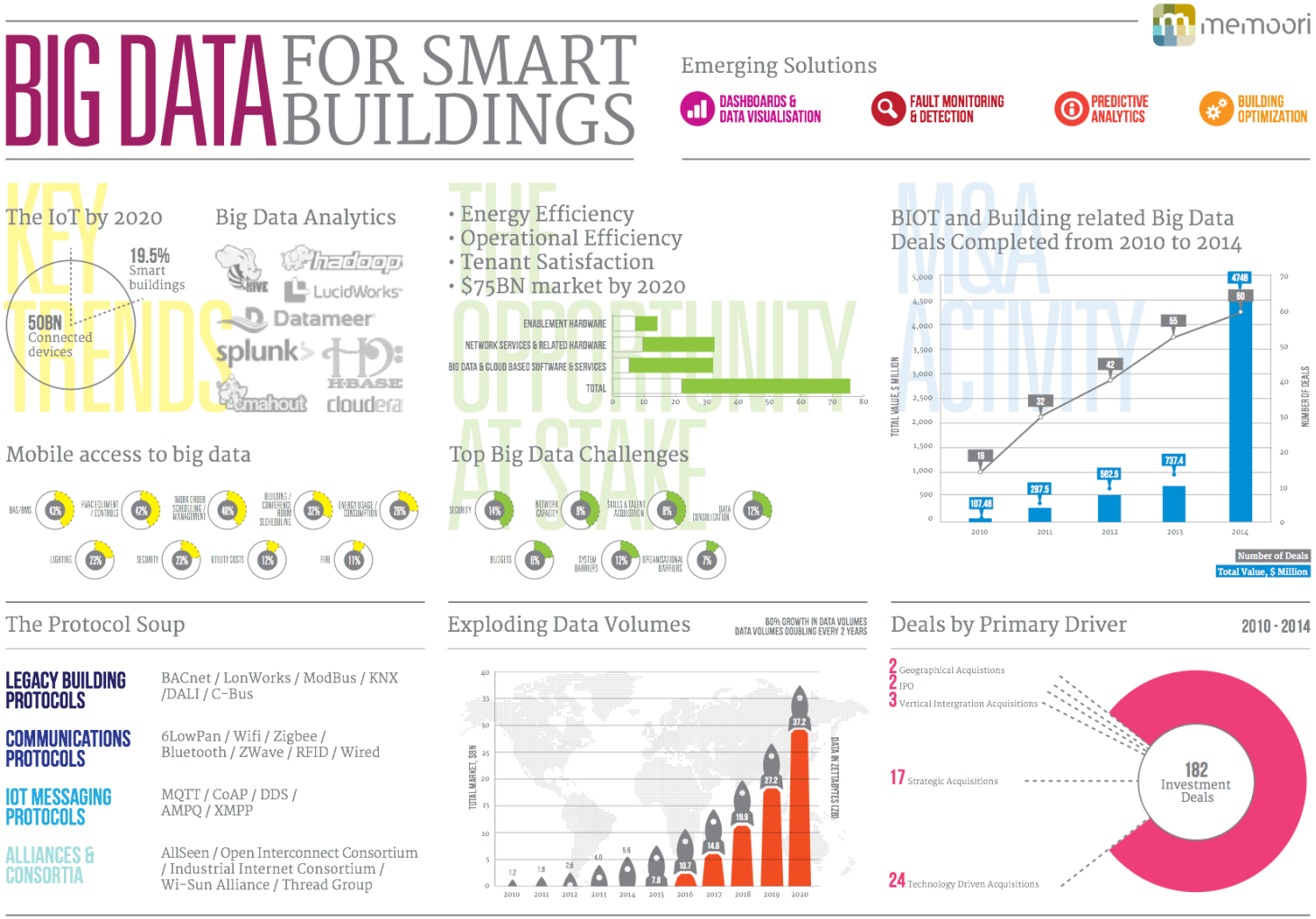
Big Data – Analytics – IoT – BIoT – Smart, Connected Buildings – Smart Energy Analytics



Lots of buildings, lots of applications, lots of potential.

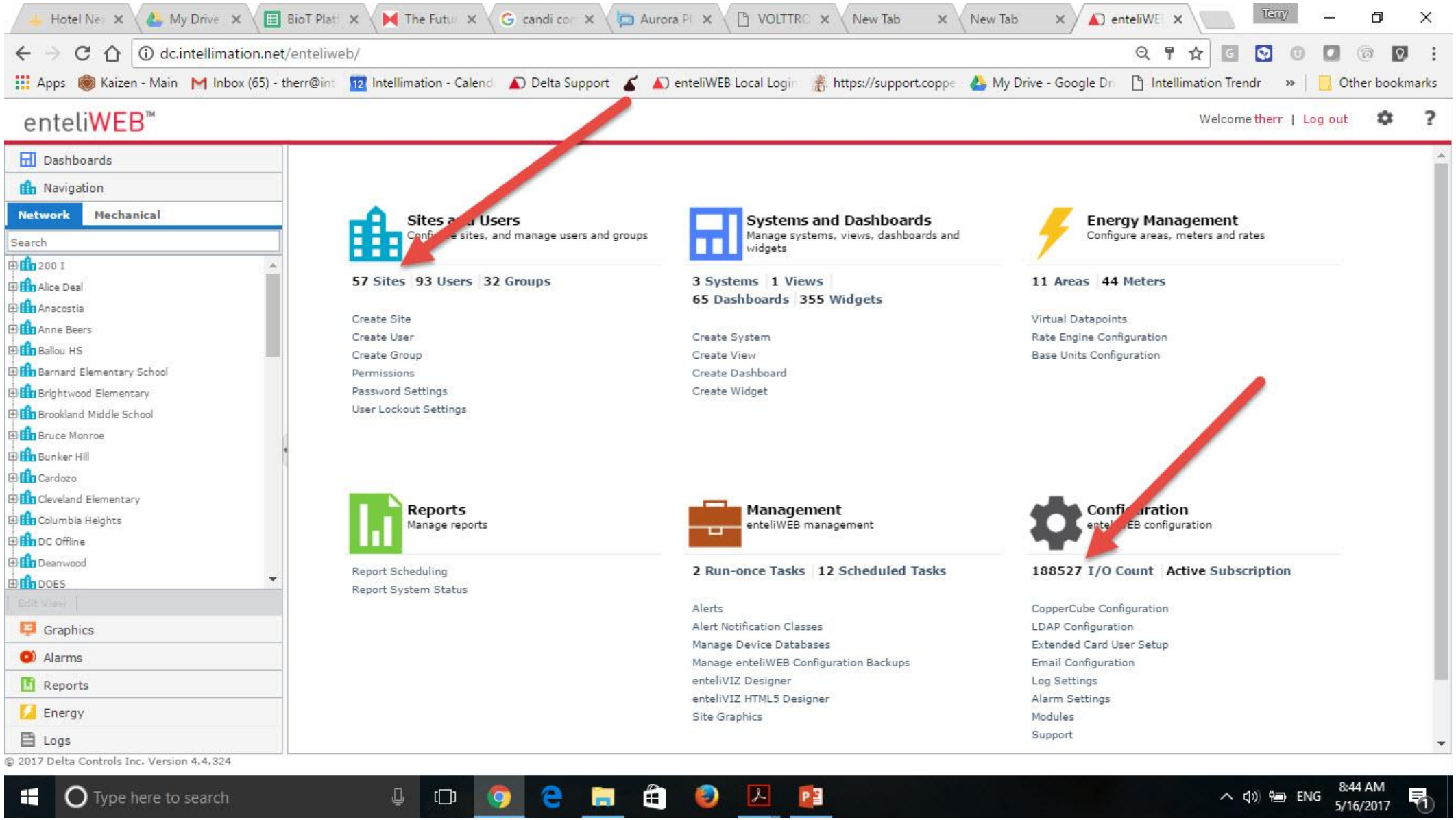
- What's needed to extract this POTENTIAL??
- A connecting middleware or platform - Volttron??

Partial and growing list of applications that need BAS & energy data from buildings

Skyfoundry	http://skyfoundry.com/
Clockworks	http://www.kgsbuildings.com/clockworks.aspx
Infometrics	http://www.cimetrics.com/
Iconics	http://www.iconics.com/Home/Products/AnalytiX/Facility-AnalytiX.aspx
Coppertree Analytics	http://coppertreeanalytics.com/
Panoptix (JCI)	http://whatspossible.johnsoncontrols.com/community/panoptix
BuildingIQ	http://www.buildingiq.com
entic	http://www.enticusa.com
LOBOS	http://www.enerliance.com
BuildingOS	http://luciddesigngroup.com
Splunk	http://www.splunk.com/view/SP-CAAAHVB
bdoc	http://www.biforbuildings.com/
Ezenics	http://ezenics.com/
Accenture	http://www.accenture.com/us-en/Pages/service-smart-building-solutions.aspx
IBM	http://www-142.ibm.com/software/products/us/en/tririga-energy-optimization
Di-BOSS	http://www.di-boss.com/di-boss.aspx
Attune	https://hbsmicrosites.honeywell.com/HBSCDMS/Attune/
Phoenix Energy Tech	http://www.phoenixet.com
Pacific Controls	http://www.pacificcontrols.net
FacilityConnex	http://facilityconnex.com/
PI Coresight	http://www.osisoft.com/software-support/what-is-pi/Analyze.aspx
PACRAT	http://www.facilitydynamics.com/
Interval Data Systems	http://www.intdatsys.com
NIST - APAR & VPACC	http://www.nist.gov/el/building_environment/mechsys/fddchac.cfm
DABO	http://adms-tech.com/
FlywheelBI	http://flywheelbi.com/

Our work with Energy Dev. Sustainability and

- Portfolio - 400 buildings, 150 with BAS. Schools, office buildings, recreation centers, libraries, police stations, etc.
- Started in 2014 connecting two buildings and doing data-driven RCx
- Today -~~50~~ 57 of the largest buildings connected. ~~150,000~~ 188,500 physical data points: inputs – temp, hum, CO2, equipment status, etc; outputs – fan, pump, valve, damper, boiler, chiller commands.
- Web-enabled facility and energy dashboards, reporting, alarming, trending.
- BAS, EIS, AFDD, DR, & Optimizations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Bruce Monroe
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Alarms
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Sites and Users
Configure sites, and manage users and groups
57 Sites | 93 Users | 32 Groups
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Create Group
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User Lockout Settings
Systems and Dashboards
Manage systems, views, dashboards and widgets
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Early Challenge – data trending, tagging, & archiving.

- No universal, open, standard, trending hardware or platform.
- No tagging standards (some positive develops here)
- No database, historian, or archiving standard.
- We tested and experimented with a few options, finally choosing Building Robotics Trendr.
- We presently have 50 Trendr's installed for 4 clients – DC (30), Ecorithm (2), Cortex Buildng Intelligence (18), Coppertree Analytics (1). Notibles – Empire State Building & Emory Univ.
- Worked OK, but alas was not to be. Lack of support, further development, discontinued product.
- Volttron?

Is Volttron a viable solution?

- **PNNL / Volttron & Intellimation Meeting (March 2016)**
- Our goal is to understand the viability / usability of Volttron for:
  - 1. As a trending/archiving/tagging middleware platform to enable analytics.
  - 2. Additional longer term features, functions, uses
  - a. DR, analytics, transactive energy (DER)
  - b. What other current functions are available?
- **Agenda**
  - ● Brief overview of the history, current state, and future vision for Volttron
  - ● Where and who is presently using it commercially in production
  - ● There are a lot of emerging IoT, IIoT, and BIoT platforms. How does Volttron stack up
  - and can it survive.

● Is it ready to be deployed commercially in 100 building in US City as a trending/archiving platform?

❑ The driver has to work with every possible type/vendor of BACnet system.

● How much can PNNL/DOE support this effort

● How many other interested players can support (Intellimation, Cortex, New City Energy, SES, Ecorthm, Vornado, ??)

● What about the user interface (our current biggest obstacle)?

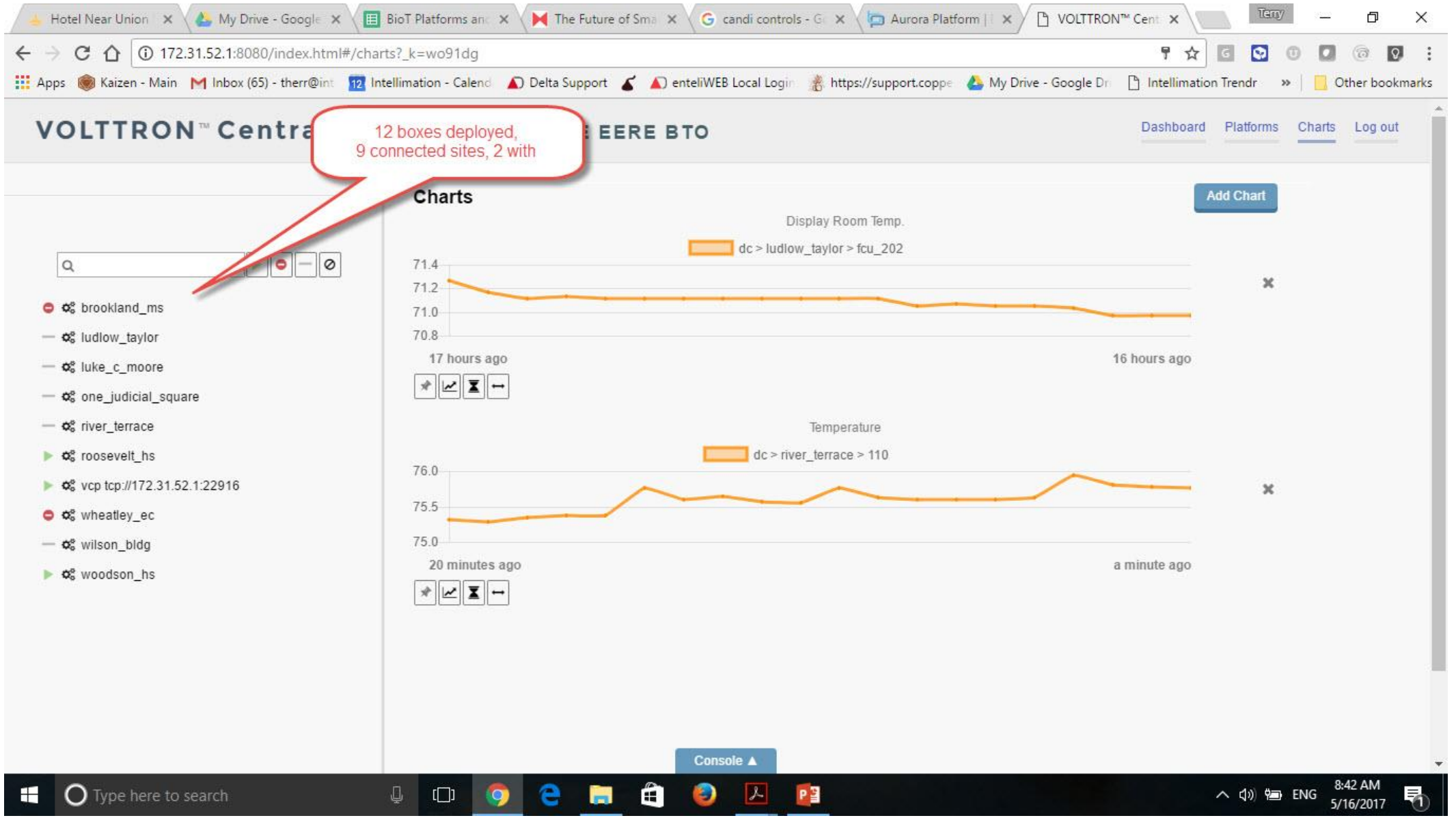
● The BACnet driver has been problematic in our limited testing with real buildings BAS.

● Tagging mechanism. (can Alex's tool with with Volttron/Mongo)

● Is Mongodb the right database for time series, for tags

Current deployment

- ~~8~~ 12 physical boxes installed – 7 Intel NUC's & 5 Jetway Industrial PC's
- Trending set-up on ~~6~~ 7 Volttron instances in ~~6~~ 7 buildings
- Largest site has 7500 points trended on $100 Kangaroo PC
- Volttron Central & Mongodb
- Refinements – better hardware, using stand naming for Volttron Name/Topic name, running VC in AWS, with a lot of other supporting tools – Ansible, Grafana, Crate.IO, Prometheus, Kibana….
- But, not without issues/problems – UI was unusable (bugs), 2 boxes crash daily.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My Drive - Google
BioT Platforms and
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71.2
71.0
70.8
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16 hours ago
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dc > river_terrace > 110
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ludlow_taylor
luke_c_moore
one_judicial_square
river_terrace
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wilson_bldg
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What's next – Try to make it work!

- Set-up trending on 4 many more sites
- Improve on the "ease of deployment" – web based interface for device and points scanning, and trending.
- Add meta-tagging capabilities.
- Add ad hoc charting, graphing, visualizations of the data - done
- Add 35 more buildings by converting existing Trendr boxes to Volttron instances.
- Data to multiple different databases – Crate.IO
- Work with 3rd party application provides (vendors) to retrieve data from Volttron platform - API

Are there Commercial Options

Market Landscape						
Product	**connectivity hardware**	**protocols supported**	**PaaS or SaaS**	**API**	**Market Focus**	**Notes**
Candi Controls	Intel box	BACnet, Modbus, Zigbee, X-Bee, Z-Wave, Insteon	PaaS	API	BIoT	
Blue Pillar	Intel box	BACnet, OPC, SNMP, Modbus, dnp	both	REST API,	BIoT	
Connexxion	Onyx	BACnet, Modbus, Haystack	PaaS	Haystack and CX API	BIoT	
WideSky	?		both	REST API,	IIoT & BIoT	Austrianian, expensive ($750/mo. for 1500 points)
Meshify		Modbus	both		IIoT	http://meshify.com/
Entouch Controls	Intel box		both			full product and service
EdgeX Foundry	Linux box	??	PaaS		IIoT & BIoT	www.edgexfoundry.org early stage open source
onyx to haystack server						