INVESTIGATING INTERNET OF THINGS (IoT) PLATFORMS FOR 3D PRINTED WEATHER STATIONS

A Prototype for Puerto Rico

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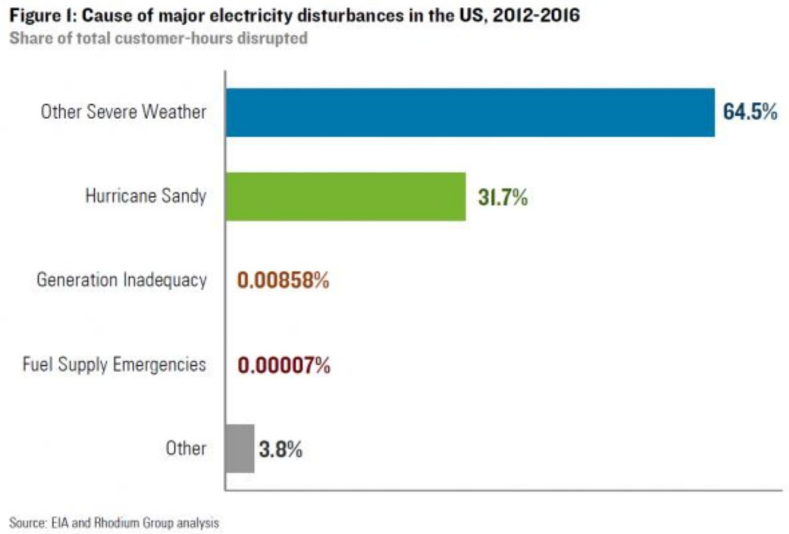
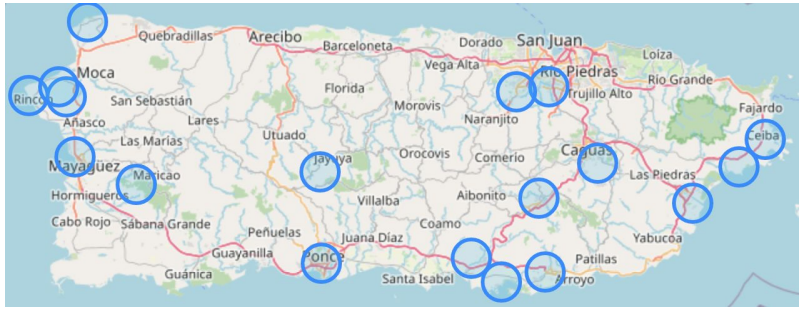
Real time monitoring of weather is required to improving weather forecasting and warning decisions.



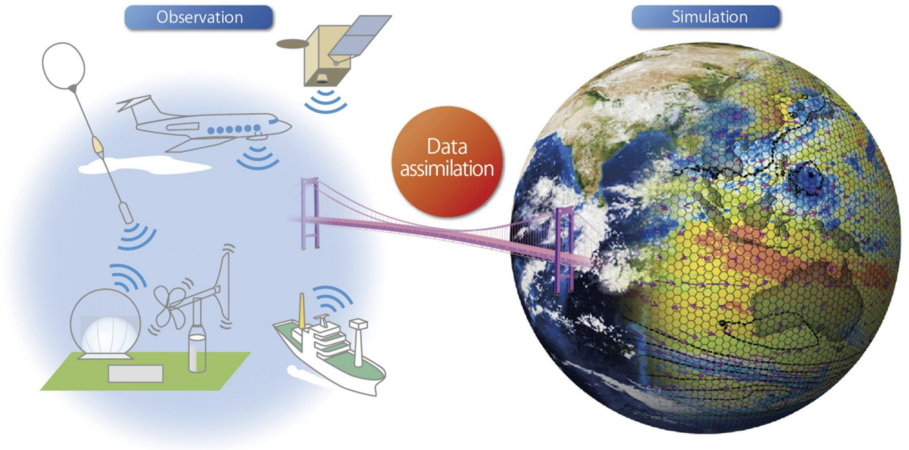


Courtesy: MesoWest, University of Utah

It took 11 months to restore power to Puerto Rico after Hurricane Maria. A similar crisis could happen again.

1.5 million customers lost electricity across Puerto Rico, causing the largest blackout in US history.

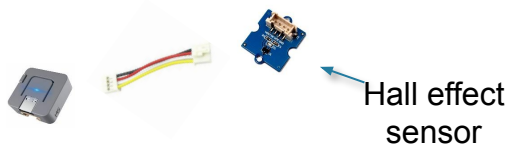
By Alexia Fernández Campbell | @AlexiaCampbell | alexia@vox.com | Aug 15, 2018, 12:40pm EDT



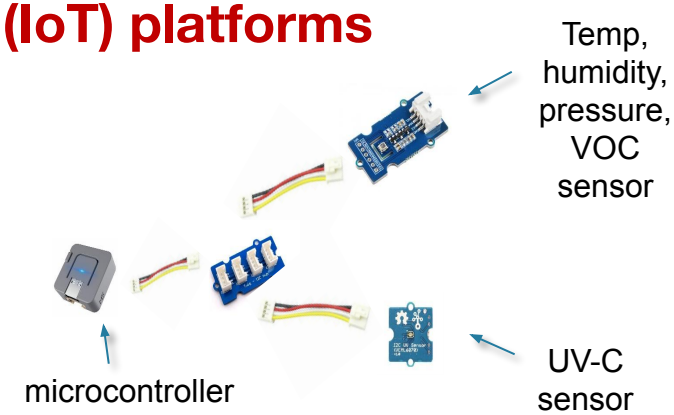
Miyoshi et al 2016

But what can be done with data sparse regions?

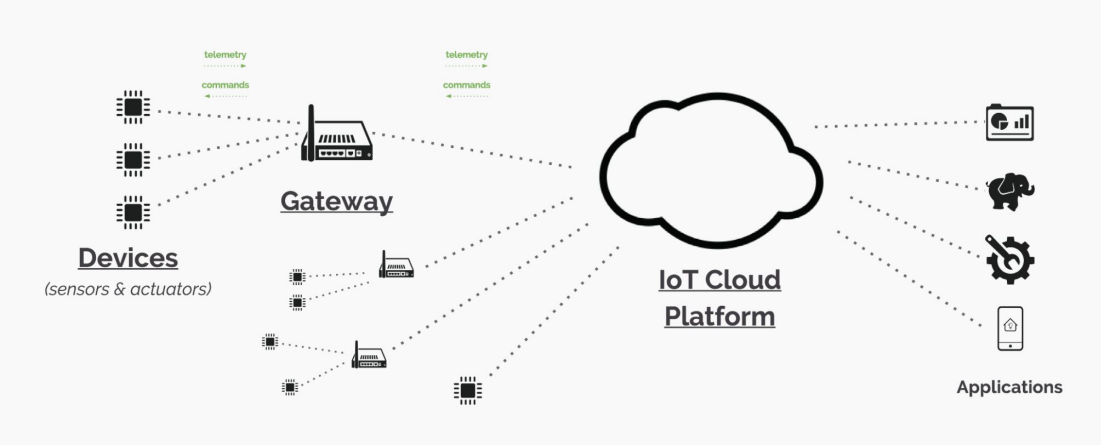
Low cost 3D printed weather stations can be a solution.



- Inexpensive environmental sensors
- Easy and replaceable 3D design
- Flexibility of wireless communications
- Solar powered, and allows for flexible power options over USB
- Configured with **lightweight network protocols (MQTT)** to transmit data to **Internet of Things (IoT) platforms**



Key attributes of an IoT Platform



Simple IoT architecture

Cost

Open vs premium

Compatibility and integration

Interoperable? (Hardware, Protocols, programming language)

Data storage

Internal or external (cost)?

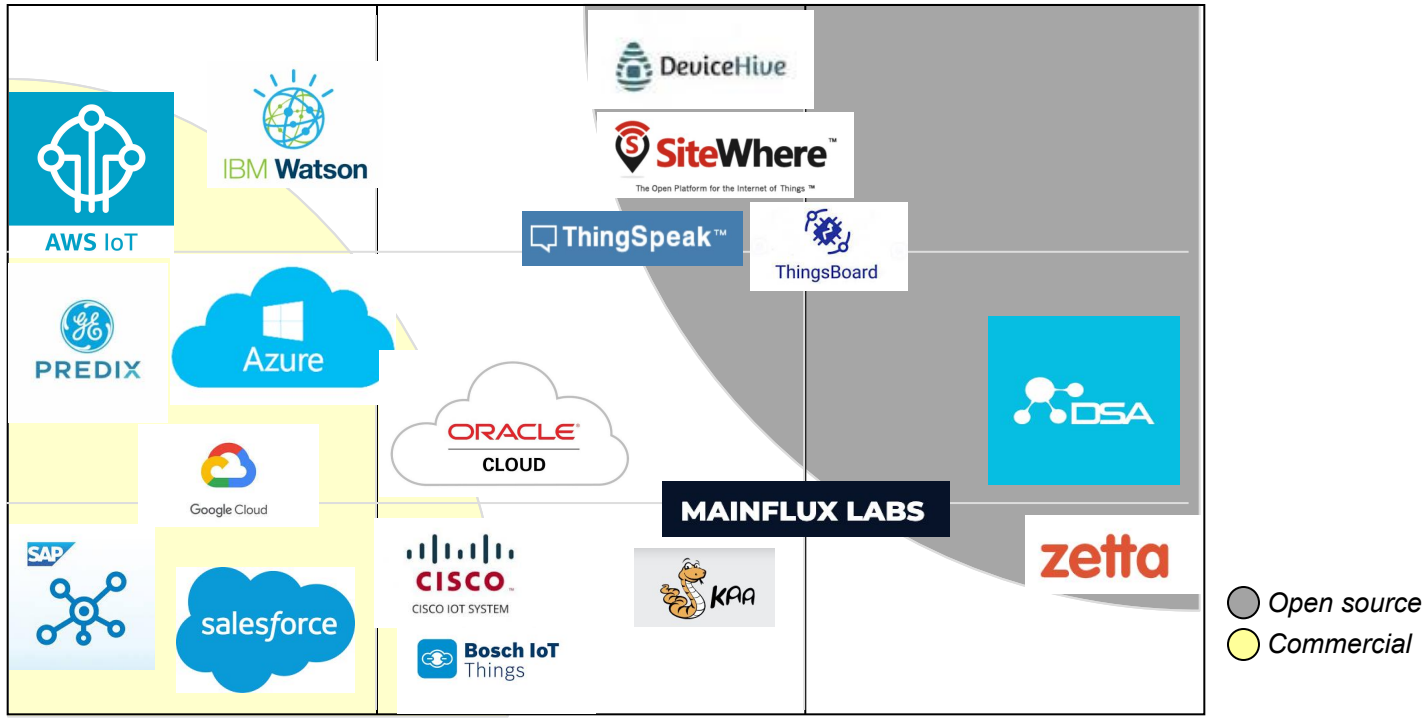
Data processing

Scalable? Cost for increasing scalability?

Analytics and visualization

Supported? Possibility of adding external engines?

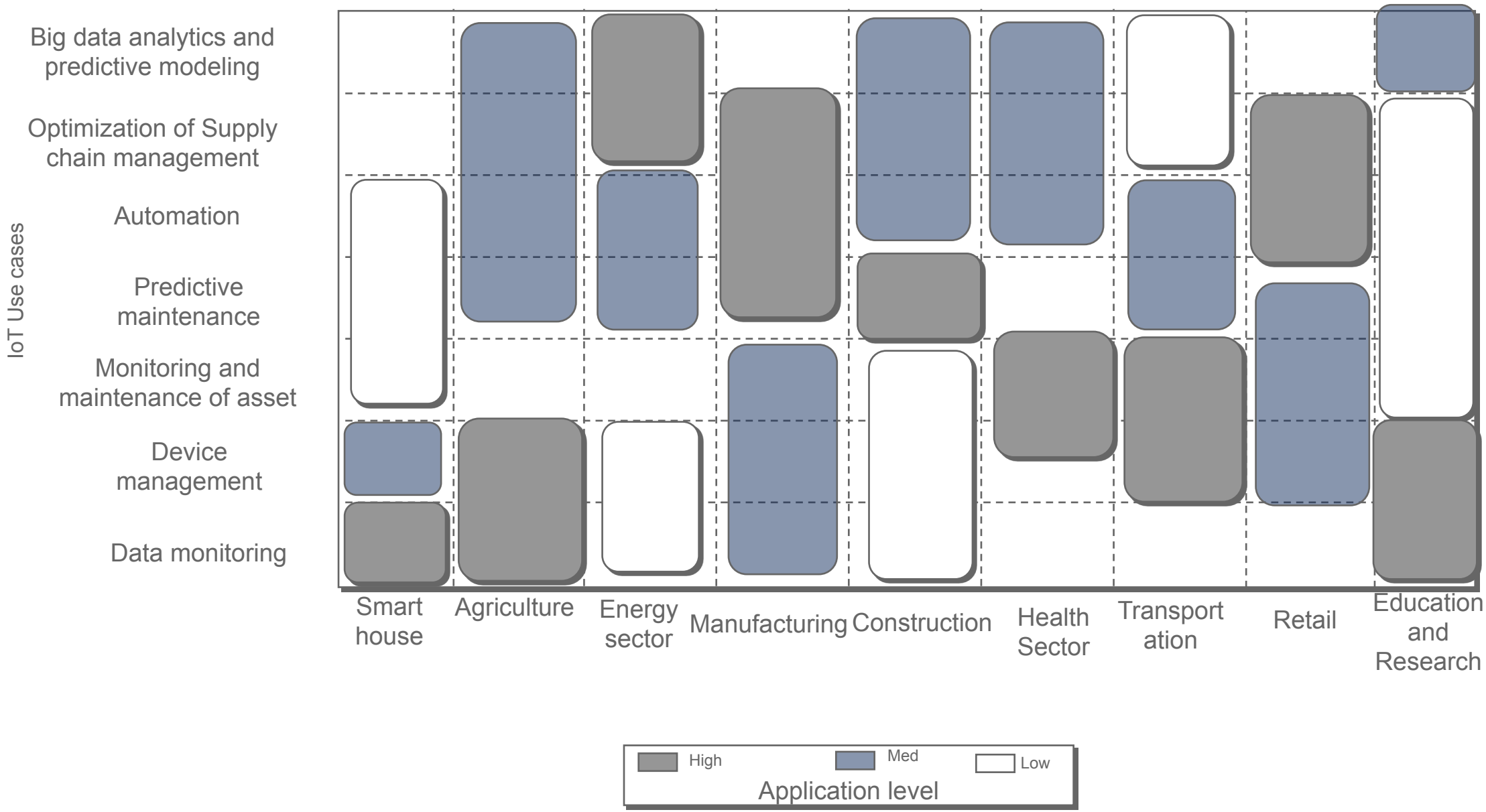
Internet of Things (IoT) platforms: complex and complicated!



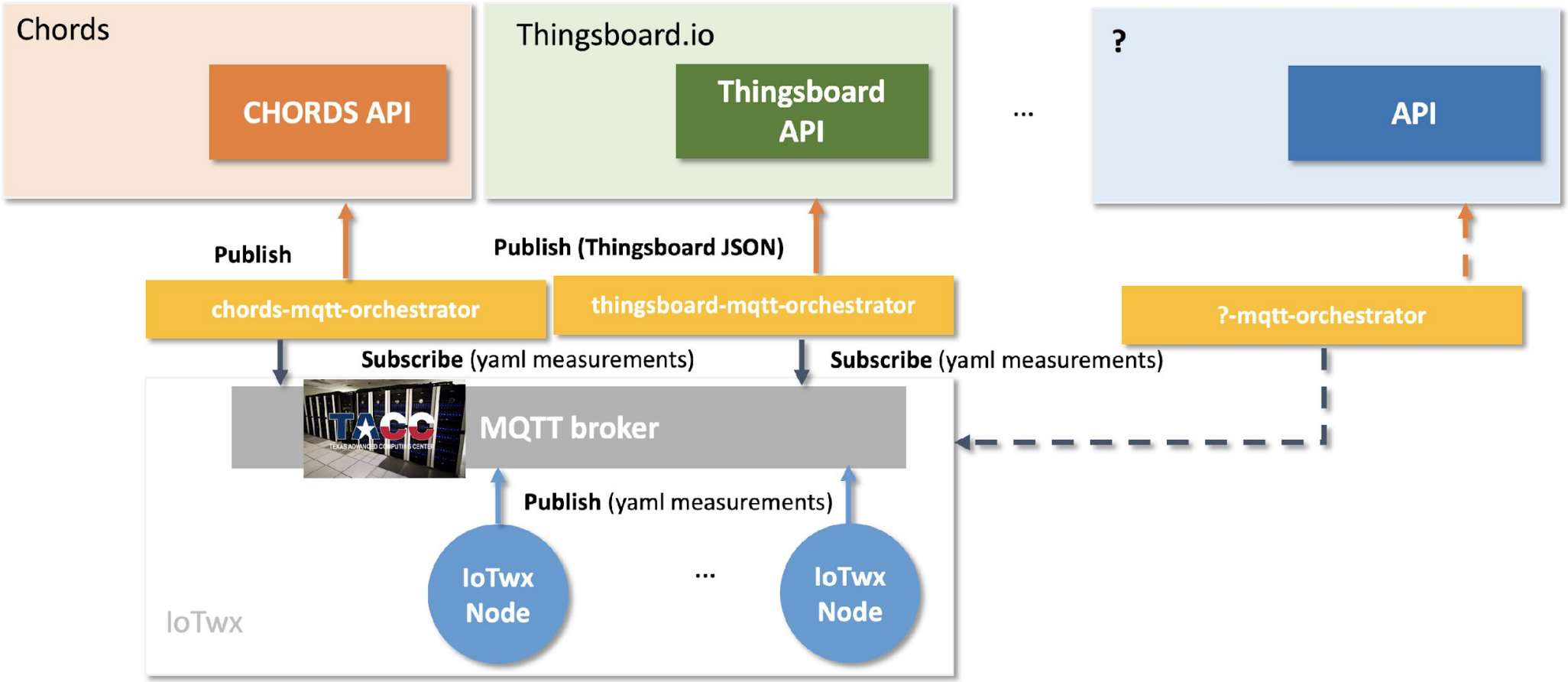
Cisco Survey Reveals Close to Three-Fourths of IoT Projects Are Failing

May 23, 2017

Complexity: Scale and application matters!



Compatibility can be enhanced with the flexibility of integration tools



Brainstorming suitable IoT platform for weather explorers

		Ease of set up			Ease with integration		Scalability and features			Data Analytics	
IoT	Application / Features	Ease of installation	Support material	Skills required	Level of Interoperability	Ease of Integration	Big data management	Big data storage	Data processing and analytics	Ease of analysis	Custom Dashboarding
Zetta	Free	M	L	H	L	L	L	L	L	L	L
DSA	Polyglot	M	M	L	H	H	L	L	L	M	L
Chords	Current 3D	H	M	M	L	M	M	L	L	L	L
Thingsboard	Utility energy	H	H	M	M	M	M	M	M	M	M
Site where	Medical	M	M	M	L	L	H	M	L	L	L
Device hive	Transportations, Retail	M	M	H	H	M	H	H	M	M	M
Thing speak	Agriculture	L	M	H	M	M	M	H	H	H	H
KAA	Manufacturing	L	L	M	H	H	H	H	H	H	M
Desirability	Weather Explorers	H	H	L	M	H	M	H	M	H	H

Levels

- L: Low
- M: Medium
- H: High

Scores

Desirable score	Level	Score
H	L	1
H	M	2
H	H	3

Notes: Scores will be given out of 3 for each attribute based on 3 desired levels (Low, Medium and High) of specific requirements for weather explorers IoT application as shown in last row.

Brainstorming suitable IoT platform for weather explorers

		Ease of set up			Ease with integration		Scalability and features			Data Analytics		
IoT	Application / Features	Ease of installation	Support material	Skills required	Level of Interoperability	Flexibility of adaptors	Big data management	Big data storage	Data processing and analytics	Ease of analysis	Custom Dashboarding	Score
Zetta	Free	2	1	2	1	1	1	1	1	1	1	13
DSA	Polyglot	2	2	3	2	3	1	1	1	2	1	18
Chords	Current 3D	3	2	2	1	2	3	1	1	1	1	17
Thingsboard	Utility energy	3	3	2	3	2	3	2	3	2	2	25
Site where	Medical	2	2	2	1	1	2	2	1	1	1	15
Device hive	Transportations, Retail	2	2	1	2	2	2	3	3	2	2	21
Thing speak	Agriculture	1	2	1	3	2	3	3	2	3	3	23
KAA	Manufacturing	1	1	2	2	3	2	3	2	3	2	21
Desirable score	Weather Explorers	H	H	L	M	H	M	H	M	H	H	30

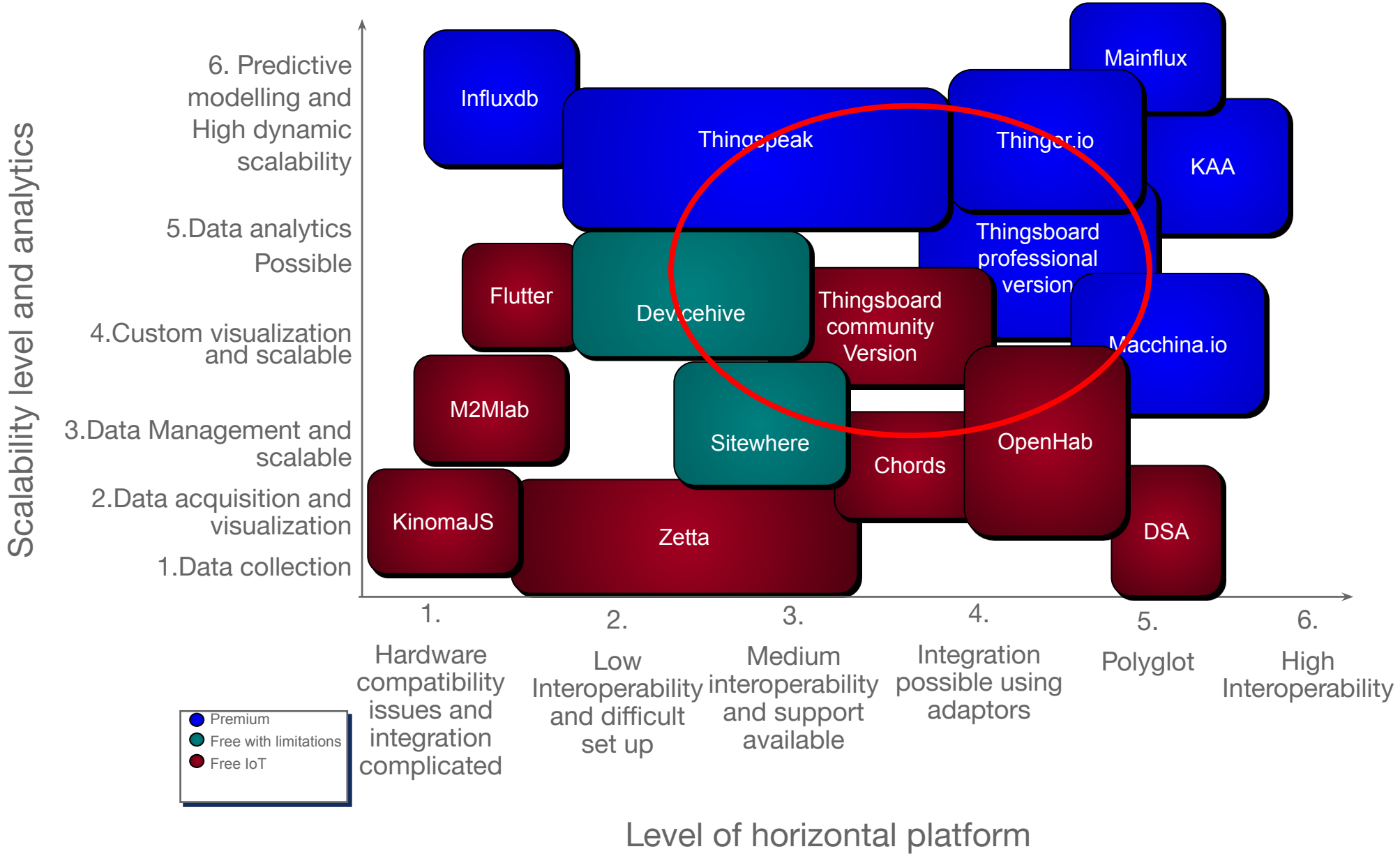
Notes: Scores will be given out of 3 for each attribute based on 3 desired levels (Low, Medium and High) of specific requirements for weather explorers IoT application as shown in last row.

Summary of comparison matrix

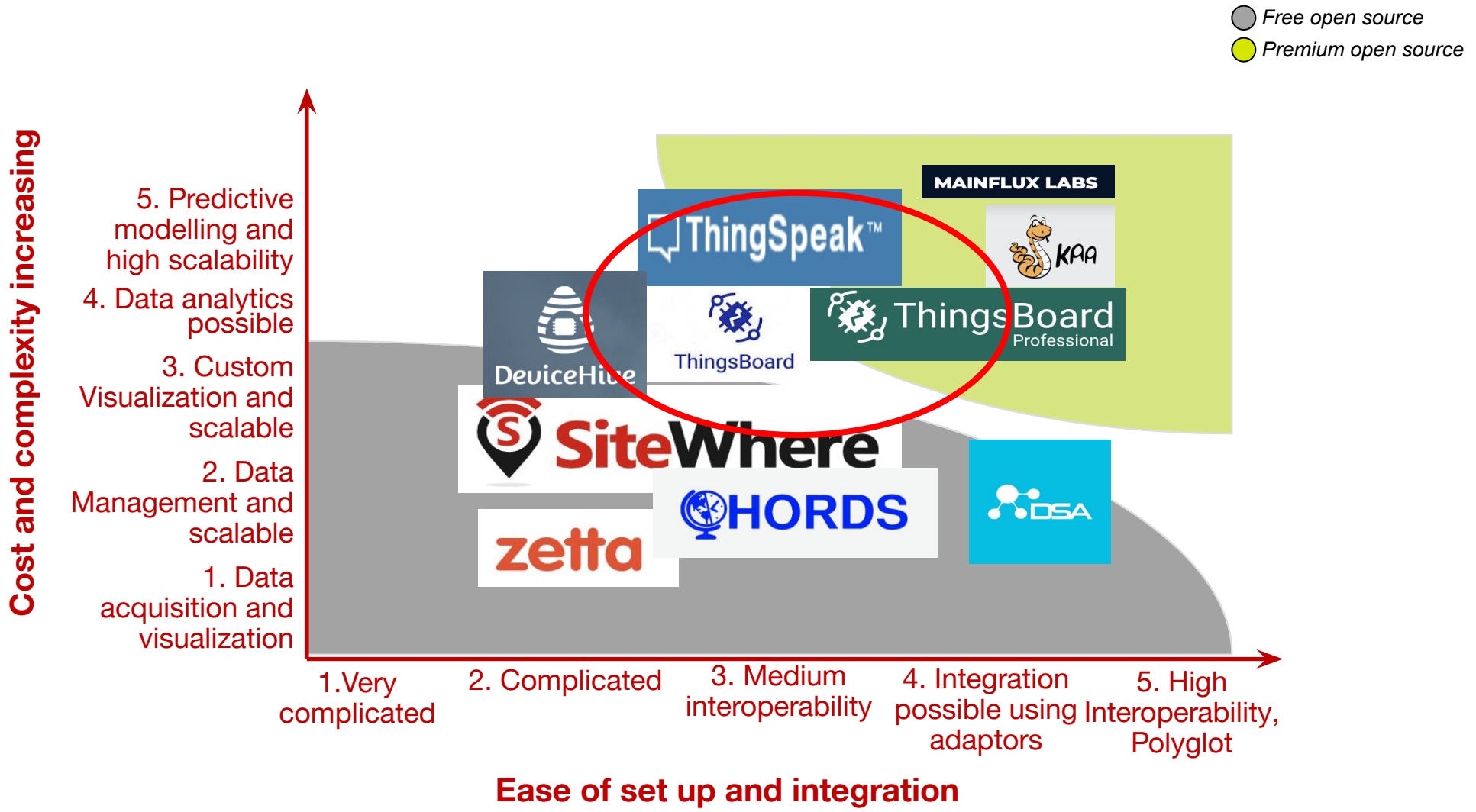
IoT platform	Ease of set up	Ease with Integration	Scalability	Data analytics	Overall score
Zetta	6	2	3	2	13
DSA	7	5	3	3	21
CHORDS	7	3	5	2	17
THINGSBOARD	8	5	8	4	25
SITEWHERE	6	2	5	2	15
DEVICEHIVE	5	4	8	4	21
THINGSPEAK	4	5	8	6	23
KAA	4	5	7	5	21
SCORE	9	6	9	6	30

Requirement	Criteria included
Ease of set up	Ease, cost, skills required
Ease of integration	Level of interoperability, ease of integration
Level of scalability	Big data management, storage and processing
Data analytics	Ease of analysis, custom dashboard

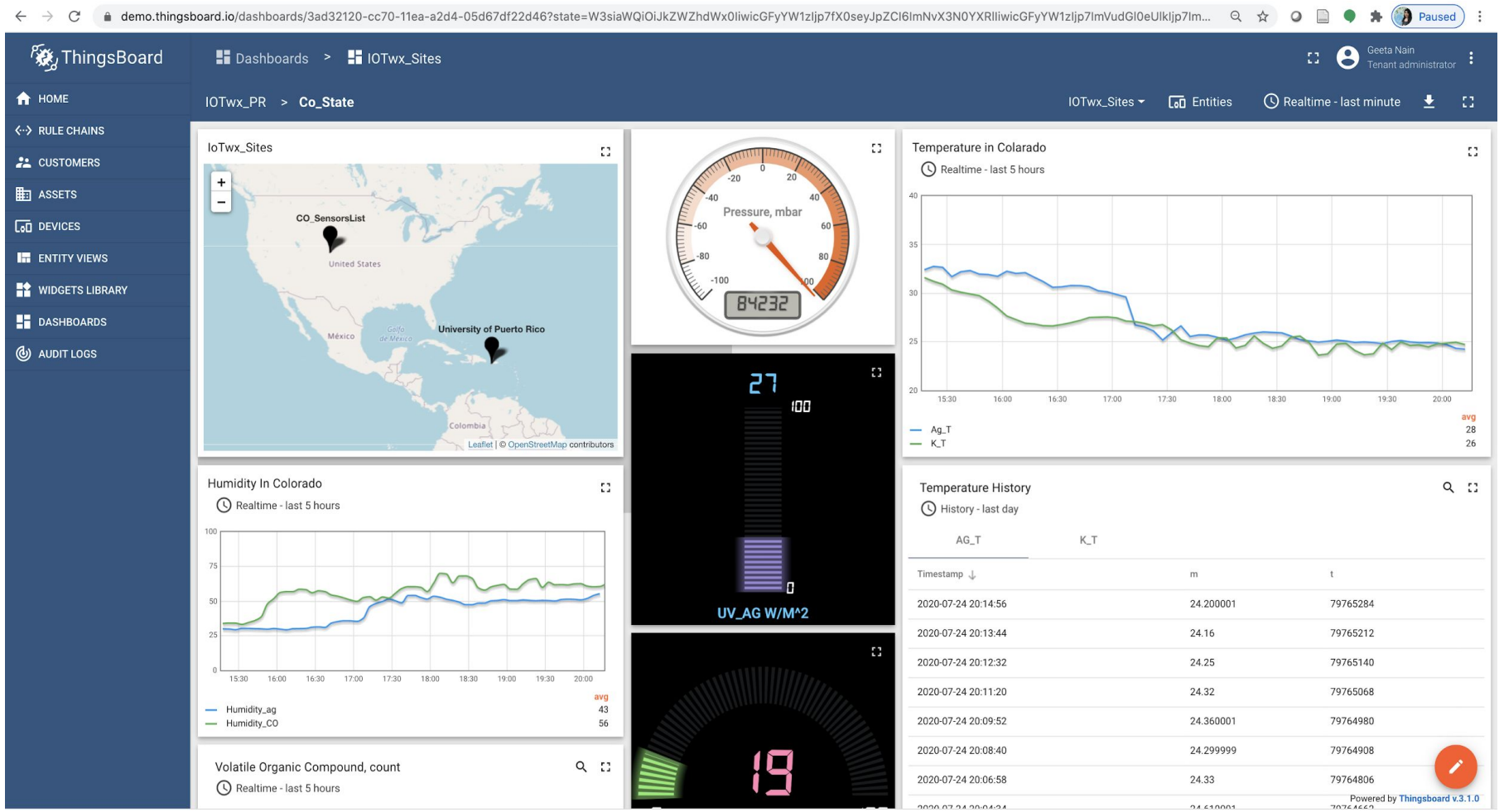
Comparison landscape mapping balancing cost, ease and features



Tradeoff between cost, complication and complexity!



Implementing Thingsboard as IoT framework for prototype 3D IoTwx



Conclusions and Moving forward

- Thingsboard was used for monitoring and visualizing data streams from mesonet in PR based on highest score in comparison matrix and reasonable tradeoff between cost, complexity and complications of integration.
- **Platform will be tested for scalability** after deploying more stations in PR
- **Implementation of LoRaWAN** will be explored to reduce power usage for network communication.
- Adding data logger nodes within mesonet can help to avoiding losing data incase of connectivity issues.
- Diagnostics tools will be integrated within dashboarding.

Acknowledgements

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- My SIParCS mentors for expanding my horizon of knowledge about innovative 3D design of IoTwx, deployment and Internet of Things platforms.
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Thank you

Questions, feedback, suggestions?

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