated with the vehicle 104 and/or the additional vehicles 105 at the first future time.

[000126] At (806), the method 800 can include scheduling a vehicle assignment. For example, the operations computing system 120 can schedule a vehicle assignment in a predetermined set of vehicle assignments for the vehicle 104 and/or the additional vehicles 105 before a first future time among the one or more future times based at least in part on a future vehicle state associated with the vehicle 104 and/or the additional vehicles 105 at the first future time. The predetermined set of vehicle assignments can include one or more assignments based at least in part on vehicle state information associated with the vehicle 104 and/or the additional vehicles 105, and/or one or more assignments based at least in part on a predetermined calendar of events. In some implementations, the operations computing system 120 can determine one or more preconditions associated with the vehicle assignment, predict one or more future times when the one or more preconditions are met, and schedule the vehicle assignment for the vehicle 104 and/or the additional vehicles 105 at a future time based at least in part on the one or more future times when the one or more preconditions are met. In some implementations, the operations computing system 120 can select a vehicle to implement the vehicle assignment among the vehicle 104 and/or the additional vehicles 105 based at least in part on a future vehicle state associated with the vehicle 104 and/or the additional vehicles 105 at the future time, and schedule the vehicle assignment for the selected vehicle based at least in part on a future vehicle state associated with the selected vehicle at the future time. In some implementations, the operations computing system 120 can edit one or more assignment attributes associated with the vehicle assignment, at one or more times before the first future time. In some implementations, the operations computing system 120 can select a first vehicle among the vehicle 104 and/or the additional vehicles 105 at a first time before the first future time, schedule the vehicle assignment for the first vehicle at the first time, select a second vehicle among the vehicle 104 and/or the additional vehicles 105 at a second time before the first future time, and reschedule the vehicle assignment for the second vehicle at the second time.

[000127] At (808), the method 800 can include transmitting a command signal. For example, the operations computing system 120 can transmit a command signal to a computing system associated with the vehicle 104 and/or the additional vehicles 105 based at

least in part on the scheduled vehicle assignment. In some implementations, the operations computing system 120 can transmit a command signal to provide an advisory that notifies a vehicle operator associated with the vehicle 104 and/or the additional vehicles 105 about the scheduled vehicle assignment for the vehicle 104 and/or the additional vehicles 105, the advisory including one or more assignment attributes associated with the scheduled vehicle assignment. In some implementations, the operations computing system 120 can transmit a command signal to control the vehicle 104 and/or the additional vehicles 105 to autonomously implement the scheduled vehicle assignment.

[000128] FIG. 9 depicts a diagram of a method 900 for implementing a vehicle assignment. At (902), the method 900 can include obtaining vehicle state information. For example, the vehicle computing system 102 can obtain data representing vehicle state information associated with the vehicle 104 at one or more collection times. The vehicle state information can include one or more vehicle attributes associated with the vehicle 104, the one or more vehicle attributes indicating one or more of a vehicle activity, vehicle schedule, trip availability, and vehicle readiness.

[000129] At (904), the method 900 can include transmitting vehicle state information. For example, the vehicle computing system 102 can transmit the vehicle state information to one or more remote computing systems at one or more transmission times.

[000130] At (906), the method 900 can include receiving a command signal. For example, the vehicle computing system 102 can receive a command signal from the one or more remote computing systems, the command signal indicative of a scheduled vehicle assignment for the vehicle 104 based at least in part on the vehicle state information. In some implementations, the vehicle computing system 102 can receive a command signal to provide an advisory that notifies a vehicle operator associated with the vehicle 104 about the scheduled vehicle assignment for the vehicle 104, the advisory including one or more assignment attributes associated with the scheduled vehicle assignment.

[000131] At (908), the method 900 can include implementing a vehicle assignment. For example, the vehicle computing system 102 can control, in response to the command signal, the vehicle 104 to implement the scheduled vehicle assignment based at least in part on the command signal. In some implementations, the vehicle computing system 102 can receive a command signal to autonomously control the vehicle 104 to implement the scheduled vehicle assignment.

[000132] FIG. 10 depicts an example computing system 1000 according to example embodiments of the present disclosure. The example system 1000 illustrated in FIG. 10 is

provided as an example only. The components, systems, connections, and/or other aspects illustrated in FIG. 10 are optional and are provided as examples of what is possible, but not required, to implement the present disclosure. The example system 1000 can include the vehicle computing system 102 of the vehicle 104 and, in some implementations, remote computing system(s) 1010 including one or more remote computing system(s) that are remote from the vehicle 104 (e.g., operations computing system 120) that can be communicatively coupled to one another over one or more networks 1020. The remote computing system 1010 can be associated with a central operations system and/or an entity associated with the vehicle 104 such as, for example, a vehicle owner, vehicle manager, fleet operator, service provider, etc.

[000133] The computing device(s) 1001 of the vehicle computing system 102 can include processor(s) 1002 and a memory 1004. The one or more processors 1002 can be any suitable processing device (e.g., a processor core, a microprocessor, an ASIC, a FPGA, a controller, a microcontroller, etc.) and can be one processor or a plurality of processors that are operatively connected. The memory 1004 can include one or more non-transitory computer-readable storage media, such as RAM, ROM, EEPROM, EPROM, one or more memory devices, flash memory devices, etc., and combinations thereof.

[000134] The memory 1004 can store information that can be accessed by the one or more processors 1002. For instance, the memory 1004 (e.g., one or more non-transitory computer-readable storage mediums, memory devices) on-board the vehicle 104 can include computer-readable instructions 1006 that can be executed by the one or more processors 1002. The instructions 1006 can be software written in any suitable programming language or can be implemented in hardware. Additionally, or alternatively, the instructions 1006 can be executed in logically and/or virtually separate threads on processor(s) 1002.

[000135] For example, the memory 1004 on-board the vehicle 104 can store instructions 1006 that when executed by the one or more processors 1002 on-board the vehicle 104 cause the one or more processors 1002 (the vehicle computing system 102) to perform operations such as any of the operations and functions of the vehicle computing system 102, as described herein, one or more operations of method 1000, and/or any other operations and functions of the vehicle computing system 102, as described herein.

[000136] The memory 1004 can store data 1008 that can be obtained, received, accessed, written, manipulated, created, and/or stored. The data 1008 can include, for instance, data associated with perception, prediction, motion plan, maps, vehicle diagnostics, vehicle state information, vehicle assignment information, and/or other data/information as described

herein. In some implementations, the computing device(s) 1001 can obtain data from one or more memory device(s) that are remote from the vehicle 104.

[000137] The computing device(s) 1001 can also include a communication interface 1003 used to communicate with one or more other system(s) on-board the vehicle 104 and/or a remote computing device that is remote from the vehicle 104 (e.g., of remote computing system(s) 1010). The communication interface 1003 can include any circuits, components, software, etc. for communicating via one or more networks (e.g., 1020). In some implementations, the communication interface 1003 can include, for example, one or more of a communications controller, receiver, transceiver, transmitter, port, conductors, software, and/or hardware for communicating data.

[000138] The network(s) 1020 can be any type of network or combination of networks that allows for communication between devices. In some embodiments, the network(s) can include one or more of a local area network, wide area network, the Internet, secure network, cellular network, mesh network, peer-to-peer communication link, and/or some combination thereof, and can include any number of wired or wireless links. Communication over the network(s) 1020 can be accomplished, for instance, via a communication interface using any type of protocol, protection scheme, encoding, format, packaging, etc.

[000139] The remote computing system 1010 can include one or more remote computing devices that are remote from the vehicle computing system 102. The remote computing devices can include components (e.g., processor(s), memory, instructions, data) similar to that described herein for the computing device(s) 1001. Moreover, the remote computing system(s) 1010 can be configured to perform one or more operations of the operations computing system 120, as described herein. Moreover, the computing systems of other vehicles described herein can include components similar to that of vehicle computing system 102.

[000140] Computing tasks discussed herein as being performed at computing device(s) remote from the vehicle can instead be performed at the vehicle (e.g., via the vehicle computing system), or vice versa. Such configurations can be implemented without deviating from the scope of the present disclosure. The use of computer-based systems allows for a great variety of possible configurations, combinations, and divisions of tasks and functionality between and among components. Computer-implemented operations can be performed on a single component or across multiple components. Computer-implemented tasks and/or operations can be performed sequentially or in parallel. Data and instructions can be stored in a single memory device or across multiple memory devices.

[000141] While the present subject matter has been described in detail with respect to specific example embodiments and methods thereof, it will be appreciated that those skilled in the art, upon attaining an understanding of the foregoing can readily produce alterations to, variations of, and equivalents to such embodiments. Accordingly, the scope of the present disclosure is by way of example rather than by way of limitation, and the subject disclosure does not preclude inclusion of such modifications, variations and/or additions to the present subject matter as would be readily apparent to one of ordinary skill in the art.

WHAT IS CLAIMED IS:

1. A computer-implemented method for managing a fleet of vehicles, the method comprising:

obtaining, by a computing system comprising one or more computing devices, data representing vehicle state information associated with one or more vehicles among a fleet of vehicles at one or more times;

predicting, by the computing system, a future vehicle state associated with the one or more vehicles at one or more future times based at least in part on the vehicle state information;

scheduling, by the computing system, a vehicle assignment in a predetermined set of vehicle assignments for a selected vehicle among the one or more vehicles before a first future time of the one or more future times based at least in part on a future vehicle state associated with the selected vehicle at the first future time; and

transmitting, by the computing system, a command signal to a computing system associated with the selected vehicle based at least in part on the scheduled vehicle assignment.

2. The computer-implemented method of claim 1, wherein the vehicle state information includes one or more vehicle attributes associated with the one or more vehicles, the one or more vehicle attributes indicating one or more of a vehicle activity, vehicle schedule, trip availability, and vehicle readiness.

3. The computer-implemented method of any of the preceding claims , wherein the predetermined set of vehicle assignments includes one or more assignments based at least in part on vehicle state information associated with the vehicle.

4. The computer-implemented method of any of the preceding claims , wherein the predetermined set of vehicle assignments includes one or more assignments based at least in part on a predetermined calendar of events.

5. The computer-implemented method of any of the preceding claims , wherein predicting, by the computing system, a future vehicle state associated with the one or more

vehicles at one or more future times based at least in part on the vehicle state information comprises:

aggregating, by the computing system, the vehicle state information associated with one or more vehicles at multiple times;

analyzing, by the computing system, the aggregated vehicle state information to determine one or more utilization patterns associated with the one or more vehicles; and

predicting, by the computing system, the future vehicle state associated with the one or more vehicles at one or more future times based at least in part on the one or more utilization patterns.

6. The computer-implemented method of claim 5, wherein analyzing, by the computing system, the aggregated vehicle state information to determine one or more utilization patterns associated with the one or more vehicles comprises:

determining, by the computing system, multiple times when each of the one or more vehicles is associated with each of one or more vehicle attributes; and

determining, by the computing system, a utilization pattern for each of the one or more vehicle attributes over a duration corresponding to the multiple times when the one or more vehicles are associated with the one or more vehicle attributes.

7. The computer-implemented method of claim 5, wherein predicting, by the computing system, the future vehicle state associated with the one or more vehicles at one or more future times based at least in part on the one or more utilization patterns comprises:

determining, by the computing system, one or more vehicle utilization scores, each vehicle utilization score associated with a vehicle in the one or more vehicles and based at least in part on a future vehicle state associated with the vehicle at the one or more future times; and

determining, by the computing system, a fleet utilization score associated with the fleet of vehicles, based at least in part on the one or more vehicle utilization scores.

8. The computer-implemented method of any of claims 1-5, wherein scheduling, by the computing system, a vehicle assignment in a predetermined set of vehicle assignments for a selected vehicle among the one or more vehicles before a first future time of the one or more future times based at least in part on a future vehicle state associated with the selected vehicle at the first future time comprises:

determining, by the computing system, one or more preconditions associated with the vehicle assignment;

predicting, by the computing system, one or more future times when the one or more preconditions are met;

scheduling, by the computing system, the vehicle assignment for the selected vehicle at a future time based at least in part on the one or more future times when the one or more preconditions are met.

9. The computer-implemented method of any of claims 1-5, or 8, wherein scheduling, by the computing system, a vehicle assignment in a predetermined set of vehicle assignments for a selected vehicle among the one or more vehicles before a first future time of the one or more future times based at least in part on a future vehicle state associated with the selected vehicle at the first future time comprises:

selecting, by the computing system, a vehicle to implement the vehicle assignment among the one or more vehicles based at least in part on a future vehicle state associated with the one or more vehicles at the future time; and

scheduling, by the computing system, the vehicle assignment for the selected vehicle based at least in part on a future vehicle state associated with the selected vehicle at the future time.

10. The computer-implemented method of any of claims 1-5, 8, or 9, further comprising:

editing, by the computing system, one or more assignment attributes associated with the vehicle assignment, at one or more times before the first future time.

11. The computer-implemented method of any of claims 1-5, or 8-10, further comprising:

updating, by the computing system, the predicted future vehicle state associated with the one or more vehicles at the first future time; and

selecting, by the computing system, a vehicle to implement the vehicle assignment among the one or more vehicles based at least in part on the updated future vehicle state associated with the one or more vehicles at the first future time.

12. The computer-implemented method of any of claims 1-5, or 8-11, wherein scheduling, by the computing system, a vehicle assignment in a predetermined set of vehicle assignments for a selected vehicle among the one or more vehicles before a first future time of the one or more future times based at least in part on a future vehicle state associated with the selected vehicle at the first future time comprises:

selecting, by the computing system, a first vehicle among the one or more vehicles at a first time before the first future time;

scheduling, by the computing system, the vehicle assignment for the first vehicle at the first time;

selecting, by the computing system, a second vehicle among the one or more vehicles at a second time before the first future time; and

rescheduling, by the computing system, the vehicle assignment for the second vehicle at the second time.

13. The computer-implemented method of any of claims 1-5, or 8-12, wherein transmitting, by the computing system, a command signal to a computing system associated with the vehicle based at least in part on the scheduled vehicle assignment comprises:

transmitting, by the computing system, a command signal to provide an advisory that notifies a vehicle operator associated with the vehicle about the scheduled vehicle assignment for the vehicle, the advisory including one or more assignment attributes associated with the scheduled vehicle assignment.

14. The computer-implemented method of any of claims 1-5, or 8-13, wherein transmitting, by the computing system, a command signal to a computing system associated with the vehicle based at least in part on the scheduled vehicle assignment comprises:

transmitting, by the computing system, a command signal to control the vehicle to autonomously implement the scheduled vehicle assignment.

15. A computer-implemented method for implementing a vehicle assignment, the method comprising:

obtaining, by a computing system comprising one or more computing devices, data representing vehicle state information associated with a vehicle at one or more collection times;

transmitting, by the computing system, the vehicle state information to one or more remote computing systems at one or more transmission times;

receiving, by the computing system, a command signal from the one or more remote computing systems, the command signal indicative of a scheduled vehicle assignment for the vehicle based at least in part on the vehicle state information; and

controlling, by the computing system, in response to the command signal, the vehicle to implement the scheduled vehicle assignment based at least in part on the command signal.

16. The computer-implemented method of claim 15, wherein the vehicle state information includes one or more vehicle attributes associated with the vehicle, the one or more vehicle attributes indicating one or more of a vehicle activity, vehicle schedule, trip availability, and vehicle readiness.

17. The computer-implemented method of any of claim 15-16, wherein receiving, by the computing system, a command signal from the one or more remote computing system, the command signal indicative of a scheduled vehicle assignment for the vehicle comprises:

receiving, by the computing system, a command signal to provide an advisory that notifies a vehicle operator associated with the vehicle about the scheduled vehicle assignment for the vehicle, the advisory including one or more assignment attributes associated with the scheduled vehicle assignment.

18. The computer-implemented method of any of claim 15-17, wherein receiving, by the computing system, a command signal from the one or more remote computing system, the command signal indicative of a scheduled vehicle assignment for the vehicle comprises:

receiving, by the computing system, a command signal to autonomously control the vehicle to implement the scheduled vehicle assignment.

19. A computing system for managing a fleet of vehicles, the system comprising:

a fleet of vehicles;

a fleet manager that manages the fleet of vehicles;

one or more processors; and

one or more tangible, non-transitory, computer readable media that collectively store instructions that when executed by the one or more processors cause the computing system to perform operations, the operations comprising:

collecting, by one or more vehicle in the fleet, data representing vehicle state information associated with the one or more vehicles at one or more collection times;

transmitting, by the one or more vehicles, data representing the vehicle state information associated with the one or more vehicles, to the fleet manager at one or more transmission times;

obtaining, by the fleet manager, data representing the vehicle state information;

predicting, by the fleet manager, a future vehicle state associated with the one or more vehicles at one or more future times based at least in part on the vehicle state information;

scheduling, by the fleet manager, a vehicle assignment in a predetermined set of vehicle assignments for a selected vehicle among the one or more vehicles before a first future time of the one or more future times based at least in part on a future vehicle state associated with the selected vehicle at the first future time;

transmitting, by the fleet manager, a command signal to the selected vehicle based at least in part on the scheduled vehicle assignment, the command signal indicative of the scheduled vehicle assignment for the selected vehicle;

receiving, by the selected vehicle, a command signal from the one or more remote computing systems, the command signal indicative of a scheduled vehicle assignment for the vehicle based at least in part on the vehicle state information; and

implementing, by the selected vehicle, the scheduled vehicle assignment in response to the command signal.

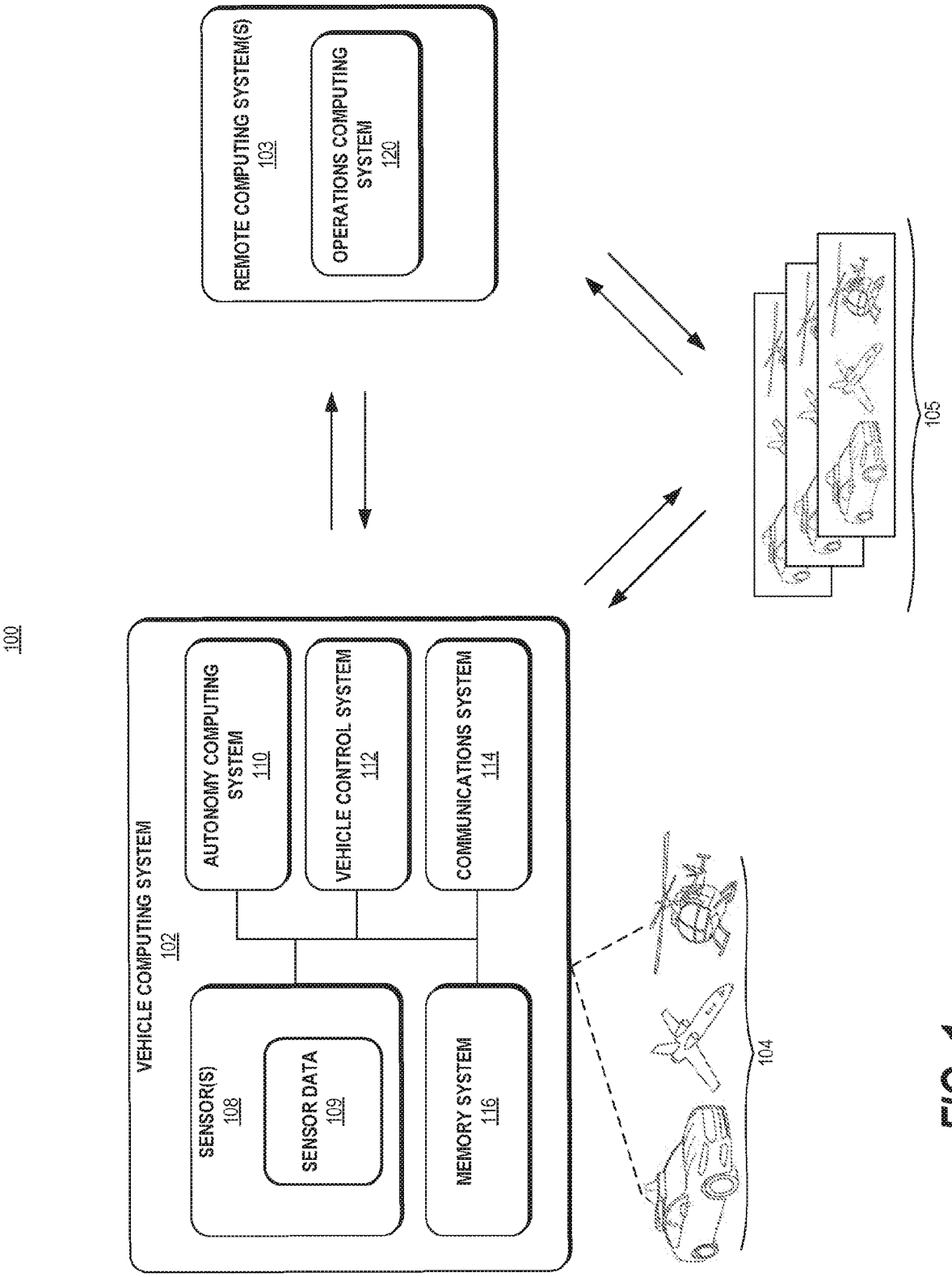

100
VEHICLE COMPUTING SYSTEM
102
AUTONOMY COMPUTING SYSTEM
110
VEHICLE CONTROL SYSTEM
112
COMMUNICATIONS SYSTEM
114
SENSOR(S)
108
SENSOR DATA
109
MEMORY SYSTEM
116
REMOTE COMPUTING SYSTEM(S)
103
OPERATIONS COMPUTING SYSTEM
120
104
105

FIG. 1

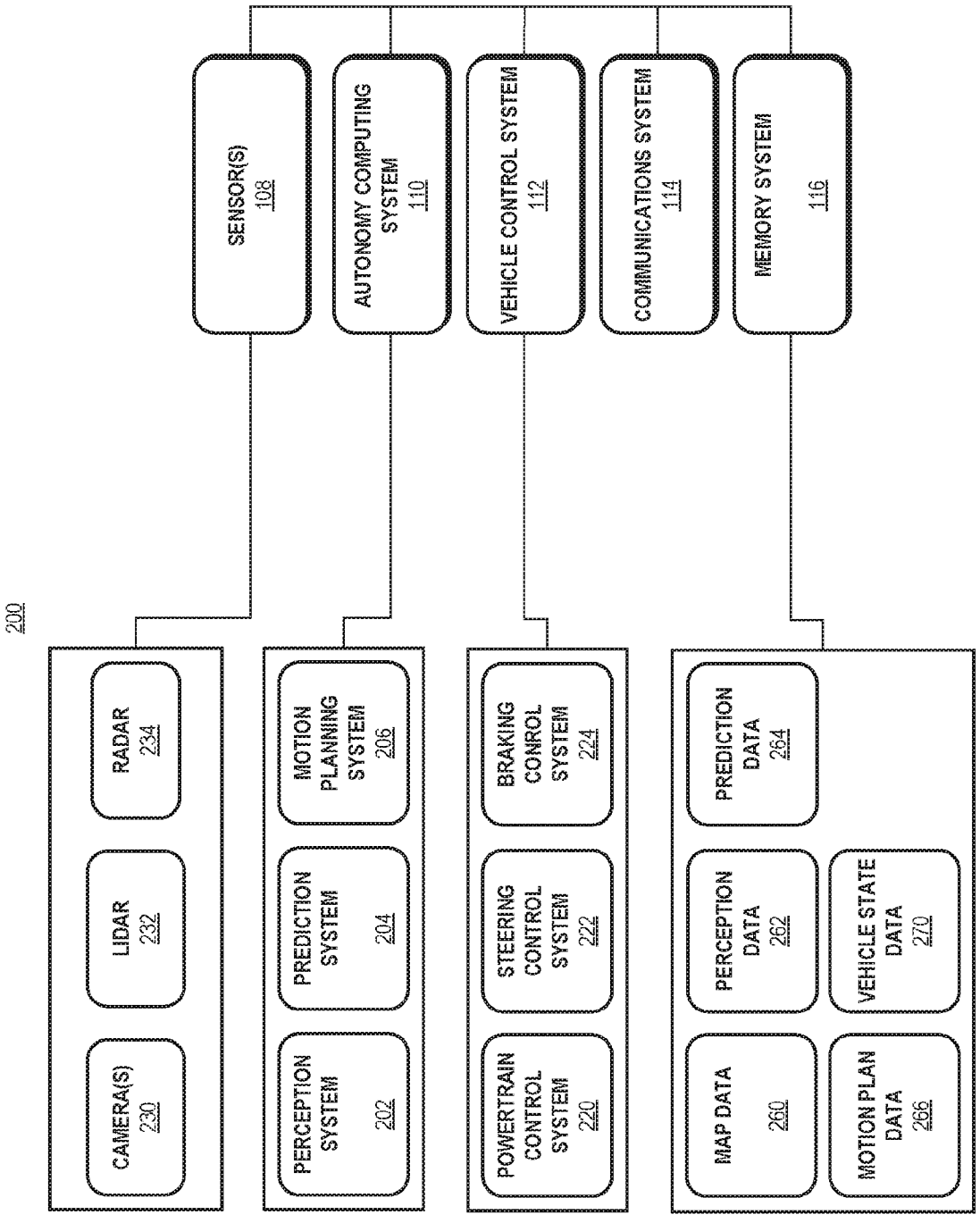

200
SENSOR(S) 108
AUTONOMY COMPUTING SYSTEM 110
VEHICLE CONTROL SYSTEM 112
COMMUNICATIONS SYSTEM 114
MEMORY SYSTEM 116
CAMERA(S) 230
LIDAR 232
RADAR 234
PERCEPTION SYSTEM 202
PREDICTION SYSTEM 204
MOTION PLANNING SYSTEM 206
POWERTRAIN CONTROL SYSTEM 220
STEERING CONTROL SYSTEM 222
BRAKING CONROL SYSTEM 224
MAP DATA 260
PERCEPTION DATA 262
PREDICTION DATA 264
MOTION PLAN DATA 266
VEHICLE STATE DATA 270

FIG. 2

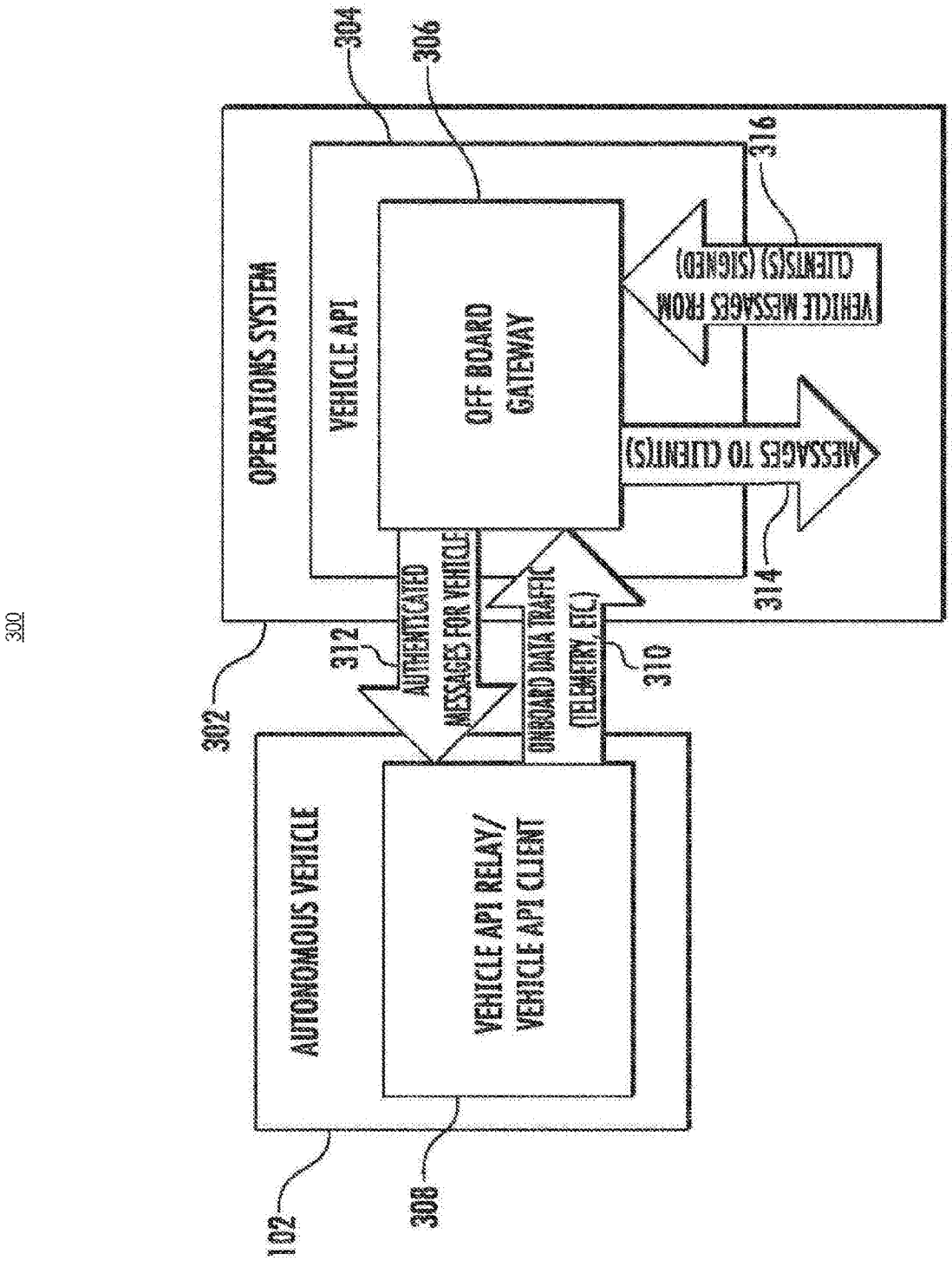

300
304
306
316
OPERATIONS SYSTEM
VEHICLE API
OFF BOARD GATEWAY
VEHICLE MESSAGES FROM CLIENT(S) (SIGNED)
MESSAGES TO CLIENT(S)
314
302
312
AUTHENTICATED MESSAGES FOR VEHICLE
ONBOARD DATA TRAFFIC (TELEMETRY, ETC.)
310
AUTONOMOUS VEHICLE
VEHICLE API RELAY/ VEHICLE API CLIENT
102
308

FIG. 3

Time	Readiness	Activity	Trip Availability	Scheduling	General Operations
5:45 AM	Ready	Parked	Not available	Scheduled	NA
6:00 AM	Ready	Parked	Not available	Scheduled	Inspection
6:14 AM	Ready	Autonomous	Not available	Scheduled	NA
6:16 AM	Ready	Autonomous	Available	Scheduled	NA
6:21 AM	Ready	Autonomous	Available	Scheduled	NA
...					
7:11 AM	Ready	Manual	Available	Scheduled	NA
7:29 AM	Troubleshooting	Manual	Not available	Scheduled	NA
7:46 AM	Troubleshooting	Manual	Not available	Scheduled	Return to base
8:10 AM	Troubleshooting	Parked	Not available	Scheduled	NA
...					
9:07 AM	Ready	Parked	Not available	Scheduled	NA
9:08 AM	Ready	Manual	Available	Scheduled	NA
9:10 AM	Ready	Autonomous	Available	Scheduled	NA
...					

FIG. 4

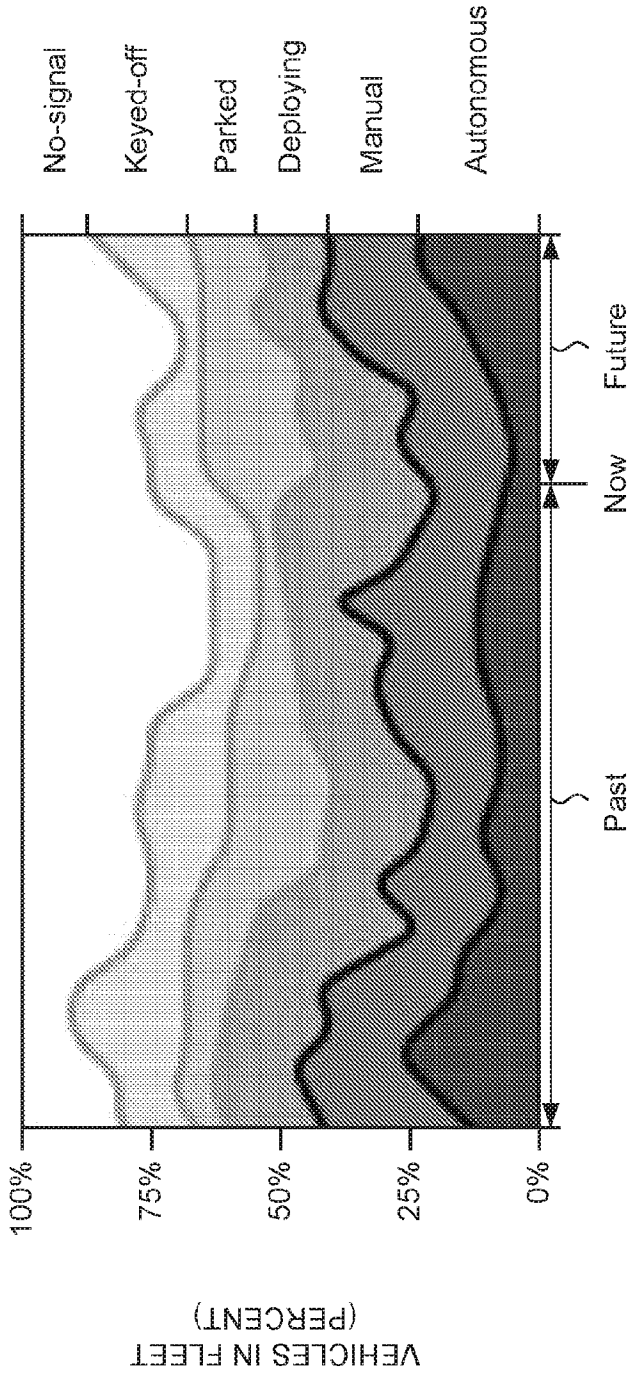

No-signal
Keyed-off
Parked
Deploying
Manual
Autonomous
100%
75%
50%
25%
0%
VEHICLES IN FLEET
(PERCENT)
Past
Now
Future
TIME

FIG. 5

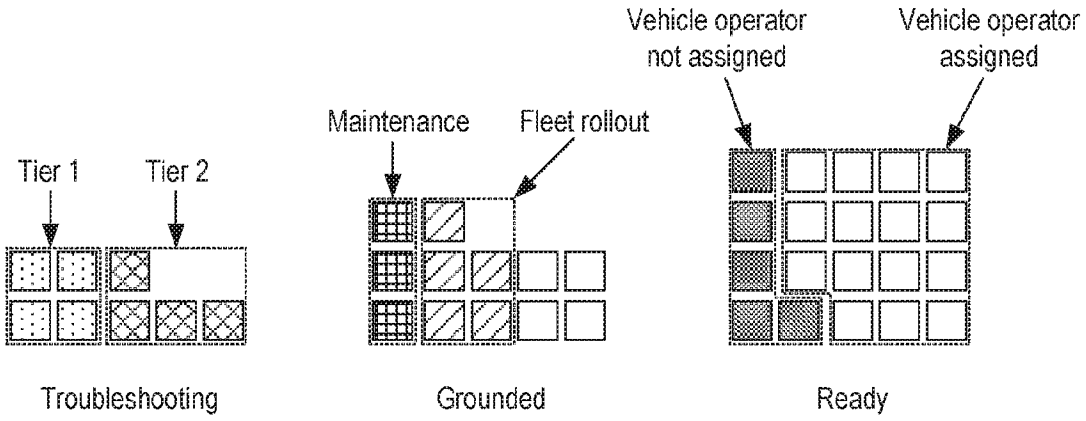

Vehicle operator not assigned
Vehicle operator assigned
Maintenance
Fleet rollout
Tier 1
Tier 2
Troubleshooting
Grounded
Ready

FIG. 6A

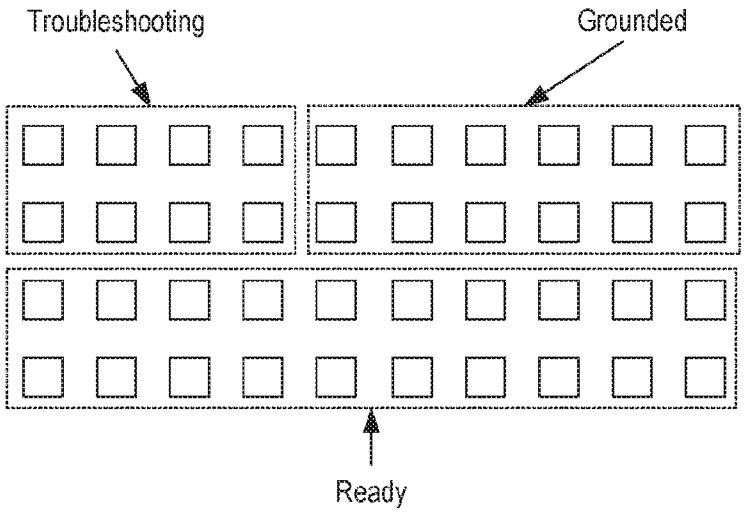

Troubleshooting
Grounded
Ready

FIG. 6B

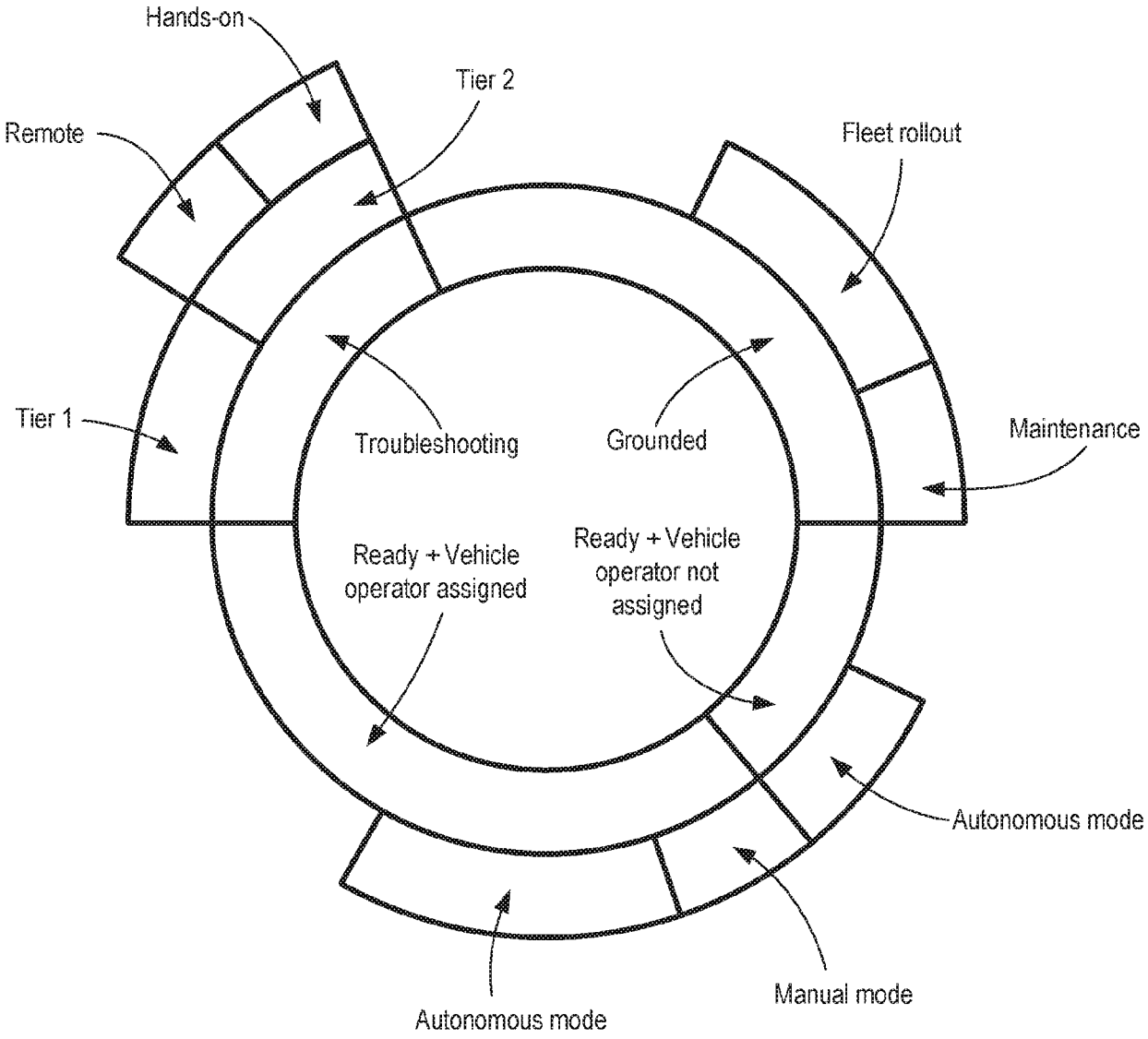

Hands-on
Tier 2
Remote
Fleet rollout
Tier 1
Troubleshooting
Grounded
Maintenance
Ready + Vehicle operator assigned
Ready + Vehicle operator not assigned
Autonomous mode
Manual mode
Autonomous mode

FIG. 6C

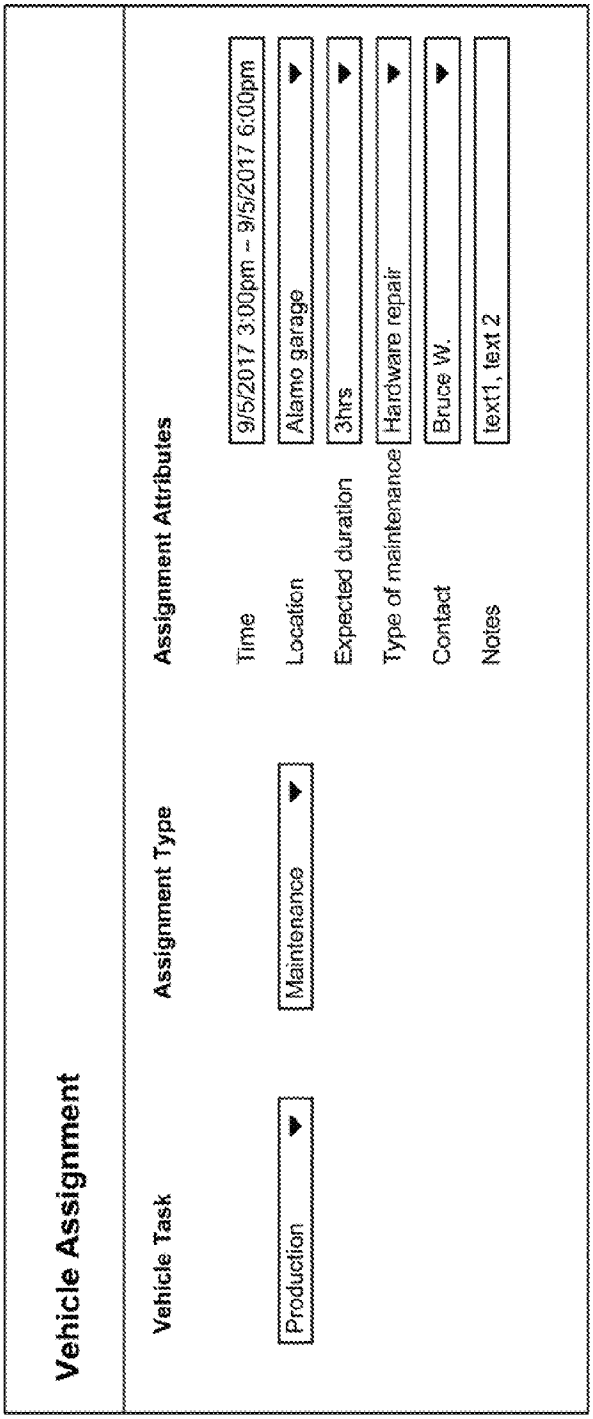

Vehicle Assignment
Vehicle Task
Production
Assignment Type
Maintenance
Assignment Attributes
Time
9/5/2017 3:00pm ~ 9/5/2017 6:00pm
Location
Alamo garage
Expected duration
3hrs
Type of maintenance
Hardware repair
Contact
Bruce W.
Notes
text1, text 2

FIG. 7

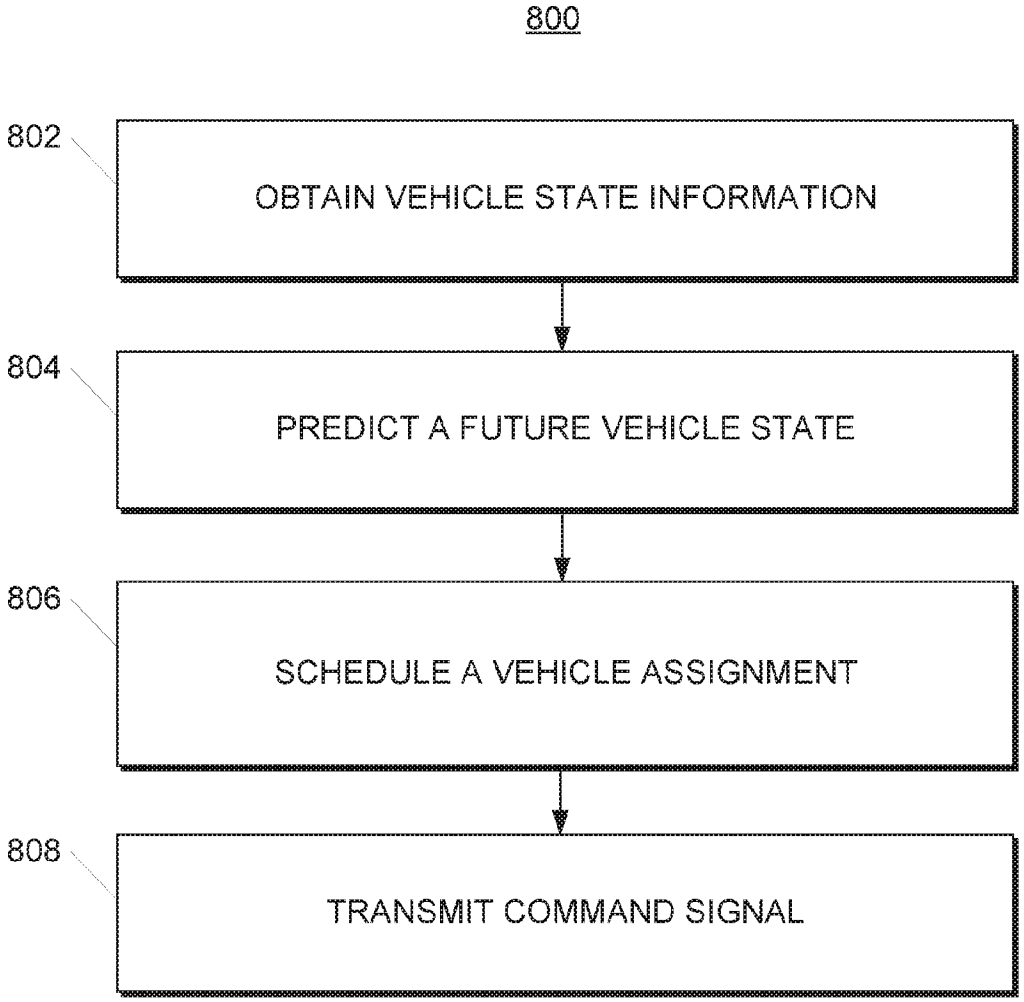

800
802
OBTAIN VEHICLE STATE INFORMATION
804
PREDICT A FUTURE VEHICLE STATE
806
SCHEDULE A VEHICLE ASSIGNMENT
808
TRANSMIT COMMAND SIGNAL

FIG. 8

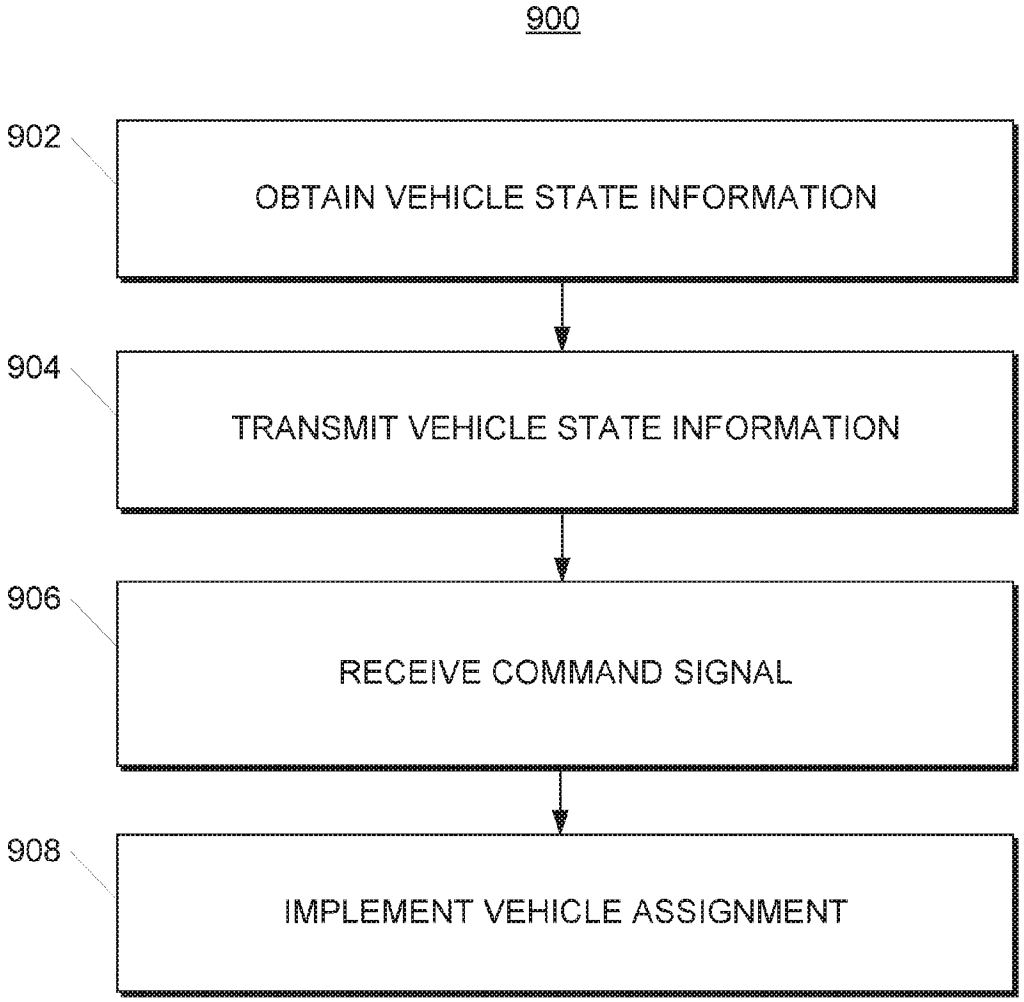

900
902
OBTAIN VEHICLE STATE INFORMATION
904
TRANSMIT VEHICLE STATE INFORMATION
906
RECEIVE COMMAND SIGNAL
908
IMPLEMENT VEHICLE ASSIGNMENT

FIG. 9

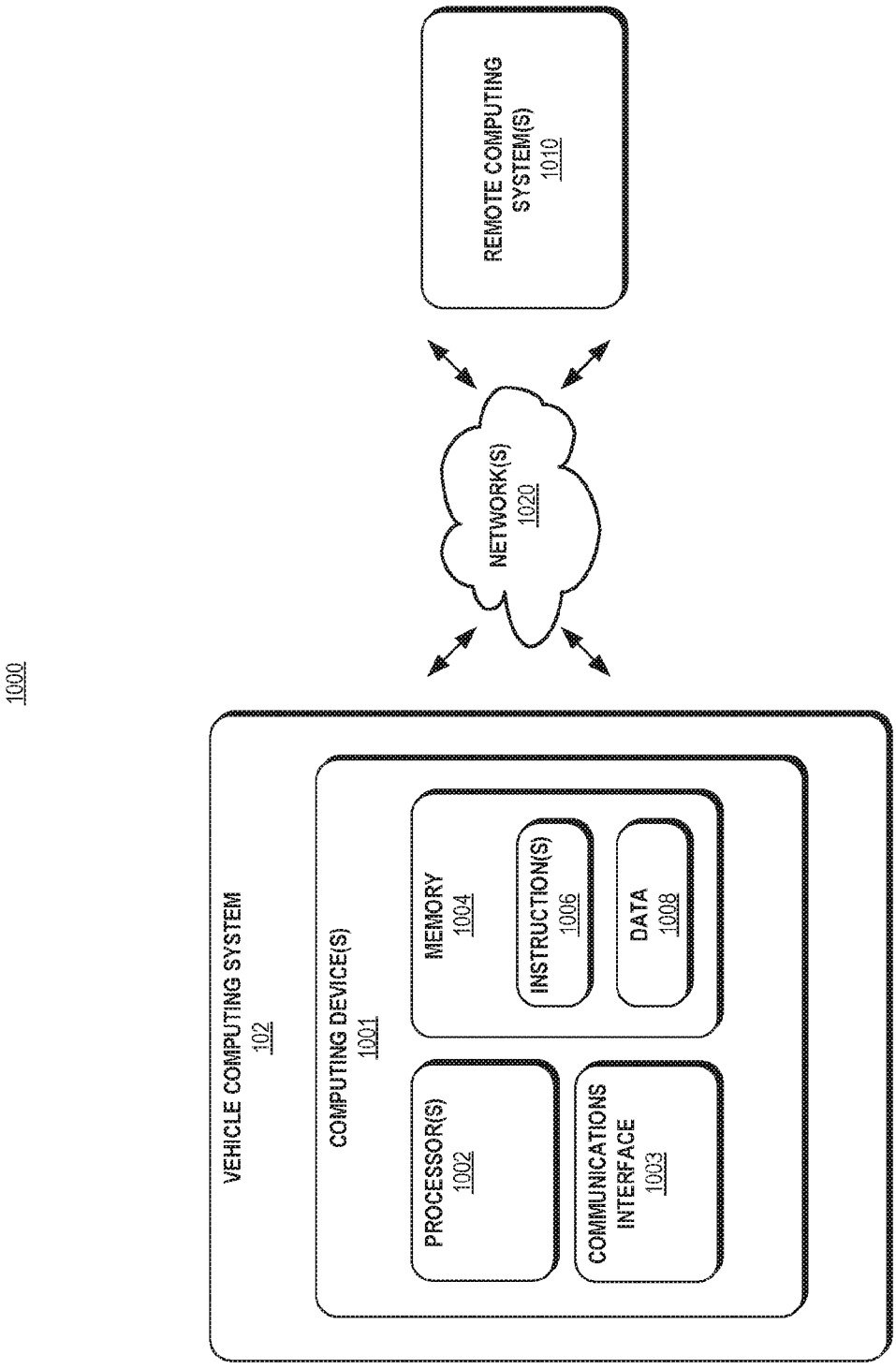

1000
VEHICLE COMPUTING SYSTEM
102
COMPUTING DEVICE(S)
1001
PROCESSOR(S)
1002
MEMORY
1004
INSTRUCTION(S)
1006
DATA
1008
COMMUNICATIONS INTERFACE
1003
NETWORK(S)
1020
REMOTE COMPUTING SYSTEM(S)
1010

FIG. 10

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2019/013904

A. CLASSIFICATION OF SUBJECT MATTER
INV. G06Q10/06 G05D1/02 G06Q50/30 G08G1/00
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
G06Q G05D G08G

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2015/339928 A1 (RAMANUJAM MADHUSOODHAN [US]) 26 November 2015 (2015-11-26) paragraphs [0004], [0005], [0014] - [0017], [0024], [0027], [0031] - [0038], [0040], [0044], [0045], [0049], [0055] - [0058], [0060], [0061], [0064] paragraphs [0073] - [0076], [0089] - [0091], [0116]; claims; figures	1-19
X	US 9 811 086 B1 (POEPPEL SCOTT [US] ET AL) 7 November 2017 (2017-11-07) columns 3-5, 8,9; claims; figures	1-19
X	US 2017/123429 A1 (LEVINSON JESSE SOL [US] ET AL) 4 May 2017 (2017-05-04) paragraphs [0052], [0101] - [0107]; claims; figures 1,7,9,11,14-19	1-19

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
29 March 2019	09/04/2019

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Herry, Tzvetanka

1

Form PCT/ISA/210 (second sheet) (April 2005)

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2015339928 A1	26-11-2015	NONE	
US 9811086 B1	07-11-2017	US 9811086 B1	07-11-2017
		US 2018164813 A1	14-06-2018
		US 2018164814 A1	14-06-2018
US 2017123429 A1	04-05-2017	CN 108292473 A	17-07-2018
		EP 3371794 A2	12-09-2018
		JP 2019501072 A	17-01-2019
		US 2017123429 A1	04-05-2017
		US 2018196439 A1	12-07-2018
		WO 2017079228 A2	11-05-2017

Electronic Acknowledgement Receipt

EFS ID:	45235501
Application Number:	16720543
International Application Number:	
Confirmation Number:	4655
Title of Invention:	Fleet Controller
First Named Inventor/Applicant Name:	Grant Mark Bristow
Customer Number:	145156
Filer:	Robert G. Graham/Jennifer Rubio
Filer Authorized By:	Robert G. Graham
Attorney Docket Number:	BEL-IN140-19.02
Receipt Date:	15-MAR-2022
Filing Date:	19-DEC-2019
Time Stamp:	18:14:43
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Information Disclosure Statement (IDS) Form (SB08)	BELIN1401902_IDS.PDF	1235766 7f1444cf6aea6786de593cceb716811451cf56b8	no	4

Warnings:

Information:					
2	Foreign Reference	WO2019143752A1_53.pdf	5296432 00f15559b774bdd62b124082a5a71b1fddf9b75f	no	53
Warnings:					
Information:					
			Total Files Size (in bytes):	6532198	

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PTO/AIA/122 (08-12)
Approved for use through 01/31/2018. OMB 0651-0035
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
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CHANGE OF CORRESPONDENCE ADDRESS
Application

Address to:
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Application Number	16/720,543
Filing Date	12/19/2019
First Named Inventor	Grant Mark Bristow
Art Unit	3666
Examiner Name	Tyler D Paige
Attorney Docket Number	BEL-IN140-19.02

Please change the Correspondence Address for the above-identified patent application to:

☐ The address associated with Customer Number: ____

OR

☒ Firm or Individual Name Bell Textron Inc.

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P.O. Box 48

City Fort Worth | State TX | Zip 76101

Country US

Telephone | Email IPDepartment@bellflight.com

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I am the:

☐ Applicant

☒ Attorney or agent of record. Registration Number 58042.

☐ Registered practitioner named in the application transmittal papers who acts in a representative capacity under 37 CFR 1.34. See 37 CFR 1.33(a)(1). Registration Number ____.

Signature /Robert G. Graham/

Typed or Printed Name Robert G. Graham

Date 03/16/2022 | Telephone (972) 732-1001

NOTE: This form must be signed in accordnace with 37 CFR 1.33. See 37 CFR 1.4(d) for signature requirements and certifications. Submit multiple forms if more than one signature is required, see below*.

☒ *Total of 1 forms are submitted.

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The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether disclosure of these records is required by the Freedom of Information Act.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (*i.e.*, GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspection or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

Electronic Acknowledgement Receipt

EFS ID:	45246437
Application Number:	16720543
International Application Number:	
Confirmation Number:	4655
Title of Invention:	Fleet Controller
First Named Inventor/Applicant Name:	Grant Mark Bristow
Customer Number:	145156
Filer:	Robert G. Graham/Jennifer Rubio
Filer Authorized By:	Robert G. Graham
Attorney Docket Number:	BEL-IN140-19.02
Receipt Date:	16-MAR-2022
Filing Date:	19-DEC-2019
Time Stamp:	18:05:48
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Maintenance Fee Address Change	BEL-IN140-1902_ChangeCorrespondenceAddress.PDF	216226 7206240f2aafed478d0acc256f74bed106868548	no	2

Warnings:

Information:	
Total Files Size (in bytes):	216226

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New International Application Filed with the USPTO as a Receiving Office

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U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
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Application

Address to:
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Application Number	16/720,543
Filing Date	12/19/2019
First Named Inventor	Grant Mark Bristow
Art Unit	3666
Examiner Name	Tyler D Paige
Attorney Docket Number	BEL-IN140-19.02

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P.O. Box 48

City	State	Zip
Fort Worth	TX	76101

Country US

Telephone	Email
	IPDepartment@bellflight.com

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I am the:

☐ Applicant

☒ Attorney or agent of record. Registration Number 58042.

☐ Registered practitioner named in the application transmittal papers who acts in a representative capacity under 37 CFR 1.34. See 37 CFR 1.33(a)(1). Registration Number ____.

Signature /Robert G. Graham/

Typed or Printed Name Robert G. Graham

Date	Telephone
03/16/2022	(972) 732-1001

NOTE: This form must be signed in accordnace with 37 CFR 1.33. See 37 CFR 1.4(d) for signature requirements and certifications. Submit multiple forms if more than one signature is required, see below*.

☒ *Total of 1 forms are submitted.

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The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether disclosure of these records is required by the Freedom of Information Act.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (*i.e.*, GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspection or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

Electronic Acknowledgement Receipt

EFS ID:	45752406
Application Number:	16720543
International Application Number:	
Confirmation Number:	4655
Title of Invention:	Fleet Controller
First Named Inventor/Applicant Name:	Grant Mark Bristow
Customer Number:	145156
Filer:	Robert G. Graham/Christi Lara
Filer Authorized By:	Robert G. Graham
Attorney Docket Number:	BEL-IN140-19.02
Receipt Date:	19-MAY-2022
Filing Date:	19-DEC-2019
Time Stamp:	10:48:10
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Change of Address	BEL-IN140-19_02_Change_Address.pdf	192017 ac27136570ea17b21ed922dc64ed0a07c9151bd2	no	2

Warnings:

Information:	
Total Files Size (in bytes):	192017

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

AO 120 (Rev. 08/10)

TO:	REPORT ON THE FILING OR DETERMINATION OF AN ACTION REGARDING A PATENT OR TRADEMARK
Mail Stop 8 Director of the U.S. Patent and Trademark Office P.O. Box 1450 Alexandria, VA 22313-1450	

In Compliance with 35 U.S.C. § 290 and/or 15 U.S.C. § 1116 you are hereby advised that a court action has been filed in the U.S. District Court Eastern District of Texas, Marshall Division on the following

☐ Trademarks or ☑ Patents. (☐ the patent action involves 35 U.S.C. § 292.):

DOCKET NO.	DATE FILED	U.S. DISTRICT COURT
2:22-cv-00351-RWS-RSP	9/9/2022	Eastern District of Texas, Marshall Division

PLAINTIFF	DEFENDANT
Textron Innovations Inc.	SZ DJI Technology Co., Ltd., DJI Europe B.V., SZ DJI Baiwang Technology Co. Ltd., and iFlight Technology Company Ltd.

	PATENT OR TRADEMARK NO.	DATE OF PATENT OR TRADEMARK	HOLDER OF PATENT OR TRADEMARK
1	10,275,950	4/30/2019	Textron Innovations Inc.
2	8,332,082	12/11/2012	Textron Innovations Inc.
3	8,682,505	3/25/2014	Textron Innovations Inc.
4	11,288,972	3/29/2022	Textron Innovations Inc.
5			

In the above---entitled case, the following patent(s)/ trademark(s) have been included:

DATE INCLUDED	INCLUDED BY ☐ Amendment ☐ Answer ☐ Cross Bill ☐ Other Pleading	
PATENT OR TRADEMARK NO.	DATE OF PATENT OR TRADEMARK	HOLDER OF PATENT OR TRADEMARK
1		
2		
3		
4		
5		

In the above---entitled case, the following decision has been rendered or judgement issued:

DECISION/JUDGEMENT

CLERK	(BY) DEPUTY CLERK	DATE

Copy 1---Upon initiation of action, mail this copy to Director Copy 3---Upon termination of action, mail this copy to Director
Copy 2---Upon filing document adding patent(s), mail this copy to Director Copy 4---Case file copy