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 NO.	ISSUE DATE	PATENT NO.	ATTORNEY DOCKET NO.	CONFIRMATION NO.
16/482,495	05/25/2021	11016456	84008-322155	7727

23644 7590 05/05/2021

Barnes & Thornburg LLP (CH)
P.O. Box 2786
Chicago, IL 60690-2786

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 0 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.

APPLICANT(s) (Please see PAIR WEB site http://pair.uspto.gov for additional applicants):

David Henson, The Woodlands, TX;
Lancium LLC, The Woodlands, TX;
Michael McNamara, The Woodlands, TX;
Raymond Cline, The Woodlands, TX;

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.

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)

23644 7590 04/20/2021
Barnes & Thornburg LLP (CH)
P.O. Box 2786
Chicago, IL 60690-2786

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.
16/482,495	07/31/2019	David Henson	84008-322155	7727

TITLE OF INVENTION: Method and System for Dynamic Power Delivery to a Flexible Datacenter Using Unutilized Energy Sources

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	07/20/2021

EXAMINER	ART UNIT	CLASS-SUBCLASS
BROWN, MICHAEL J	2115	713-310000

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 Barnes & Thornburg 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: LANCIUM LLC

(B) RESIDENCE: (CITY and STATE OR COUNTRY): Houston, Texas

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. 12-0913

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 /Mark P. Vrla/ Date April 20, 2021

Typed or printed name Mark P. Vrla Registration No. 43973

Electronic Patent Application Fee Transmittal

Application Number:	16482495
Filing Date:	31-Jul-2019
Title of Invention:	Method and System for Dynamic Power Delivery to a Flexible Datacenter Using Unutilized Energy Sources
First Named Inventor/Applicant Name:	David Henson
Filer:	Mark P. Vrla/Mark Sweetin
Attorney Docket Number:	84008-322155

Filed as Large Entity

Filing Fees for U.S. National Stage under 35 USC 371

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:	42504150
Application Number:	16482495
International Application Number:	
Confirmation Number:	7727
Title of Invention:	Method and System for Dynamic Power Delivery to a Flexible Datacenter Using Unutilized Energy Sources
First Named Inventor/Applicant Name:	David Henson
Customer Number:	23644
Filer:	Mark P. Vrla/Mark Sweetin
Filer Authorized By:	Mark P. Vrla
Attorney Docket Number:	84008-322155
Receipt Date:	20-APR-2021
Filing Date:	31-JUL-2019
Time Stamp:	17:48:56
Application Type:	U.S. National Stage under 35 USC 371

Payment information:

Submitted with Payment	yes
Payment Type	CARD
Payment was successfully received in RAM	$1200
RAM confirmation Number	E20214JH49224726
Deposit Account	120913
Authorized User	Mark Sweetin
The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows: 37 CFR 1.17 (Patent application and reexamination processing 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	Issue Fee Payment (PTO-85B)	322155_Issue-Fee_210420.pdf	169102 18c237d5eccc1932d4358641b3a6e3e7386aa822	no	1
Warnings:					
Information:					
2	Fee Worksheet (SB06)	fee-info.pdf	30621 c06e9625e1133d58fb3ef86f963a795d086a0446	no	2
Warnings:					
Information:					
		Total Files Size (in bytes):	199723		

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
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Alexandria, Virginia 22313-1450
www.uspto.gov

NOTICE OF ALLOWANCE AND FEE(S) DUE

23644 7590 04/20/2021

Barnes & Thornburg LLP (CH)
P.O. Box 2786
Chicago, IL 60690-2786

EXAMINER
BROWN, MICHAEL J

ART UNIT	PAPER NUMBER
2115	

DATE MAILED: 04/20/2021

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
16/482,495	07/31/2019	David Henson	84008-322155	7727

TITLE OF INVENTION: Method and System for Dynamic Power Delivery to a Flexible Datacenter Using Unutilized Energy Sources

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	07/20/2021

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.

THE ISSUE FEE AND PUBLICATION FEE (IF REQUIRED) MUST BE PAID WITHIN THREE MONTHS FROM THE MAILING DATE OF THIS NOTICE OR THIS APPLICATION SHALL BE REGARDED AS ABANDONED. THIS STATUTORY PERIOD CANNOT BE EXTENDED. SEE 35 U.S.C. 151. THE ISSUE FEE DUE INDICATED ABOVE DOES NOT REFLECT A CREDIT FOR ANY PREVIOUSLY PAID ISSUE FEE IN THIS APPLICATION. IF AN ISSUE FEE HAS PREVIOUSLY BEEN PAID IN THIS APPLICATION (AS SHOWN ABOVE), THE RETURN OF PART B OF THIS FORM WILL BE CONSIDERED A REQUEST TO REAPPLY THE PREVIOUSLY PAID ISSUE FEE TOWARD THE ISSUE FEE NOW DUE.

HOW TO REPLY TO THIS NOTICE:

I. Review the ENTITY STATUS shown above. If the ENTITY STATUS is shown as SMALL or MICRO, verify whether entitlement to that entity status still applies.

If the ENTITY STATUS is the same as shown above, pay the TOTAL FEE(S) DUE shown above.

If the ENTITY STATUS is changed from that shown above, on PART B - FEE(S) TRANSMITTAL, complete section number 5 titled "Change in Entity Status (from status indicated above)".

For purposes of this notice, small entity fees are 1/2 the amount of undiscounted fees, and micro entity fees are 1/2 the amount of small entity fees.

II. PART B - FEE(S) TRANSMITTAL, or its equivalent, must be completed and returned to the United States Patent and Trademark Office (USPTO) with your ISSUE FEE and PUBLICATION FEE (if required). If you are charging the fee(s) to your deposit account, section "4b" of Part B - Fee(s) Transmittal should be completed and an extra copy of the form should be submitted. If an equivalent of Part B is filed, a request to reapply a previously paid issue fee must be clearly made, and delays in processing may occur due to the difficulty in recognizing the paper as an equivalent of Part B.

III. All communications regarding this application must give the application number. Please direct all communications prior to issuance to Mail Stop ISSUE FEE unless advised to the contrary.

IMPORTANT REMINDER: Maintenance fees are due in utility patents issuing on applications filed on or after Dec. 12, 1980. It is patentee's responsibility to ensure timely payment of maintenance fees when due. More information is available at www.uspto.gov/PatentMaintenanceFees.

PTOL-85 (Rev. 02/11)

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)

23644 7590 04/20/2021
Barnes & Thornburg LLP (CH)
P.O. Box 2786
Chicago, IL 60690-2786

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.
16/482,495	07/31/2019	David Henson	84008-322155	7727

TITLE OF INVENTION: Method and System for Dynamic Power Delivery to a Flexible Datacenter Using Unutilized Energy Sources

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	07/20/2021

EXAMINER	ART UNIT	CLASS-SUBCLASS
BROWN, MICHAEL J	2115	713-310000

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.
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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
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.
16/482,495	07/31/2019	David Henson	84008-322155	7727

23644 7590 04/20/2021

Barnes & Thornburg LLP (CH)
P.O. Box 2786
Chicago, IL 60690-2786

EXAMINER	
BROWN, MICHAEL J	

ART UNIT	PAPER NUMBER
2115	

DATE MAILED: 04/20/2021

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.

PTOL-85 (Rev. 02/11)

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. 16/482,495	Applicant(s) Henson et al.	
	Examiner MICHAEL J BROWN	Art Unit 2115	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 Terminal Disclaimer filed on 4/1/2021.
   ☐ 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 35-64 . 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 _____.

/MICHAEL J BROWN/
Primary Examiner, Art Unit 2115

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	16/482,495	Henson et al.
	Examiner	Art Unit
	MICHAEL J BROWN	2115

CPC - Searched*		
Symbol	**Date**	**Examiner**
G05B 19/042, 2219/2639	02/27/2021	MJB
H02J 13/00002, 3/381, 13/00, 3/383, 3/386, 13/0017, 2300/28, 2300/24	02/27/2021	MJB
G06F 1/3203, 9/4856	02/27/2021	MJB
H02S 40/32, 10/00	02/27/2021	MJB
A01G 9/249, 9/18, 9/243, 9/246, 9/247, 9/26, 9/24, 31/06	02/27/2021	MJB
Y02E 10/76, 10/56	02/27/2021	MJB
Y02P 60/21, 60/12	02/27/2021	MJB
Y02A 40/25	02/27/2021	MJB
G05B 19/042, 2219/2639	03/27/2021	MJB
H02J 13/00002, 3/381, 13/00, 3/383, 3/386, 13/0017, 2300/28, 2300/24	03/27/2021	MJB
G06F 1/3203, 9/4856	03/27/2021	MJB
H02S 40/32, 10/00	03/27/2021	MJB
A01G 9/249, 9/18, 9/243, 9/246, 9/247, 9/26, 9/24, 31/06	03/27/2021	MJB
Y02E 10/76, 10/56	03/27/2021	MJB
Y02P 60/21, 60/12	03/27/2021	MJB
Y02A 40/25	03/27/2021	MJB
G05B 19/042, 2219/2639	04/10/2021	MJB
H02J 13/00002, 3/381, 13/00, 3/383, 3/386, 13/0017, 2300/28, 2300/24	04/10/2021	MJB
G06F 1/3203, 9/4856	04/10/2021	MJB
H02S 40/32, 10/00	04/10/2021	MJB
A01G 9/249, 9/18, 9/243, 9/246, 9/247, 9/26, 9/24, 31/06	04/10/2021	MJB
Y02E 10/76, 10/56	04/10/2021	MJB
Y02P 60/21, 60/12	04/10/2021	MJB
Y02A 40/25	04/10/2021	MJB

/MICHAEL J BROWN/ Primary Examiner, Art Unit 2115	

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	16/482,495	Henson et al.
	Examiner	Art Unit
	MICHAEL J BROWN	2115

CPC Combination Sets - Searched*		
Symbol	Date	Examiner

US Classification - Searched*			
Class	Subclass	Date	Examiner
713	300,310,320,330	02/27/2021	MJB
713	300,310,320,330	03/27/2021	MJB
713	300,310,320,330	04/10/2021	MJB

* 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	02/13/2021	MJB
EAST search *Report Attached*	02/27/2021	MJB
classification search *Report Attached*	02/27/2021	MJB
EAST search *Report Attached*	03/27/2021	MJB
classification search *Report Attached*	03/27/2021	MJB
Foreign Art search *Report Attached*	03/27/2021	MJB
NPL search *Report Attached*	03/27/2021	MJB
EAST search *Report Attached*	04/10/2021	MJB
classification search *Report Attached*	04/10/2021	MJB
Foreign Art search *Report Attached*	04/10/2021	MJB
NPL search *Report Attached*	04/10/2021	MJB
interference search *Report Attached*	04/10/2021	MJB

/MICHAEL J BROWN/ Primary Examiner, Art Unit 2115	

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	16/482,495	Henson et al.
	Examiner	Art Unit
	MICHAEL J BROWN	2115

Interference Search			
US Class/CPC Symbol	**US Subclass/CPC Group**	**Date**	**Examiner**
713	300,310,320,330	04/10/2021	MJB
G05B	19/042, 2219/2639	04/10/2021	MJB
H02J	13/00002, 3/381, 13/00, 3/383, 3/386, 13/0017, 2300/28, 2300/24	04/10/2021	MJB
G06F	1/3203, 9/4856	04/10/2021	MJB
H02S	40/32, 10/00	04/10/2021	MJB
A01G	9/249, 9/18, 9/243, 9/246, 9/247, 9/26, 9/24, 31/06	04/10/2021	MJB
Y02E	10/76, 10/56	04/10/2021	MJB
Y02P	60/21, 60/12	04/10/2021	MJB
Y02A	40/25	04/10/2021	MJB

/MICHAEL J BROWN/ Primary Examiner, Art Unit 2115	

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	16/482,495	Henson et al.
	Examiner	Art Unit
	MICHAEL J BROWN	2115

CPC						
Symbol					Type	Version
G05B	/	19	/	042	F	2013-01-01
H02J	/	3	/	383	I	2020-01-01
H02J	/	3	/	386	I	2020-01-01
H02J	/	13	/	0017	I	2020-01-01
H02S	/	40	/	32	I	2014-12-01
A01G	/	9	/	249	I	2019-05-01
A01G	/	9	/	18	I	2013-01-01
A01G	/	9	/	243	I	2013-01-01
A01G	/	9	/	246	I	2013-01-01
A01G	/	9	/	247	I	2013-01-01
A01G	/	9	/	26	I	2013-01-01
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H02J	/	13	/	00	I	2013-01-01
H02J	/	13	/	00002	I	2020-01-01
G06F	/	1	/	3203	I	2013-01-01
G06F	/	9	/	4856	I	2013-01-01
G05B	/	2219	/	2639	A	2013-01-01
H02J	/	2300	/	28	A	2020-01-01
H02J	/	2300	/	24	A	2020-01-01

CPC Combination Sets								
Symbol					Type	Set	Ranking	Version
	/		/					

NONE		Total Claims Allowed:	
(Assistant Examiner)	(Date)	30	
/MICHAEL J BROWN/ Primary Examiner, Art Unit 2115	10 April 2021	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	2

U.S. Patent and Trademark Office — Part of Paper No.: 20210410

Ex.1002
Cholla Energy LLC & OBM, Inc. / Page 15 of 611

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	16/482,495	Henson et al.
	Examiner	Art Unit
	MICHAEL J BROWN	2115

INTERNATIONAL CLASSIFICATION					
CLAIMED					
G05B	/	19	/	042	
G06F	/	1	/	3203	

NON-CLAIMED					
H02J	/	3	/	38	
H02J	/	13	/	00	

US ORIGINAL CLASSIFICATION	
CLASS	SUBCLASS
713	310

CROSS REFERENCES(S)						
CLASS	SUBCLASS (ONE SUBCLASS PER BLOCK)					
713	300	320	330			

NONE (Assistant Examiner)	(Date)	Total Claims Allowed: 30	
/MICHAEL J BROWN/ Primary Examiner, Art Unit 2115 (Primary Examiner)	10 April 2021 (Date)	O.G. Print Claim(s) 1	O.G. Print Figure 2

U.S. Patent and Trademark Office — Part of Paper No.: 20210410

Ex.1002
Cholla Energy LLC & OBM, Inc. / Page 16 of 611

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	16/482,495	Henson et al.
	Examiner	Art Unit
	MICHAEL J BROWN	2115

☐ 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
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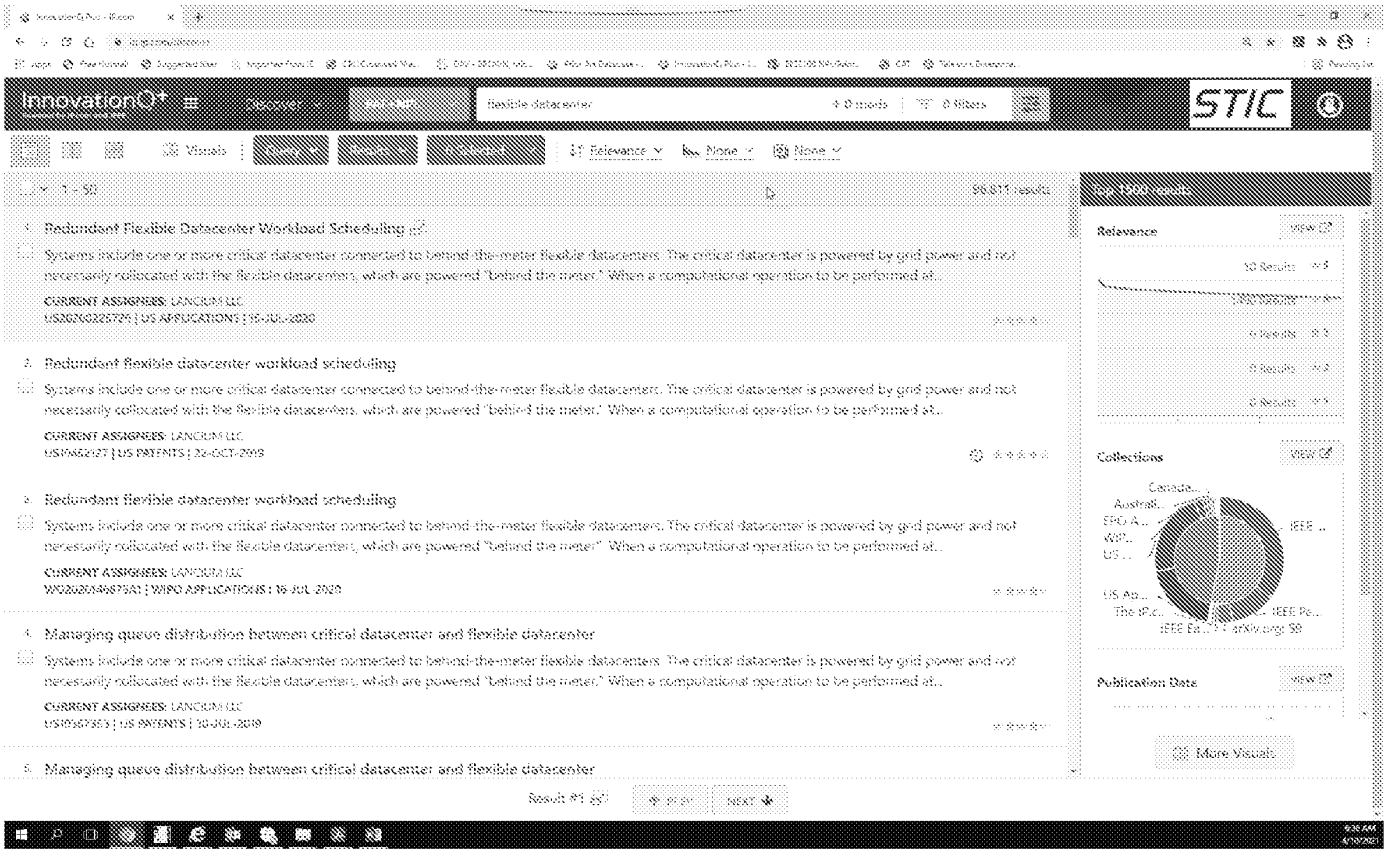
-	2	-	11	-	20	-	29	4	38	8	47	22	56		
-	3	-	12	-	21	-	30	14	39	9	48	23	57		
-	4	-	13	-	22	-	31	15	40	10	49	24	58		
-	5	-	14	-	23	-	32	16	41	11	50	25	59		
-	6	-	15	-	24	-	33	17	42	12	51	26	60		
-	7	-	16	-	25	-	34	18	43	13	52	27	61		
-	8	-	17	-	26	1	35	5	44	19	53	28	62		
-	9	-	18	-	27	2	36	6	45	20	54	29	63		

NONE (Assistant Examiner)	(Date)	Total Claims Allowed: 30	
/MICHAEL J BROWN/ Primary Examiner, Art Unit 2115 (Primary Examiner)	10 April 2021 (Date)	O.G. Print Claim(s) 1	O.G. Print Figure 2

U.S. Patent and Trademark Office Part of Paper No.: 20210410

Ex.1002
Cholla Energy LLC & OBM, Inc. / Page 17 of 611


Innovation
Discover
flexible datacenter
STIC
Visuals
Relevance
None
None
1 - 50
96,811 results
Top 1500 results
Redundant Flexible Datacenter Workload Scheduling
Systems include one or more critical datacenter connected to behind-the-meter flexible datacenters. The critical datacenter is powered by grid power and not necessarily collocated with the flexible datacenters, which are powered "behind the meter." When a computational operation to be performed at...
CURRENT ASSIGNEES: LANCIUM LLC
US20200226726 | US APPLICATIONS | 16-JUL-2020
Redundant flexible datacenter workload scheduling
Systems include one or more critical datacenter connected to behind-the-meter flexible datacenters. The critical datacenter is powered by grid power and not necessarily collocated with the flexible datacenters, which are powered "behind the meter." When a computational operation to be performed at...
CURRENT ASSIGNEES: LANCIUM LLC
US10462127 | US PATENTS | 22-OCT-2019
Redundant flexible datacenter workload scheduling
Systems include one or more critical datacenter connected to behind-the-meter flexible datacenters. The critical datacenter is powered by grid power and not necessarily collocated with the flexible datacenters, which are powered "behind the meter." When a computational operation to be performed at...
CURRENT ASSIGNEES: LANCIUM LLC
WO2020146875A1 | WIPO APPLICATIONS | 16-JUL-2020
Managing queue distribution between critical datacenter and flexible datacenter
Systems include one or more critical datacenter connected to behind-the-meter flexible datacenters. The critical datacenter is powered by grid power and not necessarily collocated with the flexible datacenters, which are powered "behind the meter." When a computational operation to be performed at...
CURRENT ASSIGNEES: LANCIUM LLC
US10367353 | US PATENTS | 30-JUL-2019
Managing queue distribution between critical datacenter and flexible datacenter
Relevance
Collections
Publication Date
More Visuals
Result #1
NEXT

EAST Search History

EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L1	579	(before prior) near3 step-up	US-PGPUB; USPAT	OR	OFF	2021/04/10 06:28
L2	5	L1 with ((distribut$4 deliver$4) near2 (power energy))	US-PGPUB; USPAT	OR	OFF	2021/04/10 06:28
L3	3	L2.clm.	US-PGPUB; USPAT	OR	OFF	2021/04/10 06:28
L4	3	L3 and ((G05B19/042 or H02J13/00002 or G06F1/3203 or G06F9/4856 or H02S40/32 or A01G9/249 or A01G9/18 or A01G9/243 or A01G9/246 or A01G9/247 or A01G9/26 or H02J3/381 or H02J13/00 or H02J3/383 or H02J3/386 or H02J13/0017 or H02J2300/28 or H02J2300/24 or G05B2219/2639 or Y02E10/76 or Y02P60/21 or Y02P60/12 or Y02E10/56 or Y02A40/25 or A01G9/24 or A01G31/06 or H02S10/00).cpc. 713/300,310,320,330.ccls.)	US-PGPUB; USPAT	OR	OFF	2021/04/10 06:29
L5	0	L4 and @ad<"20180111"	US-PGPUB; USPAT	OR	OFF	2021/04/10 06:30
L7	15	(receiv$4 near3 power) with ((before prior) near3 (step$4up) near2 transform$7)	US-PGPUB; USPAT	OR	OFF	2021/04/10 06:30
L8	15	L7 same (grid $6grid)	US-PGPUB; USPAT	OR	OFF	2021/04/10 06:30
L9	9	L8.clm.	US-PGPUB; USPAT	OR	OFF	2021/04/10 06:30
L10	6	L9 and ((G05B19/042 or H02J13/00002 or G06F1/3203 or G06F9/4856 or H02S40/32 or A01G9/249 or A01G9/18 or A01G9/243 or A01G9/246 or A01G9/247 or A01G9/26 or H02J3/381 or H02J13/00 or H02J3/383 or H02J3/386 or H02J13/0017 or H02J2300/28 or H02J2300/24 or G05B2219/2639 or Y02E10/76 or Y02P60/21 or Y02P60/12 or Y02E10/56 or Y02A40/25 or A01G9/24 or	US-PGPUB; USPAT	OR	OFF	2021/04/10 06:30

		A01G31/06 or H02S10/00).cpc. 713/300,310,320,330.ccls.)				
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L14	0	("2020/0379537").URPN.	USPAT	OR	OFF	2021/04/10 06:35
L15	7	(flexible adj datacenter)	USPAT	OR	OFF	2021/04/10 06:35
L16	0	L15 not Lancium.as.	USPAT	OR	OFF	2021/04/10 06:36
L17	6	mobile adj datacenter	USPAT	OR	OFF	2021/04/10 06:44
L18	0	L17.clm.	USPAT	OR	OFF	2021/04/10 06:45
L19	3	L17 and ((G05B19/042 or H02J13/00002 or G06F1/3203 or G06F9/4856 or H02S40/32 or A01G9/249 or A01G9/18 or A01G9/243 or A01G9/246 or A01G9/247 or A01G9/26 or H02J3/381 or H02J13/00 or H02J3/383 or H02J3/386 or H02J13/0017 or H02J2300/28 or H02J2300/24 or G05B2219/2639 or Y02E10/76 or Y02P60/21 or Y02P60/12 or Y02E10/56 or Y02A40/25 or A01G9/24 or A01G31/06 or H02S10/00).cpc. 713/300,310,320,330.ccls.)	US-PGPUB; USPAT	OR	OFF	2021/04/10 06:45
L20	0	L19 and @ad<"20180111"	US-PGPUB; USPAT	OR	OFF	2021/04/10 06:45
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S2	14	S1 and ((G05B19/042 or H02J13/00002 or G06F1/3203 or G06F9/4856 or H02S40/32 or A01G9/249 or A01G9/18 or A01G9/243 or A01G9/246 or A01G9/247 or A01G9/26 or H02J3/381 or H02J13/00 or H02J3/383 or H02J3/386 or H02J13/0017 or H02J2300/28 or H02J2300/24 or G05B2219/2639 or Y02E10/76 or Y02P60/21 or Y02P60/12 or Y02E10/56 or Y02A40/25 or A01G9/24 or A01G31/06 or H02S10/00).cpc. 713/300,310,320,330.ccls.)	US-PGPUB; USPAT	OR	OFF	2021/02/27 13:17

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S8	14	("0000002" | "10608433" | "10618427" | "20090078401" | "20100235004" | "20120306271" | "20150012113" | "20150288183" | "20150372538" | "20160006066" | "20160011617" | "20160043552" | "20160126783" | "20200073466").PN.	US-PGPUB; USPAT	OR	OFF	2021/02/27 13:47

S9	1	"10637353".pn.	US-PGPUB; USPAT	OR	OFF	2021/02/27 13:49
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S12	14	S11 and ((G05B19/042 or H02J13/00002 or G06F1/3203 or G06F9/4856 or H02S40/32 or A01G9/249 or A01G9/18 or A01G9/243 or A01G9/246 or A01G9/247 or A01G9/26 or H02J3/381 or H02J13/00 or H02J3/383 or H02J3/386 or H02J13/0017 or H02J2300/28 or H02J2300/24 or G05B2219/2639 or Y02E10/76 or Y02P60/21 or Y02P60/12 or Y02E10/56 or Y02A40/25 or A01G9/24 or A01G31/06 or H02S10/00).cpc. 713/300,310,320,330.ccls.)	US-PGPUB; USPAT	OR	OFF	2021/02/27 14:37
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S14	0	S11 and @ad<"20180111"	US-PGPUB; USPAT	OR	OFF	2021/02/27 14:37
S15	8,471	(datacenter (data adj center)) and (wind solar)	US-PGPUB; USPAT	OR	OFF	2021/02/27 14:38
S16	2,870	(datacenter (data adj center)) and ((wind solar) near3 power)	US-PGPUB; USPAT	OR	OFF	2021/02/27 14:38
S17	448	S16 and ((G05B19/042 or H02J13/00002 or G06F1/3203 or G06F9/4856 or H02S40/32 or A01G9/249 or A01G9/18 or A01G9/243 or A01G9/246 or A01G9/247 or A01G9/26 or H02J3/381 or H02J13/00 or H02J3/383 or H02J3/386 or H02J13/0017 or H02J2300/28 or H02J2300/24 or G05B2219/2639 or Y02E10/76 or Y02P60/21 or Y02P60/12 or Y02E10/56 or Y02A40/25 or A01G9/24 or A01G31/06 or H02S10/00).cpc. 713/300,310,320,330.ccls.)	US-PGPUB; USPAT	OR	OFF	2021/02/27 14:38
S18	842	S16 and (power near2 deliver$4)	US-PGPUB; USPAT	OR	OFF	2021/02/27 14:39

S19	271	S18 and ((G05B19/042 or H02J13/00002 or G06F1/3203 or G06F9/4856 or H02S40/32 or A01G9/249 or A01G9/18 or A01G9/243 or A01G9/246 or A01G9/247 or A01G9/26 or H02J3/381 or H02J13/00 or H02J3/383 or H02J3/386 or H02J13/0017 or H02J2300/28 or H02J2300/24 or G05B2219/2639 or Y02E10/76 or Y02P60/21 or Y02P60/12 or Y02E10/56 or Y02A40/25 or A01G9/24 or A01G31/06 or H02S10/00).cpc. 713/300,310,320,330.ccls.)	US-PGPUB; USPAT	OR	OFF	2021/02/27 14:39
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S21	211	S16 and ((power near2 deliver$4) near3 (comput$4 server$1 node$1))	US-PGPUB; USPAT	OR	OFF	2021/02/27 14:40
S22	118	S21 and ((remote$3 external$4) near3 control$4)	US-PGPUB; USPAT	OR	OFF	2021/02/27 14:40
S23	18	S22 and ((G05B19/042 or H02J13/00002 or G06F1/3203 or G06F9/4856 or H02S40/32 or A01G9/249 or A01G9/18 or A01G9/243 or A01G9/246 or A01G9/247 or A01G9/26 or H02J3/381 or H02J13/00 or H02J3/383 or H02J3/386 or H02J13/0017 or H02J2300/28 or H02J2300/24 or G05B2219/2639 or Y02E10/76 or Y02P60/21 or Y02P60/12 or Y02E10/56 or Y02A40/25 or A01G9/24 or A01G31/06 or H02S10/00).cpc. 713/300,310,320,330.ccls.)	US-PGPUB; USPAT	OR	OFF	2021/02/27 14:41
S24	0	S23 and @ad<"20180111"	US-PGPUB; USPAT	OR	OFF	2021/02/27 14:41
S25	11	("0000002" | "20020158749" | "20100280675" | "20140070756" | "20140180886" | "20150212122" | "20170373500" | "20180026478" | "8639392" | "9645596" | "9994118").PN.	US-PGPUB; USPAT	OR	OFF	2021/03/27 12:45
S26	1,212	(datacenter (data adj center) crac) and meter and power and generat$4 and server and (remote with control$4) and grid and monitor$4	US-PGPUB; USPAT	OR	OFF	2021/03/27 14:23
S27	113	S26 and ((modulat$4 control$4) near3 (power near2 (deliver$4 distribut$5)))	US-PGPUB; USPAT	OR	OFF	2021/03/27 14:33
S28	32	S27 and ((G05B19/042 or H02J13/00002 or G06F1/3203 or G06F9/4856 or H02S40/32 or A01G9/249 or A01G9/18 or A01G9/243 or	US-PGPUB; USPAT	OR	OFF	2021/03/27 14:34

		A01G9/246 or A01G9/247 or A01G9/26 or H02J3/381 or H02J13/00 or H02J3/383 or H02J3/386 or H02J13/0017 or H02J2300/28 or H02J2300/24 or G05B2219/2639 or Y02E10/76 or Y02P60/21 or Y02P60/12 or Y02E10/56 or Y02A40/25 or A01G9/24 or A01G31/06 or H02S10/00).cpc. 713/300,310,320,330.ccls.)				
S29	508	(datacenter (data adj center) crac) same ((modulat$4 control$4) near3 (power near2 (deliver$4 distribut$5)))	US-PGPUB; USPAT	OR	OFF	2021/03/27 14:35
S30	20	S29 and (behind-the-meter BTM)	US-PGPUB; USPAT	OR	OFF	2021/03/27 14:37
S31	14	S30 and ((G05B19/042 or H02J13/00002 or G06F1/3203 or G06F9/4856 or H02S40/32 or A01G9/249 or A01G9/18 or A01G9/243 or A01G9/246 or A01G9/247 or A01G9/26 or H02J3/381 or H02J13/00 or H02J3/383 or H02J3/386 or H02J13/0017 or H02J2300/28 or H02J2300/24 or G05B2219/2639 or Y02E10/76 or Y02P60/21 or Y02P60/12 or Y02E10/56 or Y02A40/25 or A01G9/24 or A01G31/06 or H02S10/00).cpc. 713/300,310,320,330.ccls.)	US-PGPUB; USPAT	OR	OFF	2021/03/27 14:37
S32	0	S31 and @ad<"20180111"	US-PGPUB; USPAT	OR	OFF	2021/03/27 14:38
S33	0	S30 and @ad<"20180111"	US-PGPUB; USPAT	OR	OFF	2021/03/27 14:38
S34	20	S29 and ((beyond behind) near3 meter)	US-PGPUB; USPAT	OR	OFF	2021/03/27 14:39
S35	0	S34 and @ad<"20180111"	US-PGPUB; USPAT	OR	OFF	2021/03/27 14:40
S36	575	(before prior) near3 step-up	US-PGPUB; USPAT	OR	OFF	2021/03/27 14:41
S37	5	S36 with ((distribut$4 deliver$4) near2 (power energy))	US-PGPUB; USPAT	OR	OFF	2021/03/27 14:41
S38	2	S37 and @ad<"20180111"	US-PGPUB; USPAT	OR	OFF	2021/03/27 14:42

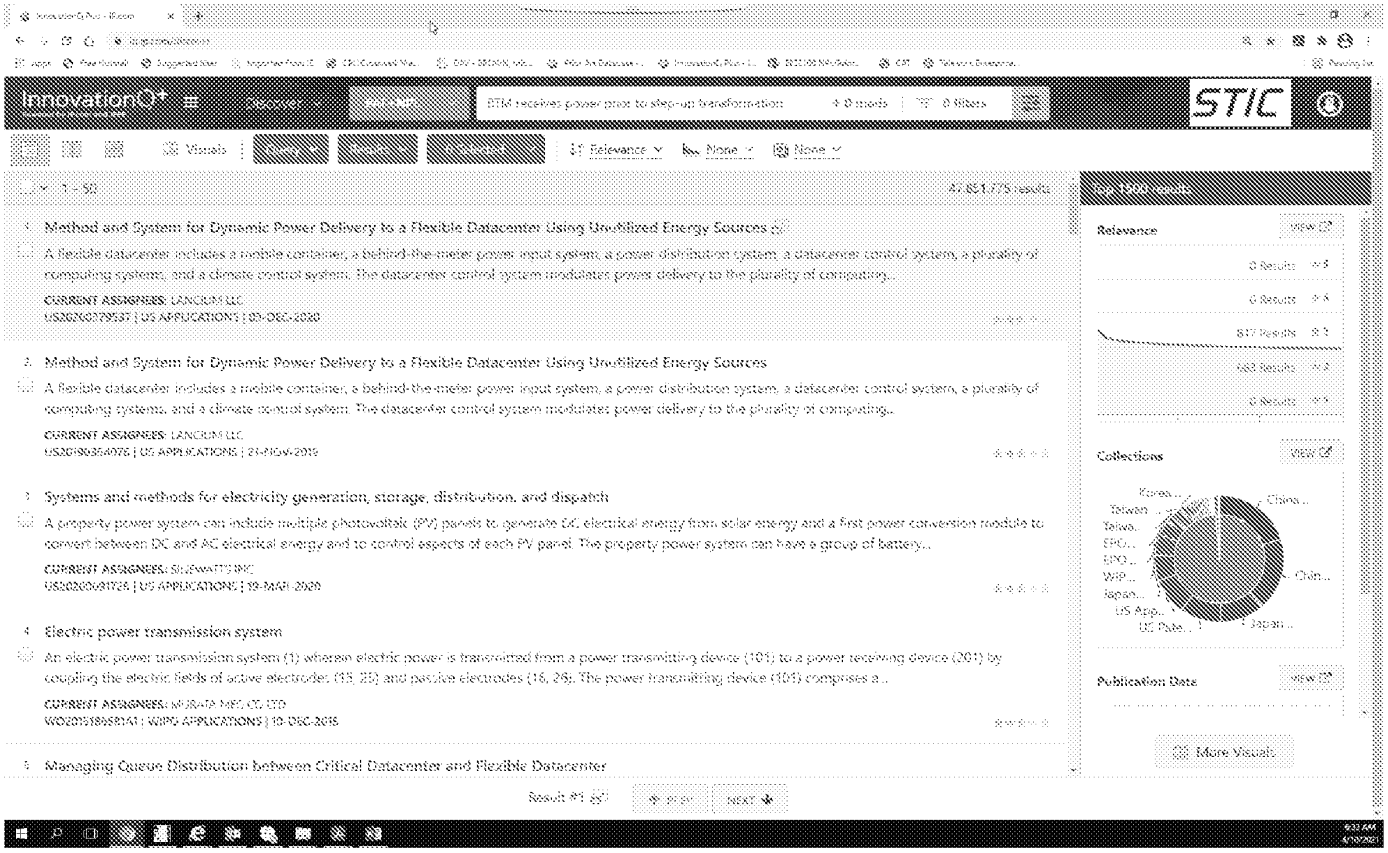
S39	238,059	(before prior) near3 (transform$7 conver$7)	US-PGPUB; USPAT	OR	OFF	2021/03/27 14:42
S40	2	("6288456" "8001403").pn.	US-PGPUB; USPAT	OR	OFF	2021/03/27 14:47
S41	1	("10452127").pn.	US-PGPUB; USPAT	OR	OFF	2021/03/27 15:11
S42	3	"20120324259" "20020072686"	US-PGPUB; USPAT	OR	OFF	2021/03/27 15:42
S43	1	"20020072868"	US-PGPUB; USPAT	OR	OFF	2021/03/27 15:46
S44	38	(datacenter (data adj center) crac) same (step$5up)	US-PGPUB; USPAT	OR	OFF	2021/03/27 15:51
S45	15	S44 same ((behind beyond) near2 meter)	US-PGPUB; USPAT	OR	OFF	2021/03/27 15:51
S46	15	S45 same transform$7	US-PGPUB; USPAT	OR	OFF	2021/03/27 15:52
S47	11	S46 and ((G05B19/042 or H02J13/00002 or G06F1/3203 or G06F9/4856 or H02S40/32 or A01G9/249 or A01G9/18 or A01G9/243 or A01G9/246 or A01G9/247 or A01G9/26 or H02J3/381 or H02J13/00 or H02J3/383 or H02J3/386 or H02J13/0017 or H02J2300/28 or H02J2300/24 or G05B2219/2639 or Y02E10/76 or Y02P60/21 or Y02P60/12 or Y02E10/56 or Y02A40/25 or A01G9/24 or A01G31/06 or H02S10/00).cpc. 713/300,310,320,330.ccls.)	US-PGPUB; USPAT	OR	OFF	2021/03/27 15:52
S48	0	S47 and @ad<"20180111"	US-PGPUB; USPAT	OR	OFF	2021/03/27 15:53
S49	0	rampp-up.clm.	US-PGPUB; USPAT	OR	OFF	2021/03/27 15:58
S50	1,372	ramp-up.clm.	US-PGPUB; USPAT	OR	OFF	2021/03/27 15:58
S51	2	S50 and BTM.clm.	US-PGPUB; USPAT	OR	OFF	2021/03/27 15:58

S52	0	S51 and @ad<"20180111"	US-PGPUB; USPAT	OR	OFF	2021/03/27 15:59
S53	15	(receiv$4 near3 power) with ((before prior) near3 (step$4up) near2 transform$7)	US-PGPUB; USPAT	OR	OFF	2021/03/27 16:15
S54	15	S53 same (grid $6grid)	US-PGPUB; USPAT	OR	OFF	2021/03/27 16:15
S55	10	S54 and ((G05B19/042 or H02J13/00002 or G06F1/3203 or G06F9/4856 or H02S40/32 or A01G9/249 or A01G9/18 or A01G9/243 or A01G9/246 or A01G9/247 or A01G9/26 or H02J3/381 or H02J13/00 or H02J3/383 or H02J3/386 or H02J13/0017 or H02J2300/28 or H02J2300/24 or G05B2219/2639 or Y02E10/76 or Y02P60/21 or Y02P60/12 or Y02E10/56 or Y02A40/25 or A01G9/24 or A01G31/06 or H02S10/00).cpc. 713/300,310,320,330.ccls.)	US-PGPUB; USPAT	OR	OFF	2021/03/27 16:15
S56	0	S55 and @ad<"20180111"	US-PGPUB; USPAT	OR	OFF	2021/03/27 16:16
S57	1	S54 and @ad<"20180111"	US-PGPUB; USPAT	OR	OFF	2021/03/27 16:16
S58	6	S55 and ramp-up.clm.	US-PGPUB; USPAT	OR	OFF	2021/03/27 16:17

EAST Search History (Interference)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L6	108,606	"L4" and @ad<"20180111"	US-PGPUB; USPAT	OR	OFF	2021/04/10 06:30
L12	19,931	"L10" and @ad<"20180111"	US-PGPUB; USPAT	OR	OFF	2021/04/10 06:31

4/10/2021 6:46:08 AM
C:\Users\mbrown7\Documents\EAST\Workspaces\16482495.wsp


Innovation IP
STIC
BTM receives power prior to step-up transformation
Visuals
Relevance
None
1 - 50
Method and System for Dynamic Power Delivery to a Flexible Datacenter Using Unutilized Energy Sources
A flexible datacenter includes a mobile container, a behind-the-meter power input system, a power distribution system, a datacenter control system, a plurality of computing systems, and a climate control system. The datacenter control system modulates power delivery to the plurality of computing...
CURRENT ASSIGNEES: LANCIUM LLC
US20200379537 | US APPLICATIONS | 03-DEC-2020
Method and System for Dynamic Power Delivery to a Flexible Datacenter Using Unutilized Energy Sources
A flexible datacenter includes a mobile container, a behind-the-meter power input system, a power distribution system, a datacenter control system, a plurality of computing systems, and a climate control system. The datacenter control system modulates power delivery to the plurality of computing...
CURRENT ASSIGNEES: LANCIUM LLC
US20190354976 | US APPLICATIONS | 21-NOV-2019
Systems and methods for electricity generation, storage, distribution, and dispatch
A property power system can include multiple photovoltaic (PV) panels to generate DC electrical energy from solar energy and a first power conversion module to convert between DC and AC electrical energy and to control aspects of each PV panel. The property power system can have a group of battery...
CURRENT ASSIGNEES: SUNWATTS INC
US20200091726 | US APPLICATIONS | 19-MAR-2020
Electric power transmission system
An electric power transmission system (1) wherein electric power is transmitted from a power transmitting device (101) to a power receiving device (201) by coupling the electric fields of active electrodes (13, 23) and passive electrodes (16, 26). The power transmitting device (101) comprises a ...
CURRENT ASSIGNEES: MURATA MFG CO, LTD
WO2015165974A1 | WIPO APPLICATIONS | 10-DEC-2015
Managing Queue Distribution between Critical Datacenter and Flexible Datacenter
Result #1 of
NEXT
Relevance
VIEW
Collections
VIEW
Publication Date
VIEW
More Visuals

Bibliographic Data

Application No: 16/482,495

Foreign Priority claimed: ○ Yes ◉ No

35 USC 119 (a-d) conditions met: ☐ Yes ☑ No ☐ Met After Allowance

Verified and Acknowledged: /MICHAEL J BROWN/ (Examiner's Signature) | MJB (Initials)

Title: Method and System for Dynamic Power Delivery to a Flexible Datacenter Using Unutilized Energy Sources

FILING or 371(c) DATE	CLASS	GROUP ART UNIT	ATTORNEY DOCKET NO.
07/31/2019	713	2115	84008-322155
RULE			

APPLICANTS

Lancium LLC, The Woodlands, TX, UNITED STATES

INVENTORS

David Henson, The Woodlands, TX, UNITED STATES

Michael McNamara, The Woodlands, TX, UNITED STATES

Raymond Cline, The Woodlands, TX, UNITED STATES

CONTINUING DATA

This application is a 371 of PCT/US2018/017950 02/13/2018

PCT/US2018/017950 has PRO of 62616348 01/11/2018

FOREIGN APPLICATIONS

IF REQUIRED, FOREIGN LICENSE GRANTED**

08/23/2020

STATE OR COUNTRY

UNITED STATES

ADDRESS

Barnes & Thornburg LLP (CH)

P.O. Box 2786

Chicago, IL 60690-2786

UNITED STATES

FILING FEE RECEIVED

$1,290

PATENT
Attorney Docket No. 84008-322155
(18-874-WO1-US)

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

First named inventor:

David Henson

Application No. 16/482,495

Filed: July 31, 2019

Confirmation No. 7727

Group Art Unit: 2115

Examiner: BROWN, Michael J.

For: METHOD AND SYSTEM FOR DYNAMIC POWER DELIVERY TO A FLEXIBLE DATACENTER USING UNUTILIZED ENERGY SOURCES

AMENDMENT AND RESPONSE TO OFFICE ACTION

Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450

Dear Sir:

This paper responds to the non-final Office Action dated April 1, 2021. Applicant has submitted a Terminal Disclaimer to overcome the double-patenting rejections set forth therein.

In view of the above, Applicant respectfully requests reconsideration and withdrawal of the pending rejections and allowance of the application. If the Examiner believes that a telephone conference would expedite the prosecution of the application, the Examiner is invited to call the undersigned attorney.

Respectfully submitted,

/Mark P. Vrla/

Date: April 1, 2021

Mark P. Vrla, Reg. No. 43973
One of the Attorneys for Applicant(s)
BARNES & THORNBURG LLP
P.O. Box 2786
Chicago, Illinois 60690-2786
Phone: 312-357-1313
Facsimile: 312-759-5646
Customer No.: 23644

Electronic Acknowledgement Receipt

EFS ID:	42345860
Application Number:	16482495
International Application Number:	
Confirmation Number:	7727
Title of Invention:	Method and System for Dynamic Power Delivery to a Flexible Datacenter Using Unutilized Energy Sources
First Named Inventor/Applicant Name:	David Henson
Customer Number:	23644
Filer:	Mark P. Vrla/Mark Sweetin
Filer Authorized By:	Mark P. Vrla
Attorney Docket Number:	84008-322155
Receipt Date:	01-APR-2021
Filing Date:	31-JUL-2019
Time Stamp:	14:37:05
Application Type:	U.S. National Stage under 35 USC 371

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	Amendment/Req. Reconsideration-After Non-Final Reject	322155_Response_NFOA_210401.pdf	18032 4b88a617deed2ae7cd3f45529d85ee8ac9626a6b	no	1

Warnings:

Information:	
Total Files Size (in bytes):	18032

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.

Doc Code: DIST.E.FILE **Document Description: Electronic Terminal Disclaimer - Filed**	PTO/SB/26 U.S. Patent and Trademark Office Department of Commerce

Electronic Petition Request	**TERMINAL DISCLAIMER TO OBVIATE A DOUBLE PATENTING REJECTION OVER A "PRIOR" PATENT**
Application Number	16482495
Filing Date	31-Jul-2019
First Named Inventor	David Henson
Attorney Docket Number	84008-322155
Title of Invention	Method and System for Dynamic Power Delivery to a Flexible Datacenter Using Unutilized Energy Sources

☒ Filing of terminal disclaimer does not obviate requirement for response under 37 CFR 1.111 to outstanding Office Action

☒ This electronic Terminal Disclaimer is not being used for a Joint Research Agreement.

Owner	Percent Interest
LANCIUM LLC	100%

The owner(s) with percent interest listed above in the instant application hereby disclaims, except as provided below, the terminal part of the statutory term of any patent granted on the instant application which would extend beyond the expiration date of the full statutory term of prior patent number(s)

10452127

as the term of said prior patent is presently shortened by any terminal disclaimer. The owner hereby agrees that any patent so granted on the instant application shall be enforceable only for and during such period that it and the prior patent are commonly owned. This agreement runs with any patent granted on the instant application and is binding upon the grantee, its successors or assigns.

In making the above disclaimer, the owner does not disclaim the terminal part of the term of any patent granted on the instant application that would extend to the expiration date of the full statutory term of the prior patent, "as the term of said prior patent is presently shortened by any terminal disclaimer," in the event that said prior patent later:
- expires for failure to pay a maintenance fee;
- is held unenforceable;
- is found invalid by a court of competent jurisdiction;
- is statutorily disclaimed in whole or terminally disclaimed under 37 CFR 1.321;
- has all claims canceled by a reexamination certificate;
- is reissued; or
- is in any manner terminated prior to the expiration of its full statutory term as presently shortened by any terminal disclaimer.

◉ Terminal disclaimer fee under 37 CFR 1.20(d) is included with Electronic Terminal Disclaimer request.

○ I certify, in accordance with 37 CFR 1.4(d)(4), that the terminal disclaimer fee under 37 CFR 1.20(d) required for this terminal disclaimer has already been paid in the above-identified application.	
Applicant claims the following fee status: ○ Small Entity ○ Micro Entity ◉ Regular Undiscounted I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.	
THIS PORTION MUST BE COMPLETED BY THE SIGNATORY OR SIGNATORIES I certify, in accordance with 37 CFR 1.4(d)(4) that I am: ◉ An attorney or agent registered to practice before the Patent and Trademark Office who is of record in this application Registration Number 43973 ○ A sole inventor ○ A joint inventor; I certify that I am authorized to sign this submission on behalf of all of the inventors as evidenced by the power of attorney in the application ○ A joint inventor; all of whom are signing this request	
Signature	/Mark P. Vrla/
Name	Mark P. Vrla

*Statement under 37 CFR 3.73(b) is required if terminal disclaimer is signed by the assignee (owner).
Form PTO/SB/96 may be used for making this certification. See MPEP § 324.

Electronic Patent Application Fee Transmittal

Application Number:	16482495
Filing Date:	31-Jul-2019
Title of Invention:	Method and System for Dynamic Power Delivery to a Flexible Datacenter Using Unutilized Energy Sources
First Named Inventor/Applicant Name:	David Henson
Filer:	Mark P. Vrla/Mark Sweetin
Attorney Docket Number:	84008-322155

Filed as Large Entity

Filing Fees for U.S. National Stage under 35 USC 371

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
STATUTORY OR TERMINAL DISCLAIMER	1814	1	170	170
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Extension-of-Time:				
Miscellaneous:				
		Total in USD ($)		**170**

Doc Code: DISQ.E.FILE
Document Description: Electronic Terminal Disclaimer – Approved

Application No.: 16482495

Filing Date: 31-Jul-2019

Applicant/Patent under Reexamination: Henson

Electronic Terminal Disclaimer filed on April 1, 2021

☒ APPROVED

This patent is subject to a terminal disclaimer

☐ DISAPPROVED

Approved/Disapproved by: Electronic Terminal Disclaimer automatically approved by EFS-Web

U.S. Patent and Trademark Office

Electronic Acknowledgement Receipt	
EFS ID:	42343691
Application Number:	16482495
International Application Number:	
Confirmation Number:	7727
Title of Invention:	Method and System for Dynamic Power Delivery to a Flexible Datacenter Using Unutilized Energy Sources
First Named Inventor/Applicant Name:	David Henson
Customer Number:	23644
Filer:	Mark P. Vrla/Mark Sweetin
Filer Authorized By:	Mark P. Vrla
Attorney Docket Number:	84008-322155
Receipt Date:	01-APR-2021
Filing Date:	31-JUL-2019
Time Stamp:	14:33:41
Application Type:	U.S. National Stage under 35 USC 371

Payment information:

Submitted with Payment	yes
Payment Type	CARD
Payment was successfully received in RAM	$170
RAM confirmation Number	E202141E33360171
Deposit Account	120913
Authorized User	Mark Sweetin
The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows: 37 CFR 1.17 (Patent application and reexamination processing 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	Terminal Disclaimer-Filed (Electronic)	eTerminal-Disclaimer.pdf	33443 08f3296e52e797d0912bd3d7aa3e5603cac1f206	no	2
Warnings:					
Information:					
2	Fee Worksheet (SB06)	fee-info.pdf	30914 3b2472a3e3492c848f6c30551e3654f68dada9cc	no	2
Warnings:					
Information:					
		Total Files Size (in bytes):	64357		

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 NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
16/482,495	07/31/2019	David Henson	84008-322155	7727

23644 7590 04/01/2021

Barnes & Thornburg LLP (CH)
P.O. Box 2786
Chicago, IL 60690-2786

EXAMINER	
BROWN, MICHAEL J	

ART UNIT	PAPER NUMBER
2115	

NOTIFICATION DATE	DELIVERY MODE
04/01/2021	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):

Patent-ch@btlaw.com

Office Action Summary	Application No. 16/482,495	Applicant(s) Henson et al.	
	Examiner MICHAEL J BROWN	Art Unit 2115	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 7/31/2019.

☐ 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) 35-64 is/are pending in the application.

5a) Of the above claim(s) _____ is/are withdrawn from consideration.

6) ☑ Claim(s) 62-64 is/are allowed.

7) ☑ Claim(s) 35-61 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 7/31/2019 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 See Continuation Sheet.

3) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date _____.

4) ☐ Other: _____.

Continuation of Attachment(s) 2) Information Disclosure Statement(s) (PTO/SB/08a and/or PTO/SB/08b) Paper No(s)/Mail Date: 7/31/19, 10/15/19, 12/17/19, 2/11/20, 5/11/20, 1/31/21, and 3/9/21

DETAILED ACTION

Notice of Pre-AIA or AIA Status

1. The present application, filed on or after March 16, 2013, is being examined under the first inventor to file provisions of the AIA.

Information Disclosure Statement

2. The information disclosure statements (IDS) submitted on 7/31/2019, 10/15/2019, 12/17/2019, 2/11/2020, 5/11/2020, 1/31/2021, and 3/9/2021 were filed. The submission is in compliance with the provisions of 37 CFR 1.97. Accordingly, the information disclosure statement is being considered by the examiner.

Double Patenting

3. The nonstatutory double patenting rejection is based on a judicially created doctrine grounded in public policy (a policy reflected in the statute) so as to prevent the unjustified or improper timewise extension of the "right to exclude" granted by a patent and to prevent possible harassment by multiple assignees. A nonstatutory double patenting rejection is appropriate where the conflicting claims are not identical, but at least one examined application claim is not patentably distinct from the reference claim(s) because the examined application claim is either anticipated by, or would have been obvious over, the reference claim(s). See, e.g., *In re Berg*, 140 F.3d 1428, 46 USPQ2d 1226 (Fed. Cir. 1998); *In re Goodman*, 11 F.3d 1046, 29 USPQ2d 2010 (Fed. Cir. 1993); *In re Longi*, 759 F.2d 887, 225 USPQ 645 (Fed. Cir. 1985); *In re Van Ornum*,

686 F.2d 937, 214 USPQ 761 (CCPA 1982); *In re Vogel*, 422 F.2d 438, 164 USPQ 619 (CCPA 1970); *In re Thorington*, 418 F.2d 528, 163 USPQ 644 (CCPA 1969).

A timely filed terminal disclaimer in compliance with 37 CFR 1.321(c) or 1.321(d) may be used to overcome an actual or provisional rejection based on nonstatutory double patenting provided the reference application or patent either is shown to be commonly owned with the examined application, or claims an invention made as a result of activities undertaken within the scope of a joint research agreement. See MPEP § 717.02 for applications subject to examination under the first inventor to file provisions of the AIA as explained in MPEP § 2159. See MPEP § 2146 *et seq.* for applications not subject to examination under the first inventor to file provisions of the AIA. A terminal disclaimer must be signed in compliance with 37 CFR 1.321(b).

The USPTO Internet website contains terminal disclaimer forms which may be used. Please visit www.uspto.gov/patent/patents-forms. The filing date of the application in which the form is filed determines what form (e.g., PTO/SB/25, PTO/SB/26, PTO/AIA/25, or PTO/AIA/26) should be used. A web-based eTerminal Disclaimer may be filled out completely online using web-screens. An eTerminal Disclaimer that meets all requirements is auto-processed and approved immediately upon submission. For more information about eTerminal Disclaimers, refer to www.uspto.gov/patents/process/file/efs/guidance/eTD-info-I.jsp.

4. Claims 35-61 are rejected on the ground of nonstatutory double patenting as being unpatentable over claims 1-10 of U.S. Patent No. 10,452,532. Please see the below chart outlining the similarities and differences between the present patent application and U.S. Patent No. 10,452,532.

Present Patent Application	Patent No. 10,452,127 (not necessarily in order)
	1. A system comprising:
35. A flexible datacenter comprising:	a **first** flexible datacenter comprising:
a behind-the-meter (BTM) power input system, wherein the BTM power input system is configured to receive power from a power generation station prior to the power undergoing step-up transformation for transmission to a power grid;	a **first** behind-the-meter power input system configured to receive power from a power generation system prior to the power undergoing step-up transformation for transmission to the grid,
a power distribution system;	a **first** power distribution system,
a plurality of computing systems; and	a first plurality of computing systems powered by the first behind-the-meter power input system via the first power distribution system, wherein the **first** *datacenter control system is configured to modulate power delivery to the first plurality of computing systems based on one or more monitored power system conditions or an operational directive*;
a datacenter control system configured to modulate power delivery to the plurality of computing systems based on an operational directive	a **first** datacenter control system,
59. A system comprising:	1. A system comprising:
a first flexible datacenter that comprises:	a first flexible datacenter comprising:
a behind-the-meter (BTM) power input system, wherein the BTM power input system is configured to receive power from a power generation station prior to the power undergoing step-up transfom1ation for transmission to a power grid;	a first behind-the-meter power input system configured to receive power from a power generation system prior to the power undergoing step-up transformation for transmission to the grid,
a power distribution system; and	a first power distribution system,
a plurality of computing systems configured to receive power from the BTM power input system via the power distribution system;	a **first** plurality of computing systems powered by the first behind-the-meter power input system via the first power distribution system, wherein the *first datacenter control system is configured to modulate power delivery to the first plurality of computing systems* **based on one or more monitored power system conditions or an operational directive;**
a second flexible datacenter: and	a second flexible datacenter comprising:
	a second plurality of computing systems powered by the second behind-the-meter power input system via the second power distribution system, wherein the *second*

	datacenter control system is configured to modulate power delivery to the second plurality of computing systems **based on one or more monitored power system conditions or an operational directive; and**
a routing control system configured to modulate power delivery to the first flexible datacenter and the second flexible datacenter.	a routing control system **configured to (i) identify a computational operation to be performed, (ii) determine whether to route at least a portion of the computational operation to the first flexible datacenter, and (iii) based on a determination to route at least the portion of the computational operation to the first flexible datacenter, cause a first portion of the computational operation to be sent to the first flexible datacenter and a second portion of the computational operation to be sent to the second flexible datacenter.**

Although the claims at issue are not identical, they are not patentably distinct from each other as illustrated above.

Allowable Subject Matter

5. Claims 35-61 are allowable over the prior art except for the above Double Patenting rejection. Claims 62-64 are entirely allowed.

6. The following is a statement of reasons for the indication of allowable subject matter: Prior art fails to specifically disclose a behind-the-meter (BTM) power input system configured to receive power from a power generation station prior to the power undergoing step-up transformation for transmission to a power grid. Accordingly, the present claims 62-64 are in condition for allowance and claims 35-61 would be in condition for allowance if not for the above Double Patenting rejection.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Michael J. Brown whose telephone number is (571)272-5932. The examiner can normally be reached Monday-Thursday from 5:30am-4:00pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Thomas Lee can be reached at (571)272-3667. 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 http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/Michael J Brown/
Primary Examiner, Art Unit 2115

Notice of References Cited	Application/Control No. 16/482,495	Applicant(s)/Patent Under Reexamination Henson et al.	
	Examiner MICHAEL J BROWN	Art Unit 2115	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-10452127-B1	10-2019	McNamara; Michael T.	G06F1/3206	1/1
	B					
	C					
	D					
	E					
	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.

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	16/482,495	Henson et al.
	Examiner	Art Unit
	MICHAEL J BROWN	2115

CPC - Searched*		
Symbol	**Date**	**Examiner**
G05B 19/042, 2219/2639	02/27/2021	MJB
H02J 13/00002, 3/381, 13/00, 3/383, 3/386, 13/0017, 2300/28, 2300/24	02/27/2021	MJB
G06F 1/3203, 9/4856	02/27/2021	MJB
H02S 40/32, 10/00	02/27/2021	MJB
A01G 9/249, 9/18, 9/243, 9/246, 9/247, 9/26, 9/24, 31/06	02/27/2021	MJB
Y02E 10/76, 10/56	02/27/2021	MJB
Y02P 60/21, 60/12	02/27/2021	MJB
Y02A 40/25	02/27/2021	MJB
G05B 19/042, 2219/2639	03/27/2021	MJB
H02J 13/00002, 3/381, 13/00, 3/383, 3/386, 13/0017, 2300/28, 2300/24	03/27/2021	MJB
G06F 1/3203, 9/4856	03/27/2021	MJB
H02S 40/32, 10/00	03/27/2021	MJB
A01G 9/249, 9/18, 9/243, 9/246, 9/247, 9/26, 9/24, 31/06	03/27/2021	MJB
Y02E 10/76, 10/56	03/27/2021	MJB
Y02P 60/21, 60/12	03/27/2021	MJB
Y02A 40/25	03/27/2021	MJB

CPC Combination Sets - Searched*		
Symbol	**Date**	**Examiner**

/MICHAEL J BROWN/ Primary Examiner, Art Unit 2115	

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	16/482,495	Henson et al.
	Examiner	Art Unit
	MICHAEL J BROWN	2115

US Classification - Searched*			
Class	**Subclass**	**Date**	**Examiner**
713	300,310,320,330	02/27/2021	MJB
713	300,310,320,330	03/27/2021	MJB

* 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	02/13/2021	MJB
EAST search *Report Attached*	02/27/2021	MJB
classification search *Report Attached*	02/27/2021	MJB
EAST search *Report Attached*	03/27/2021	MJB
classification search *Report Attached*	03/27/2021	MJB
Foreign Art search *Report Attached*	03/27/2021	MJB
NPL search *Report Attached*	03/27/2021	MJB

Interference Search			
US Class/CPC Symbol	**US Subclass/CPC Group**	**Date**	**Examiner**

/MICHAEL J BROWN/ Primary Examiner, Art Unit 2115	

Index of Claims	Application/Control No.	Applicant(s)/Patent Under Reexamination
	16/482,495	Henson et al.
	Examiner	**Art Unit**
	MICHAEL J BROWN	2115

✓	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	03/27/2021								
	1	-								
	2	-								
	3	-								
	4	-								
	5	-								
	6	-								
	7	-								
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	33	-								
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	35	✓								
	36	✓								
	37	✓								
	38	✓								
	39	✓								
	40	✓								
	41	✓								
	42	✓								

Index of Claims	Application/Control No.	Applicant(s)/Patent Under Reexamination
	16/482,495	Henson et al.
	Examiner	**Art Unit**
	MICHAEL J BROWN	2115

CLAIM		DATE								
Final	Original	03/27/2021								
	43	✓								
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	46	✓								
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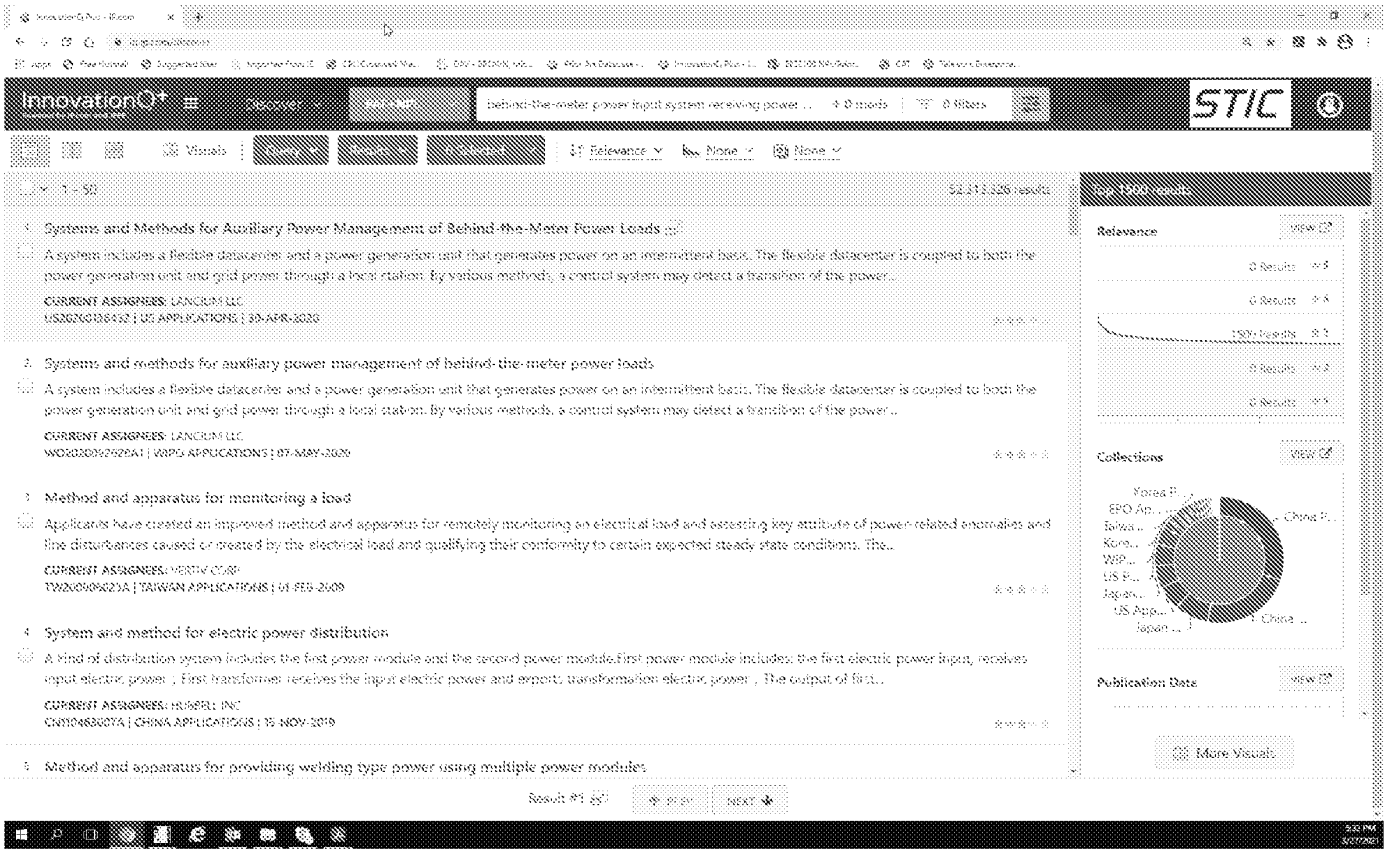
	63	=								
	64	=								


Innovation
Discover
behind-the-meter power input system receiving power ...
0 filters
STIC
Visuals
Relevance
None
None
1 - 50
52,313,326 results
Systems and Methods for Auxiliary Power Management of Behind-the-Meter Power Loads
A system includes a flexible datacenter and a power generation unit that generates power on an intermittent basis. The flexible datacenter is coupled to both the power generation unit and grid power through a local station. By various methods, a control system may detect a transition of the power...
CURRENT ASSIGNEES: LANCIUM LLC
US20200108432 | US APPLICATIONS | 30-APR-2020
Systems and methods for auxiliary power management of behind-the-meter power loads
A system includes a flexible datacenter and a power generation unit that generates power on an intermittent basis. The flexible datacenter is coupled to both the power generation unit and grid power through a local station. By various methods, a control system may detect a transition of the power...
CURRENT ASSIGNEES: LANCIUM LLC
WO2020092928A1 | WIPO APPLICATIONS | 07-MAY-2020
Method and apparatus for monitoring a load
Applicants have created an improved method and apparatus for remotely monitoring an electrical load and assessing key attribute of power-related anomalies and line disturbances caused or created by the electrical load and qualifying their conformity to certain expected steady state conditions. The...
CURRENT ASSIGNEES: VERTIV CORP
TW200909023A | TAIWAN APPLICATIONS | 01-FEB-2009
System and method for electric power distribution
A kind of distribution system includes the first power module and the second power module.First power module includes: the first electric power input, receives input electric power ; First transformer receives the input electric power and exports transformation electric power ; The output of first...
CURRENT ASSIGNEES: HUBBELL INC
CN110468007A | CHINA APPLICATIONS | 15-NOV-2019
Method and apparatus for providing welding type power using multiple power modules
Top 1500 results
Relevance
VIEW
0 Results
0 Results
1500 Results
0 Results
0 Results
Collections
VIEW
Korea P...
EPO Ap...
Taiwa...
Kore...
WIP...
US P...
Japan...
US App...
Japan ...
China P...
China ...
Publication Date
VIEW
More Visuals
Result #1
PREV
NEXT

EAST Search History

EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L1	11	("0000002" | "20020158749" | "20100280675" | "20140070756" | "20140180886" | "20150212122" | "20170373500" | "20180026478" | "8639392" | "9645596" | "9994118").PN.	US-PGPUB; USPAT	OR	OFF	2021/03/27 12:45
L2	1,212	(datacenter (data adj center) crac) and meter and power and generat$4 and server and (remote with control$4) and grid and monitor$4	US-PGPUB; USPAT	OR	OFF	2021/03/27 14:23
L3	113	L2 and ((modulat$4 control$4) near3 (power near2 (deliver$4 distribut$5)))	US-PGPUB; USPAT	OR	OFF	2021/03/27 14:33
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L5	508	(datacenter (data adj center) crac) same ((modulat$4 control$4) near3 (power near2 (deliver$4 distribut$5)))	US-PGPUB; USPAT	OR	OFF	2021/03/27 14:35
L6	20	L5 and (behind-the-meter BTM)	US-PGPUB; USPAT	OR	OFF	2021/03/27 14:37
L7	14	L6 and ((G05B19/042 or H02J13/00002 or G06F1/3203 or G06F9/4856 or H02S40/32 or A01G9/249 or A01G9/18 or A01G9/243 or A01G9/246 or A01G9/247 or A01G9/26 or H02J3/381 or H02J13/00 or H02J3/383 or H02J3/386 or H02J13/0017 or H02J2300/28 or H02J2300/24 or G05B2219/2639 or Y02E10/76 or Y02P60/21 or Y02P60/12 or Y02E10/56 or Y02A40/25 or A01G9/24 or A01G31/06 or H02S10/00).cpc. 713/300,310,320,330.ccls.)	US-PGPUB; USPAT	OR	OFF	2021/03/27 14:37
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L9	0	L6 and @ad<"20180111"	US-PGPUB; USPAT	OR	OFF	2021/03/27 14:38
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L12	575	(before prior) near3 step-up	US-PGPUB; USPAT	OR	OFF	2021/03/27 14:41
L13	5	L12 with ((distribut$4 deliver$4) near2 (power energy))	US-PGPUB; USPAT	OR	OFF	2021/03/27 14:41
L14	2	L13 and @ad<"20180111"	US-PGPUB; USPAT	OR	OFF	2021/03/27 14:42
L15	238,059	(before prior) near3 (transform$7 conver$7)	US-PGPUB; USPAT	OR	OFF	2021/03/27 14:42
L16	2	("6288456" "8001403").pn.	US-PGPUB; USPAT	OR	OFF	2021/03/27 14:47
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L18	3	"20120324259" "20020072686"	US-PGPUB; USPAT	OR	OFF	2021/03/27 15:42
L19	1	"20020072868"	US-PGPUB; USPAT	OR	OFF	2021/03/27 15:46
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L21	15	L20 same ((behind beyond) near2 meter)	US-PGPUB; USPAT	OR	OFF	2021/03/27 15:51
L22	15	L21 same transform$7	US-PGPUB; USPAT	OR	OFF	2021/03/27 15:52
L23	11	L22 and ((G05B19/042 or H02J13/00002 or G06F1/3203 or G06F9/4856 or H02S40/32 or A01G9/249 or A01G9/18 or A01G9/243 or A01G9/246 or A01G9/247 or A01G9/26 or H02J3/381 or H02J13/00 or H02J3/383 or	US-PGPUB; USPAT	OR	OFF	2021/03/27 15:52

		H02J3/386 or H02J13/0017 or H02J2300/28 or H02J2300/24 or G05B2219/2639 or Y02E10/76 or Y02P60/21 or Y02P60/12 or Y02E10/56 or Y02A40/25 or A01G9/24 or A01G31/06 or H02S10/00).cpc. 713/300,310,320,330.ccls.)				
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L26	1,372	ramp-up.clm.	US-PGPUB; USPAT	OR	OFF	2021/03/27 15:58
L27	2	L26 and BTM.clm.	US-PGPUB; USPAT	OR	OFF	2021/03/27 15:58
L28	0	L27 and @ad<"20180111"	US-PGPUB; USPAT	OR	OFF	2021/03/27 15:59
L29	15	(receiv$4 near3 power) with ((before prior) near3 (step$4up) near2 transform$7)	US-PGPUB; USPAT	OR	OFF	2021/03/27 16:15
L30	15	L29 same (grid $6grid)	US-PGPUB; USPAT	OR	OFF	2021/03/27 16:15
L31	10	L30 and ((G05B19/042 or H02J13/00002 or G06F1/3203 or G06F9/4856 or H02S40/32 or A01G9/249 or A01G9/18 or A01G9/243 or A01G9/246 or A01G9/247 or A01G9/26 or H02J3/381 or H02J13/00 or H02J3/383 or H02J3/386 or H02J13/0017 or H02J2300/28 or H02J2300/24 or G05B2219/2639 or Y02E10/76 or Y02P60/21 or Y02P60/12 or Y02E10/56 or Y02A40/25 or A01G9/24 or A01G31/06 or H02S10/00).cpc. 713/300,310,320,330.ccls.)	US-PGPUB; USPAT	OR	OFF	2021/03/27 16:15
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L33	1	L30 and @ad<"20180111"	US-PGPUB; USPAT	OR	OFF	2021/03/27 16:16
L34	6	L31 and ramp-up.clm.	US-PGPUB; USPAT	OR	OFF	2021/03/27 16:17

S1	22	((modulat$4 regulat$4 adjust$4 balanc$4 modif$6) near3 (power near2 deliver$5)) with (((plurality multiple several) near3 (comput$4 server$1 node$1)) datacenter)	US-PGPUB; USPAT	OR	OFF	2021/02/27 13:14
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EAST Search History (Interference)

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Use as many sheets as necessary)

Sheet 1 of 6

Complete if Known	
Application Number	16482495
Filing Date	07-13-2019
First Named Inventor	HENSON; David
Art Unit	2187
Examiner Name	
Attorney Docket Number	84008-322155

U. S. PATENT DOCUMENTS

Examiner Initials*	Cite No.[1]	Document Number Number-Kind Code[2] (if known)	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear
/M.J.B/	001	US-10608433	03-31-2020	McNAMARA; Michael T. et al.	
/M.J.B/	002	US-10618427	04-14-2020	McNAMARA; Michael T. et al.	
/M.J.B/	003	US-10637353	04-28-2020	OHYAMA; Soichiro et al.	
/M.J.B/	004	US-20090078401	03-26-2009	CICHANOWICZ; J. Edward	
/M.J.B/	005	US-20100235004	09-16-2010	THIND; Deepinder Singh	
/M.J.B/	006	US-20120306271	12-06-2012	KURIYAMA; Hiroshi	
/M.J.B/	007	US-20150012113	01-08-2015	CELEBI; Dogan	
/M.J.B/	008	US-20150288183	10-08-2015	VILLANUEVA, Jr.; et al.	
/M.J.B/	009	US-20150372538	12-24-2015	SIEGLER; John J. et al.	
/M.J.B/	010	US-20160006066	01-07-2016	ROBERTSON; John S.	
/M.J.B/	011	US-20160011617	01-14-2016	LIU; Jie et al.	
/M.J.B/	012	US-20160043552	02-11-2016	VILLANUEVA, Jr. et al.	
/M.J.B/	013	US-20160126783	05-05-2016	CHENG; Win Sheng et al.	
/M.J.B/	014	US-20200073466	03-05-2020	WALSH; Sean	

FOREIGN PATENT DOCUMENTS

Examiner Initials*	Cite No.[1]	Foreign Patent Document Country Code[3]-Number[4]-Kind Code[5] (if known)	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages Or Relevant Figures Appear	T[6]
		None				

Examiner Signature	/MICHAEL J BROWN/	Date Considered	02/27/2021

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Use as many sheets as necessary)

Sheet 2 of 6

Complete if Known	
Application Number	16482495
Filing Date	07-13-2019
First Named Inventor	HENSON; David
Art Unit	2187
Examiner Name	
Attorney Docket Number	84008-322155

NON-PATENT LITERATURE DOCUMENTS

Examiner Initials*	Cite No.[1]	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,page(s),volume-issue number(s),publisher, city and/or country where published.	T[2]
/M.J.B/	001	Advisory Action mailed on 13 November 2020 for U.S. Patent Application No. 16/529,360, filed on 01 August 2019, 182 pages.	☐
/M.J.B/	002	Advisory Action mailed on 22 October 2020 for U.S. Patent Application No. 16/528,348, filed on 31 July 2019, 3 pages.	☐
/M.J.B/	003	Bakar.N et al., "Microgrid and Load Shedding Scheme During Islanded Mode: a Review," Elsevier, May 26, 2020, Vol. 71, pp. 161-169. https://www.sciencedirect.com/science/article/pii/S1364032116311030.	☐
/M.J.B/	004	Choi.Y et al., "Optimal Load Shedding for Maximizing Satisfaction in an Islanded Microgrid," Energies, 2017, Vol. 10, pp.45. doi: 10.3390/en10010045.	☐
/M.J.B/	005	Final Office Action mailed 23 July 2020 on for U.S. Patent Application No. 16/132,062, filed on 14 September 2018, 26 pages.	☐
/M.J.B/	006	Final Office Action mailed on 19 May 2020 for U.S. Patent Application No. 16/809,111, filed on 04 March 2020, 36 pages.	☐
/M.J.B/	007	Final Office Action mailed on 03 June 2020 for U.S.Patent Application No. 16/528,348, filed on 31 July 2019, 33 pages.	☐
/M.J.B/	008	Final Office Action mailed on 28 May 2020 for U.S. Patent Application No. 16/132,098, filed on 14 September 2018, 24 pages.	☐
/M.J.B/	009	Final Office Action mailed on 29 July 2020 for U.S. Patent Application No. 16/132,092, filed on 14 September 2018, 5 pages.	☐
/M.J.B/	010	Gao.H et al., "Dynamic Load Shedding for an Islanded Microgrid With Limited Generation Resources," IET Generation, Transmission & Distribution, September 2016, Vol. 10(12), pp. 2953-2961. doi: 10.1049/iet-gtd.2015.1452.	☐
/M.J.B/	011	International Search Report and Written Opinion of PCT Application No. PCT/US2020/044536, mailed on 26 August 2020, 24 pages.	☒

Examiner Signature	/MICHAEL J BROWN/	Date Considered	02/27/2021

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT

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Sheet 3 of 6

Complete if Known	
Application Number	16482495
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First Named Inventor	HENSON; David
Art Unit	2187
Examiner Name	
Attorney Docket Number	84008-322155

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/M.J.B/	012	International Search Report and Written Opinion of PCT Application No. PCT/US2020/044539, mailed on 26 August 2020, 7 pages.	☐
/M.J.B/	013	JOHN, "Stem and CPower to Combine Behind-the-Meter Batteries and Demand Response," Energy Storage, August 08, 2017, 1 page.	☐
/M.J.B/	014	Lim.Y et al., "Distributed Load-shedding System for Agent-based Autonomous Microgrid Operations," Energies, 2014, Vol. 7(1), pp. 385-401. doi: 10.3390/en7010385.	☐
/M.J.B/	015	Liu.W et al., "Improved Average Consensus Algorithm Based Distributed Cost Optimization for Loading Shedding of Autonomous Microgrids,"International Journal of Electrical Power & Energy Systems, December 2015, Vol. 73, pp. 89-96. doi: 10.1016/j.ijepes.2015.04.006.	☐
/M.J.B/	016	Mousavizadeh.S et al., "A Linear Two-stage Method for Resiliency Analysis in Distribution Systems Considering Renewable Energy and Demand Response Resources," Elsevier, 2017, pp. 443-460. doi: 10.1016/j.apenergy.2017.11.067.	☐
/M.J.B/	017	Non-Final Office Action mailed on 12 June 2020 for U.S. Patent Application No. 16/803,109, filed on 27 December 2020, 31 pages.	☐
/M.J.B/	018	Non-Final Office Action mailed 14 May 2020 on for U.S. Patent Application No. 16/834,987, filed on 30 March 2020, 30 pages.	☐
/M.J.B/	019	Notice of Allowance mailed 13 October 2020 on for U.S. Patent Application No. 16/132,098, filed on 14 September 2018, 5 pages.	☐
/M.J.B/	020	Notice of Allowance mailed 12 June 2020 on for U.S. Patent Application No. 16/834,987, filed on 30 March 2020, 9 pages.	☐
/M.J.B/	021	Notice of Allowance mailed 13 January 2021 on for U.S. Patent Application No. 16/175246, filed on 30 October 2018, 5 pages.	☐
/M.J.B/	022	Notice of Allowance mailed 17 September 2020 on for U.S. Patent Application No. 16/175,246, filed on 30 October 2018, 5 pages.	☐

Examiner Signature	/MICHAEL J BROWN/	Date Considered	02/27/2021

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Use as many sheets as necessary)

Sheet 4 of 6

Complete if Known	
Application Number	16482495
Filing Date	07-13-2019
First Named Inventor	HENSON; David
Art Unit	2187
Examiner Name	
Attorney Docket Number	84008-322155

NON-PATENT LITERATURE DOCUMENTS

Examiner Initials*	Cite No.[1]	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,page(s),volume-issue number(s),publisher, city and/or country where published.	T[2]
/M.J.B/	023	Notice of Allowance mailed 19 November 2020 on for U.S. Patent Application No. 16/132,062, filed on 14 September 2018, 7 pages.	☐
/M.J.B/	024	Notice of Allowance mailed 27 January 2021 on for U.S. Patent Application No. 16/132,092, filed on 14 September 2018, 8 pages.	
/M.J.B/	025	Notice of Allowance mailed 29 July 2020 on for U.S. Patent Application No. 16/132,011, filed on 14 September 2018, 5 pages.	☐
/M.J.B/	026	Notice of Allowance mailed 29 October 2020 on for U.S. Patent Application No. 16/132,092, filed on 14 September 2018, 8 pages.	☐
/M.J.B/	027	Notice of Allowance mailed 25 January 2021 on for U.S. Patent Application No. 16/132,098, filed on 14 September 2018, 5 pages.	
/M.J.B/	028	Pashajavid.E et al., "A Multimode Supervisory Control Scheme for Coupling Remote Droop-Regulated Microgrids," IEEE Transactions on Smart Grid, May 26, 2020, Vol. 9(5), pp. 5381-5392. https://ieeexplore.ieee.org/abstract/document/7888570/.	☐
/M.J.B/	029	Pashajavid.E et al., "Frequency Support for Remote Microgrid Systems With Intermittent Distributed Energy Resources-A Two-level Hierarchical Strategy," IEEE Systems Journal, May 26, 2020, Vol. 12(3), pp. 2760-2771. https://ieeexplore.ieee.org/abstract/document/7862156/.	☐
/M.J.B/	030	Rudez.U and Mihalic.R, "Predictive Underfrequency Load Shedding Scheme for Islanded Power Systems With Renewable Generation," Electric Power Systems Research, May 2015, Vol. 126, pp. 21-28. doi: 10.1016/j.epsr.2015.04.017.	☐
/M.J.B/	031	Wilson, "Utility-Scale Deployment Project of Behind-the-Meter Energy Storage for Use in Ancillary Services, Energy Resiliency, Grid Infrastructure Investment Deferment, and Demand-Response Integration," Portland State University Thesis, 154 pages (6/9/2016).	
/M.J.B/	032	Xu.Q et al., "Distributed Load Shedding for Microgrid With Compensation Support via Wireless Network," IET Generation, Transmission & Distribution, May 2018, Vol. 12(9), pp. 2006-2018. doi: 10.1049/iet-gtd.2017.1029.	☐

Examiner Signature	/MICHAEL J BROWN/	Date Considered	02/27/2021

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Use as many sheets as necessary)

Sheet 5 of 6

Complete if Known	
Application Number	16482495
Filing Date	07-13-2019
First Named Inventor	HENSON; David
Art Unit	2187
Examiner Name	
Attorney Docket Number	84008-322155

NON-PATENT LITERATURE DOCUMENTS

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/M.J.B/	033	Zhou.Q et al., "Two-Stage Load Shedding for Secondary Control in Hierarchical Operation of Islanded Microgrids," IEEE Transactions on Smart Grid, May 2019, Vol. 10(3), pp. 3103-3111. doi: 10.1109/TSG.2018.2817738.	☐

Examiner Signature	/MICHAEL J BROWN/	Date Considered	02/27/2021

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Substitute for form 1449/PTO				Complete if Known	
INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Use as many sheets as necessary)				Application Number	16482495
				Filing Date	07-13-2019
				First Named Inventor	HENSON; David
				Art Unit	2187
				Examiner Name	
Sheet	6	of	6	Attorney Docket Number	84008-322155

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.

☒ Authorization to charge the Fee set forth in 37 CFR 1.17(p) to Deposit Account No. 12-0913 and to charge any fee deficiencies or credit any overpayments to Deposit Account No. 12-0913.

☐ 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	/Kurt W. Rohde/	Date (YYYY-MM-DD)	January 31, 2021
Name/Print	Kurt W. Rohde	Registration Number	62923

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
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (**Not for submission under 37 CFR 1.99**)		
	Application Number	16482495
	Filing Date	2019-07-31
	First Named Inventor	HENSON, David
	Art Unit	TBD
	Examiner Name	TBD
	Attorney Docket Number	18-874-WO1-US

U.S.PATENTS Remove

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/M.J.B/	1	20040117330		2004-06-17	EHLERS, Gregory A. et al.	

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	16482495
	Filing Date	2019-07-31
	First Named Inventor	HENSON, David
	Art Unit	TBD
	Examiner Name	TBD
	Attorney Docket Number	18-874-WO1-US

/M.J.B/	1	Final Office Action mailed on 17 April 2020 for U.S. Patent Application No. 16/529,402, filed on 01 August 2019, 59 pages.	
/M.J.B/	2	HAYES, Adam S., "A Cost of Production Model for Bitcoin," Department of Economics, The New School for Social Research, March 2015, 5 pages.	
/M.J.B/	3	Non-Final Office Action mailed on 20 February 2020 for U.S. Patent Application No. 16/702,894, filed on 04 December 2019, 30 pages.	
/M.J.B/	4	Non-Final Office Action mailed 02 April 2020 on for U.S. Patent Application No. 16/132,011, filed on 14 September 2018, 5 pages.	
/M.J.B/	5	Non-Final Office Action mailed on 30 March 2020 for U.S. Patent Application No. 16/132,092, filed on 14 September 2018, 46 pages.	
/M.J.B/	6	Notice of Allowance mailed on 02 March 2020, for U.S. Patent Application No. 16/596,190, filed on 08 October 2019, 15 pages.	
/M.J.B/	7	Notice of Allowance mailed on 06 April 2020, for U.S. Patent Application No. 16/175,246, filed on 30 October 2018, 12 pages.	

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Examiner Signature	/MICHAEL J BROWN/	Date Considered	02/27/2021

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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	16482495
	Filing Date	2019-07-31
	First Named Inventor	HENSON, David
	Art Unit	TBD
	Examiner Name	TBD
	Attorney Docket Number	18-874-WO1-US

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	/Alexander D. Georges/	Date (YYYY-MM-DD)	2020-05-11
Name/Print	Alexander D. Georges	Registration Number	70534

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.**

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.

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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)).

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: IDS
Doc description: Information Disclosure Statement (IDS) Filed

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT
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Application Number	16482495
Filing Date	2019-07-31
First Named Inventor	HENSON, David
Art Unit	TBD
Examiner Name	TBD
Attorney Docket Number	18-874-WO1-US

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	Art Unit	TBD
	Examiner Name	TBD
	Attorney Docket Number	18-874-WO1-US

/M.J.B/	1	Final Office Action mailed on 01 October 2019 for U.S. Patent Application No. 16/175,246, filed on 30 October 2018, 18 pages.	
/M.J.B/	2	Notice of Allowance mailed on 15 August 2019, for U.S. Patent Application No. 16/175146, filed on 30 October 2018, 17 pages.	
/M.J.B/	3	WILSON, J., "A Utility-Scale Deployment Project of Behind-the-Meter Energy Storage for Use in Ancillary Services, Energy Resiliency, Grid Infrastructure Investment Deferment, and Demand-Response Integration," Portland State University, 2016.	

If you wish to add additional non-patent literature document citation information please click the Add button Add

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Examiner Signature	/MICHAEL J BROWN/	Date Considered	02/27/2021

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Signature	/Alexander D. Georges/	Date (YYYY-MM-DD)	2019-10-15
Name/Print	Alexander D. Georges	Registration Number	70534

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Confirmation No. 7727

Substitute for form 1449/PTO

INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Use as many sheets as necessary)

Sheet 1 of 3

Complete if Known	
Application Number	16/482495
Filing Date	07-13-2019
First Named Inventor	HENSON; David
Art Unit	2187
Examiner Name	
Attorney Docket Number	84008-322155 (18-874-WO1-US)

U. S. PATENT DOCUMENTS

Examiner Initials*	Cite No.[1]	Document Number Number-Kind Code[2] (if known)	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear
/M.J.B/	001	US-8639392	01-28-2014	CHASSIN; David P.	
/M.J.B/	002	US-9645596	05-09-2017	LEE; Ja-Chin Audrey et al.	
/M.J.B/	003	US-9994118	06-12-2018	WILLIAMS; Nate et al.	
/M.J.B/	004	US-20020158749	10-31-2002	IKEDA; Masakazu et al.	
/M.J.B/	005	US-20100280675	11-04-2010	TATE, Jr.; Edward D. et al.	
/M.J.B/	006	US-20140070756	03-13-2014	KEARNS; Ben et al.	
/M.J.B/	007	US-20140180886	06-26-2014	FORBES, Jr.; Joseph W.	
/M.J.B/	008	US-20150212122	07-30-2015	SOBOTKA; Peter et al.	
/M.J.B/	009	US-20170373500	12-28-2017	SHAFI; Sayed Yusef et al.	
/M.J.B/	010	US-20180026478	01-25-2018	PELOSO; Matthew	

FOREIGN PATENT DOCUMENTS

Examiner Initials*	Cite No.[1]	Foreign Patent Document Country Code[3]-Number[4]-Kind Code[5] (if known)	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages Or Relevant Figures Appear	T[6]
/M.J.B/	001	WO-2019139633-A1	07-18-2019	LANCIUM LLC [US]		☐

Examiner Signature	/MICHAEL J BROWN/	Date Considered	03/27/2021

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT

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Sheet 2 of 3

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Application Number	16/482495
Filing Date	07-13-2019
First Named Inventor	HENSON; David
Art Unit	2187
Examiner Name	
Attorney Docket Number	84008-322155 (18-874-WO1-US)

NON-PATENT LITERATURE DOCUMENTS			
Examiner Initials*	Cite No.[1]	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,page(s),volume-issue number(s),publisher, city and/or country where published.	T[2]
/M.J.B/	001	International Search Report and Written Opinion of PCT Application No. PCT/US20/57686, mailed on 22 February 2021, 67 pages.	☐
/M.J.B/	002	ISO, "Distributed Energy Resources Roadmap for New York's Wholesale Electricity Markets," Distributed Energy Resource Roadmap, January 2017, pp 1-39. [retrieved on 2020-12-15], Retrieved from the Internet:< url:< a="" href="https://www.nyiso.com/documents/20142/1391862/Distributed_Energy_Resources_Roadmap.pdf/ec0b3b64-4de2-73e0-ffef-49a4b8b1">https://www.nyiso.com/documents/20142/1391862/Distributed_Energy_Resources_Roadmap.pdf/ec0b3b64-4de2-73e0-ffef-49a4b8b1 b3ca.</url:>.	☐
/M.J.B/	003	Non-Final Office Action mailed 04 February 2021 on for U.S. Patent Application No. 16/284,610, filed on 25 February 2019, 9 pages.	☐
/M.J.B/	004	Non-Final Office Action mailed 12 February 2021 on for U.S. Patent Application No.16/528,348, filed on 31 July 2019, 54 pages.	☐
/M.J.B/	005	Notice of Allowance mailed 08 February 2021 on for U.S. Patent Application No. 16/132,062, filed on 14 September 2018, 21 pages.	☐
/M.J.B/	006	Notice of Allowance mailed 08 February 2021 on for U.S. Patent Application No. 16/803,109, filed on 27 February 2020, 29 pages.	☐
/M.J.B/	007	Notice of Allowance mailed 08 February 2021 on for U.S. Patent Application No. 16/834,987, filed on 30 March 2020, 180 pages.	☐
/M.J.B/	008	Notice of Allowance mailed 25 January 2021 on for U.S. Patent Application No. 16/702,894, filed on 04 December 2019, 24 pages.	☐

Examiner Signature	/MICHAEL J BROWN/	Date Considered	03/27/2021

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Sheet 3 of 3

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☐ See attached certification statement.

☒ Please charge any required fees or credit any overpayments in connection with this communication to Deposit Account No. 12-0913.

☐ 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	/Kurt W. Rohde/	Date (YYYY-MM-DD)	March 9, 2021
Name/Print	Kurt W. Rohde	Registration Number	62923

PTO/SB/08a (02-18)
Approved for use through 11/30/2020. OMB 0651-0031
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT
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Application Number	16482495
Filing Date	2019-07-31
First Named Inventor	David Henson
Art Unit	TBD
Examiner Name	TBD
Attorney Docket Number	18-874-WO1-US

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
/M.J.B/	1	8700929		2014-04-15	WEBER; Wolf-Dietrich et al.	

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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
/M.J.B/	1	20050203761		2005-09-15	BARR; Andrew Harvey et al.	
/M.J.B/	2	20090070611		2009-03-12	BOWER III; Fred A. et al.	
/M.J.B/	3	20090089595		2009-04-02	BREY; Thomas M. et al.	
/M.J.B/	4	20160187906		2016-06-30	BODAS; Devadatta V. et al.	

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/M.J.B/	1	Co-pending US patent application No. US16/132092, filed on 09-14-2018.	
/M.J.B/	2	Co-pending US patent application No. US16/175246, filed on 10-30-2018.	
/M.J.B/	3	Notice of Allowance mailed on 27 January 2020, for U.S. Patent Application No. 16/702,931, filed on 04 December 2019, 23 pages.	

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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	/Alexander D. Georges/	Date (YYYY-MM-DD)	2020-02-10
Name/Print	Alexander D. Georges	Registration Number	70534

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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 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.

Bibliographic Data

Application No: 16/482,495

Foreign Priority claimed: ○ Yes ◉ No

35 USC 119 (a-d) conditions met: ☐ Yes ☑ No ☐ Met After Allowance

Verified and Acknowledged: /MICHAEL J BROWN/ (Examiner's Signature) | MJB (Initials)

Title: Method and System for Dynamic Power Delivery to a Flexible Datacenter Using Unutilized Energy Sources

FILING or 371(c) DATE	CLASS	GROUP ART UNIT	ATTORNEY DOCKET NO.
07/31/2019	713	2115	84008-322155
RULE			

APPLICANTS

Lancium LLC, The Woodlands, TX, UNITED STATES

INVENTORS

David Henson, The Woodlands, TX, UNITED STATES

Michael McNamara, The Woodlands, TX, UNITED STATES

Raymond Cline, The Woodlands, TX, UNITED STATES

CONTINUING DATA

This application is a 371 of PCT/US2018/017950 02/13/2018

PCT/US2018/017950 has PRO of 62616348 01/11/2018

FOREIGN APPLICATIONS

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Chicago, IL 60690-2786
UNITED STATES

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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	16482495
Filing Date	2019-07-31
First Named Inventor	DAVID; Henson
Art Unit	TBD
Examiner Name	TBD
Attorney Docket Number	18-874-WO1-US

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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
/M.J.B/	1	10367535		2019-07-30	CORSE; Nir et al.	
/M.J.B/	2	10444818		2019-10-15	MCNAMARA; Michael T. et al.	
/M.J.B/	3	10452127		2019-10-22	MCNAMARA; Michael T. et al.	
/M.J.B/	4	10497072		2019-12-03	HOOSHMAND; Ali et al.	

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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
/M.J.B/	1	20020072868		2002-06-13	BARTONE; Erik J. et al.	
/M.J.B/	2	20030074464		2003-04-17	BOHRER; Patrick Joseph et al.	

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
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	Attorney Docket Number	18-874-WO1-US

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/M.J.B/	4	20110072289		2011-03-24	KATO; Hideharu	
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	Examiner Name	TBD
	Attorney Docket Number	18-874-WO1-US

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/M.J.B/	16	20180366978		2018-12-20	MATAN; Stefan et al.	
/M.J.B/	17	20180367320		2018-12-20	MONTALVO; Rey	
/M.J.B/	18	20190052094		2019-02-14	PMSVVSV; Prasad et al.	
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/M.J.B/	20	20190258307		2019-08-22	SHAIKH; Karimulla Raja et al.	
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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]
/M.J.B/	1	20090012523	KR	A	2009-02-04	PUMPKIN NETWORKS KOREA INC [KR]		

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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]
/M.J.B/	1	GHAMKHARI et al., "Optimal Integration of Renewable Energy Resources in Data Centers with Behind-the-Meter Renewable Generator," Department of Electrical and Computer Engineering Texas Tech University, 2012, pp. 3340-3444.	
/M.J.B/	2	Non-Final Office Action mailed on 05 December 2019 for U.S. Patent Application No. 16/529,360, filed on 01 August 2019, 72 pages.	
/M.J.B/	3	Non-Final Office Action mailed on 10 December 2019 for U.S. Patent Application No. 16/596,190, filed on 08 October 2019, 72 pages.	
/M.J.B/	4	Non-Final Office Action mailed on 14 November 2019 for U.S. Patent Application No. 16/132,098, filed on 14 September 2018, 25 pages.	
/M.J.B/	5	Non-Final Office Action mailed on 21 November 2019 for U.S. Patent Application No. 16/529,402, filed on 01 August 2019, 57 pages.	
/M.J.B/	6	Non-Final Office Action mailed 11 December 2019 on for U.S. Patent Application No. 16/132,062, filed on 14 September 2018, 17 pages.	
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	Attorney Docket Number	18-874-WO1-US

/M.J.B/	8	RAHIMI, Farrokh, "Using a Transactive Energy Framework," IEEE Electrification Magazine, December 2016, pp. 23-29.	

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Examiner Signature	/MICHAEL J BROWN/	Date Considered	02/27/2021

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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.

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	First Named Inventor	DAVID; Henson
	Art Unit	TBD
	Examiner Name	TBD
	Attorney Docket Number	18-874-WO1-US

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	/Alexander D. Georges/	Date (YYYY-MM-DD)	2019-12-17
Name/Print	Alexander D. Georges	Registration Number	70,534

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT
(Not for submission under 37 CFR 1.99)

Application Number	16/482,495
Filing Date	2019-07-31
First Named Inventor	David Henson
Art Unit	TBD
Examiner Name	TBD
Attorney Docket Number	18-874-WO1-US

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
/M.J.B/	1	6288456		2001-09-11	CRATTY; William E.	
/M.J.B/	2	6633823		2003-10-14	BARTONE; Erik J. et al.	
/M.J.B/	3	7143300		2006-11-28	POTTER; Mark R. et al.	
/M.J.B/	4	7647516		2010-01-12	RANGANATHAN; Parthasarathy et al.	
/M.J.B/	5	7702931		2010-04-20	GOODRUM; Alan L. et al.	
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	Attorney Docket Number	18-874-WO1-US

/M.J.B/	9	7970561		2011-06-28	PFEIFFER; Clemens	
/M.J.B/	10	8001403		2011-08-16	HAMILTON; James R. et al.	
/M.J.B/	11	8006108		2011-08-23	BREY; Thomas M. et al.	
/M.J.B/	12	8214843		2012-07-03	BOSS; Gregory J. et al.	
/M.J.B/	13	8374928		2013-02-12	GOPISETTY; Sandeep et al.	
/M.J.B/	14	8447993		2013-05-21	GREENE; Daniel H. et al.	
/M.J.B/	15	8571820		2013-10-29	PFEIFFER; Clemens	
/M.J.B/	16	8627123		2014-01-07	JAIN; Navendu et al.	
/M.J.B/	17	8789061		2014-07-22	PAVEL; Milan et al.	
/M.J.B/	18	8799690		2014-08-05	DAWSON; Christopher J. et al.	
/M.J.B/	19	9003211		2015-04-07	PFEIFFER; Clemens	

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	Attorney Docket Number	18-874-WO1-US

/M.J.B/	20	9003216		2015-04-07	SANKAR; Sriram et al.	
/M.J.B/	21	9026814		2015-05-05	AASHEIM; Jered et al.	
/M.J.B/	22	9207993		2015-12-08	JAIN; Navendu	
/M.J.B/	23	9218035		2015-12-22	LI; Tao et al.	
/M.J.B/	24	9552234		2017-01-24	BOLDYREV; Sergey et al.	
/M.J.B/	25	10367353		2019-07-30	MICHAEL; T. Mcnamara	

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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
/M.J.B/	1	20080030078		2008-02-07	WHITTED; William et al.	
/M.J.B/	2	20080094797		2008-04-24	COGLITORE; Giovanni et al.	
/M.J.B/	3	20090055665		2009-02-26	MAGLIONE; Stephen C. et al.	

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	Examiner Name	TBD
	Attorney Docket Number	18-874-WO1-US

/M.J.B/	4	20100211810		2010-08-19	ZACHO; Carl Edvard Martin	
/M.J.B/	5	20100328849		2010-12-30	EWING; Carrel W. et al.	
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/M.J.B/	10	20130006401		2013-01-03	SHAN; Xinxin	
/M.J.B/	11	20130063991		2013-03-14	XIAO; Yuan et al.	
/M.J.B/	12	20130086404		2013-04-04	SANKAR; Sriram et al.	
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/M.J.B/	16	20140379156		2014-12-25	KAMEL; Michel Roger et al.	
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/M.J.B/	18	20150229227		2015-08-13	AELOIZA; Eddy C. et al.	
/M.J.B/	19	20160198656		2016-07-14	MCNAMARA; Brad et al.	
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/M.J.B/	21	20160324077		2016-11-10	FRANTZEN; Kohlar T. et al.	
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/M.J.B/	23	20180144414		2018-05-24	LEE; Ja-Chin Audrey et al.	

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	Application Number	16/482,495
	Filing Date	2019-07-31
	First Named Inventor	David Henson
	Art Unit	TBD
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	Attorney Docket Number	18-874-WO1-US

/M.J.B/	1	103163904	CN	A	2013-06-19	UNIV ZHEJIANG TECHNOLOGY.	English Abstract	☒
/M.J.B/	2	2015199629	WO	A1	2015-12-30	DOKUZ EYLÜL ÜNIVERSITESI REKTÖRLÜGÜ [TR]		☐

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/M.J.B/	1	BIRD L., et al., "Wind and Solar Energy Curtailment: Experience and Practices in the United States," National Renewable Energy Lab (NREL), Technical Report NREL/TP-6A20-60983, March 2014, 58 pages.	
/M.J.B/	2	EPEX Spot, "How They Occur, What They Mean," https://www.epexspot.com/en/company-info/basics_of_the_power_market/negative_prices, 2018, 2 pages.	
/M.J.B/	3	International Search Report and Written Opinion of PCT Application No. PCT/US2018/017955, mailed on 30 April 2018, 22 pages.	
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/M.J.B/	5	Notice of Allowance mailed on 02 April 2019, for U.S. Patent Application No. 16/175,335, filed on 30 October 2018, 12 pages.	
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/M.J.B/	7	SOLUNA., "Powering the Block Chain," August 2018, version 1.1, 29 pages.	

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	Application Number	16/482,495
	Filing Date	2019-07-31
	First Named Inventor	David Henson
	Art Unit	TBD
	Examiner Name	TBD
	Attorney Docket Number	18-874-WO1-US

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	Examiner Name	TBD
	Attorney Docket Number	18-874-WO1-US

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Name/Print	Alexander D. Georges	Registration Number	70534

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(Use as many sheets as necessary)

Sheet 1 of 3

Complete if Known	
Application Number	16/482495
Filing Date	07-13-2019
First Named Inventor	HENSON; David
Art Unit	2187
Examiner Name	
Attorney Docket Number	84008-322155 (18-874-WO1-US)

U. S. PATENT DOCUMENTS

Examiner Initials*	Cite No.[1]	Document Number Number-Kind Code[2] (if known)	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear
	001	US-8639392	01-28-2014	CHASSIN; David P.	
	002	US-9645596	05-09-2017	LEE; Ja-Chin Audrey et al.	
	003	US-9994118	06-12-2018	WILLIAMS; Nate et al.	
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	009	US-20170373500	12-28-2017	SHAFI; Sayed Yusef et al.	
	010	US-20180026478	01-25-2018	PELOSO; Matthew	

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	001	WO-2019139633-A1	07-18-2019	LANCIUM LLC [US]		☐

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	001	International Search Report and Written Opinion of PCT Application No. PCT/US20/57686, mailed on 22 February 2021, 67 pages.	☐
	002	ISO, "Distributed Energy Resources Roadmap for New York's Wholesale Electricity Markets," Distributed Energy Resource Roadmap, January 2017, pp 1-39. [retrieved on 2020-12-15], Retrieved from the Internet:< url:< a="" href="https://www.nyiso.com/documents/20142/1391862/Distributed_Energy_Resources_Roadmap.pdf/ec0b3b64-4de2-73e0-ffef-49a4b8b1">https://www.nyiso.com/documents/20142/1391862/Distributed_Energy_Resources_Roadmap.pdf/ec0b3b64-4de2-73e0-ffef-49a4b8b1 b3ca.</url:>.	☐
	003	Non-Final Office Action mailed 04 February 2021 on for U.S. Patent Application No. 16/284,610, filed on 25 February 2019, 9 pages.	☐
	004	Non-Final Office Action mailed 12 February 2021 on for U.S. Patent Application No.16/528,348, filed on 31 July 2019, 54 pages.	☐
	005	Notice of Allowance mailed 08 February 2021 on for U.S. Patent Application No. 16/132,062, filed on 14 September 2018, 21 pages.	☐
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	Examiner Name	
Sheet 3 of 3	Attorney Docket Number	84008-322155 (18-874-WO1-US)

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Signature	/Kurt W. Rohde/	Date (YYYY-MM-DD)	March 9, 2021
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(54) Title: METHOD AND SYSTEM FOR DYNAMIC POWER DELIVERY TO A FLEXIBLE GROWCENTER USING UNUTILIZED ENERGY SOURCES

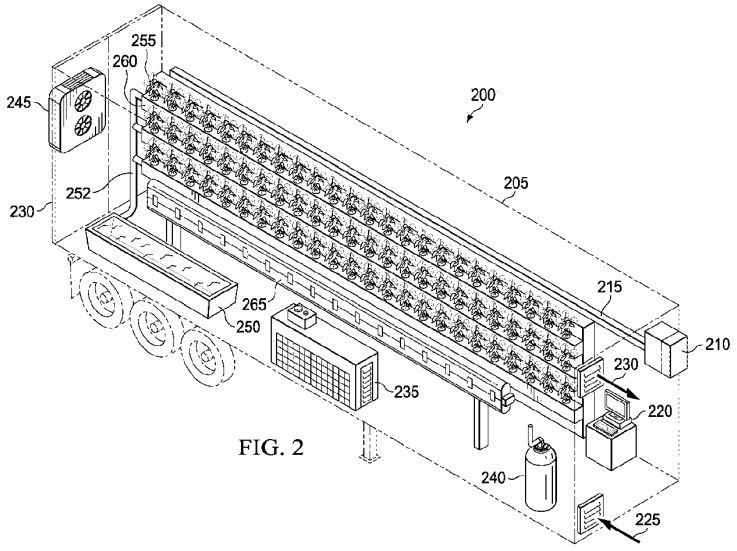

FIG. 2

(57) Abstract: A flexible growcenter includes a mobile container, a behind-the-meter power input system, a power distribution system, a growcenter control system, a climate control system, a lighting system, and an irrigation system. The growcenter control system modulates power delivery to one or more components of the climate control system, the lighting system, and the irrigation system based on unutilized behind-the-meter power availability or an operational directive. A method of dynamic power delivery to a flexible growcenter using unutilized behind-the-meter power includes monitoring unutilized behind-the-meter power availability, determining when a growcenter ramp-up condition is met, and enabling behind-the-meter power delivery to one or more computing systems when the growcenter ramp-up condition is met.

[Continued on next page]

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METHOD AND SYSTEM FOR DYNAMIC POWER DELIVERY TO A FLEXIBLE GROWCENTER USING UNUTILIZED ENERGY SOURCES

BACKGROUND OF THE INVENTION

[0001] Rapid population growth threatens to outpace food production, storage, and distribution capabilities. While modern agricultural practices have thus far allowed production to keep pace with population growth, the population is expected to swell to more than nine (9) billion by the year 2050. It is predicted that, by the year 2025, supply will no longer be able to meet demand. This anticipated food shortage is further complicated by the fact that large scale production farms produce the vast majority of food. As such, many regions rely completely on food produced in one location, stored in another, and distributed for local consumption. Storage and distribution logistics further complicate the delivery of fresh food and add additional cost. Thus, new agricultural practices are needed to address these issues as demand starts to outpace supply.

[0002] Shipping containers have been adapted for use in farming in non-traditional locations. Containers have successfully been used in traditional agriculture, hydroponics, aquaculture, and aquaponics applications growing food, cash, plantation, and horticulture crops. A single 40-foot container can potentially yield the annual equivalent of three to five acres of farm land. The use of containers offers a number of unique advantages over conventional farming. Container farms are self-contained and modular, thereby allowing them to be built, transported, and situated where local demand exists. In addition, container farms allow farming to take place in locations and climates where farming otherwise wouldn't be viable due to climate, soil conditions, or water availability. Perhaps most importantly, because of their modularity, container farms allow production to scale. Containers may be stacked vertically on top of one another to minimize the footprint and maximize yield.

BRIEF SUMMARY OF THE INVENTION

[0003] According to one aspect of one or more embodiments of the present invention, a flexible growcenter includes a mobile container, a behind-the-meter power input system, a power distribution system, a growcenter control system, a climate control system, a lighting system, and an irrigation system. The growcenter control system

modulates power delivery to one or more components of the climate control system, the lighting system, and the irrigation system based on unutilized behind-the-meter power availability or an operational directive.

[0004] According to one aspect of one or more embodiments of the present invention, a method of dynamic power delivery to a flexible growcenter using unutilized behind-the-meter power includes monitoring unutilized behind-the-meter power availability, determining when a growcenter ramp-up condition is met, and enabling behind-the-meter power delivery to one or more computing systems when the growcenter ramp-up condition is met.

[0005] Other aspects of the present invention will be apparent from the following description and claims.

BRIEF DESCRIPTION OF THE DRAWINGS

[0006] Figure **1** shows a computing system in accordance with one or more embodiments of the present invention.

[0007] Figure **2** shows a flexible growcenter in accordance with one or more embodiments of the present invention.

[0008] Figure **3** shows a three-phase power distribution of a flexible growcenter in accordance with one or more embodiments of the present invention.

[0009] Figure **4** shows a control distribution scheme of a flexible growcenter in accordance with one or more embodiments of the present invention.

[0010] Figure **5** shows a control distribution scheme of a fleet of flexible growcenters in accordance with one or more embodiments of the present invention.

[0011] Figure **6** shows a flexible growcenter powered by one or more wind turbines in accordance with one or more embodiments of the present invention.

[0012] Figure **7** shows a flexible growcenter powered by one or more solar panels in accordance with one or more embodiments of the present invention.

[0013] Figure **8** shows a flexible growcenter powered by flare gas in accordance with one or more embodiments of the present invention.

[0014] Figure **9** shows a method of dynamic power delivery to a flexible growcenter using unutilized behind-the-meter power in accordance with one or more embodiments of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

[0015] One or more embodiments of the present invention are described in detail with reference to the accompanying figures. For consistency, like elements in the various figures are denoted by like reference numerals. In the following detailed description of the present invention, specific details are set forth in order to provide a thorough understanding of the present invention. In other instances, well-known features to one having ordinary skill in the art are not described to avoid obscuring the description of the present invention.

[0016] The modular and scalable nature of container farms provides significant advantage in that they may be located on site near consumption and production may be scaled based on demand. The largest operational cost of a container farm is power. As container farms scale, the power consumption of each container becomes increasingly important. Each container typically includes a climate control system, an irrigation system, and a lighting system, as well as others systems that may be critical to its function, each of which consume power. While advancements have been made to reduce the power consumption of these systems, perhaps most notably, the use of light emitting diode ("LED") lighting systems, the power consumption remains significant and more so as the container farm scales up in size. As such, one of the greatest impediments to the widespread adoption of container farms is the cost prohibitive nature of providing power.

[0017] Accordingly, in one or more embodiments of the present invention, a method and system for dynamic power delivery to a flexible growcenter uses unutilized behind-the-meter power sources without transmission and distribution costs. The flexible growcenter may be configured to modulate power delivery to one or more components of the climate control system, an irrigation system, or a lighting system based on the availability of unutilized behind-the-meter power or an operational directive. For example, the flexible growcenter may ramp-up to a fully online status, ramp-down to a fully offline status, or dynamically adjust power consumption, act a load balancer, or adjust the power factor based on which systems, or subsystems thereof, receive power. Advantageously, the flexible growcenter may allow localized farm operations to be performed with little to no energy costs, using clean and renewable energy that would otherwise be wasted.

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[0018] Figure **1** shows a computing system **100** in accordance with one or more embodiments of the present invention. Computing system **100** may include one or more central processing units (singular "CPU" or plural "CPUs") **105**, host bridge **110**, input/output ("IO") bridge **115**, graphics processing units (singular "GPU" or plural "GPUs") **125**, and/or application-specific integrated circuits (singular "ASIC or plural "ASICs") (not shown) disposed on one or more printed circuit boards (not shown) that are configured to perform computational operations. Each of the one or more CPUs **105**, GPUs **125**, or ASICs (not shown) may be a single-core (not independently illustrated) device or a multi-core (not independently illustrated) device. Multi-core devices typically include a plurality of cores (not shown) disposed on the same physical die (not shown) or a plurality of cores (not shown) disposed on multiple die (not shown) that are collectively disposed within the same mechanical package (not shown).

[0019] CPU **105** may be a general purpose computational device typically configured to execute software instructions. CPU **105** may include an interface **108** to host bridge **110**, an interface **118** to system memory **120**, and an interface **123** to one or more IO devices, such as, for example, one or more GPUs **125**. GPU **125** may serve as a specialized computational device typically configured to perform graphics functions related to frame buffer manipulation. However, one of ordinary skill in the art will recognize that GPU **125** may be used to perform non-graphics related functions that are computationally intensive. In certain embodiments, GPU **125** may interface **123** directly with CPU **125** (and interface **118** with system memory **120** through CPU **105**). In other embodiments, GPU **125** may interface **121** with host bridge **110** (and interface **116** or **118** with system memory **120** through host bridge **110** or CPU **105** depending on the application or design). In still other embodiments, GPU **125** may interface **133** with IO bridge **115** (and interface **116** or **118** with system memory **120** through host bridge **110** or CPU **105** depending on the application or design). The functionality of GPU **125** may be integrated, in whole or in part, with CPU **105**.

[0020] Host bridge **110** may be an interface device configured to interface between the one or more computational devices and IO bridge **115** and, in some embodiments, system memory **120**. Host bridge **110** may include an interface **108** to CPU **105**, an interface **113** to IO bridge **115**, for embodiments where CPU **105** does not include an interface **118** to system memory **120**, an interface **116** to system

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memory **120**, and for embodiments where CPU **105** does not include an integrated GPU **125** or an interface **123** to GPU **125**, an interface **121** to GPU **125**. The functionality of host bridge **110** may be integrated, in whole or in part, with CPU **105**. IO bridge **115** may be an interface device configured to interface between the one or more computational devices and various IO devices (*e.g.*, **140**, **145**) and IO expansion, or add-on, devices (not independently illustrated). IO bridge **115** may include an interface **113** to host bridge **110**, one or more interfaces **133** to one or more IO expansion devices **135**, an interface **138** to keyboard **140**, an interface **143** to mouse **145**, an interface **148** to one or more local storage devices **150**, and an interface **153** to one or more network interface devices **155**. The functionality of IO bridge **115** may be integrated, in whole or in part, with CPU **105** or host bridge **110**. Each local storage device **150**, if any, may be a solid-state memory device, a solid-state memory device array, a hard disk drive, a hard disk drive array, or any other non-transitory computer readable medium. Network interface device **155** may provide one or more network interfaces including any network protocol suitable to facilitate networked communications.

[0021] Computing system **100** may include one or more network-attached storage devices **160** in addition to, or instead of, one or more local storage devices **150**. Each network-attached storage device **160**, if any, may be a solid-state memory device, a solid-state memory device array, a hard disk drive, a hard disk drive array, or any other non-transitory computer readable medium. Network-attached storage device **160** may or may not be collocated with computing system **100** and may be accessible to computing system **100** via one or more network interfaces provided by one or more network interface devices **155**.

[0022] One of ordinary skill in the art will recognize that computing system **100** may be a conventional computing system or an application-specific computing system. In certain embodiments, an application-specific computing system may include one or more ASICs (not shown) that are configured to perform one or more functions in a more efficient manner. The one or more ASICs (not shown) may interface directly with CPU **105**, host bridge **110**, or GPU **125** or interface through IO bridge **115**. Alternatively, in other embodiments, an application-specific computing system may be reduced to only those components necessary to perform a desired function in an effort to reduce one or more of chip count, printed circuit board footprint, thermal design power, and power consumption. The one or more ASICs (not shown) may be

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used instead of one or more of CPU **105**, host bridge **110**, IO bridge **115**, or GPU **125**. In such systems, the one or more ASICs may incorporate sufficient functionality to perform certain network and computational functions in a minimal footprint with substantially fewer component devices.

[0023] As such, one of ordinary skill in the art will recognize that CPU **105**, host bridge **110**, IO bridge **115**, GPU **125**, or ASIC (not shown) or a subset, superset, or combination of functions or features thereof, may be integrated, distributed, or excluded, in whole or in part, based on an application, design, or form factor in accordance with one or more embodiments of the present invention. Thus, the description of computing system **100** is merely exemplary and not intended to limit the type, kind, or configuration of component devices that constitute a computing system **100** suitable for performing computing operations in accordance with one or more embodiments of the present invention.

[0024] One of ordinary skill in the art will recognize that computing system **100** may be a stand alone, laptop, desktop, server, blade, or rack mountable system and may vary based on an application or design.

[0025] Figure **2** shows a flexible growcenter **200** in accordance with one or more embodiments of the present invention. Flexible growcenter **200** may include a mobile container **205**, a behind-the-meter power input system **210**, a power distribution system **215**, a growcenter control system **220**, a climate control system (*e.g.*, **225**, **230**, **235**, **240**, and/or **245**), an irrigation system (*e.g.*, **250** and **252**), a plurality of plants **255** disposed in a plurality of grow containers **260**, and a lighting system **265**.

[0026] Growcenter control system **220** may be a computing system (*e.g.*, **100** of Figure **1**) configured to dynamically modulate power delivery to one or more components of the climate control system (*e.g.*, **235**, **240**, and/or **245**), the irrigation system (*e.g.*, **252**), and lighting system **265** disposed within flexible growcenter **200** based on unutilized behind-the-meter power availability or an operational directive from a local station control system (not shown), a remote master control system (not shown), or a grid operator (not shown).

[0027] In certain embodiments, mobile container **205** may be a storage trailer disposed on wheels and configured for rapid deployment. In other embodiments, mobile container **205** may be a storage container (not shown) configured for placement on the ground and potentially stacked in a vertical manner (not shown).

In still other embodiments, mobile container **205** may be an inflatable container, a floating container, or any other type or kind of container suitable for housing a mobile growcenter **200**.

[0028] Flexible growcenter **200** may be rapidly deployed on site near a source of unutilized behind-the-meter power generation. Behind-the-meter power input system **210** may be configured to input power to flexible growcenter **200**. Behind-the-meter power input system **210** may include a first input (not independently illustrated) configured to receive three-phase behind-the-meter alternating current ("AC") voltage. In certain embodiments, behind-the-meter power input system **210** may include a supervisory AC-to-AC step-down transformer (not shown) configured to step down three-phase behind-the-meter AC voltage to single-phase supervisory nominal AC voltage or a second input (not independently illustrated) configured to receive single-phase supervisory nominal AC voltage from the local station (not shown) or a metered source (not shown). Behind-the-meter power input system **210** may provide single-phase supervisory nominal AC voltage to growcenter control system **220**, which may remain powered at almost all times to control the operation of flexible growcenter **200**. The first input (not independently illustrated) or a third input (not independently illustrated) of behind-the-meter power input system **210** may direct three-phase behind-the-meter AC voltage to an operational AC-to-AC step-down transformer (not shown) configured to controllably step down three-phase behind-the-meter AC voltage to three-phase nominal AC voltage. Growcenter control system **220** may controllably enable or disable generation or provision of three-phase nominal AC voltage by the operational AC-to-AC step-down transformer (not shown).

[0029] Behind-the-meter power input system **210** may provide three phases of three-phase nominal AC voltage to power distribution system **215**. Power distribution system **215** may controllably provide a single phase of three-phase nominal AC voltage to components of the climate control system (*e.g.*, **235**, **240**, and/or **245**), the irrigation system (*e.g.*, **252**), and subsets of lights (not independently illustrated) of lighting system **265** disposed within flexible growcenter **200**. Growcenter control system **220** may controllably select which phase of three-phase nominal AC voltage that power distribution system **215** provides to components of the climate control system (*e.g.*, **235**, **240**, and/or **245**), the irrigation system (*e.g.*, **252**), and one or more lights (not independently illustrated) of lighting system **265**. In this way,

growcenter control system **220** may modulate power delivery by either ramping-up flexible growcenter **200** to fully operational status, ramping-down flexible growcenter **200** to offline status (where only growcenter control system **220** remains powered), reducing power consumption by withdrawing power delivery from, or reducing power to, one or more components of the climate control system (*e.g.*, **235**, **240**, and/or **245**), the irrigation system (*e.g.*, **252**), and lights (not independently illustrated) of lighting system **265**, or modulating a power factor correction factor for the local station by controllably adjusting which phases of three-phase nominal AC voltage are used by one or more components of the climate control system (*e.g.*, **235**, **240**, and/or **245**), the irrigation system (*e.g.*, **252**), and lights (not independently illustrated) of lighting system **265**.

[0030] Flexible growcenter **200** may include a climate control system (*e.g.*, **225**, **230**, **235**, **240**, and/or **245**) configured to maintain the climate within container **205**. In certain embodiments, the climate control system may include an air intake **225**, an air outtake **230**, a humidity control system **235**, a gas system **240**, and an air conditioner/heater **245**, each of which may be independently powered, with a single phase of three-phase nominal AC voltage for maximum flexibility. Humidity control system **235** may, under the direction of growcenter computing system **220** or based on one or more sensors (not independently illustrated), regulate the relative humidity within container **205** to control the transpiration of the plants **255**. Gas system **240** may, under the direction of growcenter computing system **220** or based on one or more sensors (not independently illustrated), regulate the release of one or more gases, such as, for example, carbon dioxide, CO_2, that, with light and nutrients, aid the plants **255** in photosynthesis. Air conditioner/heater **245** may be used to control the temperature within container **205**. The enclosure of container **205**, as well as the use of heat generating lights **265**, tends to increase the ambient temperature within container **205**, which damages plants **255**. In warm climates, air conditioner **245** may be configured to lower the temperature within container **205** to a temperature suitable for growth of the plants **255**. In cold climates, heater **245** may be configured to raise the temperature within container **205** to a temperature suitable for growth of the plants **255**.

[0031] The irrigation system may include a water tank **250**, a pump system (not independently illustrated), and a plurality of irrigation lines **252** that provide water to plants **255**. The pump system (not independently illustrated) may be powered by

a single phase of three-phase nominal AC voltage. Lighting system **265** may include a plurality of lights (not independently illustrated) that provide light for photosynthesis. Each light (not independently illustrated) or group of lights (not independently illustrated) of lighting system **265** may be powered by a single phase of three-phase nominal AC voltage. Lighting system **265** may, under direction of growcenter computing system **220**, control the on or off state of one or more lights (not independently illustrated) or groups of lights (not independently illustrated) of lighting system **265**. The lights (not independently illustrated) may be fluorescent, high intensity discharge ("HID"), or LED lights. Because the lighting system **265** tends to work antagonistically with the climate control system (*e.g.*, **225**, **230**, **235**, **240**, and/or **245**), the modern trend is to use LED lights. However, one of ordinary skill in the art will recognize that the type of lights used may vary based on an application or design.

[0032] Flexible growcenter **200** may include a battery system (not shown) configured to convert three-phase nominal AC voltage to nominal DC voltage and store power in a plurality of storage cells. The battery system (not shown) may include a DC-to-AC inverter configured to convert nominal DC voltage to three-phase nominal AC voltage for flexible growcenter **200** use. Alternatively, the battery system (not shown) may include a DC-to-AC inverter configured to convert nominal DC voltage to single-phase nominal AC voltage to power growcenter control system **220**.

[0033] One of ordinary skill in the art will recognize that a voltage level of three-phase behind-the-meter AC voltage may vary based on an application or design and the type or kind of local power generation. As such, a type, kind, or configuration of the operational AC-to-AC step down transformer (not shown) may vary based on the application or design. In addition, the frequency and voltage level of three-phase nominal AC voltage, single-phase nominal AC voltage, and nominal DC voltage may vary based on the application or design in accordance with one or more embodiments of the present invention.

[0034] Figure **3** shows a three-phase power distribution of a flexible growcenter **200** in accordance with one or more embodiments of the present invention. Flexible growcenter **200** may include a plurality of plants **255** disposed within a plurality of containers **260**. As discussed above, the behind-the-meter power input system (**210** of Figure **2**) may provide three phases of three-phase nominal AC voltage to the power distribution system (**215** of Figure **2**). The power distribution system (**215** of

Figure **2**) may controllably provide a single phase of three-phase nominal AC voltage to one or more components of the climate control system (*e.g.*, **235**, **240**, and/or **245**), the pump system (*e.g.*, pump for **252**) that drives water through the irrigation lines **252** of the irrigation system to one or more plants **255**, and one or more lights (not independently illustrated) of the lighting system **265** disposed within flexible growcenter **200**. For example, for purposes of illustration only, a flexible growcenter **200** may include three groups (*e.g.*, **310**, **320**, and **330**) of plants **255**, each of which may have one or more independently controlled lights (not independently illustrated) of the lighting system **265** and the pump system (not independently illustrated) that drives one or more irrigation lines **252**. The power distribution system (**215** of Figure **2**) may control which phase of three-phase nominal AC voltage is provided to the one or more lights (not independently illustrated) of the lighting system **265** and the pump system (not independently illustrated) that drives one or more irrigation lines **252**.

[0035] In the figure, for purposes of illustration only, the plurality of plants **255** disposed in the plurality of containers **260** may be divided into a first group **310**, a second group **320**, and a third group **330**, where each group includes a subset of lights (not independently illustrated) of lighting system **265**, and potentially other components such as, for example, the pumping system (not independently illustrated) that drives one or more irrigation lines **252**. The power distribution system (**215** of Figure **2**) may, for example, provide a first phase of three-phase nominal AC voltage to the first group **310**, a second phase of three-phase nominal AC voltage to the second group **320**, and a third phase of three-phase nominal AC voltage to the third group **330**. If the flexible growcenter (**200** of Figure **2**) receives an operational directive from the local station (not shown) to provide power factor correction, the growcenter control system (**220** of Figure **2**) may direct the power distribution system (**215** of Figure **2**) to adjust which phase or phases of three-phase nominal AC voltage are used to provide the power factor correction required by the local station (not shown) or grid operator (not shown). One of ordinary skill in the art will recognize that, in addition to the power distribution, the load may be varied by adjusting the number of groups operatively powered. As such, the flexible growcenter (**200** of Figure **2**) may be configured to act as a capacitive or inductive load to provide the appropriate reactance necessary to achieve the power factor correction required by the local station (not shown).

[0036] Figure **4** shows a control distribution scheme of a flexible growcenter **200** in accordance with one or more embodiments of the present invention. Growcenter control system **220** may independently, or cooperatively with one or more of local station control system **410**, remote master control system **420**, and grid operator **440**, modulate power delivery to flexible growcenter **200**. Specifically, power delivery may be dynamically adjusted based on conditions or operational directives.

[0037] Local station control system **410** may be a computing system (*e.g.*, **100** of Figure **1**) that is configured to control various aspects of the local station (not independently illustrated) that generates power and sometimes generates unutilized behind-the-meter power. Local station control system **410** may communicate with remote master control system **420** over a networked connection **430** and with growcenter control system **220** over a networked or hardwired connection **415**. Remote master control system **420** may be a computing system (*e.g.*, **100** of Figure **1**) that is located offsite, but connected via a network connection **425** to growcenter control system **220**, that is configured to provide supervisory or override control of flexible growcenter **200** or a fleet (not shown) of flexible growcenters **200**. Grid operator **440** may be a computing system (*e.g.*, **100** of Figure **1**) that is configured to control various aspects of the grid (not independently illustrated) that receives power from the local station (not independently illustrated). Grid operator **440** may communicate with local station control system **440** over a networked or hardwired connection **445**.

[0038] Growcenter control system **220** may monitor unutilized behind-the-meter power availability at the local station (not independently illustrated) and determine when a growcenter ramp-up condition is met. Unutilized behind-the-meter power availability may include one or more of excess local power generation, excess local power generation that the grid cannot accept, local power generation that is subject to economic curtailment, local power generation that is subject to reliability curtailment, local power generation that is subject to power factor correction, situations where local power generation is prohibitively low, start up situations, transient situations, or testing situations where there is an economic advantage to using locally generated behind-the-meter power generation, specifically power available at little to no cost and with no associated transmission or distribution costs.

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[0039] The growcenter ramp-up condition may be met if there is sufficient behind-the-meter power availability and there is no operational directive from local station control system **410**, remote master control system **420**, or grid operator **440** to go offline or reduce power. As such, growcenter control system **220** may enable **435** behind-the-meter power input system **210** to provide three-phase nominal AC voltage to the power distribution system (**215** of Figure **2**) to power one or more components of the climate control system (*e.g.*, **235**, **240**, and/or **245**), the irrigation system (*e.g.*, **252**), and lighting system **265** or a subset thereof.

[0040] Remote master control system **420** may specify to growcenter control system **220** what sufficient behind-the-meter power availability constitutes, or growcenter control system **220** may be programmed with a predetermined preference or criteria on which to make the determination independently. For example, in certain circumstances, sufficient behind-the-meter power availability may be less than that required to fully power the entire flexible growcenter **200**. In such circumstances, growcenter control system **220** may provide power to only a subset of one or more components of the climate control system (*e.g.*, **235**, **240**, and/or **245**), the irrigation system (*e.g.*, **252**), and lighting system **265**, that is within the sufficient, but less than full, range of power that is available.

[0041] While flexible growcenter **200** is online and operational, a growcenter ramp-down condition may be met when there is insufficient, or anticipated to be insufficient, behind-the-meter power availability or there is an operational directive from local station control system **410**, remote master control system **420**, or grid operator **440**. Growcenter control system **220** may monitor and determine when there is insufficient, or anticipated to be insufficient, behind-the-meter power availability. As noted above, sufficiency may be specified by remote master control system **420** or growcenter control system **220** may be programmed with a predetermined preference or criteria on which to make the determination independently. An operational directive may be based on current dispatchability, forward looking forecasts for when unutilized behind-the-meter power is, or is expected to be, available, economic considerations, reliability considerations, operational considerations, or the discretion of the local station **410**, remote master control **420**, or grid operator **440**. For example, local station control system **410**, remote master control system **420**, or grid operator **440** may issue an operational directive to flexible growcenter **200** to go offline and power down. When the

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growcenter ramp-down condition is met, growcenter control system **220** may disable power delivery to one or more components of the climate control system (*e.g.*, **235**, **240**, and/or **245**), the irrigation system (*e.g.*, **252**), and lighting system **265**. Growcenter control system **220** may disable **435** behind-the-meter power input system **210** from providing three-phase nominal AC voltage to the power distribution system (**215** of Figure **2**) to power down the one or more components of the climate control system (*e.g.*, **235**, **240**, and/or **245**), the irrigation system (*e.g.*, **252**), and lighting system **265**, while growcenter control system **220** remains powered and is capable of rebooting flexible growcenter **200** when unutilized behind-the-meter power becomes available again.

[0042] While flexible growcenter **200** is online and operational, changed conditions or an operational directive may cause growcenter control system **220** to modulate power consumption by flexible growcenter **200**. Growcenter control system **220** may determine, or local station control system **410**, remote master control system **420**, or grid operator **440** may communicate, that a change in local conditions may result in less power generation, availability, or economic feasibility, than would be necessary to fully power flexible growcenter **200**. In such situations, growcenter control system **220** may take steps to reduce or stop power consumption by flexible growcenter **200** (other than that required to maintain operation of growcenter control system **220**). Alternatively, local station control system **410**, remote master control system **420**, or grid operator **440**, may issue an operational directive to reduce power consumption for any reason, the cause of which may be unknown. In response, growcenter control system **220** may dynamically reduce or withdraw power delivery to one or more components of the climate control system (*e.g.*, **235**, **240**, and/or **245**), the irrigation system (*e.g.*, **252**), and lighting system **265** to meet the dictate. Growcenter control system **220** may controllably provide three-phase nominal AC voltage to a smaller subset of one or more components of the climate control system (*e.g.*, **235**, **240**, and/or **245**), the irrigation system (*e.g.*, **252**), and lighting system **265** to reduce power consumption.

[0043] Figure **5** shows a control distribution of a fleet **500** of flexible growcenters **200** in accordance with one or more embodiments of the present invention. The control distribution of a flexible growcenter **200** shown and described with respect to Figure **4** may be extended to a fleet **500** of flexible growcenters **200**. For example, a first local station (not independently illustrated), such as, for example, a wind farm (not

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shown), may include a first plurality **510** of flexible growcenters **200*a*** through **200*d***, which may be collocated or distributed across the local station (not shown). A second local station (not independently illustrated), such as, for example, another wind farm or a solar farm (not shown), may include a second plurality **520** of flexible growcenters **200*e*** through **200*h***, which may be collocated or distributed across the local station (not shown). One of ordinary skill in the art will recognize that the number of flexible growcenters **200** deployed at a given station and the number of stations within the fleet **500** may vary based on an application or design in accordance with one or more embodiments of the present invention.

[0044] Remote master control system **420** may provide supervisory control over fleet **500** of flexible growcenters **200** in a similar manner to that shown and described with respect to Figure **4**, with the added flexibility to make high level decisions with respect to fleet **500** that may be counterintuitive to a given station. Remote master control system **420** may make decisions regarding the issuance of operational directives to a given local station based on, for example, the status of each local station where flexible growcenters **200** are deployed.

[0045] Figure **6** shows a flexible growcenter **200** powered by one or more wind turbines **610** in accordance with one or more embodiments of the present invention. A wind farm **600** typically includes a plurality of wind turbines **610**, each of which intermittently generates a wind-generated AC voltage. The wind-generated AC voltage may vary based on a type, kind, or configuration of farm **600**, turbine **610**, and incident wind speed. The wind-generated AC voltage is typically input into a turbine AC-to-AC step-up transformer (not shown) that is disposed within the nacelle (not independently illustrated) or at the base of the mast (not independently illustrated) of turbine **610**. The turbine AC-to-AC step up transformer (not shown) outputs three-phase wind-generated AC voltage **620**. Three-phase wind-generated AC voltage **620** produced by the plurality of wind turbines **610** is collected **625** and provided **630** to another AC-to-AC step-up transformer **640** that steps up three-phase wind-generated AC voltage **620** to three-phase grid AC voltage **650** suitable for delivery to grid **660**. Three-phase grid AC voltage **650** may be stepped down with an AC-to-AC step-down transformer **670** configured to produce three-phase local station AC voltage **680** provided to local station **690**. One of ordinary skill in the art will recognize that the actual voltage levels may vary based on the type, kind,

or number of wind turbines **610**, the configuration or design of wind farm **600**, and grid **660** that it feeds into.

[0046] The output side of AC-to-AC step-up transformer **640** that connects to grid **660** may be metered and is typically subject to transmission and distribution costs. In contrast, power consumed on the input side of AC-to-AC step-up transformer **640** may be considered behind-the-meter and is typically not subject to transmission and distribution costs. As such, one or more flexible growcenters **200** may be powered by three-phase wind-generated AC voltage **620**. Specifically, in wind farm **600** applications, the three-phase behind-the-meter AC voltage used to power flexible growcenter **200** may be three-phase wind-generated AC voltage **620**. As such, flexible growcenter **200** may reside behind-the-meter, avoid transmission and distribution costs, and may be dynamically powered when unutilized behind-the-meter power is available.

[0047] Unutilized behind-the-meter power availability may occur when there is excess local power generation. In high wind conditions, wind farm **600** may generate more power than, for example, AC-to-AC step-up transformer **640** is rated for. In such situations, wind farm **600** may have to take steps to protect its equipment from damage, which may include taking one or more turbines **610** offline or shunting their voltage to dummy loads or ground. Advantageously, one or more flexible growcenters **200** may be used to consume power on the input side of AC-to-AC step-up transformer **640**, thereby allowing wind farm **600** to operate equipment within operating ranges while flexible growcenter **200** receives behind-the-meter power without transmission or distribution costs. The local station control system (not independently illustrated) of local station **690** may issue an operational directive to the one or more flexible growcenters **200** or to the remote master control system (**420** of Figure **4**) to ramp-up to the desired power consumption level. When the operational directive requires the cooperative action of multiple flexible growcenters **200**, the remote mater control system (**420** of Figure **4**) may determine how to power each individual flexible growcenter **200** in accordance with the operational directive or provide an override to each flexible growcenter **200**.

[0048] Another example of unutilized behind-the-meter power availability is when grid **660** cannot, for whatever reason, take the power being produced by wind farm **600**. In such situations, wind farm **600** may have to take one or more turbines **610** offline or shunt their voltage to dummy loads or ground. Advantageously, one or

more flexible growcenters **200** may be used to consume power on the input side of AC-to-AC step-up transformer **640**, thereby allowing wind farm **600** to either produce power to grid **660** at a lower level or shut down transformer **640** entirely while flexible growcenter **200** receives behind-the-meter power without transmission or distribution costs. The local station control system (not independently illustrated) of local station **690** or the grid operator (not independently illustrated) of grid **660** may issue an operational directive to the one or more flexible growcenters **200** or to the remote master control system (**420** of Figure **4**) to ramp-up to the desired power consumption level. When the operational directive requires the cooperative action of multiple flexible growcenters **200**, the remote master control system (**420** of Figure **4**) may determine how to power each individual flexible growcenter **200** in accordance with the operational directive or provide an override to each flexible growcenter **200**.

[0049] Another example of unutilized behind-the-meter power availability is when wind farm **600** is selling power to grid **660** at a negative price that is offset by a production tax credit. In certain circumstances, the value of the production tax credit may exceed the price wind farm **600** would have to pay to grid **660** to offload their generated power. Advantageously, one or more flexible growcenters **200** may be used to consume power behind-the-meter, thereby allowing wind farm **600** to produce and obtain the production tax credit, but sell less power to grid **660** at the negative price. The local station control system (not independently illustrated) of local station **690** may issue an operational directive to the one or more flexible growcenters **200** or to the remote master control system (**420** of Figure **4**) to ramp-up to the desired power consumption level. When the operational directive requires the cooperative action of multiple flexible growcenter **200**, the remote master control system (**420** of Figure **4**) may determine how to power each individual flexible growcenter **200** in accordance with the operational directive or provide an override to each flexible growcenter **200**.

[0050] Another example of unutilized behind-the-meter power availability is when wind farm **600** is selling power to grid **660** at a negative price because grid **660** is oversupplied or is instructed to stand down and stop producing altogether. The grid operator (not independently illustrated) may select certain power generation stations to go offline and stop producing power to grid **660**. Advantageously, one or more flexible growcenters **200** may be used to consume power behind-the-meter, thereby

allowing wind farm **600** to stop producing power to grid **660**, but making productive use of the power generated behind-the-meter without transmission or distribution costs. The local station control system (not independently illustrated) of the local station **690** or the grid operator (not independently illustrated) of grid **660** may issue an operational directive to the one or more flexible growcenters **200** or to the remote master control system (**420** of Figure **4**) to ramp-up to the desired power consumption level. When the operational directive requires the cooperative action of multiple flexible growcenters **200**, the remote master control system (**420** of Figure **4**) may determine how to power each individual flexible growcenter **200** in accordance with the operational directive or provide an override to each flexible growcenter **200**.

[0051] Another example of unutilized behind-the-meter power availability is when wind farm **600** is producing power to grid **660** that is unstable, out of phase, or at the wrong frequency, or grid **660** is already unstable, out of phase, or at the wrong frequency for whatever reason. The grid operator (not independently illustrated) may select certain power generation stations to go offline and stop producing power to grid **660**. Advantageously, one or more flexible growcenters **200** may be used to consume power behind-the-meter, thereby allowing wind farm **600** to stop producing power to grid **660**, but make productive use of the power generated behind-the-meter without transmission or distribution costs. The local station control system (not independently illustrated) of local station **690** may issue an operational directive to the one or more flexible growcenters **200** or to the remote master control system (**420** of Figure **4**) to ramp-up to the desired power consumption level. When the operational directive requires the cooperative action of multiple flexible growcenters **200**, the remote master control system (**420** of Figure **4**) may determine how to power each individual flexible growcenter **200** in accordance with the operational directive or provide an override to each flexible growcenter **200**.

[0052] Further examples of unutilized behind-the-meter power availability is when wind farm **600** experiences low wind conditions that make it not economically feasible to power up certain components, such as, for example, the local station (not independently illustrated), but there may be sufficient behind-the-meter power availability to power one or more flexible growcenters **200**. Similarly, unutilized behind-the-meter power availability may occur when wind farm **600** is starting up,

or testing, one or more turbines **610**. Turbines **610** are frequently offline for installation, maintenance, and service and must be tested prior to coming online as part of the array. One or more flexible growcenters **200** may be powered by one or more turbines **610** that are offline from farm **600**. The above-noted examples of when unutilized behind-the-meter power is available are merely exemplary and are not intended to limit the scope of what one of ordinary skill in the art would recognize as unutilized behind-the-meter power availability. Unutilized behind-the-meter power availability may occur anytime there is power available and accessible behind-the-meter that is not subject to transmission and distribution costs and there is an economic advantage to using it.

[0053] One of ordinary skill in the art will recognize that wind farm **600** and wind turbine **610** may vary based on an application or design in accordance with one or more embodiments of the present invention.

[0054] Figure 7 shows a flexible growcenter **200** powered by one or more solar panels **710** in accordance with one or more embodiments of the present invention. A solar farm **700** typically includes a plurality of solar panels **710**, each of which intermittently generates a solar-generated DC voltage **720**. Solar-generated DC voltage **720** may vary based on a type, kind, or configuration of farm **700**, panel **710**, and incident sunlight. Solar-generated DC voltage **720** produced by the plurality of solar panels **710** is collected **725** and provided **730** to a DC-to-AC inverter that converts solar-generated DC voltage into three-phase solar-generated AC voltage **750**. Three-phase solar-generated AC voltage **750** is provided to an AC-to-AC step-up transformer **760** that steps up three-phase solar-generated AC voltage to three-phase grid AC voltage **790**. Three-phase grid AC voltage **790** may be stepped down with an AC-to-AC step-down transformer **785** configured to produce three-phase local station AC voltage **777** provided to local station **775**. One of ordinary skill in the art will recognize that the actual voltage levels may vary based on the type, kind, or number of solar panels **710**, the configuration or design of solar farm **700**, and grid **790** that it feeds into.

[0055] The output side of AC-to-AC step-up transformer **760** that connects to grid **790** may be metered and is typically subject to transmission and distribution costs. In contrast, power consumed on the input side of AC-to-AC step-up transformer **760** may be considered behind-the-meter and is typically not subject to transmission and distribution costs. As such, one or more flexible growcenters **200** may be powered

by three-phase solar-generated AC voltage **750**. Specifically, in solar farm **700** applications, the three-phase behind-the-meter AC voltage used to power flexible growcenter **200** may be three-phase solar-generated AC voltage **750**. As such, flexible growcenter **200** may reside behind-the-meter, avoid transmission and distribution costs, and may be dynamically powered when unutilized behind-the-meter power is available.

[0056] Unutilized behind-the-meter power availability may occur when there is excess local power generation. In high incident sunlight situations, solar farm **700** may generate more power than, for example, AC-to-AC step-up transformer **760** is rated for. In such situations, solar farm **700** may have to take steps to protect its equipment from damage, which may include taking one or more panels **710** offline or shunting their voltage to dummy loads or ground. Advantageously, one or more flexible growcenters **200** may be used to consume power on the input side of AC-to-AC step-up transformer **760**, thereby allowing solar farm **700** to operate equipment within operating ranges while flexible growcenter **200** receives behind-the-meter power without transmission or distribution costs. The local station control system (not independently illustrated) of local station **775** may issue an operational directive to the one or more flexible growcenters **200** or to the remote master control system (**420** of Figure **4**) to ramp-up to the desired power consumption level. When the operational directive requires the cooperative action of multiple flexible growcenters **200**, the remote mater control system (**420** of Figure **4**) may determine how to power each individual flexible growcenter **200** in accordance with the operational directive or provide an override to each flexible growcenter **200**.

[0057] Another example of unutilized behind-the-meter power availability is when grid **790** cannot, for whatever reason, take the power being produced by solar farm **700**. In such situations, solar farm **700** may have to take one or more panels **710** offline or shunt their voltage to dummy loads or ground. Advantageously, one or more flexible growcenters **200** may be used to consume power on the input side of AC-to-AC step-up transformer **760**, thereby allowing solar farm **700** to either produce power to grid **790** at a lower level or shut down transformer **760** entirely while flexible growcenter **200** receives behind-the-meter power without transmission or distribution costs. The local station control system (not independently illustrated) of local station **775** or the grid operator (not independently illustrated) of grid **790** may issue an operational directive to the one

or more flexible growcenters **200** or to the remote master control system (**420** of Figure **4**) to ramp-up to the desired power consumption level. When the operational directive requires the cooperative action of multiple flexible growcenters **200**, the remote master control system (**420** of Figure **4**) may determine how to power each individual flexible growcenter **200** in accordance with the operational directive or provide an override to each flexible growcenter **200**.

[0058] Another example of unutilized behind-the-meter power availability is when solar farm **700** is selling power to grid **790** at a negative price that is offset by a production tax credit. In certain circumstances, the value of the production tax credit may exceed the price solar farm **700** would have to pay to grid **790** to offload their generated power. Advantageously, one or more flexible growcenters **200** may be used to consume power behind-the-meter, thereby allowing solar farm **700** to produce and obtain the production tax credit, but sell less power to grid **790** at the negative price. The local station control system (not independently illustrated) of local station **775** may issue an operational directive to the one or more flexible growcenters **200** or to the remote master control system (**420** of Figure **4**) to ramp-up to the desired power consumption level. When the operational directive requires the cooperative action of multiple flexible growcenter **200**, the remote master control system (**420** of Figure **4**) may determine how to power each individual flexible growcenter **200** in accordance with the operational directive or provide an override to each flexible growcenter **200**.

[0059] Another example of unutilized behind-the-meter power availability is when solar farm **700** is selling power to grid **790** at a negative price because grid **790** is oversupplied or is instructed to stand down and stop producing altogether. The grid operator (not independently illustrated) may select certain power generation stations to go offline and stop producing power to grid **790**. Advantageously, one or more flexible growcenters **200** may be used to consume power behind-the-meter, thereby allowing solar farm **700** to stop producing power to grid **790**, but making productive use of the power generated behind-the-meter without transmission or distribution costs. The local station control system (not independently illustrated) of the local station **775** or the grid operator (not independently illustrated) of grid **790** may issue an operational directive to the one or more flexible growcenters **200** or to the remote master control system (**420** of Figure **4**) to ramp-up to the desired power consumption level. When the operational directive requires the cooperative action of

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multiple flexible growcenters **200**, the remote master control system (**420** of Figure **4**) may determine how to power each individual flexible growcenter **200** in accordance with the operational directive or provide an override to each flexible growcenter **200**.

[0060] Another example of unutilized behind-the-meter power availability is when solar farm **700** is producing power to grid **790** that is unstable, out of phase, or at the wrong frequency, or grid **790** is already unstable, out of phase, or at the wrong frequency for whatever reason. The grid operator (not independently illustrated) may select certain power generation stations to go offline and stop producing power to grid **790**. Advantageously, one or more flexible growcenters **200** may be used to consume power behind-the-meter, thereby allowing solar farm **700** to stop producing power to grid **790**, but make productive use of the power generated behind-the-meter without transmission or distribution costs. The local station control system (not independently illustrated) of local station **775** may issue an operational directive to the one or more flexible growcenters **200** or to the remote master control system (**420** of Figure **4**) to ramp-up to the desired power consumption level. When the operational directive requires the cooperative action of multiple flexible growcenters **200**, the remote master control system (**420** of Figure **4**) may determine how to power each individual flexible growcenter **200** in accordance with the operational directive or provide an override to each flexible growcenter **200**.

[0061] Further examples of unutilized behind-the-meter power availability is when solar farm **700** experiences intermittent cloud cover such that it is not economically feasible to power up certain components, such as, for example local station 775, but there may be sufficient behind-the-meter power availability to power one or more flexible growcenters **200**. Similarly, unutilized behind-the-meter power availability may occur when solar farm **700** is starting up, or testing, one or more panels **710**. Panels **710** are frequently offline for installation, maintenance, and service and must be tested prior to coming online as part of the array. One or more flexible growcenters **200** may be powered by one or more panels **710** that are offline from farm **700**. The above-noted examples of when unutilized behind-the-meter power is available are merely exemplary and are not intended to limit the scope of what one of ordinary skill in the art would recognize as unutilized behind-the-meter power availability. Behind-the-meter power availability may occur anytime there is power

available and accessible behind-the-meter that is not subject to transmission and distribution costs and there is an economic advantage to using it.

[0062] One of ordinary skill in the art will recognize that solar farm **700** and solar panel **710** may vary based on an application or design in accordance with one or more embodiments of the present invention.

[0063] Figure **8** shows a flexible growcenter **200** powered by flare gas **800** in accordance with one or more embodiments of the present invention. Flare gas **800** is combustible gas produced as a product or by-product of petroleum refineries, chemical plants, natural gas processing plants, oil and gas drilling rigs, and oil and gas production facilities. Flare gas **800** is typically burned off through a flare stack (not shown) or vented into the air. In one or more embodiments of the present invention, flare gas **800** may be diverted **812** to a gas-powered generator that produces three-phase gas-generated AC voltage **822**. This power may be considered behind-the-meter and is not subject to transmission and distribution costs. As such, one or more flexible growcenters **200** may be powered by three-phase gas-generated AC voltage. Specifically, the three-phase behind-the-meter AC voltage used to power flexible growcenter **200** may be three-phase gas-generated AC voltage **822**. Accordingly, flexible growcenter **200** may reside behind-the-meter, avoid transmission and distribution costs, and may be dynamically powered when unutilized behind-the-meter power is available.

[0064] Figure **9** shows a method of dynamic power delivery to a flexible growcenter (**200** of Figure **2**) using unutilized behind-the-meter power **900** in accordance with one or more embodiments of the present invention. In step **910**, the growcenter control system (**220** of Figure **4**), or the remote master control system (**420** of Figure **4**), may monitor unutilized behind-the-meter power availability. In certain embodiments, monitoring may include receiving information or an operational directive from the local station control system (**410** of Figure **4**) or the grid operator (**440** of Figure **4**) corresponding to unutilized behind-the-meter power availability.

[0065] In step **920**, the growcenter control system (**220** of Figure **4**), or the remote master control system (**420** of Figure **4**), may determine when a growcenter ramp-up condition is met. In certain embodiments, the growcenter ramp-up condition may be met when there is sufficient behind-the-meter power availability and there is no operational directive from the local station to go offline or reduce power. In step **930**, the growcenter control system (**220** of Figure **4**) may enable behind-the-meter

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power delivery to one or more components of the climate control system (*e.g.*, **235**, **240**, and/or **245**), the irrigation system (*e.g.*, **252**), and lighting system **265**.

[0066] While operational, the growcenter control system (**220** of Figure **4**), or the remote master control system (**420** of Figure **4**), may receive an operational directive to modulate power consumption. In certain embodiments, the operational directive may be a directive to reduce power consumption. In such embodiments, the growcenter control system (**220** of Figure **4**) or the remote master control system (**420** of Figure **4**) may dynamically withdraw power delivery to one or more components of the climate control system (*e.g.*, **235**, **240**, and/or **245**), the irrigation system (*e.g.*, **252**), and lighting system **265** or subsets thereof or dynamically reduce power consumption of one or more components of the climate control system (*e.g.*, **235**, **240**, and/or **245**), the irrigation system (*e.g.*, **252**), and lighting system **265** or subsets thereof. In other embodiments, the operational directive may be a directive to provide a power factor correction factor. In such embodiments, the growcenter control system (**220** of Figure **4**) or the remote master control system (**420** of Figure **4**) may dynamically adjust power delivery to one or more components of the climate control system (*e.g.*, **235**, **240**, and/or **245**), the irrigation system (*e.g.*, **252**), and lighting system **265** to achieve a desired power factor correction factor. In still other embodiments, the operational directive may be a directive to go offline or power down. In such embodiments, the growcenter control system (**220** of Figure **4**) may disable power delivery to one or more components of the climate control system (*e.g.*, **235**, **240**, and/or **245**), the irrigation system (*e.g.*, **252**), and lighting system **265**.

[0067] The growcenter control system (**220** of Figure **4**), or the remote master control system (**420** of Figure **4**), may determine when a growcenter ramp-down condition is met. In certain embodiments, the growcenter ramp-down condition may be met if there is insufficient or anticipated to be insufficient behind-the-meter power availability or there is an operational directive from the local station to go offline or reduce power. The growcenter control system (**220** of Figure **4**) may disable behind-the-meter power delivery to one or more components of the climate control system (*e.g.*, **235**, **240**, and/or **245**), the irrigation system (*e.g.*, **252**), and lighting system **265**. Once ramped-down, the growcenter control system (**220** of Figure **4**) remains powered and in communication with the remote master control system (**420** of

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Figure **4**) so that it may dynamically power the flexible growcenter (**200** of Figure **2**) when conditions change.

[0068] One of ordinary skill in the art will recognize that a growcenter control system (**220** of Figure **4**) may dynamically modulate power delivery to one or more computing systems (**100** of Figure **2**) of a flexible growcenter (**200** of Figure **2**) based on unutilized behind-the-meter power availability or an operational directive. The flexible growcenter (**200** of Figure **2**) may transition between a fully powered down state (while the growcenter control system remains powered), a fully powered up state, and various intermediate states in between. In addition, flexible growcenter (**200** of Figure **2**) may have a blackout state, where all power consumption, including that of the growcenter control system (**220** of Figure **4**) is halted. However, once the flexible growcenter (**200** of Figure **2**) enters the blackout state, it will have to be manually rebooted to restore power to growcenter control system (**220** of Figure **4**). Local station conditions or operational directives may cause flexible growcenter (**200** of Figure **2**) to ramp-up, reduce power consumption, change power factor, or ramp-down.

[0069] Advantages of one or more embodiments of the present invention may include one or more of the following:

[0070] In one or more embodiments of the present invention, a method and system for dynamic power delivery to a flexible growcenter using unutilized energy sources provides a green solution to the problem of scalable container farming.

[0071] In one or more embodiments of the present invention, a method and system for dynamic power delivery to a flexible growcenter using unutilized energy sources allows for the rapid deployment of mobile growcenters to local stations. The mobile growcenters may be deployed on site, near the source of power generation, and receive unutilized behind-the-meter power when it is available.

[0072] In one or more embodiments of the present invention, a method and system for dynamic power delivery to a flexible growcenter using unutilized energy sources allows for the power delivery to the growcenter to be modulated based on conditions or an operational directive received from the local station or the grid operator.

[0073] In one or more embodiments of the present invention, a method and system for dynamic power delivery to a flexible growcenter using unutilized energy sources may dynamically adjust power consumption by ramping-up, ramping-down, or

adjusting the power consumption of one or more computing systems within the flexible growcenter.

[0074] In one or more embodiments of the present invention, a method and system for dynamic power delivery to a flexible growcenter using unutilized energy sources may be powered by unutilized behind-the-meter power that is free from transmission and distribution costs. As such, the flexible growcenter may perform computational operations, such as hashing function operations, with little to no energy cost.

[0075] In one or more embodiments of the present invention, a method and system for dynamic power delivery to a flexible growcenter using unutilized energy sources provides a number of benefits to the hosting local station. The local station may use the flexible growcenter to adjust a load, provide a power factor correction, to offload power, or operate in a manner that invokes a production tax credit.

[0076] While the present invention has been described with respect to the above-noted embodiments, those skilled in the art, having the benefit of this disclosure, will recognize that other embodiments may be devised that are within the scope of the invention as disclosed herein. Accordingly, the scope of the invention should be limited only by the appended claims.

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CLAIMS

What is claimed is:

1. A flexible growcenter comprising:
   a mobile container;
   a behind-the-meter power input system;
   a power distribution system;
   a growcenter control system;
   a climate control system,
   a lighting system; and
   an irrigation system;
   wherein the growcenter control system modulates power delivery to one or more components of the climate control system, the lighting system, and the irrigation system based on unutilized behind-the-meter power availability or an operational directive.

2. The flexible growcenter of claim 1, further comprising:
   a remote master control system.

3. The flexible growcenter of claim 1, wherein the behind-the-meter power input system comprises an input configured to receive three-phase behind-the-meter AC voltage and a supervisory AC-to-AC step-down transformer configured to step down the three-phase behind-the-meter AC voltage to a single-phase supervisory nominal AC voltage or an input configured to receive single-phase supervisory nominal AC voltage from a local station or metered source.

4. The flexible growcenter of claim 3, wherein the behind-the-meter power input system provides the single-phase supervisory nominal AC voltage to the growcenter control system.

5. The flexible growcenter of claim 1, wherein the behind-the-meter power input system comprises an input configured to receive three-phase behind-the-meter AC voltage and an

operational AC-to-AC step-down transformer configured to controllably step down the three-phase behind-the-meter AC voltage to three-phase nominal AC voltage.

6. The flexible growcenter of claim 5, wherein the growcenter control system controllably enables or disables generation of the three-phase nominal AC voltage by the operational AC-to-AC step-down transformer.

7. The flexible growcenter of claim 1, wherein the behind-the-meter power input system provides three-phases of the three-phase nominal AC voltage to the power distribution system.

8. The flexible growcenter of claim 7, wherein the power distribution system controllably provides a single phase of the three-phase nominal AC voltage to one or more components of the climate control system, the irrigation system, and the lighting system.

9. The flexible data center of claim 7, wherein the growcenter control system controllably selects which phase of the three-phase nominal AC voltage the power distribution system provides to each components of the climate control system, the irrigation system, and the lighting system.

10. The flexible growcenter of claim 7, wherein the growcenter control system modulates a power factor correction factor by controllably adjusting which phase of the three-phase nominal AC voltage each component of the climate control system, the irrigation system, and the lighting system receive.

11. The flexible growcenter of claim 5, wherein the three-phase behind-the-meter AC voltage comprises a three-phase wind-generated AC voltage output by one or more wind turbines prior to an AC-to-AC step-up transformer that steps up the three-phase wind-generated AC voltage to a three-phase grid AC voltage.

12. The flexible growcenter of claim 5, wherein the three-phase behind-the-meter AC voltage comprises a three-phase solar-generated AC voltage output by a DC-to-AC inverter that inputs solar-generated DC voltage from one or more solar panels and prior to an AC-to-

AC step-up transformer that steps up the three-phase solar-generated AC voltage to a three-phase grid AC voltage.

13. The flexible growcenter of claim 5, wherein the three-phase behind-the-meter AC voltage comprises a three-phase gas-generated AC voltage output by a generator that inputs combustible gas diverted from a flare or venting system.

14. The flexible growcenter of claim 5, wherein the three-phase behind-the-meter AC voltage is a three-phase metered AC voltage.

15. The flexible growcenter of claim 1, wherein unutilized behind-the-meter power availability comprises one or more of excess local power generation at a local station level, excess local power generation that a grid cannot receive, local power generation subject to economic curtailment, local power generation subject to reliability curtailment, local power generation subject to power factor correction, low local power generation, start up local power generation situations, transient local power generation situations, or testing local power generation situations where there is an economic advantage to using local behind-the-meter power generation to power the flexible growcenter.

16. The flexible growcenter of claim 1, wherein an operational directive comprises one or more of a local station directive, a remote master control directive, or a grid directive.

17. The flexible growcenter of claim 1, wherein an operational directive comprises one or more of a dispatchability directive or a forecast directive.

18. The flexible growcenter of claim 1, wherein an operational directive comprises a workload directive based on actual behind-the-meter power availability or projected behind-the-meter power availability.

19. The flexible growcenter of claim 2, wherein the remote master control system dynamically adjusts power delivery to the flexible growcenter based on a remote master control directive.

20. The flexible growcenter of claim 1, wherein the climate control system comprises a humidity control system, a gas system, and an air conditioner/heater.

21. The flexible growcenter of claim 1, wherein the irrigation system comprises a water tank, a pump system, and a plurality of irrigation lines.

22. The flexible growcenter of claim 1, wherein the lighting system comprises a plurality of lights.

23. The flexible growcenter of claim 1, wherein the mobile container comprises a storage container configured for placement on a ground surface.

24. The flexible growcenter of claim 1, wherein the mobile container comprises a storage trailer on wheels.

25. The flexible growcenter of claim 5, further comprising a battery system configured to convert the three-phase nominal AC voltage to DC nominal voltage and store power in a plurality of storage cells.

26. The flexible growcenter of claim 23, wherein the DC nominal voltage from the plurality of storage cells are converted via a DC-to-AC inverter to three-phase nominal AC voltage for flexible growcenter use.

27. A method of dynamic power delivery to a flexible growcenter using unutilized behind-the-meter power comprising:

monitoring unutilized behind-the-meter power availability;

determining when a growcenter ramp-up condition is met; and

enabling behind-the-meter power delivery to one or more components of a climate control system, a lighting system, and an irrigation system when the growcenter ramp-up condition is met.

28. The method of claim 27, further comprising:

determining when a growcenter ramp-down condition is met; and

disabling power delivery to one or more components of the climate control system, the irrigation system, and the lighting system when the growcenter ramp-down condition is met.

29. The method of claim 27, further comprising:

receiving an operational directive to go offline; and

disabling power delivery to the climate control system, the irrigation system, and the lighting system.

30. The method of claim 27, further comprising:

receiving an operational directive to reduce power consumption; and

dynamically reducing power delivery to a subset of the one or more components of the climate control system, the irrigation system, and the lighting system.

31. The method of claim 27, further comprising:

receiving an operational directive to reduce power consumption, and

dynamically reducing power consumption to one or more components of the climate control system, the irrigation system, and the lighting system.

32. The method of claim 27, further comprising:

receiving an operational directive to provide power factor correction; and

dynamically adjusting power delivery to a subset of the one or more components of the climate control system, the irrigation system, and the lighting system.

33. The method of claim 27, wherein unutilized behind-the-meter power availability comprises one or more of excess local power generation at a local station level, excess local power generation that a grid cannot receive, local power generation subject to economic curtailment, local power generation subject to reliability curtailment, local power generation subject to power factor correction, low local power generation, start up local power generation situations, transient local power generation situations, or testing local power generation situations where there is an economic advantage to using local behind-the-meter power generation.

34. The method of claim 27, wherein the growcenter ramp-up condition is met if there is sufficient behind-the-meter power availability and there is no operational directive from a local station to go offline.

35. The method of claim 27, wherein the growcenter ramp-down condition is met if there is insufficient behind-the-meter power availability or there is an operational directive from a local station to go offline.

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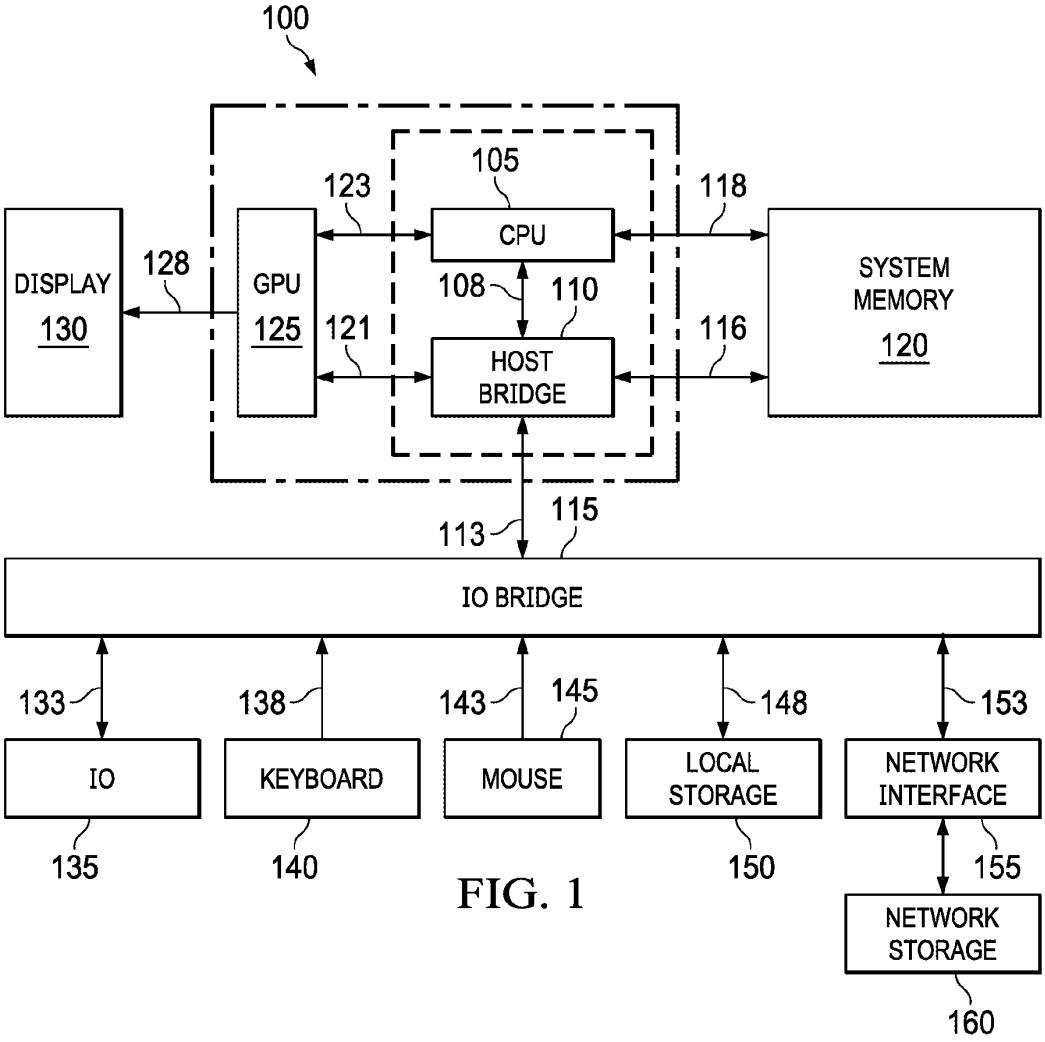
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FIG. 1

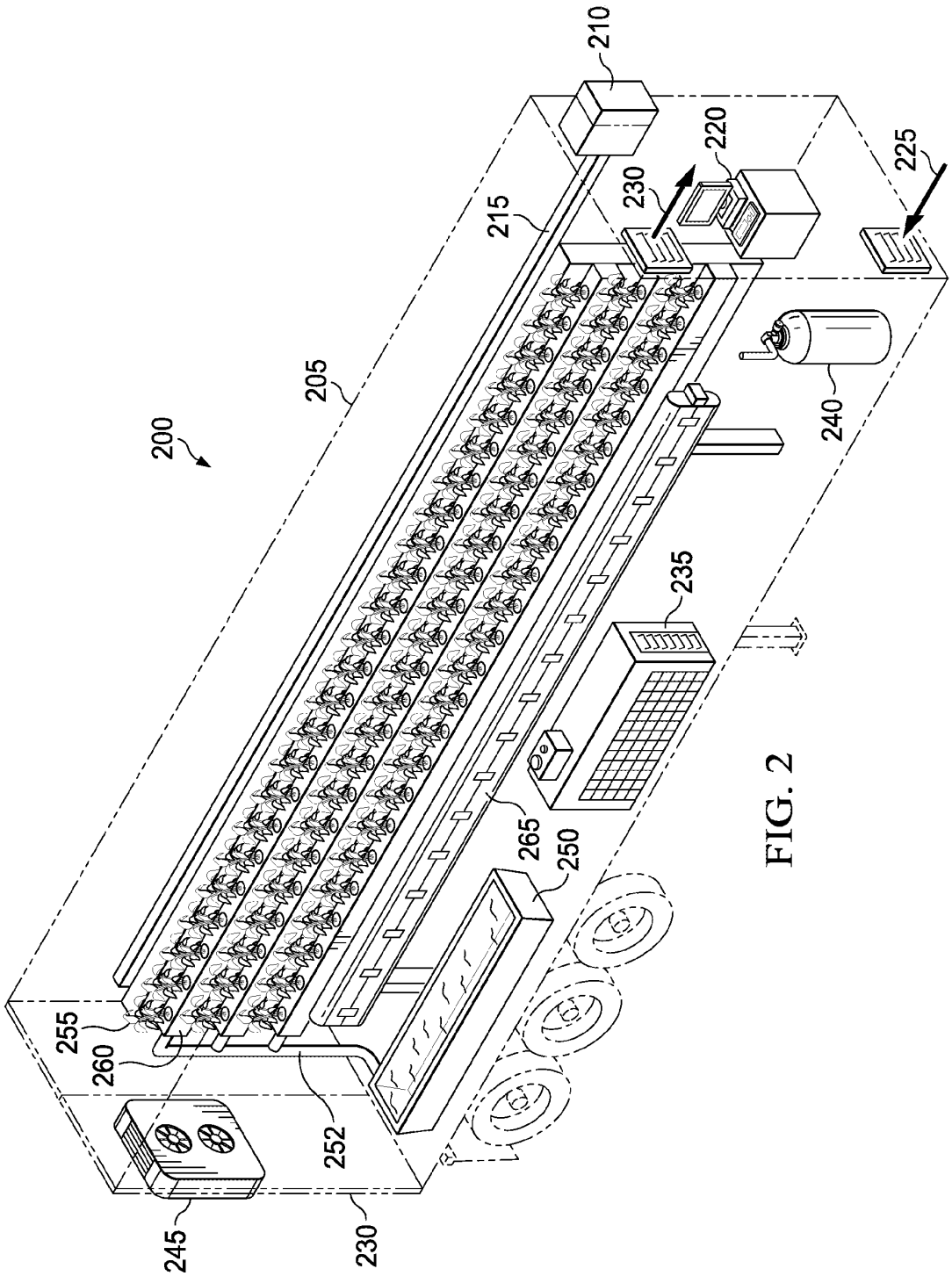


FIG. 2

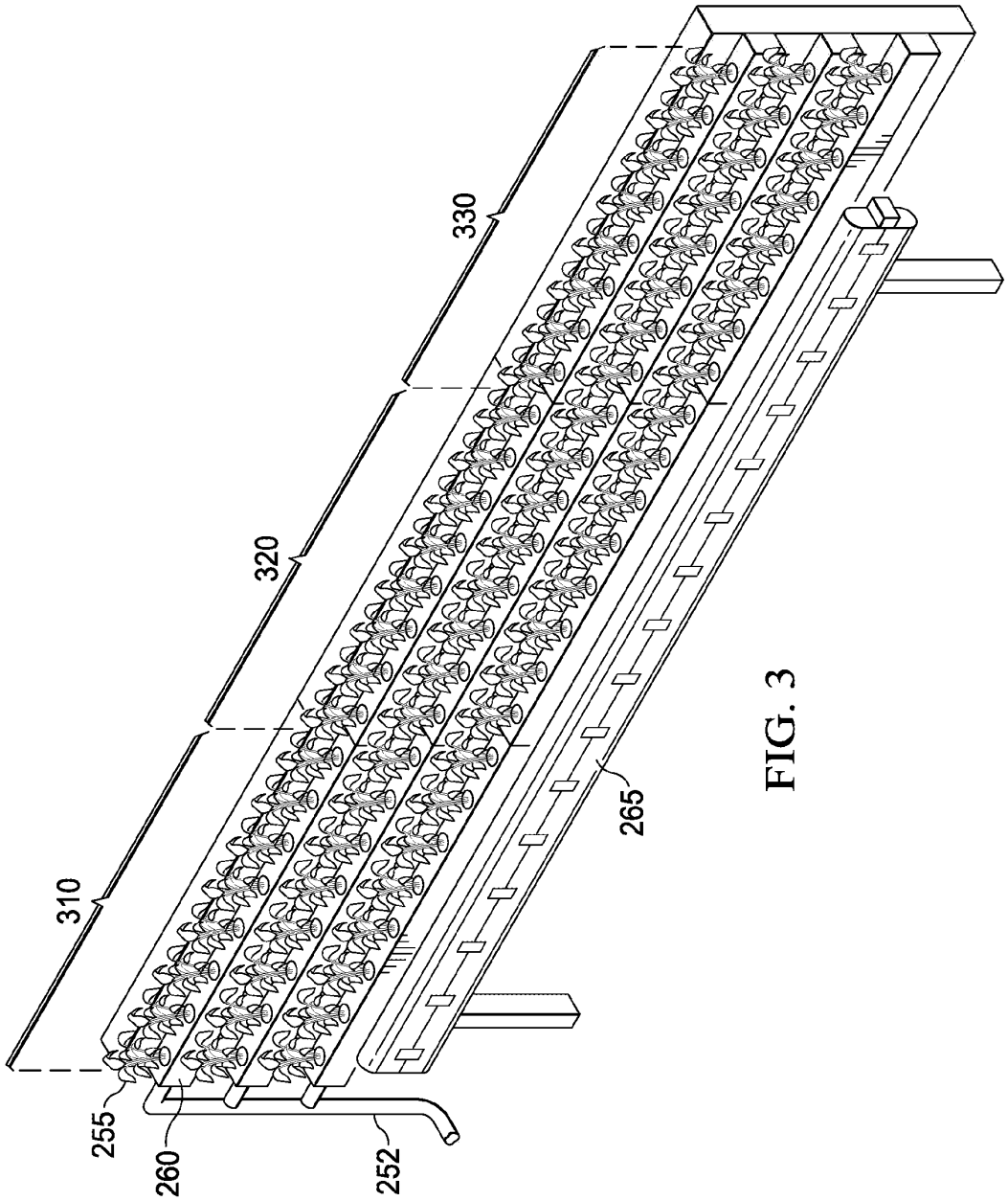
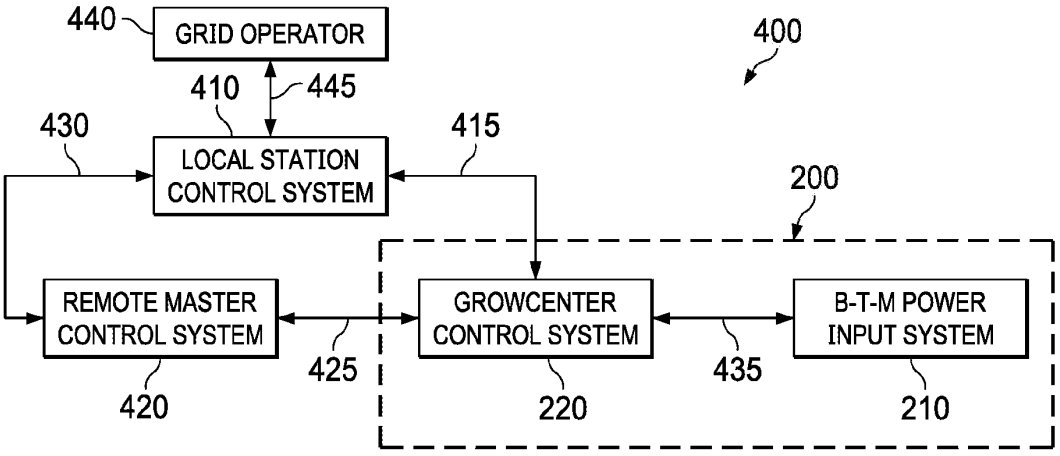


FIG. 3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GRID OPERATOR
400
410
445
430
415
LOCAL STATION CONTROL SYSTEM
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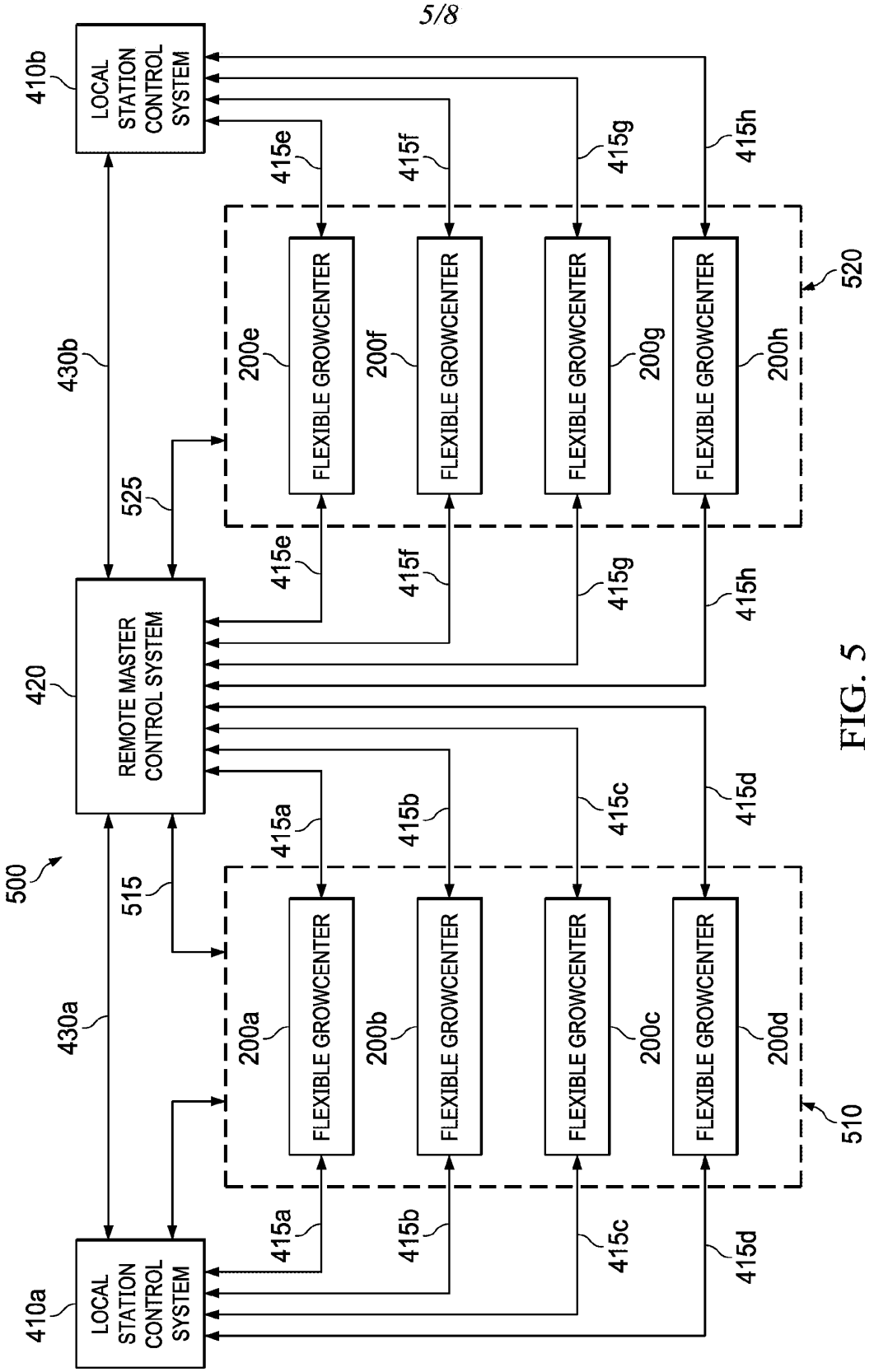
REMOTE MASTER CONTROL SYSTEM
GROWCENTER CONTROL SYSTEM
B-T-M POWER INPUT SYSTEM
425
435
420
220
210

FIG. 4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415f
415g
415h
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FLEXIBLE GROWCENTER
200f
FLEXIBLE GROWCENTER
200g
FLEXIBLE GROWCENTER
200h
FLEXIBLE GROWCENTER
430b
525
420
REMOTE MASTER CONTROL SYSTEM
500
515
415a
415b
415c
415d
200a
FLEXIBLE GROWCENTER
200b
FLEXIBLE GROWCENTER
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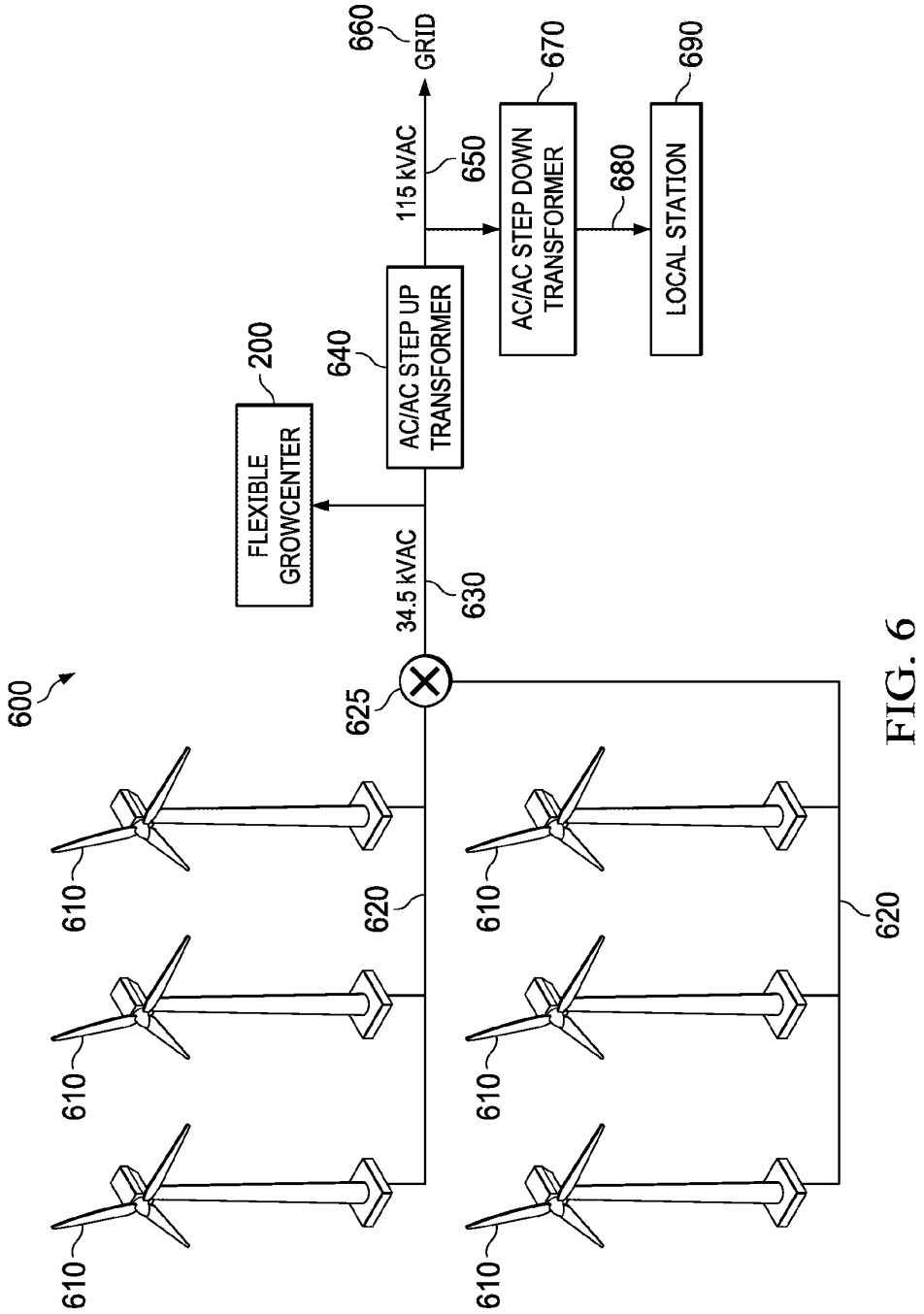
200d
FLEXIBLE GROWCENTER
510
430a
410a
LOCAL STATION CONTROL SYSTEM

FIG. 5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610
620
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FLEXIBLE GROWCENTER
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115 kVAC
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GRID
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AC/AC STEP DOWN TRANSFORMER
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LOCAL STATION
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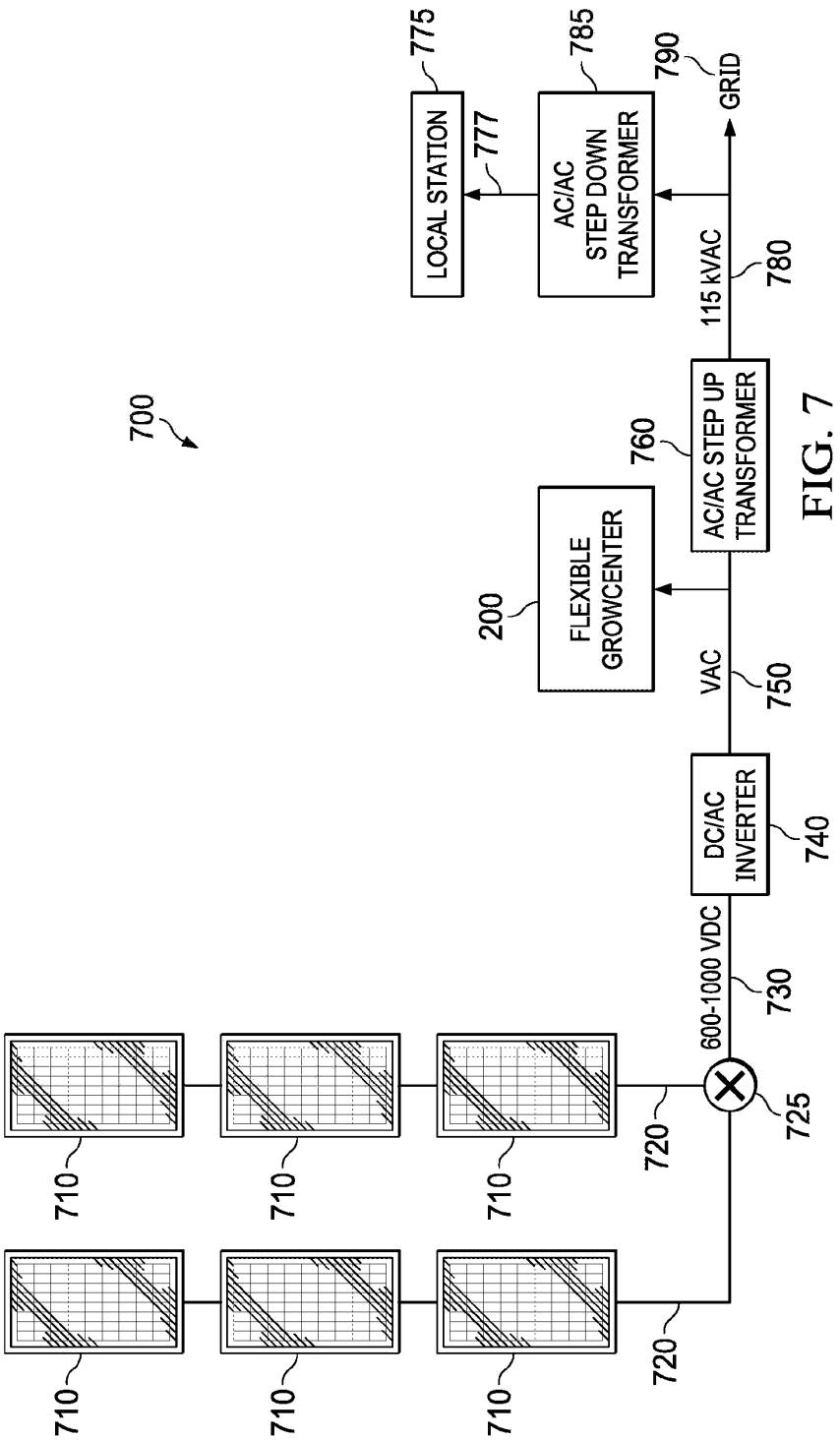
610
610
620

FIG. 6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DC/AC INVERTER
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VAC
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FLEXIBLE GROWCENTER
200
AC/AC STEP UP TRANSFORMER
760
115 kVAC
780
AC/AC STEP DOWN TRANSFORMER
785
GRID
790
LOCAL STATION
777
775

FIG. 7

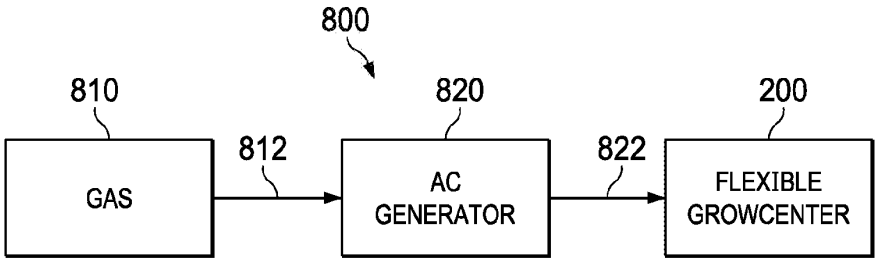
800
810
820
200
812
822
GAS
AC GENERATOR
FLEXIBLE GROWCENTER

FIG. 8

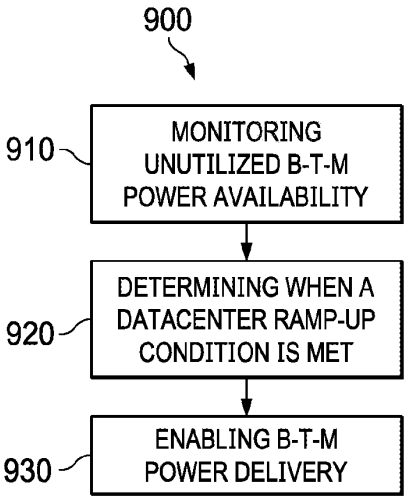
900
910
MONITORING UNUTILIZED B-T-M POWER AVAILABILITY
920
DETERMINING WHEN A DATACENTER RAMP-UP CONDITION IS MET
930
ENABLING B-T-M POWER DELIVERY

FIG. 9

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2018/017955

A. CLASSIFICATION OF SUBJECT MATTER
IPC(8) - A01G 9/16; A01G 9/14; A01G 9/24; H02S 10/40; H02S 20/30 (2018.01)
CPC - A01G 9/16; A01G 9/14; A01G 9/24; H02S 10/40; H02S 20/30 (2018.02)

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
USPC - 47/17; 47/66.7; 47/66.6 (keyword delimited)

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	US 2016/0198656 A1 (FREIGHT FARMS, INC.) 14 July 2016 (14.07.2016) entire document	1, 2, 15-23, 26
---		---
Y		3-14, 24, 25
Y	US 2013/0187464 A1 (SELDON ENERGY PARTNERS, LLC et al) 25 July 2013 (25.07.2013) entire document	3-14, 25
Y	US 2015/0229227 A1 (ABB TECHNOLOGY AG) 13 August 2015 (13.08.2015) entire document	10, 32
Y	US 2016/0324077 A1 (HELICAL HOLDINGS, LLC) 10 November 2016 (10.11.2016) entire document	24
Y	US 2012/0000121 A1 (SWANN) 05 January 2012 (05.01.2012) entire document	27-35
Y	US 2017/0104336 A1 (JOHNSON CONTROLS TECHNOLOGY COMPANY) 13 April 2017 (13.04.2017) entire document	27-35
A	US 2016/0212954 A1 (ARGENTO) 28 July 2016 (28.07.2016) entire document	1-35
A	US 2014/0137468 A1 (CHING) 22 May 2014 (22.05.2014) entire document	1-35
A	WO 2015/199629 A1 (DOKUZ EYLÜL ÜNIVERSITESI REKTÖRLÜGÜ) 30 December 2015 (30.12.2015) entire document	1-35
A	US 2013/0006401 A1 (SHAN) 03 January 2013 (03.01.2013) entire document	1-35

☒ 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
16 April 2018	30 APR 2018
Name and mailing address of the ISA/US Mail Stop PCT, Attn: ISA/US, Commissioner for Patents P.O. Box 1450, Alexandria, VA 22313-1450 Facsimile No. 571-273-8300	Authorized officer Blaine R. Copenheaver PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774

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

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2018/017955

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	CN 103163904 A (ZHEJIANG INDUSTRY UNIVERSITY) 19 June 2013 (19.06.2013) entire document	1-35

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

PATENT COOPERATION TREATY

From the INTERNATIONAL SEARCHING AUTHORITY

To: MARK P. VRLA
BARNES & THORNBURG LLP
P.O. BOX 2786
CHICAGO, IL 60690-2786

PCT

NOTIFICATION OF TRANSMITTAL OF THE INTERNATIONAL SEARCH REPORT AND THE WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY, OR THE DECLARATION

(PCT Rule 44.1)

Applicant's or agent's file reference 84008-328630	Date of mailing *(day/month/year)* 22 FEB 2021 **FOR FURTHER ACTION** See paragraphs 1 and 4 below
International application No. PCT/US2020/057686	International filing date *(day/month/year)* 28 October 2020
Applicant LANCIUM LLC	

1. ☒ The applicant is hereby notified that the international search report and the written opinion of the International Searching Authority have been established and are transmitted herewith.

   Filing of amendments and statement under Article 19:
   The applicant is entitled, if he so wishes, to amend the claims of the international application (see Rule 46):

   When? The time limit for filing such amendments is normally two months from the date of transmittal of the international search report.

   How? Directly to the International Bureau preferably through ePCT, or on paper to:
   The International Bureau of WIPO, 34, chemin des Colombettes, 1211 Geneva 20, Switzerland
   (Facsimile No.: +41 22 338 82 70)

   For more detailed instructions, see the *PCT Applicant's Guide*, International Phase, paragraphs 9.004 – 9.011.

2. ☐ The applicant is hereby notified that no international search report will be established and that the declaration under Article 17(2)(a) to that effect and the written opinion of the International Searching Authority are transmitted herewith.

3. ☐ **With regard to any protest** against payment of (an) additional fee(s) under Rule 40.2, the applicant is notified that:
   ☐ the protest together with the decision thereon has been transmitted to the International Bureau together with any request to forward the texts of both the protest and the decision thereon to the designated Offices.
   ☐ no decision has been made yet on the protest; the applicant will be notified as soon as a decision is made.

4. **Reminders**

   The applicant may **submit comments on an informal basis on the written opinion of the International Searching Authority** to the International Bureau. These comments will be made available to the public after international publication. The International Bureau will send a copy of such comments to all designated Offices unless an international preliminary examination report has been or is to be established.

   Shortly after the expiration of **18 months from the priority date, the international application will be published** by the International Bureau. If the applicant wishes to avoid or postpone publication, a notice of withdrawal of the international application, or of the priority claim, must reach the International Bureau before the completion of the technical preparations for international publication (Rules 90*bis*.1 and 90*bis*.3).

   Within **19 months** from the priority date, but only in respect of some designated Offices, a demand for international preliminary examination must be filed if the applicant wishes to postpone the entry into the national phase **until 30 months** from the priority date (in some Offices even later); otherwise, the applicant must, **within 20 months** from the priority date, perform the prescribed acts for **entry into the national phase** before those designated Offices. In respect of other designated Offices, the time limit of **30 months** (or later) will apply even if no demand is filed within 19 months. For details about the applicable time limits, Office by Office, see www.wipo.int/pct/en/texts/time_limits.html and the *PCT Applicant's Guide*, National Chapters.

   Within **22 months from the priority date, the applicant may request that a supplementary international search be carried out** by a different International Searching Authority that offers this service (Rule 45*bis*.1). The procedure for requesting supplementary international search is described in the *PCT Applicant's Guide*, International Phase, paragraphs 8.006-8.032.

Name and mailing address of the ISA/US Mail Stop PCT, Attn: ISA/US Commissioner for Patents P.O. Box 1450, Alexandria, VA 22313-1450 Facsimile No. 571-273-8300	Authorized officer Blaine R. Copenheaver Telephone No. PCT Helpdesk: 571-272-4300

Form PCT/ISA/220 (revised January 2019)

PATENT COOPERATION TREATY

PCT

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference		FOR FURTHER ACTION
84008-328630		see Form PCT/ISA/220 as well as, where applicable, item 5 below.
International application No.	International filing date *(day/month/year)*	(Earliest) Priority Date *(day/month/year)*
PCT/US2020/057686	28 October 2020	28 October 2019
Applicant		
LANCIUM LLC		

This international search report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This international search report consists of a total of 3 sheets.

☐ It is also accompanied by a copy of each prior art document cited in this report.

1. **Basis of the report**
   a. With regard to the **language**, the international search was carried out on the basis of:
      ☒ the international application in the language in which it was filed.
      ☐ a translation of the international application into _____ which is the language of a translation furnished for the purposes of international search (Rules 12.3(a) and 23.1(b)).
   b. ☐ This international search report has been established taking into account the **rectification of an obvious mistake** authorized by or notified to this Authority under Rule 91 (Rule 43.6*bis*(a)).
   c. ☐ With regard to **any nucleotide and/or amino acid sequence** disclosed in the international application, see Box No. I.

2. ☐ **Certain claims were found unsearchable** (see Box No. II).

3. ☐ **Unity of invention is lacking** (see Box No. III).

4. With regard to the **title**,
   ☒ the text is approved as submitted by the applicant.
   ☐ the text has been established by this Authority to read as follows:

5. With regard to the **abstract**,
   ☒ the text is approved as submitted by the applicant.
   ☐ the text has been established, according to Rule 38.2, by this Authority as it appears in Box No. IV. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. With regard to the **drawings**,
   a. the figure of the **drawings** to be published with the abstract is Figure No. 2
      ☐ as suggested by the applicant.
      ☒ as selected by this Authority, because the applicant failed to suggest a figure.
      ☐ as selected by this Authority, because this figure better characterizes the invention.
   b. ☐ none of the figures is to be published with the abstract.

Form PCT/ISA/210 (first sheet) (July 2019)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2020/057686

A. CLASSIFICATION OF SUBJECT MATTER

IPC(8) - G05D 5/00; G05D 17/00; H02J 3/28 (2020.01)

CPC - G05B 13/027; G05B 15/02; G05F 1/66; G06Q 30/04; G06Q 50/06; H02J 11/00 (2020.08)

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	Iso, "Distributed Energy Resources Roadmap for New York's Wholesale Electricity Markets," Distributed Energy Resource Roadmap, [retrieved on 2020-12-15]. Retrieved from the Internet: <URL:	1-4, 7-9, 14, 15, 19-23, 29, 31, 33, 35, 37, 40-44, 49, 51, 53, 55, 57, 60
---	https://www.nyiso.com/documents/20142/1391862/Distributed_Energy_Resources_Roadmap.p	---
Y	df/ec0b3b64-4de2-73e0-ffef-49a4b8b1b3ca> pp 1-39	10, 11, 30, 32, 38, 50, 52, 58
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A		5, 6, 12, 13, 16-18, 24-28, 34, 36, 39, 45-48, 54, 56, 59
Y	US 2014/0180886 A1 (CAUSAM ENERGY, INC.) 26 June 2014 (26.06.2014) entire document	10, 11, 30, 32, 50, 52
Y	US 9,645,596 B1 (ADVANCED MICROGRID SOLUTIONS, INC.) 09 May 2017 (09.05.2017) entire document	38, 58
A	US 8,639,392 B2 (CHASSIN) 28 January 2014 (28.01.2014) entire document	1-60
A	US 2015/0212122 A1 (CORINEX COMMUNICATIONS CORP.) 30 July 2015 (30.07.2015) entire document	1-60
A	WO 2019/139633 A1 (LANCIUM LLC) 18 July 2019 (18.07.2019) entire document	1-60
A	US 2017/0373500 A1 (ROBERT BOSCH GMBH) 28 December 2017 (28.12.2017) entire document	1-60

☒ 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

"D" document cited by the applicant in the international application

"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
17 December 2020	22 FEB 2021
Name and mailing address of the ISA/US Mail Stop PCT, Attn: ISA/US, Commissioner for Patents P.O. Box 1450, Alexandria, VA 22313-1450 Facsimile No. 571-273-8300	Authorized officer Blaine R. Copenheaver Telephone No. PCT Helpdesk: 571-272-4300

Form PCT/ISA/210 (second sheet) (July 2019)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2020/057686

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 2014/0070756 A1 (STEM, INC) 13 March 2014 (13.03.2014) entire document	1-60
A	US 2018/0026478 A1 (SUN ELECTRIC PTE. LTD.) 25 January 2018 (25.01.2018) entire document	1-60

PATENT COOPERATION TREATY

From the
INTERNATIONAL SEARCHING AUTHORITY

To: MARK P. VRLA
BARNES & THORNBURG LLP
P.O. BOX 2786
CHICAGO, IL 60690-2786

PCT

WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY

(PCT Rule 43*bis*.1)

Date of mailing *(day/month/year)*	22 FEB 2021

Applicant's or agent's file reference	FOR FURTHER ACTION
84008-328630	See paragraph 2 below

International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/US2020/057686	28 October 2020	28 October 2019

International Patent Classification (IPC) or both national classification and IPC
IPC(8) - G05D 5/00; G05D 17/00; H02J 3/28 (2020.01)
CPC - G05B 13/027; G05B 15/02; G05F 1/66; G06Q 30/04; G06Q 50/06; H02J 11/00 (2020.08)

Applicant LANCIUM LLC

1. This opinion contains indications relating to the following items:

- ☒ Box No. I Basis of the opinion
- ☐ Box No. II Priority
- ☐ Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- ☐ Box No. IV Lack of unity of invention
- ☒ Box No. V Reasoned statement under Rule 43*bis*.1(a)(i) with regard to novelty, inventive step and industrial applicability; citations and explanations supporting such statement
- ☐ Box No. VI Certain documents cited
- ☐ Box No. VII Certain defects in the international application
- ☐ Box No. VIII Certain observations on the international application

2. **FURTHER ACTION**

If a demand for international preliminary examination is made, this opinion will be considered to be a written opinion of the International Preliminary Examining Authority ("IPEA") except that this does not apply where the applicant chooses an Authority other than this one to be the IPEA and the chosen IPEA has notified the International Bureau under Rule 66.1*bis*(b) that written opinions of this International Searching Authority will not be so considered.

If this opinion is, as provided above, considered to be a written opinion of the IPEA, the applicant is invited to submit to the IPEA a written reply together, where appropriate, with amendments, before the expiration of 3 months from the date of mailing of Form PCT/ISA/220 or before the expiration of 22 months from the priority date, whichever expires later.

For further options, see Form PCT/ISA/220.

Name and mailing address of the ISA/US	Date of completion of this opinion	Authorized officer
Mail Stop PCT, Attn: ISA/US Commissioner for Patents P.O. Box 1450, Alexandria, VA 22313-1450 Facsimile No. 571-273-8300	17 December 2020	Blaine R. Copenheaver PCT Helpdesk: 571-272-4300 Telephone No. 571-272-4300

Form PCT/ISA/237 (cover sheet) (revised January 2019)

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/US2020/057686

Box No. I Basis of this opinion

1. With regard to the **language**, this opinion has been established on the basis of:

   ☒ the international application in the language in which it was filed.

   ☐ a translation of the international application into _____ which is the language of a translation furnished for the purposes of international search (Rules 12.3(a) and 23.1(b)).

2. ☐ This opinion has been established taking into account the **rectification of an obvious mistake** authorized by or notified to this Authority under Rule 91 (Rule 43*bis*.1(b)).

3. ☐ With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, this opinion has been established on the basis of a sequence listing:

   a. ☐ forming part of the international application as filed:

      ☐ in the form of an Annex C/ST.25 text file.

      ☐ on paper or in the form of an image file.

   b. ☐ furnished together with the international application under PCT Rule 13*ter*.1(a) for the purposes of international search only in the form of an Annex C/ST.25 text file.

   c. ☐ furnished subsequent to the international filing date for the purposes of international search only:

      ☐ in the form of an Annex C/ST.25 text file (Rule 13*ter*.1(a)).

      ☐ on paper or in the form of an image file (Rule 13*ter*.1(b) and Administrative Instructions, Section 713).

4. ☐ In addition, in the case that more than one version or copy of a sequence listing has been filed or furnished, the required statements that the information in the subsequent or additional copies is identical to that forming part of the application as filed or does not go beyond the application as filed, as appropriate, were furnished.

5. Additional comments:

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/US2020/057686

Box No. V **Reasoned statement under Rule 43*bis*.1(a)(i) with regard to novelty, inventive step and industrial applicability; citations and explanations supporting such statement**

1. Statement

Novelty (N)	Claims	see claims below	YES
	Claims	see claims below	NO
Inventive step (iS)	Claims	see claims below	YES
	Claims	see claims below	NO
Industrial applicability (IA)	Claims	see claims below	YES
	Claims	see claims below	NO

2. Citations and explanations:

Novelty (N):
5, 6, 10-13, 16-18, 24-28, 30, 32, 34, 36, 38, 39, 45-48, 50, 52, 54, 56, 58, 59 (YES)

1-4, 7-9, 14, 15, 19-23, 29, 31, 33, 35, 37, 40-44, 49, 51, 53, 55, 57, 60 (NO)

Inventive Step (IS):
5, 6, 12, 13, 16-18, 24-28, 34, 36, 39, 45-48, 54, 56, 59 (YES)

1-4, 7-11, 14, 15, 19-23, 29-33, 35, 37, 38, 40-44, 49-53, 55, 57, 58, 60 (NO)

Industrial Applicability (IA):
1-60 (YES)

None (NO)

Claims 1-4, 7-9, 14, 15, 19-23, 29, 31, 33, 35, 37, 40-44, 49, 51, 53, 55, 57, and 60 lack novelty under PCT Article 33(2) as being anticipated by Iso.

Regarding Claim 1, Iso discloses a system comprising: a set of computing systems (page 29, last paragraph for DER participating in the NYISO's Energy and Ancillary Services markets will require well-defined metering configurations as well as processes for calculating baseline load levels from which to measure performance. Establishing the baseline will require estimating a participant's load based on data from time periods with page 25, last two paragraphs for DER will be required to be available during all intervals in which they submit offers to provide wholesale service. If DER is derated or unavailable, it must report its unavailability to NYISO. Given the expected size and number of DER, the NYISO expects to modify its outage software to accommodate DER),

wherein the set of computing systems is configured to perform computational operations using power from a power grid (page 30, second paragraph for Behind-the-meter generators and storage devices further complicate these calculations because operation of such generation or storage for local needs alters the baseline demand making it more difficult to assess DER performance [using a power grid]. A policy for meter data and metering requirements will be critical to ensuring the integrity of the market. The ability for the NYISO to measure gross generation and gross native load at DER sites participating in NYISO markets will be necessary to ensure that the market is properly compensating DER for their contribution to system needs);

and a control system configured to: monitor a set of conditions (page 21 second paragraph for required to have 6-second real-time telemetry. The NYISO's current meter data infrastructure supports PTID-level data, primarily collected through real-time telemetry for real-time operations and monitoring functions [means for monitoring and control], and after-the-fact uploads to support settlement. The integration of dispatchable DER into Capacity, Energy, and Ancillary Service markets is expected to follow a comparable model. DCEAs will be required to provide PTID-level i.e., aggregation level real-time telemetry data for operations and monitoring functions);

while monitoring the set of conditions, receive first power option data based, at least in part, on a power option agreement (page 23, Section IX second paragraph for The NYISO recognizes that some DER will be unable to deliver capacity in all 24 hours due to its physical characteristics e.g., DER aggregations consisting of load curtailment assets that have a typical "9 to 5" load profile [load power options based on time periods] These DER are still valuable to the system, but perhaps less than a full 24 hour DER. In order to determine the varying degree of operational benefit that different DER can provide to the grid, the NYISO intends to develop options for service tiers that dispatchable DER can provide to help the NYISO meet its daily load with page 28, last two paragraphs for reliability-based Demand Response programs SCR and EDRP are expected to continue, with some changes to better align these programs with the DER market rules. Any changes to the SCR program, including eligibility, obligations [agreements to provide power], or payments, will be addressed after the development of the dispatchable DER program concepts. If NYISO determines future changes to the SCR program are warranted, NYISO will work with stakeholders to develop an appropriate transition plan from the current rules),

wherein the first power option data specify a first minimum power usage threshold associated with a first time interval (page 24, and Figure 11 for having first minimum power threshold associated with the first time interval of hours 7-13 of the day that is known as peak demand with the minimum and maximum thresholds shown with the tan box approximately 17000-23000 MW respectively [first power option of a peak load] with page 25, second paragraph for evaluation of DER-specific thresholds of existing offer parameters, such as

Supplemental Box

In case **the space in any of the preceding boxes is not sufficient.**
Continuation of:

minimum down time, minimum run-time, response rate, and to introduce a new DER offer parameter, maximum commitments per day. The threshold for the minimum run-time for DER is the minimum time a resource will be committed by the Real-Time Commitment software [using software to determine thresholds and minimize power down time intervals]);

responsive to receiving the first power option data (page 24, and Figure 11, for having first minimum power threshold associated with the first time interval of hours 7-13 of the day the first power condition being an off peak option peak power [changing power option from off peak to peak power]),

provide first control instructions for the set of computing systems based on a combination of at least a portion of the first power option data and at least one condition of the set of conditions (page 25, first and second paragraph for he purpose of NYISO's DAM is to procure enough supply to meet the load bid in the NYISO's DAM. All 10-minute-capable traditional generators east of Central East have an obligation to offer into the real-time market. The NYISO intends to apply the same obligation to dispatchable DER to offer in the real-time market. If more supply resources are required due to system condition changes in real-time [power condition of off peak power with control instructions to provide power in real time] and The threshold for the minimum run-time for DER is the minimum time a resource will be committed by the Real-Time Commitment software [using computing systems to determine power demands] Response rate is the speed with which a resource can reach its upper operating limit within the minimum run-time),

wherein the first control instructions comprises a first power consumption target for the set of computing systems for the first time interval (page 24, and figure 11 for having first minimum power threshold associated with the first time interval of hours 7-13 of the day with a first power consumption target of peak [first power option of peak power]),

and wherein the first power consumption target is equal to or greater than the first minimum power usage threshold associated with the first time interval (page 24, and figure 11 for the first minimum power usage of low from 0-6 hours as the first minimum value of 16000 MW and transitioning to the first time interval of 7-13 hours and a peak hours minimum values or 17000 MW);

while monitoring the set of conditions, receive second power option data based, at least in part, on the power option agreement (page 24, and top figure for having second power threshold of peak power window associated with the second time interval of hours 14-20 of the day that is greater than the peak threshold value with page 25 last paragraph for In another scenario, if an aggregation is scheduled for four hours, the DCE may choose to meet its obligation [power option agreements] by discharging storage devices for two hours and by load curtailment for the remaining two hours. Importantly, the NYISO intends to establish performance obligations at the aggregation level, and not at individual resource level),

wherein the second power option data specify a second minimum power usage threshold associated with a second time interval (page 24, and figure 11 for having a second power usage threshold of daytime peak from hours 14-20 as the second time interval showing a second minimum and maximum values shown by the orange box from 21000-23000 MW for the second time interval of 14-20 hours);

and responsive to receiving the second power option data (page 25 first paragraph for intends to apply the same obligation to dispatchable DER to offer in the real-time market. If more supply resources are required due to system condition changes in real-time [receiving a need for a different power option], NYISO operations can initiate its Supplemental Resource Evaluation (SRE) process. All NYISO capacity resources are eligible for selection and are required to respond to a SRE request in real-time regardless of whether they received an award/schedule in the DAM),

provide second control instructions for the set of computing systems based on a combination of at least a portion of the second power data and at least one condition of the set of conditions (page 23, Section A, second paragraph for ER are still valuable to the system, but perhaps less than a full 24 hour DER. In order to determine the varying degree of operational benefit that different DER can provide to the grid, the NYISO intends to develop options for service tiers that dispatchable [adjust for conditions based on load tiers] DER can provide to help the NYISO meet its daily load. The NYISO currently proposes three such tiers - full day service, on-peak service and daytime peak service with page 25, last paragraph for if an aggregation is scheduled for four hours, the DCE may choose to meet its obligation by discharging storage devices for two hours and by load curtailment for the remaining two hours. Importantly, the NYISO intends to establish performance obligations at the aggregation level, and not at individual resource level),

wherein the second control instructions comprises a second power consumption target for the set of computing systems for the second time interval (page 23 bottom section for Daytime peak service is the provision of wholesale service to help the NYISO manage its daily peak hours. Consistent with the key principle of aligning payments with system requirements, the NYISO believes that Capacity market compensation commensurate with a DER's capabilities and performance is appropriate, and, therefore, the NYISO expects to develop market rules through the stakeholder process to prorate capacity and associated capacity payments),

and wherein the second power consumption target is equal to or greater than the second minimum power usage threshold associated with the second time interval (page 24, and figure 11 for having a second power consumption of daytime peak that is greater than the regular peak power interval threshold, and page 12, second paragraph for while activating DER to displace wholesale energy purchases during periods of high market prices [higher power usage threshold resulting in a time interval of higher prices] New York's LSEs submit approximately 3-5% of their day-ahead Load bids as price responsive, some of which is used for other purposes such as price hedging).

Regarding Claim 2, Iso discloses the control system is configured to: receive the second power option data subsequent to receiving the first power option data (page 28, fourth bullet for valuate how load served by DER operating at the time of the system peak will be incorporated into load forecasts and LSE capacity obligations with page 12, second paragraph for LSEs would rely more heavily on wholesale energy purchases during periods of low prices while activating DER to displace wholesale energy purchases during periods of high market prices [knowing power option data to know when to go to second power level for peaks] New York's LSEs submit approximately 3-5% of their day-ahead Load bids as price responsive, some of which is used for other purposes such as price hedging).

Regarding Claim 3, Iso discloses the first time interval corresponds to a first hour and the second time interval corresponds to a second

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hour, and wherein the second hour is subsequent to the first hour (page 24, figure 11 for having a first hour 15 at the first peak power level, and a second hour element 16 at the daytime peak power hour that is subsequent to the first hour 15).

Regarding Claim 4, Iso discloses the control system is configured to monitor the set of conditions comprising: a price of power from the power grid (page 12, second paragraph for Under existing market rules a LSE may choose to submit price-sensitive Day-Ahead load bids for some, or all, of the load it must procure. That is, a LSE may choose the Day-Ahead Market price [threshold price] at which it will serve its Load. If the Day-Ahead price exceeds the LSE's Price-Capped Load bid [making sure the power for the day is below the price capped load threshold] the LSE will then either reduce its Load or procure energy through another source. DER may participate in wholesale markets as a tool LSEs use to modulate load in response to wholesale price signals);

and a plurality of parameters associated with one or more computational operations to be performed at the set of computing systems (page 12 third paragraph for Another economic-based mechanism for DER that can inject at least 1 MW into the grid is to participate as a Behind-the-Meter Net Generation BTM:NG Resource. This initiative is designed for large facilities that have on-site generation capability routinely serving a local, on-site Load the facility's Host Load, and that have excess generation capability after serving that Host Load [using computations such as host load values]).

Regarding Claim 7, Iso discloses the first power consumption target is greater than the first minimum power threshold when a cost of power from the power grid is below a threshold price during the first time interval (page 12, second paragraph for Under existing market rules a LSE may choose to submit price-sensitive Day-Ahead load bids for some, or all, of the load it must procure. That is, a LSE may choose the Day-Ahead Market price [threshold price] at which it will serve its Load. If the Day-Ahead price exceeds the LSE's Price-Capped Load bid [making sure the power for the day is below the price capped load threshold] the LSE will then either reduce its Load or procure energy through another source. DER may participate in wholesale markets as a tool LSEs use to modulate load in response to wholesale price signals).

Regarding Claim 8, Iso discloses the first power consumption target is equal to the first minimum power threshold when a cost of power from the power grid is above a threshold price during the first time interval (page 12, second paragraph for LSEs can submit load bid curves to the NYISO reflecting a "willingness to buy" energy by modifying load bids in response to the NYISO's clearing price. In a typical scenario, LSEs would rely more heavily on wholesale energy purchases during periods of low prices while activating DER to displace wholesale energy purchases during periods of high market prices [modifying power pricing based on time interval thresholds] New York's LSEs submit approximately 3-5% of their day-ahead Load bids as price responsive, some of which is used for other purposes such as price hedging).

Regarding Claim 9, Iso disclose the control system is a remote master control system positioned remotely from the set of computing systems (page 4, second paragraph for his DER Roadmap is only the first step in building that grid of the future. We are committed to seamlessly transitioning from a primarily central station-based grid [remote master control]).

Regarding Claim 14, Iso discloses a method comprising: monitoring, at a computing system, a set of conditions (page 29, last paragraph for DER participating in the NYISO's Energy and Ancillary Services markets will require well-defined metering configurations as well as processes for calculating baseline load levels from which to measure performance. Establishing the baseline will require estimating a participant's load based on data from time periods with page 25, last two paragraphs for DER will be required to be available during all intervals in which they submit offers to provide wholesale service. If DER is derated or unavailable, it must report its unavailability to NYISO. Given the expected size and number of DER, the NYISO expects to modify its outage software to accommodate DER);

while monitoring the set of conditions and a control system configured to: monitor a set of conditions (page 21 second paragraph for required to have 6-second real-time telemetry. The NYISO's current meter data infrastructure supports PTID-level data, primarily collected through real-time telemetry for real-time operations and monitoring functions [means for monitoring and control], and after-the-fact uploads to support settlement. The integration of dispatchable DER into Capacity, Energy, and Ancillary Service markets is expected to follow a comparable model. DCEAs will be required to provide PTID-level i.e., aggregation level real-time telemetry data for operations and monitoring functions),

receiving first power option data based, at least in part, on a power option agreement (page 23, Section IX second paragraph for The NYISO recognizes that some DER will be unable to deliver capacity in all 24 hours due to its physical characteristics e.g., DER aggregations consisting of load curtailment assets that have a typical "9 to 5" load profile [load conditions based on time periods] These DER are still valuable to the system, but perhaps less than a full 24 hour DER. In order to determine the varying degree of operational benefit that different DER can provide to the grid, the NYISO intends to develop options for service tiers that dispatchable DER can provide to help the NYISO meet its daily load with page 28, last two paragraphs for reliability-based Demand Response programs SCR and EDRP are expected to continue, with some changes to better align these programs with the DER market rules. Any changes to the SCR program, including eligibility, obligations [agreements to provide power], or payments, will be addressed after the development of the dispatchable DER program concepts. If NYISO determines future changes to the SCR program are warranted, NYISO will work with stakeholders to develop an appropriate transition plan from the current rules),

wherein the first power option data specify a first minimum power usage threshold associated with a first time interval (page 24, and Figure 11 for having first minimum power threshold associated with the first time interval of hours 7-13 of the day that is known as peak demand);

responsive to receiving the first power option data (page 24, and Figure 11, for having first minimum power threshold associated with the first time interval of hours 7-13 of the day the first power condition being an off peak option peak power [changing power option from off peak to peak power]),

providing first control instructions for a set of computing systems based on a combination of at least a portion of the first power option data and at least one condition of the set of conditions (page 25, first and second paragraph for he purpose of NYISO's DAM is to procure enough supply to meet the load bid in the NYISO's DAM. All 10-minute-capable traditional generators east of Central East have an

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obligation to offer into the real-time market. The NYISO intends to apply the same obligation to dispatchable DER to offer in the real-time market. If more supply resources are required due to system condition changes in real-time [power condition of off peak power with control instructions to provide power in real time] and The threshold for the minimum run-time for DER is the minimum time a resource will be committed by the Real-Time Commitment software [using computing systems to determine power demands] Response rate is the speed with which a resource can reach its upper operating limit within the minimum run-time),

wherein the first control instructions comprises a first power consumption target for the set of computing systems for the first time interval (page 25, first and second paragraph for he purpose of NYISO's DAM is to procure enough supply to meet the load bid in the NYISO's DAM. All 10-minute-capable traditional generators east of Central East have an obligation to offer into the real-time market. The NYISO intends to apply the same obligation to dispatchable DER to offer in the real-time market. If more supply resources are required due to system condition changes in real-time [power condition of off peak power with control instructions to provide power in real time] and The threshold for the minimum run-time for DER is the minimum time a resource will be committed by the Real-Time Commitment software [using computing systems to determine power demands] Response rate is the speed with which a resource can reach its upper operating limit within the minimum run-time),

and wherein the first power consumption target is equal to or greater than the first minimum power usage threshold associated with the first time interval (page 24, and figure 11 for having first minimum power threshold associated with the first time interval of hours 7-13 of the day with a first power consumption target of peak);

while monitoring the set of conditions, receiving second power option data based (page 24, and figure 11 for the first minimum power usage of low from 0-6 hours as the first minimum value of 16000 MW and transitioning to the first time interval of 7-13 hours),

at least in part, on the power option agreement (page 24, and top figure for having second power threshold of peak power window associated with the second time interval of hours 14-20 of the day that is greater than the peak threshold value with page 25 last paragraph for In another scenario, if an aggregation is scheduled for four hours, the DCE may choose to meet its obligation [power option agreements] by discharging storage devices for two hours and by load curtailment for the remaining two hours. Importantly, the NYISO intends to establish performance obligations at the aggregation level, and not at individual resource level),

wherein the second power option data specify a second minimum usage power threshold associated with a second time interval (page 24, and figure 11 for having a second power usage threshold of daytime peak from hours 14-20 as the second time interval);

and responsive to receiving the second power option data (page 25 first paragraph for intends to apply the same obligation to dispatchable DER to offer in the real-time market. If more supply resources are required due to system condition changes in real-time [receiving a need for a different power option], NYISO operations can initiate its Supplemental Resource Evaluation (SRE) process. All NYISO capacity resources are eligible for selection and are required to respond to a SRE request in real-time regardless of whether they received an award/schedule in the DAM),

providing second control instructions for the set of computing systems based on a combination of at least a portion of the second power data and at least one condition of the set of conditions (page 23, Section A, second paragraph for ER are still valuable to the system, but perhaps less than a full 24 hour DER. In order to determine the varying degree of operational benefit that different DER can provide to the grid, the NYISO intends to develop options for service tiers that dispatchable [adjust for conditions based on load tiers] DER can provide to help the NYISO meet its daily load. The NYISO currently proposes three such tiers - full day service, on-peak service and daytime peak service with page 25, last paragraph for if an aggregation is scheduled for four hours, the DCE may choose to meet its obligation by discharging storage devices for two hours and by load curtailment for the remaining two hours. Importantly, the NYISO intends to establish performance obligations at the aggregation level, and not at individual resource level),

wherein the second control instructions comprises a second power consumption target for the set of computing systems for the second time interval (page 23 bottom section for Daytime peak service is the provision of wholesale service to help the NYISO manage its daily peak hours. Consistent with the key principle of aligning payments with system requirements, the NYISO believes that Capacity market compensation commensurate with a DER's capabilities and performance is appropriate, and, therefore, the NYISO expects to develop market rules through the stakeholder process to prorate capacity and associated capacity payments),

and wherein the second power consumption target is equal to or greater than the second minimum power usage threshold associated with the second time interval (page 24, and figure 11 for having a second power usage threshold of daytime peak from hours 14-20 as the second time interval showing a second minimum and maximum values shown by the orange box from 21000-23000 MW for the second time interval of 14-20 hours and also for having a second power consumption of daytime peak that is greater than the regular peak power interval threshold, and page 12, second paragraph for while activating DER to displace wholesale energy purchases during periods of high market prices [higher power usage threshold resulting in a time interval of higher prices] New York's LSEs submit approximately 3-5% of their day-ahead Load bids as price responsive, some of which is used for other purposes such as price hedging).

Regarding Claim 15, Iso discloses monitoring the set of conditions comprises: monitoring: (i) a price of power from a power grid (page 12, second paragraph for Under existing market rules a LSE may choose to submit price-sensitive Day-Ahead load bids for some, or all, of the load it must procure. That is, a LSE may choose the Day-Ahead Market price [threshold price] at which it will serve its Load. If the Day-Ahead price exceeds the LSE's Price-Capped Load bid [making sure the power for the day is below the price capped load threshold] the LSE will then either reduce its Load or procure energy through another source. DER may participate in wholesale markets as a tool LSEs use to modulate load in response to wholesale price signals),

(ii) a plurality of parameters associated with a set of computational operations to be performed at the set of computing systems (page 12, Section 3 for Load modifiers can consist of many different technologies that LSEs can use to manage its load. Load modifiers are primarily used: (i) to avoid purchasing high-cost power during peak hours, and (ii) to reduce the LSE's seasonal capacity obligations),

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and (iii) a plurality of parameters associated with the set of computing systems (page 12 third paragraph for Another economic-based mechanism for DER that can inject at least 1 MW into the grid is to participate as a Behind-the-Meter Net Generation BTM:NG Resource. This initiative is designed for large facilities that have on-site generation capability routinely serving a local, on-site Load the facility's Host Load, and that have excess generation capability after serving that Host Load [using computations such as host load values]).

Regarding Claim 19, Iso discloses receiving second power option data based, at least in part, on the power option agreement comprises (page 28, last two paragraphs for reliability-based Demand Response programs SCR and EDRP are expected to continue, with some changes to better align these programs with the DER market rules. Any changes to the SCR program, including eligibility, obligations [agreements to provide power], or payments, will be addressed after the development of the dispatchable DER program concepts. If NYISO determines future changes to the SCR program are warranted, NYISO will work with stakeholders to develop an appropriate transition plan from the current rules):

receiving the second power option data during the first time interval (page 23 bottom section for Daytime peak service is the provision of wholesale service to help the NYISO manage its daily peak hours. Consistent with the key principle of aligning payments with system requirements, the NYISO believes that Capacity market compensation commensurate with a DER's capabilities and performance is appropriate, and, therefore, the NYISO expects to develop market rules through the stakeholder process to prorate capacity and associated capacity payments);

and wherein providing second control instructions for the set of computing systems comprises: providing the second control instructions for the set of computing systems prior to an end of the first time interval (page 24, figure 11 for having a first hour 15 at the first peak power level, and a second hour element 16 at the daytime peak power hour that is subsequent to the first hour 15).

Regarding Claim 20, Iso discloses a non-transitory computer readable medium having stored therein instructions executable by one or more processors to cause a computing system to perform functions comprising (page 29, last paragraph for DER participating in the NYISO's Energy and Ancillary Services markets will require well-defined metering configurations as well as processes for calculating baseline load levels from which to measure performance. Establishing the baseline will require estimating a participant's load based on data from time periods with page 25, last two paragraphs for DER will be required to be available during all intervals in which they submit offers to provide wholesale service. If DER is derated or unavailable, it must report its unavailability to NYISO. Given the expected size and number of DER, the NYISO expects to modify its outage software to accommodate DER):

monitoring a set of conditions; while monitoring the set of conditions (page 21 second paragraph for required to have 6-second real-time telemetry. The NYISO's current meter data infrastructure supports PTID-level data, primarily collected through real-time telemetry for real-time operations and monitoring functions [means for monitoring and control], and after-the-fact uploads to support settlement. The integration of dispatchable DER into Capacity, Energy, and Ancillary Service markets is expected to follow a comparable model. DCEAs will be required to provide PTID-level i.e., aggregation level real-time telemetry data for operations and monitoring functions),

receiving first power option data based, at least in part, on a power option agreement (page 23, Section IX second paragraph for The NYISO recognizes that some DER will be unable to deliver capacity in all 24 hours due to its physical characteristics e.g., DER aggregations consisting of load curtailment assets that have a typical "9 to 5" load profile [load conditions based on time periods] These DER are still valuable to the system, but perhaps less than a full 24 hour DER. In order to determine the varying degree of operational benefit that different DER can provide to the grid, the NYISO intends to develop options for service tiers that dispatchable DER can provide to help the NYISO meet its daily load with page 28, last two paragraphs for reliability-based Demand Response programs SCR and EDRP are expected to continue, with some changes to better align these programs with the DER market rules. Any changes to the SCR program, including eligibility, obligations [agreements to provide power], or payments, will be addressed after the development of the dispatchable DER program concepts. If NYISO determines future changes to the SCR program are warranted, NYISO will work with stakeholders to develop an appropriate transition plan from the current rules),

wherein the first power option data specify a first minimum power usage threshold associated with a first time interval (page 24, and Figure 11 for having first minimum power threshold associated with the first time interval of hours 7-13 of the day that is known as peak demand);

responsive to receiving the first power option data (page 24, and Figure 11, for having first minimum power threshold associated with the first time interval of hours 7-13 of the day the first power condition being an off peak option peak power [changing power option from off peak to peak power]),

providing first control instructions for a set of computing systems based on a combination of at least a portion of the first power option data and at least one condition of the set of conditions (page 25, first and second paragraph for he purpose of NYISO's DAM is to procure enough supply to meet the load bid in the NYISO's DAM. All 10-minute-capable traditional generators east of Central East have an obligation to offer into the real-time market. The NYISO intends to apply the same obligation to dispatchable DER to offer in the real-time market. If more supply resources are required due to system condition changes in real-time [power condition of off peak power with control instructions to provide power in real time] and The threshold for the minimum run-time for DER is the minimum time a resource will be committed by the Real-Time Commitment software [using computing systems to determine power demands] Response rate is the speed with which a resource can reach its upper operating limit within the minimum run-time),

wherein the first control instructions comprises a first power consumption target for the set of computing systems for the first time interval (page 24, and figure 11 for having first minimum power threshold associated with the first time interval of hours 7-13 of the day with a first power consumption target of peak),

and wherein the first power consumption target is equal to or greater than the first minimum power usage threshold associated with the first time interval (page 24, and figure 11 for the first minimum power usage of low from 0-6 hours as the first minimum value of 16000 MW and transitioning to the first time interval of 7-13 hours);

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while monitoring the set of conditions, receiving second power option data based, at least in part, on the power option agreement (page 24, and top figure for having second power threshold of peak power window associated with the second time interval of hours 14-20 of the day that is greater than the peak threshold value with page 25 last paragraph for In another scenario, if an aggregation is scheduled for four hours, the DCE may choose to meet its obligation [power option agreements] by discharging storage devices for two hours and by load curtailment for the remaining two hours. Importantly, the NYISO intends to establish performance obligations at the aggregation level, and not at individual resource level),

wherein the second power option data specify a second minimum power usage threshold associated with a second time interval (page 24, and figure 11 for having a second power usage threshold of daytime peak from hours 14-20 as the second time interval showing a second minimum and maximum values shown by the orange box from 21000-23000 MW for the second time interval of 14-20 hours);

and responsive to receiving the second power option data (page 25 first paragraph for intends to apply the same obligation to dispatchable DER to offer in the real-time market. If more supply resources are required due to system condition changes in real-time [receiving a need for a different power option], NYISO operations can initiate its Supplemental Resource Evaluation (SRE) process. All NYISO capacity resources are eligible for selection and are required to respond to a SRE request in real-time regardless of whether they received an award/schedule in the DAM),

providing second control instructions for the set of computing systems based on a combination of at least a portion of the second power data and at least one condition of the set of conditions (page 23, Section A, second paragraph for ER are still valuable to the system, but perhaps less than a full 24 hour DER. In order to determine the varying degree of operational benefit that different DER can provide to the grid, the NYISO intends to develop options for service tiers that dispatchable [adjust for conditions based on load tiers] DER can provide to help the NYISO meet its daily load. The NYISO currently proposes three such tiers - full day service, on-peak service and daytime peak service with page 25, last paragraph for if an aggregation is scheduled for four hours, the DCE may choose to meet its obligation by discharging storage devices for two hours and by load curtailment for the remaining two hours. Importantly, the NYISO intends to establish performance obligations at the aggregation level, and not at individual resource level),

wherein the second control instructions comprises a second power consumption target for the set of computing systems for the second time interval (page 23 bottom section for Daytime peak service is the provision of wholesale service to help the NYISO manage its daily peak hours. Consistent with the key principle of aligning payments with system requirements, the NYISO believes that Capacity market compensation commensurate with a DER's capabilities and performance is appropriate, and, therefore, the NYISO expects to develop market rules through the stakeholder process to prorate capacity and associated capacity payments),

and wherein the second power consumption target is equal to or greater than the second minimum power usage threshold associated with the second time interval (page 24, and figure 11 for having a second power consumption of daytime peak that is greater than the regular peak power interval threshold, and page 12, second paragraph for while activating DER to displace wholesale energy purchases during periods of high market prices [higher power usage threshold resulting in a time interval of higher prices] New York's LSEs submit approximately 3-5% of their day-ahead Load bids as price responsive, some of which is used for other purposes such as price hedging).

Regarding Claim 21, Iso discloses a system comprising (page 29, last paragraph for DER participating in the NYISO's Energy and Ancillary Services markets will require well-defined metering configurations as well as processes for calculating baseline load levels from which to measure performance. Establishing the baseline will require estimating a participant's load based on data from time periods with page 25, last two paragraphs for DER will be required to be available during all intervals in which they submit offers to provide wholesale service. If DER is derated or unavailable, it must report its unavailability to NYISO. Given the expected size and number of DER, the NYISO expects to modify its outage software to accommodate DER):

a set of computing systems coupled to a behind-the-meter (BTM) power generation source (page 30, second paragraph for Behind-the-meter generators and storage devices further complicate these calculations because operation of such generation or storage for local needs alters the baseline demand making it more difficult to assess DER performance [using a power grid]. A policy for meter data and metering requirements will be critical to ensuring the integrity of the market. The ability for the NYISO to measure gross generation and gross native load at DER sites participating in NYISO markets will be necessary to ensure that the market is properly compensating DER for their contribution to system needs),

wherein the set of computing systems is configured to perform computational operations (page 27 first paragraph for Currently, resources participating in NYISO SCR program and EDRP have the option to participate in utility level demand response programs. The NYISO intends to continue allowing DER participating in utility level Demand Response programs to participate in the NYISO SCR program and EDRP. The NYISO is also in ongoing conversations with utilities to explore the possibility of additional dual participation opportunities);

a control system configured to: monitor a set of conditions (page 21 second paragraph for required to have 6-second real-time telemetry. The NYISO's current meter data infrastructure supports PTID-level data, primarily collected through real-time telemetry for real-time operations and monitoring functions [means for monitoring and control], and after-the-fact uploads to support settlement. The integration of dispatchable DER into Capacity, Energy, and Ancillary Service markets is expected to follow a comparable model. DCEAs will be required to provide PTID-level i.e., aggregation level real-time telemetry data for operations and monitoring functions);

receive power option data based that specifies: (i) a set of minimum power thresholds (page 23, Section IX second paragraph for The NYISO recognizes that some DER will be unable to deliver capacity in all 24 hours due to its physical characteristics e.g., DER aggregations consisting of load curtailment assets that have a typical "9 to 5" load profile [load conditions based on time periods] These DER are still valuable to the system, but perhaps less than a full 24 hour DER. In order to determine the varying degree of operational benefit that different DER can provide to the grid, the NYISO intends to develop options for service tiers that dispatchable DER can provide to help the NYISO meet its daily load),

and (ii) a set of time intervals, wherein each minimum power threshold in the set of minimum power thresholds is associated with a time

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interval in the set of time intervals (page 24, and Figure 11 for having first minimum power threshold associated with the first time interval of hours 7-13 of the day that is known as peak demand);

responsive to receiving the power option data (page 24, and Figure 11, for having first minimum power threshold associated with the first time interval of hours 7-13 of the day the first power condition being an off peak option peak power [changing power option from off peak to peak power]),

determine a performance strategy for the set of computing systems based on a combination of at least a portion of the power option data and at least one condition from the set of conditions (page 25, first and second paragraph for he purpose of NYISO's DAM is to procure enough supply to meet the load bid in the NYISO's DAM. All 10-minute-capable traditional generators east of Central East have an obligation to offer into the real-time market. The NYISO intends to apply the same obligation to dispatchable DER to offer in the real-time market. If more supply resources are required due to system condition changes in real-time [power condition of off peak power with control instructions to provide power in real time] and The threshold for the minimum run-time for DER is the minimum time a resource will be committed by the Real-Time Commitment software [using computing systems to determine power demands] Response rate is the speed with which a resource can reach its upper operating limit within the minimum run-time),

wherein the performance strategy comprises a power consumption target for the set of computing systems for each time interval in the set of time intervals (page 24, and figure 11 for having first minimum power threshold associated with the first time interval of hours 7-13 of the day with a first power consumption target of peak),

wherein each power consumption target is equal to or greater than the minimum power threshold associated with each time interval (page 24, and figure 11 for the first minimum power usage of low from 0-6 hours as the first minimum value of 16000 MW and transitioning to the first time interval of 7-13 hours);

and provide instructions to the set of computing systems to perform one or more computational operations based on the performance strategy (page 24, and top figure for having second power threshold of peak power window associated with the second time interval of hours 14-20 of the day that is greater than the peak threshold value with page 25 last paragraph for In another scenario, if an aggregation is scheduled for four hours, the DCE may choose to meet its obligation [power option agreements] by discharging storage devices for two hours and by load curtailment for the remaining two hours. importantly, the NYISO intends to establish performance obligations at the aggregation level, and not at individual resource level).

Regarding Claim 22, Iso discloses the control system is configured to monitor the set of conditions comprising: a price of power from a power grid (page 12, second paragraph for Under existing market rules a LSE may choose to submit price-sensitive Day-Ahead load bids for some, or all, of the load it must procure. That is, a LSE may choose the Day-Ahead Market price [threshold price] at which it will serve its Load. If the Day-Ahead price exceeds the LSE's Price-Capped Load bid [making sure the power for the day is below the price capped load threshold] the LSE will then either reduce its Load or procure energy through another source. DER may participate in wholesale markets as a tool LSEs use to modulate load in response to wholesale price signals);

and a plurality of parameters associated with one or more computational operations to be performed at the set of computing systems (page 12 third paragraph for Another economic-based mechanism for DER that can inject at least 1 MW into the grid is to participate as a Behind-the-Meter Net Generation BTM:NG Resource. This initiative is designed for large facilities that have on-site generation capability routinely serving a local, on-site Load the facility's Host Load, and that have excess generation capability after serving that Host Load [using computations such as host load values]).

Regarding Claim 23, Iso discloses the control system is configured to: determine the performance strategy for the set of computing systems based on a combination of at least the portion option data (page 25, last paragraph for For example, an aggregation with a 24-hour capacity obligation might rely on load curtailment assets to provide performance during the day and generation assets when sufficient load curtailment capability is not available to meet the aggregation's obligation. In another scenario, if an aggregation is scheduled for four hours, the DCE may choose to meet its obligation by discharging storage devices for two hours and by load curtailment for the remaining two hours),

the price of power from the power grid (page 12, second paragraph for Under existing market rules a LSE may choose to submit price-sensitive Day-Ahead load bids for some, or all, of the load it must procure. That is, a LSE may choose the Day-Ahead Market price [threshold price] at which it will serve its Load. If the Day-Ahead price exceeds the LSE's Price-Capped Load bid [making sure the power for the day is below the price capped load threshold] the LSE will then either reduce its Load or procure energy through another source. DER may participate in wholesale markets as a tool LSEs use to modulate load in response to wholesale price signals),

and the plurality of parameters associated with the one or more computational operations (page 12 third paragraph for Another economic-based mechanism for DER that can inject at least 1 MW into the grid is to participate as a Behind-the-Meter Net Generation BTM:NG Resource. This initiative is designed for large facilities that have on-site generation capability routinely serving a local, on-site Load the facility's Host Load, and that have excess generation capability after serving that Host Load [using computations such as host load values]).

Regarding Claim 29, Iso discloses the control system is a remote master control system positioned remotely from the set of computing systems (page 4, second paragraph for his DER Roadmap is only the first step in building that grid of the future. We are committed to seamlessly transitioning from a primarily central station-based grid [remote master control]).

Regarding Claim 31, Iso discloses the control system is configured to receive the power option data while monitoring the set of conditions (page 19, second paragraph for granular monitoring and control of DER aggregations at the transmission substation load bus level is needed to effectively and efficiently manage transmission system congestion and reliability. Therefore, the NYISO proposes that dispatchable DER aggregation boundaries to be limited to all DER interconnected to, and having direct impact on, the same transmission

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substation load bus).

Regarding Claim 33, Iso discloses the power option data specify: (i) a first minimum power threshold associated with a first time interval in the set of time intervals (page 24, and figure 11 for the first minimum power usage of low from 0-6 hours as the first minimum value of 16000 MW and transitioning to the first time interval of 7-13 hours and a peak hours minimum values or 17000 MW),

and (ii) a second minimum power threshold associated with a second time interval in the set of time intervals (page 24, and figure 11 for having a second power usage threshold of daytime peak from hours 14-20 as the second time interval showing a second minimum and maximum values shown by the orange box from 21000-23000 MW for the second time interval of 14-20 hours),

wherein the second time interval is subsequent to the first time interval (page 28, fourth bullet for valuate how load served by DER operating at the time of the system peak will be incorporated into load forecasts and LSE capacity obligations with page 12, second paragraph for LSEs would rely more heavily on wholesale energy purchases during periods of low prices while activating DER to displace wholesale energy purchases during periods of high market prices [knowing power option data to know when to go to second power level for peaks] New York's LSEs submit approximately 3-5% of their day-ahead Load bids as price responsive, some of which is used for other purposes such as price hedging).

Regarding Claim 35, Iso discloses a total duration of the set of time intervals corresponds to a twenty-four hour period (page 24, and figure 11 for showing three sets of time intervals in a 24 hour time period for minimum, peak, and daytime peak loads).

Regarding Claim 37, Iso discloses a method comprising: monitoring, by a computing system, a set of conditions (page 29, last paragraph for DER participating in the NYISO's Energy and Ancillary Services markets will require well-defined metering configurations as well as processes for calculating baseline load levels from which to measure performance. Establishing the baseline will require estimating a participant's load based on data from time periods with page 25, last two paragraphs for DER will be required to be available during all intervals in which they submit offers to provide wholesale service. If DER is derated or unavailable, it must report its unavailability to NYISO. Given the expected size and number of DER, the NYISO expects to modify its outage software to accommodate DER);

receiving, at the computing system, power option data, wherein the power option data specify (page 23, Section IX second paragraph for The NYISO recognizes that some DER will be unable to deliver capacity in all 24 hours due to its physical characteristics e.g., DER aggregations consisting of load curtailment assets that have a typical "9 to 5" load profile [load conditions based on time periods] These DER are still valuable to the system, but perhaps less than a full 24 hour DER. In order to determine the varying degree of operational benefit that different DER can provide to the grid, the NYISO intends to develop options for service [having power option tiers] tiers that dispatchable DER can provide to help the NYISO meet its daily load with page 28, last two paragraphs for reliability-based Demand Response programs SCR and EDRP are expected to continue, with some changes to better align these programs with the DER market rules. Any changes to the SCR program, including eligibility, obligations [agreements to provide power], or payments, will be addressed after the development of the dispatchable DER program concepts. If NYISO determines future changes to the SCR program are warranted, NYISO will work with stakeholders to develop an appropriate transition plan from the current rules):

(i) a set of minimum power thresholds, and (ii) a set of time intervals (page 24, and Figure 11 for having first minimum power threshold associated with the first time interval of hours 7-13 of the day that is known as peak demand with the minimum and maximum thresholds shown with the tan box approximately 17000-23000 MW respectively, with page 25, second paragraph for evaluation of DER-specific thresholds of existing offer parameters, such as minimum down time, minimum run-time, response rate, and to introduce a new DER offer parameter, maximum commitments per day. The threshold for the minimum run-time for DER is the minimum time a resource will be committed by the Real-Time Commitment software [using software to determine thresholds and minimize power down time intervals]),

wherein each minimum power threshold in the set of minimum power thresholds is associated with a time interval in the set of time intervals (page 24, and figure 11 for having a second power usage threshold of daytime peak from hours 14-20 as the second time interval [multiple intervals] showing a second minimum and maximum values shown by the orange box from 21000-23000 MW for the second time interval of 14-20 hours);

responsive to receiving the power option data (page 25 first paragraph for intends to apply the same obligation to dispatchable DER to offer in the real-time market. If more supply resources are required due to system condition changes in real-time [receiving a need for a different power option], NYISO operations can initiate its Supplemental Resource Evaluation (SRE) process. All NYISO capacity resources are eligible for selection and are required to respond to a SRE request in real-time regardless of whether they received an award/schedule in the DAM),

determining a performance strategy for a set of computing systems based on a combination of at least a portion of the power option data and at least one condition in the set of conditions (page 22, third paragraph for measure resource performance in the Energy market. The NYISO plans to draw on conclusions of that study for dispatchable DER relying on a baseline methodology to measure performance. DER participating in the Ancillary Services market will be measured by the current DSASP baseline to evaluate performance [determining performance strategies] for the ancillary product with page 25, last paragraph for an aggregation with a 24-hour capacity obligation might rely on load curtailment assets to provide performance during the day and generation assets when sufficient load curtailment capability is not available to meet the aggregation's obligation. In another scenario [using different power conditions], if an aggregation is scheduled for four hours, the DCE may choose to meet its obligation by discharging storage devices for two hours and by load curtailment for the remaining two hours),

wherein the performance strategy comprises a power consumption target for the set of computing systems for each time interval in the set of time intervals (page 25, second paragraph for could potentially involve evaluation of DER-specific thresholds of existing offer parameters, such as minimum down time,22minimum run-time, response rate, and to introduce a new DER offer parameter, maximum commitments per day. The threshold for the minimum run-time for DER is the minimum time a resource will be committed by the Real-Time Commitment software. Response rate is the speed with which a resource can reach its upper operating limit within the

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minimum run-time),

wherein each power consumption target is equal to or greater than the minimum power threshold associated with each time interval (page 24, and figure 11 for having a second power consumption of daytime peak that is greater than the regular peak power interval threshold, and page 12, second paragraph for while activating DER to displace wholesale energy purchases during periods of high market prices [higher power usage threshold resulting in a time interval of higher prices] New York's LSEs submit approximately 3-5% of their day-ahead Load bids as price responsive, some of which is used for other purposes such as price hedging),

and wherein the set of computing systems is coupled to a behind-the-meter (BTM) power generation source (page 30, second paragraph for Behind-the-meter generators [BTM] and storage devices further complicate these calculations because operation of such generation or storage for local needs alters the baseline demand making it more difficult to assess DER performance. A policy for meter data and metering requirements will be critical to ensuring the integrity of the market. The ability for the NYISO to measure gross generation and gross native load at DER sites participating in NYISO markets will be necessary to ensure that the market is properly compensating DER for their contribution to system needs);

and providing instructions to the set of computing systems to perform one or more computational operations based on the performance strategy (page 23, Section A, second paragraph for ER are still valuable to the system, but perhaps less than a full 24 hour DER. In order to determine the varying degree of operational benefit that different DER can provide to the grid, the NYISO intends to develop options for service tiers that dispatchable [adjust for conditions based on load tiers] DER can provide to help the NYISO meet its daily load. The NYISO currently proposes three such tiers - full day service, on-peak service and daytime peak service with page 25, last paragraph for if an aggregation is scheduled for four hours, the DCE may choose to meet its obligation by discharging storage devices for two hours and by load curtailment for the remaining two hours. Importantly, the NYISO intends to establish performance obligations at the aggregation level, and not at individual resource level).

Regarding Claim 40, Iso discloses a non-transitory computer readable medium having stored therein instructions executable by one or more processors to cause a computing system to perform functions comprising (page 29, last paragraph for DER participating in the NYISO's Energy and Ancillary Services markets will require well-defined metering configurations as well as processes for calculating baseline load levels from which to measure performance. Establishing the baseline will require estimating a participant's load based on data from time periods with page 25, last two paragraphs for DER will be required to be available during all intervals in which they submit offers to provide wholesale service. If DER is derated or unavailable, it must report its unavailability to NYISO. Given the expected size and number of DER, the NYISO expects to modify its outage software to accommodate DER):

monitoring a set of conditions (page 21 second paragraph for required to have 6-second real-time telemetry. The NYISO's current meter data infrastructure supports PTID-level data, primarily collected through real-time telemetry for real-time operations and monitoring functions [means for monitoring and control], and after-the-fact uploads to support settlement. The integration of dispatchable DER into Capacity, Energy, and Ancillary Service markets is expected to follow a comparable model. DCEAs will be required to provide PTID-level i.e., aggregation level real-time telemetry data for operations and monitoring functions);

receiving power option data that specify: (i) a set of minimum power thresholds, and (ii) a set of time intervals (page 24, and Figure 11 for having first minimum power threshold associated with the first time interval of hours 7-13 of the day that is known as peak demand with the minimum and maximum thresholds shown with the tan box approximately 17000-23000 MW respectively, with page 25, second paragraph for evaluation of DER-specific thresholds of existing offer parameters, such as minimum down time, minimum run-time, response rate, and to introduce a new DER offer parameter, maximum commitments per day. The threshold for the minimum run-time for DER is the minimum time a resource will be committed by the Real-Time Commitment software [using software to determine thresholds and minimize power down time intervals]),

wherein each minimum power threshold in the set of minimum power thresholds is associated with a time interval in the set of time intervals (page 24, and figure 11 for having a second power usage threshold of daytime peak from hours 14-20 as the second time interval [multiple intervals] showing a second minimum and maximum values shown by the orange box from 21000-23000 MW for the second time interval of 14-20 hours);

responsive to receiving the power option data (page 25 first paragraph for intends to apply the same obligation to dispatchable DER to offer in the real-time market. If more supply resources are required due to system condition changes in real-time [receiving a need for a different power option], NYISO operations can initiate its Supplemental Resource Evaluation (SRE) process. All NYISO capacity resources are eligible for selection and are required to respond to a SRE request in real-time regardless of whether they received an award/schedule in the DAM),

determining a performance strategy for a set of computing systems based on a combination of at least a portion of the power option data and at least one condition in the set of conditions (page 22, third paragraph for measure resource performance in the Energy market. The NYISO plans to draw on conclusions of that study for dispatchable DER relying on a baseline methodology to measure performance. DER participating in the Ancillary Services market will be measured by the current DSASP baseline to evaluate performance [determining performance strategies] for the ancillary product with page 25, last paragraph for an aggregation with a 24-hour capacity obligation might rely on load curtailment assets to provide performance during the day and generation assets when sufficient load curtailment capability is not available to meet the aggregation's obligation. In another scenario [using different power conditions], if an aggregation is scheduled for four hours, the DCE may choose to meet its obligation by discharging storage devices for two hours and by load curtailment for the remaining two hours),

wherein the performance strategy comprises a power consumption target for the set of computing systems for each time interval in the set of time intervals (page 25, second paragraph for could potentially involve evaluation of DER-specific thresholds of existing offer parameters, such as minimum down time,22minimum run-time, response rate, and to introduce a new DER offer parameter, maximum commitments per day. The threshold for the minimum run-time for DER is the minimum time a resource will be committed by the

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Real-Time Commitment software. Response rate is the speed with which a resource can reach its upper operating limit within the minimum run-time),

wherein each power consumption target is equal to or greater than the minimum power threshold associated with each time interval (page 24, and figure 11 for having a second power consumption of daytime peak that is greater than the regular peak power interval threshold, and page 12, second paragraph for while activating DER to displace wholesale energy purchases during periods of high market prices [higher power usage threshold resulting in a time interval of higher prices] New York's LSEs submit approximately 3-5% of their day-ahead Load bids as price responsive, some of which is used for other purposes such as price hedging);

and providing instructions to the set of computing systems to perform one or more computational operations based on the performance strategy (page 23, Section A, second paragraph for ER are still valuable to the system, but perhaps less than a full 24 hour DER. In order to determine the varying degree of operational benefit that different DER can provide to the grid, the NYISO intends to develop options for service tiers that dispatchable [adjust for conditions based on load tiers] DER can provide to help the NYISO meet its daily load. The NYISO currently proposes three such tiers - full day service, on-peak service and daytime peak service with page 25, last paragraph for if an aggregation is scheduled for four hours, the DCE may choose to meet its obligation by discharging storage devices for two hours and by load curtailment for the remaining two hours. Importantly, the NYISO intends to establish performance obligations at the aggregation level, and not at individual resource level).

Regarding Claim 41, Iso discloses a system comprising: a set of computing systems (page 29, last paragraph for DER participating in the NYISO's Energy and Ancillary Services markets will require well-defined metering configurations as well as processes for calculating baseline load levels from which to measure performance. Establishing the baseline will require estimating a participant's load based on data from time periods with page 25, last two paragraphs for DER will be required to be available during all intervals in which they submit offers to provide wholesale service. If DER is derated or unavailable, it must report its unavailability to NYISO. Given the expected size and number of DER, the NYISO expects to modify its outage software to accommodate DER),

wherein the set of computing systems is configured to perform computational operations using power from a power grid (page 12, third paragraph for economic-based mechanism for DER that can inject at least 1 MW into the grid is to participate as a Behind-the-Meter Net Generation BTM:NG Resource.14This initiative is designed for large facilities that have on-site generation capability routinely serving a local, on-site Load the facility's Host Load, and that have excess generation capability after serving that Host Load);

a control system configured to: monitor a set of conditions (page 30, second paragraph for Behind-the-meter generators [BTM] and storage devices further complicate these calculations because operation of such generation or storage for local needs alters the baseline demand making it more difficult to assess DER performance. A policy for meter data and metering requirements will be critical to ensuring the integrity of the market. The ability for the NYISO to measure gross generation and gross native load at DER sites participating in NYISO markets will be necessary to ensure that the market is properly compensating DER for their contribution to system needs);

receive power option data based, at least in part, on a power option agreement, wherein the power option data specify (page 23, Section IX second paragraph for The NYISO recognizes that some DER will be unable to deliver capacity in all 24 hours due to its physical characteristics e.g., DER aggregations consisting of load curtailment assets that have a typical "9 to 5" load profile [load conditions based on time periods] These DER are still valuable to the system, but perhaps less than a full 24 hour DER. In order to determine the varying degree of operational benefit that different DER can provide to the grid, the NYISO intends to develop options for service [having power option tiers] tiers that dispatchable DER can provide to help the NYISO meet its daily load with page 28, last two paragraphs for reliability-based Demand Response programs SCR and EDRP are expected to continue, with some changes to better align these programs with the DER market rules. Any changes to the SCR program, including eligibility, obligations [agreements to provide power], or payments, will be addressed after the development of the dispatchable DER program concepts. If NYISO determines future changes to the SCR program are warranted, NYISO will work with stakeholders to develop an appropriate transition plan from the current rules):

(i) a set of minimum power thresholds, and (ii) a set of time intervals (page 24, and Figure 11 for having first minimum power threshold associated with the first time interval of hours 7-13 of the day that is known as peak demand with the minimum and maximum thresholds shown with the tan box approximately 17000-23000 MW respectively, with page 25, second paragraph for evaluation of DER-specific thresholds of existing offer parameters, such as minimum down time, minimum run-time, response rate, and to introduce a new DER offer parameter, maximum commitments per day. The threshold for the minimum run-time for DER is the minimum time a resource will be committed by the Real-Time Commitment software [using software to determine thresholds and minimize power down time intervals]),

wherein each minimum power threshold in the set of minimum power thresholds is associated with a time interval in the set of time intervals (page 24, and figure 11 for having a second power usage threshold of daytime peak from hours 14-20 as the second time interval [multiple intervals] showing a second minimum and maximum values shown by the orange box from 21000-23000 MW for the second time interval of 14-20 hours);

responsive to receiving the power option data (page 25 first paragraph for intends to apply the same obligation to dispatchable DER to offer in the real-time market. If more supply resources are required due to system condition changes in real-time [receiving a need for a different power option], NYISO operations can initiate its Supplemental Resource Evaluation (SRE) process. All NYISO capacity resources are eligible for selection and are required to respond to a SRE request in real-time regardless of whether they received an award/schedule in the DAM),

determine a performance strategy for the set of computing systems based on a combination of at least a portion of the power option data and at least one condition in the set of conditions (page 22, third paragraph for measure resource performance in the Energy market. The NYISO plans to draw on conclusions of that study for dispatchable DER relying on a baseline methodology to measure performance. DER participating in the Ancillary Services market will be measured by the current DSASP baseline to evaluate performance [determining performance strategies] for the ancillary product with page 25, last paragraph for an aggregation with a 24-hour capacity obligation might rely on load curtailment assets to provide performance during the day and generation assets when sufficient load curtailment capability is

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not available to meet the aggregation's obligation. In another scenario [using different power conditions], if an aggregation is scheduled for four hours, the DCE may choose to meet its obligation by discharging storage devices for two hours and by load curtailment for the remaining two hours),

wherein the performance strategy comprises a power consumption target for the set of computing systems for each time interval in the set of time intervals (page 25, second paragraph for could potentially involve evaluation of DER-specific thresholds of existing offer parameters, such as minimum down time,22minimum run-time, response rate, and to introduce a new DER offer parameter, maximum commitments per day. The threshold for the minimum run-time for DER is the minimum time a resource will be committed by the Real-Time Commitment software. Response rate is the speed with which a resource can reach its upper operating limit within the minimum run-time),

wherein each power consumption target is equal to or greater than the minimum power threshold associated with each time interval (page 24, and figure 11 for having a second power consumption of daytime peak that is greater than the regular peak power interval threshold, and page 12, second paragraph for while activating DER to displace wholesale energy purchases during periods of high market prices [higher power usage threshold resulting in a time interval of higher prices] New York's LSEs submit approximately 3-5% of their day-ahead Load bids as price responsive, some of which is used for other purposes such as price hedging);

and provide instructions to the set of computing systems to perform one or more computational operations based on the performance strategy (page 23, Section A, second paragraph for ER are still valuable to the system, but perhaps less than a full 24 hour DER. In order to determine the varying degree of operational benefit that different DER can provide to the grid, the NYISO intends to develop options for service tiers that dispatchable [adjust for conditions based on load tiers] DER can provide to help the NYISO meet its daily load. The NYISO currently proposes three such tiers - full day service, on-peak service and daytime peak service with page 25, last paragraph for if an aggregation is scheduled for four hours, the DCE may choose to meet its obligation by discharging storage devices for two hours and by load curtailment for the remaining two hours. Importantly, the NYISO intends to establish performance obligations at the aggregation level, and not at individual resource level).

Regarding Claim 42, Iso discloses the control system is configured to monitor the set of conditions comprising: a price of power from the power grid (page 12, second paragraph for Under existing market rules a LSE may choose to submit price-sensitive Day-Ahead load bids for some, or all, of the load it must procure. That is, a LSE may choose the Day-Ahead Market price [threshold price] at which it will serve its Load. If the Day-Ahead price exceeds the LSE's Price-Capped Load bid [making sure the power for the day is below the price capped load threshold] the LSE will then either reduce its Load or procure energy through another source. DER may participate in wholesale markets as a tool LSEs use to modulate load in response to wholesale price signals);

and a plurality of parameters associated with one or more computational operations to be performed at the set of computing systems (page 12 third paragraph for Another economic-based mechanism for DER that can inject at least 1 MW into the grid is to participate as a Behind-the-Meter Net Generation BTM:NG Resource. This initiative is designed for large facilities that have on-site generation capability routinely serving a local, on-site Load the facility's Host Load, and that have excess generation capability after serving that Host Load [using computations such as host load values]).

Regarding Claim 43, Iso discloses the control system is configured to: determine the performance strategy for the set of computing systems based on a combination of at least the portion option data (page 24, and top figure for having second power threshold of peak power window associated with the second time interval of hours 14-20 of the day that is greater than the peak threshold value with page 25 last paragraph for In another scenario, if an aggregation is scheduled for four hours, the DCE may choose to meet its obligation [power option agreements] by discharging storage devices for two hours and by load curtailment for the remaining two hours. Importantly, the NYISO intends to establish performance obligations [performance strategy] at the aggregation level, and not at individual resource level),

the price of power from the power grid, and the plurality of parameters associated with the one or more computational operations (page 15, last paragraph for DER operating in response to economic signals can work to shift grid-based electricity consumption to off-peak hours, creating the potential for greater stability in prices throughout the day by flattening the load. In this sense, the NYISO's vision for dispatchable DER integration aligns well with REV in that it offers the potential to engage or animate certain consumers).

Regarding Claim 44, Iso discloses the performance strategy further comprises: an order for the set of computing systems to follow when performing the one or more computational operations (page 25, second paragraph for the NYISO also plans to evaluate the feasibility of market software and NYISO system operators making commitment decisions for DCEAs. This could potentially involve evaluation of DER-specific thresholds of existing offer parameters, such as minimum down time,22minimum run-time, response rate, and to introduce a new DER offer parameter),

wherein the order is based on respective priorities associated with the one or more computational operations (page 25, second paragraph for threshold for the minimum run-time for DER is the minimum time a resource will be committed by the Real-Time Commitment software. Response rate is the speed with which a resource can reach its upper operating limit within the minimum run-time).

Regarding Claim 49, Iso discloses the control system is a remote master control system positioned remotely from the set of computing systems (page 4, second paragraph for his DER Roadmap is only the first step in building that grid of the future. We are committed to seamlessly transitioning from a primarily central station-based grid [remote master control]).

Regarding Claim 51, Iso discloses the control system is configured to receive the power option data while monitoring the set of conditions (page 21 second paragraph for required to have 6-second real-time telemetry. The NYISO's current meter data infrastructure supports PTID-level data, primarily collected through real-time telemetry for real-time operations and monitoring functions [means for monitoring and control], and after-the-fact uploads to support settlement. The integration of dispatchable DER into Capacity, Energy, and Ancillary Service markets is expected to follow a comparable model. DCEAs will be required to provide PTID-level i.e., aggregation level real-time telemetry data for operations and monitoring functions).

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Regarding Claim 53, Iso discloses the power option data specify: (i) a first minimum power threshold associated with a first time interval in the set of time intervals (page 24, and figure 11 for the first minimum power usage of low from 0-6 hours as the first minimum value of 16000 MW and transitioning to the first time interval of 7-13 hours and a peak hours minimum values or 17000 MW),

and (ii) a second minimum power threshold associated with a second time interval in the set of time intervals (page 24, and figure 11 for having a second power usage threshold of daytime peak from hours 14-20 as the second time interval showing a second minimum and maximum values shown by the orange box from 21000-23000 MW for the second time interval of 14-20 hours),

wherein the second time interval is subsequent to the first time interval (page 28, fourth bullet for valuate how load served by DER operating at the time of the system peak will be incorporated into load forecasts and LSE capacity obligations with page 12, second paragraph for LSEs would rely more heavily on wholesale energy purchases during periods of low prices while activating DER to displace wholesale energy purchases during periods of high market prices [knowing power option data to know when to go to second power level for peaks] New York's LSEs submit approximately 3-5% of their day-ahead Load bids as price responsive, some of which is used for other purposes such as price hedging).

Regarding Claim 55, Iso discloses a total duration of the set of time intervals corresponds to a twenty-four hour period (page 24, and figure 11 for showing three sets of time intervals in a 24 hour time period for minimum, peak, and daytime peak loads).

Regarding Claim 57, Iso discloses a method comprising: monitoring, by a computing system, a set of conditions (page 29, last paragraph for DER participating in the NYISO's Energy and Ancillary Services markets will require well-defined metering configurations as well as processes for calculating baseline load levels from which to measure performance. Establishing the baseline will require estimating a participant's load based on data from time periods with page 25, last two paragraphs for DER will be required to be available during all intervals in which they submit offers to provide wholesale service. If DER is derated or unavailable, it must report its unavailability to NYISO. Given the expected size and number of DER, the NYISO expects to modify its outage software to accommodate DER);

receiving, at the computing system (page 21 second paragraph for required to have 6-second real-time telemetry. The NYISO's current meter data infrastructure supports PTID-level data, primarily collected through real-time telemetry for real-time operations and monitoring functions [means for monitoring and control], and after-the-fact uploads to support settlement. The integration of dispatchable DER into Capacity, Energy, and Ancillary Service markets is expected to follow a comparable model. DCEAs will be required to provide PTID-level i.e., aggregation level real-time telemetry data for operations and monitoring functions),

power option data based, at least in part, on a power option agreement, wherein the power option data specify (page 25 first paragraph for intends to apply the same obligation to dispatchable DER to offer in the real-time market. If more supply resources are required due to system condition changes in real-time [receiving a need for a different power option], NYISO operations can initiate its Supplemental Resource Evaluation (SRE) process. All NYISO capacity resources are eligible for selection and are required to respond to a SRE request in real-time regardless of whether they received an award/schedule in the DAM):

(i) a set of minimum power thresholds, and (ii) a set of time intervals (page 24, and Figure 11 for having first minimum power threshold associated with the first time interval of hours 7-13 of the day that is known as peak demand with the minimum and maximum thresholds shown with the tan box approximately 17000-23000 MW respectively, with page 25, second paragraph for evaluation of DER-specific thresholds of existing offer parameters, such as minimum down time, minimum run-time, response rate, and to introduce a new DER offer parameter, maximum commitments per day. The threshold for the minimum run-time for DER is the minimum time a resource will be committed by the Real-Time Commitment software [using software to determine thresholds and minimize power down time intervals]),

wherein each minimum power threshold in the set of minimum power thresholds is associated with a time interval in the set of time intervals (page 24, and figure 11 for having a second power usage threshold of daytime peak from hours 14-20 as the second time interval [multiple intervals] showing a second minimum and maximum values shown by the orange box from 21000-23000 MW for the second time interval of 14-20 hours);

responsive to receiving the power option data, determining a performance strategy for a set of computing systems based on a combination of at least a portion of the power option data and at least one condition in the set of conditions (page 22, third paragraph for measure resource performance in the Energy market. The NYISO plans to draw on conclusions of that study for dispatchable DER relying on a baseline methodology to measure performance. DER participating in the Ancillary Services market will be measured by the current DSASP baseline to evaluate performance [determining performance strategies] for the ancillary product with page 25, last paragraph for an aggregation with a 24-hour capacity obligation might rely on load curtailment assets to provide performance during the day and generation assets when sufficient load curtailment capability is not available to meet the aggregation's obligation. In another scenario [using different power conditions], if an aggregation is scheduled for four hours, the DCE may choose to meet its obligation by discharging storage devices for two hours and by load curtailment for the remaining two hours),

wherein the performance strategy comprises a power consumption target for the set of computing systems for each time interval in the set of time intervals (page 25, second paragraph for could potentially involve evaluation of DER-specific thresholds of existing offer parameters, such as minimum down time,22minimum run-time, response rate, and to introduce a new DER offer parameter, maximum commitments per day. The threshold for the minimum run-time for DER is the minimum time a resource will be committed by the Real-Time Commitment software. Response rate is the speed with which a resource can reach its upper operating limit within the minimum run-time),

wherein each power consumption target is equal to or greater than the minimum power threshold associated with each time interval (page 24, and figure 11 for having a second power consumption of daytime peak that is greater than the regular peak power interval threshold, and page 12, second paragraph for while activating DER to displace wholesale energy purchases during periods of high market prices [higher power usage threshold resulting in a time interval of higher prices] New York's LSEs submit approximately 3-5% of their day-ahead Load bids as price responsive, some of which is used for other purposes such as price hedging);

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and providing instructions to the set of computing systems to perform one or more computational operations based on the performance strategy (page 23, Section A, second paragraph for ER are still valuable to the system, but perhaps less than a full 24 hour DER. In order to determine the varying degree of operational benefit that different DER can provide to the grid, the NYISO intends to develop options for service tiers that dispatchable [adjust for conditions based on load tiers] DER can provide to help the NYISO meet its daily load. The NYISO currently proposes three such tiers - full day service, on-peak service and daytime peak service with page 25, last paragraph for if an aggregation is scheduled for four hours, the DCE may choose to meet its obligation by discharging storage devices for two hours and by load curtailment for the remaining two hours. Importantly, the NYISO intends to establish performance obligations at the aggregation level, and not at individual resource level).

Regarding Claim 60, Iso discloses a non-transitory computer readable medium having stored therein instructions executable by one or more processors to cause a computing system to perform functions comprising (page 29, last paragraph for DER participating in the NYISO's Energy and Ancillary Services markets will require well-defined metering configurations as well as processes for calculating baseline load levels from which to measure performance. Establishing the baseline will require estimating a participant's load based on data from time periods with page 25, last two paragraphs for DER will be required to be available during all intervals in which they submit offers to provide wholesale service. If DER is derated or unavailable, it must report its unavailability to NYISO. Given the expected size and number of DER, the NYISO expects to modify its outage software to accommodate DER):

monitoring a set of conditions (page 21 second paragraph for required to have 6-second real-time telemetry. The NYISO's current meter data infrastructure supports PTID-level data, primarily collected through real-time telemetry for real-time operations and monitoring functions [means for monitoring and control], and after-the-fact uploads to support settlement. The integration of dispatchable DER into Capacity, Energy, and Ancillary Service markets is expected to follow a comparable model. DCEAs will be required to provide PTID-level i.e., aggregation level real-time telemetry data for operations and monitoring functions);

receiving power option data based, at least in part, on a power option agreement, wherein the power option data specify (page 23, Section IX second paragraph for The NYISO recognizes that some DER will be unable to deliver capacity in all 24 hours due to its physical characteristics e.g., DER aggregations consisting of load curtailment assets that have a typical "9 to 5" load profile [load conditions based on time periods] These DER are still valuable to the system, but perhaps less than a full 24 hour DER. In order to determine the varying degree of operational benefit that different DER can provide to the grid, the NYISO intends to develop options for service [having power option tiers] tiers that dispatchable DER can provide to help the NYISO meet its daily load with page 28, last two paragraphs for reliability-based Demand Response programs SCR and EDRP are expected to continue, with some changes to better align these programs with the DER market rules. Any changes to the SCR program, including eligibility, obligations [agreements to provide power], or payments, will be addressed after the development of the dispatchable DER program concepts. If NYISO determines future changes to the SCR program are warranted, NYISO will work with stakeholders to develop an appropriate transition plan from the current rules):

(i) a set of minimum power thresholds, and (ii) a set of time intervals (page 24, and Figure 11 for having first minimum power threshold associated with the first time interval of hours 7-13 of the day that is known as peak demand with the minimum and maximum thresholds shown with the tan box approximately 17000-23000 MW respectively, with page 25, second paragraph for evaluation of DER-specific thresholds of existing offer parameters, such as minimum down time, minimum run-time, response rate, and to introduce a new DER offer parameter, maximum commitments per day. The threshold for the minimum run-time for DER is the minimum time a resource will be committed by the Real-Time Commitment software [using software to determine thresholds and minimize power down time intervals]),

wherein each minimum power threshold in the set of minimum power thresholds is associated with a time interval in the set of time intervals (page 24, and figure 11 for having a second power usage threshold of daytime peak from hours 14-20 as the second time interval [multiple intervals] showing a second minimum and maximum values shown by the orange box from 21000-23000 MW for the second time interval of 14-20 hours);

responsive to receiving the power option data (page 25 first paragraph for intends to apply the same obligation to dispatchable DER to offer in the real-time market. If more supply resources are required due to system condition changes in real-time [receiving a need for a different power option], NYISO operations can initiate its Supplemental Resource Evaluation (SRE) process. All NYISO capacity resources are eligible for selection and are required to respond to a SRE request in real-time regardless of whether they received an award/schedule in the DAM),

determining a performance strategy for a set of computing systems based on a combination of at least a portion of the power option data and at least one condition in the set of conditions (page 22, third paragraph for measure resource performance in the Energy market. The NYISO plans to draw on conclusions of that study for dispatchable DER relying on a baseline methodology to measure performance. DER participating in the Ancillary Services market will be measured by the current DSASP baseline to evaluate performance [determining performance strategies] for the ancillary product with page 25, last paragraph for an aggregation with a 24-hour capacity obligation might rely on load curtailment assets to provide performance during the day and generation assets when sufficient load curtailment capability is not available to meet the aggregation's obligation. In another scenario [using different power conditions], if an aggregation is scheduled for four hours, the DCE may choose to meet its obligation by discharging storage devices for two hours and by load curtailment for the remaining two hours),

wherein the performance strategy comprises a power consumption target for the set of computing systems for each time interval in the set of time intervals (page 25, second paragraph for could potentially involve evaluation of DER-specific thresholds of existing offer parameters, such as minimum down time,22minimum run-time, response rate, and to introduce a new DER offer parameter, maximum commitments per day. The threshold for the minimum run-time for DER is the minimum time a resource will be committed by the Real-Time Commitment software. Response rate is the speed with which a resource can reach its upper operating limit within the minimum run-time),

wherein each power consumption target is equal to or greater than the minimum power threshold associated with each time interval (page 24, and figure 11 for having a second power consumption of daytime peak that is greater than the regular peak power interval threshold,

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and page 12, second paragraph for while activating DER to displace wholesale energy purchases during periods of high market prices [higher power usage threshold resulting in a time interval of higher prices] New York's LSEs submit approximately 3-5% of their day-ahead Load bids as price responsive, some of which is used for other purposes such as price hedging);

and providing instructions to the set of computing systems to perform one or more computational operations based on the performance strategy (page 23, Section A, second paragraph for ER are still valuable to the system, but perhaps less than a full 24 hour DER. In order to determine the varying degree of operational benefit that different DER can provide to the grid, the NYISO intends to develop options for service tiers that dispatchable [adjust for conditions based on load tiers] DER can provide to help the NYISO meet its daily load. The NYISO currently proposes three such tiers - full day service, on-peak service and daytime peak service with page 25, last paragraph for if an aggregation is scheduled for four hours, the DCE may choose to meet its obligation by discharging storage devices for two hours and by load curtailment for the remaining two hours. Importantly, the NYISO intends to establish performance obligations at the aggregation level, and not at individual resource level).

Claims 10, 11, 30, 32, 50, and 52 lack an inventive step under PCT Article 33(3) as being obvious over Iso in view of Causam Energy, Inc. (hereinafter Causam).

Regarding Claim 10, Iso discloses the power system as shown above. Iso fails to explicitly disclose the control system is a mobile computing device.

Causam has management of physical and financial settlement for participation of active grid elements in Supply and/or curtailment of power (abstract) and teaches the control system is a mobile computing device (paragraph 91 for messaging to mobile device and/or remote computer devices or processors relating to activation or deactivation of any grid elements registered and associated with communications through that mobile device, and for settlement information to be including with the messaging of grid element participation within the electric power grid).

It would have been obvious to one of ordinary skill in the art at the time of the invention to modify Iso with the teaching of Causam for the purpose of messaging of grid element participation within the electric power grid (Causam, paragraph 91).

Regarding Claim 11, Iso discloses the power system as shown above. Iso fails to explicitly disclose the control system is further configured to: provide a request to a qualified scheduling entity (QSE) to determine the power option agreement; and receive first power option data in response to providing the request to the QSE.

Causam has management of physical and financial settlement for participation of active grid elements in Supply and/or curtailment of power (abstract) and teaches the control system is further configured to: provide a request to a qualified scheduling entity (QSE) to determine the power option agreement (paragraph 84 for he grid element Supplying power (generating power for Supply to the electric power grid) provides its output through a TDSP smart meter, collecting near-real-time information, telemetry, and metrology through the reading of ANSI or other approved C12.19 tables, communicated to qualified scheduling entity (QSE) and/or energy registration or trader that presents the aggregated generation);

and receive first power option data in response to providing the request to the QSE (paragraph 84 for to call immediately or in near-real-time to generate Supply at market prices and to introduce it to the feeder associated with an electrical bus or substation of an electric power grid. The coordinator communicates with the market for obtaining market price at the time of Supply, and with the market participant(s) or utility, NERC/FERC, preferably with bi-directional communication. The market is always providing transmission information, price per kilowatt packet, modeling, forecasting, clearing, schedules, and combinations in real-time or near-real-time).

It would have been obvious to one of ordinary skill in the art at the time of the invention to modify Iso with the teaching of Causam for the purpose of collecting near-real-time information (Causam, paragraph 84).

Regarding Claim 30, Iso discloses the power system as shown above. Iso fails to explicitly disclose the control system is a mobile computing device.

Causam has management of physical and financial settlement for participation of active grid elements in Supply and/or curtailment of power (abstract) and teaches the control system is a mobile computing device (paragraph 91 for messaging to mobile device and/or remote computer devices or processors relating to activation or deactivation of any grid elements registered and associated with communications through that mobile device, and for settlement information to be including with the messaging of grid element participation within the electric power grid).

It would have been obvious to one of ordinary skill in the art at the time of the invention to modify Iso with the teaching of Causam for the purpose of messaging of grid element participation within the electric power grid (Causam, paragraph 91).

Regarding Claim 32, Iso discloses the power system as shown above. Iso fails to explicitly disclose the control system is further configured to: provide a request to a qualified scheduling entity (QSE) to determine a power option agreement having power option data; and receive power option data in response to providing the request to the QSE.

Causam has management of physical and financial settlement for participation of active grid elements in Supply and/or curtailment of power (abstract) and teaches the control system is further configured to: provide a request to a qualified scheduling entity (QSE) to determine the power option agreement (paragraph 84 for he grid element Supplying power (generating power for Supply to the electric power grid) provides its output through a TDSP smart meter, collecting near-real-time information, telemetry, and metrology through the reading of ANSI or other approved C12.19 tables, communicated to qualified scheduling entity (QSE) and/or energy registration or trader that presents the aggregated generation);

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and receive first power option data in response to providing the request to the QSE (paragraph 84 for to call immediately or in near-real-time to generate Supply at market prices and to introduce it to the feeder associated with an electrical bus or substation of an electric power grid. The coordinator communicates with the market for obtaining market price at the time of Supply, and with the market participant(s) or utility, NERC/FERC, preferably with bi-directional communication. The market is always providing transmission information, price per kilowatt packet, modeling, forecasting, clearing, schedules, and combinations in real-time or near-real-time).

It would have been obvious to one of ordinary skill in the art at the time of the invention to modify Iso with the teaching of Causam for the purpose of collecting near-real-time information (Causam, paragraph 84).

Regarding Claim 50, Iso discloses the power system as shown above. Iso fails to explicitly disclose the control system is a mobile computing device.

Causam has management of physical and financial settlement for participation of active grid elements in Supply and/or curtailment of power (abstract) and teaches the control system is a mobile computing device (paragraph 91 for messaging to mobile device and/or remote computer devices or processors relating to activation or deactivation of any grid elements registered and associated with communications through that mobile device, and for settlement information to be including with the messaging of grid element participation within the electric power grid).

It would have been obvious to one of ordinary skill in the art at the time of the invention to modify Iso-with the teaching of Causam for the purpose of messaging of grid element participation within the electric power grid (Causam, paragraph 91).

Regarding Claim 52, Iso discloses the power system as shown above. Iso fails to explicitly disclose the control system is further configured to: provide a request to a qualified scheduling entity (QSE) to determine the power option agreement; and receive power option data in response to providing the request to the QSE.

Causam has management of physical and financial settlement for participation of active grid elements in Supply and/or curtailment of power (abstract) and teaches the control system is further configured to: provide a request to a qualified scheduling entity (QSE) to determine the power option agreement (paragraph 84 for he grid element Supplying power (generating power for Supply to the electric power grid) provides its output through a TDSP smart meter, collecting near-real-time information, telemetry, and metrology through the reading of ANSI or other approved C12.19 tables, communicated to qualified scheduling entity (QSE) and/or energy registration or trader that presents the aggregated generation);

and receive first power option data in response to providing the request to the QSE (paragraph 84 for to call immediately or in near-real-time to generate Supply at market prices and to introduce it to the feeder associated with an electrical bus or substation of an electric power grid. The coordinator communicates with the market for obtaining market price at the time of Supply, and with the market participant(s) or utility, NERC/FERC, preferably with bi-directional communication. The market is always providing transmission information, price per kilowatt packet, modeling, forecasting, clearing, schedules, and combinations in real-time or near-real-time).

It would have been obvious to one of ordinary skill in the art at the time of the invention to modify Iso with the teaching of Causam for the purpose of collecting near-real-time information (Causam, paragraph 84).

Claims 38 and 58 lack an inventive step under PCT Article 33(3) as being obvious over Iso in view of Advanced Microgrid Solutions, Inc. (hereinafter Advanced).

Regarding Claim 38, Iso discloses the power system as shown above. Iso fails to explicitly disclose determining the performance strategy for the set of computing systems comprises: identifying information about the set of computing systems; and determining the performance strategy to further comprise instructions for at least a subset of the set of computing systems to operate at an increased frequency based on a combination of at least the portion of the power option data and the information about the set of computing systems.

Advanced has control of a fleet of on-site energy assets (abstract) and teaches determining the performance strategy for the set of computing systems comprises: identifying information about the set of computing systems (col 31, lines 5-20 for As shown in block 1020 of FIG. 10, an apparatus, such as apparatus 20 embodied by the operational platform 300 and/or apparatus 400, may be configured to provide the site-level schedules to each of the plurality of affected gateway apparatuses for facilitating control of on-site);

and determining the performance strategy to further comprise instructions for at least a subset of the set of computing systems to operate at an increased frequency based on a combination of at least the portion of the power option data and the information about the set of computing systems (col 31, lines 10-30 for the multi-site portfolio optimization. The system may be configured to perform site-level optimization on each of a plurality of sites. That is, for example, on an hourly or more frequent basis [increasing frequency], a portfolio optimization algorithm may run, generating optimal dispatch instructions and sending DCR schedules to controllable asset systems each time it runs. The algorithm may utilize forecast data for each site, and expected asset availability based on the forecast, site outage data, reflecting most recent status information from gateway components)

It would have been obvious to one of ordinary skill in the art at the time of the invention to modify Iso with the teaching of Advanced for the purpose of ensuring the system is prepared to meet the maximum dispatch request from, for example, the utility system/company (Advanced, col 31, lines 25-40).

Regarding Claim 58, Iso discloses the power system as shown above. Iso fails to explicitly disclose determining the performance strategy for the set of computing systems comprises: identifying information about the set of computing systems; and determining the performance strategy to further comprise instructions for at least a subset of the set of computing systems to operate at an increased frequency based on a combination of at least the portion of the power option data and the information about the set of computing systems.

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Advanced has control of a fleet of on-site energy assets (abstract) and teaches determining the performance strategy for the set of computing systems comprises: identifying information about the set of computing systems (col 31, lines 5-20 for As shown in block 1020 of FIG. 10, an apparatus, such as apparatus 20 embodied by the operational platform 300 and/or apparatus 400, may be configured to provide the site-level schedules to each of the plurality of affected gateway apparatuses for facilitating control of on-site);

and determining the performance strategy to further comprise instructions for at least a subset of the set of computing systems to operate at an increased frequency based on a combination of at least the portion of the power option data and the information about the set of computing systems (col 31, lines 10-30 for the multi-site portfolio optimization. The system may be configured to perform site-level optimization on each of a plurality of sites. That is, for example, on an hourly or more frequent basis [increasing frequency], a portfolio optimization algorithm may run, generating optimal dispatch instructions and sending DCR schedules to controllable asset systems each time it runs. The algorithm may utilize forecast data for each site, and expected asset availability based on the forecast, site outage data, reflecting most recent status information from gateway components).

It would have been obvious to one of ordinary skill in the art at the time of the invention to modify Iso with the teaching of Advanced for the purpose of ensuring the system is prepared to meet the maximum dispatch request from, for example, the utility system/company (Advanced, col 31, lines 25-40).

Claims 5, 6, 12, 13, 16-18, 24-28, 34, 36, 39, 45-48, 54, 56, and 59 meet the criteria set out in PCT Article 33(2)-(3), because the prior art does not teach or fairly suggest:

Regarding claim 5, the prior art of record, individually or in combination, does not teach or fairly suggest the control system is configured to: determine the first control instructions for the set of computing systems based on a combination of at least the portion of the first power option data, the price of power from the power grid, and the plurality of parameters associated with the one or more computational operations.

Claim 6 depends from claim 5, and therefore meets the criteria set out in PCT Article 33(2)-(3) for at least the same reasons as claim 5.

Iso discloses a system comprising: a set of computing systems (page 29, last paragraph for DER participating in the NYISO's Energy and Ancillary Services markets will require well-defined metering configurations as well as processes for calculating baseline load levels from which to measure performance. Establishing the baseline will require estimating a participant's load based on data from time periods with page 25, last two paragraphs for DER will be required to be available during all intervals in which they submit offers to provide wholesale service. If DER is derated or unavailable, it must report its unavailability to NYISO. Given the expected size and number of DER, the NYISO expects to modify its outage software to accommodate DER). However, Iso. fail to disclose said determine the first control instructions for the set of computing systems based on a combination of at least the portion of the first power option data.

Regarding claim 12, the prior art of record, individually or in combination, does not teach or fairly suggest the set of conditions monitored by the control system further comprises: a price of power from the power grid; and a global mining hash rate and a price for a cryptocurrency; and wherein the control system is configured to: determine the second control instructions for the set of computing systems based on a combination of at the portion of the second power option data, the price of power from the power grid, and the global mining hash rate and the price for the cryptocurrency, wherein the second control instructions specify for at least a subset of the set of computing systems to perform mining operations for the cryptocurrency when the price of power from the power grid is equal to or less than a revenue obtained by performing the mining operations for the cryptocurrency.

Iso discloses a system comprising: a set of computing systems (page 29, last paragraph for DER participating in the NYISO's Energy and Ancillary Services markets will require well-defined metering configurations as well as processes for calculating baseline load levels from which to measure performance. Establishing the baseline will require estimating a participant's load based on data from time periods with page 25, last two paragraphs for DER will be required to be available during all intervals in which they submit offers to provide wholesale service. If DER is derated or unavailable, it must report its unavailability to NYISO. Given the expected size and number of DER, the NYISO expects to modify its outage software to accommodate DER). However, Iso. fail to disclose said the second control instructions specify for at least a subset of the set of computing systems to perform mining operations for the cryptocurrency when the price of power from the power grid is equal to or less than a revenue obtained by performing the mining operations for the cryptocurrency.

Regarding claim 13, the prior art of record, individually or in combination, does not teach or fairly suggest the control system is further configured to: receive the second power option data during the first time interval such that the second time interval overlaps the first time interval.

Iso discloses a system comprising: a set of computing systems (page 29, last paragraph for DER participating in the NYISO's Energy and Ancillary Services markets will require well-defined metering configurations as well as processes for calculating baseline load levels from which to measure performance. Establishing the baseline will require estimating a participant's load based on data from time periods with page 25, last two paragraphs for DER will be required to be available during all intervals in which they submit offers to provide wholesale service. If DER is derated or unavailable, it must report its unavailability to NYISO. Given the expected size and number of DER, the NYISO expects to modify its outage software to accommodate DER). However, Iso. fail to disclose said receive the second power option data during the first time interval such that the second time interval overlaps the first time interval.

Regarding claim 16, the prior art of record, individually or in combination, does not teach or fairly suggest providing first control instructions for the set of computing systems based on the combination of at least the portion of the first power option data and at least one condition of the set of conditions comprises: providing first control instructions based on a weighted combination of the first power option data, the price of power from the power grid, the plurality of parameters associated with the set of computational operations, and the plurality of parameters associated with the set of computing systems.

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Claims 17 and 18 depend from claim 16, and therefore meet the criteria set out in PCT Article 33(2)-(3) for at least the same reasons as claim 16.

Iso discloses a system comprising: a set of computing systems (page 29, last paragraph for DER participating in the NYISO's Energy and Ancillary Services markets will require well-defined metering configurations as well as processes for calculating baseline load levels from which to measure performance. Establishing the baseline will require estimating a participant's load based on data from time periods with page 25, last two paragraphs for DER will be required to be available during all intervals in which they submit offers to provide wholesale service. If DER is derated or unavailable, it must report its unavailability to NYISO. Given the expected size and number of DER, the NYISO expects to modify its outage software to accommodate DER). However, Iso. fail to disclose said the plurality of parameters associated with the set of computational operations, and the plurality of parameters associated with the set of computing systems.

Regarding claim 24, the prior art of record, individually or in combination, does not teach or fairly suggest the performance strategy further comprises: an order for the set of computing systems to follow when performing the one or more computational operations, wherein the order is based on respective priorities associated with the one or more computational operations.

Claim 25 depends from claim 24, and therefore meets the criteria set out in PCT Article 33(2)-(3) for at least the same reasons as claim 24.

Iso discloses a system comprising: a set of computing systems (page 29, last paragraph for DER participating in the NYISO's Energy and Ancillary Services markets will require well-defined metering configurations as well as processes for calculating baseline load levels from which to measure performance. Establishing the baseline will require estimating a participant's load based on data from time periods with page 25, last two paragraphs for DER will be required to be available during all intervals in which they submit offers to provide wholesale service. If DER is derated or unavailable, it must report its unavailability to NYISO. Given the expected size and number of DER, the NYISO expects to modify its outage software to accommodate DER). However, Iso. fail to disclose said an order for the set of computing systems to follow when performing the one or more computational operations, wherein the order is based on respective priorities associated with the one or more computational operations.

Regarding claim 26, the prior art of record, individually or in combination, does not teach or fairly suggest the control system is further configured to: receive subsequent power option data, wherein the subsequent power option data specify to decrease one or more minimum power thresholds of the set of minimum power thresholds.

Claims 27 and 28 depend from claim 26, and therefore meet the criteria set out in PCT Article 33(2)-(3) for at least the same reasons as claim 26.

Iso discloses a system comprising: a set of computing systems (page 29, last paragraph for DER participating in the NYISO's Energy and Ancillary Services markets will require well-defined metering configurations as well as processes for calculating baseline load levels from which to measure performance. Establishing the baseline will require estimating a participant's load based on data from time periods with page 25, last two paragraphs for DER will be required to be available during all intervals in which they submit offers to provide wholesale service. If DER is derated or unavailable, it must report its unavailability to NYISO. Given the expected size and number of DER, the NYISO expects to modify its outage software to accommodate DER). However, Iso. fail to disclose said the control system is further configured to: receive subsequent power option data, wherein the subsequent power option data specify to decrease one or more minimum power thresholds of the set of minimum power thresholds.

Regarding claim 34, the prior art of record, individually or in combination, does not teach or fairly suggest the control system is configured to: determine the performance strategy for the set of computing systems such that the performance strategy comprises: a first power consumption target for the set of computing systems for the first time interval, wherein the first power consumption target is equal to or greater than the first minimum power threshold; and a second power consumption target for the set of computing systems for the second time interval, wherein the second power consumption target is equal to or greater than the second minimum power threshold.

Iso discloses a system comprising: a set of computing systems (page 29, last paragraph for DER participating in the NYISO's Energy and Ancillary Services markets will require well-defined metering configurations as well as processes for calculating baseline load levels from which to measure performance. Establishing the baseline will require estimating a participant's load based on data from time periods with page 25, last two paragraphs for DER will be required to be available during all intervals in which they submit offers to provide wholesale service. If DER is derated or unavailable, it must report its unavailability to NYISO. Given the expected size and number of DER, the NYISO expects to modify its outage software to accommodate DER). However, Iso. fail to disclose said second power consumption target for the set of computing systems for the second time interval, wherein the second power consumption target is equal to or greater than the second minimum power threshold.

Regarding claim 36, the prior art of record, individually or in combination, does not teach or fairly suggest the set of conditions monitored by the control system further comprise: a price of power from a power grid; and a global mining hash rate and a price for a cryptocurrency; and wherein the control system is configured to: determine the performance strategy for the set of computing systems based on a combination of at the portion of the power option data, the price of power from the power grid, the global mining hash rate and the price for the cryptocurrency, wherein the performance strategy specifies for at least a subset of the set of computing systems to perform mining operations for the cryptocurrency when the price of power from the power grid is equal to or less than a revenue obtained by performing the mining operations for the cryptocurrency.

Iso discloses a system comprising: a set of computing systems (page 29, last paragraph for DER participating in the NYISO's Energy and Ancillary Services markets will require well-defined metering configurations as well as processes for calculating baseline load levels from which to measure performance. Establishing the baseline will require estimating a participant's load based on data from time periods with page 25, last two paragraphs for DER will be required to be available during all intervals in which they submit offers to provide wholesale service. If DER is derated or unavailable, it must report its unavailability to NYISO. Given the expected size and number of DER, the

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NYISO expects to modify its outage software to accommodate DER). However, Iso. fail to disclose said the performance strategy specifies for at least a subset of the set of computing systems to perform mining operations for the cryptocurrency when the price of power from the power grid is equal to or less than a revenue obtained by performing the mining operations for the cryptocurrency.

Regarding claim 39, the prior art of record, individually or in combination, does not teach or fairly suggest receiving subsequent power option data, wherein the subsequent power option data specify to decrease one or more minimum power thresholds of the set of minimum power thresholds; responsive to receiving the subsequent power option data, modifying the performance strategy for the set of computing systems based on a combination of at least the portion of the subsequent power option data and at least one condition in the set of conditions, wherein the modified performance strategy comprises one or more reduced power consumption targets for the set of computing systems; and providing instructions to the set of computing systems to perform the one or more computational operations based on the modified performance strategy.

Iso discloses a system comprising: a set of computing systems (page 29, last paragraph for DER participating in the NYISO's Energy and Ancillary Services markets will require well-defined metering configurations as well as processes for calculating baseline load levels from which to measure performance. Establishing the baseline will require estimating a participant's load based on data from time periods with page 25, last two paragraphs for DER will be required to be available during all intervals in which they submit offers to provide wholesale service. If DER is derated or unavailable, it must report its unavailability to NYISO. Given the expected size and number of DER, the NYISO expects to modify its outage software to accommodate DER). However, Iso. fail to disclose said providing instructions to the set of computing systems to perform the one or more computational operations based on the modified performance strategy.

Regarding claim 45, the prior art of record, individually or in combination, does not teach or fairly suggest the performance strategy further comprises: at least one power consumption target that is greater than a minimum power threshold when the price of power from the power grid is below a threshold price during the time interval associated with the minimum power threshold.

Iso discloses a system comprising: a set of computing systems (page 29, last paragraph for DER participating in the NYISO's Energy and Ancillary Services markets will require well-defined metering configurations as well as processes for calculating baseline load levels from which to measure performance. Establishing the baseline will require estimating a participant's load based on data from time periods with page 25, last two paragraphs for DER will be required to be available during all intervals in which they submit offers to provide wholesale service. If DER is derated or unavailable, it must report its unavailability to NYISO. Given the expected size and number of DER, the NYISO expects to modify its outage software to accommodate DER). However, Iso. fail to disclose said at least one power consumption target that is greater than a minimum power threshold when the price of power from the power grid is below a threshold price during the time interval associated with the minimum power threshold.

Regarding claim 46, the prior art of record, individually or in combination, does not teach or fairly suggest the control system is further configured to: receive subsequent power option data based, at least in part, on the power option agreement, wherein the subsequent power option data specify to decrease one or more minimum power thresholds of the set of minimum power thresholds.

Claims 47 and 48 depend from claim 46, and therefore meet the criteria set out in PCT Article 33(2)-(3) for at least the same reasons as claim 46.

Iso discloses a system comprising: a set of computing systems (page 29, last paragraph for DER participating in the NYISO's Energy and Ancillary Services markets will require well-defined metering configurations as well as processes for calculating baseline load levels from which to measure performance. Establishing the baseline will require estimating a participant's load based on data from time periods with page 25, last two paragraphs for DER will be required to be available during all intervals in which they submit offers to provide wholesale service. If DER is derated or unavailable, it must report its unavailability to NYISO. Given the expected size and number of DER, the NYISO expects to modify its outage software to accommodate DER). However, Iso. fail to disclose said wherein the subsequent power option data specify to decrease one or more minimum power thresholds of the set of minimum power thresholds.

Regarding claim 54, the prior art of record, individually or in combination, does not teach or fairly suggest the control system is configured to: determine the performance strategy for the set of computing systems such that the performance strategy comprises: a first power consumption target for the set of computing systems for the first time interval, wherein the first power consumption target is equal to or greater than the first minimum power threshold; and a second power consumption target for the set of computing systems for the second time interval, wherein the second power consumption target is equal to or greater than the second minimum power threshold.

Iso discloses a system comprising: a set of computing systems (page 29, last paragraph for DER participating in the NYISO's Energy and Ancillary Services markets will require well-defined metering configurations as well as processes for calculating baseline load levels from which to measure performance. Establishing the baseline will require estimating a participant's load based on data from time periods with page 25, last two paragraphs for DER will be required to be available during all intervals in which they submit offers to provide wholesale service. If DER is derated or unavailable, it must report its unavailability to NYISO. Given the expected size and number of DER, the NYISO expects to modify its outage software to accommodate DER). However, Iso. fail to disclose said a second power consumption target for the set of computing systems for the second time interval, wherein the second power consumption target is equal to or greater than the second minimum power threshold.

Regarding claim 56, the prior art of record, individually or in combination, does not teach or fairly suggest the set of conditions monitored by the control system further comprise: a price of power from the power grid; and a global mining hash rate and a price for a cryptocurrency; and wherein the control system is configured to: determine the performance strategy for the set of computing systems based on a combination of at the portion of the power option data, the price of power from the power grid, the global mining hash rate and the price for the cryptocurrency, wherein the performance strategy specifies for at least a subset of the set of computing systems to perform mining operations for the cryptocurrency when the price of power from the power grid is equal to or less than a revenue obtained by performing the mining operations for the cryptocurrency.

WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/US2020/057686

Supplemental Box

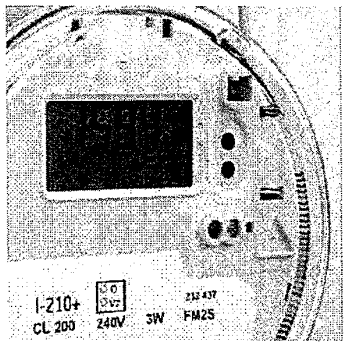
In case the space in any of the preceding boxes is not sufficient.
Continuation of:

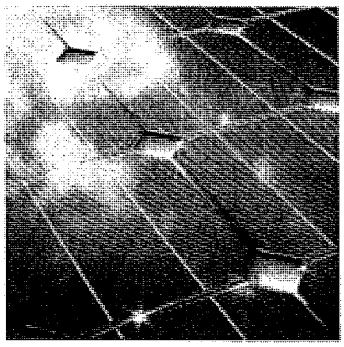
Iso discloses a system comprising: a set of computing systems (page 29, last paragraph for DER participating in the NYISO's Energy and Ancillary Services markets will require well-defined metering configurations as well as processes for calculating baseline load levels from which to measure performance. Establishing the baseline will require estimating a participant's load based on data from time periods with page 25, last two paragraphs for DER will be required to be available during all intervals in which they submit offers to provide wholesale service. If DER is derated or unavailable, it must report its unavailability to NYISO. Given the expected size and number of DER, the NYISO expects to modify its outage software to accommodate DER). However, Iso. fail to disclose said the performance strategy specifies for at least a subset of the set of computing systems to perform mining operations for the cryptocurrency when the price of power from the power grid is equal to or less than a revenue obtained by performing the mining operations for the cryptocurrency.

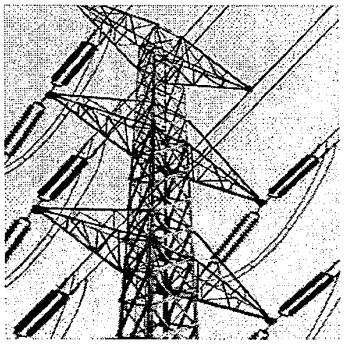
Regarding claim 59, the prior art of record, individually or in combination, does not teach or fairly suggest receiving subsequent power option data based, at least in part, on the power option agreement, wherein the subsequent power option data specify to decrease one or more minimum power thresholds of the set of minimum power thresholds; responsive to receiving the subsequent power option data, modifying the performance strategy for the set of computing systems based on a combination of at least the portion of the subsequent power option data and at least one condition in the set of conditions, wherein the modified performance strategy comprises one or more reduced power consumption targets for the set of computing systems; and providing instructions to the set of computing systems to perform the one or more computational operations based on the modified performance strategy.

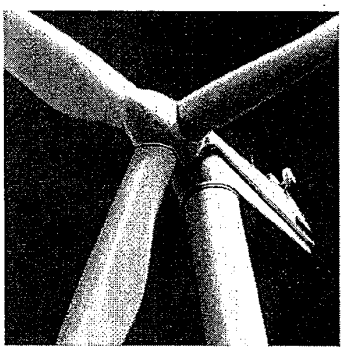
Iso discloses a system comprising: a set of computing systems (page 29, last paragraph for DER participating in the NYISO's Energy and Ancillary Services markets will require well-defined metering configurations as well as processes for calculating baseline load levels from which to measure performance. Establishing the baseline will require estimating a participant's load based on data from time periods with page 25, last two paragraphs for DER will be required to be available during all intervals in which they submit offers to provide wholesale service. If DER is derated or unavailable, it must report its unavailability to NYISO. Given the expected size and number of DER, the NYISO expects to modify its outage software to accommodate DER). However, Iso. fail to disclose said the performance strategy specifies for at least a subset of the set of computing systems to perform mining operations for the cryptocurrency when the price of power from the power grid is equal to or less than a revenue obtained by performing the mining operations for the cryptocurrency.

Claims 1-60 meet the criteria set out in PCT Article 33(4), and thus have industrial applicability because the subject matter claimed can be made or used in industry.





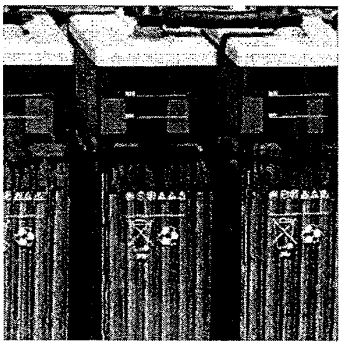




Distributed Energy Resources Roadmap for New York's Wholesale Electricity Markets

A Report by the New York Independent System Operator

January 2017



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I. Introduction

Distributed Energy Resources (DER) are poised to transform New York's wholesale electric system. DER can help grid operators by improving system resiliency, energy security, and fuel diversity. DER can lower consumer prices, improve market efficiency, and allow consumers to take greater control of their electricity use and costs through a variety of new technologies. DER will also improve our environment through the development of new renewable generation and energy storage technologies, helping the State of New York achieve its goals under the Reforming the Energy Vision (REV) initiative and Clean Energy Standard. The NYISO stands ready to harness these benefits and build the grid of the future.

This DER Roadmap is only the first step in building that grid of the future. We are committed to seamlessly transitioning from a primarily central station-based grid (Figure 1) to a diverse bi-directional grid (Figure 2). The transition will require careful and extensive planning by the NYISO and its stakeholders. NYISO will continue to provide its stakeholders and the public with independent and impartial information it can trust. This transition will fundamentally alter the composition of New York's infrastructure and energy markets and, throughout this transformation, the NYISO will continue to ensure economic electricity that New York's consumers can rely on.

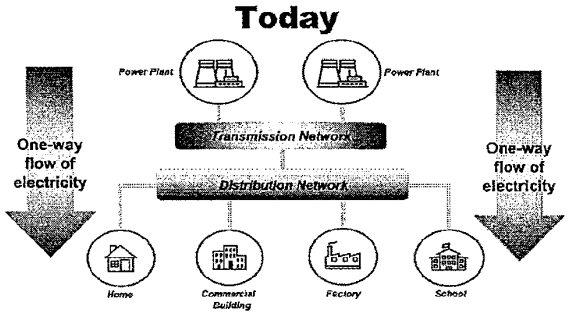

Figure 1 - Today's Electrical Grid

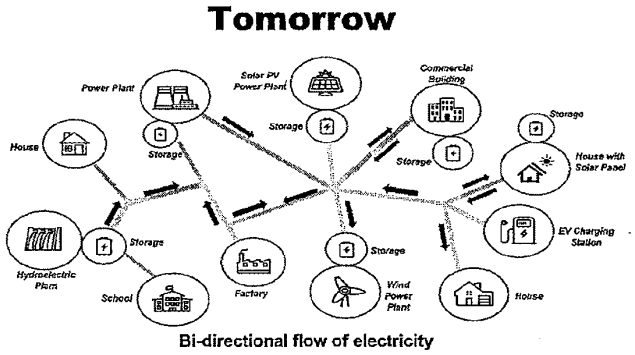

Figure 2 - Tomorrow's Electrical Grid

In the pages that follow we describe how DER is already providing valuable services in New York's Wholesale Markets. We outline the key objectives we intend to achieve in the initial phase of DER integration, and the progress we expect to make in the next three to five years. We also highlight certain technical challenges including measurement and verification of resource performance, and simultaneous participation in wholesale markets and in retail programs. Finally, we explain how the NYISO expects to transition certain existing wholesale market programs (such as demand response) to a fully integrated DER model.

We believe that opening the NYISO's markets to all resource types and configurations will improve the strength and efficiency of the electric grid. The ideas and proposals explained in this Roadmap will transform as we learn more about emerging technologies and receive input from stakeholders. But one thing is certain: in the coming decades we will look back at this evolution of the electric system and know that New York state has been on the leading edge of reforms that have improved reliability, increased resiliency, reduced prices for consumers, and improved our environment.

II. Purpose and Scope of this Roadmap

Technological advancements and public policies, particularly REV, are encouraging greater adoption of DER to meet consumer energy needs as well as electric system needs. DER offer the potential to make load more dynamic and responsive to wholesale market price signals, potentially improving overall system efficiencies.

The NYISO's market enhancements will permit dispatchable DER (*i.e.*, controllable resources) with various capabilities to participate in the wholesale markets. Integrating DER in this manner will require enhancements to wholesale market design, system planning, and grid operations to better align resource investments and performance with system needs and conditions.

The NYISO generally considers DER to be behind-the-meter resources, although small aggregations of Community Distributed Generation (CDG), may also be considered DER. Some DER may be net-generators and others net-loads. The NYISO defines DER as a resource, or a set of resources, typically located on an end-use customer's premises that can provide wholesale market services but are usually operated for the purpose of supplying the customer's electric load. DER can consist of curtailable load (demand response), generation, storage, or various combinations aggregated into a single entity. For resources that are net-generators, the scope of participation in the dispatchable DER program will be limited to resources and aggregations that do not meet the requirements to be Behind-the-Meter Net Generation ("BTM:NG") Resources.[1]

The purpose of this document is to present the NYISO's vision for integrating DER into the NYISO's Energy, Ancillary Services, and Capacity markets. It outlines high-level concepts to facilitate the emergence of dispatchable DER through a series of economic-based products. Doing so will promote greater grid and market efficiencies by coordinating load in conjunction with supply on the basis of price signals. These high level concepts are presented in an order that uses the previous concept's market design to inform the next concept's market design such that each concept builds upon all previous concepts. Existing reliability-based demand response (DR) programs, the Special Case Resource ("SCR") Program and Emergency Demand Response Program ("EDRP"), will continue to be an important tool for system operators to curtail load in response to periods of high demand or emergency system conditions that could threaten reliability in the near term. However, by facilitating the growth of economic-based DER products, the NYISO is looking to more effectively manage demand through automated,

[1] Capitalized terms not otherwise defined in the body of this Report shall have the meaning specified in Section 1 of the NYISO's Open Access Transmission Tariff and Section 2 of the NYISO's Market Administration and Control Area Services Tariff.

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market-based economic transactions, that reduce the need for manual operator actions and thereby increase market efficiency.

This document is not intended to be a detailed market design with specific implementation details. Where the NYISO has developed detail on certain concepts, however, it has included that detail in this document as a basis for further discussion with stakeholders.

III. Overview

DER currently have limited opportunities to participate in the NYISO's Energy, Ancillary Services, and Capacity markets. The NYISO's goal in this Roadmap is to develop a series of market enhancements to more fully integrate DER.

Achieving the key objectives of this Roadmap, below, will more fully open New York's wholesale markets to DER, and will support NYISO goals to improve market animation, increase system-wide efficiency, and improve system reliability and resiliency.

Key Objectives

1. Integrate DER into Energy, Ancillary Services, and Capacity markets;
2. Align with the goals of New York State's REV;
3. Enhance measurement and verification methodologies;
4. Align compensation with wholesale service performance; and
5. Focus on wholesale market transactions.

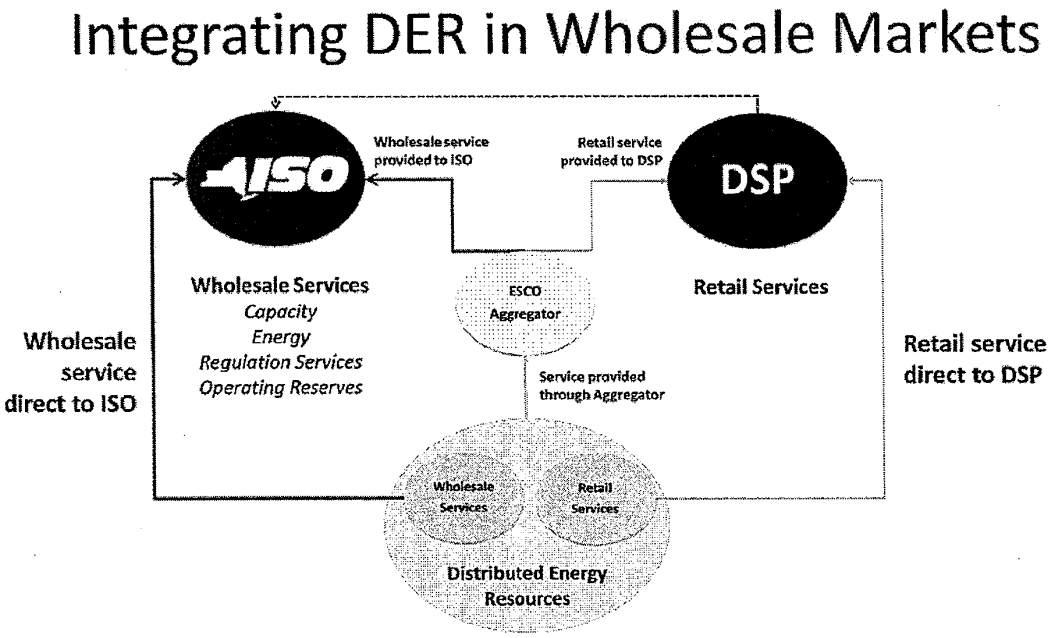

Figure 3 – Integrating DER in Wholesale Markets

Figure 3 depicts how DER may provide services in the wholesale and retail markets in the future, and the dark green lines are intended to show the scope of NYISO's DER Roadmap initiative.

The NYISO's existing Open Access Transmission Tariff (OATT) and Market Administration and Control Area Services Tariff (Services Tariff) do not recognize the full complement of wholesale market services DER are capable of providing. Although DER can currently participate in limited ways, the NYISO recognizes that market enhancements to further integrate DER will benefit the system as a whole. Therefore, the main objective of this Roadmap is to identify the key, high-level concepts we will address in integrating existing and emerging DER technologies. These concepts will be further developed, refined, and implemented through the NYISO's shared governance process.

The objectives described in this Roadmap, though focused on wholesale markets, largely parallel the Public Service Commission's (PSC) REV objectives in order to complement the retail market enhancements undertaken by the PSC and utilities.[2]

The NYISO intends to treat dispatchable DER comparable to traditional generators but recognizes that the capabilities of DER may be different from traditional generators. For example, traditional generators that were awarded capacity in a NYISO ICAP auction, with certain exceptions, currently have a Day-Ahead Market ("DAM") bidding obligation.[3] We anticipate that dispatchable DER participating in the Capacity market will have similar obligations requiring a dispatchable DER to offer into the Energy and Ancillary Services market each day.[4] Commensurate with the operational flexibility provided to DER ICAP Suppliers, the NYISO intends to reflect the operational value of the DER's contribution to the system and prorate Capacity payments based on the service provided.

Unlike traditional generators, DER are likely to participate in the NYISO's wholesale markets on an aggregated basis due to individual resource size and capability. The NYISO's current infrastructure was designed to support central-station supply resources using telemetry for real-time operations and monitoring, and after-the-fact data uploads for financial settlements. This data is collected on a Point Identifier (PTID) basis.[5] We intend to use the existing infrastructure for DER and DER aggregations, however, as described in section VIII below, adjustments to existing metering and telemetry requirements may be appropriate for DER depending on the configuration of a particular resource or aggregation. It is expected, however, that DER will be required, at a minimum, to provide PTID-level real-time supervisory control and data acquisition (SCADA) quality telemetry data and after-the-fact revenue quality meter data from individual resources.[6] The NYISO will explore whether the use of real-time telemetered data from a sample set of resources in a DER aggregation may be appropriate in certain circumstances.

The market enhancements developed over the next three to five years will permit DER participation in the NYISO's Energy, Ancillary Services, and Capacity markets with the option of being either dispatchable for economics or non-dispatchable for economics. The existing Day Ahead Demand Response Program (DADRP) and Demand-Side Ancillary Services Program (DSASP) will be replaced with new initiatives emerging from this Roadmap, while the SCR program, EDRP, and the opportunity for Price-Capped Load Bidding will remain. We also intend to develop rules accounting for wholesale market

[2] Unlike traditional Generators that are connected to the high-voltage transmission grid, many DER will be connected to distribution networks posing operations and planning challenges for the NYISO and New York's utilities.

[3] *See* Services Tariff § 5.12.1.6 and 5.12.7. The NYISO requires ICAP Suppliers, with certain exceptions, to bid, schedule a bilateral transaction, or notify the NYISO of any derates, the full amount of its ICAP obligation on each day.

[4] DER electing not to participate in the NYISO's Capacity market may offer into the Energy and Ancillary Services markets based on their capability.

[5] A Point Identifier is a resource-specific numerical identifier used by the NYISO's software systems to identify Generators and other Suppliers.

[6] Certain metering and telemetry obligations may be performed by an aggregator instead of the individual DER.

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load modifiers. Figure 2 depicts the NYISO's vision of future DER participation in the wholesale markets.

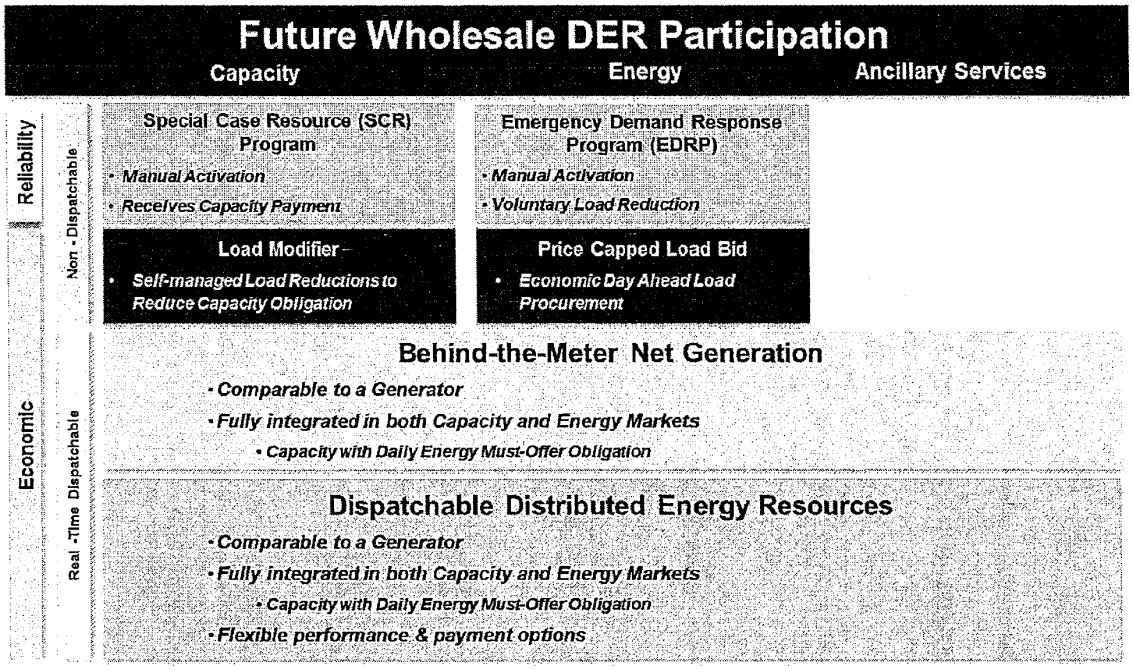

Figure 4 - Future Wholesale DER Participation

Implementing this initiative will entail considerable time, effort, and stakeholder engagement. This Roadmap represents a starting point to initiate discussions that will lead to further refinement on the key market design elements, functional requirements, and tariff language necessary to implement our vision.

Below is a high level timeline depicting the development and implementation of DER Roadmap concepts as well as other supporting initiatives. The implementation schedules noted below are subject to revision based on the specific market designs developed with stakeholders, and upon NYISO's budgeting and project prioritization process.

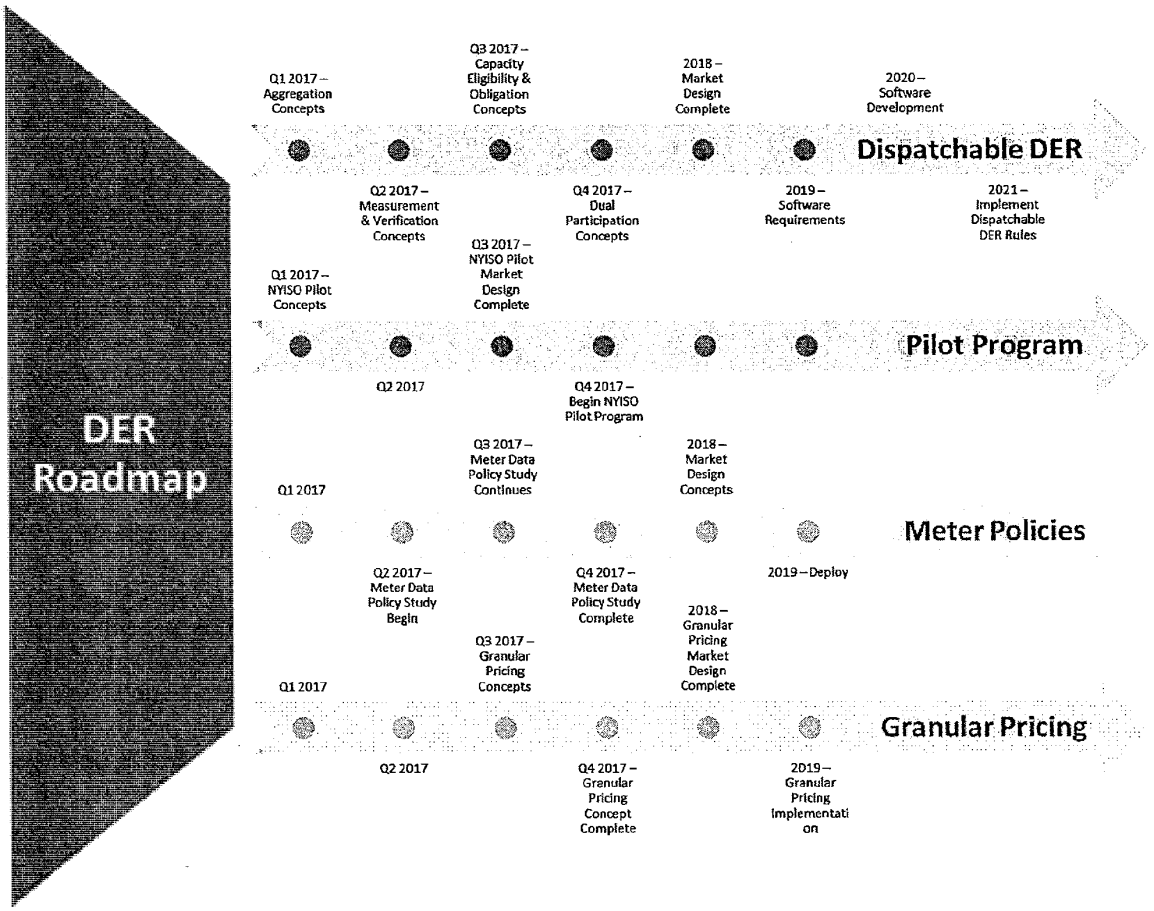

Figure 5 - DER Roadmap Timeline

IV. Current State of DER Integration

The number and type of DER operating in New York has grown over the last decade. Distributed behind-the-meter technologies are changing the way energy is produced, stored, and consumed. DER also address local needs for power quality, energy cost savings, carbon footprint reduction, and resiliency. Energy storage technology in particular has become more efficient and economical over the last decade leading to increased penetration.[7] Combined, these advances will allow consumers to

[7] Ultimately, the NYISO believes that DER applications will be a more effective and complete solution for grid operators and system planners with increased grid-scale storage capability.

change their consumption profiles in an effort to lower costs, access new sources of revenue, and reduce the environmental impacts of their energy use. While the NYISO does not have comprehensive data on the penetration of DER in the state, it commissioned a study in 2014 to (i) review the potential for DER in New York State, and (ii) explore the various DER technologies available to the public. [8]

The 2014 DER Study examined DER investment drivers and the effect of regulatory regimes and other policies in determining the market potential for DER, including a review of how DER is treated in other balancing authorities and by utilities.[9] The study concluded that DER adoption was well underway throughout the United States due to public policies encouraging DER as well as performance improvements and cost reduction of available technology.[10] These findings supported the study's conclusion that there was significant potential for DER expansion in New York.

Despite the 2014 DER Study's conclusion that there is potential for expanded DER use, the precise technological mix and scale of DER penetration is unknown and will be influenced by the economics of the technologies themselves as well as evolving rules and incentives established by public policy and the NYISO's markets. The market enhancements contemplated by the NYISO in this Roadmap are intended to encourage integration of a mix of resources, including aggregations that combine technologies.[11]

While the NYISO's efforts to enhance wholesale market participation of DER are underway, the PSC has been developing concepts for retail DER since 2014 in its Reforming the Energy Vision proceeding. Recognizing the rapid advancements in DER, the PSC initiated the REV proceeding to encourage deeper penetration of retail DER, engage end users, promote system efficiency, and meet the challenges presented by New York's aging infrastructure and severe weather events. The proceeding is designed to examine how regulatory policies, utility business models, and market designs could be enhanced to encourage investment in, and operation of, DER technologies. Through the retail market changes brought by REV, DER will serve local needs through Distribution System Platform (DSP) providers that plan, operate, and administer retail markets for distribution-level services.[12]

The vision articulated by the REV framework is, in many ways, consistent with the manner in which the NYISO administers wholesale markets, plans for bulk power system needs, and operates the grid, and the NYISO shares the goals articulated by the PSC in the REV proceeding. DER has the potential to further enhance the efficiency of wholesale markets with appropriately located injections and demand elasticity. Uncertainty exists, however, regarding the services DER may offer the bulk power system while also serving distribution system or end-user needs, the level of DER investment likely to be realized, and the limited visibility NYISO's market and grid operators will have of DER investments and technologies.

---

[8] A Review of Distributed Energy Resources, New York Independent System Operator (Prepared by DNV GL) (Sept. 2014), http://www.nyiso.com/public/webdocs/media_room/publications_presentations/Other_Reports/Other_Reports/A_Review_of_Distributed_Energy_Resources_September_2014.pdf.

[9] The study defined DER as behind-the-meter power generation and storage technologies located on an end user's premises and operated for the purpose of supplying all or a portion of the customer's electric load, but with the potential to inject power into the transmission system, distribution system, and/or a parallel local non-utility grid. The definition used in the 2014 DER Study is more restrictive than that used in this DER Roadmap, and therefore we expect greater benefit than described in the study.

[10] The 2014 DER Study did not specifically examine demand response because the goal was to assess the enabling technologies themselves, and not their impact on the grid.

[11] Although the NYISO has reviewed passive and intermittent technologies that provide energy efficiency, peak shaving, and other services to co-located loads, we do not anticipate that these technologies will directly provide wholesale market services. It is expected that these technologies will instead affect wholesale markets indirectly, in the form of modifications to New York's load profile. Moving forward the NYISO expects to enhance its forecasting tools to assist with more efficient dispatch of supply resources on the bulk power system in a separate forum.

[12] The PSC, NYISO and resource developers are also determining the extent to which retail-level DER can also participate in wholesale markets.

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DER provide important but limited support to bulk power system needs under the NYISO's existing market rules. The vast majority of DER are facilities participating in the NYISO's economic and reliability-based demand response programs, and among all demand response programs, the reliability-based programs have more robust participation. Figure 6, below, illustrates the NYISO's current demand response programs. Load modifiers do not actively participate in the NYISO's markets but instead are integrated with the various Load Serving Entities (LSEs) in New York to reduce the Load the LSE must procure from the NYISO.

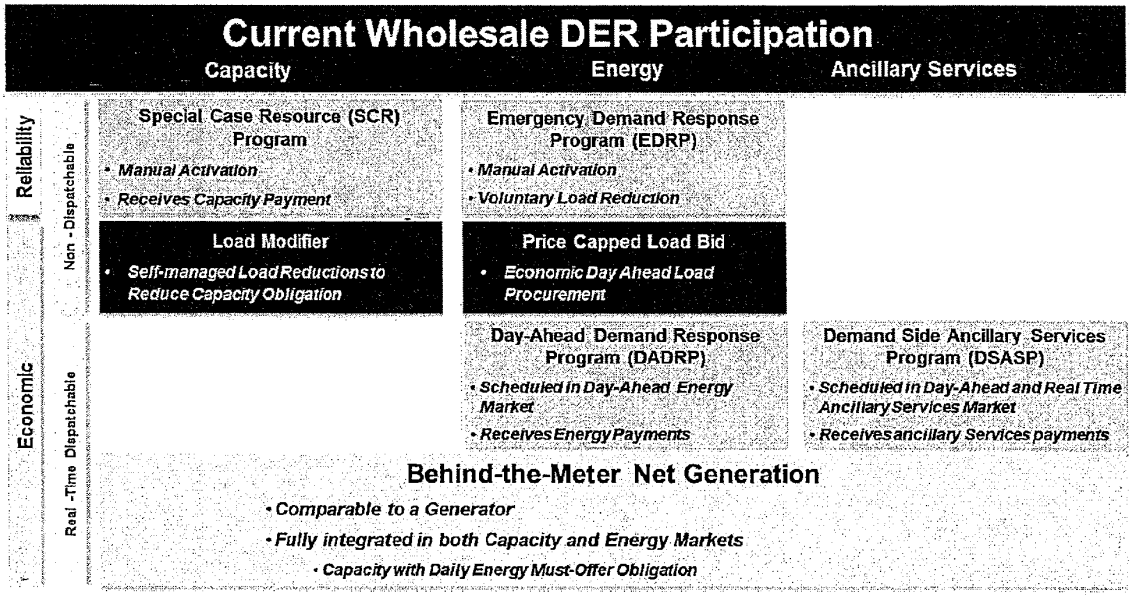

Figure 6 – Current State of DER Integration

A. Economic Programs

1. Economic Demand Response

The DADRP provides eligible resources the opportunity to offer load reduction in response to DAM price signals. DADRP resources offer into the DAM the amount of load reduction they are willing to provide at a particular price (or along a curve). If the bid is accepted, the resource performs by simply reducing consumption or by self-supplying a portion of their load with DER during the intervals in which it is dispatched. DADRP resources receive energy payments for delivering load reduction as if it were generation. We believe that DADRP is an effective tool to elicit demand elasticity, and although there was some historical participation, there is no active participation as of the date of this Roadmap.[13]

Eligible demand response resources may also submit bids for Ancillary Services through the NYISO's DSASP. Demand response resources that are capable of modulating their load in response to basepoint signals from the NYISO are eligible to supply and be paid for Operating Reserves and

[13] The DADRP was initiated in May 2001 and experienced limited participation through December, 2010. There has been no DADRP Resource participation since that time.

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Regulation Service. As of July 2016, the DSASP had 106 MW of registered capability providing Ancillary Services. DSASP resources provide approximately 16% of the NYCA's 10-minute spinning reserves.

The NYISO markets also permit LSEs to submit Day-Ahead Price-Capped Load bids. Under existing market rules a LSE may choose to submit price-sensitive Day-Ahead load bids for some, or all, of the load it must procure. That is, a LSE may choose the Day-Ahead Market price at which it will serve its Load. If the Day-Ahead price exceeds the LSE's Price-Capped Load bid, the LSE will then either reduce its Load or procure energy through another source. DER may participate in wholesale markets as a tool LSEs use to modulate load in response to wholesale price signals. LSEs can submit load bid curves to the NYISO reflecting a "willingness to buy" energy by modifying load bids in response to the NYISO's clearing price. In a typical scenario, LSEs would rely more heavily on wholesale energy purchases during periods of low prices while activating DER to displace wholesale energy purchases during periods of high market prices. New York's LSEs submit approximately 3-5% of their day-ahead Load bids as price responsive, some of which is used for other purposes such as price hedging.

2. Behind-the-Meter Net Generation Resources

Another economic-based mechanism for DER that can inject at least 1 MW into the grid is to participate as a Behind-the-Meter Net Generation (BTM:NG) Resource.[14] This initiative is designed for large facilities that have on-site generation capability routinely serving a local, on-site Load (the facility's Host Load), and that have excess generation capability after serving that Host Load. Examples of potential BTM:NG Resources include industrial complexes, large residential facilities, and college campuses. The Resource must have nameplate generation capability with a minimum rating of at least 2 MW, a minimum Load of at least 1 MW, and an interconnection allowing an export of at least 1 MW to the New York State (NYS) Transmission System. Eligible BTM:NG Resources can sell Energy, Ancillary Services, and Capacity to the wholesale markets and participate in a manner similar to traditional Generators.

3. Load Modifiers

Load modifiers are not wholesale market resources, but instead are a tool that LSEs can use to reduce their wholesale market load and capacity obligation.

Load modifiers can consist of many different technologies that LSEs can use to manage its load. Load modifiers are primarily used: (i) to avoid purchasing high-cost power during peak hours, and (ii) to reduce the LSE's seasonal capacity obligations.

Load modifiers are not dispatched by the NYISO and therefore any load reduction is not based on an explicit bulk power system or wholesale market need.

B. Reliability-Based Programs

The NYISO currently has two reliability-based demand response programs: EDRP and the SCR program. The EDRP offers eligible resources the opportunity to voluntarily curtail load in response to NYISO requests for load reduction to address specific system conditions such as forecasted operating reserve shortages.[15] EDRP resources can reduce Load in response to a NYISO activation via curtailment, Local Generator deployment, or both, and receive energy payments for verified load reductions. The EDRP is useful to grid operators because it supports near-term reliability. Because load reductions are voluntary, however, EDRP does not benefit the NYISO's long-term planning and grid management objectives.

[14] The market rules permitting BTM:NG Resource participation in the wholesale energy, ancillary service, and capacity markets became effective on December 13, 2016.
[15] As of July 2016, the EDRP has 75 MW of capability throughout the state.

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A more reliable demand response tool for planning and grid management is the SCR program.[16] The SCR program is similar to EDRP in that the NYISO activates SCRs in response to specific reliability-related system conditions, but, in exchange for receiving capacity payments (in addition to energy payments for real-time performance), SCRs are obligated to reduce load when called on by the NYISO.[17] SCRs that fail to respond to appropriate SCR activation notifications can be subject to financial penalties. The SCR program has been activated on numerous occasions to maintain reliable system operation.

The SCR program has proven a valuable tool for grid operators, and planners have relied upon SCR enrollments to determine if the system is capable of handling projected peak loads while maintaining compliance with reserve requirements. Despite its value, the SCR program is an imperfect market product because resources have little ability to predict or control the effect the SCR program participation has on a facility's primary day-to-day operations. From 2014 through 2016 the NYISO had only a single mandatory activation of the SCR program. In 2013, however, the SCR program had mandatory activations five times on five consecutive days in several NYISO load zones.

From the NYISO's perspective, the SCR program is a generally effective way to reduce strain on the bulk power system during periods of high demand. However, the program does have its shortcomings. First and foremost, the SCR program must be manually activated: operators must look at load forecasts as well as generator and transmission availability to determine whether SCR resources will be necessary to maintain reliability. Since NYISO Operations must manually activate the SCR program based on the forecasted conditions, these actions are inherently less efficient than automated commitment and dispatch. Further, there is limited ability to target SCR calls in response to local conditions on the transmission grid because SCRs are activated on a zonal basis. Eliminating these inefficiencies will be effective in supporting grid reliability.

V. Key Objectives behind this Effort

While the types, configurations, and capabilities of DER vary depending on the needs of the customer, the following key objectives will guide the effort to integrate DER into the NYISO's wholesale electricity markets:

[16] As of July 2016, 1,192 MW of load reduction capability was enrolled in the SCR program.

[17] Under the existing SCR program rules, the NYISO is required to provide SCRs with a 21-hour advance notification of a potential SCR activation provided that the notification is made by 3 pm. If the notification is provided after 3 pm, the NYISO must provide a 24-hour advanced notification. The NYISO is also required to provide SCRs with a 2-hour intra-day notification of an actual SCR activation. If the NYISO does not meet its notification obligations, resource participation in the SCR activation becomes voluntary.

A. Integrate DER into Energy, Ancillary Services, and Capacity Markets

The NYISO seeks the seamless integration of DER into Energy, Ancillary Services, and Capacity markets. Currently, there are limited options for DER to participate in the NYISO's markets. More fully integrating dispatchable DER will provide a means for DER to take advantage of real-time scheduling. It is important for the NYISO's real-time systems to access and dispatch these resources in response to price signals reflective of grid conditions and needs. From an operational perspective, the intent of this effort is to minimize out-of-market manual activation of these resources by operators. Ultimately, implementation of this roadmap is expected to enhance the NYISO's portfolio of DER products by creating a market environment that facilitates the emergence of DER capable of being economically dispatched within the wholesale markets. At the same time, the NYISO's vision provides end users added flexibility to meet their energy needs more economically by modulating their demand for grid-based electricity in response to price signals.

B. Align with the goals of New York State's REV

The NYISO's goal to provide additional options for DER to participate in the wholesale markets aligns with NYS REV objectives of market animation leveraging customer contributions, increasing system wide efficiency, and improving system reliability and resiliency. The NYISO's approach to DER participation is to focus on system needs and performance requirements of resources and to provide opportunities for facilitating demand-side elasticity.

C. Enhance Measurement and Verification Methodologies

Accurate timely metering and load forecasts are essential to balancing supply and demand in real-time. Enhancing measurement and verification methodologies is critical to ensure that NYISO is able to accommodate various technologies and customer load profiles. The data provided by enhanced measurement and verification will help system planners and grid operators better prepare for system needs and support the continued reliability of the bulk power system while further improving system efficiency. Enhanced measurement is also a critical component to appropriately compensating resources for the services they provide, which also leads to the next key objective.

D. Align Compensation with Wholesale Service Performance

Markets function best when payments are aligned with the value of services provided. In this context, the NYISO intends to align DER incentives and compensation based on the flexibility and measured performance of the DER (or aggregation), and market clearing prices based on the needs of the system. The intent is to treat DER comparably with traditional generators participating in the NYISO's Energy, Ancillary Services, and Capacity markets.

E. Focus on Wholesale Market Transactions

Unlike traditional wholesale generators which are primarily connected to the high-voltage transmission grid, many of the DER will be connected to the distribution networks. To ensure bulk power system reliability, it is important to accurately represent DER impacts at their corresponding interface to the bulk power system, which is typically at the transmission-level substation load bus associated with that distribution network.

Achieving these key objectives will facilitate the integration of dispatchable DER into the NYISO's wholesale markets. The NYISO also hopes to achieve a better understanding of the implications non-dispatchable resources have on wholesale load requirements in a future with demand-side animation. The NYISO envisions that those resources capable of participating in its markets will do so directly or via

third-party aggregation (including potentially via the DSP providers envisioned in the New York State PSC's REV recommendations) such that smaller resources (*e.g.*, those resources less than 100 kW) can be aggregated in a coordinated fashion to respond to price signals in support of bulk system needs. The NYISO also anticipates that the integration of non-dispatchable DER will require new forecasting and planning tools to measure the impact of non-dispatchable activity in order to continue operating the bulk system in an economically efficient manner. Such tools include solar forecasting, enhanced communications and advanced metering to facilitate increased data exchange and collection, and enhanced coordination with utilities to account for DER investments over a long horizon and the impacts on resource adequacy and transmission security.

VI. Integrating Dispatchable DER

Integrating dispatchable DER will expand opportunities for eligible resources by opening wholesale electricity markets to technologies, or combinations thereof, whose participation is limited under the NYISO's existing market rules. Specifically, five types of resources will be enabled to participate in the NYISO's Energy, Capacity, and Ancillary Services markets:

1. Load-only resources – end-users that modulate their energy usage in response to a NYISO dispatch signal strictly through load curtailment measures;
2. Load with generation – end-users capable of dispatching behind-the-meter generation resources, supplemented with load curtailment, to modulate their energy withdrawals and potentially inject energy into the grid in response to a NYISO dispatch signal;
3. Load with storage – end-users capable of dispatching behind-the-meter storage resources, supplemented with load curtailment, to modulate their energy withdrawals and potentially inject energy into the grid in response to a NYISO dispatch signal;
4. Load with generation and storage – end-users with a combination of behind-the-meter generation, storage and/or load curtailment that can modulate the facility's energy withdrawals and potentially inject energy into the grid in response to a NYISO dispatch signal; and
5. Community distributed generation. [18]

The remaining sections of this roadmap further describe concepts that must be enabled in order to achieve the key objectives associated with more fully integrating DER into the NYISO's wholesale markets.

The DER program will treat distributed resources comparably with other wholesale market resources, more fully integrating them with Energy and Ancillary Services markets, while awarding payments reflective of the performance capabilities of the resources. Creating a viable mechanism for DER to participate in markets on an economic basis offers advantages to NYISO markets as well as participants.

Animating these resources will improve economic efficiency by reducing the need to call high-cost peaking generation. At the same time, DER operating in response to economic signals can work to shift grid-based electricity consumption to off-peak hours, creating the potential for greater stability in prices throughout the day by flattening the load. In this sense, the NYISO's vision for dispatchable DER integration aligns well with REV in that it offers the potential to engage or animate certain consumers in ways that support more optimized grid utilization while helping these consumers better manage their own

[18] Use cases for each of these resource types are located in Appendix A.

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energy needs and costs. The potential to improve grid utilization of existing infrastructure may help to avoid expensive capital investments that might otherwise be needed to meet peak demands over relatively few hours during the year.

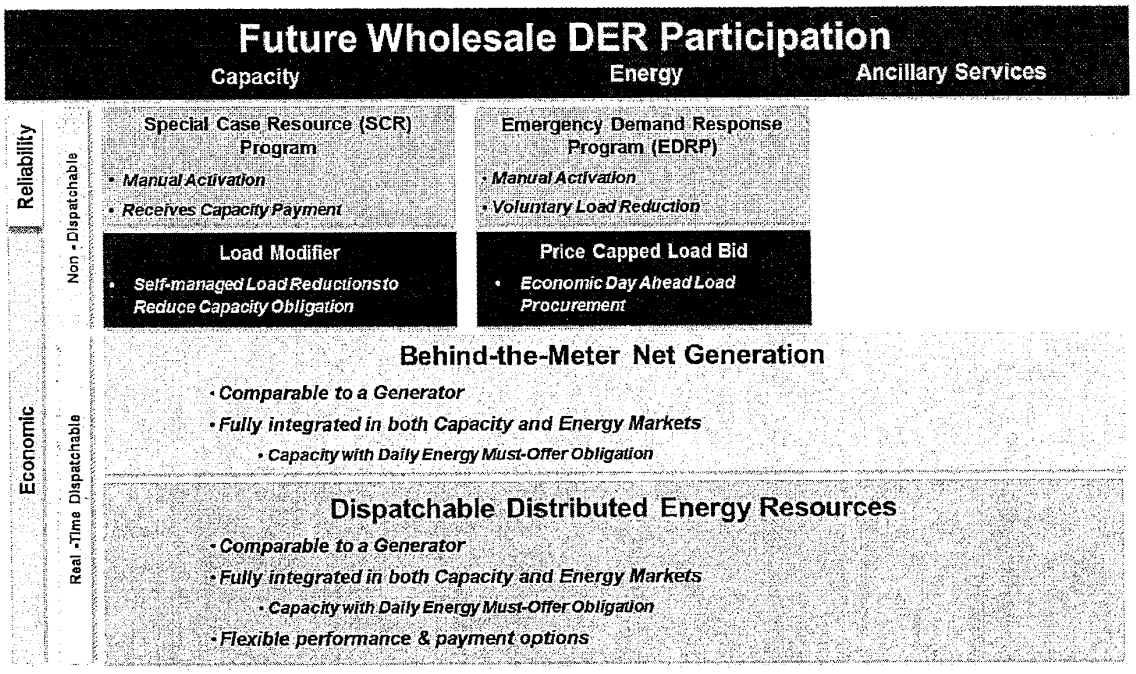

Figure 7 - Future Wholesale DER Participation

The NYISO is not proposing to change the existing SCR program, EDRP, or BTM:NG Resource rules in conjunction with this Roadmap at this time. The NYISO does not propose to add any new rules for LSE use of load modifiers to reduce Load and capacity obligations, nor is it altering existing Price-Capped Load Bidding rules in conjunction with this with this Roadmap at this time.

On November 17, 2016 FERC issued a Notice of Proposed Rulemaking (NOPR) on Electric Storage Participation in Markets Operated by Regional Transmission Organizations and Independent System Operators that included proposed rules for DER.[19] The NOPR describes FERC's current vision for the development of rules regarding DER in the organized markets. The NYISO recognizes that some of the proposals contained in this Roadmap do not perfectly align with those contained in the NOPR. FERC's decisions in that rulemaking proceeding may ultimately impact the NYISO's final market design. The NYISO is and will continue monitoring this proceeding and will revisit specific areas of the dispatchable DER market design if necessary.

[19] *Electric Storage Participation in Markets Operated by Regional Transmission Organizations and Independent System Operators*, Notice of Proposed Rulemaking, 157 FERC ¶ 61,121 (Nov. 17, 2016).

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VII. Aggregation and Modeling

The NYISO recognizes that allowing Market Participants to aggregate individual DER to meet wholesale market eligibility and performance requirements is beneficial to both market participants and the markets. The NYISO proposes to aggregate DER similar to its existing demand response programs, with certain modifications to reduce the minimum aggregation size and to limit the geographical footprint of aggregations to less than a Load Zone. Each aggregation is expected to be modeled and represented by a PTID in the NYISO systems.[20]

A. DER Aggregation and Aggregators

The rules related to DER aggregation will be the foundation upon which the remaining concepts and rules are built, and will be the first concept developed in the market design process. As part of the effort to open the wholesale markets up to all resource types, the aggregation rules will be technology agnostic. Therefore, a single DER aggregation could include a heterogeneous mix of different technologies such as load reduction, generation, and storage technologies that, when combined, meet NYISO dispatch instructions. The NYISO currently does not believe that aggregations must be homogeneous (*i.e.*, consisting of DER with the same technology), but the NYISO will explore whether homogenous aggregations can provide additional or different services than heterogeneous aggregations and therefore be valued differently. This will be explored further in the market design process.

We expect to allow DER aggregations of at least one resource. The DER Coordination Entity (DCE) will be the Market Participant interfacing with the NYISO. A DCE may be a direct customer, a third-party aggregator (similar to a Responsible Interface Party in the SCR Program), or a DSP.

B. Granularity

Unlike the traditional wholesale generators, which are primarily connected to the transmission grid, many DER will be connected to distribution networks. To ensure bulk power system reliability, it is important to accurately represent DER impacts at their corresponding interface to the bulk power system, which is typically at a transmission node (substation load bus transformer/PTID) associated with a distribution network. Therefore, we propose at this time, and subject to further study and development in the stakeholder process, to limit the geographical footprint of DER aggregations to only those resources connected to the same bulk transmission node. This geographical limit to DER aggregations will help ensure DER compensation in the wholesale markets reflects the locational and temporal value of the DER aggregation on the bulk power system.

Figure 8, below, is an example of a transmission substation with two transmission nodes, where the transmission nodes are at each of the two step down transformers.

[20] The NYISO updates its power system model on multiple occasions throughout the year. 60-90 days advanced notice is typically required in order for a new resource to be incorporated into the power system model.

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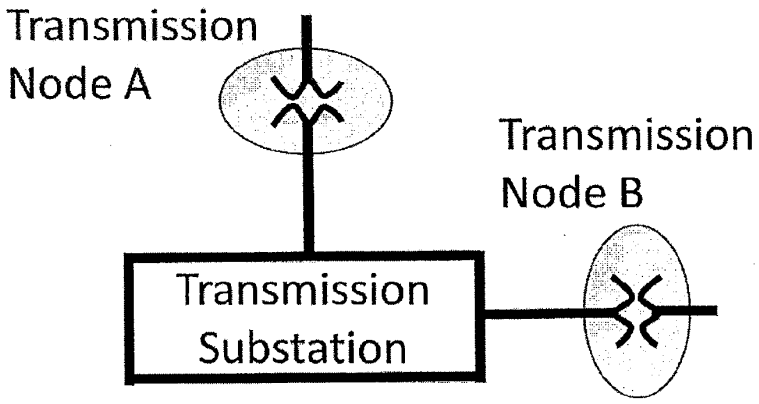

Figure 8 - Transmission Substation with two transmission nodes

Aggregating DER on a broader level (such as zonally) could create operational issues. To illustrate this point, consider two generators connected on the opposite ends of a constrained transmission line (as depicted in Figure 9). Due to the constraint, injections from Generator 1 will further aggravate the overloaded transmission line. Injections from Generator 2, however, will help alleviate the constraint. In this example, to effectively and efficiently manage the constraint the NYISO would dispatch Generator 1 and Generator 2 separately (*i.e.*, dispatch Generator 1, down and Generator 2 up).

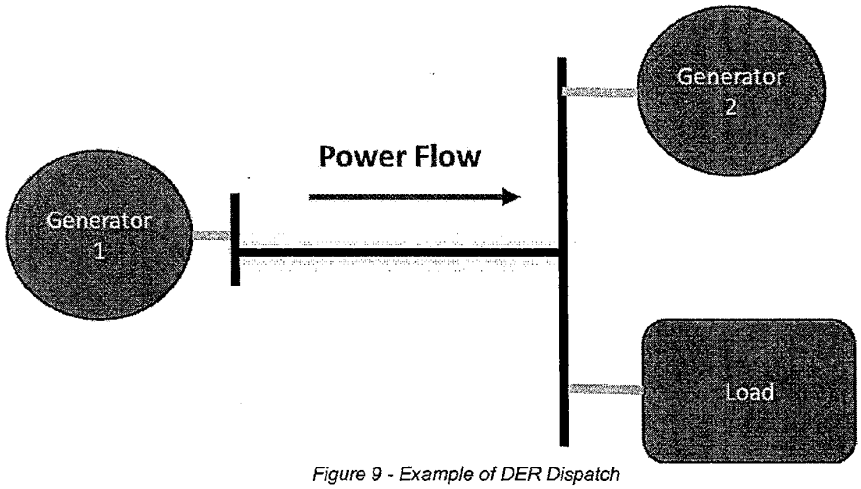

Figure 9 - Example of DER Dispatch

If Generator 1 and Generator 2 were aggregated, they would be modeled and dispatched as an aggregated single unit in the NYISO system. If the aggregation is dispatched up, the constraint will get

further aggravated due to injections from Generator 1. If the aggregation is dispatched down, NYISO would not be effectively using Generator 2 to relieve congestion.

The NYISO believes granular monitoring and control of DER aggregations at the transmission substation load bus level is needed to effectively and efficiently manage transmission system congestion and reliability. Therefore, the NYISO proposes that dispatchable DER aggregation boundaries to be limited to all DER interconnected to, and having direct impact on, the same transmission substation load bus.

C. Sizes and Types

Aggregations represented by a DCE will be known as a DCE Aggregation (DCEA). The NYISO is not proposing a minimum size restriction for the individual DER that are part of the DCEA, however DCEAs must be a minimum of 100 kW in total size. DCEAs will be allowed to participate in Capacity markets and be able to set Capacity prices.

The NYISO runs Security Constrained Economic Dispatch (SCED) nominally every five minutes. SCED is a complex mathematical optimization to dispatch resources to meet load for the least total production cost while respecting transmission constraints. Adding a multitude of smaller resources below a certain size to this already complex problem adds significant computational time with each small resource having little to no impact on the total production cost. The NYISO believes this minimum DCEA size appropriately balances the additional computational complexity of integrating small resources with the benefits to total production cost. The NYISO will integrate DCEAs based on the service provided:

1. Energy, Operating Reserves and/or Regulation

DCEAs that are 1 MW or greater will be eligible to provide Energy, Operating Reserves and/or Regulation. DCEAs that are qualified to provide Operating Reserves and/or Regulation are expected to be treated and modeled as a single PTID for scheduling and optimization purposes. Such DCEAs will be optimized by SCED, and they will be eligible to set prices in NYISO's Energy, Operating Reserves and/or Regulation markets.

2. Energy Only

DCEAs that are less than 1 MW can still participate in the NYISO wholesale market but can provide energy only. In order to maximize DER participation opportunities while minimizing impact to SCED, the NYISO will combine the offers of all DCEAs less than 1 MW into a "Super Aggregation" (SA) with the offers of all other such DCEAs at the same transmission node. SAs will be optimized by SCED, and they will be eligible to set prices in NYISO's Energy markets. After the schedule for the SA is determined, NYISO will disaggregate the schedule among individual DCEA.

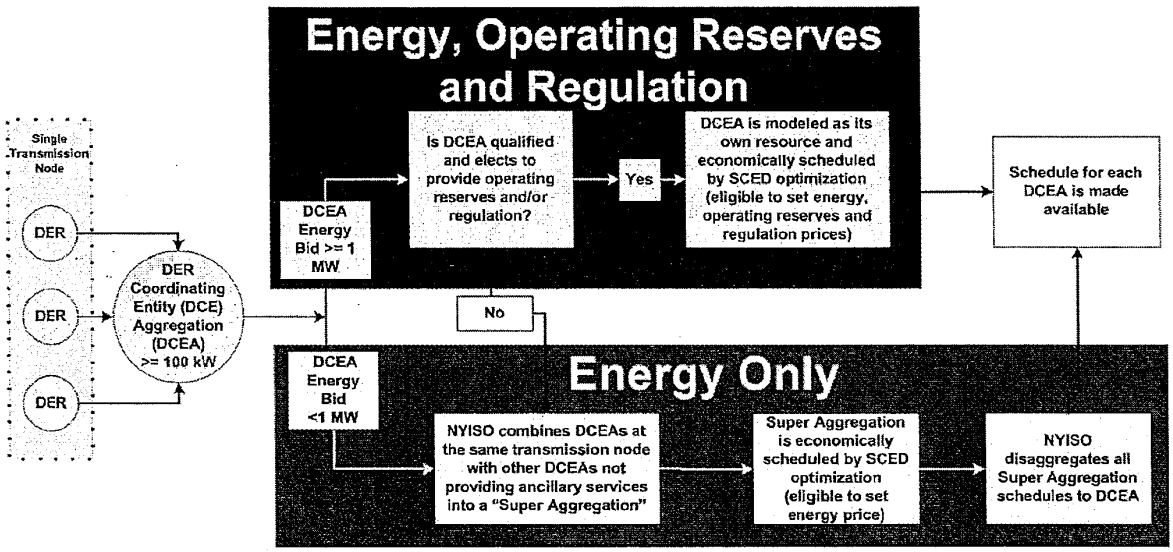

Figure 10 - Concept for DCEAs in Energy, Operating Reserves and Regulation

D. Coordination between the NYISO, Utilities, and DCEs

In order to facilitate the participation of DER in the NYISO's wholesale markets, it will be important that the NYISO establish seamless coordination practices with the NY utilities and the DCEs. This will ensure that the participation of DERs in the wholesale market does not compromise the reliability or safety of the transmission and distribution systems.

To allow for the accurate accounting of individual DER on the system and to ensure that all parties are aware of potential obligations for the DER and potential risks to the grid, the NYISO will establish registration processes that coordinate with the utilities and DCEs. This will allow the NYISO to verify that all DER part of the DCEA are capable of providing services to the NYISO and accurately map the DCEA to the correct transmission location. Additionally, this coordination will provide the utilities an opportunity to (i) review all individual DER, (ii) assess the DER impact on the distribution system, including mapping the individual components of the DCEA to the correct distribution location, and (iii) inform the NYISO if the DER or DCEA will present any reliability risk to the distribution system.

Further coordination will be required between NYISO, the utilities, and the DCEA to facilitate real-time electric system reliability and improved electric system planning processes. For example, the NYISO will expect that any offer provided by the DCEA account for any operational restrictions of the DER in the aggregation, as well as the distribution system that the DCEA is connected to. This obligation will require the DCEA and the utility to work closely with the NYISO ensuring that any dispatch instruction provided by the NYISO is a valid and executable instruction by the DCEA and maintains safe and reliable operation of the distribution system.

VIII. Measurement and Verification

Dispatchable DER participating in the NYISO's Energy or Ancillary Services markets will be scheduled and dispatched in a manner comparable to traditional Generators. DER will also be held to comparable compliance obligations as traditional Generators. Failure of DER to perform as scheduled may result in higher costs to consumers and may impact grid reliability. Therefore, the NYISO will work to develop performance criteria and compliance metrics for dispatchable DER. These criteria and metrics will be developed once greater clarity and consensus is reached on market rules related to aggregation. The NYISO has identified the following high-level topics it expects to address more fully in stakeholder discussions.

A. Metering and Telemetry Requirements

1. Real-time Telemetry for DCEA

DCEAs will be required to have 6-second real-time telemetry. The NYISO's current meter data infrastructure supports PTID-level data, primarily collected through real-time telemetry for real-time operations and monitoring functions, and after-the-fact uploads to support settlement. The integration of dispatchable DER into Capacity, Energy, and Ancillary Service markets is expected to follow a comparable model. DCEAs will be required to provide PTID-level (*i.e.,* aggregation level) real-time telemetry data for operations and monitoring functions. More granular circuit location data may be requested by the utilities as outlined in the individual utility interconnection requirements and the Supplemental Distributed System Implementation Plan (SDSIP). In addition, DCEAs will be required to provide, and after-the-fact meter data from individual resources for settlements which may not be as granular as the 6-second real-time requirement.

To ensure that NYISO and the utility have situational awareness, all real-time telemetry communications will be either through the utility (who then communicates with the NYISO), or, alternatively, to the utility and NYISO at the same time.

2. After-the-fact Meter Data for DER

All DCEAs will be required to have revenue-quality (minimum of ANSI C12 hourly interval metering) meter data for settlement and billing purposes, and for quality assurance of real-time data. The NYISO will use the same timelines for after-the-fact meter data submission for DCEA as that of traditional generators. Meter data for settlements and billing will be collected per DCEA.

The NYISO will require DCEs to provide the net meter data for each DER for verification purposes. If such a DER has on-site generation and/or storage, the NYISO will consider requiring after-the-fact meter data from two of the following: net meter, load meter, and generator/storage meter. The NYISO recognizes that the New York utilities are undertaking an effort to install Advanced Metering Infrastructure (AMI) meters in their service territories and NYISO intends to leverage this meter data to the extent possible.

3. DCEA Sampling

The NYISO is considering permitting aggregations of less than 1 MW to use real-time telemetered data from a sample set (at least 30%) of DER in a DCEA. This is primarily intended for residential and small C&I customers. The purpose of sampling is to provide a representative view of the real-time performance of the entire DCEA without subjecting small DER to onerous metering requirements. The NYISO will explore whether this sampled data can be used for settlement, billing, audit/verification and telemetry. The feasibility and associated requirements of this approach will be developed as part of the detailed market design phase of this initiative.

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4. Meter Data Service Providers

The NYISO's existing demand response program rules require demand response resources to have the utility or a New York PSC-certified Meter Data Service Provider or Meter Service Provider read the interval meters used for wholesale market participation. The NYISO recognizes that this is a potential barrier to entry for DER and will explore options to address this barrier as the DER program evolves. This will be evaluated as part of the 2017 study on meter data requirements for DER.

B. Baselines

A baseline is the estimated amount of energy use expected by a facility if a load reduction had not occurred in response to the NYISO instruction or schedule. The NYISO currently uses baselines to measure performance of demand response resources, and expects to use baselines for DER that are net loads.

1. Recommendations from the 2014 Baseline Study

The NYISO and DNV GL conducted a Baseline Study in 2014 to investigate baseline methodologies for the SCR program.[21] Notably, the study recommended that the Average Coincident Load (ACL) baseline should be used to determine the upper limit on the amount of capacity a SCR could offer, and that a Customer Baseline Load (CBL) should be used to measure resource performance in the Energy market. The NYISO plans to draw on conclusions of that study for dispatchable DER relying on a baseline methodology to measure performance. DER participating in the Ancillary Services market will be measured by the current DSASP baseline to evaluate performance for the ancillary product. The NYISO will work on establishing detailed market rules to measure the performance of a net load DER that is simultaneously providing energy and reserve products.

The study also recommended potential enhancements for the CBL methodology. The enhancements were specifically related to the exclusion rules and the caps on in-day weather adjustments. The NYISO intends to incorporate these recommendations in the baseline methodologies used for DER.

2. Baselines for Different Technology and Load Types

The NYISO plans to adapt these general baseline methodologies to accommodate different technologies and load types. For example, a CBL methodology for a highly variable load may be different from the CBL methodology for a load with a high load factor. The NYISO also recognizes that existing baseline methodologies may not accurately represent the load profile of small customer, weather-sensitive loads, and intends to explore different baseline measurement methodologies for such resources. Similarly, the NYISO recognizes that the existing methodologies may not be appropriate for behind-the-meter energy storage devices and intends to evaluate baseline methodology options that account for the unique characteristics of behind-the-meter energy storage. Although the NYISO intends to use CBL methodology to measure Energy market performance in instances when DER are net-loads (*i.e.*, consuming energy from the grid) and net meter data when DER are net injectors (*i.e.*, injecting energy into the grid), the NYISO is evaluating whether baselines may still be needed for net injectors in special situations.

[21] NYISO SCR Baseline Study, New York Independent System Operator, Inc. (prepared by DNV KEMA, Inc.) (Mar. 2014), http://www.nyiso.com/public/webdocs/markets_operations/market_data/demand_response/Demand_Response/Special_Case_Resource_ICAP_Program/NYISO%202013%20SCR%20Baseline%20Study%20Report-final.pdf.

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C. Settlements

The NYISO expects DER settlements to be comparable to the existing settlements processes for traditional generators. Dispatchable DER will be measured at their applicable PTID and will be subject to the same settlement timelines for meter data submissions as that of traditional generators.

The NYISO currently has special settlement provisions for the electricity consumed to charge the storage devices participating as Limited Energy Storage Resources (LESR). The NYISO will consider evaluating if additional settlement rules would be required for the electricity consumed to charge behind-the-meter storage devices participating in the dispatchable DER program.

IX. Performance Obligations

A. DER that are ICAP Suppliers

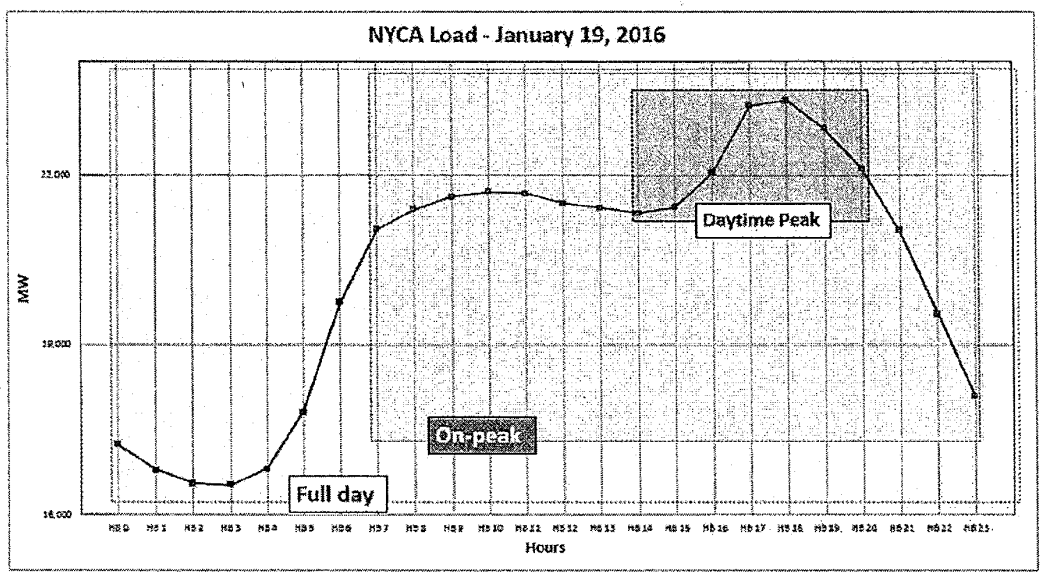
Traditional generators participating in the NYISO Capacity market are required to submit Day-Ahead Market bids for at least the amount of capacity they sold in the Capacity market. The NYISO proposes to require dispatchable DER to submit Day-Ahead Market bids for at least the amount of capacity they sell in the Capacity market. At this time the NYISO believes DER desiring full capacity payments will be expected to be capable of delivering its full capacity for a full 24 hour period, comparable to what is expected of traditional generators.

The NYISO recognizes that some DER will be unable to deliver capacity in all 24 hours due to its physical characteristics (*e.g.*, DER aggregations consisting of load curtailment assets that have a typical "9 to 5" load profile). These DER are still valuable to the system, but perhaps less than a full 24 hour DER. In order to determine the varying degree of operational benefit that different DER can provide to the grid, the NYISO intends to develop options for service tiers that dispatchable DER can provide to help the NYISO meet its daily load. The NYISO currently proposes three such tiers - full day service, on-peak service and daytime peak service, where:

1. Full day service is the provision of wholesale service for all 24 hours in a day;
2. On-peak service is the provision of wholesale service to help the NYISO meet its load during early morning through late evening hours; and
3. Daytime peak service is the provision of wholesale service to help the NYISO manage its daily peak hours.

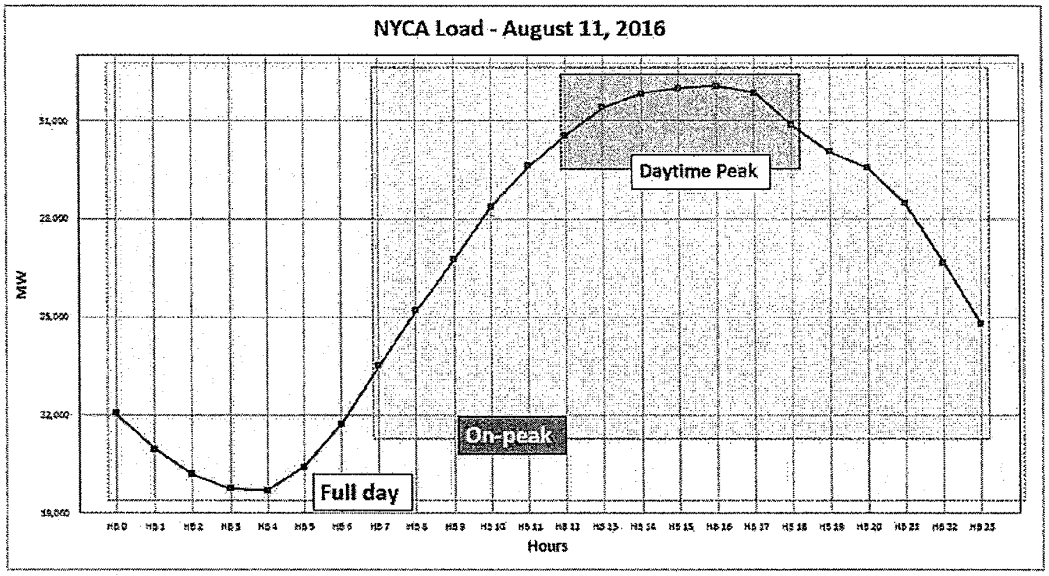
Consistent with the key principle of aligning payments with system requirements, the NYISO believes that Capacity market compensation commensurate with a DER's capabilities and performance is appropriate, and, therefore, the NYISO expects to develop market rules through the stakeholder process to prorate capacity and associated capacity payments.

As part of this effort, the NYISO also plans to look at establishing a window of time in which the DER must offer for those providing fewer than 24 hours of service. This window is expected to be consistent with the service that DER is intended to perform for the NYISO to balance supply and demand.



Note: NERC defines "On-peak" as 7am to 11pm (HB 7 to HB 22) for the Eastern Interconnection

Figure 11 – Example of Winter Load



Note: NERC defines "On-peak" as 7am to 11pm (HB 7 to HB 22) for the Eastern Interconnection

Figure 12 – Example of Summer Load

The purpose of NYISO's DAM is to procure enough supply to meet the load bid in the NYISO's DAM. All 10-minute-capable traditional generators east of Central East have an obligation to offer into the real-time market. The NYISO intends to apply the same obligation to dispatchable DER to offer in the real-time market. If more supply resources are required due to system condition changes in real-time, NYISO operations can initiate its Supplemental Resource Evaluation (SRE) process. All NYISO capacity resources are eligible for selection and are required to respond to a SRE request in real-time regardless of whether they received an award/schedule in the DAM. Consistent with the obligations of traditional generators, DER with a Capacity obligation must also be available in real-time for the amount of capacity sold into the capacity market. Because SRE is a manual operator action and inherently involves operator judgment, it does not guarantee lowest production cost. Given the expected size and number of DER, it is operationally challenging to SRE these resources in real-time if they do not clear in the DAM, and therefore will necessitate additional operator tools to facilitate the most economic SRE process for such resources. The NYISO also intends to evaluate whether to extend these obligations to the Day-Ahead Reliability Unit process as well.

As part of this effort, the NYISO also plans to evaluate the feasibility of market software and NYISO system operators making commitment decisions for DCEAs. This could potentially involve evaluation of DER-specific thresholds of existing offer parameters, such as minimum down time,[22] minimum run-time, response rate, and to introduce a new DER offer parameter, maximum commitments per day. The threshold for the minimum run-time for DER is the minimum time a resource will be committed by the Real-Time Commitment software. Response rate is the speed with which a resource can reach its upper operating limit within the minimum run-time.

DER will be required to be available during all intervals in which they submit offers to provide wholesale service. If DER is derated or unavailable, it must report its unavailability to NYISO. Given the expected size and number of DER, the NYISO expects to modify its outage software to accommodate DER.

Because aggregations are likely to include multiple technologies, the NYISO expects to develop market rules that will allow DCEs to manage the performance from various resource types in order to meet the requirements discussed above. For example, an aggregation with a 24-hour capacity obligation might rely on load curtailment assets to provide performance during the day and generation assets when sufficient load curtailment capability is not available to meet the aggregation's obligation. In another scenario, if an aggregation is scheduled for four hours, the DCE may choose to meet its obligation by discharging storage devices for two hours and by load curtailment for the remaining two hours. Importantly, the NYISO intends to establish performance obligations at the aggregation level, and not at individual resource level.

[22] Minimum down time in the context of load curtailment assets would mean the time between consecutive interruptions.

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	Traditional Generator with Capacity Obligation	DER with Capacity Obligation
Products (if qualified)	***Energy, Capacity and Ancillary Services***	***Energy, Capacity and Ancillary Services***
Day-Ahead Market	***Must-offer for 24 hours***	***Must-offer for 24 hours for Full Day service (Prorated capacity and associated payments for on-peak and daytime peak service)***
Real-Time Market	***Must be available in real-time***	***Must be available in real-time***
Activation	***Economic Dispatch or Self-Schedule***	***Economic Dispatch or Self-Schedule***

Figure 13 – Capacity Resource Obligations

NYISO has received stakeholder feedback requesting consideration of additional performance attributes when we begin the market design process. Stakeholders have indicated such attributes include service duration, operational flexibility, and response rate. The NYISO anticipates exploring these three additional attributes, as well as others recommended by stakeholders.

B. DER that are not ICAP Suppliers

DER that are not ICAP Suppliers may offer into the Energy and Ancillary Services markets and be scheduled by the NYISO. DER that are participating only in the Energy and Ancillary Service market will be expected to have similar obligations as traditional generators when they are only participating in the Day-Ahead and/or Real-Time Markets.

X. DER Integration into System Planning

Integration of DER into the NYISO's Energy, Ancillary Services, and Capacity markets will likely require changes to the existing planning, interconnection and forecasting rules and procedures. These changes, however, will be dependent on market design details that will be determined through the upcoming stakeholder process. Once the NYISO has more clarity and consensus on these details, revisions to existing rules and process will be proposed.

XI. Simultaneous Participation in Retail/Distribution-Level Programs

The NYISO expects that many DER will be connected to the distribution networks and capable of providing distribution level services to the extent its utility seeks such services. The NYISO recognizes that DER would like to provide wholesale service and retail service, thereby accessing multiple revenue streams. With the exception of certain demand response programs, simultaneous participation is a new concept to the NYISO, and is being explored to determine impacts to the markets and grid operations.

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Currently, resources participating in NYISO SCR program and EDRP have the option to participate in utility level demand response programs. The NYISO intends to continue allowing DER participating in utility level Demand Response programs to participate in the NYISO SCR program and EDRP. The NYISO is also in ongoing conversations with utilities to explore the possibility of additional dual participation opportunities (*e.g.*, NYISO will explore whether Non-Wire Alternative (NWA) resources are eligible to participate in the dispatchable DER program), but many operational, market, and legal challenges must be addressed prior to defining further opportunities for dual participation. Some of the outstanding issues that need to be addressed include:

- Whether the NYISO or DSP has operational control over a DER in a given interval, and whether that changes depending on the services provided?
- What are the appropriate communications paths when participating in wholesale and retail programs?
- How do the NYISO and utilities address conflicting market signals? A market signal from NYISO may be in direct conflict with the market signal from the DSP and vice versa. If the resource has obligations to both markets, does the DER make the decision as to which signal to follow causing uncertainty for NYISO and distribution system operators? The resource's response to these multiple signals could lead to wholesale or retail/local operational and reliability issues.
- Can individual DER in an aggregation participate in both wholesale and retail markets, or is such participation on an aggregation-wide basis (and if it is on an individual DER basis, who is responsible for non-performance, the aggregation or the DER)?
- If a storage resource charges at a wholesale rate and discharges to an end-use customer through a retail program, does the electric storage resource become a LSE by engaging in sales for resale? What regulatory issues are implicated by occasional sales for resale?
- What is the FERC's view of simultaneous participation?

The NYISO and the utilities are collaborating and discussing these challenges. Enhanced planning, operational, and market coordination will be required between all involved. As these challenges are new they may best be handled by establishing some initial concepts and validating them as Pilot Projects. Once the NYISO has determined a particular project is feasible, it can be included in the full market design. Testing new ideas as Pilot Projects allows the NYISO and its stakeholders to determine whether a project is valuable and viable while minimizing financial and reliability impacts to the entire transmission and distribution systems.

XII. Other Considerations

The NYISO has identified several other considerations it will need to address as part of its future detailed market designs. These issues include:

- Consider receiving the electric storage resource "State-of-Charge" (SOC) level from individual DER through real-time telemetry in order for the NYISO to provide State-of-Charge management, similar to the way NYISO provides State-of-Charge management for LESR. The NYISO is also reviewing other tools to facilitate electric storage resource participation in its Energy Storage Integration and Optimization project. Although this effort is aimed at front-of-the-meter resources, the tools would be made available to DER if they are found practical and useful for DER energy management.

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- The NYISO requested clarification from the Northeast Power Coordinating Council (NPCC) on whether resources that rely on inverter technology (such as batteries) can provide synchronous reserves. The NPCC has confirmed that inverter based technologies are eligible to provide synchronous reserves. NYISO intends to use this clarification from NPCC as it formulates the DER eligibility requirements for providing synchronous reserves.
- Some DER may utilize technologies that are capable of supplying leading and lagging VARs to the bulk system. If a DER wishes to qualify for Voltage Support Service (VSS), they will be subject to all of the tariff and manual requirements that apply to current service providers.
- The NYISO will consider establishing generic reference prices for DER offering in the energy market. If a resource or aggregation can demonstrate differing costs, they can consult with the NYISO's Market Mitigation and Analysis Department for an adjusted reference price.
- The NYISO will also evaluate how load served by DER operating at the time of the system peak will be incorporated into load forecasts and LSE capacity obligations.
- The NYISO will be evaluating the appropriate penalty structure for DER, including penalties for non-performance.
- The NYISO believes that energy efficiency is compensated by energy savings and reducing the load's cost to procure capacity. Therefore the NYISO will not be addressing energy efficiency in the DER Roadmap at this time.
- The dispatchable DER program design will need to consider FERC Order No. 745 compliance, including but not limited to the application of Net Benefits Test concept for load reduction based resources.

XIII. Transition plan

The DER roadmap is intended to be a starting point for conversations with stakeholders to develop the detailed market rules, requirements, and software. This effort will take several years to develop and implement. The programs currently in place will continue "as is" for the immediate future. As the market design evolves in collaboration with stakeholders, there may be interim or transitional changes made to the existing demand response programs. Ultimately, the dispatchable DER rules will supersede the economic demand response programs (DSASP and DADRP), as the new rules will offer similar benefits with increased features and flexibility. The reliability-based Demand Response programs (SCR and EDRP) are expected to continue, with some changes to better align these programs with the DER market rules. Any changes to the SCR program, including eligibility, obligations, or payments, will be addressed after the development of the dispatchable DER program concepts. If NYISO determines future changes to the SCR program are warranted, NYISO will work with stakeholders to develop an appropriate transition plan from the current rules.

XIV. Other Supporting Initiatives

A. NYISO Pilot Framework

The NYISO has a 2017 initiative to develop a framework in collaboration with its stakeholders to enable small, limited scope pilot projects to be tested in the wholesale markets to help the NYISO gain an understanding of how the integration of various new technologies will affect NYISO systems. The

expectation is that the NYISO will use that understanding to develop detailed market rules and tariff changes to fully integrate these technologies into NYISO markets and operations.

Pilot projects will allow NYISO and its stakeholders (DSPs, Aggregators and Individual Resources) to test the concepts developed to address challenges discussed in this Roadmap. By testing these concepts as pilot projects potential wholesale market integration issues can be identified and mitigated, reducing or eliminating system impacts.

To ensure that there is minimal impact on the larger transmission and distribution systems, and to prevent potential harm to other Market Participants, pilot projects will not be eligible to set prices in the NYISO markets.

B. REV Demonstration Support

The PSC's REV proceeding requires distribution utilities to propose, develop, and implement demonstration projects to advance the goals of the proceeding. The NYISO is working with the utilities as they develop these demonstration initiatives to support any efforts that require coordination or integration with bulk power system operations or wholesale markets.

C. Granular Pricing

Price transparency is a critical element of animating markets and encouraging economically efficient decision-making. The dispatchable DER market rules will automate DER activation based on price signals and the participant's economic willingness to consume electricity from the grid. This economic willingness needs to be informed by actionable information.

The NYISO currently delivers real-time load bus price signals, calculated every five minutes, at the zonal level. These price signals are comprised of sub-zonal price signals that reflect differing conditions within a given zone. Sub-zones and load pockets within a zone may experience real-time conditions that are not fully reflected in the zonal price. Pricing at the zonal level, therefore, dilutes incentives for DER to locate in areas that could provide significant benefits to the grid and the market. To facilitate more economically efficient DER benefits, the NYISO will provide more granular price signals reflecting location specific system conditions. These granular price signals are available to the NYISO, but have not been publicly available. To provide more locationally accurate pricing data to DER, resources that choose to participate in the NYISO's Energy and Ancillary Services markets will be mapped to their appropriate electrical buses and settled at the nodal price associated with the bus. The NYISO's goals are to deliver real-time nodal LBMPs, calculated every five minutes, to reflect more localized system conditions. The NYISO is currently posting a limited set of these nodal load prices at select locations around the state as part of a pilot initiative.

These granular prices will not be used for wholesale Load settlements.

D. Market Price Delivery

The NYISO will continue to post pricing data on its website, as well as in maps and graphical forms. The NYISO plans to explore other options including Automated Programmatic Interfaces (API) for sharing and transfer of nodal pricing.

E. Meter Data Policy

One of the key challenges to participation of DER in NYISO markets is accurately measuring and verifying resource performance in order to compensate resources appropriately. DER participating in the NYISO's Energy and Ancillary Services markets will require well-defined metering configurations as well as processes for calculating baseline load levels from which to measure performance. Establishing the baseline will require estimating a participant's load based on data from time periods in advance of DER

dispatch to establish an average load profile. The participant's performance, and ultimately compensation, will reflect the deviation of its load from that estimated baseline.

Behind-the-meter generators and storage devices further complicate these calculations because operation of such generation or storage for local needs alters the baseline demand making it more difficult to assess DER performance. A policy for meter data and metering requirements will be critical to ensuring the integrity of the market. The ability for the NYISO to measure gross generation and gross native load at DER sites participating in NYISO markets will be necessary to ensure that the market is properly compensating DER for their contribution to system needs. The NYISO proposes to work with stakeholders to devise and specify acceptable metering configurations and reporting requirements in compliance with meter data protocols.

Currently, the NYISO requires Market Participants to have the utility or a PSC-certified Meter Data Service Provider or Meter Service Provider to read interval meters. The NYISO recognizes that this is a potential barrier for DER to enter the market and hopes to explore options to address this barrier as the DER program evolves.

XV. Next Steps

The fundamental premise behind the NYISO's proposed dispatchable DER program initiative is straightforward: competitive markets and system operations will benefit from access to emerging technologies that can adjust demand on an economic basis in response to price signals from the market. However, developing and implementing such an initiative will entail a considerable amount of time, effort, and stakeholder engagement. The NYISO will use this roadmap over the next three to five years as a framework to develop the market design elements, functional requirements, and tariff language necessary to implement its vision to integrate dispatchable DER.

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XVI. Appendix A – Use Cases for DER in Wholesale Markets

A. Fixed Load Consumers

A consumer that can be thought of as the consumer of today, where there is little ability to change their power consumption based on price/dispatch signals. This consumer prefers to simply use power when they want, how they want, and will pay for their usage as is. They prefer to not think about or be inconvenienced by any type of load reduction or shifting due to power prices at that time.

Fixed load
Small residential customer, no controls, may have solar panels, pays weighted zonal price, no advanced metering.

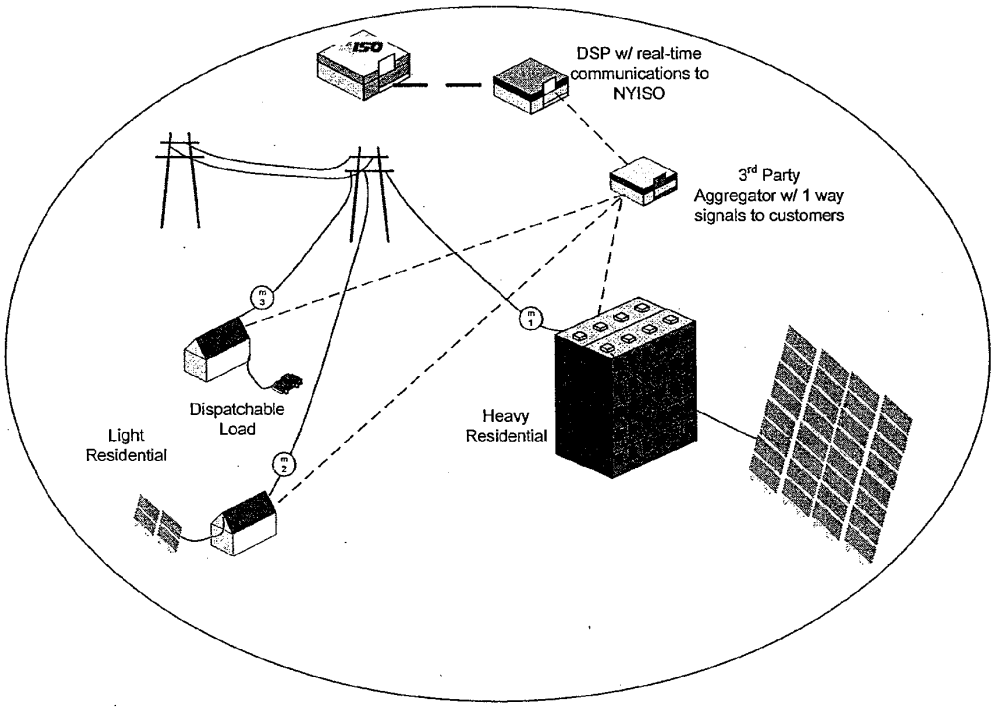
B. DER Prosumers

This prosumer is price conscious and is willing to make investments of time and/or money to generate cost savings by reacting to a price signals.

DER Prosumer Use Cases

#	Type	Description
i	Dispatchable Load	An DCEA of small to large size residential customers with dispatchable load only
ii	Dispatchable Load	Similar to #1 but there is no DCEA
iii	Dispatchable Load and Generation	An DCEA of small to large size residential customers with dispatchable load and generation with electronic communications going through an aggregator
iv	Dispatchable Load and Generation	Similar to #3 but there is no DCEA and electronic communications are direct to the DSP
v	Dispatchable Load and Storage	Similar to #3 except generation is replaced with storage
vi	Dispatchable Load and Storage	Similar to #4 except generation is replaced with storage
vii	Dispatchable Load, Storage and Generation	Similar to #3 except it includes storage
viii	Dispatchable Load, Storage and Generation	Similar to #4 except it includes storage

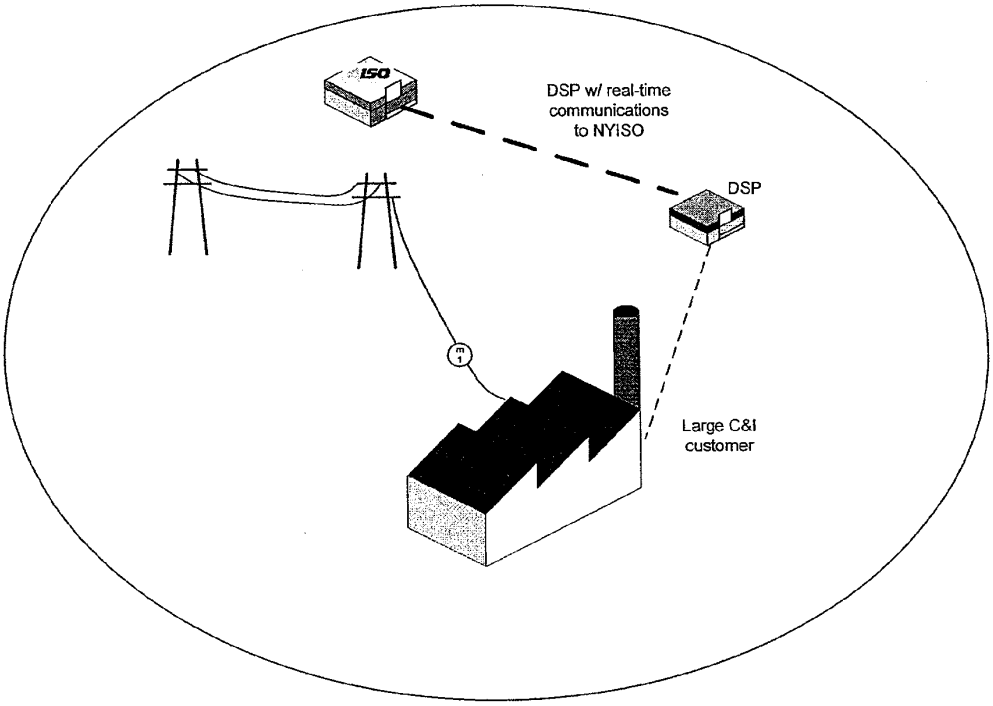
1. Use Case 1 — Dispatchable Load



Participant(s)	Small to large size residential customers
Features	Partially sophisticated load
Metering	Interval metering
Signaling	Partially sophisticated notifications to curtail load
Dispatchable	Partial load
Aggregated	Yes
Services	Energy and possibly Capacity (EDRP or SCR)
Telemetry Communications Path	N/A
Notes	

Return to Use Case List

2. Use Case 2 - Dispatchable Load



Participant(s)	Medium to large size C&I customers
Features	Partially sophisticated load
Metering	Interval metering
Signaling	Partially sophisticated notifications to curtail load
Dispatchable	Partial load
Aggregated	No
Services	Energy (EDRP)
Telemetry Communications Path	N/A
Notes	Similar to #1 but there is no aggregation

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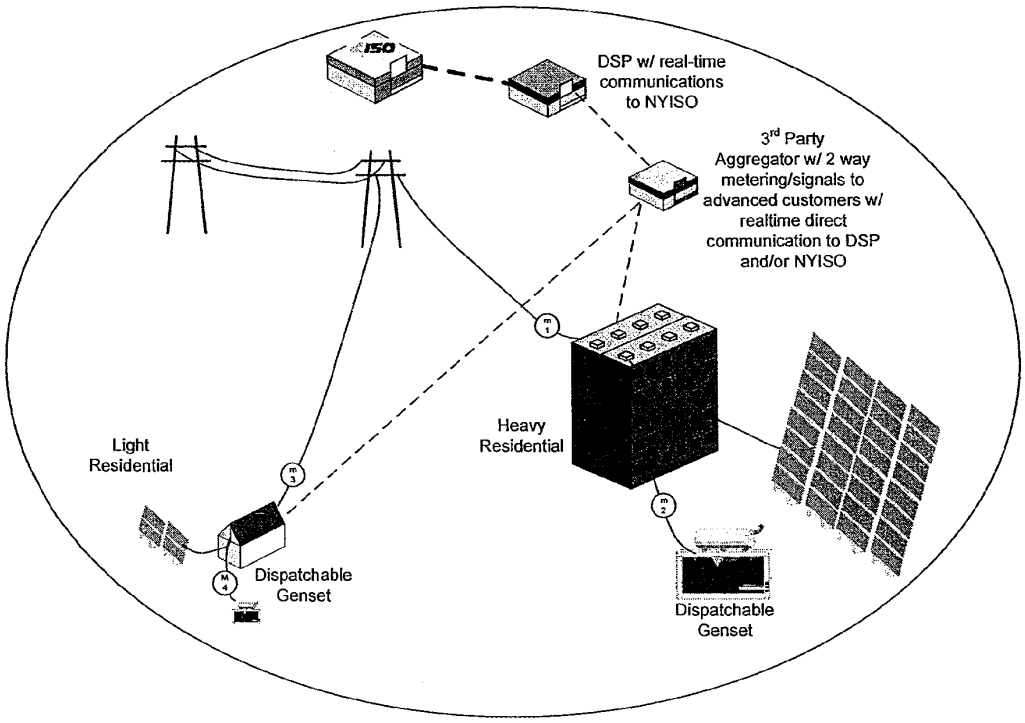
3. Use Case 3 - Dispatchable Load and Generation



Participant(s)	Small to large size residential customers
Features	Sophisticated load and sophisticated generation
Metering	Real-time metering with telemetry
Signaling	Capable of sophisticated notifications to curtail load and/or activate other services as instructed
Dispatchable	Load, storage & generation
Aggregated	Yes
Services	Energy, Capacity and Reserves
Telemetry Communications Path	Aggregator -> DSP -> NYISO
Notes	

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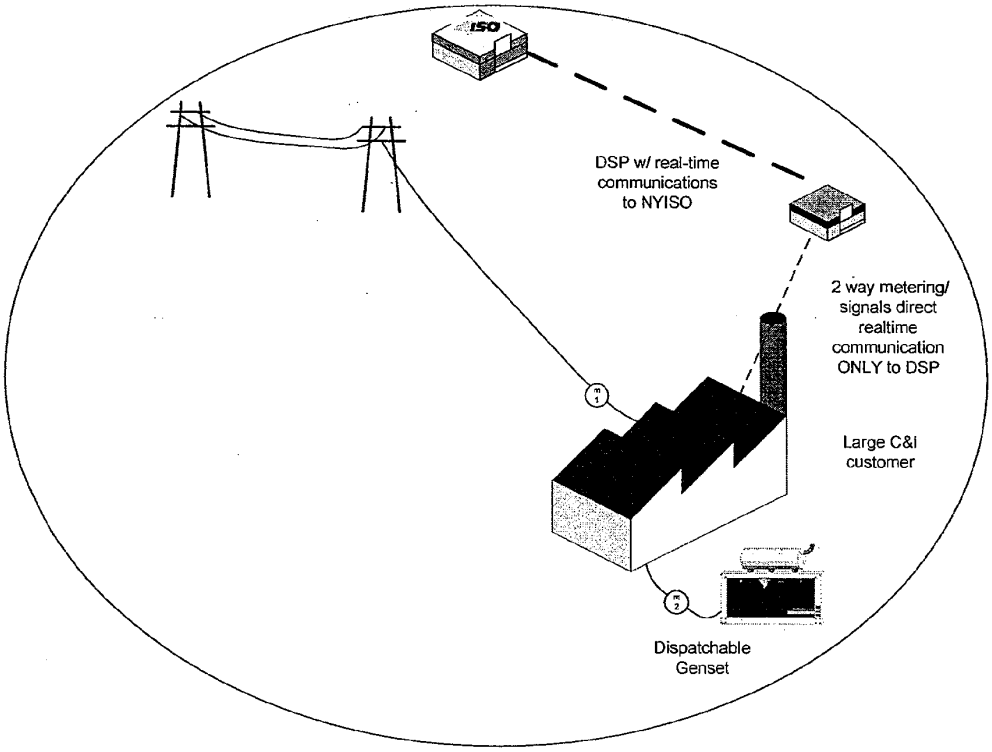
4. Use Case 4 - Dispatchable Load and Generation



Participant(s)	Medium to large size C&I customers
Features	Sophisticated load and sophisticated generation
Metering	Real-time metering with telemetry
Signaling	Capable of sophisticated notifications to curtail load and/or activate other services as instructed
Dispatchable	Load & generation
Aggregated	No
Services	Energy, Capacity, Reserves
Telemetry Communications Path	Aggregator -> DSP -> NYISO
Notes	Similar to #3 but there is no aggregation and electronic communications are direct to the DSP

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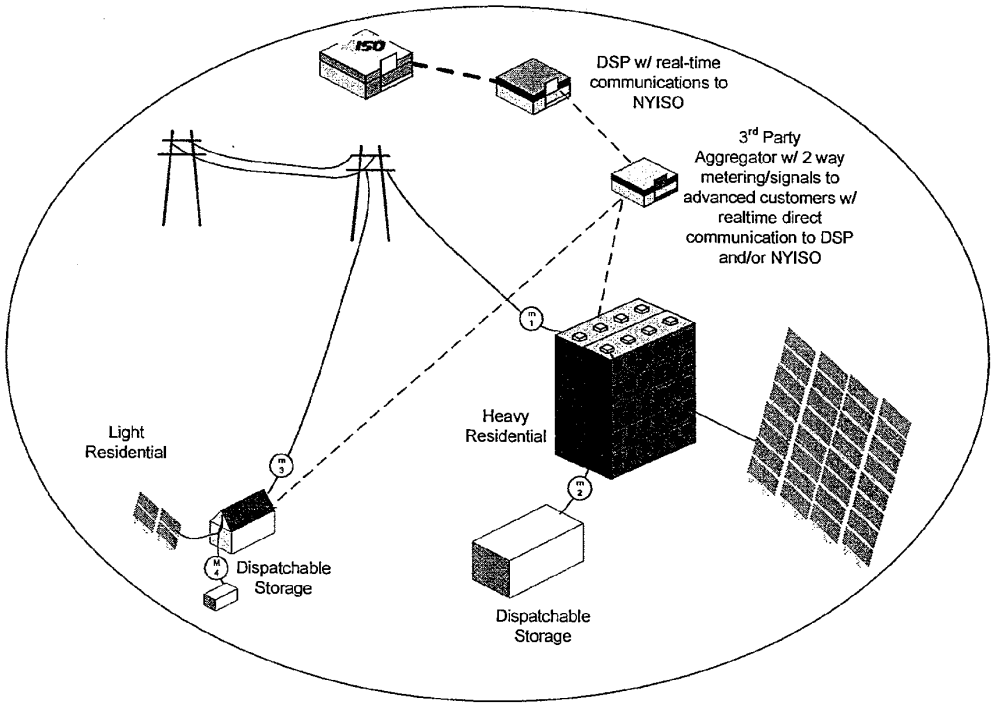
5. Use Case 5 - Dispatchable Load and Storage



Participant(s)	Small to large size residential customers
Features	Sophisticated load and sophisticated storage
Metering	Real-time metering with telemetry
Signaling	Capable of highly sophisticated notifications to curtail load and/or activate other services as instructed
Dispatchable	Load & storage
Aggregated	Yes
Services	Energy, Capacity, Reserves, Regulation
Telemetry Communications Path	Aggregator -> DSP -> NYISO
Notes	Similar to #3 except generation is replaced with storage

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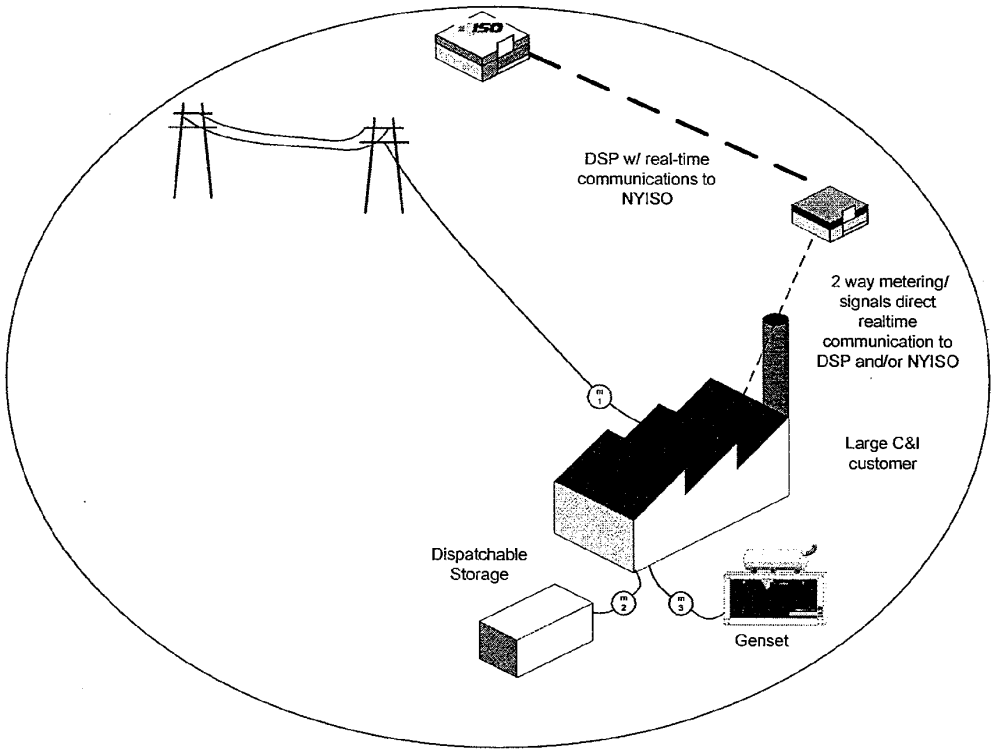
6. Use Case 6 - Dispatchable Load and Storage



Participant(s)	Medium and large size C&I customers
Features	Sophisticated load and sophisticated storage
Metering	Real-time metering with telemetry
Signaling	Capable of sophisticated notifications to curtail load and/or activate other services as instructed
Dispatchable	Load & storage
Aggregated	No
Services	Energy, Capacity, Reserves, Regulation
Telemetry Communications Path	Aggregator -> DSP -> NYISO
Notes	Similar to #4 except generation is replaced with storage

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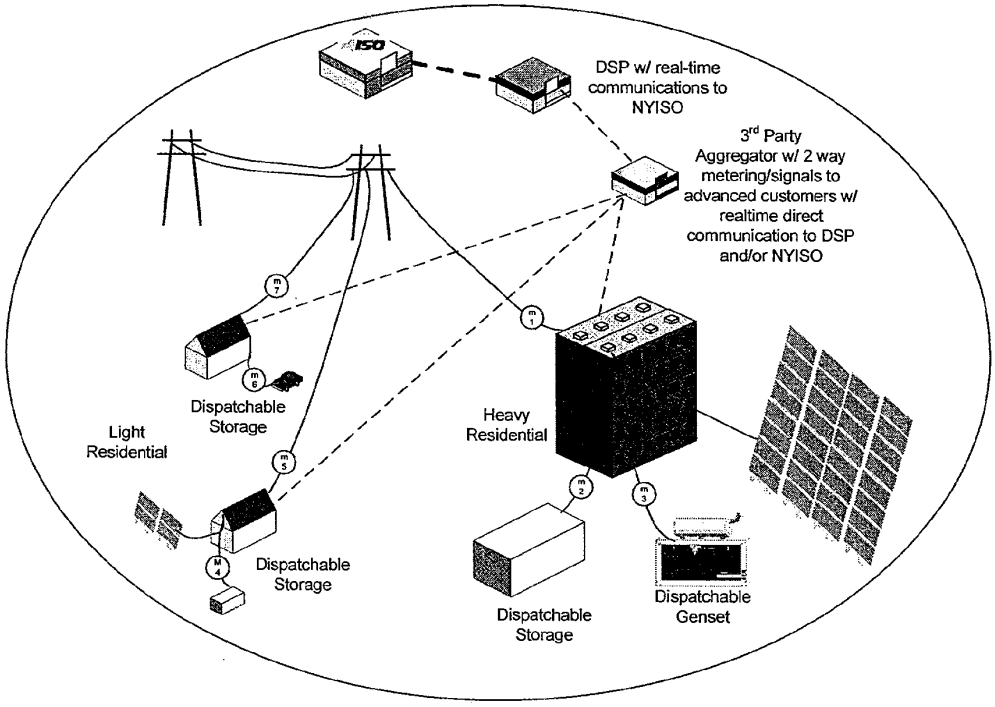
7. Use Case 7 - Dispatchable Load, Storage and Generation



Participant(s)	Small to large size residential customers
Features	Sophisticated load, sophisticated storage and sophisticated generation
Metering	Real-time metering with telemetry
Signaling	Capable of sophisticated notifications to curtail load and/or activate other services as instructed
Dispatchable	Load, storage & generation
Aggregated	Yes
Services	Energy, Capacity, Reserves, Regulation
Telemetry Communications Path	Aggregator -> DSP -> NYISO
Notes	Similar to #3 except it includes storage

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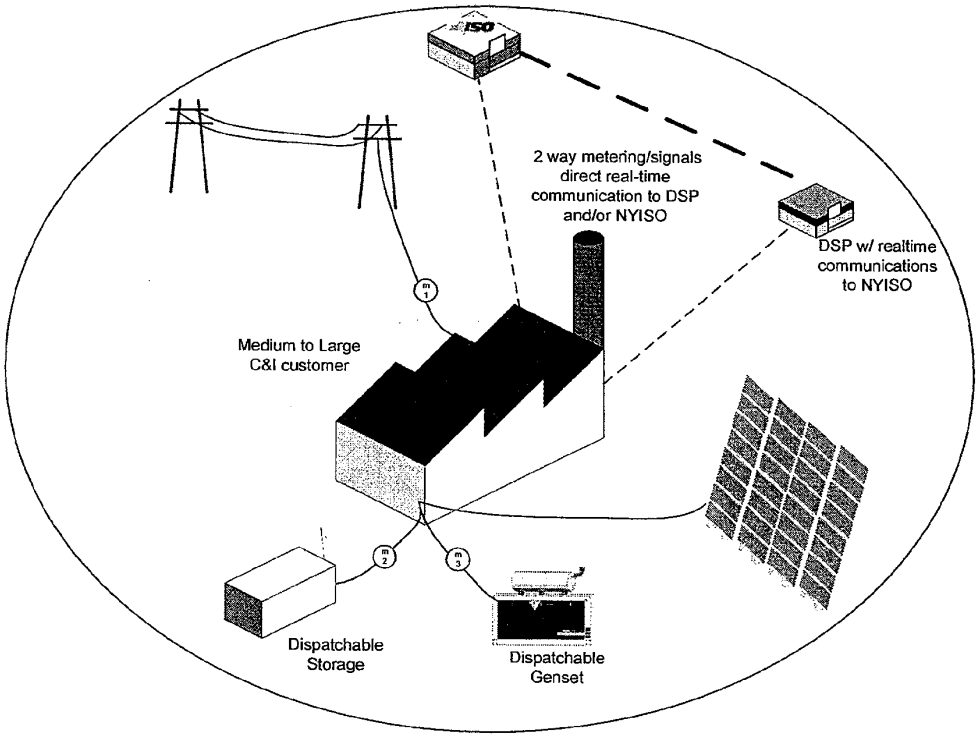
8. Use Case 8 - Dispatchable Load, Storage and Generation



Participant(s)	Medium to large size C&I customer
Features	Sophisticated load, sophisticated storage and sophisticated generation
Metering	Real-time metering with telemetry
Signaling	Capable of sophisticated notifications to curtail load and/or activate other services as instructed
Dispatchable	Load, storage & generation
Aggregated	No
Services	Energy, Capacity, Reserves, Regulation
Telemetry Communications Path	Aggregator -> (DSP and NYISO) OR (Aggregator -> DSP -> NYISO)
Notes	Similar to #4 except it includes storage

Return to Use Case List

Search History:

Limited Classification Search

The Patent Analyst performed a limited classification search within the following US, IPC, CPC, ECLA, or F-Term classification areas:

CPC Class/Subclass(es): G05B 13/027; G05B 15/02; G05F 1/66; G06Q 30/04; G06Q 50/06; H02J 11/00 (2020.08)

IPC (8) Class/Subclass(es): G05D 5/00; G05D 17/00; H02J 3/28 (2020.01)

U.S. Class/Subclass(es): 320/101; 320/128

See Global Search Results.

Global Patent Literature Text Search

The Patent Analyst performed the following global text search, which was not limited by classification but may or may not have been limited by other criteria:

Questel Orbit: https://www.orbit.com

#	Search query	Results
1	((LANCIUM+)/PA/OPA)	12
2	(POWER+ AND GRID+ AND METER+)/TI/AB/DESC/ODES/OBJ/ADB/ICLM/TX	255160
3	(POWER+ AND GRID+ AND METER+)/TI/AB/DESC/ODES/OBJ/ADB/ICLM/TX AND (320101)/PCLM	62
4	(320101)/PCLM	831
5	(320128)/PCLM	469
6	(POWER+ AND GRID+ AND METER+)/TI/AB/DESC/ODES/OBJ/ADB/ICLM/TX AND (320128)/PCLM	19
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9	(G05D-017/00)/IPC	1229
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13	(H02J-003/28)/IPC	4494

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Google Patents: https://patents.google.com

#	Search query	Results
1	power load demand second threshold	140000
2	power load demand second threshold behind meter	41600
3	power load demand second threshold behind meter btm	10
4	power load demand second threshold behind-the-meter time period	9920

5	power load demand second threshold behind-the-meter multiple time intervals	6850
6	power grid behind meter qualified scheduling entity mobile	1710
7	power grid minimum power level behind meter	40600
8	power grid minimum power threshold time period behind meter	20700
9	power grid "minimum" power threshold time period behind meter	19000
10	power grid "minimum" power threshold time period behind meter price	4730

Computer Accessed Text Databases Searched

The Patent Analyst searched the following computer accessed text databases:

Google: https://www.google.com/

#	Search query	Results
1	power load demand second threshold behind-the-meter multiple time intervals	3410000
2	power load demand second threshold behind-the-meter second time period pdf	4590000
3	power load demand second threshold behind-the-meter "behind" second time period pdf	3270000
4	power load demand second threshold behind-the-meter btm "behind" second time period pdf	3230
5	power load demand second threshold behind-the-meter btm "behind" second time period pdf peak	23500
6	power load demand second threshold behind-the-meter btm "behind" second time period pdf grid	29600
7	power grid "minimum" power threshold time period behind meter price	4570000
8	power grid "minimum" power threshold time period behind meter pdf	7880000
9	power grid "minimum" power threshold time period behind the meter cost pdf	4080000

Date search was completed: 17 December 2020

RM/MP

Electronic Acknowledgement Receipt

EFS ID:	42128237
Application Number:	16482495
International Application Number:	
Confirmation Number:	7727
Title of Invention:	Method and System for Dynamic Power Delivery to a Flexible Datacenter Using Unutilized Energy Sources
First Named Inventor/Applicant Name:	David Henson
Customer Number:	23644
Filer:	Kurt William Rohde/Melissa Mattio
Filer Authorized By:	Kurt William Rohde
Attorney Docket Number:	84008-322155
Receipt Date:	09-MAR-2021
Filing Date:	31-JUL-2019
Time Stamp:	15:18:47
Application Type:	U.S. National Stage under 35 USC 371

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)	322155_18-874-WO1-US_Supp_IDS_210309.pdf	42745 89b52deae126fcbb1723170d23f72ba498e2c50d	no	3

Warnings:

Information:					
This is not an USPTO supplied IDS fillable form					
2	Foreign Reference	WO2019139633A1_EFS.pdf	7932166 6706aa91a2180c5d16ea437f0f09077e7302e431	no	43
Warnings:					
Information:					
3	Non Patent Literature	ISR_WO_PCTUS2057686_22Feb2021_EFS.pdf	13472270 6e71187a6118ac71d46a97fb4b9083137a3febe3	no	67
Warnings:					
Information:					
4	Non Patent Literature	ISO_DistEnergRoad_2017_EFS.pdf	7198873 eeede6946ee65a351714eb480f418be8fd054313	no	39
Warnings:					
Information:					
5	Non Patent Literature	NFOA_US16284610_04Feb2021_EFS.pdf	294890 3ed1327c9058d57b2d1cf196b1716413836d41bf	no	9
Warnings:					
Information:					
6	Non Patent Literature	NFOA_US16528348_12Feb2021_EFS.pdf	4870584 de7832a8599ae63b8bc36be5cb38d7186f9cf3c2	no	54
Warnings:					
Information:					
7	Non Patent Literature	NOA_US16132062_08Feb2021_EFS.pdf	925605 002d4f5ece49626dc7db0be4b366eca891e35c55	no	21
Warnings:					
Information:					
8	Non Patent Literature	NOA_US16803109_08Feb2021_EFS.pdf	1470280 870c1d7f4c02cc56528ec3bf85af08cb9d52476c	no	29
Warnings:					
Information:					

9	Non Patent Literature	NOA_US16834987_08Feb2021_EFS.pdf	7491065 02c6ef927a29064a05ec403edd1379d74b878fba	no	180
Warnings:					
Information:					
10	Non Patent Literature	NOA_US16702894_25Jan2021_EFS.pdf	1101920 98815c94477de56b7936ea8a09fe46deffaae76b	no	24
Warnings:					
Information:					
			Total Files Size (in bytes):	44800398	

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.

Substitute for form 1449/PTO

INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Use as many sheets as necessary)

Sheet 1 of 6

Complete if Known	
Application Number	16482495
Filing Date	07-13-2019
First Named Inventor	HENSON; David
Art Unit	2187
Examiner Name	
Attorney Docket Number	84008-322155

U. S. PATENT DOCUMENTS

Examiner Initials*	Cite No.[1]	Document Number Number-Kind Code[2] (if known)	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear
	001	US-10608433	03-31-2020	McNAMARA; Michael T. et al.	
	002	US-10618427	04-14-2020	McNAMARA; Michael T. et al.	
	003	US-10637353	04-28-2020	OHYAMA; Soichiro et al.	
	004	US-20090078401	03-26-2009	CICHANOWICZ; J. Edward	
	005	US-20100235004	09-16-2010	THIND; Deepinder Singh	
	006	US-20120306271	12-06-2012	KURIYAMA; Hiroshi	
	007	US-20150012113	01-08-2015	CELEBI; Dogan	
	008	US-20150288183	10-08-2015	VILLANUEVA, Jr.; et al.	
	009	US-20150372538	12-24-2015	SIEGLER; John J. et al.	
	010	US-20160006066	01-07-2016	ROBERTSON; John S.	
	011	US-20160011617	01-14-2016	LIU; Jie et al.	
	012	US-20160043552	02-11-2016	VILLANUEVA, Jr. et al.	
	013	US-20160126783	05-05-2016	CHENG; Win Sheng et al.	
	014	US-20200073466	03-05-2020	WALSH; Sean	

FOREIGN PATENT DOCUMENTS

Examiner Initials*	Cite No.[1]	Foreign Patent Document Country Code[3]-Number[4]-Kind Code[5] (if known)	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages Or Relevant Figures Appear	T[6]
		None				

Examiner Signature		Date Considered	

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant. [1] Applicant's unique citation designation number (optional). [2] See Kinds Codes of USPTO Patent Documents at www.uspto.gov or MPEP 901.04. [3] Enter Office that issued the document, by the two-letter code (WIPO Standard ST.3). [4] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [5] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [6] Applicant is to place a check mark here if English language Translation is attached.

Substitute for form 1449/PTO

INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Use as many sheets as necessary)

Sheet 2 of 6

Complete if Known	
Application Number	16482495
Filing Date	07-13-2019
First Named Inventor	HENSON; David
Art Unit	2187
Examiner Name	
Attorney Docket Number	84008-322155

NON-PATENT LITERATURE DOCUMENTS			
Examiner Initials*	Cite No.[1]	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,page(s),volume-issue number(s),publisher, city and/or country where published.	T[2]
	001	Advisory Action mailed on 13 November 2020 for U.S. Patent Application No. 16/529,360, filed on 01 August 2019, 182 pages.	☐
	002	Advisory Action mailed on 22 October 2020 for U.S. Patent Application No. 16/528,348, filed on 31 July 2019, 3 pages.	☐
	003	Bakar.N et al., "Microgrid and Load Shedding Scheme During Islanded Mode: a Review," Elsevier, May 26, 2020, Vol. 71, pp. 161-169. https://www.sciencedirect.com/science/article/pii/S1364032116311030.	☐
	004	Choi.Y et al., "Optimal Load Shedding for Maximizing Satisfaction in an Islanded Microgrid," Energies, 2017, Vol. 10, pp.45. doi: 10.3390/en10010045.	☐
	005	Final Office Action mailed 23 July 2020 on for U.S. Patent Application No. 16/132,062, filed on 14 September 2018, 26 pages.	☐
	006	Final Office Action mailed on 19 May 2020 for U.S. Patent Application No. 16/809,111, filed on 04 March 2020, 36 pages.	☐
	007	Final Office Action mailed on 03 June 2020 for U.S.Patent Application No. 16/528,348, filed on 31 July 2019, 33 pages.	☐
	008	Final Office Action mailed on 28 May 2020 for U.S. Patent Application No. 16/132,098, filed on 14 September 2018, 24 pages.	☐
	009	Final Office Action mailed on 29 July 2020 for U.S. Patent Application No. 16/132,092, filed on 14 September 2018, 5 pages.	☐
	010	Gao.H et al., "Dynamic Load Shedding for an Islanded Microgrid With Limited Generation Resources," IET Generation, Transmission & Distribution, September 2016, Vol. 10(12), pp. 2953-2961. doi: 10.1049/iet-gtd.2015.1452.	☐
	011	International Search Report and Written Opinion of PCT Application No. PCT/US2020/044536, mailed on 26 August 2020, 24 pages.	☒

Examiner Signature		Date Considered	

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant. 1 Applicant's unique citation designation number (optional). 2 Applicant is to place a check mark here if English language Translation is attached.

Substitute for form 1449/PTO

INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Use as many sheets as necessary)

Sheet 3 of 6

Complete if Known	
Application Number	16482495
Filing Date	07-13-2019
First Named Inventor	HENSON; David
Art Unit	2187
Examiner Name	
Attorney Docket Number	84008-322155

NON-PATENT LITERATURE DOCUMENTS

Examiner Initials*	Cite No.[1]	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,page(s),volume-issue number(s),publisher, city and/or country where published.	T[2]
	012	International Search Report and Written Opinion of PCT Application No. PCT/US2020/044539, mailed on 26 August 2020, 7 pages.	☐
	013	JOHN, "Stem and CPower to Combine Behind-the-Meter Batteries and Demand Response," Energy Storage, August 08, 2017, 1 page.	☐
	014	Lim.Y et al., "Distributed Load-shedding System for Agent-based Autonomous Microgrid Operations," Energies, 2014, Vol. 7(1), pp. 385-401. doi: 10.3390/en7010385.	☐
	015	Liu.W et al., "Improved Average Consensus Algorithm Based Distributed Cost Optimization for Loading Shedding of Autonomous Microgrids,"International Journal of Electrical Power & Energy Systems, December 2015, Vol. 73, pp. 89-96. doi: 10.1016/j.ijepes.2015.04.006.	☐
	016	Mousavizadeh.S et al., "A Linear Two-stage Method for Resiliency Analysis in Distribution Systems Considering Renewable Energy and Demand Response Resources," Elsevier, 2017, pp. 443-460. doi: 10.1016/j.apenergy.2017.11.067.	☐
	017	Non-Final Office Action mailed on 12 June 2020 for U.S. Patent Application No. 16/803,109, filed on 27 December 2020, 31 pages.	☐
	018	Non-Final Office Action mailed 14 May 2020 on for U.S. Patent Application No. 16/834,987, filed on 30 March 2020, 30 pages.	☐
	019	Notice of Allowance mailed 13 October 2020 on for U.S. Patent Application No. 16/132,098, filed on 14 September 2018, 5 pages.	☐
	020	Notice of Allowance mailed 12 June 2020 on for U.S. Patent Application No. 16/834,987, filed on 30 March 2020, 9 pages.	☐
	021	Notice of Allowance mailed 13 January 2021 on for U.S. Patent Application No. 16/175246, filed on 30 October 2018, 5 pages.	☐
	022	Notice of Allowance mailed 17 September 2020 on for U.S. Patent Application No. 16/175,246, filed on 30 October 2018, 5 pages.	☐

Examiner Signature		Date Considered	

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant. 1 Applicant's unique citation designation number (optional). 2 Applicant is to place a check mark here if English language Translation is attached.

Substitute for form 1449/PTO

INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Use as many sheets as necessary)

Sheet 4 of 6

Complete if Known	
Application Number	16482495
Filing Date	07-13-2019
First Named Inventor	HENSON; David
Art Unit	2187
Examiner Name	
Attorney Docket Number	84008-322155

NON-PATENT LITERATURE DOCUMENTS

Examiner Initials*	Cite No.[1]	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,page(s),volume-issue number(s),publisher, city and/or country where published.	T[2]
	023	Notice of Allowance mailed 19 November 2020 on for U.S. Patent Application No. 16/132,062, filed on 14 September 2018, 7 pages.	☐
	024	Notice of Allowance mailed 27 January 2021 on for U.S. Patent Application No. 16/132,092, filed on 14 September 2018, 8 pages.	
	025	Notice of Allowance mailed 29 July 2020 on for U.S. Patent Application No. 16/132,011, filed on 14 September 2018, 5 pages.	☐
	026	Notice of Allowance mailed 29 October 2020 on for U.S. Patent Application No. 16/132,092, filed on 14 September 2018, 8 pages.	☐
	027	Notice of Allowance mailed 25 January 2021 on for U.S. Patent Application No. 16/132,098, filed on 14 September 2018, 5 pages.	
	028	Pashajavid.E et al., "A Multimode Supervisory Control Scheme for Coupling Remote Droop-Regulated Microgrids," IEEE Transactions on Smart Grid, May 26, 2020, Vol. 9(5), pp. 5381-5392. https://ieeexplore.ieee.org/abstract/document/7888570/.	☐
	029	Pashajavid.E et al., "Frequency Support for Remote Microgrid Systems With Intermittent Distributed Energy Resources-A Two-level Hierarchical Strategy," IEEE Systems Journal, May 26, 2020, Vol. 12(3), pp. 2760-2771. https://ieeexplore.ieee.org/abstract/document/7862156/.	☐
	030	Rudez.U and Mihalic.R, "Predictive Underfrequency Load Shedding Scheme for Islanded Power Systems With Renewable Generation," Electric Power Systems Research, May 2015, Vol. 126, pp. 21-28. doi: 10.1016/j.epsr.2015.04.017.	☐
	031	Wilson, "Utility-Scale Deployment Project of Behind-the-Meter Energy Storage for Use in Ancillary Services, Energy Resiliency, Grid Infrastructure Investment Deferment, and Demand-Response Integration," Portland State University Thesis, 154 pages (6/9/2016).	
	032	Xu.Q et al., "Distributed Load Shedding for Microgrid With Compensation Support via Wireless Network," IET Generation, Transmission & Distribution, May 2018, Vol. 12(9), pp. 2006-2018. doi: 10.1049/iet-gtd.2017.1029.	☐

Examiner Signature		Date Considered	

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant. 1 Applicant's unique citation designation number (optional). 2 Applicant is to place a check mark here if English language Translation is attached.

Substitute for form 1449/PTO

INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Use as many sheets as necessary)

Sheet 5 of 6

Complete if Known	
Application Number	16482495
Filing Date	07-13-2019
First Named Inventor	HENSON; David
Art Unit	2187
Examiner Name	
Attorney Docket Number	84008-322155

NON-PATENT LITERATURE DOCUMENTS

Examiner Initials*	Cite No.[1]	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,page(s),volume-issue number(s),publisher, city and/or country where published.	T[2]
	033	Zhou.Q et al., "Two-Stage Load Shedding for Secondary Control in Hierarchical Operation of Islanded Microgrids," IEEE Transactions on Smart Grid, May 2019, Vol. 10(3), pp. 3103-3111. doi: 10.1109/TSG.2018.2817738.	☐

Examiner Signature		Date Considered	

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant. 1 Applicant's unique citation designation number (optional). 2 Applicant is to place a check mark here if English language Translation is attached.

Substitute for form 1449/PTO				Complete if Known	
INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Use as many sheets as necessary)				Application Number	16482495
				Filing Date	07-13-2019
				First Named Inventor	HENSON; David
				Art Unit	2187
				Examiner Name	
Sheet	6	of	6	Attorney Docket Number	84008-322155

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.

☒ Authorization to charge the Fee set forth in 37 CFR 1.17(p) to Deposit Account No. 12-0913 and to charge any fee deficiencies or credit any overpayments to Deposit Account No. 12-0913.

☐ 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	/Kurt W. Rohde/	Date (YYYY-MM-DD)	January 31, 2021
Name/Print	Kurt W. Rohde	Registration Number	62923

PATENT COOPERATION TREATY

From the INTERNATIONAL SEARCHING AUTHORITY

To:
KURT W. ROHDE
BARNES & THORNBURG LLP
P.O. BOX 2786
CHICAGO, ILLINOIS 60690-2786
UNITED STATES OF AMERICA

PCT

NOTIFICATION OF TRANSMITTAL OF THE INTERNATIONAL SEARCH REPORT AND THE WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY, OR THE DECLARATION

(PCT Rule 44.1)

Date of mailing *(day/month/year)*	26 AUG 2020
Applicant's or agent's file reference **84008-323765**	**FOR FURTHER ACTION** See paragraphs 1 and 4 below
International application No. **PCT/US2020/044536**	International filing date *(day/month/year)* **31 July 2020 (31.07.2020)**
Applicant **LANCIUM LLC**	

1. ☑ The applicant is hereby notified that the international search report and the written opinion of the International Searching Authority have been established and are transmitted herewith.

   Filing of amendments and statement under Article 19:
   The applicant is entitled, if he so wishes, to amend the claims of the international application (see Rule 46):

   When? The time limit for filing such amendments is normally two months from the date of transmittal of the international search report.

   How? Directly to the International Bureau preferably through ePCT, or on paper to: The International Bureau of WIPO, 34 chemin des Colombettes, 1211 Geneva 20, Switzerland (Facsimile No.: +41 22 338 82 70)

   For more detailed instructions, see the *PCT Applicant's Guide*, International Phase, paragraphs 9.004 – 9.011.

2. ☐ The applicant is hereby notified that no international search report will be established and that the declaration under Article 17(2)(a) to that effect and the written opinion of the International Searching Authority are transmitted herewith.

3. ☐ **With regard to any protest** against payment of (an) additional fee(s) under Rule 40.2, the applicant is notified that:

   ☐ the protest together with the decision thereon has been transmitted to the International Bureau together with any request to forward the texts of both the protest and the decision thereon to the designated Offices.

   ☐ no decision has been made yet on the protest; the applicant will be notified as soon as a decision is made.

4. Reminders

   The applicant may **submit comments on an informal basis on the written opinion of the International Searching Authority** to the International Bureau. These comments will be made available to the public after international publication. The International Bureau will send a copy of such comments to all designated Offices unless an international preliminary examination report has been or is to be established.

   Shortly after the expiration of **18 months from the priority date, the international application will be published** by the International Bureau. If the applicant wishes to avoid or postpone publication, a notice of withdrawal of the international application, or of the priority claim, must reach the International Bureau before the completion of the technical preparations for international publication (Rules 90bis.1 and 90bis.3).

   Within **19 months** from the priority date, but only in respect of some designated Offices, a demand for international preliminary examination must be filed if the applicant wishes to postpone the entry into the national phase **until 30 months** from the priority date (in some Offices even later); otherwise, the applicant must, **within 20 months** from the priority date, perform the prescribed acts for **entry into the national phase** before those designated Offices. In respect of other designated Offices, the time limit of **30 months** (or later) will apply even if no demand is filed within 19 months. For details about the applicable time limits, Office by Office, see www.wipo.int/pct/en/texts/time_limits.html and the PCT Applicant's Guide, National Chapters.

   Within **22 months from the priority date, the applicant may request that a supplementary international search be carried out** by a different International Searching Authority that offers this service (Rule 45bis.1). The procedure for requesting supplementary international search is described in the *PCT Applicant's Guide,* International Phase, paragraphs 8.006-8.032.

Name and mailing address of the ISA/US **COMMISSIONER FOR PATENTS MAIL STOP PCT, ATTN: ISA/US P.O. BOX 1450 ALEXANDRIA, VA 22313-1450, UNITED STATES OF AMERICA**	Authorized officer **HARRY C. KIM**
Facsimile No. **(571)273-8300**	Telephone No. **571-272-4300**

Form PCT/ISA/220 (revised January 2019)

PATENT COOPERATION TREATY

PCT

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference **84008-323765**	**FOR FURTHER ACTION**	see Form PCT/ISA/220 as well as, where applicable, item 5 below.
International application No. **PCT/US2020/044536**	International filing date *(day/month/year)* **31 July 2020 (31.07.2020)**	(Earliest) Priority Date *(day/month/year)* **01 August 2019 (01.08.2019)**
Applicant **LANCIUM LLC**		

This international search report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This international search report consists of a total of __3__ sheets.

☐ It is also accompanied by a copy of each prior art document cited in this report.

1. **Basis of the report**

   a. With regard to the **language**, the international search was carried out on the basis of:

   ☑ the international application in the language in which it was filed.

   ☐ a translation of the international application into _____ which is the language of a translation furnished for the purposes of international search (Rules 12.3(a) and 23.1(b)).

   b. ☐ This international search report has been established taking into account the **rectification of an obvious mistake** authorized by or notified to this Authority under Rule 91 (Rule 43.6*bis*(a)).

   c. ☐ With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, see Box No. I.

2. ☐ **Certain claims were found unsearchable** (see Box No. II).

3. ☐ **Unity of invention is lacking** (see Box No. III).

4. With regard to the **title**,

   ☑ the text is approved as submitted by the applicant.

   ☐ the text has been established by this Authority to read as follows:

5. With regard to the **abstract**,

   ☑ the text is approved as submitted by the applicant.

   ☐ the text has been established, according to Rule 38.2, by this Authority as it appears in Box No. IV. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. With regard to the **drawings**,

   a. the figure of the **drawings** to be published with the abstract is Figure No. __1__

   ☐ as suggested by the applicant.

   ☑ as selected by this Authority, because the applicant failed to suggest a figure.

   ☐ as selected by this Authority, because this figure better characterizes the invention.

   b. ☐ none of the figures is to be published with the abstract.

Form PCT/ISA/210 (first sheet) (July 2019)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2020/044536

A. CLASSIFICATION OF SUBJECT MATTER

IPC: H02J 13/00; G05B 19/042
CPC: H02J 13/00

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)

CPC: H02J 13/00; G05B 19/042, 2219/2639

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)

EAST: US-PGPUB; USPAT; Search Terms: behind, meter, BTM, control$4, computer$3, processor, master, critical, deferrable, excess$4, surplus, reduc$8, power, energy, availability, devices, shar$3, shed$4, increas$3, decreas$3, servers, scada, remote, manag$3, direct$3, control$3, adjust$3, computers, farm, multiple, numerous, plurality, racks, ramp$3, up, down, usage, consumption, consum$4, sets, groups, pairs, time, period, deadline, schedul$3, expiration, completion, boot, hash, card, function, rate, memory

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 2015/012113 A1 (RAMAMURTHY ET AL.) 30 April 2015 (30.04.2015), entire document.	1-30
Y,P	US 2019/0280521 A1 (LUNDSTROM ET AL.) 12 September 2019 (12.09.2019), entire document.	1-30
Y	US 2018/0366978 A1 (MATAN ET AL.) 20 December 2018 (20.12.2018), entire document.	2, 5-7 and 24-26
Y	US 2002/0072868 A1 (BARTONE ET AL.) 13 June 2002 (13.06.2002), entire document.	8-14, 16-19 and 27-30
Y	US 2017/0261949 A1 (HOFFMANN ET AL.) 14 September 2017 (14.09.2017), entire document.	10
Y	US 2006/0161765 A1 (CROMER ET AL.) 20 July 2006 (20.07.2006), entire document.	17

☑ 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
"D" document cited by the applicant in the international application
"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
18 August 2020 (18.08.2020)	26 AUG 2020
Name and mailing address of the ISA/US **COMMISSIONER FOR PATENTS MAIL STOP PCT, ATTN: ISA/US P.O. BOX 1450 ALEXANDRIA, VA 22313-1450, UNITED STATES OF AMERICA** Facsimile No. **(571)273-8300**	Authorized officer **HARRY C. KIM** Telephone No. **571-272-4300**

Form PCT/ISA/210 (second sheet) (July 2019)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2020/044536

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 2003/0074464 A1 (BOHRER ET AL.) 17 April 2003 (17.04.2003), entire document.	18 and 28
Y	US 2013/0227139 A1 (SUFFLING) 29 August 2013 (29.08.2013), entire document.	19
Y	KR 20090012523 A (CHUNG ET AL.) 04 February 2009 (04.02.2009), entire document.	19
Y	US 2016/0170469 A1 (SEHGAL ET AL.) 16 June 2016 (16.06.2016), entire document.	27

PATENT COOPERATION TREATY

From the INTERNATIONAL SEARCHING AUTHORITY

To:
KURT W. ROHDE
BARNES & THORNBURG LLP
P.O. BOX 2786
CHICAGO, ILLINOIS 60690-2786
UNITED STATES OF AMERICA

PCT

WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY

(PCT Rule 43*bis*.1)

Date of mailing *(day/month/year)*	26 AUG 2020
Applicant's or agent's file reference	**FOR FURTHER ACTION** See paragraph 2 below
84008-323765	

International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/US2020/044536	**31 July 2020 (31.07.2020)**	**01 August 2019 (01.08.2019)**

International Patent Classification (IPC) or both national classification and IPC
IPC: H02J 13/00; G05B 19/042
CPC: H02J 13/00

Applicant **LANCIUM LLC**

1. This opinion contains indications relating to the following items:

- [x] Box No. I Basis of the opinion
- [ ] Box No. II Priority
- [ ] Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- [ ] Box No. IV Lack of unity of invention
- [x] Box No. V Reasoned statement under Rule 43*bis*.1(a)(i) with regard to novelty, inventive step and industrial applicability; citations and explanations supporting such statement
- [ ] Box No. VI Certain documents cited
- [ ] Box No. VII Certain defects in the international application
- [ ] Box No. VIII Certain observations on the international application

2. **FURTHER ACTION**

If a demand for international preliminary examination is made, this opinion will be considered to be a written opinion of the International Preliminary Examining Authority ("IPEA") except that this does not apply where the applicant chooses an Authority other than this one to be the IPEA and the chosen IPEA has notified the International Bureau under Rule 66.1*bis*(b) that written opinions of this International Searching Authority will not be so considered.

If this opinion is, as provided above, considered to be a written opinion of the IPEA, the applicant is invited to submit to the IPEA a written reply together, where appropriate, with amendments, before the expiration of 3 months from the date of mailing of Form PCT/ISA/220 or before the expiration of 22 months from the priority date, whichever expires later.

For further options, see Form PCT/ISA/220.

Name and mailing address of the ISA/US	Date of completion of this opinion	Authorized officer
COMMISSIONER FOR PATENTS MAIL STOP PCT, ATTN: ISA/US P.O. BOX 1450 ALEXANDRIA, VA 22313-1450, UNITED STATES OF AMERICA	**18 August 2020 (18.08.2020)**	**HARRY C. KIM**
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Form PCT/ISA/237 (Cover sheet) (revised January 2019)

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/US2020/044536

Box No. I Basis of the opinion

1. With regard to the **language**, this opinion has been established on the basis of:
   - [x] the international application in the language in which it was filed.
   - [ ] a translation of the international application into _____ which is the language of a translation furnished for the purposes of international search (Rules 12.3(a) and 23.1(b)).

2. [ ] This opinion has been established taking into account the **rectification of an obvious mistake** authorized by or notified to this Authority under Rule 91 (Rule 43*bis*.1(b)).

3. [ ] With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, this opinion has been established on the basis of a sequence listing:
   - a. [ ] forming part of the international application as filed:
     - [ ] in the form of an Annex C/ST.25 text file.
     - [ ] on paper or in the form of an image file.
   - b. [ ] furnished together with the international application under PCT Rule 13*ter*.1(a) for the purposes of international search only in the form of an Annex C/ST.25 text file.
   - c. [ ] furnished subsequent to the international filing date for the purposes of international search only:
     - [ ] in the form of an Annex C/ST.25 text file (Rule 13*ter*.1(a)).
     - [ ] on paper or in the form of an image file (Rule 13*ter*.1(b) and Administrative Instructions, Section 713).

4. [ ] In addition, in the case that more than one version or copy of a sequence listing has been filed or furnished, the required statements that the information in the subsequent or additional copies is identical to that forming part of the application as filed or does not go beyond the application as filed, as appropriate, were furnished.

5. Additional comments:

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/US2020/044536

Box No. V **Reasoned statement under Rule 43*bis*.1(a)(i) with regard to novelty, inventive step and industrial applicability; citations and explanations supporting such statement**

1. Statement

Novelty (N)	Claims	1-30	YES
	Claims	NONE	NO
Inventive step (IS)	Claims	1-30	YES
	Claims	NONE	NO
Industrial applicability (IA)	Claims	1-30	YES
	Claims	NONE	NO

2. Citations and explanations :

---------- **EXPLANATION** ----------

Claim(s) 1-30 meet the criteria set out in PCT Article 33(2)-(3) because the prior art does not teach or fairly suggest the claimed invention.

Claim(s) 1-30 meet the criteria set out in PCT Article 33(4), and thus have industrial applicability because the subject matter claimed can be made or used in industry.

This rendering is not an exact copy of the original publication. The information included here is related content which may have been OCR'd or acquired independently. If this is about a patent or application, the official version originates solely from the issuing authority. If you need a copy of the original, it may be available as an additional download option.

Publication Number: KR 2009-0012523 A
PUBLISHED ON 4-Feb-2009

Application Number: KR 2007-0076426 A
FILED ON 30-Jul-2007

A dynamic hashing based load balancing system and its method (English)
동적 해싱 기반의 부하 분산 시스템 및 그 방법 (Korean)

Korea Invention Application Publication (Source: KR)

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Classifications: International (2006.01): G05F 15/16

Priority: KR 2007-0076426 A (30 Jul 2007)

Abstract (English)

The present invention has been made to solve the technical problem of the hashing algorithm of the conventional load balancer, and it is a session-based algorithm while taking infinite session processing capacity and high-speed processing speed with only a small amount of memory designated as an advantage of the hashing algorithm. As the hashing value is changed due to the sophistication of load balancing and the redistribution when the server is added / deleted or the server is overloaded, the problem of not guaranteeing the connectivity between the user and the server and the problem of degrading the caching effect are solved. The present invention relates to a load balancing system based on dynamic hashing that provides high performance even in a small system having a low specification.

The present invention is installed in front of the servers for load balancing to receive the request of the user 101 to the server and delivers to the server; The system has more hashing values than the number of servers; The hashing value is properly distributed to each server; Calculates a hashing value using some information of the user 101's request; Sends a request of the user 101 to a server having the corresponding hashing value; Load balancing is performed by allocating a portion of the hashing value of each server to the added server when the server is added; Distributes the hashing value of the server to other servers when the server is deleted / failed; If excessive requests are concentrated on one server, some of the hashing values are moved to other servers to balance the load appropriately; If excessive load is concentrated on a particular hashing value, it is then distributed among multiple servers; Such a series of tasks are processed at a time interval by scheduling so that the request of the user 101 is naturally passed from the server having the hashing value to the other server; For the purpose of sticking between the request of the user 101 and the server, the session of the user 101 is identified for the hashing value passed to another server, and the connection between the user 101 request and the server is maintained for a predetermined time. A system that includes applying hashing based load balancing only for new sessions.

A system and a method for distributing load based on dynamic hashing to improve caching effect are provided to guarantee connectivity between a user and a server, and improve the caching effect by using ingenious load distribution, and changing a hashing function in addition, removal, and overload of the server. A hashing value extractor(420) calculates a hash value from information by a user request. A hashing table(430) moves the hashing value to change a server allocated when the server is added, removed, failed, or overloaded. A hashing value movement information table(440) stores contextual information, such as hashing value moving time, session recording time, and overload state information for the hashing value, capable of moving the hashing value. A session table(450) stores session information for the user request for a predetermined time. A load distribution controlling and failure monitoring unit(410) includes a function for excluding the server from candidates when a failure occurs in the server by periodically checking the state of the servers.

Abstract (Korean)

본 발명은 종래 부하분산기의 해싱알고리즘의 기술상의 문제점을 해결하기 위해서 안출된 것으로서, 해싱 알고리즘의 장점인 지정된 소량의 메모리만으로 무한대의 세션 처리 능력과 고속의 처리속도를 그대로 취하면서, 세션 기반의 알고리즘들의 장점인 부하분산의 정교함과 서버의 추가/삭제 또는 서버 과부하시의 재분배로 해싱값이 변화하게 됨에 따라 사용자와 서버간의 연결성을 보장하지 못하는 문제점과 캐싱 효과가 저하되는 문제점을 해결하며, 이를 통하여 낮은 사양

의 소형 시스템에서도 고성능의 기능을 제공하는 동적 해싱 기반의 부하 분산 시스템 및 그 방법에 관한 것이다.

본 발명은 부하분산을 위하여 서버를 앞단에 설치되어 서버로 향하는 사용자(101)의 요청을 수신하여 서버에 전달하며; 상기 시스템은 서버의 수보다 많은 해싱값을 가지며; 해싱값은 각각의 서버에게 적절하게 분배가 되며; 사용자(101)의 요청 중 일부 정보를 사용하여 해싱값을 계산하며; 해당 해싱값을 가지고 있는 서버에게 사용자(101)의 요청을 전달하며; 서버의 추가 시에 각각의 서버가 가지고 있는 해싱값의 일부를 추가된 서버에 할당하여 부하분산을 수행하며; 서버의 삭제/장애 시에 해당 서버가 가지고 있는 해싱값을 타 서버에 분배하며; 특정 서버에 과도한 요청이 집중한 경우에 해싱값의 일부를 다른 서버로 이동하여 부하를 적절히 분산하며; 특정 해싱값에 과도한 부하가 집중한 경우 이를 다수의 서버로 부하분산하며; 상기와 같은 일련의 작업이 스케줄링에 의해 시간 간격을 두고 처리함으로써 사용자(101)의 요청이 해싱값을 가지고 있는 서버에서 타 서버로 자연스럽게 넘어가도록 하며; 사용자(101)의 요청과 서버간의 연결성 보장(stickiness)을 위하여 타 서버로 넘기는 해싱값에 대해서 사용자(101)의 세션을 파악하여 일정시간동안 사용자(101) 요청과 서버간의 연결 관계를 유지하며 그 외의 신규 세션들에 대해서만 해싱 기반의 부하분산을 적용하는 것을 포함하는 시스템이다.

부하분산기, 서버 추가, 서버 삭제/장애, 과부하, 동적 해싱, 스케줄, 세션

Document Description

Dynamic Hashing based Load Balancing System and Its Method

The present invention relates to a hashing-based load balancer, and more particularly, to fine-tune load balancing, which is an advantage of session-based algorithms, while maintaining low memory utilization, infinite session processing capacity, and high throughput. When adding / deleting / overloading servers and servers, changes in hashing function ensures connectivity between users and servers and improves caching effects. Therefore, it provides an efficient load balancer through a simple load balancing algorithm. A dynamic hashing based load balancing system and method thereof are provided.

In general, there are Layer 4 methods for load balancing based on IP addresses and ports, and Layer 7 methods for load balancing addresses using identifiers in applications such as HTTP URLs and cookies. Regardless of which information is used as the address, all the load balancers use the same load balancing algorithm. Representative techniques include round-robin, least connection, load balancing based on response time, load balancing using server status or load information. Use them.

1 is a block diagram illustrating a general situation in which a conventional load balancer is used. In general, load balancing techniques are a technique for properly distributing connections between a request of a user 101 or a user 101 and servers 1, 2, 3, (104, 105, and 106) to a server. Units are called sessions or connections. Since these algorithms allocate and use a certain amount of memory per session in the load balancer, the number of sessions increases when the request of the user 101 or the user 101 increases, and the memory usage of the load balancer increases proportionally. In order to find a session at high speed, we introduce a hashing technique to find a session.

However, this session-based load balancing method finds infinite sessions within a finite hashing table. When the number of sessions increases due to many users 101, the search time increases in proportion to the load balancer processing speed. The disadvantage is that the limit is proportional to the size of the finite memory.

In addition, the load balancers 103 together with the load distribution between the servers 1, 2, 3 (104, 105, 106) If the user 101 connection or identification information cannot be shared between the application servers 1, 2, 3 (104, 105, 106). The stickiness between the user 101 and the servers 1, 2, 3 (104, 105, 106) must be maintained. In this case, when the user 101 attempts to access the server or requests information from the user 101 side, his identification information should be attached and sent, and the load balancer 103 should keep the identification information for a certain time, and within a certain time. When a request with the identification information comes in, it must be delivered to the same server. If connectivity is not guaranteed in such a situation, a problem arises in that the application cannot be used normally. This is one of the reasons why session-based load balancing algorithms are often used.

The hashing algorithm, which does not belong to the session-based load balancing algorithm, uses a hashing function based on the number of load balancing target servers. Instead of recording a session, the hashing algorithm judges the value from the hashing function as the load balancing result and requests the user 101 to the server. To pass. In the above method, the request of the user 101 and the user 101 is converted into a hashing value through a hashing function of information such as a source IP address, a source IP address and a port, an HTTP cookie, a URL, and a URI. To select the server.

For example, a conventional server load balancing method using a hashing algorithm will be described.

Suppose there are six servers in a server group, server 0, server 1, .. server 5. Modulo 6 is applied to the source IP address value in the user's request packet, and the corresponding server is determined by the result value (0 ~ 5).

Since the hashing-based load balancing algorithm uses a hashing function unlike the session-based load balancing algorithm, it does not consider the load information of the server at all and does not allocate a session for each of the user 101 and the request of the user 101. Even if the number of requests of the user 101 or the user 101 increases, there is no increase in the memory in the load balancer, and thus there is an advantage that the user 101 or the user 101 may process requests indefinitely.

In addition, since the request of the user 101 or the user 101 is transmitted only to a specific server, the connection security and the caching effect of the server may be increased.

However, since the servers 104, 105, and 106 are determined by the hashing value, the load distribution is not sophisticated, and when the input value of the hashing function uses only the source IP address, the proxy or source network address translation (SNAT) is used. The requests of the users 101 who came through are seen as one user 101 and the load is concentrated on a specific server. In addition, when a server add / delete / failure occurs, the algorithm using the hashing function based on the number of servers changes the hashing function due to the change in the number of available servers, resulting in a change in the connection between the user's request and the server. As

a result, there is a problem in that it does not guarantee the stickiness between the user 101 or the user 101 and the server, which may have a problem that the connection is disconnected or the application malfunctions according to the characteristics of the server application.

When using a hashing-based algorithm, even if any server in the server group becomes overloaded and needs to relocate some of the sessions that the server was in charge to another server, the request of the user 101 or the user 101 described above. There is a problem that does not guarantee the stickiness between the server and the server.

In the existing hashing-based load balancing algorithm, if the number of available servers in the server group is changed, the hashing function is changed to break the stickness between the user and the server. The situation in which the number of servers changes is largely divided into three. A situation where a failure occurs in a server, the average server load in the server group is too low, or the server is deleted when the server is down for maintenance server purposes, and the server load in the server group is too high. . Another situation where the number of servers remains unchanged, but stickiness is broken, can occur when a particular server in a server group is too heavy to redistribute user requests to other servers. In any of the above situations, if any server fails, connection security cannot be maintained even if a session-based load balancing algorithm is used.

Hashing based load balancing techniques are known in the art. For example, since the patent specification relating to the overload control method and apparatus of the load balancing system of Patent No. 0713625 registered on April 25, 2007 is also described, a detailed description of the hashing-based load balancing technique is omitted here.

SUMMARY OF THE INVENTION The present invention has been made to solve the above-mentioned problems of the prior art, and an object of the present invention is to provide a method of session-based algorithms while maintaining low memory utilization, infinite session processing capability, and high processing speed. It is a dynamic hashing-based load balancing system that guarantees connectivity between users and servers and improves caching effect due to the sophistication of load balancing and changes in the hashing function during server addition / deletion / overload.

Another object of the present invention is to provide a load balancing system based on a dynamic hashing that provides an efficient load balancer through a simple load balancing algorithm, thereby providing a high performance function even in a small system.

It is still another object of the present invention to maintain the low memory utilization, infinite session processing capability, and high processing speed of the hashing algorithm, while the load balancing sophistication and server addition / deletion / overload are advantages of the session-based algorithm. It is to provide a load balancing method based on dynamic hashing that guarantees connectivity between user and server and improves caching effect by changing hashing function.

It is still another object of the present invention to provide an efficient load balancer through a simple load balancing algorithm, thereby providing a load balancing method based on dynamic hashing that provides high performance to a small system.

Dynamic hashing-based load balancing system of the present invention for achieving the above object is a hashing-based load balancer that distributes the user's request to the server groups, and calculates any information in the user's request as a hashing value Hashing value extractor; A hashing table for selecting a processable server using the calculated hashing value, and moving the hashing value to change a server assigned at the time of addition / deletion / fault / overload of the server; In order to dynamically change the connection between hashing value and server while guaranteeing connectivity between user request and server when adding / deleting server or specific server overload, hashing time movement time, session recording time and overload status information about hashing value A hashing value movement information table containing situation information in which the hashing value can move; A session table capable of recording session information about a user request for a predetermined time in order to smoothly move the hashing value when the server is added / deleted or overloaded; A load that includes a function of excluding a server from candidates when a failure occurs by periodically checking the status of the servers while selecting one of a plurality of target servers to which a user request is delivered while using the table information or updating the table information. It is characterized by consisting of distributed control and fault monitoring unit.

In the dynamic hashing-based load balancing system of the present invention, the hashing value extractor may also use any part of the information in the user request information to calculate the hashing value; This information is characterized by the use of IP addresses, TCP / UDP ports, cookies included in HTTP, URLs, URIs, and any other information in packets.

In the dynamic hashing-based load balancing system of the present invention, the load balancing control and fault monitoring unit evenly distributes the hashing value processed by the server when one server in the load balancing server group fails to the remaining load balancing target servers. To this end, the hashing values may be evenly distributed or the number of hashing values may be evenly distributed using the average load information for each hashing value.

In the load balancing system based on the dynamic hashing of the present invention, the load balancing control and fault monitoring unit distributes the hashing values processed by the server evenly to the remaining load balancing target servers when one server in the load balancing server group is deleted. To this end, the hashing value may be evenly distributed or the number of hashing values may be evenly distributed by using the load information average value for each hashing value.

The load balancing system based on the dynamic hashing of the present invention may further include the load balancing control and fault monitoring unit to distribute the hashing values processed by the servers evenly to the newly added server when a new server is added in the load balancing server group. The hashing value may be evenly distributed or the number of hashing values may be evenly distributed by using the load information average value for the hashing value.

In the dynamic hashing-based load balancing system of the present invention, the load balancing control and fault monitoring unit may continue processing by a specific server in the load balancing server group, but the load balancing system may be in a state exceeding a normal load. When the first overload threshold is exceeded, the load information of the hashing value of the server is used to distribute hashing values among the smaller loads among the servers having a smaller load than the server.

The dynamic hashing-based load balancing system of the present invention also includes the load balancing control and fault monitoring unit having exceeded the secondary overload threshold specified in the hashing value movement information table, in which a specific server in the load balancing server group cannot continue to process. In this case, the server finds a hashing value causing the overload, and distributes a user request to the hashing value to all or small load servers sequentially or through another method corresponding thereto.

In the dynamic hashing-based load balancing method of the present invention, in a hashing-based load balancer that distributes and distributes user requests to server groups, the hashing table has more hashing values than the number of servers in the hashing table. Hashing in the hashing table without changing the size of the hashing value in the server reassignment situation, including the case where the number of servers to be changed due to the failure / deletion / addition of the server or the load redistribution to another server occurs when an arbitrary server is overloaded. By dynamically changing servers to which values are assigned, the server may be reassigned through hashing.

The dynamic hashing-based load balancing method of the present invention also has a hashing-based load balancer that distributes and distributes user requests to server groups, and has more hashing values than the number of servers in the hashing table. In case of server relocation including the case where the number of servers operating due to the deletion / addition of arbitrary server is changed or the load is over-loaded from one server to another server, all hashing values are not moved to another server immediately. It is characterized in that the hashing-based load balancer prevents the user's request from being disconnected from the server by gradually moving the request based on a predetermined time so that the existing connection between the request and the server is not broken.

The dynamic hashing-based load balancing method of the present invention also has a hashing-based load balancer that distributes and distributes user requests to server groups, and has more hashing values than the number of servers in the hashing table. In the server reassignment situation, including the case where the number of servers operating due to the deletion / addition of any server is changed or the server wants to redistribute the load to another server in case of an overload in any server, the user's request and server The session table is temporarily operated for storing and referencing the user's request and connection information with the server until the hashing value movements are completed.

The dynamic hashing-based load balancing method of the present invention also has a hashing-based load balancer that distributes and distributes user requests to server groups, and has more hashing values than the number of servers in the hashing table. In the case of server relocation including the case where the number of servers operating due to the deletion / addition of any server is changed or the load redistribution to another server is overwhelmed by an overload in a certain server, the movement to another server is required to ensure the user's connectivity. Generate session information on a request of a user who has entered the hashing value for a specified time with respect to the determined hashing value; The generated session information is maintained for a predetermined time; If the user 101's request for an existing session is received within a certain time, the session is further maintained for a specified time; Maintain a connection with a server for a specified time for the session being held; Forwarding the user's request by a hashing method to the user's request not registered in the session within the designated time; The user's request in which the session is recorded may be delivered to a new server or another server by a hashing method after a certain time.

The dynamic hashing-based load balancing method of the present invention is also installed in front of the servers for load balancing to receive a user's request to the server and deliver it to the server; The system has more hashing values than the number of servers; The hashing value is properly distributed to each server; Calculates a hashing value using some information of the user's request; Forward the user's request to the server with the corresponding hashing value; Load balancing is performed by allocating a portion of the hashing value

of each server to the added server when the server is added; Distributes the hashing value of the server to other servers when the server is deleted / failed; If excessive requests are concentrated on one server, some of the hashing values are moved to other servers to balance the load appropriately; If excessive load is concentrated on a particular hashing value, it is then distributed among multiple servers; Such a series of tasks are processed at a time interval by scheduling so that a user's request naturally passes from a server having a hashing value to another server; It checks the user's session for the hashing value passed to other server for the stickiness between the user's request and the server and maintains the connection relationship between the user's request and the server for a certain period of time. It is characterized by applying load balancing.

The dynamic hashing-based load balancing system and method thereof of the present invention are different from the conventional method (unbalance of load) in which user requests are distributed unevenly among servers in server addition / deletion / failure / overload situations. Evenly distributes requests between servers (evenly load). In addition, dynamic hashing-based load balancing system and its method are continuously connected between user request and server regardless of the situation, unlike the existing method in which a continuous connection relationship between a user request and a server cannot be established in a server add / delete / fault / overload situation. The connection is established.

Hereinafter, the present invention will be described in more detail with reference to the accompanying drawings.

1 shows a general situation in which a conventional load balancer 103 is used. When the user 101 requests a web service through the internet network 102, the load balancer 103 installed in front of the server 1 104, the server 2 105, and the server 3 106 makes the request most quickly. The request of the user 101 is sent to the server capable of processing. In this case, when hashing is used in the load balancing policy, requests of the same user 101 may be mapped 1: 1 to the same server. For example, if the server 1 104 processes the user 101 request 1, the server 1 104, which has processed this, is processed again when the user 101 request 1 is requested again.

2 is a block diagram illustrating a structure of a conventional hashing-based load balancer 200. The conventional load balancer 200 includes a hashing value extractor 220, a hashing table 230, a load balancing control and a fault monitoring unit 210.

The hashing value extractor 220 is responsible for calculating arbitrary information as a hashing value in a user's request, and the hashing table 230 is responsible for selecting a server that can be processed using the calculated hashing value. . The load balancing control and fault monitoring unit 210 selects a target server to which a user request is delivered from among several servers using hashing table information, and periodically checks the state of the servers to exclude the server from candidates when a failure occurs. In charge of the function.

3 is a block diagram illustrating a conventional hashing-based load balancer 320 to process a user's request 310. The load balancer 320 extracts a hashing value of 1 from the user request 310 information through the hashing value extractor 321, and finds the server 330 2 assigned to the hashing value 1 in the hashing table 322. It sends a request to the server (330) 2.

4 is a block diagram showing the structure of the load balancer 400 based on the dynamic hashing of the present invention.

The dynamic hashing-based load balancer 400 according to the present invention includes a hashing value extractor 420, a hashing table 430, a hashing value movement information table 440, a session table 450, a load balancing control and a fault monitoring unit (410).

The hashing value extractor 420 is responsible for calculating arbitrary information as a hashing value in a user's request, and the hashing table 430 is responsible for selecting a server that can be processed using the calculated hashing value. .

The hashing value movement information table 440 is a hashing value movement time and a session recording time to dynamically change the connection relationship between the hashing value and the server while ensuring connectivity between the user request and the server when a server is added / deleted or overloaded. And situation information in which the hashing value can move, such as overload state information for the hashing value.

The session table 450 records session information on a user request for a predetermined time in order to smoothly move a hashing value when a server is added / deleted or overloaded. The load balancing control and failure monitoring unit 410 checks the status of the servers periodically by selecting one of a plurality of servers to which the user request is to be delivered while using the table information or updating the table information. Responsible for removing the server from the candidate.

5 is a block diagram illustrating a process of processing the user's request 510 by the dynamic hashing-based load balancer 520 of the present invention.

In a general situation in which a situation such as server deletion / failure / addition / overload does not occur, the process of processing the user's request 510 by the dynamic hashing-based load balancer 520 of the present invention is performed by the conventional load balancer 320. Same as the process of processing the user's request (310). The load balancer 520 extracts a hashing value of 5 through the hashing value extractor 521 from the user request 510 information, and finds the server 530 2 assigned to the hashing value 5 in the hashing table 522 of the user. It sends the request 510 to the server 530 2.

However, in special situations such as deletion / fault / addition / overload of the server 530, FIG 7, 8, 9, and 10 illustrating an embodiment of the present invention will follow.

6A and 6B are block diagrams illustrating the structure of the hashing value movement information table 440 and the session table 450 in the load balancer based on the dynamic hashing of the present invention.

The hashing value movement information table 440 includes a movement time, a session recording time, a threshold value of one overload level, and a threshold value of two overload levels. The movement time represents the time taken for the actual hashing value to move by scheduling, and the session recording time represents the time for recording the session of the hashing value to be moved. The hashing value whose movement is determined according to the situation of the server should be moved to another server within 60 seconds by the scheduling time. The session recording time is used as a criterion for determining whether or not the corresponding hashing value may be moved. The load balancer determines that the session does not need to be maintained any longer when there is no request for 60 seconds based on the session recording time and moves only the hashing value. The overload threshold is a value that is compared with the load of the server. If the load of the server is between the threshold 80 of the first stage of overload and the threshold 100 of the second stage of overload, the load balancer determines that the server is in the first stage of overload. In addition, if the load of the server is equal to the threshold value 100 of the second stage of overload, the load balancer determines that the server is in the second stage of overload. The session table 450 is composed of a source address and port, a destination address and port, a real server address and port, and a hashing value.

The general hashing-based load balancing method connects the previous user 101 to the server 104 because the server 104 recalculates the hashing value using the number of available servers 104 in case of deletion / fault and addition. The connection is changed to a state that is not preserved and recalculated. In this case, in the case of the web application, the connection of the user 101 is terminated, and in the case of the caching server 104, the hit rate decreases rapidly. 7 and 8 relate to a method for minimizing recalculation of hashing values in the case of server 104 deletion / failure and addition to solve this problem.

FIG. 7 is a block diagram illustrating an operation process of processing a deletion / failure of a server using the dynamic hashing-based load balancer 520 of the present invention. For example, if server 3 is deleted or fails, the hashing values that server 3 handled are transferred to servers 1 and 2. In this example, the hashing values 6 and 7 handled by server 3 are moved to server 1 (arrows 721 and 722), and the hashing values 8 handled by server 3 are transferred to server 2 (arrows 723). In case of server failure, the guarantee of connectivity between the user request and the server is broken, so the above hashing value movement occurs. On the other hand, in the case of server deletion, the hashing value movement can be gradually performed to guarantee user request and connectivity with the server. When the server needs to be deleted, information about the incoming session for a certain period of time is recorded in the session table. After that, when a user request comes in, the session table is searched to determine whether or not it is an existing session.

If the session is new, for example, if the hashing value is 8, the server 2 is allocated according to the reassignment principle. If it is an existing session, it is determined whether a request comes in within a certain time. If the user request comes back for a certain period of time, it is assigned to the existing server 3 (this is determined by step F123 of FIG. 11). The information of server 3 is registered in the corresponding session and the actual server address in the corresponding session in the session table of FIG. 6-b. the / port field contains information about Server 3).

If the request comes in after a certain period of time, it is determined that the session does not need to be maintained. For example, if the hashing value is 8, the server 2 is allocated according to the reassignment principle. If all the requests processed by the existing server 3 are finished and the server 3 is no longer responsible, the server 3 is deleted. In the process of moving a hashing value when deleting a server, the hashing value is gradually moved by using hashing movement time and session recording time information in the hashing value movement information table 440. The session table runs only temporarily for hashing value movement.

8 is a block diagram illustrating an operation process of processing the addition of a server using the dynamic hashing-based load balancer 520 of the present invention. For example, when Server 4 is added, the hashing values of the existing servers are transferred to the new Server 4. In the example, the hashing value 5 processed by server 2 is moved to server 4 (arrow 821), and the hashing value 8 processed

by server 3 is transferred to server 4 (arrow 822). Here, the hashing value movement is also processed in the same manner as the progressive movement method using the hashing value movement information table 440 information described in the server deletion process of FIG. 7 in order to ensure the connection security between the user request and the server.

In a general hashing-based load balancing method, there is a tendency that the performance of the overall servers depends on the server 104 where the request is overloaded because the request of the user 101 is overloaded with one or some servers. 9 and 10 relate to a method for servers to uniformly handle the request of the user 101 in the event of request overload to solve this problem.

9 is a block diagram illustrating an operation process of processing a server when a primary overload, which is an overload state, may be processed by the server using the dynamic hashing-based load balancer 520. For example, if the server 2941 has a primary overload, the server 2941 moves to another server among hashing values processed by the server 294. The threshold of primary overload is specified in the hashing value movement information table 440 of FIG. In this example, the hashing value 3 being processed by server 2941 moves to server 1 (arrow 931), and the hashing value 5 moves to server 3 (arrow 932), so that requests from user 101 are equalized to the servers. We can see that it is distributed (all servers have a load of 100 after moving the hashing value). Here, the hashing value movement is also processed in the same manner as the progressive movement method using the hashing value movement information table 440 information described in the server deleton process of FIG. 7 in order to guarantee the connection security between the user request and the server.

FIG. 10 is a block diagram illustrating an operation process of processing a secondary overload, which is an overload state in which the server can no longer continue using the dynamic hashing-based load balancer 520. For example, if server 2 1041 has a secondary overload, since server 2 cannot handle this alone, it redistributes in the form of round robin with other servers. The threshold of secondary overload is specified in the hashing value movement information table 440 of FIG. 6, for example 100. If server 2 receives a request 1021 with a hashing value of 4 that cannot be handled by itself and determines that it is a secondary overload, then the user request coming to hashing value 4 determines the server in a scheduling manner (round robin). 11 F140 step).

For example, the first request is handled by server 1 (arrow 1031), the second request is handled by server 2 (arrow 1032), the third request is handled by server 3 (arrow 1033), and the fourth request is Server 1 is distributed by processing again (arrow 1031).

The dynamic hashing-based load balancing technique of the present invention will be described in detail with reference to FIGS. 11, 12, and 13.

11 is a flowchart illustrating an overall session processing process for a user request according to an embodiment of the present invention.

F101: Start the whole operation.

F110: Receive a session.

F120: Check whether there is a corresponding session in the session table.

F121: If the session exists in the session table, check if the session has expired.

F122: Discard the session information if the session has expired.

F123: If the session has not expired, select the server recorded in the session table.

F130: If there is no session in the session table, the hashing value is calculated and the server is selected.

F140: Verify that load balancing for hashing values is round robin.

F141: If the load balancing for hashing value is round robin, choose server as round robin.

F150: If the load balancing for hashing value is not round robin, check if session recording for hashing value is enabled.

F151: End session recording if session recording for hashing value is activated.

F152: Record the session.

F160: Send a session.

F170: End the whole operation.

FIG. 12 is a flowchart illustrating managing a state change of a server before calculating the hashing value of FIG. 11 and selecting a server (F130) according to an exemplary embodiment of the present invention.

F201: Start overall operation.

F210: Check if the server has been deleted.

F211: If the server is deleted, distribute the deleted server's hashing value to the remaining servers. A specific example follows FIG. 7.

F220: If the server has not been deleted, check if there is a failed server.

F221: If there is a failed server, distribute the failed server's hashing value to the remaining servers. A specific example follows FIG. 7.

F230: If the failed server does not exist, check if the server has been added.

F231: If a server has been added, set the session to record the hashing value to move from the existing server to the added server. A specific example follows FIG. 8.

F232: Select hashing value to send to added server according to load rate and condition of existing server.

F240: If no server has been added, verify that the server's status is Overload 1, which the server can handle.

F241: If the server state is overload state 1 that the server can handle, select a hashing value to move according to the load rate and state of the servers. A specific example follows FIG. 9.

F242: The hashing value to move gradually moves according to the scheduling policy.

F250: If the server's state is not overload state 1 that the server can handle, check whether the server's state is overload state 2, which the server cannot handle.

F251: If the state of the server is an overload state 2 that the server cannot handle, the scheduling is performed by changing the hashing value of the overload state to round robin. A specific example follows FIG. 10.

13 is a flowchart illustrating an operation of moving a hashing value (F242) according to the scheduling policy of FIG. 12 according to an embodiment of the present invention.

F301: Start overall operation.

F310: Check if there is a hashing value that started recording the session.

F311: If there is a hashing value that started recording the session, check whether the session recording time for the hashing value has expired.

F312: If the session recording time for the hashing value has expired, stop recording the session for the hashing value.

F320: If no hashing value starts the session recording, check if there is a hashing value to move to another server.

F321: If there is a hashing value to move to another server, the hashing value is moved according to a specified scheduling method.

The load balancing scheme based on the dynamic hashing of the present invention distributes the request of the user 101 evenly among the servers in the addition / deletion / fault / overload situation of the server (evenly distributing the load) and the request of the user 101 and the server. Ensure a lasting connection between them. This distribution and connection ensures a stable service without delay due to server addition / deletion / failure / overload to all users 101 who use the servers.

Although the invention has been described in detail only with respect to the described embodiments, it will be apparent to those skilled in the art that various changes or modifications can be made within the spirit and scope of the invention, and such changes or modifications are consequently attached to the appended claims. It will have to belong to the scope of.

1 is a block diagram illustrating a general situation in which a conventional load balancer is used.

2 is a block diagram showing the structure of a conventional hashing-based load balancer.

3 is a block diagram illustrating a conventional hashing-based load balancer processing a user request.

4 is a block diagram showing the structure of a load balancer based on dynamic hashing according to the present invention.

5 is a block diagram illustrating a process of processing a user's request by the load balancing based on the dynamic hashing according to the present invention.

6A and 6B are block diagrams illustrating the structure of the hashing value movement information table and the session table in the load balancing based on the dynamic hashing of the present invention.

7 is a block diagram illustrating an operation process of processing a deletion / failure of a server using a dynamic hashing-based load balancer according to the present invention

FIG. 8 is a block diagram illustrating an operation process of adding a server using a dynamic hashing-based load balancer according to the present invention.

FIG. 9 is a block diagram illustrating an operation process of processing a server when the first overload, which is an overload state, may be processed by the server using the dynamic hashing-based load balancer.

FIG. 10 is a block diagram illustrating an operation process of processing a secondary overload, which is an overload state in which a server can no longer continue using the dynamic hashing-based load balancer of the present invention.

11 is a flowchart illustrating an overall session processing process for a user request according to an embodiment of the present invention.

FIG. 12 illustrates a flowchart of managing a state change of a server before calculating the hashing value of FIG. 11 and selecting a server according to an exemplary embodiment of the present invention.

13 is a flowchart illustrating an operation of moving a hashing value according to the scheduling policy of FIG. 12 according to an exemplary embodiment of the present invention.

<Description of the symbols for the main parts of the drawings>

400: load balancer

410: load distribution control and fault monitoring unit

420: hashing value extractor

430 hashing table

440: hashing value movement information table

450: session table

Document Claims

Language: (English)

In the hashing-based load balancer that distributes user requests to server groups,

A hashing value extractor 420 that calculates arbitrary information as a hashing value in a request of the user 101;

A hashing table 430 for selecting a processable server by using the calculated hashing value, and moving the hashing value to change the assigned server upon adding / deleting / faulting / loading the server;

In order to dynamically change the connection between hashing value and server while guaranteeing connectivity between user request and server when adding / deleting server or specific server overload, hashing time movement time, session recording time and overload status information about hashing value A hashing value movement information table 440 including situation information in which the hashing value can move;

A session table 450 capable of recording session information for a user 101 request for a predetermined time in order to smoothly move a hashing value when adding / deleting or overloading a server;

A load that includes a function of excluding a server from candidates when a failure occurs by periodically checking the status of the servers while selecting one of a plurality of target servers to which a user request is delivered while using the table information or updating the table information. Dynamic hashing-based load balancing system, characterized in that composed of a distributed control and fault monitoring unit (410).

2. The hashing value extractor (420) of claim 1, wherein the hashing value extractor (420) may use any part of the information in the user (101) request information for hashing value calculation; This information uses an IP address, a TCP / UDP port, a cookie included in HTTP, a URL, a URI, and any other information in a packet other than the dynamic hashing-based load balancing system.

2. The load balancing control and failure monitoring unit 410 of claim 1, wherein when one server 741 in the load balancing server group fails, the hashing value processed by the server is evenly distributed to the remaining load balancing target server. To distribute, the hashing value is distributed evenly or the number of hashing values is evenly distributed using the load information average value for each hashing value.

2. The load balancing control and failure monitoring unit 410 of claim 1, wherein the hashing value processed by the server is uniformly distributed to the remaining load balancing target servers when one server 741 in the load balancing server group is deleted. To distribute, the hashing value is distributed evenly or the number of hashing values is evenly distributed using the load information average value for each hashing value.

The load balancing control and failure monitoring unit 410 distributes the hashing values processed by the servers evenly to the newly added server 832 when the new server 832 in the load balancing server group is added. In order to uniformly distribute the hashing value or evenly distribute the number of hashing values using the load information average value for each hashing value.

The hashing value movement information table according to claim 1, wherein the load balancing control and fault monitoring unit 410 is able to continue processing by a specific server 941 in the load balancing server group but exceeds a normal load. When the first overload threshold specified in 440 is exceeded, the load information of the hashing value of the server 941 is used to distribute hashing values having a smaller load among the servers having a lower load than the server 941. Dynamic hashing based load balancing system, characterized in that.

The secondary load designated by the hash value movement information table 440 of claim 1, wherein the load balancing control and fault monitoring unit 410 is in a state in which the specific server 1041 in the load balancing server group cannot continue processing. When the overload threshold is exceeded, the server 1041 finds a hashing value causing the overload, and sequentially distributes the user 101 request coming in to the hashing value to all or lightly loaded servers, or other equivalent. Dynamic hashing-based load balancing system, characterized in that the distribution through the method.

In the hashing-based load balancer that distributes user requests to server groups,

The hashing table 430 has more hashing values than the number of servers, and the number of servers operating due to the failure / deletion / addition of any server in the server group is changed or the load on other servers when an overload occurs in any server. Dynamic hashing-based load, characterized in that the server is reassigned by moving the hashing value by dynamically changing the servers assigned the hashing values in the hashing table without changing the size of the hashing value in the server reassignment situation including redistribution. Dispersion method.

In the hashing-based load balancer that distributes user requests to server groups,

The hashing table 430 has more hashing values than the number of servers, and in order to redistribute the load to another server when the number of servers changed due to the deletion / addition of random servers in the server group is changed or when an overload occurs in a random server. In a server reassignment situation, a user in a hashing-based load balancer does not move all the hashing values directly to another server, but instead moves them incrementally based on a randomly specified time so that the user's request and existing connections with the server are not broken. Dynamic hashing-based load balancing method, characterized in that the connection between the request and the server is disconnected.

In the hashing-based load balancer that distributes user requests to server groups,

The hashing table 430 has more hashing values than the number of servers, and in order to redistribute the load to other servers when the number of servers changed due to the deletion / addition of arbitrary servers in the server group is changed or when an overload occurs in any server. In the server reassignment situation, including the case where the server reassignment situation occurs, for the purpose of storing and referencing the user's request and the connection information between the server and the server until the hashing value movements are completed so that the connection between the user's request and the server is not broken. Dynamic hashing-based load balancing method, characterized in that for operating the session table (450).

In the hashing-based load balancer that distributes user requests to server groups,

The hashing table 430 has more hashing values than the number of servers, and in order to redistribute the load to another server when the number of servers changed due to the deletion / addition of random servers in the server group is changed or when an overload occurs in a random server. In the server reassignment situation including the case, to ensure the connectivity of the user 101 to generate the session information for the request of the user 101 entered the hashing value for a specified time with respect to the hashing value determined to move to another server ;

The generated session information is maintained for a predetermined time;

If the user 101's request for an existing session is received within a certain time, the session is further maintained for a specified time;

Maintain a connection with a server for a specified time for the session being held;

Forwarding the request of the user 101 by a hashing method to the request of the user 101 not registered in the session within the designated time;

Dynamic hashing-based load balancing method characterized in that the request of the user 101 recorded the session is transmitted to a new server or another server by a hashing method after a predetermined time.

Language: (Korean)

사용자의 요청을 서버그룹들에 분산하여 전달하는 해싱기반의 부하분산기에 있어서,

사용자(101)의 요청에서 임의의 정보를 해싱값으로 계산하는 해싱값 추출기(420);

계산된 해싱값을 이용하여 처리가능한 서버를 선택하게 하며, 서버의 추가/삭제/장애/과부하시 배정된 서버를 변경하기 위해 해싱값을 이동하는 해싱테이블(430);

서버의 추가/삭제 또는 특정 서버 과부하시 사용자의 요청과 서버간의 연결성을 보장하면서 해싱값과 서버와의 연결관계를 동적으로 바꾸기 위해 해싱값 이동시간, 세션기록시간 그리고 해싱값에 대한 과부하 상태 정보등 해싱값이 이동할 수 있는 상황 정보를 포함하는 해싱값이동정보테이블(440);

서버의 추가/삭제 또는 과부하시 해싱값 이동을 원활하게 하기 위하여 일정시간 동안 사용자(101) 요청에 대한 세션 정보를 기록할 수 있는 세션테이블(450);

상기 테이블 정보를 이용하거나 또는 테이블 정보를 갱신하면서 사용자 요청을 전달할 대상서버를 여러 서버 중에서 하나를 선택하면서, 주기적으로 서버들의 상태를 확인하여 장애가 발생하면 해당 서버를 후보에서 제외하는 기능을 포함하는 부하분산제어 및 장애감시부(410)로 구성되어 있는 것을 특징으로 하는 동적 해싱기반의 부하분산시스템.

제 1항에 있어서, 상기 해싱값 추출기(420)는 해싱값 계산을 위해 사용자(101) 요청 정보내 임의의 일부 정보가 사용될 수 있으며; 이러한 정보는 IP 주소, TCP/UDP 포트, HTTP에 포함된 Cookie, URL, URI 그리고 이외의 패킷 내의 임의의 정보를 사용하는 것을 특징으로 하는 동적 해싱기반의 부하분산 시스템.

제 1항에 있어서, 상기 부하분산제어 및 장애감시부(410)는 부하분산 서버그룹내 하나의 임의 서버(741)가 장애가 발생한 경우에 상기 서버가 처리했던 해싱값이 나머지 부하분산대상 서버에게 고르게 분배하기 위해, 각 해싱값에 대한 부하정보 평균값을 이용하여 해싱값을 고르게 분산하거나 또는 해싱값의 개수를 고르게 분배하는 것을 특징으로 하는 동적 해싱기반의 부하분산 시스템.

제 1항에 있어서, 상기 부하분산제어 및 장애감시부(410)는 부하분산 서버 그룹내 하나의 임의 서버(741)가 삭제된 경우에 상기 서버가 처리했던 해싱값이 나머지 부하분산대상 서버에게 고르게 분배하기 위해, 각 해싱값에 대한 부하정보 평균값을 이용하여 해싱값을 고르게 분산하거나 또는 해싱값의 개수를 고르게 분배하는 것을 특징으로 하는 동적 해싱기반의 부하분산 시스템.

제 1항에 있어서, 상기 부하분산제어 및 장애감시부(410)는 부하분산 서버그룹내 새로운 서버(832)가 추가되는 경우에 서버들이 처리했던 해싱값이 새로 추가 된 서버(832)에게 고르게 분배하기 위해, 각 해싱값에 대한 부하정보 평균값을 이용하여 해싱값을 고르게 분산하거나 또는 해싱값의 개수를 고르게 분배하는 것을 특징으로 하는 동적 해싱기반의 부하분산 시스템.

제 1항에 있어서, 상기 부하분산제어 및 장애감시부(410)는 부하분산 서버그룹내 특정 서버(941)가 계속 처리할 수 있으나 평상 부하를 많이 초과하는 상태가 되는, 해싱값 이동정보테이블(440)에 지정된 1차 과부하 임계치를 넘었을 때, 상기 서버(941)의 해싱값의 부하정보를 이용하여, 이들 중 부하가 작은 해싱값들을 상기 서버(941)보다 부하가 작은 서버들로 분배하는 것을 특징으로 하는 동적 해싱기반의 부하분산 시스템.

제 1항에 있어서, 상기 부하분산제어 및 장애감시부(410)는 부하분산 서버그룹내 특정 서버(1041)가 계속 처리 할 수 없는 상태가 되는, 해싱값 이동정보테이블(440)에 지정된 2차 과부하 임계치를 넘었을 때, 상기 서버(1041)에서 과부하를 유발하는 해싱값을 찾아내어, 해당 해싱값으로 들어오는 사용자(101) 요청을 모든 또는 부하가 작은 서버들에게 순차 분배하거나 또는 이에 상응하는 다른 방식을 통하여 분배하는 것을 특징으로 하는 동적 해싱기반의 부하분산 시스템.

사용자의 요청을 서버그룹들에 분산하여 전달하는 해싱기반의 부하분산기에 있어서,

해싱테이블(430)에서 서버의 대수보다 더 많은 해싱값을 가지게 하며, 서버그룹에서 임의의 서버의 장애/삭제/추가로 인하여 동작하는 서버 대수가 변경되거나 임의의 서버에서 과부하 발생시 타 서버로의 부하 재분배를 하고자 하는 경우를 포함한 서버 재배정 상황에서 해싱값 크기는 변경하지 않고 해싱테이블내 해싱값들이 배정된 서버들을 동적으로 변경함으로써, 해싱값 이동을 통하여 서버 재배정하는 것을 특징으로 하는 동적 해싱기반의 부하분산방법.

사용자의 요청을 서버그룹들에 분산하여 전달하는 해싱기반의 부하분산기에 있어서,

해싱테이블(430)에서 서버의 대수보다 더 많은 해싱값을 가지게 하며, 서버그룹에서 임의의 서버 삭제/추가로 인하여 동작하는 서버 대수가 변경되거나 임의의 서버에서 과부하 발생시 타 서버로의 부하 재분배를 하고자 하는 경우를 포함한 서버 재배정 상황에서 모든 해싱값을 곧바로 타 서버로 이동시키지 않고, 사용자의 요청과 서버와의 기존 연결성이 끊어지지 않도록 임의의 지정된 시간을 기준으로 점진적으로 이동함으로써 해싱기반 부하분산기에서 사용자의 요청과 서버와의 연결성이 끊기는 것을 방지하는 것을 특징으로 하는 동적 해싱기반의 부하분산방법.

사용자의 요청을 서버그룹들에 분산하여 전달하는 해싱기반의 부하분산기에 있어서,

해싱테이블(430)에서 서버의 대수보다 더 많은 해싱값을 가지게 하며, 서버 그룹에서 임의의 서버 삭제/추가로 인하여 동작하는 서버 대수가 변경되거나 임의의 서버에서 과부하 발생시 타 서버로의 부하 재분배를 하고자 하는 경우를 포함한 서버 재배정 상황에서, 서버 재배정 상황

이 발생한 시점부터 사용자의 요청과 서버와의 연결성이 끊기지 않게 해싱값 이동들이 끝날 때 까지 사용자의 요청과 서버와의 연결 정보 저장 및 참조를 위하여 한시적으로 세션테이블(450)을 운영하는 것을 특징으로 하는 동적 해싱기반의 부하분산방법.

사용자의 요청을 서버그룹들에 분산하여 전달하는 해싱기반의 부하분산기에 있어서,

해싱테이블(430)에서 서버의 대수보다 더 많은 해싱값을 가지게 하며, 서버그룹에서 임의의 서버 삭제/추가로 인하여 동작하는 서버 대수가 변경되거나 임의의 서버에서 과부하 발생시 타 서버로의 부하 재분배를 하고자 하는 경우를 포함한 서버 재배정 상황에서, 사용자(101)의 연결성을 보장하기 위하여 타 서버로 이동이 결정된 해싱값에 대하여 지정된 시간동안 상기 해싱값으로 들어온 사용자(101)의 요청에 대한 세션 정보를 생성하며;

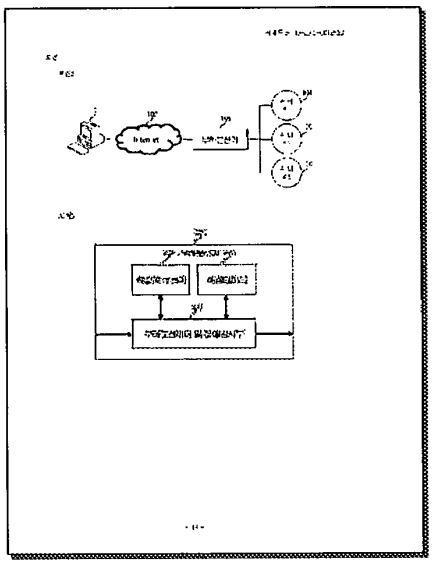
상기 생성된 세션 정보는 일정시간동안 유지하며;

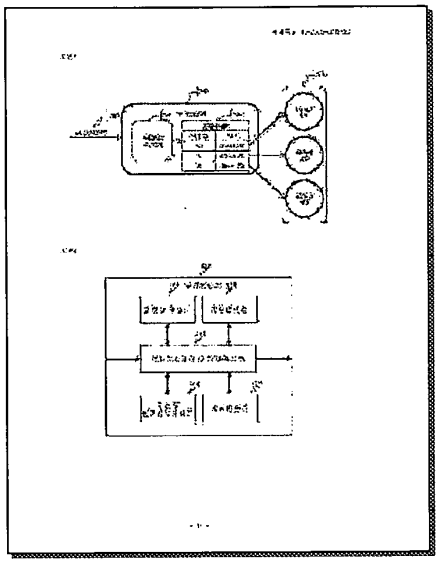
일정 시간 내에 기존 세션에 대한 사용자(101)의 요청이 들어오면 지정된 시간만큼 세션을 더 유지시키며;

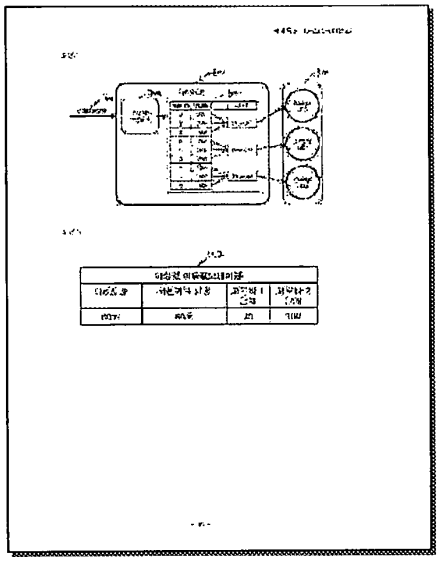
상기 유지 되고 있는 세션에 대해서는 서버와의 접속을 지정된 시간동안 유지하며;

상기 지정된 시간 내에 세션에 등록되지 않은 사용자(101)의 요청에 대해서는 해싱방법에 의하여 사용자(101)의 요청을 전달하며;

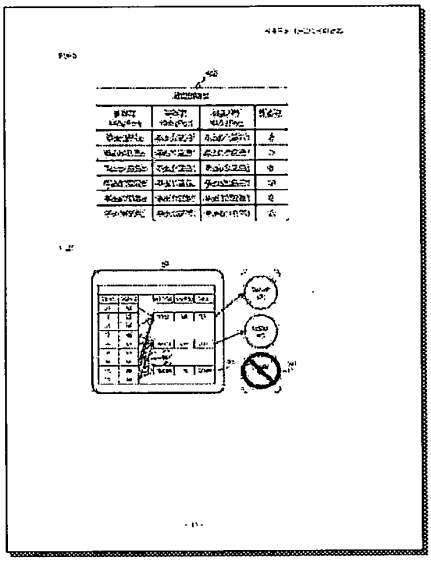
세션이 기록된 사용자(101)의 요청은 일정 시간이 지난 이후에 해싱방법에 의하여 새로운 서버 또는 다른 서버에 전달하는 것을 특징으로 하는 동적 해싱기반의 부하분산방법.

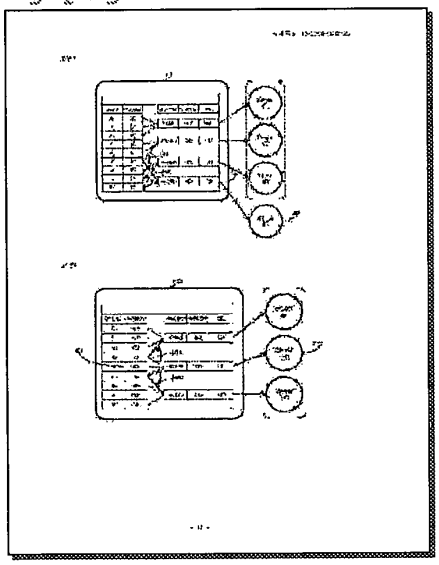


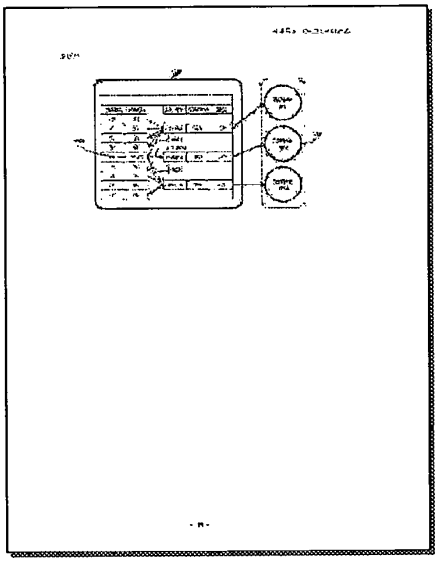


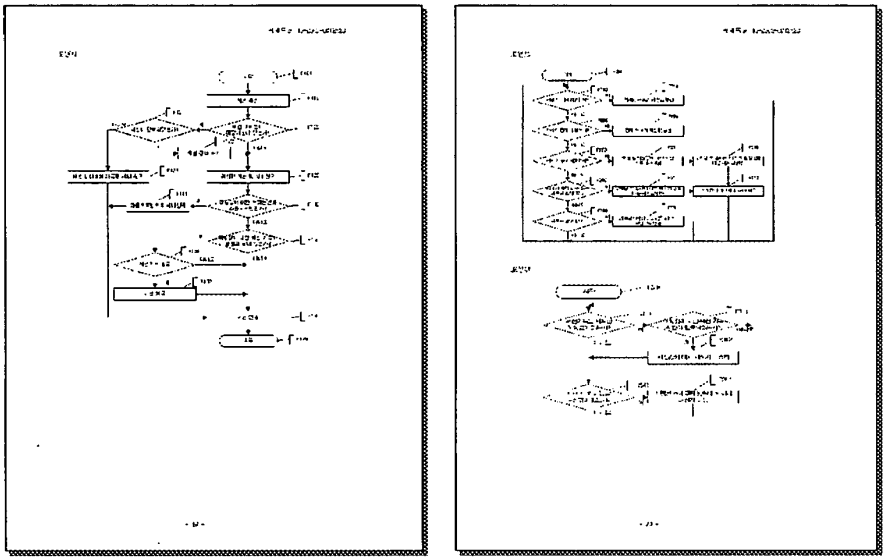


Drawing pages of KR20090012523 A









Drawing pages of KR20090012523 A

PATENT COOPERATION TREATY

From the INTERNATIONAL SEARCHING AUTHORITY

To:
KURT W. ROHDE
BARNES & THORNBURG LLP
P.O. BOX 2786
CHICAGO, ILLINOIS 60690-2786
UNITED STATES OF AMERICA

PCT

NOTIFICATION OF TRANSMITTAL OF THE INTERNATIONAL SEARCH REPORT AND THE WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY, OR THE DECLARATION

(PCT Rule 44.1)

Date of mailing *(day/month/year)*	26 AUG 2020
Applicant's or agent's file reference: **84008-323766**	**FOR FURTHER ACTION** See paragraphs 1 and 4 below
International application No.: **PCT/US2020/044539**	International filing date *(day/month/year)*: **31 July 2020 (31.07.2020)**
Applicant: **LANCIUM LLC**	

1. ☑ The applicant is hereby notified that the international search report and the written opinion of the International Searching Authority have been established and are transmitted herewith.

   Filing of amendments and statement under Article 19:
   The applicant is entitled, if he so wishes, to amend the claims of the international application (see Rule 46):

   When? The time limit for filing such amendments is normally two months from the date of transmittal of the international search report.

   How? Directly to the International Bureau preferably through ePCT, or on paper to: The International Bureau of WIPO, 34 chemin des Colombettes, 1211 Geneva 20, Switzerland (Facsimile No.: +41 22 338 82 70)

   For more detailed instructions, see the *PCT Applicant's Guide*, International Phase, paragraphs 9.004 – 9.011.

2. ☐ The applicant is hereby notified that no international search report will be established and that the declaration under Article 17(2)(a) to that effect and the written opinion of the International Searching Authority are transmitted herewith.

3. ☐ **With regard to any protest** against payment of (an) additional fee(s) under Rule 40.2, the applicant is notified that:

   ☐ the protest together with the decision thereon has been transmitted to the International Bureau together with any request to forward the texts of both the protest and the decision thereon to the designated Offices.

   ☐ no decision has been made yet on the protest; the applicant will be notified as soon as a decision is made.

4. Reminders

   The applicant may **submit comments on an informal basis on the written opinion of the International Searching Authority** to the International Bureau. These comments will be made available to the public after international publication. The International Bureau will send a copy of such comments to all designated Offices unless an international preliminary examination report has been or is to be established.

   Shortly after the expiration of **18 months from the priority date, the international application will be published** by the International Bureau. If the applicant wishes to avoid or postpone publication, a notice of withdrawal of the international application, or of the priority claim, must reach the International Bureau before the completion of the technical preparations for international publication (Rules 90bis.1 and 90bis.3).

   Within **19 months** from the priority date, but only in respect of some designated Offices, a demand for international preliminary examination must be filed if the applicant wishes to postpone the entry into the national phase **until 30 months** from the priority date (in some Offices even later); otherwise, the applicant must, **within 20 months** from the priority date, perform the prescribed acts for **entry into the national phase** before those designated Offices. In respect of other designated Offices, the time limit of **30 months** (or later) will apply even if no demand is filed within 19 months. For details about the applicable time limits, Office by Office, see www.wipo.int/pct/en/texts/time_limits.html and the PCT Applicant's Guide, National Chapters.

   Within **22 months from the priority date, the applicant may request that a supplementary international search be carried out** by a different International Searching Authority that offers this service (Rule 45bis.1). The procedure for requesting supplementary international search is described in the *PCT Applicant's Guide*, International Phase, paragraphs 8.006-8.032.

Name and mailing address of the ISA/US: **COMMISSIONER FOR PATENTS MAIL STOP PCT, ATTN: ISA/US P.O. BOX 1450 ALEXANDRIA, VA 22313-1450, UNITED STATES OF AMERICA**	Authorized officer: **HARRY C. KIM**
Facsimile No. **(571)273-8300**	Telephone No. **571-272-4300**

Form PCT/ISA/220 (revised January 2019)

PATENT COOPERATION TREATY

PCT

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference **84008-323766**	**FOR FURTHER ACTION**	see Form PCT/ISA/220 as well as, where applicable, item 5 below.
International application No. **PCT/US2020/044539**	International filing date *(day/month/year)* **31 July 2020 (31.07.2020)**	(Earliest) Priority Date *(day/month/year)* **01 August 2019 (01.08.2019)**
Applicant **LANCIUM LLC**		

This international search report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This international search report consists of a total of 3 sheets.

☐ It is also accompanied by a copy of each prior art document cited in this report.

1. **Basis of the report**

a. With regard to the **language**, the international search was carried out on the basis of:

☑ the international application in the language in which it was filed.

☐ a translation of the international application into _____ which is the language of a translation furnished for the purposes of international search (Rules 12.3(a) and 23.1(b)).

b. ☐ This international search report has been established taking into account the **rectification of an obvious mistake** authorized by or notified to this Authority under Rule 91 (Rule 43.6*bis*(a)).

c. ☐ With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, see Box No. I.

2. ☐ **Certain claims were found unsearchable** (see Box No. II).

3. ☐ **Unity of invention is lacking** (see Box No. III).

4. With regard to the **title**,

☑ the text is approved as submitted by the applicant.

☐ the text has been established by this Authority to read as follows:

5. With regard to the **abstract**,

☑ the text is approved as submitted by the applicant.

☐ the text has been established, according to Rule 38.2, by this Authority as it appears in Box No. IV. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. With regard to the **drawings**,

a. the figure of the **drawings** to be published with the abstract is Figure No. 1

☐ as suggested by the applicant.

☑ as selected by this Authority, because the applicant failed to suggest a figure.

☐ as selected by this Authority, because this figure better characterizes the invention.

b. ☐ none of the figures is to be published with the abstract.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2020/044539

A. CLASSIFICATION OF SUBJECT MATTER

IPC: G06Q 50/06, 30/02; G06F 11/34
CPC: G06Q 50/06

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)

CPC: G06Q 50/06, 30/0201; G06F 11/3495; USPC: 700/286

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)

EAST: US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; Search Terms: data, center, information, handling, server, farm, "IHS", power, energy, block, chain, hash, level, difficulty, finish, deadline, schedule, completion, operating, frequency, process$3, speed, increas$3, higher, adjust$3, modify$3, coalculat$3, determin$3, parameter, based, according, accordance, depend$3, condition, capacity, workload, meter, metre, "BTM", mix, mixture, operat$3, operational, ratio, renewable, generator, photovoltaic, battery, wind, supply, source, availability, available, statistic$2, weight, distribution, coefficient, partition, percentage, "%", wind, transmission, cost, price, line, charge, complexity, display$3, show$3, quantity, type, current, cryptocurrenc$3m bitcoin, market, select$3, choos$3, "OFF"

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y,P	US 2019/0258307 A1 (SHAIKH ET AL.) 22 August 2019 (22.08.2019), entire document.	1-30
Y	US 2015/0278968 A1 (STEVEN ET AL.) 01 October 2015 (01.10.2015), entire document.	1-30
Y	US 2018/0367320 A1 (MONTALVO) 20 December 2018 (20.12.2018), entire document.	7 and 23
Y	US 2016/0172900 A1 (WELCH, JR.) 16 June 2016 (16.06.2016), entire document.	8-11 and 25
Y	US 2018/0240112 A1 (CASTINADO ET AL.) 23 August 2018 (23.08.2018), entire document.	9-11

☑ 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
"D" document cited by the applicant in the international application
"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
19 August 2020 (19.08.2020)	26 AUG 2020
Name and mailing address of the ISA/US **COMMISSIONER FOR PATENTS MAIL STOP PCT, ATTN: ISA/US P.O. BOX 1450 ALEXANDRIA, VA 22313-1450, UNITED STATES OF AMERICA** Facsimile No. **(571)273-8300**	Authorized officer **HARRY C. KIM** Telephone No. **571-272-4300**

Form PCT/ISA/210 (second sheet) (July 2019)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2020/044539

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y,P	US 2019/0318327 A1 (SOWELL ET AL.) 17 October 2019 (17.10.2019), entire document.	10-13
Y,P	US 2019/0324820 A1 (KRISHNAN ET AL.) 24 October 2019 (24.10.2019), entire document.	11
Y	US 2011/0072289 A1 (KATO) 24 March 2011 (24.03.2011), entire document.	14 and 15
Y	US 2017/0023969 A1 (SHOWS ET AL.) 26 January 2017 (26.01.2017), entire document.	26 and 27

PATENT COOPERATION TREATY

From the INTERNATIONAL SEARCHING AUTHORITY

To:
KURT W. ROHDE
BARNES & THORNBURG LLP
P.O. BOX 2786
CHICAGO, ILLINOIS 60690-2786
UNITED STATES OF AMERICA

PCT

WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY

(PCT Rule 43*bis*.1)

Date of mailing *(day/month/year)*	26 AUG 2020
Applicant's or agent's file reference: **84008-323766**	**FOR FURTHER ACTION** See paragraph 2 below

International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/US2020/044539	**31 July 2020 (31.07.2020)**	**01 August 2019 (01.08.2019)**

International Patent Classification (IPC) or both national classification and IPC
IPC: G06Q 50/06, 30/02; G06F 11/34
CPC: G06Q 50/06

Applicant: **LANCIUM LLC**

1. This opinion contains indications relating to the following items:
   - [x] Box No. I — Basis of the opinion
   - [ ] Box No. II — Priority
   - [ ] Box No. III — Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
   - [ ] Box No. IV — Lack of unity of invention
   - [x] Box No. V — Reasoned statement under Rule 43*bis*.1(a)(i) with regard to novelty, inventive step and industrial applicability; citations and explanations supporting such statement
   - [ ] Box No. VI — Certain documents cited
   - [ ] Box No. VII — Certain defects in the international application
   - [ ] Box No. VIII — Certain observations on the international application

2. **FURTHER ACTION**

If a demand for international preliminary examination is made, this opinion will be considered to be a written opinion of the International Preliminary Examining Authority ("IPEA") except that this does not apply where the applicant chooses an Authority other than this one to be the IPEA and the chosen IPEA has notified the International Bureau under Rule 66.1*bis*(b) that written opinions of this International Searching Authority will not be so considered.

If this opinion is, as provided above, considered to be a written opinion of the IPEA, the applicant is invited to submit to the IPEA a written reply together, where appropriate, with amendments, before the expiration of 3 months from the date of mailing of Form PCT/ISA/220 or before the expiration of 22 months from the priority date, whichever expires later.

For further options, see Form PCT/ISA/220.

Name and mailing address of the ISA/US	Date of completion of this opinion	Authorized officer
COMMISSIONER FOR PATENTS MAIL STOP PCT, ATTN: ISA/US P.O. BOX 1450 ALEXANDRIA, VA 22313-1450, UNITED STATES OF AMERICA	**19 August 2020 (19.08.2020)**	**HARRY C. KIM**
Facsimile No. **(571)273-8300**		Telephone No. **571-272-4300**

Form PCT/ISA/237 (Cover sheet) (revised January 2019)

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/US2020/044539

Box No. I Basis of the opinion

1. With regard to the **language**, this opinion has been established on the basis of:
   - [x] the international application in the language in which it was filed.
   - [ ] a translation of the international application into _____ which is the language of a translation furnished for the purposes of international search (Rules 12.3(a) and 23.1(b)).

2. [ ] This opinion has been established taking into account the **rectification of an obvious mistake** authorized by or notified to this Authority under Rule 91 (Rule 43*bis*.1(b)).

3. [ ] With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, this opinion has been established on the basis of a sequence listing:
   - a. [ ] forming part of the international application as filed:
     - [ ] in the form of an Annex C/ST.25 text file.
     - [ ] on paper or in the form of an image file.
   - b. [ ] furnished together with the international application under PCT Rule 13*ter*.1(a) for the purposes of international search only in the form of an Annex C/ST.25 text file.
   - c. [ ] furnished subsequent to the international filing date for the purposes of international search only:
     - [ ] in the form of an Annex C/ST.25 text file (Rule 13*ter*.1(a)).
     - [ ] on paper or in the form of an image file (Rule 13*ter*.1(b) and Administrative Instructions, Section 713).

4. [ ] In addition, in the case that more than one version or copy of a sequence listing has been filed or furnished, the required statements that the information in the subsequent or additional copies is identical to that forming part of the application as filed or does not go beyond the application as filed, as appropriate, were furnished.

5. Additional comments:

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/US2020/044539

Box No. V **Reasoned statement under Rule 43*bis*.1(a)(i) with regard to novelty, inventive step and industrial applicability; citations and explanations supporting such statement**

1. Statement

Novelty (N)	Claims	1-30	YES
	Claims	NONE	NO
Inventive step (IS)	Claims	1-30	YES
	Claims	NONE	NO
Industrial applicability (IA)	Claims	1-30	YES
	Claims	NONE	NO

2. Citations and explanations :

---------- **EXPLANATION** ----------

Claim(s) 1-30 meet the criteria set out in PCT Article 33(2)-(3) because the prior art does not teach or fairly suggest the claimed invention.

Claim(s) 1-30 meet the criteria set out in PCT Article 33(4), and thus have industrial applicability because the subject matter claimed can be made or used in industry.

Electronic Acknowledgement Receipt

EFS ID:	41794031
Application Number:	16482495
International Application Number:	
Confirmation Number:	7727
Title of Invention:	Method and System for Dynamic Power Delivery to a Flexible Datacenter Using Unutilized Energy Sources
First Named Inventor/Applicant Name:	David Henson
Customer Number:	23644
Filer:	Kurt William Rohde/Mark Sweetin
Filer Authorized By:	Kurt William Rohde
Attorney Docket Number:	84008-322155
Receipt Date:	31-JAN-2021
Filing Date:	31-JUL-2019
Time Stamp:	13:22:22
Application Type:	U.S. National Stage under 35 USC 371

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)	322155_18-874-WO1-US_Supp_IDS_210131.pdf	74083 af456c90841a96c77f02b08655d27dec4d372cba	no	6

Warnings:

Information:					
This is not an USPTO supplied IDS fillable form					
2	Non Patent Literature	Advisory_Action_US16528348_22Oct2020_EFS.pdf	692737 2e96271e2dae7a9521ee50e3eba8e8fd412a313f	no	3
Warnings:					
Information:					
3	Non Patent Literature	Advisory_Action_US16529360_13NOV2020_EFS.pdf	11039137 46b46fd4167b279ec486d691b7e348a0ac4cc793	no	182
Warnings:					
Information:					
4	Non Patent Literature	BAKAR_Microgrid_EFS.pdf	5732868 5e863051456bcd0a854b27644eb67de04b6ed4e0	no	9
Warnings:					
Information:					
5	Non Patent Literature	CHOI_Optimal_EFS.pdf	4963454 677b26db0c21dea44d988a806c7efae86966a5ec	no	13
Warnings:					
Information:					
6	Non Patent Literature	FOA_US16132062_23Jul2020_EFS.pdf	1124447 0eaa29b96c68f1167c948347105c73b42830839f	no	26
Warnings:					
Information:					
7	Non Patent Literature	FOA_US16132092_29Jul2020_EFS.pdf	160337 933523cb958b1f792e8ddafa8a916eea8f49a187	no	5
Warnings:					
Information:					
8	Non Patent Literature	FOA_US16132098_28May2020_EFS.pdf	1005693 fcba768e32fbee91557fd14a53c30e0e8b7de990	no	24
Warnings:					
Information:					

9	Non Patent Literature	FOA_US16528348_03Jun2020_EFS.pdf	3026323 3678380dfa4601081f57a4bcf5277f3a26ea6231	no	33
Warnings:					
Information:					
10	Non Patent Literature	FOA_US16809111_19May2020_EFS.pdf	2713889 4c80fb5161df0505cb8bd0b96bce47b229ccafa1	no	36
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Information:					
11	Non Patent Literature	GAO_Dynamic_EFS.pdf	5271181 ca42edd60997dfe49742d6199317344236a559a8	no	9
Warnings:					
Information:					
12	Non Patent Literature	ISR_WO_PCTUS2020044536_26Aug2020_EFS.pdf	5037127 28fa85ab1149a4631eb1f16a89006d2cfb0bd3ea	no	24
Warnings:					
Information:					
13	Non Patent Literature	ISR_WO_PCTUS2020044539_26Aug2020_EFS.pdf	942951 0061fcd765e26b75a19a33fc21e671f3c8de8c47	no	7
Warnings:					
Information:					
14	Non Patent Literature	JOHN_StemCPower_EnergyStorage_2017_EFS.pdf	430096 5239bc51235e12240dc35d71611fd25f264b0f58	no	1
Warnings:					
Information:					
15	Non Patent Literature	LIM_Distributed_EFS.pdf	5425769 ee513315be20091c033c8f0315d03894d35c2a06	no	17
Warnings:					
Information:					

16	Non Patent Literature	LIU_Improved_EFS.pdf	3538843 113c7eaf53640d5373f262a9a04f213b5cd1f79a	no	8
Warnings:					
Information:					
17	Non Patent Literature	MOUSAVIZADEH_Linear_EFS.pdf	10036169 025a76d8c048f22d96d4b4cccc2055345a4de240	no	18
Warnings:					
Information:					
18	Non Patent Literature	NFOA_US16803109_12Jun2020_EFS.pdf	2476404 60a41029e69153c93ded5b0f9a4acb75deab5d80	no	31
Warnings:					
Information:					
19	Non Patent Literature	NFOA_US16834987_14May2020_EFS.pdf	1096877 5b4ac5ecb11ea084bc619cbe51f479e52c684091	no	30
Warnings:					
Information:					
20	Non Patent Literature	NOA_US16132011_29Jul2020_EFS.pdf	352399 b6e6ac3ac03855d5b2489b3078d7ae61f6704bcb	no	5
Warnings:					
Information:					
21	Non Patent Literature	NOA_US16132062_19NOV2020_EFS.pdf	1932888 7b73cbbd7e69f39e4bc85b2aa5d1852b977a2f50	no	7
Warnings:					
Information:					
22	Non Patent Literature	NOA_US16132092_27Jan2021_8pages_EFS.pdf	1536378 c5d57b84b5c301771159c35d683a450d4163d7f4	no	8
Warnings:					
Information:					

23	Non Patent Literature	NOA_US16132092_29Oct2020_EFS.pdf	2116631 100fb8b2f37a0e219846d16adb719cda38d601ef	no	8
Warnings:					
Information:					
24	Non Patent Literature	NOA_US16132098_13Oct2020_EFS.pdf	742714 4bc069ff367ab451f0fbe4bc4fdba2b372478c25	no	5
Warnings:					
Information:					
25	Non Patent Literature	NOA_US16132098_25Jan2021_5pages_EFS.pdf	1182808 0d543001d948286fd228bed376ef5b1983056d16	no	5
Warnings:					
Information:					
26	Non Patent Literature	NOA_US16175246_13Jan2021_5pages_EFS.pdf	353441 85791b66774f61bed00d17ce66288c2ba3201b22	no	5
Warnings:					
Information:					
27	Non Patent Literature	NOA_US16175246_17Sep2020_EFS.pdf	357529 36a7dce432c1b68d8686477c3ef73f6604d99322	no	5
Warnings:					
Information:					
28	Non Patent Literature	NOA_US16834987_12Jun2020_EFS.pdf	985507 ea5544c251468f8a4a08d07e7455b81bdef4d9f5	no	9
Warnings:					
Information:					
29	Non Patent Literature	PASHAJAVID_Frequency_EFS.pdf	6756354 3c2bea2b51ed12cd965c1e75027e902229888016	no	12
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Information:					

30	Non Patent Literature	PASHAJAVID_Multimode_EFS.pdf	7323352 d8f6e843c92beb918a936f28dfe81a4bd6f45e8b	no	12
Warnings:					
Information:					
31	Non Patent Literature	RUDEZ_Predictive_EFS.pdf	4876625 5f21a1effa8d51e17bd3ed2188e59c9bfd3ec7e8	no	8
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Information:					
32	Non Patent Literature	WILSON_EnerRes_2016_EFS.pdf	8649209 d5fee42e2de6a8a5b0a20140c2e01248869f2d53	no	154
Warnings:					
Information:					
33	Non Patent Literature	XU_Distributed_EFS.pdf	9585989 0a60debc1ca61c614eeb4f853fed0d26fc5afb09	no	27
Warnings:					
Information:					
34	Non Patent Literature	ZHOU_TwoStage_EFS.pdf	4569026 532200d4cfc8ef82a4d6db5b7d3354fc0e60653d	no	9
Warnings:					
Information:					
		Total Files Size (in bytes):	116109235		

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
16/482,495	07/31/2019	David Henson	84008-322155

CONFIRMATION NO. 7727

23644
Barnes & Thornburg LLP (CH)
P.O. Box 2786
Chicago, IL 60690-2786

PUBLICATION NOTICE

Title: Method and System for Dynamic Power Delivery to a Flexible Datacenter Using Unutilized Energy Sources

Publication No.US-2020-0379537-A1
Publication Date:12/03/2020

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/.

The publication process established by the Office does not provide for mailing a copy of the publication to applicant. A copy of the publication may be obtained from the Office upon payment of the appropriate fee set forth in 37 CFR 1.19(a)(1). Orders for copies of patent application publications are handled by the USPTO's Public Records Division. The Public Records Division can be reached by telephone at (571) 272-3150 or (800) 972-6382, by facsimile at (571) 273-3250, by mail addressed to the United States Patent and Trademark Office, Public Records Division, Alexandria, VA 22313-1450 or via the Internet.

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.

Further assistance in electronically accessing the publication, or about PAIR, is available by calling the Patent Electronic Business Center at 1-866-217-9197.

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

PATENT APPLICATION FEE DETERMINATION RECORD

Substitute for Form PTO-875

Application or Docket Number: 16/482,495

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	150		N/A	
SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A	N/A	70		N/A	
EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A	380		N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	30 minus 20 =	* 10	x 50 =	500	OR		
INDEPENDENT CLAIMS (37 CFR 1.16(h))	3 minus 3 =	*	x 230 =	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	1100		TOTAL	

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($)	ADDITIONAL FEE($)	OR	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.

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
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P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

U.S. APPLICATION NO.	FIRST NAMED INVENTOR	ATTY. DOCKET NO.
16/482,495	David Henson	18-874-WO1-US

23644
Barnes & Thornburg LLP (CH)
P.O. Box 2786
Chicago, IL 60690-2786

INTERNATIONAL APPLICATION NO.	
PCT/US2018/017950	
I.A. FILING DATE	PRIORITY DATE
02/13/2018	01/11/2018

CONFIRMATION NO. 7727
371 ACCEPTANCE LETTER

OC00000011942970 3

Date Mailed: 08/25/2020

NOTICE OF ACCEPTANCE OF APPLICATION UNDER 35 U.S.C 371 AND 37 CFR 1.495

The applicant is hereby advised that the United States Patent and Trademark Office, in its capacity as a Designated / Elected Office (37 CFR 1.495), has ACCEPTED the above identified international application for national patentability examination in the United States Patent and Trademark Office.

The United States Application Number assigned to the application is shown above. A Filing Receipt will be issued for the present application in due course. **THE DATE APPEARING ON THE FILING RECEIPT AS THE "FILING DATE or 371(c) DATE" IS THE DATE ON WHICH THE LAST OF THE 35 U.S.C. 371 (c)(1) and (c)(2) REQUIREMENTS HAS BEEN RECEIVED IN THE OFFICE. THIS DATE IS SHOWN BELOW.** The filing date of the above identified application is the international filing date of the international application (Article 11(3) and 35 U.S.C. 363)

07/31/2019
DATE OF RECEIPT OF 35 U.S.C.
371(c)(1) and (c)(2) REQUIREMENTS

The following items have been received:

- Indication of Small Entity Status
- Copy of the International Application filed on 07/31/2019
- Copy of the International Search Report filed on 07/31/2019
- Preliminary Amendments filed on 07/31/2019
- Information Disclosure Statements filed on 07/31/2019
- Inventor's Oath or Declaration filed on 07/31/2019
- U.S. Basic National Fees filed on 07/31/2019
- Authorize Access to Search Results filed on 07/31/2019
- Priority Documents filed on 07/31/2019
- Power of Attorney filed on 06/24/2020
- Authorization to Permit Access filed on 07/31/2019
- Application Data Sheet (37 CFR 1.76) filed on 07/31/2019

FORM PCT/DO/EO/903 (371 Acceptance Notice)

Applicant is reminded that any communications to the United States Patent and Trademark Office must be mailed to the address given in the heading and include the U.S. application no. shown above (37 CFR 1.5)

RODERICK M JONES

Telephone: (703) 756-1424

FORM PCT/DO/EO/903 (371 Acceptance Notice)

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
16/482,495	07/31/2019		1290	18-874-WO1-US	30	3

CONFIRMATION NO. 7727

23644
Barnes & Thornburg LLP (CH)
P.O. Box 2786
Chicago, IL 60690-2786

FILING RECEIPT

OC000000119429702

Date Mailed: 08/25/2020

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)

David Henson, The Woodlands, TX;
Michael McNamara, The Woodlands, TX;
Raymond Cline, The Woodlands, TX;

Applicant(s)

Lancium LLC, The Woodlands, TX;

Power of Attorney: The patent practitioners associated with Customer Number 23644

Domestic Priority data as claimed by applicant

This application is a 371 of PCT/US2018/017950 02/13/2018
which claims benefit of 62/616,348 01/11/2018

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: 08/23/2020

The country code and number of your priority application, to be used for filing abroad under the Paris Convention, is **US 16/482,495**

Projected Publication Date: 12/03/2020

Non-Publication Request: No

Early Publication Request: No
**** SMALL ENTITY ****
Title

Method and System for Dynamic Power Delivery to a Flexible Datacenter Using Unutilized Energy Sources

Preliminary Class

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

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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.

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NOT GRANTED

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MULTIPLE DEPENDENT CLAIM FEE CALCULATION SHEET

Substitute for Form PTO-1360
(For use with Form PTO/SB/06)

Application Number	Filing Date
16482495	

Applicant(s) David Henson

* May be used for additional claims or amendments

CLAIMS	AS FILED		AFTER FIRST AMENDMENT		AFTER SECOND AMENDMENT	
	Indep	Depend	Indep	Depend	Indep	Depend
1	1		---	---		
2		1	---	---		
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Total Indep	2		3		0	
Total Depend	32	↵	27	↵	0	↵
Total Claims	34		30		0	

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Doc Code: PA..
Document Description: Power of Attorney

Confirmation No. 7727

PTO/AIA/82A (07-13)
Approved for use through 11/30/2014. OMB 0651-0051
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
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TRANSMITTAL FOR POWER OF ATTORNEY TO ONE OR MORE REGISTERED PRACTITIONERS

NOTE: This form is to be submitted with the Power of Attorney by Applicant form (PTO/AIA/82B) to identify the application to which the Power of Attorney is directed, in accordance with 37 CFR 1.5, unless the application number and filing date are identified in the Power of Attorney by Applicant form. If neither form PTO/AIA/82A nor form PTO/AIA82B identifies the application to which the Power of Attorney is directed, the Power of Attorney will not be recognized in the application.

Application Number	16/482495
Filing Date	07-31-2019
First Named Inventor	David Henson
Title	Method and System for Dynamic Power Delivery to a Flexible Datacenter Using Unutilized Energy Sources
Art Unit	
Examiner Name	
Attorney Docket Number	18-874-WO1-US

SIGNATURE of Applicant or Patent Practitioner

Signature	/Kurt W. Rohde/	Date (Optional)	2020-06-24
Name	Kurt W. Rohde	Registration Number	62923
Title (if Applicant is a juristic entity)			
Applicant Name (if Applicant is a juristic entity)	LANCIUM LLC		

NOTE: This form must be signed in accordance with 37 CFR 1.33. See 37 CFR 1.4(d) for signature requirements and certifications. If more than one applicant, use multiple forms.

☐ *Total of _____ forms are submitted.

This collection of information is required by 37 CFR 1.131, 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.

POWER OF ATTORNEY BY APPLICANT

Client No. 84008

I hereby revoke all previous powers of attorney given in the application identified in either the attached transmittal letter or the boxes below.

Application No.	Filing Date

(Note: The boxes above may be left blank if information is provided on form PTO/AIA/82A.)

☒ I hereby appoint Practitioner(s) associated with the following Customer Number as my/our attorney(s) or agent(s), and to transact all business in the United States Patent and Trademark Office connected therewith for the application referenced in the attached transmittal letter (form PTO/AIA/82A or equivalent): **23644**

OR

☐ I hereby appoint Practitioner(s) named in the attached list (form PTO/AIA/82C) as my/our attorney(s) or agent(s), and to transact all business in the United States Patent and Trademark Office connected therewith for the patent application referenced in the attached transmittal letter (form PTO/AIA/82A) or identified above. (Note: Complete form PTO/AIA/82C.)

Please recognize or change the correspondence address for the application identified in the attached transmittal letter or the boxes above to:

☐ The address associated with the above-mentioned Customer Number.

OR

☒ The address with the Customer Number: **23644**

OR

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

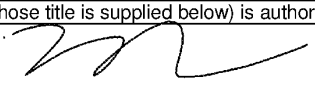
I am the Applicant (if the Applicant is a juristic entity, list the Applicant name in the box):

LANCIUM LLC
6006 Thomas Rd.
Houston, TX 77041

☐ Inventor or Joint Inventor
☐ Legal Representative of a Deceased or Legally Incapacitated Inventor
☒ Assignee or Person to Whom the Inventor is Under an Obligation to Assign
☐ Person Who Otherwise Shows Sufficient Proprietary Interest (*e.g.,* a petition under 37 CFR 1.46(b)(2) was granted in the application or is concurrently being filed with this document) (provide signer's title if applicant is a juristic entity)

SIGNATURE of Applicant for Patent

The undersigned (whose title is supplied below) is authorized to act on behalf of the applicant (e.g., where the applicant is a juristic entity)

Signature		Date:	June 12, 2020
Name	Michael McNamara		
Title	CEO		

NOTE: **Signature – This form must be signed by the applicant in accordance with 37 CFR 1.33. See 37 CFR 1.4 for signature requirements and certifications. If more than one applicant, use multiple forms.**

☐ *Total of ____ forms are submitted.

DMS17540308v1

Electronic Acknowledgement Receipt

EFS ID:	39820806
Application Number:	16482495
International Application Number:	
Confirmation Number:	7727
Title of Invention:	Method and System for Dynamic Power Delivery to a Flexible Datacenter Using Unutilized Energy Sources
First Named Inventor/Applicant Name:	David Henson
Customer Number:	20306
Filer:	Kurt William Rohde/Mark Sweetin
Filer Authorized By:	Kurt William Rohde
Attorney Docket Number:	18-874-WO1-US
Receipt Date:	24-JUN-2020
Filing Date:	
Time Stamp:	19:46:42
Application Type:	U.S. National Stage under 35 USC 371

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	18-874-WO1-US_POA_Transmittal.pdf	690754 e5952a60499df8fa7f1748a922a46bacf0e2f053	no	2

Warnings:

Information:	
Total Files Size (in bytes):	690754

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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.

Doc code: IDS
Doc description: Information Disclosure Statement (IDS) Filed

PTO/SB/08a (02-18)
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (**Not for submission under 37 CFR 1.99)**		
	Application Number	16482495
	Filing Date	2019-07-31
	First Named Inventor	HENSON, David
	Art Unit	TBD
	Examiner Name	TBD
	Attorney Docket Number	18-874-WO1-US

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					

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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	20040117330		2004-06-17	EHLERS, Gregory A. et al.	

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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]
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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]

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	16482495
	Filing Date	2019-07-31
	First Named Inventor	HENSON, David
	Art Unit	TBD
	Examiner Name	TBD
	Attorney Docket Number	18-874-WO1-US

	1	Final Office Action mailed on 17 April 2020 for U.S. Patent Application No. 16/529,402, filed on 01 August 2019, 59 pages.	
	2	HAYES, Adam S., "A Cost of Production Model for Bitcoin," Department of Economics, The New School for Social Research, March 2015, 5 pages.	
	3	Non-Final Office Action mailed on 20 February 2020 for U.S. Patent Application No. 16/702,894, filed on 04 December 2019, 30 pages.	
	4	Non-Final Office Action mailed 02 April 2020 on for U.S. Patent Application No. 16/132,011, filed on 14 September 2018, 5 pages.	
	5	Non-Final Office Action mailed on 30 March 2020 for U.S. Patent Application No. 16/132,092, filed on 14 September 2018, 46 pages.	
	6	Notice of Allowance mailed on 02 March 2020, for U.S. Patent Application No. 16/596,190, filed on 08 October 2019, 15 pages.	
	7	Notice of Allowance mailed on 06 April 2020, for U.S. Patent Application No. 16/175,246, filed on 30 October 2018, 12 pages.	

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Examiner Signature		Date Considered	

*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.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	16482495
	Filing Date	2019-07-31
	First Named Inventor	HENSON, David
	Art Unit	TBD
	Examiner Name	TBD
	Attorney Docket Number	18-874-WO1-US

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	/Alexander D. Georges/	Date (YYYY-MM-DD)	2020-05-11
Name/Print	Alexander D. Georges	Registration Number	70534

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

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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 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.

Electronic Acknowledgement Receipt

EFS ID:	39407152
Application Number:	16482495
International Application Number:	
Confirmation Number:	7727
Title of Invention:	Method and System for Dynamic Power Delivery to a Flexible Datacenter Using Unutilized Energy Sources
First Named Inventor/Applicant Name:	David Henson
Customer Number:	20306
Filer:	Alexander D. Georges
Filer Authorized By:	
Attorney Docket Number:	18-874-WO1-US
Receipt Date:	11-MAY-2020
Filing Date:	
Time Stamp:	18:09:29
Application Type:	U.S. National Stage under 35 USC 371

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)	18_874WO1US_IDS.pdf	1053701 67e8cb980f99cebf543821c0dcfddfbab6a77e1e	no	4

Warnings:

Information:					
2	Non Patent Literature	Adam_Hayes_CostProducModBit_2015_EFS.pdf	1936285 08b173306344dbb4a9682c18b98d0d378a82597d	no	5
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Information:					
3	Non Patent Literature	FOA_US16529402_17Apr2020_EFS.pdf	2432293 972230fc9160e5dbc8cf11758826c116697eb195	no	59
Warnings:					
Information:					
4	Non Patent Literature	NFOA_US16132011_02Apr2020_EFS.pdf	138406 8b661a7abf0d935515bfdc6cf3263d1eccdb22c5	no	5
Warnings:					
Information:					
5	Non Patent Literature	NFOA_US16132092_30Mar2020_EFS.pdf	4704950 0a87f65bdebd5a48584f7bbf6ed1babecb86c785	no	46
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Information:					
6	Non Patent Literature	NFOA_US16702894_20Feb2020_EFS.pdf	1143430 90f80ef0a24c970bc5df38adc5c9d43c9f920db7	no	30
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Information:					
7	Non Patent Literature	NOA_US16175246_06Apr2020_EFS.pdf	664959 2c50c6c82529cc83e8c3774a69e52bfccd7224c9	no	12
Warnings:					
Information:					
8	Non Patent Literature	NOA_US16596190_02Mar2020_EFS.pdf	1916386 1636ff1234a50b1b4947708a1633b64e91b962cb	no	15
Warnings:					
Information:					
		Total Files Size (in bytes):	13990410		

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New Applications Under 35 U.S.C. 111

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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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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	16482495
Filing Date	2019-07-31
First Named Inventor	David Henson
Art Unit	TBD
Examiner Name	TBD
Attorney Docket Number	18-874-WO1-US

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	8700929		2014-04-15	WEBER; Wolf-Dietrich 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	20050203761		2005-09-15	BARR; Andrew Harvey et al.	
	2	20090070611		2009-03-12	BOWER III; Fred A. et al.	
	3	20090089595		2009-04-02	BREY; Thomas M. et al.	
	4	20160187906		2016-06-30	BODAS; Devadatta V. et al.	

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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	16482495
	Filing Date	2019-07-31
	First Named Inventor	David Henson
	Art Unit	TBD
	Examiner Name	TBD
	Attorney Docket Number	18-874-WO1-US

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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	Co-pending US patent application No. US16/132092, filed on 09-14-2018.	
	2	Co-pending US patent application No. US16/175246, filed on 10-30-2018.	
	3	Notice of Allowance mailed on 27 January 2020, for U.S. Patent Application No. 16/702,931, filed on 04 December 2019, 23 pages.	

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	Filing Date	2019-07-31
	First Named Inventor	David Henson
	Art Unit	TBD
	Examiner Name	TBD
	Attorney Docket Number	18-874-WO1-US

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

☒ A certification statement is not submitted herewith.

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Signature	/Alexander D. Georges/	Date (YYYY-MM-DD)	2020-02-10
Name/Print	Alexander D. Georges	Registration Number	70534

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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)).

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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Electronic Acknowledgement Receipt

EFS ID:	38536399
Application Number:	16482495
International Application Number:	
Confirmation Number:	7727
Title of Invention:	Method and System for Dynamic Power Delivery to a Flexible Datacenter Using Unutilized Energy Sources
First Named Inventor/Applicant Name:	David Henson
Customer Number:	20306
Filer:	Alexander D. Georges
Filer Authorized By:	
Attorney Docket Number:	18-874-WO1-US
Receipt Date:	11-FEB-2020
Filing Date:	
Time Stamp:	12:50:31
Application Type:	U.S. National Stage under 35 USC 371

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)	18_874WO1US_IDS_FEB2020.pdf	1053513 a0bd0dfa922bc7ab9e546c6a9806c1190db83d20	no	4

Warnings:

Information:					
2	Non Patent Literature	16132092_app.pdf	5353517 773c84d54fdc418e598d11134713347d7a0fde6d	no	68
Warnings:					
Information:					
3	Non Patent Literature	16175246_app.pdf	2898012 f95a19b84520b5b6e8b6817ce45dbbaa6e7c79f9	no	64
Warnings:					
Information:					
4	Non Patent Literature	16482495_app.pdf	3054141 83fd051d226ea0d5c7beda7e254b58edc002a4b6	no	41
Warnings:					
Information:					
5	Non Patent Literature	NOA_US16702931_27Jan2020_EFS.pdf	2854444 d65ace9580c073b1472df0572f16f62806db27cf	no	23
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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.

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PTO/SB/08a (02-18)
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT
(Not for submission under 37 CFR 1.99)

Application Number	16482495
Filing Date	2019-07-31
First Named Inventor	DAVID; Henson
Art Unit	TBD
Examiner Name	TBD
Attorney Docket Number	18-874-WO1-US

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	10367535		2019-07-30	CORSE; Nir et al.	
	2	10444818		2019-10-15	MCNAMARA; Michael T. et al.	
	3	10452127		2019-10-22	MCNAMARA; Michael T. et al.	
	4	10497072		2019-12-03	HOOSHMAND; Ali et al.	

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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	20020072868		2002-06-13	BARTONE; Erik J. et al.	
	2	20030074464		2003-04-17	BOHRER; Patrick Joseph et al.	

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	Art Unit	TBD
	Examiner Name	TBD
	Attorney Docket Number	18-874-WO1-US

	3	20060161765		2006-07-20	CROMER; Daryl C. et al.	
	4	20110072289		2011-03-24	KATO; Hideharu	
	5	20120324259		2012-12-20	AASHEIM; Jered et al.	
	6	20130227139		2013-08-29	SUFFLING; David Robert	
	7	20150121113		2015-04-30	RAMAMURTHY; Shankar et al.	
	8	20150277410		2015-10-01	GUPTA; Sandeep et al.	
	9	20150278968		2015-10-01	STEVEN; Alain P. et al.	
	10	20160170469		2016-06-16	SEHGAL; Naresh K. et al.	
	11	20160172900		2016-06-16	WELCH JR.; William Douglas	
	12	20170023969		2017-01-26	SHOWS; Thomas Alexander et al.	
	13	20170261949		2017-09-14	HOFFMANN; Henry et al.	

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	Art Unit	TBD
	Examiner Name	TBD
	Attorney Docket Number	18-874-WO1-US

	14	20180202825		2018-07-19	YOU; Jae Seok et al.	
	15	20180240112		2018-08-23	CASTINADO; Joseph B. et al.	
	16	20180366978		2018-12-20	MATAN; Stefan et al.	
	17	20180367320		2018-12-20	MONTALVO; Rey	
	18	20190052094		2019-02-14	PMSVVSV; Prasad et al.	
	19	20190168630		2019-06-06	MRLIK; Richard et al.	
	20	20190258307		2019-08-22	SHAIKH; Karimulla Raja et al.	
	21	20190280521		2019-09-12	LUNDSTROM; Blake Richard et al.	
	22	20190318327		2019-10-17	SOWELL; Lawrence et al.	
	23	20190324820		2019-10-24	KRISHNAN; Santhana et al.	

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	1	20090012523	KR	A	2009-02-04	PUMPKIN NETWORKS KOREA INC [KR]		

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	1	GHAMKHARI et al., "Optimal Integration of Renewable Energy Resources in Data Centers with Behind-the-Meter Renewable Generator," Department of Electrical and Computer Engineering Texas Tech University, 2012, pp. 3340-3444.	
	2	Non-Final Office Action mailed on 05 December 2019 for U.S. Patent Application No. 16/529,360, filed on 01 August 2019, 72 pages.	
	3	Non-Final Office Action mailed on 10 December 2019 for U.S. Patent Application No. 16/596,190, filed on 08 October 2019, 72 pages.	
	4	Non-Final Office Action mailed on 14 November 2019 for U.S. Patent Application No. 16/132,098, filed on 14 September 2018, 25 pages.	
	5	Non-Final Office Action mailed on 21 November 2019 for U.S. Patent Application No. 16/529,402, filed on 01 August 2019, 57 pages.	
	6	Non-Final Office Action mailed 11 December 2019 on for U.S. Patent Application No. 16/132,062, filed on 14 September 2018, 17 pages.	
	7	Non-Final Office Action mailed on 10 December 2019 for U.S.Patent Application No.16/528,348, filed on 08 October 2019, 33 pages.	

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	Examiner Name	TBD
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	8	RAHIMI, Farrokh, "Using a Transactive Energy Framework," IEEE Electrification Magazine, December 2016, pp. 23-29.

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Signature	/Alexander D. Georges/	Date (YYYY-MM-DD)	2019-12-17
Name/Print	Alexander D. Georges	Registration Number	70,534

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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)).

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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Publication Number: KR 2009-0012523 A
PUBLISHED ON 4-Feb-2009

Application Number: KR 2007-0076426 A
FILED ON 30-Jul-2007

A dynamic hashing based load balancing system and its method (English)
동적 해싱 기반의 부하 분산 시스템 및 그 방법 (Korean)

Korea Invention Application Publication (Source: KR)

Inventors: KWON HEE WOONG (KR)
KWAK HU KEUN (KR)
KIM JEONG HWAN (KR)
CHUNG KYU SIK (KR)

Applicants: PUMPKIN NETWORKS KOREA INC (KR)

Attorney, Agent or Firm: 송한천

Classifications: International (2006.01): G06F 15/16

Priority: KR 2007-0076426 A (30-Jul-2007)

Abstract (English)

The present invention has been made to solve the technical problem of the hashing algorithm of the conventional load balancer, and it is a session-based algorithm while taking infinite session processing capacity and high-speed processing speed with only a small amount of memory designated as an advantage of the hashing algorithm. As the hashing value is changed due to the sophistication of load balancing and the redistribution when the server is added / deleted or the server is overloaded, the problem of not guaranteeing the connectivity between the user and the server and the problem of degrading the caching effect are solved. The present invention relates to a load balancing system based on dynamic hashing that provides high performance even in a small system having a low specification.

The present invention is installed in front of the servers for load balancing to receive the request of the user 101 to the server and delivers to the server; The system has more hashing values than the number of servers; The hashing value is properly distributed to each server; Calculates a hashing value using some information of the user 101's request; Sends a request of the user 101 to a server having the corresponding hashing value; Load balancing is performed by allocating a portion of the hashing value of each server to the added server when the server is added; Distributes the hashing value of the server to other servers when the server is deleted / failed; If excessive requests are concentrated on one server, some of the hashing values are moved to other servers to balance the load appropriately; If excessive load is concentrated on a particular hashing value, it is then distributed among multiple servers; Such a series of tasks are processed at a time interval by scheduling so that the request of the user 101 is naturally passed from the server having the hashing value to the other server; For the purpose of sticking between the request of the user 101 and the server, the session of the user 101 is identified for the hashing value passed to another server, and the connection between the user 101 request and the server is maintained for a predetermined time. A system that includes applying hashing based load balancing only for new sessions.

A system and a method for distributing load based on dynamic hashing to improve caching effect are provided to guarantee connectivity between a user and a server, and improve the caching effect by using ingenious load distribution, and changing a hashing function in addition, removal, and overload of the server. A hashing value extractor(420) calculates a hash value from information by a user request. A hashing table(430) moves the hashing value to change a server allocated when the server is added, removed, failed, or overloaded. A hashing value movement information table(440) stores contextual information, such as hashing value moving time, session recording time, and overload state information for the hashing value, capable of moving the hashing value. A session table(450) stores session information for the user request for a predetermined time. A load distribution controlling and failure monitoring unit(410) includes a function for excluding the server from candidates when a failure occurs in the server by periodically checking the state of the servers.

Abstract (Korean)

본 발명은 종래 부하분산기의 해싱알고리즘의 기술상의 문제점을 해결하기 위해서 안출된 것으로서, 해싱 알고리즘의 장점인 지정된 소량의 메모리만으로 무한대의 세션 처리 능력과 고속의 처리속도를 그대로 취하면서, 세션 기반의 알고리즘들의 장점인 부하분산의 정교함과 서버의 추가/삭제 또는 서버 과부하시의 재분배로 해싱값이 변화하게 됨에 따라 사용자와 서버간의 연결성을 보장하지 못하는 문제점과 캐싱 효과가 저하되는 문제점을 해결하며, 이를 통하여 낮은 사양

의 소형 시스템에서도 고성능의 기능을 제공하는 동적 해싱 기반의 부하 분산 시스템 및 그 방법에 관한 것이다.

본 발명은 부하분산을 위하여 서버들 앞단에 설치되어 서버로 향하는 사용자(101)의 요청을 수신하여 서버에 전달하며; 상기 시스템은 서버의 수보다 많은 해싱값을 가지며; 해싱값은 각각의 서버에게 적절하게 분배가 되며; 사용자(101)의 요청 중 일부 정보를 사용하여 해싱값을 계산하며; 해당 해싱값을 가지고 있는 서버에게 사용자(101)의 요청을 전달하며; 서버의 추가 시에 각각의 서버가 가지고 있는 해싱값의 일부를 추가된 서버에 할당하여 부하분산을 수행하며; 서버의 삭제/장애 시에 해당 서버가 가지고 있는 해싱값을 타 서버에 분배하며; 특정 서버에 과도한 요청이 집중한 경우에 해싱값의 일부를 다른 서버로 이동하여 부하를 적절히 분산하며; 특정 해싱값에 과도한 부하가 집중한 경우 이를 다수의 서버로 부하분산하며; 상기와 같은 일련의 작업이 스케줄링에 의해 시간 간격을 두고 처리함으로써 사용자(101)의 요청이 해싱값을 가지고 있는 서버에서 타 서버로 자연스럽게 넘어가도록 하며; 사용자(101)의 요청과 서버간의 연결성 보장(stickiness)을 위하여 타 서버로 넘기는 해싱값에 대해서 사용자(101)의 세션을 파악하여 일정시간동안 사용자(101) 요청과 서버간의 연결 관계를 유지하며 그 외의 신규 세션들에 대해서만 해싱 기반의 부하분산을 적용하는 것을 포함하는 시스템이다.

부하분산기, 서버 추가, 서버 삭제/장애, 과부하, 동적 해싱, 스케줄, 세션

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Document description

Dynamic Hashing based Load Balancing System and Its Method

The present invention relates to a hashing-based load balancer, and more particularly, to fine-tune load balancing, which is an advantage of session-based algorithms, while maintaining low memory utilization, infinite session processing capacity, and high throughput. When adding / deleting / overloading servers and servers, changes in hashing function ensures connectivity between users and servers and improves caching effects. Therefore, it provides an efficient load balancer through a simple load balancing algorithm. A dynamic hashing based load balancing system and method thereof are provided.

In general, there are Layer 4 methods for load balancing based on IP addresses and ports, and Layer 7 methods for load balancing addresses using identifiers in applications such as HTTP URLs and cookies. Regardless of which information is used as the address, all the load balancers use the same load balancing algorithm. Representative techniques include round-robin, least connection, load balancing based on response time, load balancing using server status or load information. Use them.

1 is a block diagram illustrating a general situation in which a conventional load balancer is used. In general, load balancing techniques are a technique for properly distributing connections between a request of a user 101 or a user 101 and servers 1, 2, 3, (104, 105, and 106) to a server. Units are called sessions or connections. Since these algorithms allocate and use a certain amount of memory per session in the load balancer, the number of sessions increases when the request of the user 101 or the user 101 increases, and the memory usage of the load balancer increases proportionally. In order to find a session at high speed, we introduce a hashing technique to find a session.

However, this session-based load balancing method finds infinite sessions within a finite hashing table. When the number of sessions increases due to many users 101, the search time increases in proportion to the load balancer processing speed. The disadvantage is that the limit is proportional to the size of the finite memory.

In addition, the load balancers 103 together with the load distribution between the servers 1, 2, 3 (104, 105, 106) if the user 101 connection or identification information cannot be shared between the application servers 1, 2, 3 (104, 105, 106). The stickiness between the user 101 and the servers 1, 2, 3 (104, 105, 106) must be maintained. In this case, when the user 101 attempts to access the server or requests information from the user 101 side, his identification information should be attached and sent, and the load balancer 103 should keep the identification information for a certain time, and within a certain time. When a request with the identification information comes in, it must be delivered to the same server. If connectivity is not guaranteed in such a situation, a problem arises in that the application cannot be used normally. This is one of the reasons why session-based load balancing algorithms are often used.

The hashing algorithm, which does not belong to the session-based load balancing algorithm, uses a hashing function based on the number of load balancing target servers. Instead of recording a session, the hashing algorithm judges the value from the hashing function as the load balancing result and requests the user 101 to the server. To pass. In the above method, the request of the user 101 and the user 101 is converted into a hashing value through a hashing function of information such as a source IP address, a source IP address and a port, an HTTP cookie, a URL, and a URI. To select the server.

For example, a conventional server load balancing method using a hashing algorithm will be described.

Suppose there are six servers in a server group, server 0, server 1, .. server 5. Modulo 6 is applied to the source IP address value in the user's request packet, and the corresponding server is determined by the result value (0 ~ 5).

Since the hashing-based load balancing algorithm uses a hashing function unlike the session-based load balancing algorithm, it does not consider the load information of the server at all and does not allocate a session for each of the user 101 and the request of the user 101. Even if the number of requests of the user 101 or the user 101 increases, there is no increase in the memory in the load balancer, and thus there is an advantage that the user 101 or the user 101 may process requests indefinitely.

In addition, since the request of the user 101 or the user 101 is transmitted only to a specific server, the connection security and the caching effect of the server may be increased.

However, since the servers 104, 105, and 106 are determined by the hashing value, the load distribution is not sophisticated, and when the input value of the hashing function uses only the source IP address, the proxy or source network address translation (SNAT) is used. The requests of the users 101 who came through are seen as one user 101 and the load is concentrated on a specific server. In addition, when a server add / delete / failure occurs, the algorithm using the hashing function based on the number of servers changes the hashing function due to the change in the number of available servers, resulting in a change in the connection between the user's request and the server. As

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a result, there is a problem in that it does not guarantee the stickiness between the user 101 or the user 101 and the server, which may have a problem that the connection is disconnected or the application malfunctions according to the characteristics of the server application.

When using a hashing-based algorithm, even if any server in the server group becomes overloaded and needs to relocate some of the sessions that the server was in charge to another server, the request of the user 101 or the user 101 described above. There is a problem that does not guarantee the stickiness between the server and the server.

In the existing hashing-based load balancing algorithm, if the number of available servers in the server group is changed, the hashing function is changed to break the stickness between the user and the server. The situation in which the number of servers changes is largely divided into three. A situation where a failure occurs in a server, the average server load in the server group is too low, or the server is deleted when the server is down for maintenance server purposes, and the server load in the server group is too high. . Another situation where the number of servers remains unchanged, but stickiness is broken, can occur when a particular server in a server group is too heavy to redistribute user requests to other servers. In any of the above situations, if any server fails, connection security cannot be maintained even if a session-based load balancing algorithm is used.

Hashing based load balancing techniques are known in the art. For example, since the patent specification relating to the overload control method and apparatus of the load balancing system of Patent No. 0713625 registered on April 25, 2007 is also described, a detailed description of the hashing-based load balancing technique is omitted here.

SUMMARY OF THE INVENTION The present invention has been made to solve the above-mentioned problems of the prior art, and an object of the present invention is to provide a method of session-based algorithms while maintaining low memory utilization, infinite session processing capability, and high processing speed. It is a dynamic hashing-based load balancing system that guarantees connectivity between users and servers and improves caching effect due to the sophistication of load balancing and changes in the hashing function during server addition / deletion / overload.

Another object of the present invention is to provide a load balancing system based on a dynamic hashing that provides an efficient load balancer through a simple load balancing algorithm, thereby providing a high performance function even in a small system.

It is still another object of the present invention to maintain the low memory utilization, infinite session processing capability, and high processing speed of the hashing algorithm, while the load balancing sophistication and server addition / deletion / overload are advantages of the session-based algorithm. It is to provide a load balancing method based on dynamic hashing that guarantees connectivity between user and server and improves caching effect by changing hashing function.

It is still another object of the present invention to provide an efficient load balancer through a simple load balancing algorithm, thereby providing a load balancing method based on dynamic hashing that provides high performance to a small system.

Dynamic hashing-based load balancing system of the present invention for achieving the above object is a hashing-based load balancer that distributes the user's request to the server groups, and calculates any information in the user's request as a hashing value Hashing value extractor; A hashing table for selecting a processable server using the calculated hashing value, and moving the hashing value to change a server assigned at the time of addition / deletion / fault / overload of the server; in order to dynamically change the connection between hashing value and server while guaranteeing connectivity between user request and server when adding / deleting server or specific server overload, hashing time movement time, session recording time and overload status information about hashing value A hashing value movement information table containing situation information in which the hashing value can move; A session table capable of recording session information about a user request for a predetermined time in order to smoothly move the hashing value when the server is added / deleted or overloaded; A load that includes a function of excluding a server from candidates when a failure occurs by periodically checking the status of the servers while selecting one of a plurality of target servers to which a user request is delivered while using the table information or updating the table information. It is characterized by consisting of distributed control and fault monitoring unit.

In the dynamic hashing-based load balancing system of the present invention, the hashing value extractor may also use any part of the information in the user request information to calculate the hashing value; This information is characterized by the use of IP addresses, TCP / UDP ports, cookies included in HTTP, URLs, URIs, and any other information in packets.

In the dynamic hashing-based load balancing system of the present invention, the load balancing control and fault monitoring unit evenly distributes the hashing value processed by the server when one server in the load balancing server group fails to the remaining load balancing target servers. To this end, the hashing values may be evenly distributed or the number of hashing values may be evenly distributed using the average load information for each hashing value.

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In the load balancing system based on the dynamic hashing of the present invention, the load balancing control and fault monitoring unit distributes the hashing values processed by the server evenly to the remaining load balancing target servers when one server in the load balancing server group is deleted. To this end, the hashing value may be evenly distributed or the number of hashing values may be evenly distributed by using the load information average value for each hashing value.

The load balancing system based on the dynamic hashing of the present invention may further include the load balancing control and fault monitoring unit to distribute the hashing values processed by the servers evenly to the newly added server when a new server is added in the load balancing server group. The hashing value may be evenly distributed or the number of hashing values may be evenly distributed by using the load information average value for the hashing value.

In the dynamic hashing-based load balancing system of the present invention, the load balancing control and fault monitoring unit may continue processing by a specific server in the load balancing server group, but the load balancing system may be in a state exceeding a normal load. When the first overload threshold is exceeded, the load information of the hashing value of the server is used to distribute hashing values among the smaller loads among the servers having a smaller load than the server.

The dynamic hashing-based load balancing system of the present invention also includes the load balancing control and fault monitoring unit having exceeded the secondary overload threshold specified in the hashing value movement information table, in which a specific server in the load balancing server group cannot continue to process. In this case, the server finds a hashing value causing the overload, and distributes a user request to the hashing value to all or small load servers sequentially or through another method corresponding thereto.

In the dynamic hashing-based load balancing method of the present invention, in a hashing-based load balancer that distributes and distributes user requests to server groups, the hashing table has more hashing values than the number of servers in the hashing table, Hashing in the hashing table without changing the size of the hashing value in the server reassignment situation, including the case where the number of servers to be changed due to the failure / deletion / addition of the server or the load redistribution to another server occurs when an arbitrary server is overloaded. By dynamically changing servers to which values are assigned, the server may be reassigned through hashing.

The dynamic hashing-based load balancing method of the present invention also has a hashing-based load balancer that distributes and distributes user requests to server groups, and has more hashing values than the number of servers in the hashing table. In case of server relocation including the case where the number of servers operating due to the deletion / addition of arbitrary server is changed or the load is over-loaded from one server to another server, all hashing values are not moved to another server immediately. It is characterized in that the hashing-based load balancer prevents the user's request from being disconnected from the server by gradually moving the request based on a predetermined time so that the existing connection between the request and the server is not broken.

The dynamic hashing-based load balancing method of the present invention also has a hashing-based load balancer that distributes and distributes user requests to server groups, and has more hashing values than the number of servers in the hashing table. In the server reassignment situation, including the case where the number of servers operating due to the deletion / addition of any server is changed or the server wants to redistribute the load to another server in case of an overload in any server, the user's request and server The session table is temporarily operated for storing and referencing the user's request and connection information with the server until the hashing value movements are completed.

The dynamic hashing-based load balancing method of the present invention also has a hashing-based load balancer that distributes and distributes user requests to server groups, and has more hashing values than the number of servers in the hashing table. In the case of server relocation including the case where the number of servers operating due to the deletion / addition of any server is changed or the load redistribution to another server is overwhelmed by an overload in a certain server, the movement to another server is required to ensure the user's connectivity. Generate session information on a request of a user who has entered the hashing value for a specified time with respect to the determined hashing value; The generated session information is maintained for a predetermined time; If the user 101's request for an existing session is received within a certain time, the session is further maintained for a specified time; Maintain a connection with a server for a specified time for the session being held; Forwarding the user's request by a hashing method to the user's request not registered in the session within the designated time; The user's request in which the session is recorded may be delivered to a new server or another server by a hashing method after a certain time.

The dynamic hashing-based load balancing method of the present invention is also installed in front of the servers for load balancing to receive a user's request to the server and deliver it to the server; The system has more hashing values than the number of servers; The hashing value is properly distributed to each server; Calculates a hashing value using some information of the user's request; Forward the user's request to the server with the corresponding hashing value; Load balancing is performed by allocating a portion of the hashing value

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of each server to the added server when the server is added; Distributes the hashing value of the server to other servers when the server is deleted / failed; If excessive requests are concentrated on one server, some of the hashing values are moved to other servers to balance the load appropriately; If excessive load is concentrated on a particular hashing value, it is then distributed among multiple servers; Such a series of tasks are processed at a time interval by scheduling so that a user's request naturally passes from a server having a hashing value to another server; It checks the user's session for the hashing value passed to other server for the stickiness between the user's request and the server and maintains the connection relationship between the user's request and the server for a certain period of time. It is characterized by applying load balancing.

The dynamic hashing-based load balancing system and method thereof of the present invention are different from the conventional method (unbalance of load) in which user requests are distributed unevenly among servers in server addition / deletion / failure / overload situations. Evenly distributes requests between servers (evenly load). In addition, dynamic hashing-based load balancing system and its method are continuously connected between user request and server regardless of the situation, unlike the existing method in which a continuous connection relationship between a user request and a server cannot be established in a server add / delete / fault / overload situation. The connection is established.

Hereinafter, the present invention will be described in more detail with reference to the accompanying drawings.

1 shows a general situation in which a conventional load balancer 103 is used. When the user 101 requests a web service through the Internet network 102, the load balancer 103 installed in front of the server 1 104, the server 2 105, and the server 3 106 makes the request most quickly. The request of the user 101 is sent to the server capable of processing. In this case, when hashing is used in the load balancing policy, requests of the same user 101 may be mapped 1: 1 to the same server. For example, if the server 1 104 processes the user 101 request 1, the server 1 104, which has processed this, is processed again when the user 101 request 1 is requested again.

2 is a block diagram illustrating a structure of a conventional hashing-based load balancer 200. The conventional load balancer 200 includes a hashing value extractor 220, a hashing table 230, a load balancing control and a fault monitoring unit 210.

The hashing value extractor 220 is responsible for calculating arbitrary information as a hashing value in a user's request, and the hashing table 230 is responsible for selecting a server that can be processed using the calculated hashing value. . The load balancing control and fault monitoring unit 210 selects a target server to which a user request is delivered from among several servers using hashing table information, and periodically checks the state of the servers to exclude the server from candidates when a failure occurs. In charge of the function.

3 is a block diagram illustrating a conventional hashing-based load balancer 320 to process a user's request 310. The load balancer 320 extracts a hashing value of 1 from the user request 310 information through the hashing value extractor 321, and finds the server 330 2 assigned to the hashing value 1 in the hashing table 322. It sends a request to the server (330) 2.

4 is a block diagram showing the structure of the load balancer 400 based on the dynamic hashing of the present invention.

The dynamic hashing-based load balancer 400 according to the present invention includes a hashing value extractor 420, a hashing table 430, a hashing value movement information table 440, a session table 450, a load balancing control and a fault monitoring unit (410).

The hashing value extractor 420 is responsible for calculating arbitrary information as a hashing value in a user's request, and the hashing table 430 is responsible for selecting a server that can be processed using the calculated hashing value. .

The hashing value movement information table 440 is a hashing value movement time and a session recording time to dynamically change the connection relationship between the hashing value and the server while ensuring connectivity between the user request and the server when a server is added / deleted or overloaded. And situation information in which the hashing value can move, such as overload state information for the hashing value.

The session table 450 records session information on a user request for a predetermined time in order to smoothly move a hashing value when a server is added / deleted or overloaded. The load balancing control and failure monitoring unit 410 checks the status of the servers periodically by selecting one of a plurality of servers to which the user request is to be delivered while using the table information or updating the table information. Responsible for removing the server from the candidate.

5 is a block diagram illustrating a process of processing the user's request 510 by the dynamic hashing-based load balancer 520 of the present invention.

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In a general situation in which a situation such as server deletion / failure / addition / overload does not occur, the process of processing the user's request 510 by the dynamic hashing-based load balancer 520 of the present invention is performed by the conventional load balancer 320. Same as the process of processing the user's request (310). The load balancer 520 extracts a hashing value of 5 through the hashing value extractor 521 from the user request 510 information, and finds the server 530 2 assigned to the hashing value 5 in the hashing table 522 of the user. It sends the request 510 to the server 530 2.

However, in special situations such as deletion / fault / addition / overload of the server 530, FIG. 7, 8, 9, and 10 illustrating an embodiment of the present invention will follow.

6A and 6B are block diagrams illustrating the structure of the hashing value movement information table 440 and the session table 450 in the load balancer based on the dynamic hashing of the present invention.

The hashing value movement information table 440 includes a movement time, a session recording time, a threshold value of one overload level, and a threshold value of two overload levels. The movement time represents the time taken for the actual hashing value to move by scheduling, and the session recording time represents the time for recording the session of the hashing value to be moved. The hashing value whose movement is determined according to the situation of the server should be moved to another server within 60 seconds by the scheduling time. The session recording time is used as a criterion for determining whether or not the corresponding hashing value may be moved. The load balancer determines that the session does not need to be maintained any longer when there is no request for 60 seconds based on the session recording time and moves only the hashing value. The overload threshold is a value that is compared with the load of the server. If the load of the server is between the threshold 80 of the first stage of overload and the threshold 100 of the second stage of overload, the load balancer determines that the server is in the first stage of overload. In addition, if the load of the server is equal to the threshold value 100 of the second stage of overload, the load balancer determines that the server is in the second stage of overload. The session table 450 is composed of a source address and port, a destination address and port, a real server address and port, and a hashing value.

The general hashing-based load balancing method connects the previous user 101 to the server 104 because the server 104 recalculates the hashing value using the number of available servers 104 in case of deletion / fault and addition. The connection is changed to a state that is not preserved and recalculated. In this case, in the case of the web application, the connection of the user 101 is terminated, and in the case of the caching server 104, the hit rate decreases rapidly. 7 and 8 relate to a method for minimizing recalculation of hashing values in the case of server 104 deletion / failure and addition to solve this problem.

FIG. 7 is a block diagram illustrating an operation process of processing a deletion / failure of a server using the dynamic hashing-based load balancer 520 of the present invention. For example, if server 3 is deleted or fails, the hashing values that server 3 handled are transferred to servers 1 and 2. In this example, the hashing values 6 and 7 handled by server 3 are moved to server 1 (arrows 721 and 722), and the hashing values 8 handled by server 3 are transferred to server 2 (arrows 723). In case of server failure, the guarantee of connectivity between the user request and the server is broken, so the above hashing value movement occurs. On the other hand, in the case of server deletion, the hashing value movement can be gradually performed to guarantee user request and connectivity with the server. When the server needs to be deleted, information about the incoming session for a certain period of time is recorded in the session table. After that, when a user request comes in, the session table is searched to determine whether or not it is an existing session.

If the session is new, for example, if the hashing value is 8, the server 2 is allocated according to the reassignment principle. If it is an existing session, it is determined whether a request comes in within a certain time. If the user request comes back for a certain period of time, it is assigned to the existing server 3 (this is determined by step F123 of FIG. 11). The information of server 3 is registered in the corresponding session and the actual server address in the corresponding session in the session table of FIG. 6-b. the / port field contains information about Server 3),

If the request comes in after a certain period of time, it is determined that the session does not need to be maintained. For example, if the hashing value is 8, the server 2 is allocated according to the reassignment principle. If all the requests processed by the existing server 3 are finished and the server 3 is no longer responsible, the server 3 is deleted. In the process of moving a hashing value when deleting a server, the hashing value is gradually moved by using hashing movement time and session recording time information in the hashing value movement information table 440. The session table runs only temporarily for hashing value movement.

8 is a block diagram illustrating an operation process of processing the addition of a server using the dynamic hashing-based load balancer 520 of the present invention. For example, when Server 4 is added, the hashing values of the existing servers are transferred to the new Server 4. In the example, the hashing value 5 processed by server 2 is moved to server 4 (arrow 821), and the hashing value 8 processed

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by server 3 is transferred to server 4 (arrow 822). Here, the hashing value movement is also processed in the same manner as the progressive movement method using the hashing value movement information table 440 information described in the server deletion process of FIG. 7 in order to ensure the connection security between the user request and the server.

In a general hashing-based load balancing method, there is a tendency that the performance of the overall servers depends on the server 104 where the request is overloaded because the request of the user 101 is overloaded with one or some servers. 9 and 10 relate to a method for servers to uniformly handle the request of the user 101 in the event of request overload to solve this problem.

9 is a block diagram illustrating an operation process of processing a server when a primary overload, which is an overload state, may be processed by the server using the dynamic hashing-based load balancer 520. For example, if the server 2941 has a primary overload, the server 2941 moves to another server among hashing values processed by the server 294. The threshold of primary overload is specified in the hashing value movement information table 440 of FIG. In this example, the hashing value 3 being processed by server 2941 moves to server 1 (arrow 931), and the hashing value 5 moves to server 3 (arrow 932), so that requests from user 101 are equalized to the servers. We can see that it is distributed (all servers have a load of 100 after moving the hashing value). Here, the hashing value movement is also processed in the same manner as the progressive movement method using the hashing value movement information table 440 information described in the server deletion process of FIG. 7 in order to guarantee the connection security between the user request and the server.

FIG. 10 is a block diagram illustrating an operation process of processing a secondary overload, which is an overload state in which the server can no longer continue using the dynamic hashing-based load balancer 520. For example, if server 2 1041 has a secondary overload, since server 2 cannot handle this alone, it redistributes in the form of round robin with other servers. The threshold of secondary overload is specified in the hashing value movement information table 440 of FIG. 6, for example 100. If server 2 receives a request 1021 with a hashing value of 4 that cannot be handled by itself and determines that it is a secondary overload, then the user request coming to hashing value 4 determines the server in a scheduling manner (round robin). 11 F140 step).

For example, the first request is handled by server 1 (arrow 1031), the second request is handled by server 2 (arrow 1032), the third request is handled by server 3 (arrow 1033), and the fourth request is Server 1 is distributed by processing again (arrow 1031).

The dynamic hashing-based load balancing technique of the present invention will be described in detail with reference to FIGS. 11, 12, and 13.

11 is a flowchart illustrating an overall session processing process for a user request according to an embodiment of the present invention.

F101: Start the whole operation.

F110: Receive a session.

F120: Check whether there is a corresponding session in the session table.

F121: If the session exists in the session table, check if the session has expired.

F122: Discard the session information if the session has expired.

F123: If the session has not expired, select the server recorded in the session table.

F130: If there is no session in the session table, the hashing value is calculated and the server is selected.

F140: Verify that load balancing for hashing values is round robin.

F141: If the load balancing for hashing value is round robin, choose server as round robin.

F150: If the load balancing for hashing value is not round robin, check if session recording for hashing value is enabled.

F151: End session recording if session recording for hashing value is activated.

F152: Record the session.

F160: Send a session.

F170: End the whole operation.

FIG. 12 is a flowchart illustrating managing a state change of a server before calculating the hashing value of FIG. 11 and selecting a server (F130) according to an exemplary embodiment of the present invention.

F201: Start overall operation.

F210: Check if the server has been deleted.

F211: If the server is deleted, distribute the deleted server's hashing value to the remaining servers. A specific example follows FIG. 7.

F220: If the server has not been deleted, check if there is a failed server.

F221: If there is a failed server, distribute the failed server's hashing value to the remaining servers. A specific example follows FIG. 7.

F230: If the failed server does not exist, check if the server has been added.

F231: If a server has been added, set the session to record the hashing value to move from the existing server to the added server. A specific example follows FIG. 8.

F232: Select hashing value to send to added server according to load rate and condition of existing server.

F240: If no server has been added, verify that the server's status is Overload 1, which the server can handle.

F241: If the server state is overload state 1 that the server can handle, select a hashing value to move according to the load rate and state of the servers. A specific example follows FIG. 9.

F242: The hashing value to move gradually moves according to the scheduling policy.

F250: If the server's state is not overload state 1 that the server can handle, check whether the server's state is overload state 2, which the server cannot handle.

F251: If the state of the server is an overload state 2 that the server cannot handle, the scheduling is performed by changing the hashing value of the overload state to round robin. A specific example follows FIG. 10.

13 is a flowchart illustrating an operation of moving a hashing value (F242) according to the scheduling policy of FIG. 12 according to an embodiment of the present invention.

F301: Start overall operation.

F310: Check if there is a hashing value that started recording the session.

F311: If there is a hashing value that started recording the session, check whether the session recording time for the hashing value has expired.

F312: If the session recording time for the hashing value has expired, stop recording the session for the hashing value.

F320: If no hashing value starts the session recording, check if there is a hashing value to move to another server.

F321: If there is a hashing value to move to another server, the hashing value is moved according to a specified scheduling method.

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The load balancing scheme based on the dynamic hashing of the present invention distributes the request of the user 101 evenly among the servers in the addition / deletion / fault / overload situation of the server (evenly distributing the load) and the request of the user 101 and the server. Ensure a lasting connection between them. This distribution and connection ensures a stable service without delay due to server addition / deletion / failure / overload to all users 101 who use the servers.

Although the invention has been described in detail only with respect to the described embodiments, it will be apparent to those skilled in the art that various changes or modifications can be made within the spirit and scope of the invention, and such changes or modifications are consequently attached to the appended claims. It will have to belong to the scope of.

1 is a block diagram illustrating a general situation in which a conventional load balancer is used.

2 is a block diagram showing the structure of a conventional hashing-based load balancer.

3 is a block diagram illustrating a conventional hashing-based load balancer processing a user request.

4 is a block diagram showing the structure of a load balancer based on dynamic hashing according to the present invention.

5 is a block diagram illustrating a process of processing a user's request by the load balancing based on the dynamic hashing according to the present invention.

6A and 6B are block diagrams illustrating the structure of the hashing value movement information table and the session table in the load balancing based on the dynamic hashing of the present invention.

7 is a block diagram illustrating an operation process of processing a deletion / failure of a server using a dynamic hashing-based load balancer according to the present invention.

FIG. 8 is a block diagram illustrating an operation process of adding a server using a dynamic hashing-based load balancer according to the present invention.

FIG. 9 is a block diagram illustrating an operation process of processing a server when the first overload, which is an overload state, may be processed by the server using the dynamic hashing-based load balancer.

FIG. 10 is a block diagram illustrating an operation process of processing a secondary overload, which is an overload state in which a server can no longer continue using the dynamic hashing-based load balancer of the present invention.

11 is a flowchart illustrating an overall session processing process for a user request according to an embodiment of the present invention.

FIG. 12 illustrates a flowchart of managing a state change of a server before calculating the hashing value of FIG. 11 and selecting a server according to an exemplary embodiment of the present invention.

13 is a flowchart illustrating an operation of moving a hashing value according to the scheduling policy of FIG. 12 according to an exemplary embodiment of the present invention.

<Description of the symbols for the main parts of the drawings>

400: load balancer

410: load distribution control and fault monitoring unit

420: hashing value extractor

430 hashing table

440: hashing value movement information table

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450: session table

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Document Claims

Language: (English)

In the hashing-based load balancer that distributes user requests to server groups,

A hashing value extractor 420 that calculates arbitrary information as a hashing value in a request of the user 101;

A hashing table 430 for selecting a processable server by using the calculated hashing value, and moving the hashing value to change the assigned server upon adding / deleting / faulting / loading the server;

In order to dynamically change the connection between hashing value and server while guaranteeing connectivity between user request and server when adding / deleting server or specific server overload, hashing time movement time, session recording time and overload status information about hashing value A hashing value movement information table 440 including situation information in which the hashing value can move;

A session table 450 capable of recording session information for a user 101 request for a predetermined time in order to smoothly move a hashing value when adding / deleting or overloading a server;

A load that includes a function of excluding a server from candidates when a failure occurs by periodically checking the status of the servers while selecting one of a plurality of target servers to which a user request is delivered while using the table information or updating the table information. Dynamic hashing-based load balancing system, characterized in that composed of a distributed control and fault monitoring unit (410).

2. The hashing value extractor (420) of claim 1, wherein the hashing value extractor (420) may use any part of the information in the user (101) request information for hashing value calculation; This information uses an IP address, a TCP / UDP port, a cookie included in HTTP, a URL, a URI, and any other information in a packet other than the dynamic hashing-based load balancing system.

2. The load balancing control and failure monitoring unit 410 of claim 1, wherein when one server 741 in the load balancing server group fails, the hashing value processed by the server is evenly distributed to the remaining load balancing target server. To distribute, the hashing value is distributed evenly or the number of hashing values is evenly distributed using the load information average value for each hashing value.

2. The load balancing control and failure monitoring unit 410 of claim 1, wherein the hashing value processed by the server is uniformly distributed to the remaining load balancing target servers when one server 741 in the load balancing server group is deleted. To distribute, the hashing value is distributed evenly or the number of hashing values is evenly distributed using the load information average value for each hashing value.

The load balancing control and failure monitoring unit 410 distributes the hashing values processed by the servers evenly to the newly added server 832 when the new server 832 in the load balancing server group is added. In order to uniformly distribute the hashing value or evenly distribute the number of hashing values using the load information average value for each hashing value.

The hashing value movement information table according to claim 1, wherein the load balancing control and fault monitoring unit 410 is able to continue processing by a specific server 941 in the load balancing server group but exceeds a normal load. When the first overload threshold specified in 440 is exceeded, the load information of the hashing value of the server 941 is used to distribute hashing values having a smaller load among the servers having a lower load than the server 941. Dynamic hashing based load balancing system, characterized in that.

The secondary load designated by the hash value movement information table 440 of claim 1, wherein the load balancing control and fault monitoring unit 410 is in a state in which the specific server 1041 in the load balancing server group cannot continue processing. When the overload threshold is exceeded, the server 1041 finds a hashing value causing the overload, and sequentially distributes the user 101 request coming in to the hashing value to all or lightly loaded servers, or other equivalent. Dynamic hashing-based load balancing system, characterized in that the distribution through the method.

In the hashing-based load balancer that distributes user requests to server groups,

The hashing table 430 has more hashing values than the number of servers, and the number of servers operating due to the failure / deletion / addition of any server in the server group is changed or the load on other servers when an overload occurs in any server. Dynamic hashing-based load, characterized in that the server is reassigned by moving the hashing value by dynamically changing the servers assigned the hashing values in the hashing table without changing the size of the hashing value in the server reassignment situation including redistribution. Dispersion method.

In the hashing-based load balancer that distributes user requests to server groups,

The hashing table 430 has more hashing values than the number of servers, and in order to redistribute the load to another server when the number of servers changed due to the deletion / addition of random servers in the server group is changed or when an overload occurs in a random server. In a server reassignment situation, a user in a hashing-based load balancer does not move all the hashing values directly to another server, but instead moves them incrementially based on a randomly specified time so that the user's request and existing connections with the server are not broken. Dynamic hashing-based load balancing method, characterized in that the connection between the request and the server is disconnected.

In the hashing-based load balancer that distributes user requests to server groups,

The hashing table 430 has more hashing values than the number of servers, and in order to redistribute the load to other servers when the number of servers changed due to the deletion / addition of arbitrary servers in the server group is changed or when an overload occurs in any server. In the server reassignment situation, including the case where the server reassignment situation occurs, for the purpose of storing and referencing the user's request and the connection information between the server and the server until the hashing value movements are completed so that the connection between the user's request and the server is not broken. Dynamic hashing-based load balancing method, characterized in that for operating the session table (450).

In the hashing-based load balancer that distributes user requests to server groups,

The hashing table 430 has more hashing values than the number of servers, and in order to redistribute the load to another server when the number of servers changed due to the deletion / addition of random servers in the server group is changed or when an overload occurs in a random server. In the server reassignment situation including the case, to ensure the connectivity of the user 101 to generate the session information for the request of the user 101 entered the hashing value for a specified time with respect to the hashing value determined to move to another server ;

The generated session information is maintained for a predetermined time;

If the user 101's request for an existing session is received within a certain time, the session is further maintained for a specified time;

Maintain a connection with a server for a specified time for the session being held;

Forwarding the request of the user 101 by a hashing method to the request of the user 101 not registered in the session within the designated time;

Dynamic hashing-based load balancing method characterized in that the request of the user 101 recorded the session is transmitted to a new server or another server by a hashing method after a predetermined time.

Language: (Korean)

사용자의 요청을 서버그룹들에 분산하여 전달하는 해싱기반의 부하분산기에 있어서,

사용자(101)의 요청에서 임의의 정보를 해싱값으로 계산하는 해싱값 추출기(420);

계산된 해싱값을 이용하여 처리가능한 서버를 선택하게 하며, 서버의 추가/삭제/장애/과부하시 배정된 서버를 변경하기 위해 해싱값을 이동하는 해싱테이블(430);

서버의 추가/삭제 또는 특정 서버 과부하시 사용자의 요청과 서버간의 연결성을 보장하면서 해싱값과 서버와의 연결관계를 동적으로 바꾸기 위해 해싱값 이동시간, 세션기록시간 그리고 해싱값에 대한 과부하 상태 정보등 해싱값이 이동할 수 있는 상황 정보를 포함하는 해싱값이동정보테이블(440);

서버의 추가/삭제 또는 과부하시 해싱값 이동을 원활하게 하기 위하여 일정시간 동안 사용자(101) 요청에 대한 세션 정보를 기록할 수 있는 세션테이블(450);

상기 테이블 정보를 이용하거나 또는 테이블 정보를 갱신하면서 사용자 요청을 전달할 대상서버를 여러 서버 중에서 하나를 선택하면서, 주기적으로 서버들의 상태를 확인하여 장애가 발생하면 해당 서버를 후보에서 제외하는 기능을 포함하는 부하분산제어 및 장애감시부(410)로 구성되어 있는 것을 특징으로 하는 동적 해싱기반의 부하분산시스템.

제 1항에 있어서, 상기 해싱값 추출기(420)는 해싱값 계산을 위해 사용자(101) 요청 정보내 임의의 일부 정보가 사용될 수 있으며; 이러한 정보는 IP 주소, TCP/UDP 포트, HTTP에 포함된 Cookie, URL, URI 그리고 이와의 패킷 내의 임의의 정보를 사용하는 것을 특징으로 하는 동적 해싱기반의 부하분산 시스템.

제 1항에 있어서, 상기 부하분산제어 및 장애감시부(410)는 부하분산 서버그룹내 하나의 임의 서버(741)가 장애가 발생한 경우에 상기 서버가 처리했던 해싱값이 나머지 부하분산대상 서버에게 고르게 분배하기 위해, 각 해싱값에 대한 부하정보 평균값을 이용하여 해싱값을 고르게 분산하거나 또는 해싱값의 개수를 고르게 분배하는 것을 특징으로 하는 동적 해싱기반의 부하분산 시스템.

제 1항에 있어서, 상기 부하분산제어 및 장애감시부(410)는 부하분산 서버 그룹내 하나의 임의 서버(741)가 삭제된 경우에 상기 서버가 처리했던 해싱값이 나머지 부하분산대상 서버에게 고르게 분배하기 위해, 각 해싱값에 대한 부하정보 평균값을 이용하여 해싱값을 고르게 분산하거나 또는 해싱값의 개수를 고르게 분배하는 것을 특징으로 하는 동적 해싱기반의 부하분산 시스템.

제 1항에 있어서, 상기 부하분산제어 및 장애감시부(410)는 부하분산 서버그룹내 새로운 서버(832)가 추가되는 경우에 서버들이 처리했던 해싱값이 새로 추가 된 서버(832)에게 고르게 분배하기 위해, 각 해싱값에 대한 부하정보 평균값을 이용하여 해싱값을 고르게 분산하거나 또는 해싱값의 개수를 고르게 분배하는 것을 특징으로 하는 동적 해싱기반의 부하분산 시스템.

제 1항에 있어서, 상기 부하분산제어 및 장애감시부(410)는 부하분산 서버그룹내 특정 서버(941)가 계속 처리할 수 있으나 평상 부하를 많이 초과하는 상태가 되는, 해싱값 이동정보테이블(440)에 지정된 1차 과부하 임계치를 넘었을 때, 상기 서버(941)의 해싱값의 부하정보를 이용하여, 이들 중 부하가 작은 해싱값들을 상기 서버(941)보다 부하가 작은 서버들로 분배하는 것을 특징으로 하는 동적 해싱기반의 부하분산 시스템.

제 1항에 있어서, 상기 부하분산제어 및 장애감시부(410)는 부하분산 서버그룹내 특정 서버(1041)가 계속 처리 할 수 없는 상태가 되는, 해싱값 이동정보테이블(440)에 지정된 2차 과부하 임계치를 넘었을 때, 상기 서버(1041)에서 과부하를 유발하는 해싱값을 찾아내어, 해당 해싱값으로 들어오는 사용자(101) 요청을 모든 또는 부하가 작은 서버들에게 순차 분배하거나 또는 이에 상응하는 다른 방식을 통하여 분배하는 것을 특징으로 하는 동적 해싱기반의 부하분산 시스템.

사용자의 요청을 서버그룹들에 분산하여 전달하는 해싱기반의 부하분산기에 있어서,

해싱테이블(430)에서 서버의 대수보다 더 많은 해싱값을 가지게 하며, 서버그룹에서 임의의 서버의 장애/삭제/추가로 인하여 동작하는 서버 대수가 변경되거나 임의의 서버에서 과부하 발생시 타 서버로의 부하 재분배를 하고자 하는 경우를 포함한 서버 재배정 상황에서 해싱값 크기는 변경하지 않고 해싱테이블내 해싱값들이 배정된 서버들을 동적으로 변경함으로써, 해싱값 이동을 통하여 서버 재배정하는 것을 특징으로 하는 동적 해싱기반의 부하분산방법.

사용자의 요청을 서버그룹들에 분산하여 전달하는 해싱기반의 부하분산기에 있어서,

해싱테이블(430)에서 서버의 대수보다 더 많은 해싱값을 가지게 하며, 서버그룹에서 임의의 서버 삭제/추가로 인하여 동작하는 서버 대수가 변경되거나 임의의 서버에서 과부하 발생시 타 서버로의 부하 재분배를 하고자 하는 경우를 포함한 서버 재배정 상황에서 모든 해싱값을 곧바로 타 서버로 이동시키지 않고, 사용자의 요청과 서버와의 기존 연결성이 끊어지지 않도록 임의의 지정된 시간을 기준으로 점진적으로 이동함으로써 해싱기반 부하분산기에서 사용자의 요청과 서버와의 연결성이 끊기는 것을 방지하는 것을 특징으로 하는 동적 해싱기반의 부하분산방법.

사용자의 요청을 서버그룹들에 분산하여 전달하는 해싱기반의 부하분산기에 있어서,

해싱테이블(430)에서 서버의 대수보다 더 많은 해싱값을 가지게 하며, 서버 그룹에서 임의의 서버 삭제/추가로 인하여 동작하는 서버 대수가 변경되거나 임의의 서버에서 과부하 발생시 타 서버로의 부하 재분배를 하고자 하는 경우를 포함한 서버 재배정 상황에서, 서버 재배정 상황

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이 발생한 시점부터 사용자의 요청과 서버와의 연결성이 끊기지 않게 해싱값 이동들이 끝날 때 까지 사용자의 요청과 서버와의 연결 정보 저장 및 참조를 위하여 한시적으로 세션테이블(450)을 운영하는 것을 특징으로 하는 동적 해싱기반의 부하분산방법.

사용자의 요청을 서버그룹들에 분산하여 전달하는 해싱기반의 부하분산기에 있어서,

해싱테이블(430)에서 서버의 대수보다 더 많은 해싱값을 가지게 하며, 서버그룹에서 임의의 서버 삭제/추가로 인하여 동작하는 서버 대수가 변경되거나 임의의 서버에서 과부하 발생시 타 서버로의 부하 재분배를 하고자 하는 경우를 포함한 서버 재배정 상황에서, 사용자(101)의 연결성을 보장하기 위하여 타 서버로 이동이 결정된 해싱값에 대하여 지정된 시간동안 상기 해싱값으로 들어온 사용자(101)의 요청에 대한 세션 정보를 생성하며;

상기 생성된 세션 정보는 일정시간동안 유지하며;

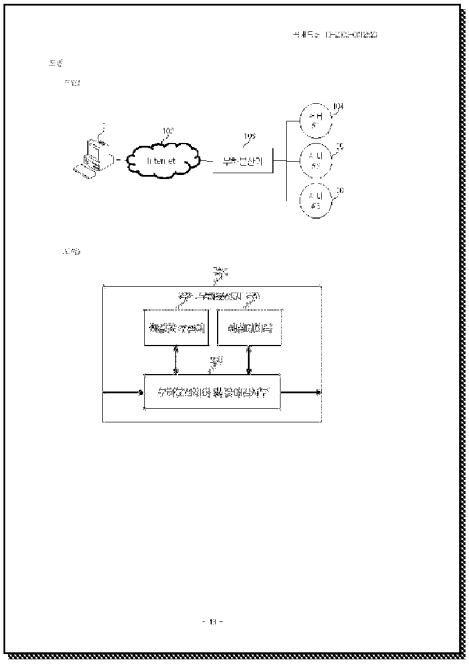
일정 시간 내에 기존 세션에 대한 사용자(101)의 요청이 들어오면 지정된 시간만큼 세션을 더 유지시키며;

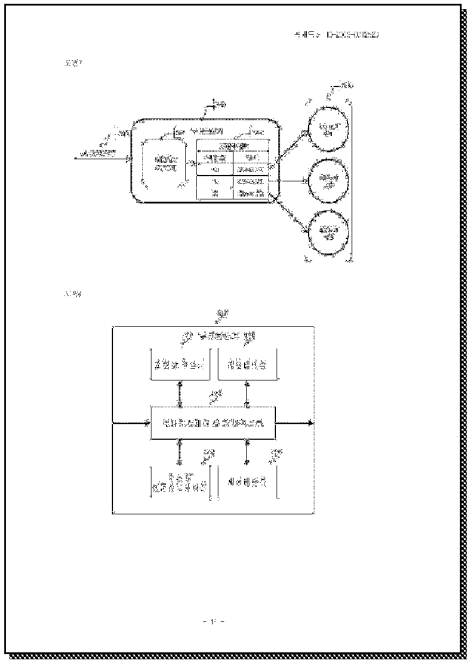
상기 유지 되고 있는 세션에 대해서는 서버와의 접속을 지정된 시간동안 유지하며;

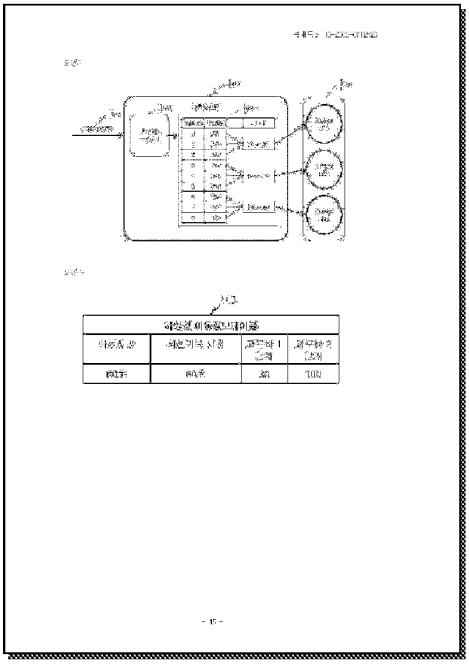
상기 지정된 시간 내에 세션에 등록되지 않은 사용자(101)의 요청에 대해서는 해싱방법에 의하여 사용자(101)의 요청을 전달하며;

세션이 기록된 사용자(101)의 요청은 일정 시간이 지난 이후에 해싱방법에 의하여 새로운 서버 또는 다른 서버에 전달하는 것을 특징으로 하는 동적 해싱기반의 부하분산방법.

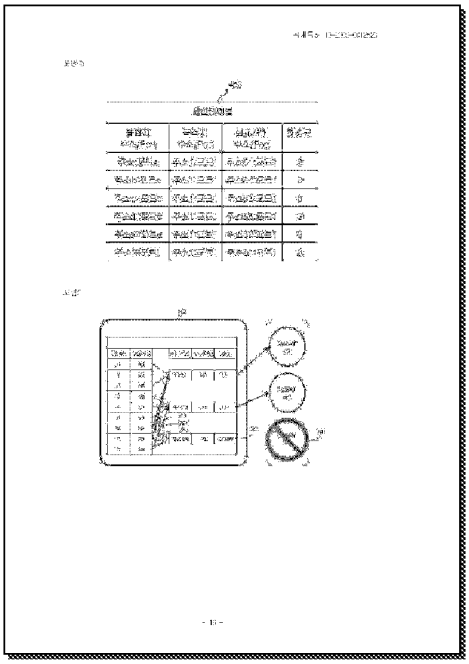
Ex.1002
Cholla Energy LLC & OBM, Inc. / Page 305 of 611

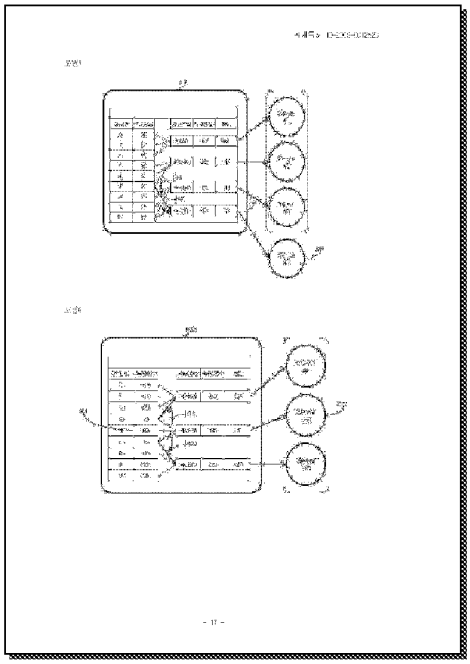


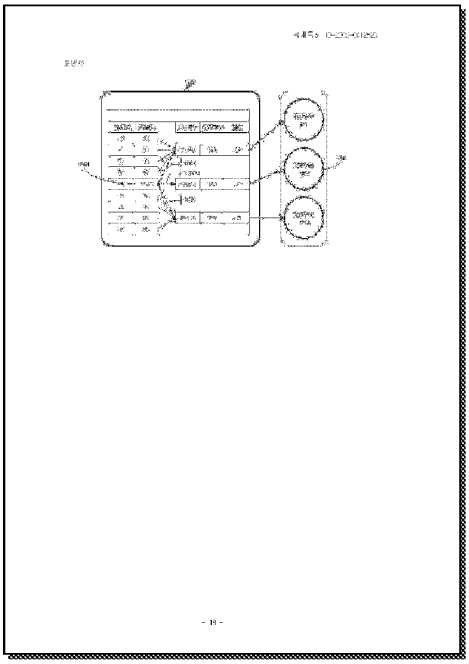


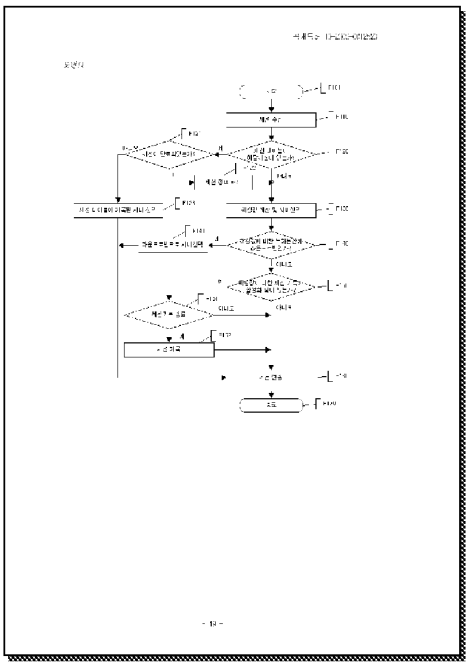


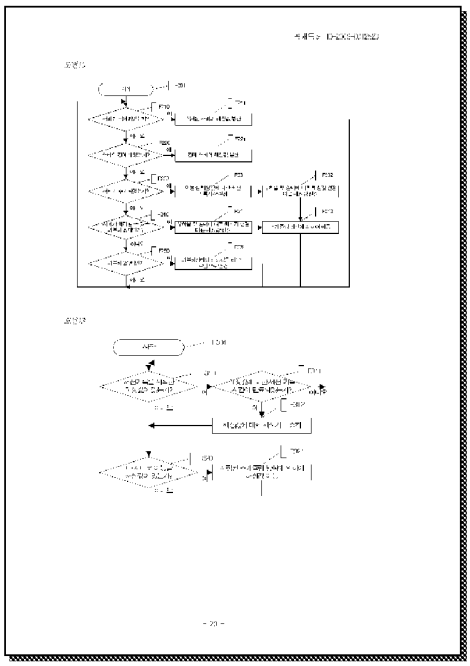
Drawing pages of KR20090012523 A











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Electronic Acknowledgement Receipt

EFS ID:	38052344
Application Number:	16482495
International Application Number:	
Confirmation Number:	7727
Title of Invention:	Method and System for Dynamic Power Delivery to a Flexible Datacenter Using Unutilized Energy Sources
First Named Inventor/Applicant Name:	David Henson
Customer Number:	20306
Filer:	Alexander D. Georges
Filer Authorized By:	
Attorney Docket Number:	18-874-WO1-US
Receipt Date:	17-DEC-2019
Filing Date:	
Time Stamp:	21:34:23
Application Type:	U.S. National Stage under 35 USC 371

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)	18_874WO1US_IDS_.pdf	1054778 1a8a9b683edd4d7f5c23a52694f4f4f6378be4f1	no	7

Warnings:

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3	Foreign Reference	KR2009001523.pdf	1737641 fa52e67c35984bf19dc34778783c30f6ad61570a	no	17
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4	Non Patent Literature	NFOA_US16132062_11DEC2019_EFS.pdf	1389767 c2f4f7677a81f0eda07fca5ecc678c5ee94d9388	no	34
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5	Non Patent Literature	NFOA_US16132098_14Nov2019_EFS.pdf	1016390 952e488e5b3043d0f9f7233f412989c4a6340ea8	no	25
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Warnings:					
Information:					
			Total Files Size (in bytes):	23181618	

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New Applications Under 35 U.S.C. 111

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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

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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
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (**Not for submission under 37 CFR 1.99)**		
	Application Number	16482495
	Filing Date	2019-07-31
	First Named Inventor	HENSON, David
	Art Unit	TBD
	Examiner Name	TBD
	Attorney Docket Number	18-874-WO1-US

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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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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	16482495
	Filing Date	2019-07-31
	First Named Inventor	HENSON, David
	Art Unit	TBD
	Examiner Name	TBD
	Attorney Docket Number	18-874-WO1-US

	1	Final Office Action mailed on 01 October 2019 for U.S. Patent Application No. 16/175,246, filed on 30 October 2018, 18 pages.	
	2	Notice of Allowance mailed on 15 August 2019, for U.S. Patent Application No. 16/175146, filed on 30 October 2018, 17 pages.	
	3	WILSON, J., "A Utility-Scale Deployment Project of Behind-the-Meter Energy Storage for Use in Ancillary Services, Energy Resiliency, Grid Infrastructure Investment Deferment, and Demand-Response Integration," Portland State University, 2016.	

If you wish to add additional non-patent literature document citation information please click the Add button Add

EXAMINER SIGNATURE

Examiner Signature		Date Considered	

*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.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	16482495
	Filing Date	2019-07-31
	First Named Inventor	HENSON, David
	Art Unit	TBD
	Examiner Name	TBD
	Attorney Docket Number	18-874-WO1-US

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	/Alexander D. Georges/	Date (YYYY-MM-DD)	2019-10-15
Name/Print	Alexander D. Georges	Registration Number	70534

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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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:

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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.

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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Electronic Acknowledgement Receipt

EFS ID:	37460432
Application Number:	16482495
International Application Number:	
Confirmation Number:	7727
Title of Invention:	Method and System for Dynamic Power Delivery to a Flexible Datacenter Using Unutilized Energy Sources
First Named Inventor/Applicant Name:	David Henson
Customer Number:	20306
Filer:	Alexander D. Georges
Filer Authorized By:	
Attorney Docket Number:	18-874-WO1-US
Receipt Date:	15-OCT-2019
Filing Date:	
Time Stamp:	15:16:05
Application Type:	U.S. National Stage under 35 USC 371

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)	18-874-WO1-US_IDS_15OCT2019.pdf	1053605 82c5248400cb8f3799939e227858d57dfc56cabc	no	4

Warnings:

Information:					
A U.S. Patent Number Citation or a U.S. Publication Number Citation is required in the Information Disclosure Statement (IDS) form for autoloading of data into USPTO systems. You may remove the form to add the required data in order to correct the Informational Message if you are citing U.S. References. If you chose not to include U.S. References, the image of the form will be processed and be made available within the Image File Wrapper (IFW) system. However, no data will be extracted from this form. Any additional data such as Foreign Patent Documents or Non Patent Literature will be manually reviewed and keyed into USPTO systems.					
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Information:					
4	Non Patent Literature	WILSON_EnerRes_2016_EFS_final.pdf	8017131 068a3b92071644645c7b8ca26d1c91c4386218ac	no	153
Warnings:					
Information:					
		Total Files Size (in bytes):	17489576		

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New Applications Under 35 U.S.C. 111

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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.

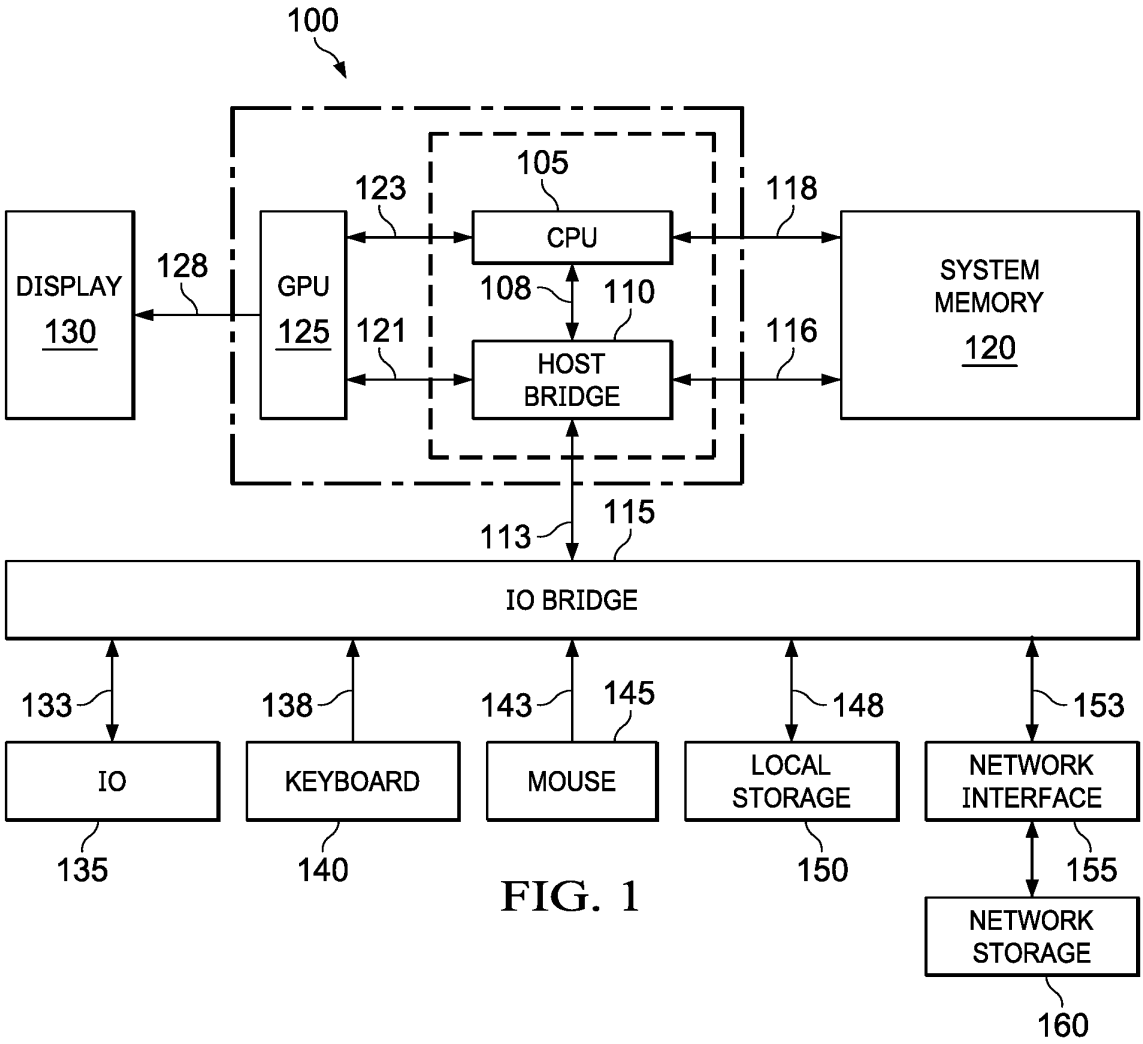
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FIG. 1

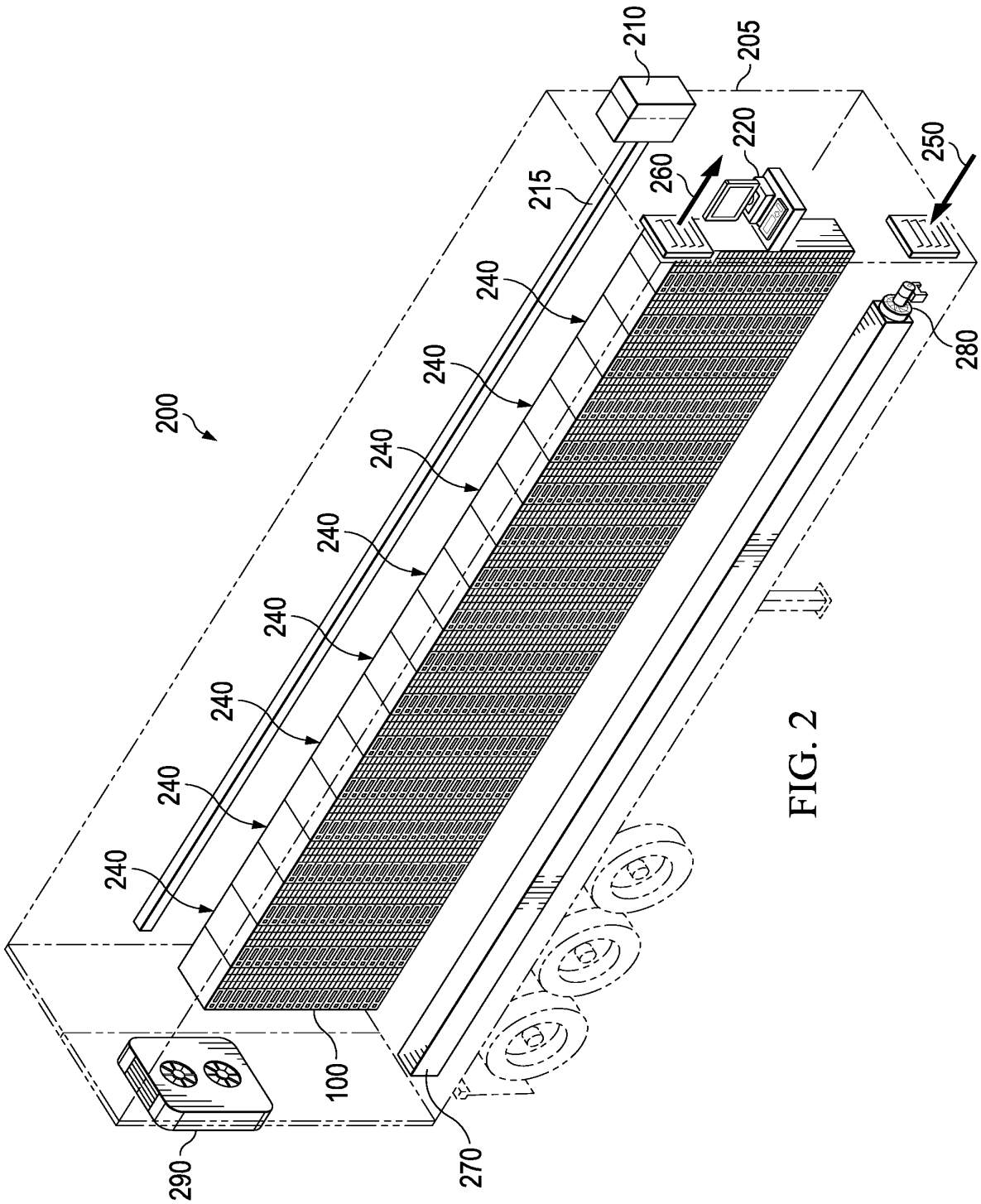
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FIG. 2

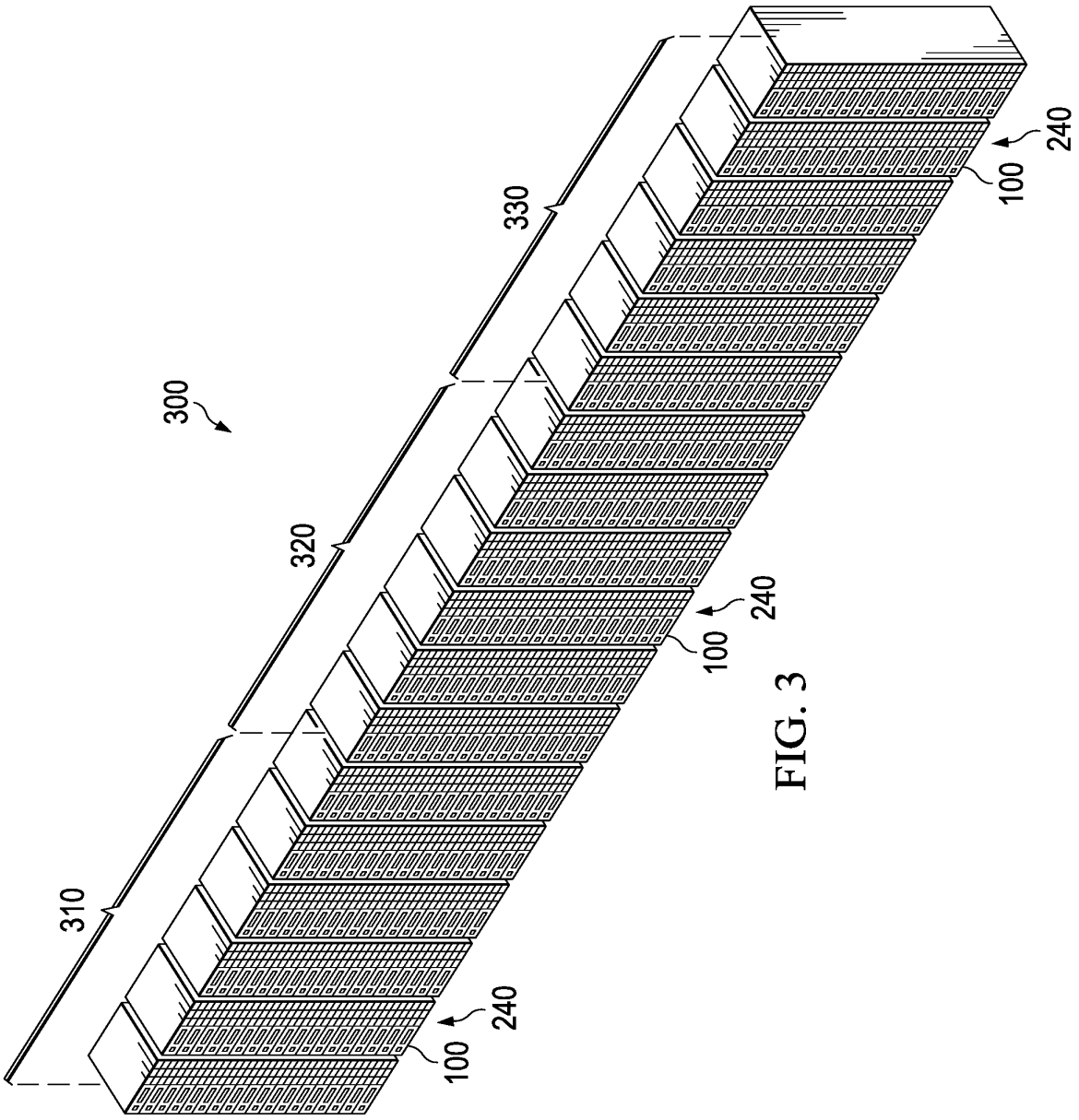
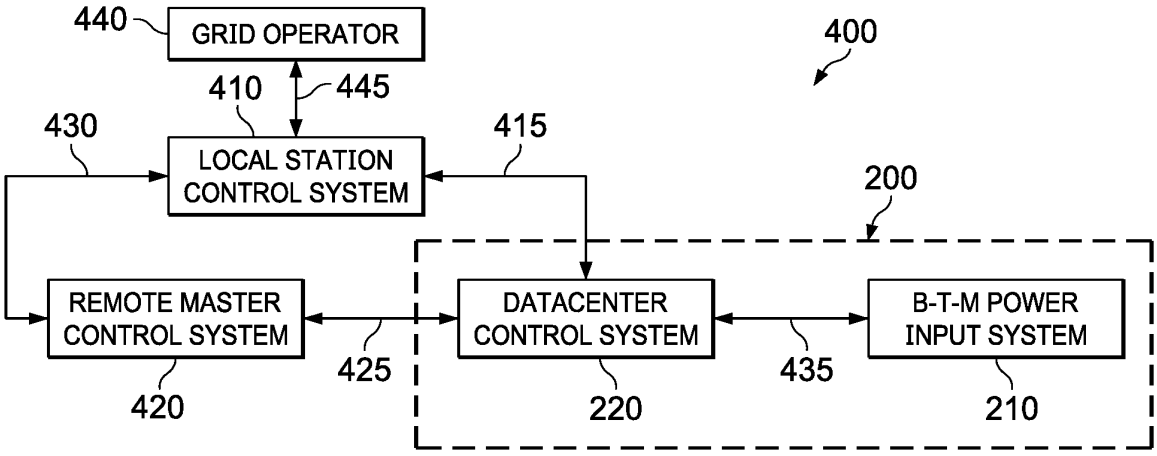


FIG. 3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410
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430
415
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REMOTE MASTER CONTROL SYSTEM
DATACENTER CONTROL SYSTEM
B-T-M POWER INPUT SYSTEM
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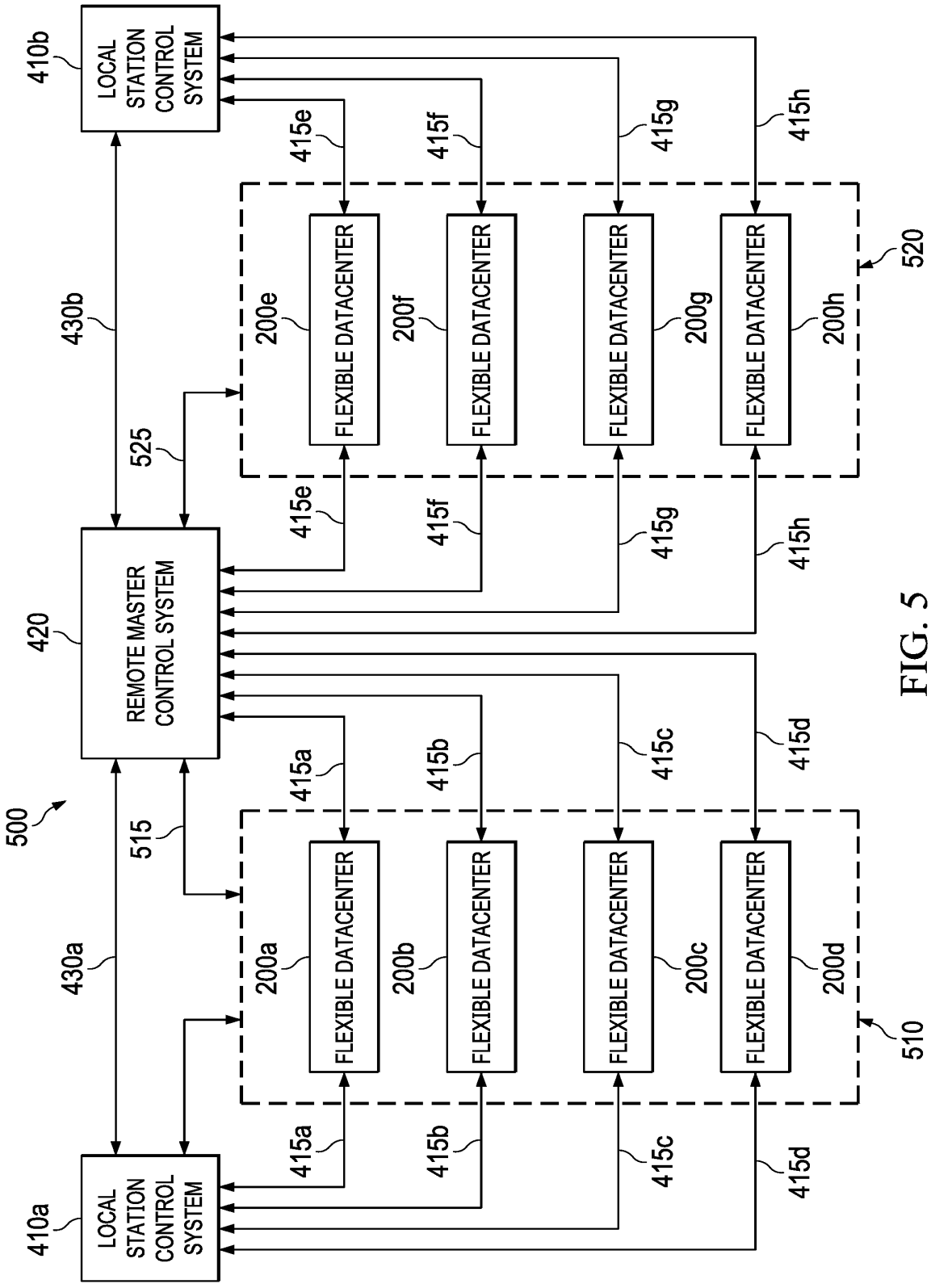
435
420
220
210

FIG. 4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415f
415g
415h
520
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FLEXIBLE DATACENTER
200f
FLEXIBLE DATACENTER
200g
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200h
FLEXIBLE DATACENTER
430b
525
420
REMOTE MASTER CONTROL SYSTEM
500
515
415a
415b
415c
415d
200a
FLEXIBLE DATACENTER
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FLEXIBLE DATACENTER
200c
FLEXIBLE DATACENTER
200d
FLEXIBLE DATACENTER
510
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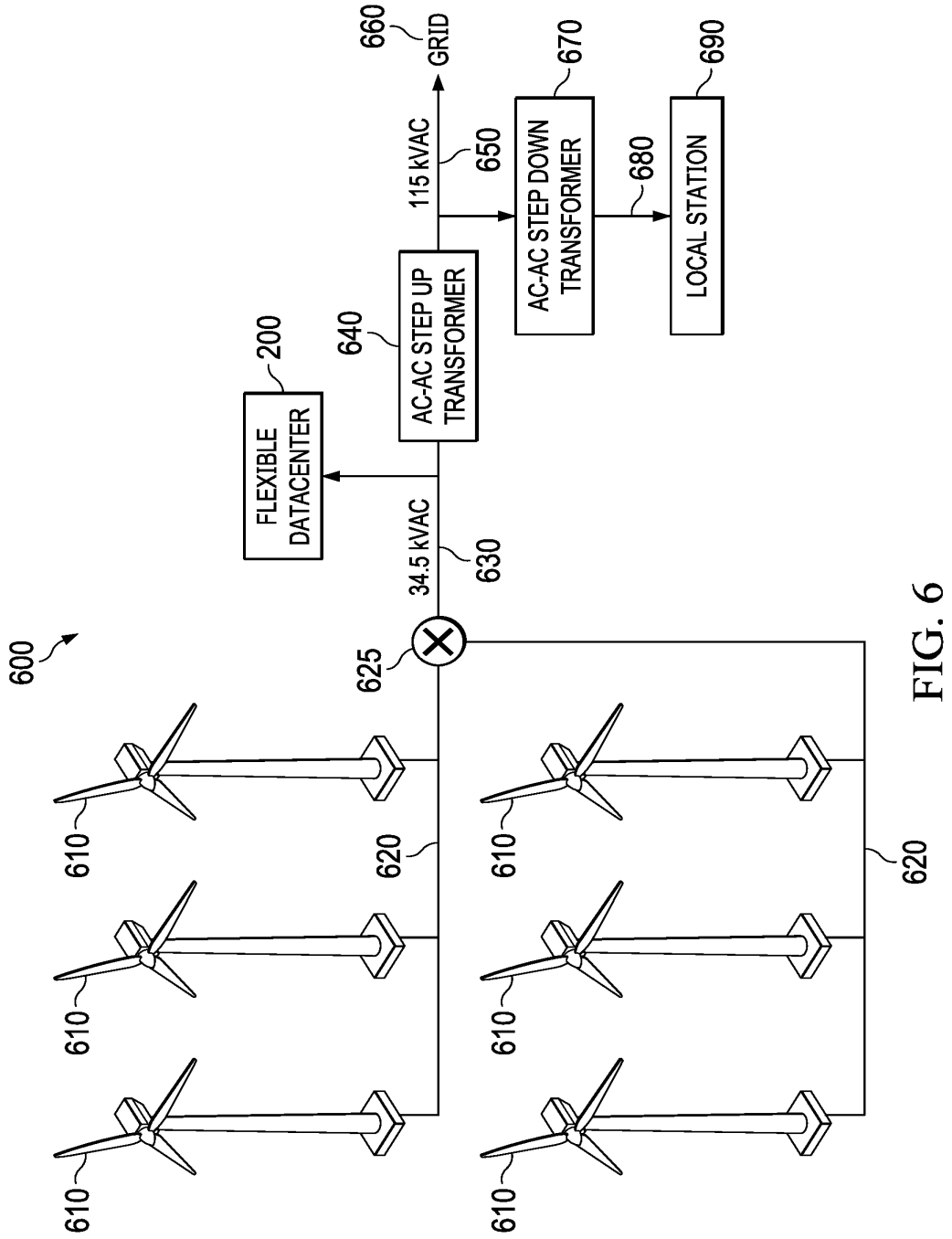
410a
LOCAL STATION CONTROL SYSTEM

FIG. 5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660
GRID
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AC-AC STEP DOWN TRANSFORMER
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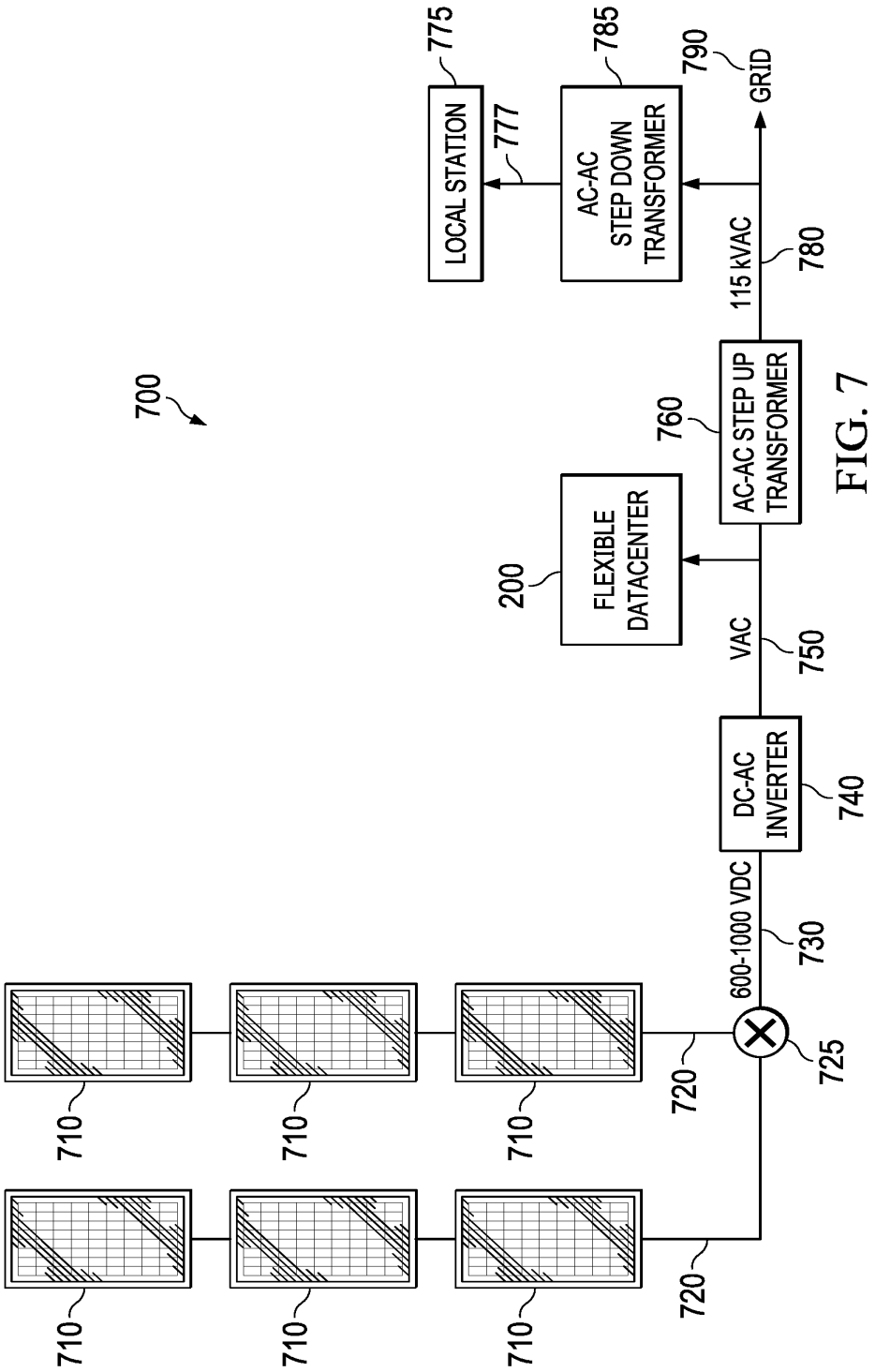
690
LOCAL STATION

FIG. 6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760
115 kVAC
780
AC-AC STEP DOWN TRANSFORMER
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790
GRID
LOCAL STATION
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777

FIG. 7

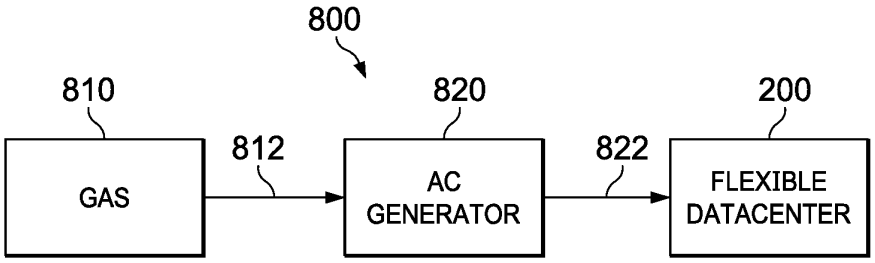
800
810
820
200
812
822
GAS
AC GENERATOR
FLEXIBLE DATACENTER

FIG. 8

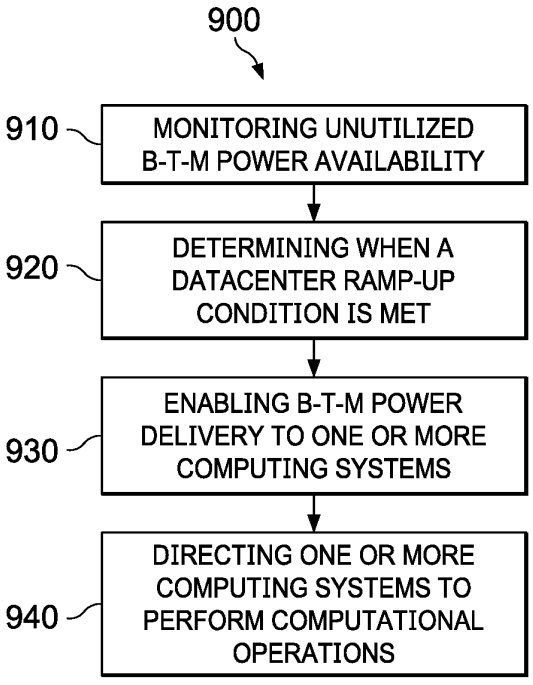
900
910
MONITORING UNUTILIZED B-T-M POWER AVAILABILITY
920
DETERMINING WHEN A DATACENTER RAMP-UP CONDITION IS MET
930
ENABLING B-T-M POWER DELIVERY TO ONE OR MORE COMPUTING SYSTEMS
940
DIRECTING ONE OR MORE COMPUTING SYSTEMS TO PERFORM COMPUTATIONAL OPERATIONS

FIG. 9

CLAIMS

What is claimed is:

1. A flexible datacenter comprising:
   a mobile container;
   a behind-the-meter power input system;
   a power distribution system;
   a datacenter control system;
   a plurality of computing systems; and
   a climate control system,
   wherein the datacenter control system modulates power delivery to the plurality of computing systems based on unutilized behind-the-meter power availability or an operational directive.

2. The flexible datacenter of claim 1, further comprising:
   a remote master control system.

3. The flexible datacenter of claim 1, wherein the behind-the-meter power input system comprises an input configured to receive three-phase behind-the-meter AC voltage and a supervisory AC-to-AC step-down transformer configured to step down the three-phase behind-the-meter AC voltage to a single-phase supervisory nominal AC voltage or an input configured to receive single-phase supervisory nominal AC voltage from a local station or metered source.

4. The flexible datacenter of claim 3, wherein the behind-the-meter power input system provides the single-phase supervisory nominal AC voltage to the datacenter control system.

5. The flexible datacenter of claim 1, wherein the behind-the-meter power input system comprises an input configured to receive three-phase behind-the-meter AC voltage and an operational AC-to-AC step-down transformer configured to controllably step down the three-phase behind-the-meter AC voltage to three-phase nominal AC voltage.

6. The flexible datacenter of claim 5, wherein the datacenter control system controllably enables or disables generation of the three-phase nominal AC voltage by the operational AC-to-AC step-down transformer.

7. The flexible datacenter of claim 1, wherein the behind-the-meter power input system provides three-phases of the three-phase nominal AC voltage to the power distribution system.

8. The flexible datacenter of claim 7, wherein the power distribution system controllably provides a single phase of the three-phase nominal AC voltage to each computing system of the plurality of computing systems.

9. The flexible data center of claim 7, wherein the datacenter control system controllably selects which phase of the three-phase nominal AC voltage the power distribution system provides to each computing system of the plurality of computing systems.

10. The flexible datacenter of claim 7, wherein the datacenter control system modulates a power factor correction factor by controllably adjusting which phase of the three-phase nominal AC voltage each computing system of the plurality of computing systems receive.

11. The flexible datacenter of claim 5, wherein the three-phase behind-the-meter AC voltage comprises a three-phase wind-generated AC voltage output by one or more wind turbines prior to an AC-to-AC step-up transformer that steps up the three-phase wind-generated AC voltage to a three-phase grid AC voltage.

12. The flexible datacenter of claim 5, wherein the three-phase behind-the-meter AC voltage comprises a three-phase solar-generated AC voltage output by a DC-to-AC inverter that inputs solar-generated DC voltage from one or more solar panels and prior to an AC-to-AC step-up transformer that steps up the three-phase solar-generated AC voltage to a three-phase grid AC voltage.

13. The flexible datacenter of claim 5, wherein the three-phase behind-the-meter AC voltage comprises a three-phase gas-generated AC voltage output by a generator that inputs combustible gas diverted from a flare or venting system.

14. The flexible datacenter of claim 5, wherein the three-phase behind-the-meter AC voltage is a three-phase metered AC voltage.

15. The flexible datacenter of claim 1, wherein unutilized behind-the-meter power availability comprises one or more of excess local power generation at a local station level, excess local power generation that a grid cannot receive, local power generation subject to economic curtailment, local power generation subject to reliability curtailment, local power generation subject to power factor correction, low local power generation, start up local power generation situations, transient local power generation situations, or testing local power generation situations where there is an economic advantage to using local behind-the-meter power generation to power the flexible datacenter.

16. The flexible datacenter of claim 1, wherein an operational directive comprises one or more of a local station directive, a remote master control directive, or a grid directive.

17. The flexible datacenter of claim 1, wherein an operational directive comprises one or more of a dispatchability directive or a forecast directive.

18. The flexible datacenter of claim 1, wherein an operational directive comprises a workload directive based on actual behind-the-meter power availability or projected behind-the-meter power availability.

19. The flexible datacenter of claim 2, wherein the remote master control system dynamically adjusts power delivery to the flexible datacenter based on a remote master control directive.

20. The flexible datacenter of claim 1, wherein the climate control system comprises a computer room air conditioner system, a computer room air handler system, an evaporative cooling system, a refrigerant cooling system, an immersive cooling system,

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or any other suitable heat extraction system configured to operate the plurality of computing systems within their operational temperature range.

21. The flexible datacenter of claim 1, wherein the mobile container comprises a storage container configured for placement on a ground surface.

22. The flexible datacenter of claim 1, wherein the mobile container comprises a storage trailer on wheels.

23. The flexible datacenter of claim 5, further comprising a battery system configured to convert the three-phase nominal AC voltage to DC nominal voltage and store power in a plurality of storage cells.

24. The flexible datacenter of claim 23, wherein the DC nominal voltage from the plurality of storage cells are converted via a DC-to-AC inverter to three-phase nominal AC voltage for flexible datacenter use.

25. A method of dynamic power delivery to a flexible datacenter using unutilized behind-the-meter power comprising:

monitoring unutilized behind-the-meter power availability;

determining when a datacenter ramp-up condition is met;

enabling behind-the-meter power delivery to one or more computing systems when the datacenter ramp-up condition is met; and

directing the one or more computing systems to perform predetermined computational operations.

26. The method of claim 25, further comprising:

determining when a datacenter ramp-down condition is met; and

disabling power delivery to one or more computing systems when the datacenter ramp-down condition is met.

27. The method of claim 25, further comprising:

receiving an operational directive to go offline; and

disabling power delivery to the one or more computing systems.

28. The method of claim 25, further comprising:

receiving an operational directive to reduce power consumption; and

dynamically reducing power delivery to a subset of the one or more computing systems.

29. The method of claim 25, further comprising:

receiving an operational directive to reduce power consumption; and

dynamically reducing power consumption of the one or more computing systems.

30. The method of claim 25, further comprising:

receiving an operational directive to provide power factor correction; and

dynamically adjusting power delivery to a subset of the one or more computing systems to achieve a desired power factor correction factor.

31. The method of claim 25, wherein unutilized behind-the-meter power availability comprises one or more of excess local power generation at a local station level, excess local power generation that a grid cannot receive, local power generation subject to economic curtailment, local power generation subject to reliability curtailment, local power generation subject to power factor correction, low local power generation, start up local power generation situations, transient local power generation situations, or testing local power generation situations where there is an economic advantage to using local behind-the-meter power generation.

32. The method of claim 25, wherein the datacenter ramp-up condition is met if there is sufficient behind-the-meter power availability and there is no operational directive from a local station to go offline.

33. The method of claim 25, wherein the datacenter ramp-down condition is met if there is insufficient behind-the-meter power availability or there is an operational directive from a local station to go offline.

34. The method of claim 25, wherein the predetermined computational operations comprise execution of one or more hashing functions.

METHOD AND SYSTEM FOR DYNAMIC POWER DELIVERY TO A FLEXIBLE DATACENTER USING UNUTILIZED ENERGY SOURCES

BACKGROUND OF THE INVENTION

[0001] Blockchain technology was originally conceived of as an open and distributed system for securely conducting transactions with cryptographic currency. However, the foundational principle of blockchain technology is the ability to securely transact information of any type or kind between anonymous parties without intermediaries or a centralized trust authority. As such, blockchain technology finds application outside the realm of cryptocurrency and is widely considered one of the more robust and secure means of transacting information in the computer sciences.

[0002] In typical blockchain implementations, each participating party creates a digital identity, or wallet, which includes a pair of cryptographic keys used to transact information securely and anonymously with the blockchain. The blockchain may be thought of as a constantly growing database of all prior transaction information that is securely and coherently replicated across all nodes of a peer-to-peer blockchain network. The blockchain includes a sequence of blocks, where each block includes a bundle of transactions and other data including a hash of the prior block in the chain. As such, each block in the blockchain is mathematically related to the prior block, protecting the integrity of the blockchain from the most recently added block to the genesis block in the chain. Because anyone may participate in the curation of the blockchain, once a block is added, it becomes a permanent and immutable part of the blockchain. Thus, the blockchain stores transactions in a manner that prevents the transactions from being altered or otherwise corrupted, unless all subsequent blocks in the blockchain are also altered. The immutability of the blockchain makes the malicious alteration of a block exceptionally difficult, if not impossible, and at the very least makes it easy to detect and deter any such attempt before being accepted and replicated across the blockchain network.

[0003] Each transacting party of the blockchain uses a pair of cryptographic keys to anonymously transact information. The private key is a random number maintained in secrecy by the party holder that is used to derive a public key and sign information. The private key and the public key are mathematically related such that anyone holding the public key may verify that information signed with the private key originated from the holder of the private key. When an initiating party wishes to

transact information, the information is signed with the initiating party's private key and broadcast to the blockchain network. A blockchain miner uses the initiating party's public key to verify that the initiating party initiated, or signed, the transaction. Once the initiating party's signature is validated, the transaction is validated, added to the next block in the blockchain, and replicated across all nodes.

[0004] The computational overhead of the blockchain is largely due to hashing functions used by blockchain miners to discover new blocks. While computationally intensive, the work performed by miners is critically important to the functionality of the blockchain. When an initiating party's transaction request has been lodged and the signatures validated, the transaction request is pooled in the blockchain network. Blockchain miners validate transactions and compete to discover a new block to be added to the blockchain. In order to add a newly discovered block to the blockchain, the blockchain miner must provide a cryptographic proof of the discovered block. To create the proof, the miner inputs the hash value of the prior block in the blockchain, the candidate block to be added, and a random number, commonly referred to as the nonce, to a hash function. The hash function takes input of any length and outputs an alphanumeric string of fixed length, commonly referred to as a hash, which uniquely identifies the input. However, the blockchain algorithm requires that the hash start with a certain number of leading zeros as determined by the current level of prescribed difficulty. The blockchain network modulates the level of difficulty for block discovery, by varying the number of leading zeros required in the calculated hash, based on the amount of computing power in the blockchain network.

[0005] As more computational capacity has come online, the hash rate has increased dramatically. In an effort to keep the block discovery time constant, the blockchain network modulates difficulty every 2016 blocks discovered. If the blockchain network hash rate is too high and the amount of time taken to discover a new block is less than 10 minutes, the difficulty is increased proportionally to increase the block discovery time to 10 minutes. Similarly, if the blockchain hash rate is too low and the amount of time taken to discover a new block is more than 10 minutes, the difficulty is increased proportionally to reduce the block discovery time to 10 minutes. Because there is no way to predict what hash value a given set of input data will generate, miners often have to execute the hash function a substantial number of times, each time inputting a new nonce, to generate a new hash value.

When a miner is the first to obtain a hash value having the correct number of leading zeros, they broadcast the newly discovered block to the blockchain network and the blockchain is replicated across all nodes.

BRIEF SUMMARY OF THE INVENTION

[0006] According to one aspect of one or more embodiments of the present invention, a flexible datacenter includes a mobile container, a behind-the-meter power input system, a power distribution system, a datacenter control system, a plurality of computing systems, and a climate control system. The datacenter control system modulates power delivery to the plurality of computing systems based on unutilized behind-the-meter power availability or an operational directive.

[0007] According to one aspect of one or more embodiments of the present invention, a method of dynamic power delivery to a flexible datacenter using unutilized behind-the-meter power includes monitoring unutilized behind-the-meter power availability, determining when a datacenter ramp-up condition is met, enabling behind-the-meter power delivery to one or more computing systems when the datacenter ramp-up condition is met, and directing the one or more computing systems to perform predetermined computational operations.

[0008] Other aspects of the present invention will be apparent from the following description and claims.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] Figure **1** shows a computing system in accordance with one or more embodiments of the present invention.

[0010] Figure **2** shows a flexible datacenter in accordance with one or more embodiments of the present invention.

[0011] Figure **3** shows a three-phase power distribution of a flexible datacenter in accordance with one or more embodiments of the present invention.

[0012] Figure **4** shows a control distribution scheme of a flexible datacenter in accordance with one or more embodiments of the present invention.

[0013] Figure **5** shows a control distribution scheme of a fleet of flexible datacenters in accordance with one or more embodiments of the present invention.

[0014] Figure **6** shows a flexible datacenter powered by one or more wind turbines in accordance with one or more embodiments of the present invention.

[0015] Figure 7 shows a flexible datacenter powered by one or more solar panels in accordance with one or more embodiments of the present invention.

[0016] Figure **8** shows a flexible datacenter powered by flare gas in accordance with one or more embodiments of the present invention.

[0017] Figure **9** shows a method of dynamic power delivery to a flexible datacenter using unutilized behind-the-meter power in accordance with one or more embodiments of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

[0018] One or more embodiments of the present invention are described in detail with reference to the accompanying figures. For consistency, like elements in the various figures are denoted by like reference numerals. In the following detailed description of the present invention, specific details are set forth in order to provide a thorough understanding of the present invention. In other instances, well-known features to one having ordinary skill in the art are not described to avoid obscuring the description of the present invention.

[0019] Blockchain miners are typically compensated for their efforts through either a discovery fee or a fee paid by one or more of the transacting parties. Consequently, more and more computing resources are coming online to compete for these fees. As the number of computing resources increases, the blockchain network modulates the difficulty level, requiring hash values with more leading zeros. In essence, the increased difficulty means more hashing operations are required to find a valid hash. As such, there is an increasing number of computing resources executing an increasing number of hash functions that do not result in the discovery of a valid hash, yet still consume a substantial amount of power.

[0020] The intensive computational demand of blockchain applications makes the widespread adoption of blockchain technology inefficient and unsustainable from an energy and environmental perspective. In certain blockchain applications, with limited participation, roughly 5 quintillion 256-bit cryptographic hashes are created each and every second of every day. While it is difficult to determine how much energy is required for that computational task, it is estimated to be in excess of 500 megawatts, the vast majority of which is sourced from fossil fuels. The majority of blockchain mining operations are currently being conducted in the People's Republic of China and powered by coal-fired energy. As blockchain technology

proliferates, there is concern that the energy required to sustain such blockchain applications could exceed that of a developed country.

[0021] While future versions of blockchain technology may improve power consumption for various blockchain operations, including hashing functions, industry efforts have focused on the development of central processing units ("CPUs"), graphics processing units ("GPUs"), and application specific integrated circuits ("ASICs") that are specifically designed to perform blockchain operations in a more efficient manner. While such efforts are beneficial, the issue remains, the widespread adoption of blockchain technology will require substantially more power than is economically and environmentally feasible.

[0022] Accordingly, in one or more embodiments of the present invention, a method and system for dynamic power delivery to a flexible datacenter uses unutilized behind-the-meter power sources without transmission and distribution costs. The flexible datacenter may be configured to modulate power delivery to one or more computing systems based on the availability of unutilized behind-the-meter power or an operational directive. For example, the flexible datacenter may ramp-up to a fully online status, ramp-down to a fully offline status, or dynamically reduce power consumption, act a load balancer, or adjust the power factor. Advantageously, the flexible datacenter may perform computational operations, such as blockchain hashing operations, with little to no energy costs, using clean and renewable energy that would otherwise be wasted.

[0023] Figure **1** shows a computing system **100** in accordance with one or more embodiments of the present invention. Computing system **100** may include one or more central processing units (singular "CPU" or plural "CPUs") **105**, host bridge **110**, input/output ("IO") bridge **115**, graphics processing units (singular "GPU" or plural "GPUs") **125**, and/or application-specific integrated circuits (singular "ASIC or plural "ASICs") (not shown) disposed on one or more printed circuit boards (not shown) that are configured to perform computational operations. Each of the one or more CPUs **105**, GPUs **125**, or ASICs (not shown) may be a single-core (not independently illustrated) device or a multi-core (not independently illustrated) device. Multi-core devices typically include a plurality of cores (not shown) disposed on the same physical die (not shown) or a plurality of cores (not shown) disposed on multiple die (not shown) that are collectively disposed within the same mechanical package (not shown).

[0024] CPU **105** may be a general purpose computational device typically configured to execute software instructions. CPU **105** may include an interface **108** to host bridge **110**, an interface **118** to system memory **120**, and an interface **123** to one or more IO devices, such as, for example, one or more GPUs **125**. GPU **125** may serve as a specialized computational device typically configured to perform graphics functions related to frame buffer manipulation. However, one of ordinary skill in the art will recognize that GPU **125** may be used to perform non-graphics related functions that are computationally intensive. In certain embodiments, GPU **125** may interface **123** directly with CPU **125** (and interface **118** with system memory **120** through CPU **105**). In other embodiments, GPU **125** may interface **121** with host bridge **110** (and interface **116** or **118** with system memory **120** through host bridge **110** or CPU **105** depending on the application or design). In still other embodiments, GPU **125** may interface **133** with IO bridge **115** (and interface **116** or **118** with system memory **120** through host bridge **110** or CPU **105** depending on the application or design). The functionality of GPU **125** may be integrated, in whole or in part, with CPU **105**.

[0025] Host bridge **110** may be an interface device configured to interface between the one or more computational devices and IO bridge **115** and, in some embodiments, system memory **120**. Host bridge **110** may include an interface **108** to CPU **105**, an interface **113** to IO bridge **115**, for embodiments where CPU **105** does not include an interface **118** to system memory **120**, an interface **116** to system memory **120**, and for embodiments where CPU **105** does not include an integrated GPU **125** or an interface **123** to GPU **125**, an interface **121** to GPU **125**. The functionality of host bridge **110** may be integrated, in whole or in part, with CPU **105**. IO bridge **115** may be an interface device configured to interface between the one or more computational devices and various IO devices (*e.g.*, **140**, **145**) and IO expansion, or add-on, devices (not independently illustrated). IO bridge **115** may include an interface **113** to host bridge **110**, one or more interfaces **133** to one or more IO expansion devices **135**, an interface **138** to keyboard **140**, an interface **143** to mouse **145**, an interface **148** to one or more local storage devices **150**, and an interface **153** to one or more network interface devices **155**. The functionality of IO bridge **115** may be integrated, in whole or in part, with CPU **105** or host bridge **110**. Each local storage device **150**, if any, may be a solid-state memory device, a solid-state memory device array, a hard disk drive, a hard disk drive array, or any other

non-transitory computer readable medium. Network interface device **155** may provide one or more network interfaces including any network protocol suitable to facilitate networked communications.

[0026] Computing system **100** may include one or more network-attached storage devices **160** in addition to, or instead of, one or more local storage devices **150**. Each network-attached storage device **160**, if any, may be a solid-state memory device, a solid-state memory device array, a hard disk drive, a hard disk drive array, or any other non-transitory computer readable medium. Network-attached storage device **160** may or may not be collocated with computing system **100** and may be accessible to computing system **100** via one or more network interfaces provided by one or more network interface devices **155**.

[0027] One of ordinary skill in the art will recognize that computing system **100** may be a conventional computing system or an application-specific computing system. In certain embodiments, an application-specific computing system may include one or more ASICs (not shown) that are configured to perform one or more functions, such as hashing, in a more efficient manner. The one or more ASICs (not shown) may interface directly with CPU **105**, host bridge **110**, or GPU **125** or interface through IO bridge **115**. Alternatively, in other embodiments, an application-specific computing system may be reduced to only those components necessary to perform a desired function in an effort to reduce one or more of chip count, printed circuit board footprint, thermal design power, and power consumption. The one or more ASICs (not shown) may be used instead of one or more of CPU **105**, host bridge **110**, IO bridge **115**, or GPU **125**. In such systems, the one or more ASICs may incorporate sufficient functionality to perform certain network and computational functions in a minimal footprint with substantially fewer component devices.

[0028] As such, one of ordinary skill in the art will recognize that CPU **105**, host bridge **110**, IO bridge **115**, GPU **125**, or ASIC (not shown) or a subset, superset, or combination of functions or features thereof, may be integrated, distributed, or excluded, in whole or in part, based on an application, design, or form factor in accordance with one or more embodiments of the present invention. Thus, the description of computing system **100** is merely exemplary and not intended to limit the type, kind, or configuration of component devices that constitute a computing system **100** suitable for performing computing operations in accordance with one or more embodiments of the present invention.

[0029] One of ordinary skill in the art will recognize that computing system **100** may be a stand alone, laptop, desktop, server, blade, or rack mountable system and may vary based on an application or design.

[0030] Figure **2** shows a flexible datacenter **200** in accordance with one or more embodiments of the present invention. Flexible datacenter **200** may include a mobile container **205**, a behind-the-meter power input system **210**, a power distribution system **215**, a climate control system (*e.g.*, **250**, **260**, **270**, **280**, and/or **290**), a datacenter control system **220**, and a plurality of computing systems **100** disposed in one or more racks **240**. Datacenter control system **220** may be a computing system (*e.g.*, **100** of Figure **1**) configured to dynamically modulate power delivery to one or more computing systems **100** disposed within flexible datacenter **200** based on unutilized behind-the-meter power availability or an operational directive from a local station control system (not shown), a remote master control system (not shown), or a grid operator (not shown).

[0031] In certain embodiments, mobile container **205** may be a storage trailer disposed on wheels and configured for rapid deployment. In other embodiments, mobile container **205** may be a storage container (not shown) configured for placement on the ground and potentially stacked in a vertical manner (not shown). In still other embodiments, mobile container **205** may be an inflatable container, a floating container, or any other type or kind of container suitable for housing a mobile datacenter **200**.

[0032] Flexible datacenter **200** may be rapidly deployed on site near a source of unutilized behind-the-meter power generation. Behind-the-meter power input system **210** may be configured to input power to flexible datacenter **200**. Behind-the-meter power input system **210** may include a first input (not independently illustrated) configured to receive three-phase behind-the-meter alternating current ("AC") voltage. In certain embodiments, behind-the-meter power input system **210** may include a supervisory AC-to-AC step-down transformer (not shown) configured to step down three-phase behind-the-meter AC voltage to single-phase supervisory nominal AC voltage or a second input (not independently illustrated) configured to receive single-phase supervisory nominal AC voltage from the local station (not shown) or a metered source (not shown). Behind-the-meter power input system **210** may provide single-phase supervisory nominal AC voltage to datacenter control system **220**, which may remain powered at almost all times to control the

operation of flexible datacenter **200**. The first input (not independently illustrated) or a third input (not independently illustrated) of behind-the-meter power input system **210** may direct three-phase behind-the-meter AC voltage to an operational AC-to-AC step-down transformer (not shown) configured to controllably step down three-phase behind-the-meter AC voltage to three-phase nominal AC voltage. Datacenter control system **220** may controllably enable or disable generation or provision of three-phase nominal AC voltage by the operational AC-to-AC step-down transformer (not shown).

[0033] Behind-the-meter power input system **210** may provide three phases of three-phase nominal AC voltage to power distribution system **215**. Power distribution system **215** may controllably provide a single phase of three-phase nominal AC voltage to each computing system **100** or group **240** of computing systems **100** disposed within flexible datacenter **200**. Datacenter control system **220** may controllably select which phase of three-phase nominal AC voltage that power distribution system **215** provides to each computing system **100** or group **240** of computing systems **100**. In this way, datacenter control system **220** may modulate power delivery by either ramping-up flexible datacenter **200** to fully operational status, ramping-down flexible datacenter **200** to offline status (where only datacenter control system **220** remains powered), reducing power consumption by withdrawing power delivery from, or reducing power to, one or more computing systems **100** or groups **240** of computing systems **100**, or modulating a power factor correction factor for the local station by controllably adjusting which phases of three-phase nominal AC voltage are used by one or more computing systems **100** or groups **240** of computing systems **100**.

[0034] Flexible datacenter **200** may include a climate control system (*e.g.*, **250**, **260**, **270**, **280**, **290**) configured to maintain the plurality of computing systems **100** within their operational temperature range. In certain embodiments, the climate control system may include an air intake **250**, an evaporative cooling system **270**, a fan **280**, and an air outtake **260**. In other embodiments, the climate control system may include an air intake **250**, an air conditioner or refrigerant cooling system **290**, and an air outtake **260**. In still other embodiments, the climate control system may include a computer room air conditioner system (not shown), a computer room air handler system (not shown), or an immersive cooling system (not shown). One of ordinary skill in the art will recognize that any suitable heat extraction system (not

shown) configured to maintain the operation of the plurality of computing systems **100** within their operational temperature range may be used in accordance with one or more embodiments of the present invention.

[0035] Flexible datacenter **200** may include a battery system (not shown) configured to convert three-phase nominal AC voltage to nominal DC voltage and store power in a plurality of storage cells. The battery system (not shown) may include a DC-to-AC inverter configured to convert nominal DC voltage to three-phase nominal AC voltage for flexible datacenter **200** use. Alternatively, the battery system (not shown) may include a DC-to-AC inverter configured to convert nominal DC voltage to single-phase nominal AC voltage to power datacenter control system **220**.

[0036] One of ordinary skill in the art will recognize that a voltage level of three-phase behind-the-meter AC voltage may vary based on an application or design and the type or kind of local power generation. As such, a type, kind, or configuration of the operational AC-to-AC step down transformer (not shown) may vary based on the application or design. In addition, the frequency and voltage level of three-phase nominal AC voltage, single-phase nominal AC voltage, and nominal DC voltage may vary based on the application or design in accordance with one or more embodiments of the present invention.

[0037] Figure **3** shows a three-phase power distribution of a flexible datacenter **200** in accordance with one or more embodiments of the present invention. Flexible datacenter **200** may include a plurality of racks **240**, each of which may include one or more computing systems **100** disposed therein. As discussed above, the behind-the-meter power input system (**210** of Figure **2**) may provide three phases of three-phase nominal AC voltage to the power distribution system (**215** of Figure **2**). The power distribution system (**215** of Figure **2**) may controllably provide a single phase of three-phase nominal AC voltage to each computing system **100** or group **240** of computing systems **100** disposed within flexible datacenter **200**. For example, a flexible datacenter **200** may include eighteen racks **240**, each of which may include eighteen computing systems **100**. The power distribution system (**215** of Figure **2**) may control which phase of three-phase nominal AC voltage is provided to one or more computing systems **100**, a rack **240** of computing systems **100**, or a group (*e.g.*, **310**, **320**, or **330**) of racks **240** of computing systems **100**.

[0038] In the figure, for purposes of illustration only, eighteen racks **240** are divided into a first group of six racks **310**, a second group of six racks **320**, and a third group

of six racks **330**, where each rack contains eighteen computing systems **100**. The power distribution system (**215** of Figure **2**) may, for example, provide a first phase of three-phase nominal AC voltage to the first group of six racks **310**, a second phase of three-phase nominal AC voltage to the second group of six racks **320**, and a third phase of three-phase nominal AC voltage to the third group of six racks **330**. If the flexible datacenter (**200** of Figure **2**) receives an operational directive from the local station (not shown) to provide power factor correction, the datacenter control system (**220** of Figure **2**) may direct the power distribution system (**215** of Figure **2**) to adjust which phase or phases of three-phase nominal AC voltage are used to provide the power factor correction required by the local station (not shown) or grid operator (not shown). One of ordinary skill in the art will recognize that, in addition to the power distribution, the load may be varied by adjusting the number of computing systems **100** operatively powered. As such, the flexible datacenter (**200** of Figure **2**) may be configured to act as a capacitive or inductive load to provide the appropriate reactance necessary to achieve the power factor correction required by the local station (not shown).

[0039] Figure **4** shows a control distribution scheme of a flexible datacenter **200** in accordance with one or more embodiments of the present invention. Datacenter control system **220** may independently, or cooperatively with one or more of local station control system **410**, remote master control system **420**, and grid operator **440**, modulate power delivery to flexible datacenter **200**. Specifically, power delivery may be dynamically adjusted based on conditions or operational directives.

[0040] Local station control system **410** may be a computing system (*e.g.*, **100** of Figure **1**) that is configured to control various aspects of the local station (not independently illustrated) that generates power and sometimes generates unutilized behind-the-meter power. Local station control system **410** may communicate with remote master control system **420** over a networked connection **430** and with datacenter control system **220** over a networked or hardwired connection **415**. Remote master control system **420** may be a computing system (*e.g.*, **100** of Figure **1**) that is located offsite, but connected via a network connection **425** to datacenter control system **220**, that is configured to provide supervisory or override control of flexible datacenter **200** or a fleet (not shown) of flexible datacenters **200**. Grid operator **440** may be a computing system (*e.g.*, **100** of Figure **1**) that is configured to control various aspects of the grid (not independently illustrated) that receives

power from the local station (not independently illustrated). Grid operator **440** may communicate with local station control system **440** over a networked or hardwired connection **445**.

[0041] Datacenter control system **220** may monitor unutilized behind-the-meter power availability at the local station (not independently illustrated) and determine when a datacenter ramp-up condition is met. Unutilized behind-the-meter power availability may include one or more of excess local power generation, excess local power generation that the grid cannot accept, local power generation that is subject to economic curtailment, local power generation that is subject to reliability curtailment, local power generation that is subject to power factor correction, situations where local power generation is prohibitively low, start up situations, transient situations, or testing situations where there is an economic advantage to using locally generated behind-the-meter power generation, specifically power available at little to no cost and with no associated transmission or distribution costs.

[0042] The datacenter ramp-up condition may be met if there is sufficient behind-the-meter power availability and there is no operational directive from local station control system **410**, remote master control system **420**, or grid operator **440** to go offline or reduce power. As such, datacenter control system **220** may enable **435** behind-the-meter power input system **210** to provide three-phase nominal AC voltage to the power distribution system (**215** of Figure **2**) to power the plurality of computing systems (**100** of Figure **2**) or a subset thereof. Datacenter control system **220** may optionally direct one or more computing systems (**100** of Figure **2**) to perform predetermined computational operations. For example, if the one or more computing systems (**100** of Figure **2**) are configured to perform blockchain hashing operations, datacenter control system **220** may direct them to perform blockchain hashing operations for a specific blockchain application, such as, for example, Bitcoin, Litecoin, or Ethereum. Alternatively, one or more computing systems (**100** of Figure **2**) may be configured to independently receive a computational directive from a network connection (not shown) to a peer-to-peer blockchain network (not shown) such as, for example, a network for a specific blockchain application, to perform predetermined computational operations.

[0043] Remote master control system **420** may specify to datacenter control system **220** what sufficient behind-the-meter power availability constitutes, or datacenter

control system **220** may be programmed with a predetermined preference or criteria on which to make the determination independently. For example, in certain circumstances, sufficient behind-the-meter power availability may be less than that required to fully power the entire flexible datacenter **200**. In such circumstances, datacenter control system **220** may provide power to only a subset of computing systems (**100** of Figure **2**), or operate the plurality of computing systems (**100** of Figure **2**) in a lower power mode, that is within the sufficient, but less than full, range of power that is available.

[0044] While flexible datacenter **200** is online and operational, a datacenter ramp-down condition may be met when there is insufficient, or anticipated to be insufficient, behind-the-meter power availability or there is an operational directive from local station control system **410**, remote master control system **420**, or grid operator **440**. Datacenter control system **220** may monitor and determine when there is insufficient, or anticipated to be insufficient, behind-the-meter power availability. As noted above, sufficiency may be specified by remote master control system **420** or datacenter control system **220** may be programmed with a predetermined preference or criteria on which to make the determination independently. An operational directive may be based on current dispatchability, forward looking forecasts for when unutilized behind-the-meter power is, or is expected to be, available, economic considerations, reliability considerations, operational considerations, or the discretion of the local station **410**, remote master control **420**, or grid operator **440**. For example, local station control system **410**, remote master control system **420**, or grid operator **440** may issue an operational directive to flexible datacenter **200** to go offline and power down. When the datacenter ramp-down condition is met, datacenter control system **220** may disable power delivery to the plurality of computing systems (**100** of Figure **2**). Datacenter control system **220** may disable **435** behind-the-meter power input system **210** from providing three-phase nominal AC voltage to the power distribution system (**215** of Figure **2**) to power down the plurality of computing systems (**100** of Figure **2**), while datacenter control system **220** remains powered and is capable of rebooting flexible datacenter **200** when unutilized behind-the-meter power becomes available again.

[0045] While flexible datacenter **200** is online and operational, changed conditions or an operational directive may cause datacenter control system **220** to modulate power consumption by flexible datacenter **200**. Datacenter control system **220** may

determine, or local station control system **410**, remote master control system **420**, or grid operator **440** may communicate, that a change in local conditions may result in less power generation, availability, or economic feasibility, than would be necessary to fully power flexible datacenter **200**. In such situations, datacenter control system **220** may take steps to reduce or stop power consumption by flexible datacenter **200** (other than that required to maintain operation of datacenter control system **220**). Alternatively, local station control system **410**, remote master control system **420**, or grid operator **440**, may issue an operational directive to reduce power consumption for any reason, the cause of which may be unknown. In response, datacenter control system **220** may dynamically reduce or withdraw power delivery to one or more computing systems (**100** of Figure **2**) to meet the dictate. Datacenter control system **220** may controllably provide three-phase nominal AC voltage to a smaller subset of computing systems (**100** of Figure **2**) to reduce power consumption. Datacenter control system **220** may dynamically reduce the power consumption of one or more computing systems (**100** of Figure **2**) by reducing their operating frequency or forcing them into a lower power mode through a network directive.

[0046] One of ordinary skill in the art will recognize that datacenter control system **220** may be configured to have a number of different configurations, such as a number or type or kind of computing systems (**100** of Figure **2**) that may be powered, and in what operating mode, that correspond to a number of different ranges of sufficient and available unutilized behind-the-meter power availability. As such, datacenter control system **220** may modulate power delivery over a variety of ranges of sufficient and available unutilized behind-the-meter power availability.

[0047] Figure **5** shows a control distribution of a fleet **500** of flexible datacenters **200** in accordance with one or more embodiments of the present invention. The control distribution of a flexible datacenter **200** shown and described with respect to Figure **4** may be extended to a fleet **500** of flexible datacenters **200**. For example, a first local station (not independently illustrated), such as, for example, a wind farm (not shown), may include a first plurality **510** of flexible datacenters **200*a*** through **200*d***, which may be collocated or distributed across the local station (not shown). A second local station (not independently illustrated), such as, for example, another wind farm or a solar farm (not shown), may include a second plurality **520** of flexible datacenters **200*e*** through **200*h***, which may be collocated or distributed

across the local station (not shown). One of ordinary skill in the art will recognize that the number of flexible datacenters **200** deployed at a given station and the number of stations within the fleet may vary based on an application or design in accordance with one or more embodiments of the present invention.

[0048] Remote master control system **420** may provide supervisory control over fleet **500** of flexible datacenters **200** in a similar manner to that shown and described with respect to Figure **4**, with the added flexibility to make high level decisions with respect to fleet **500** that may be counterintuitive to a given station. Remote master control system **420** may make decisions regarding the issuance of operational directives to a given local station based on, for example, the status of each local station where flexible datacenters **200** are deployed, the workload distributed across fleet **500**, and the expected computational demand required for the expected workload. In addition, remote master control system **420** may shift workloads from a first plurality **510** of flexible datacenters **200** to a second plurality **520** of flexible datacenters **200** for any reason, including, for example, a loss of unutilized behind-the-meter power availability at one local station and the availability of unutilized behind-the-meter power at another local station.

[0049] Figure **6** shows a flexible datacenter **200** powered by one or more wind turbines **610** in accordance with one or more embodiments of the present invention. A wind farm **600** typically includes a plurality of wind turbines **610**, each of which intermittently generates a wind-generated AC voltage. The wind-generated AC voltage may vary based on a type, kind, or configuration of farm **600**, turbine **610**, and incident wind speed. The wind-generated AC voltage is typically input into a turbine AC-to-AC step-up transformer (not shown) that is disposed within the nacelle (not independently illustrated) or at the base of the mast (not independently illustrated) of turbine **610**. The turbine AC-to-AC step up transformer (not shown) outputs three-phase wind-generated AC voltage **620**. Three-phase wind-generated AC voltage **620** produced by the plurality of wind turbines **610** is collected **625** and provided **630** to another AC-to-AC step-up transformer **640** that steps up three-phase wind-generated AC voltage **620** to three-phase grid AC voltage **650** suitable for delivery to grid **660**. Three-phase grid AC voltage **650** may be stepped down with an AC-to-AC step-down transformer **670** configured to produce three-phase local station AC voltage **680** provided to local station **690**. One of ordinary skill in the art will recognize that the actual voltage levels may vary based on the type, kind,

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or number of wind turbines **610**, the configuration or design of wind farm **600**, and grid **660** that it feeds into.

[0050] The output side of AC-to-AC step-up transformer **640** that connects to grid **660** may be metered and is typically subject to transmission and distribution costs. In contrast, power consumed on the input side of AC-to-AC step-up transformer **640** may be considered behind-the-meter and is typically not subject to transmission and distribution costs. As such, one or more flexible datacenters **200** may be powered by three-phase wind-generated AC voltage **620**. Specifically, in wind farm **600** applications, the three-phase behind-the-meter AC voltage used to power flexible datacenter **200** may be three-phase wind-generated AC voltage **620**. As such, flexible datacenter **200** may reside behind-the-meter, avoid transmission and distribution costs, and may be dynamically powered when unutilized behind-the-meter power is available.

[0051] Unutilized behind-the-meter power availability may occur when there is excess local power generation. In high wind conditions, wind farm **600** may generate more power than, for example, AC-to-AC step-up transformer **640** is rated for. In such situations, wind farm **600** may have to take steps to protect its equipment from damage, which may include taking one or more turbines **610** offline or shunting their voltage to dummy loads or ground. Advantageously, one or more flexible datacenters **200** may be used to consume power on the input side of AC-to-AC step-up transformer **640**, thereby allowing wind farm **600** to operate equipment within operating ranges while flexible datacenter **200** receives behind-the-meter power without transmission or distribution costs. The local station control system (not independently illustrated) of local station **690** may issue an operational directive to the one or more flexible datacenters **200** or to the remote master control system (**420** of Figure **4**) to ramp-up to the desired power consumption level. When the operational directive requires the cooperative action of multiple flexible datacenters **200**, the remote mater control system (**420** of Figure **4**) may determine how to power each individual flexible datacenter **200** in accordance with the operational directive or provide an override to each flexible datacenter **200**.

[0052] Another example of unutilized behind-the-meter power availability is when grid **660** cannot, for whatever reason, take the power being produced by wind farm **600**. In such situations, wind farm **600** may have to take one or more turbines **610** offline or shunt their voltage to dummy loads or ground. Advantageously, one or

more flexible datacenters **200** may be used to consume power on the input side of AC-to-AC step-up transformer **640**, thereby allowing wind farm **600** to either produce power to grid **660** at a lower level or shut down transformer **640** entirely while flexible datacenter **200** receives behind-the-meter power without transmission or distribution costs. The local station control system (not independently illustrated) of local station **690** or the grid operator (not independently illustrated) of grid **660** may issue an operational directive to the one or more flexible datacenters **200** or to the remote master control system (**420** of Figure **4**) to ramp-up to the desired power consumption level. When the operational directive requires the cooperative action of multiple flexible datacenters **200**, the remote master control system (**420** of Figure **4**) may determine how to power each individual flexible datacenter **200** in accordance with the operational directive or provide an override to each flexible datacenter **200**.

[0053] Another example of unutilized behind-the-meter power availability is when wind farm **600** is selling power to grid **660** at a negative price that is offset by a production tax credit. In certain circumstances, the value of the production tax credit may exceed the price wind farm **600** would have to pay to grid **660** to offload their generated power. Advantageously, one or more flexible datacenters **200** may be used to consume power behind-the-meter, thereby allowing wind farm **600** to produce and obtain the production tax credit, but sell less power to grid **660** at the negative price. The local station control system (not independently illustrated) of local station **690** may issue an operational directive to the one or more flexible datacenters **200** or to the remote master control system (**420** of Figure **4**) to ramp-up to the desired power consumption level. When the operational directive requires the cooperative action of multiple flexible datacenter **200**, the remote master control system (**420** of Figure **4**) may determine how to power each individual flexible datacenter **200** in accordance with the operational directive or provide an override to each flexible datacenter **200**.

[0054] Another example of unutilized behind-the-meter power availability is when wind farm **600** is selling power to grid **660** at a negative price because grid **660** is oversupplied or is instructed to stand down and stop producing altogether. The grid operator (not independently illustrated) may select certain power generation stations to go offline and stop producing power to grid **660**. Advantageously, one or more flexible datacenters **200** may be used to consume power behind-the-meter, thereby

allowing wind farm **600** to stop producing power to grid **660**, but making productive use of the power generated behind-the-meter without transmission or distribution costs. The local station control system (not independently illustrated) of the local station **690** or the grid operator (not independently illustrated) of grid **660** may issue an operational directive to the one or more flexible datacenters **200** or to the remote master control system (**420** of Figure **4**) to ramp-up to the desired power consumption level. When the operational directive requires the cooperative action of multiple flexible datacenters **200**, the remote master control system (**420** of Figure **4**) may determine how to power each individual flexible datacenter **200** in accordance with the operational directive or provide an override to each flexible datacenter **200**.

[0055] Another example of unutilized behind-the-meter power availability is when wind farm **600** is producing power to grid **660** that is unstable, out of phase, or at the wrong frequency, or grid **660** is already unstable, out of phase, or at the wrong frequency for whatever reason. The grid operator (not independently illustrated) may select certain power generation stations to go offline and stop producing power to grid **660**. Advantageously, one or more flexible datacenters **200** may be used to consume power behind-the-meter, thereby allowing wind farm **600** to stop producing power to grid **660**, but make productive use of the power generated behind-the-meter without transmission or distribution costs. The local station control system (not independently illustrated) of local station **690** may issue an operational directive to the one or more flexible datacenters **200** or to the remote master control system (**420** of Figure **4**) to ramp-up to the desired power consumption level. When the operational directive requires the cooperative action of multiple flexible datacenters **200**, the remote master control system (**420** of Figure **4**) may determine how to power each individual flexible datacenter **200** in accordance with the operational directive or provide an override to each flexible datacenter **200**.

[0056] Further examples of unutilized behind-the-meter power availability is when wind farm **600** experiences low wind conditions that make it not economically feasible to power up certain components, such as, for example, the local station (not independently illustrated), but there may be sufficient behind-the-meter power availability to power one or more flexible datacenters **200**. Similarly, unutilized behind-the-meter power availability may occur when wind farm **600** is starting up,

or testing, one or more turbines **610**. Turbines **610** are frequently offline for installation, maintenance, and service and must be tested prior to coming online as part of the array. One or more flexible datacenters **200** may be powered by one or more turbines **610** that are offline from farm **600**. The above-noted examples of when unutilized behind-the-meter power is available are merely exemplary and are not intended to limit the scope of what one of ordinary skill in the art would recognize as unutilized behind-the-meter power availability. Unutilized behind-the-meter power availability may occur anytime there is power available and accessible behind-the-meter that is not subject to transmission and distribution costs and there is an economic advantage to using it.

[0057] One of ordinary skill in the art will recognize that wind farm **600** and wind turbine **610** may vary based on an application or design in accordance with one or more embodiments of the present invention.

[0058] Figure 7 shows a flexible datacenter **200** powered by one or more solar panels **710** in accordance with one or more embodiments of the present invention. A solar farm **700** typically includes a plurality of solar panels **710**, each of which intermittently generates a solar-generated DC voltage **720**. Solar-generated DC voltage **720** may vary based on a type, kind, or configuration of farm **700**, panel **710**, and incident sunlight. Solar-generated DC voltage **720** produced by the plurality of solar panels **710** is collected **725** and provided **730** to a DC-to-AC inverter that converts solar-generated DC voltage into three-phase solar-generated AC voltage **750**. Three-phase solar-generated AC voltage **750** is provided to an AC-to-AC step-up transformer **760** that steps up three-phase solar-generated AC voltage to three-phase grid AC voltage **790**. Three-phase grid AC voltage **790** may be stepped down with an AC-to-AC step-down transformer **785** configured to produce three-phase local station AC voltage **777** provided to local station **775**. One of ordinary skill in the art will recognize that the actual voltage levels may vary based on the type, kind, or number of solar panels **710**, the configuration or design of solar farm **700**, and grid **790** that it feeds into.

[0059] The output side of AC-to-AC step-up transformer **760** that connects to grid **790** may be metered and is typically subject to transmission and distribution costs. In contrast, power consumed on the input side of AC-to-AC step-up transformer **760** may be considered behind-the-meter and is typically not subject to transmission and distribution costs. As such, one or more flexible datacenters **200** may be powered by

three-phase solar-generated AC voltage **750**. Specifically, in solar farm **700** applications, the three-phase behind-the-meter AC voltage used to power flexible datacenter **200** may be three-phase solar-generated AC voltage **750**. As such, flexible datacenter **200** may reside behind-the-meter, avoid transmission and distribution costs, and may be dynamically powered when unutilized behind-the-meter power is available.

[0060] Unutilized behind-the-meter power availability may occur when there is excess local power generation. In high incident sunlight situations, solar farm **700** may generate more power than, for example, AC-to-AC step-up transformer **760** is rated for. In such situations, solar farm **700** may have to take steps to protect its equipment from damage, which may include taking one or more panels **710** offline or shunting their voltage to dummy loads or ground. Advantageously, one or more flexible datacenters **200** may be used to consume power on the input side of AC-to-AC step-up transformer **760**, thereby allowing solar farm **700** to operate equipment within operating ranges while flexible datacenter **200** receives behind-the-meter power without transmission or distribution costs. The local station control system (not independently illustrated) of local station **775** may issue an operational directive to the one or more flexible datacenters **200** or to the remote master control system (**420** of Figure **4**) to ramp-up to the desired power consumption level. When the operational directive requires the cooperative action of multiple flexible datacenters **200**, the remote mater control system (**420** of Figure **4**) may determine how to power each individual flexible datacenter **200** in accordance with the operational directive or provide an override to each flexible datacenter **200**.

[0061] Another example of unutilized behind-the-meter power availability is when grid **790** cannot, for whatever reason, take the power being produced by solar farm **700**. In such situations, solar farm **700** may have to take one or more panels **710** offline or shunt their voltage to dummy loads or ground. Advantageously, one or more flexible datacenters **200** may be used to consume power on the input side of AC-to-AC step-up transformer **760**, thereby allowing solar farm **700** to either produce power to grid **790** at a lower level or shut down transformer **760** entirely while flexible datacenter **200** receives behind-the-meter power without transmission or distribution costs. The local station control system (not independently illustrated) of local station **775** or the grid operator (not independently illustrated) of grid **790** may issue an operational directive to the one or more flexible datacenters **200** or to

the remote master control system (**420** of Figure **4**) to ramp-up to the desired power consumption level. When the operational directive requires the cooperative action of multiple flexible datacenters **200**, the remote master control system (**420** of Figure **4**) may determine how to power each individual flexible datacenter **200** in accordance with the operational directive or provide an override to each flexible datacenter **200**.

[0062] Another example of unutilized behind-the-meter power availability is when solar farm **700** is selling power to grid **790** at a negative price that is offset by a production tax credit. In certain circumstances, the value of the production tax credit may exceed the price solar farm **700** would have to pay to grid **790** to offload their generated power. Advantageously, one or more flexible datacenters **200** may be used to consume power behind-the-meter, thereby allowing solar farm **700** to produce and obtain the production tax credit, but sell less power to grid **790** at the negative price. The local station control system (not independently illustrated) of local station **775** may issue an operational directive to the one or more flexible datacenters **200** or to the remote master control system (**420** of Figure **4**) to ramp-up to the desired power consumption level. When the operational directive requires the cooperative action of multiple flexible datacenter **200**, the remote master control system (**420** of Figure **4**) may determine how to power each individual flexible datacenter **200** in accordance with the operational directive or provide an override to each flexible datacenter **200**.

[0063] Another example of unutilized behind-the-meter power availability is when solar farm **700** is selling power to grid **790** at a negative price because grid **790** is oversupplied or is instructed to stand down and stop producing altogether. The grid operator (not independently illustrated) may select certain power generation stations to go offline and stop producing power to grid **790**. Advantageously, one or more flexible datacenters **200** may be used to consume power behind-the-meter, thereby allowing solar farm **700** to stop producing power to grid **790**, but making productive use of the power generated behind-the-meter without transmission or distribution costs. The local station control system (not independently illustrated) of the local station **775** or the grid operator (not independently illustrated) of grid **790** may issue an operational directive to the one or more flexible datacenters **200** or to the remote master control system (**420** of Figure **4**) to ramp-up to the desired power consumption level. When the operational directive requires the cooperative action of

multiple flexible datacenters **200**, the remote master control system (**420** of Figure **4**) may determine how to power each individual flexible datacenter **200** in accordance with the operational directive or provide an override to each flexible datacenter **200**.

[0064] Another example of unutilized behind-the-meter power availability is when solar farm **700** is producing power to grid **790** that is unstable, out of phase, or at the wrong frequency, or grid **790** is already unstable, out of phase, or at the wrong frequency for whatever reason. The grid operator (not independently illustrated) may select certain power generation stations to go offline and stop producing power to grid **790**. Advantageously, one or more flexible datacenters **200** may be used to consume power behind-the-meter, thereby allowing solar farm **700** to stop producing power to grid **790**, but make productive use of the power generated behind-the-meter without transmission or distribution costs. The local station control system (not independently illustrated) of local station **775** may issue an operational directive to the one or more flexible datacenters **200** or to the remote master control system (**420** of Figure **4**) to ramp-up to the desired power consumption level. When the operational directive requires the cooperative action of multiple flexible datacenters **200**, the remote master control system (**420** of Figure **4**) may determine how to power each individual flexible datacenter **200** in accordance with the operational directive or provide an override to each flexible datacenter **200**.

[0065] Further examples of unutilized behind-the-meter power availability is when solar farm **700** experiences intermittent cloud cover such that it is not economically feasible to power up certain components, such as, for example local station 775, but there may be sufficient behind-the-meter power availability to power one or more flexible datacenters **200**. Similarly, unutilized behind-the-meter power availability may occur when solar farm **700** is starting up, or testing, one or more panels **710**. Panels **710** are frequently offline for installation, maintenance, and service and must be tested prior to coming online as part of the array. One or more flexible datacenters **200** may be powered by one or more panels **710** that are offline from farm **700**. The above-noted examples of when unutilized behind-the-meter power is available are merely exemplary and are not intended to limit the scope of what one of ordinary skill in the art would recognize as unutilized behind-the-meter power availability. Behind-the-meter power availability may occur anytime there is power

available and accessible behind-the-meter that is not subject to transmission and distribution costs and there is an economic advantage to using it.

[0066] One of ordinary skill in the art will recognize that solar farm **700** and solar panel **710** may vary based on an application or design in accordance with one or more embodiments of the present invention.

[0067] Figure **8** shows a flexible datacenter **200** powered by flare gas **800** in accordance with one or more embodiments of the present invention. Flare gas **800** is combustible gas produced as a product or by-product of petroleum refineries, chemical plants, natural gas processing plants, oil and gas drilling rigs, and oil and gas production facilities. Flare gas **800** is typically burned off through a flare stack (not shown) or vented into the air. In one or more embodiments of the present invention, flare gas **800** may be diverted **812** to a gas-powered generator that produces three-phase gas-generated AC voltage **822**. This power may be considered behind-the-meter and is not subject to transmission and distribution costs. As such, one or more flexible datacenters **200** may be powered by three-phase gas-generated AC voltage. Specifically, the three-phase behind-the-meter AC voltage used to power flexible datacenter **200** may be three-phase gas-generated AC voltage **822**. Accordingly, flexible datacenter **200** may reside behind-the-meter, avoid transmission and distribution costs, and may be dynamically powered when unutilized behind-the-meter power is available.

[0068] Figure **9** shows a method of dynamic power delivery to a flexible datacenter (**200** of Figure **2**) using unutilized behind-the-meter power **900** in accordance with one or more embodiments of the present invention. In step **910**, the datacenter control system (**220** of Figure **4**), or the remote master control system (**420** of Figure **4**), may monitor unutilized behind-the-meter power availability. In certain embodiments, monitoring may include receiving information or an operational directive from the local station control system (**410** of Figure **4**) or the grid operator (**440** of Figure **4**) corresponding to unutilized behind-the-meter power availability.

[0069] In step **920**, the datacenter control system (**220** of Figure **4**), or the remote master control system (**420** of Figure **4**), may determine when a datacenter ramp-up condition is met. In certain embodiments, the datacenter ramp-up condition may be met when there is sufficient behind-the-meter power availability and there is no operational directive from the local station to go offline or reduce power. In step **930**, the datacenter control system (**220** of Figure **4**) may enable behind-the-meter

power delivery to one or more computing systems (**100** of Figure **2**). In step **940**, once ramped-up, the datacenter control system (**220** of Figure **4**) or the remote master control system (**420** of Figure **4**) may direct one or more computing systems (**100** of Figure **2**) to perform predetermined computational operations. In certain embodiments, the predetermined computational operations may include the execution of one or more hashing functions.

[0070] While operational, the datacenter control system (**220** of Figure **4**), or the remote master control system (**420** of Figure **4**), may receive an operational directive to modulate power consumption. In certain embodiments, the operational directive may be a directive to reduce power consumption. In such embodiments, the datacenter control system (**220** of Figure **4**) or the remote master control system (**420** of Figure **4**) may dynamically reduce power delivery to one or more computing systems (**100** of Figure **2**) or dynamically reduce power consumption of one or more computing systems. In other embodiments, the operational directive may be a directive to provide a power factor correction factor. In such embodiments, the datacenter control system (**220** of Figure **4**) or the remote master control system (**420** of Figure **4**) may dynamically adjust power delivery to one or more computing systems (**100** of Figure **2**) to achieve a desired power factor correction factor. In still other embodiments, the operational directive may be a directive to go offline or power down. In such embodiments, the datacenter control system (**220** of Figure **4**) may disable power delivery to one or more computing systems (**100** of Figure **2**).

[0071] The datacenter control system (**220** of Figure **4**), or the remote master control system (**420** of Figure **4**), may determine when a datacenter ramp-down condition is met. In certain embodiments, the datacenter ramp-down condition may be met if there is insufficient or anticipated to be insufficient behind-the-meter power availability or there is an operational directive from the local station to go offline or reduce power. The datacenter control system (**220** of Figure **4**) may disable behind-the-meter power delivery to one or more computing systems (**100** of Figure **2**). Once ramped-down, the datacenter control system (**220** of Figure **4**) remains powered and in communication with the remote master control system (**420** of Figure **4**) so that it may dynamically power the flexible datacenter (**200** of Figure **2**) when conditions change.

[0072] One of ordinary skill in the art will recognize that a datacenter control system (**220** of Figure **4**) may dynamically modulate power delivery to one or more

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computing systems (**100** of Figure **2**) of a flexible datacenter (**200** of Figure **2**) based on unutilized behind-the-meter power availability or an operational directive. The flexible datacenter (**200** of Figure **2**) may transition between a fully powered down state (while the datacenter control system remains powered), a fully powered up state, and various intermediate states in between. In addition, flexible datacenter (**200** of Figure **2**) may have a blackout state, where all power consumption, including that of the datacenter control system (**220** of Figure **4**) is halted. However, once the flexible datacenter (**200** of Figure **2**) enters the blackout state, it will have to be manually rebooted to restore power to datacenter control system (**220** of Figure **4**). Local station conditions or operational directives may cause flexible datacenter (**200** of Figure **2**) to ramp-up, reduce power consumption, change power factor, or ramp-down.

[0073] Advantages of one or more embodiments of the present invention may include one or more of the following:

[0074] In one or more embodiments of the present invention, a method and system for dynamic power delivery to a flexible datacenter using unutilized energy sources provides a green solution to two prominent problems: the exponential increase in power required for growing blockchain operations and the unutilized and typically wasted energy generated from renewable energy sources.

[0075] In one or more embodiments of the present invention, a method and system for dynamic power delivery to a flexible datacenter using unutilized energy sources allows for the rapid deployment of mobile datacenters to local stations. The mobile datacenters may be deployed on site, near the source of power generation, and receive unutilized behind-the-meter power when it is available.

[0076] In one or more embodiments of the present invention, a method and system for dynamic power delivery to a flexible datacenter using unutilized energy sources allows for the power delivery to the datacenter to be modulated based on conditions or an operational directive received from the local station or the grid operator.

[0077] In one or more embodiments of the present invention, a method and system for dynamic power delivery to a flexible datacenter using unutilized energy sources may dynamically adjust power consumption by ramping-up, ramping-down, or adjusting the power consumption of one or more computing systems within the flexible datacenter.

[0078] In one or more embodiments of the present invention, a method and system for dynamic power delivery to a flexible datacenter using unutilized energy sources may be powered by unutilized behind-the-meter power that is free from transmission and distribution costs. As such, the flexible datacenter may perform computational operations, such as hashing function operations, with little to no energy cost.

[0079] In one or more embodiments of the present invention, a method and system for dynamic power delivery to a flexible datacenter using unutilized energy sources provides a number of benefits to the hosting local station. The local station may use the flexible datacenter to adjust a load, provide a power factor correction, to offload power, or operate in a manner that invokes a production tax credit.

[0080] While the present invention has been described with respect to the above-noted embodiments, those skilled in the art, having the benefit of this disclosure, will recognize that other embodiments may be devised that are within the scope of the invention as disclosed herein. Accordingly, the scope of the invention should be limited only by the appended claims.

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(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DJ, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JO, JP, KE, KG, KH, KN, KP, KR, KW, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME,

(54) Title: METHOD AND SYSTEM FOR DYNAMIC POWER DELIVERY TO A FLEXIBLE DATACENTER USING UNUTILIZED ENERGY SOURCES

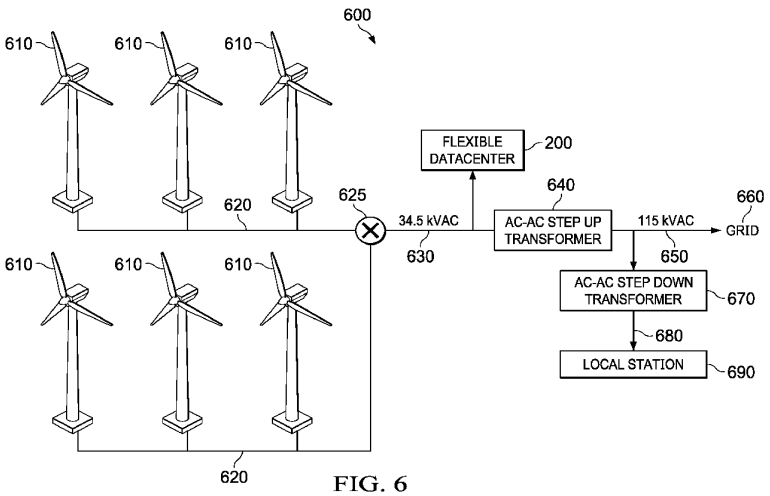

FIG. 6

(57) Abstract: A flexible datacenter includes a mobile container, a behind-the-meter power input system, a power distribution system, a datacenter control system, a plurality of computing systems, and a climate control system. The datacenter control system modulates power delivery to the plurality of computing systems based on unutilized behind-the-meter power availability or an operational directive. A method of dynamic power delivery to a flexible datacenter using unutilized behind-the-meter power includes monitoring unutilized behind-the-meter power availability, determining when a datacenter ramp-up condition is met, enabling behind-the-meter power delivery to one or more computing systems when the datacenter ramp-up condition is met, and directing the one or more computing systems to perform predetermined computational operations.

[Continued on next page]

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McDonnell Boehnen Hulbert & Berghoff LLP
300 South Wacker Drive, Suite 3200
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ÉTATS-UNIS D'AMÉRIQUE

Date of mailing *(day/month/year)*
21 February 2019 (21.02.2019)

Applicant's or agent's file reference
18-874-WO1

IMPORTANT NOTIFICATION

International application No.
PCT/US2018/017950

International filing date *(day/month/year)*
13 February 2018 (13.02.2018)

1. The following indications appeared on record concerning:

☐ the applicant ☐ the inventor ☒ the agent ☐ the common representative

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2. The International Bureau hereby notifies the applicant that the following change has been recorded concerning:

☒ the person ☐ the name ☐ the address ☐ the nationality ☐ the residence

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3. Further observations, if necessary:
The new agent's file reference is: 18-874-WO1

4. A copy of this notification has been sent to:

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APPLICATION NUMBER: ***62/616,348***
FILING DATE: ***January 11, 2018***
RELATED PCT APPLICATION NUMBER: ***PCT/US18/17950***

THE COUNTRY CODE AND NUMBER OF YOUR PRIORITY APPLICATION, TO BE USED FOR FILING ABROAD UNDER THE PARIS CONVENTION, IS ***US62/616,348***

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PROVISIONAL APPLICATION FOR PATENT COVER SHEET – Page 1 of 2

This is a request for filing a PROVISIONAL APPLICATION FOR PATENT under 37 CFR 1.53(c).

Priority Mail Express® Label No. _____

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David J.	Henson	Houston, Texas
Michael T.	McNamara	Newport Beach, California
Raymond E.	Cline Jr.	Houston, Texas

Additional inventors are being named on the _____ separately numbered sheets attached hereto.

TITLE OF THE INVENTION (500 characters max):

FLEXIBLE DATACENTER USING GREEN OR UNUTILIZED ENERGY SOURCES

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☑ Application Data Sheet. See 37 CFR 1.76.
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☑ Specification (e.g., description of the invention) *Number of Pages* 68

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TELEPHONE 281-362-2839 DOCKET NUMBER 01128-000002 PPA

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	01128-000002 PPA
	Application Number	
Title of Invention	FLEXIBLE DATACENTER USING GREEN OR UNUTILIZED ENERGY SOURCES	

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.
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☐ 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:

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	01128-000002 PPA
	Application Number	
Title of Invention	FLEXIBLE DATACENTER USING GREEN OR UNUTILIZED ENERGY SOURCES	

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Title of the Invention	FLEXIBLE DATACENTER USING GREEN OR UNUTILIZED ENERGY SOURCES		
Attorney Docket Number	01128-000002 PPA	**Small Entity Status Claimed**	☒
Application Type	Provisional		
Subject Matter	Utility		
Total Number of Drawing Sheets (if any)	0	**Suggested Figure for Publication (if any)**	

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

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	Application Number	
Title of Invention	FLEXIBLE DATACENTER USING GREEN OR UNUTILIZED ENERGY SOURCES	

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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. Add

PTO/AIA/14 (07-14)
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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	01128-000002 PPA
	Application Number	
Title of Invention	FLEXIBLE DATACENTER USING GREEN OR UNUTILIZED ENERGY SOURCES	

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.

Authorization to Permit Access:

☒ Authorization to Permit Access to the Instant Application by the Participating Offices

If 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 World Intellectual Property Office (WIPO), and any other intellectual property offices in which a foreign application claiming priority to the instant patent application is filed access to the instant patent application. See 37 CFR 1.14(c) and (h). This box should not be checked if the applicant does not wish the EPO, JPO, KIPO, WIPO, or other intellectual property office in which a foreign application claiming priority to the instant patent application is filed to have access to the instant patent application.

In accordance with 37 CFR 1.14(h)(3), access will be provided to a copy of the instant patent application with respect to: 1) the instant patent application-as-filed; 2) any foreign application to which the instant patent application claims priority under 35 U.S.C. 119(a)-(d) if a copy of the foreign application that satisfies the certified copy requirement of 37 CFR 1.55 has been filed in the instant patent application; and 3) any U.S. application-as-filed from which benefit is sought in the instant patent application.

In accordance with 37 CFR 1.14(c), access may be provided to information concerning the date o f filing this Authorization.

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.

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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	Lancium LLC		
Mailing Address Information For Applicant:			
Address 1	C/O Angelo Mikeska PLLC		
Address 2	21 Waterway Ave, Suite 300		
City	The Woodlands	**State/Province**	TX
Country	US	Postal Code	77380
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:

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

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.

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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. Add

Signature:

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NOTE: This form must be signed in accordance with 37 CFR 1.33. See 37 CFR 1.4 for signature requirements and certifications.

Signature	/Basil M. Angelo/			Date (YYYY-MM-DD)	2018-01-11
First Name	Basil	Last Name	Angelo	Registration Number	62811

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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 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:

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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.

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 C o o p eration 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.