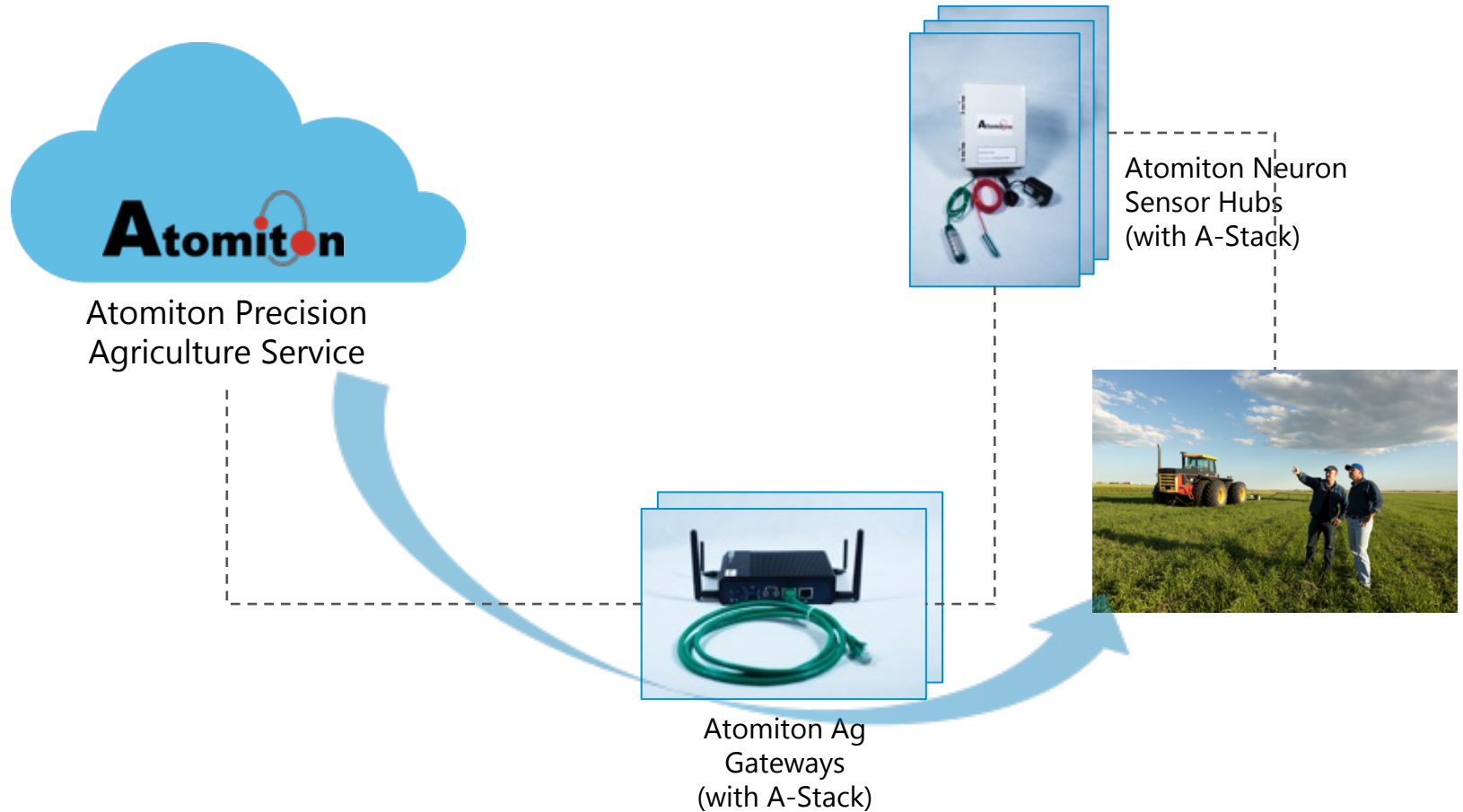# Precision Agriculture Solution Technical Track

Atomiton External

Technical Track Agenda

- ## Technical Track
  - Agri Kit Setup
  - Agri Application Overview
  - Agri Advanced Topics
  - Analysis & Usage
  - Troubleshooting Guide

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Atomiton Precision Agriculture Solution

Atomiton Precision
Agriculture Service

Atomiton Neuron
Sensor Hubs
(with A-Stack)

Atomiton Ag
Gateways
(with A-Stack)

Agri Kit Setup

Agri Kit Components

Atomiton Agri Cloud

Neuron Sensor Hub

Atomiton Gateway

Atomiton LoRa Gateway

← WiFi based Agri Kit →

← LoRa/WiFi based Agri Kit →

Agri Kit BOM

| Component	WiFi-Kit	Lora Kit
Advantech Gateway	1	1
Multitech Gateway	0	1
TQL Sensor Hub	1	1
12V Power supply for Advantech	1	1
9V Power supply for Multitech	0	1
12V Power supply for Sensor Hub	1	1
Ethernet cables	1	2

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Advantech Setup

- The Advantech Gateway consist of the central box, 4 Antennas (2 smaller one's for 3G, 2 for Wi-Fi) and a 12V DC Power supply, assemble it as shown in below image.
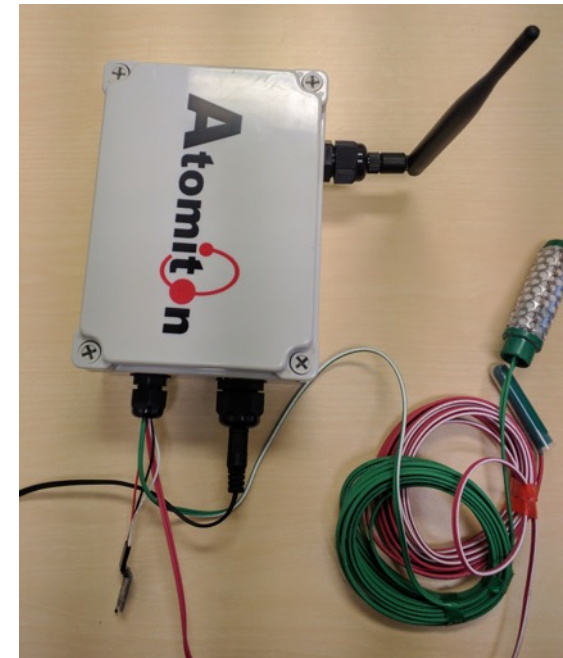
Multitech Setup

- The Multitech conduit consist of the central box, 1 Lora Antenna and a 9V DC Power supply, assemble it as shown in below image. (This step is needed only for Agri Lora Kit)
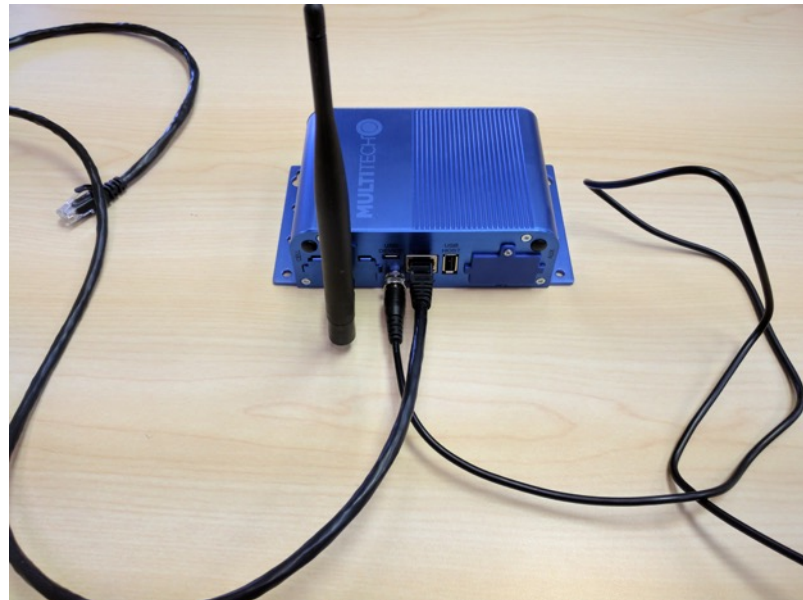
Neuron (Sensor Hub)

- The Neuron consist of the central sensor hub box, 1 Lora Antenna (present only in Lora Sensor Hub) and a 12V DC Power supply as shown in below image.

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Assembly

- Step 1

- Connect the Ethernet cable from your switch or Wi-Fi router to inner Ethernet port of Advantech as shown in image below, don't power on the Advantech yet.

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- Step 2

- Connect the other Ethernet cable from Multitech conduit to outer Ethernet port of Advantech as shown in image below and power on both Advantech Gateway and Multitech conduit.

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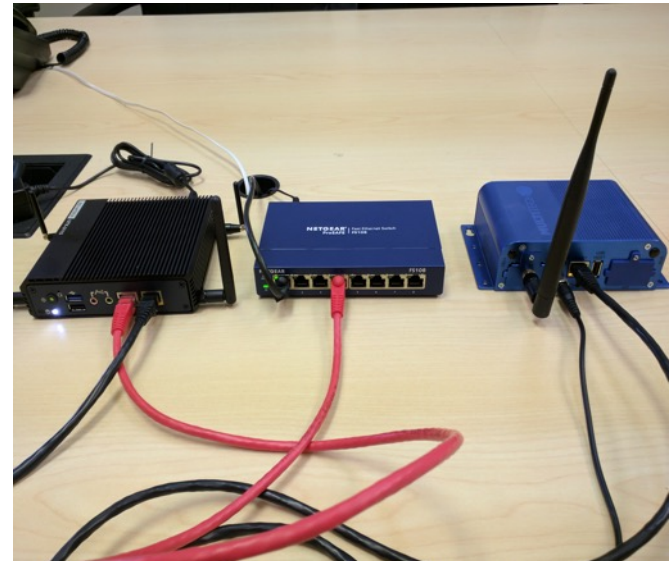
- Step 3

- After powering on Advantech and Multitech conduit wait for two minutes and power on Neuron.

Agri Application Overview

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Agri Concepts

A region defines the top most hierarchy. For example, a region is typically the entire farm.

- A zone defines a subsection of a region. For example, one of many crop fields of a farm may be defined as a zone.
- A sensor hub defines the actual location of a physical sensor hub device. For example, one crop field may have several sensor hubs located in regular intervals from each other in order to broadly capture and correlate data of the overall characteristics being measured and monitors of the crop field.
- A sensor defines the actual sensor connected to a particular sensor hub. For example, a sensor may be a soil moisture sensor, or a leaf wetness sensor connected to the sensor hub.
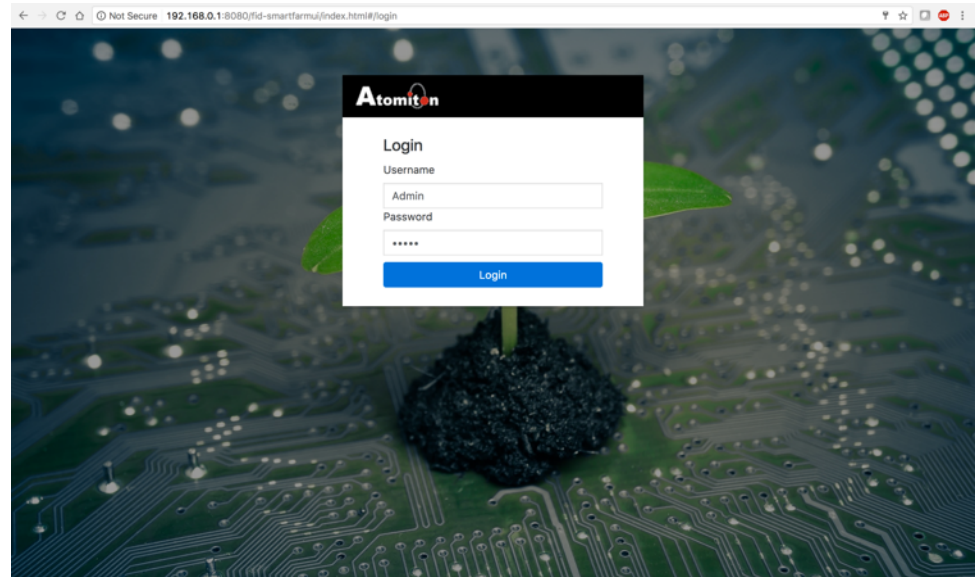
Atomiton
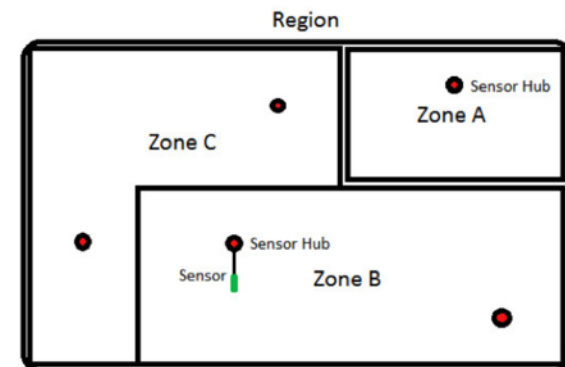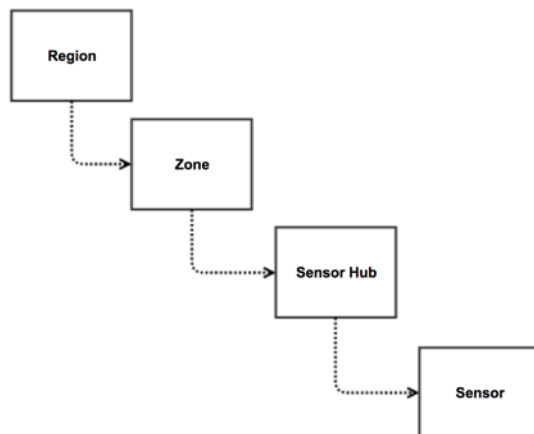
Gateway Configuration Application

- Creation of new regions, zones, sensor hubs, sensor types.

- Addition of new sensors to sensor hubs.

- Graph to view uncalibrated and raw sensor values.

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Gateway Configuration Application Home

▪ The gateway will now be broadcasting its own Wi-Fi network with the SSID of "SmartFarmGateway". Using your own PC, connect to the Wi-Fi network "SmartFarmGateway" on TQL Agri Dev Kit system using the password of "smartfarm".

▪ Using a browser, Google Chrome is recommended, open the webpage using the URL http://192.168.0.1:8080/fid-smartfarmui/index.html. The credentials to login to Gateway UI are Admin/admin.

Gateway Sample Zones

- The Gateway is preconfigured with a sample zones and a sensor hub. These preconfigured zone is to illustrate working of TQL Sensor Hub and TQL Agri Gateway.

Gateway Sensor Hubs and Sensor Data

- Select the Sensor Hub under the Sample Zone or click on the sensor hub on the map, this sensor Hub is already preconfigured with a soil moisture sensor.

- If the Sensor Hub is powered on you should start seeing the soil moisture sensor value and also the graph being updated.
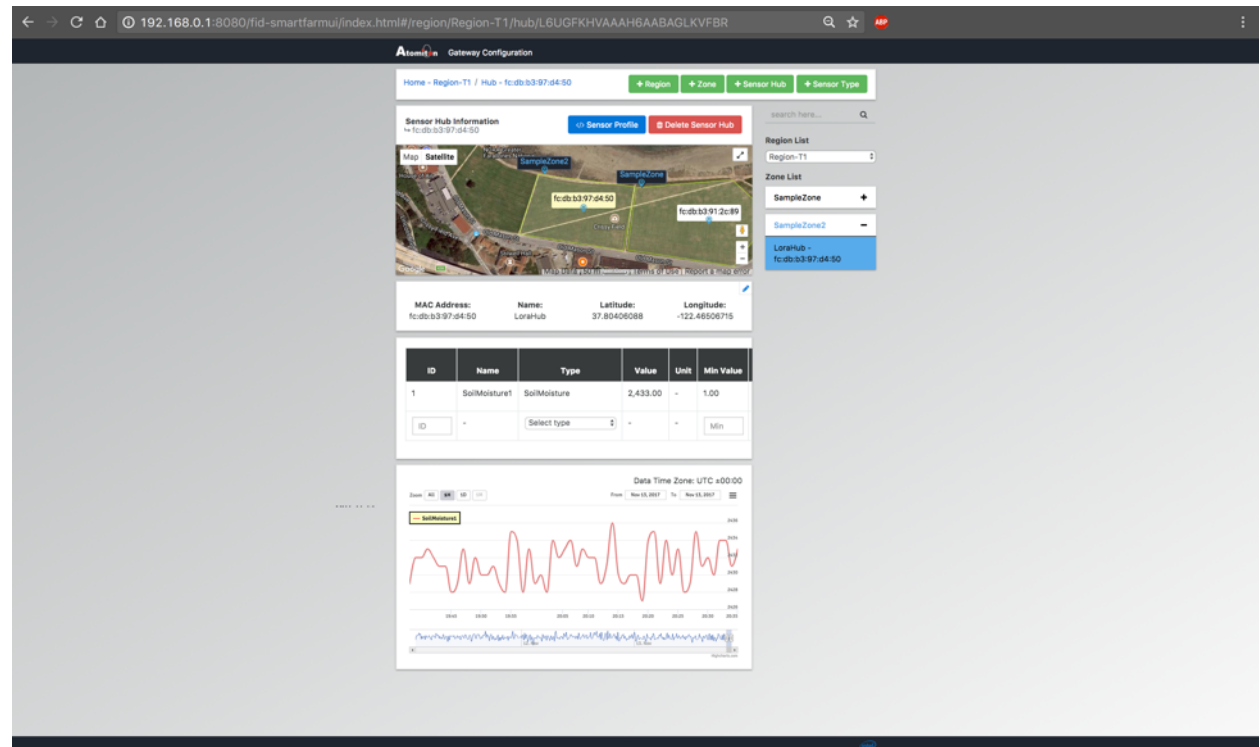
Cloud Agri Application

- Viewing all regions and zones created by multiple gateways.

- Calibrated and aggregated sensor values.

- Deletion of obsolete zones and regions.

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Cloud Agri Application Home

- The calibrated sensor data being captured by the TQL Agri Dev Kit can be viewed in the TQL Cloud Service by opening a webpage to the respective cloud url on your browser, contact Atomiton for your cloud url and login credentials. Select SampleZone in the left navigation bar.
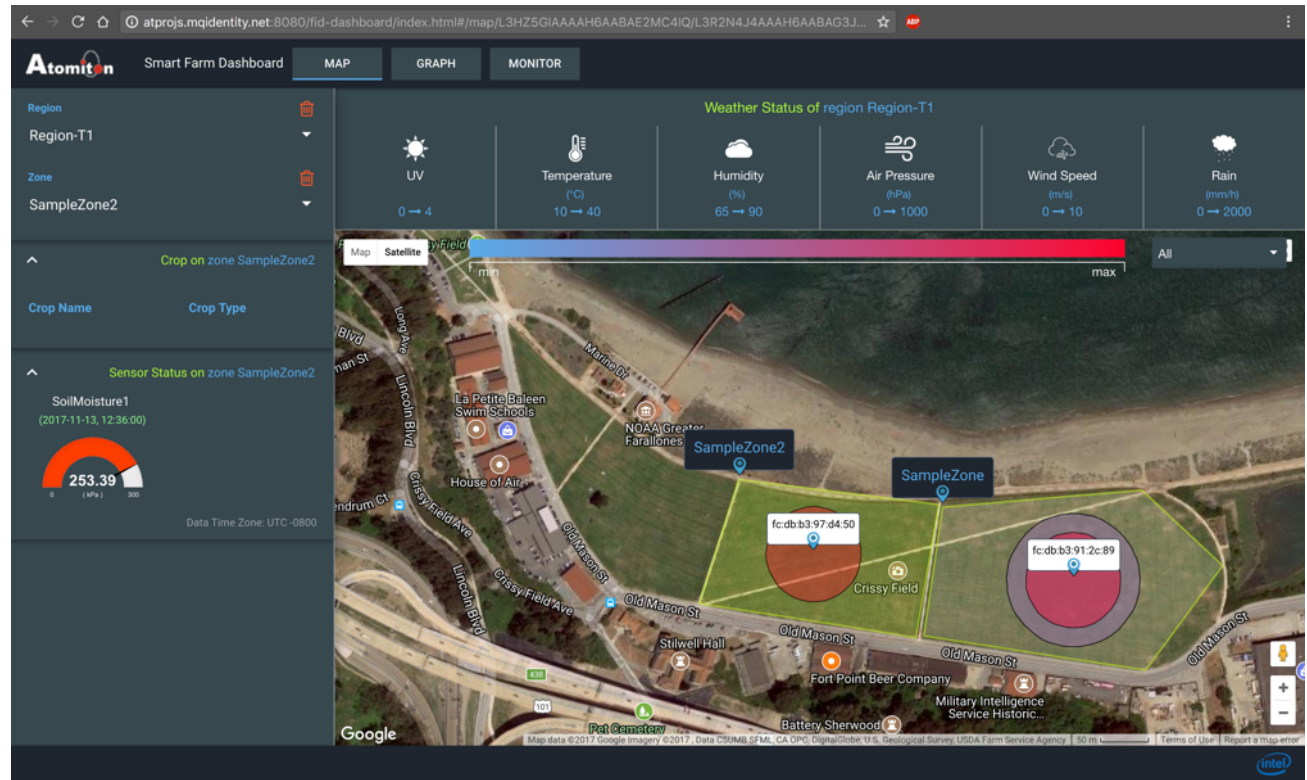
Cloud Graph

▪ You can also view the sensor data graph by clicking on the graph tab it will show calibrated historical value of all configured sensor data.
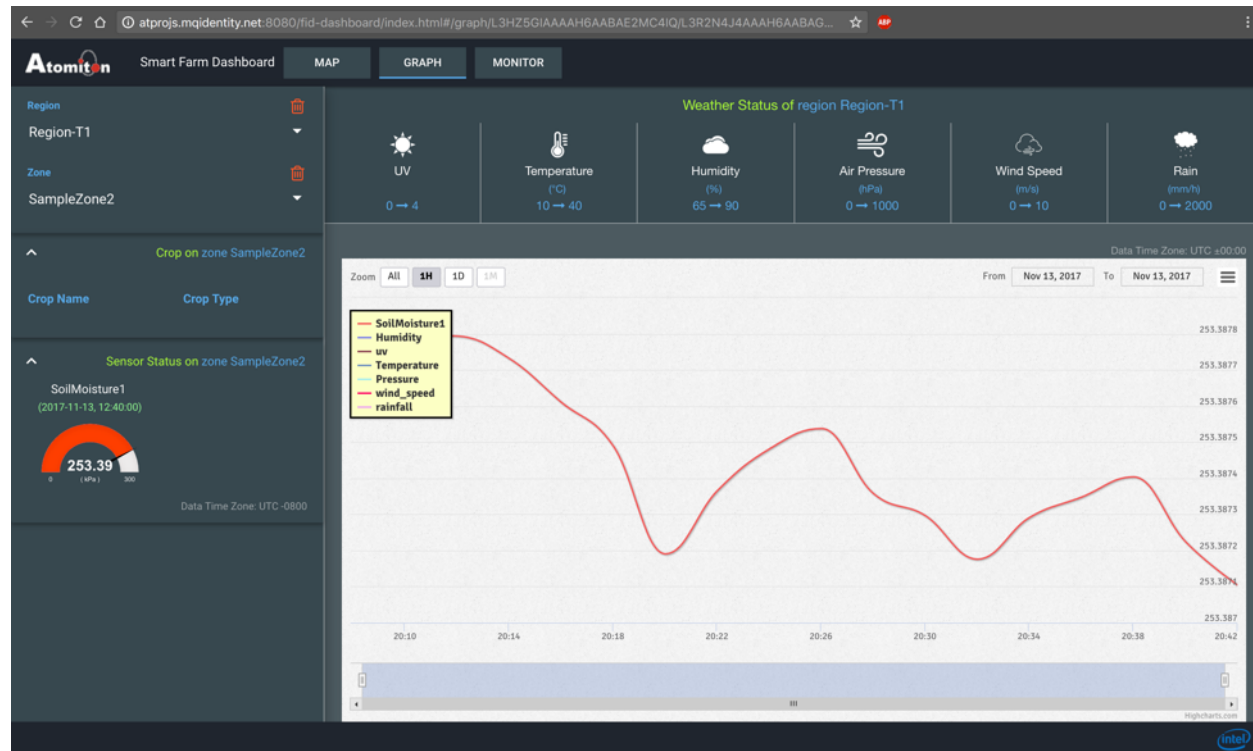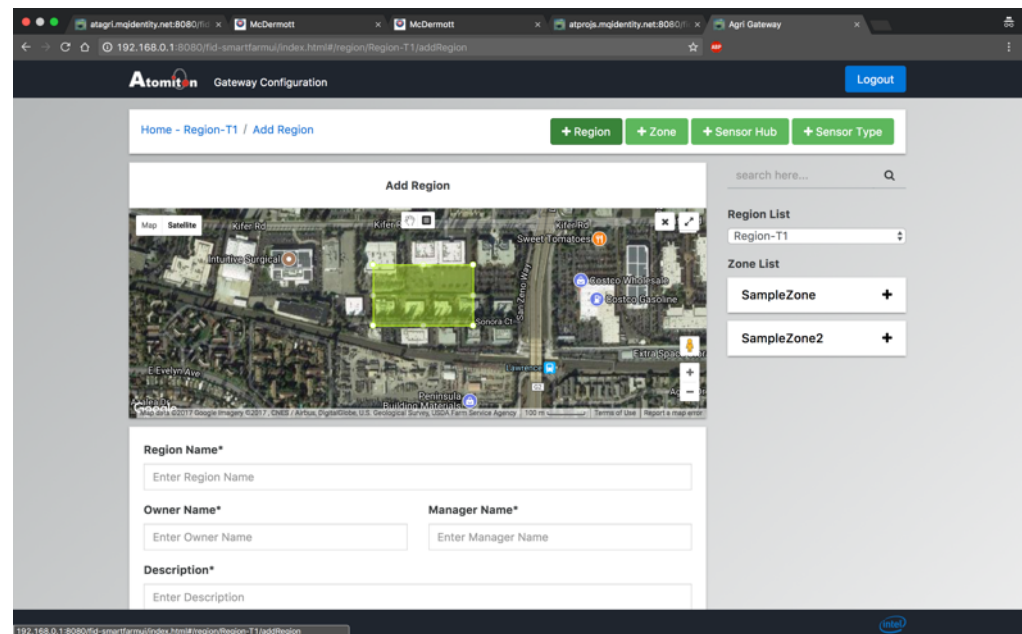
Advanced Topics

Adding a new region

- Once you login to the Gateway, Click on **"+Region"** icon to create a new region.

- Go to the area you are interested in and draw a region there on the map using the drawing tool which is next to the hand icon on the map.

- Enter some region name, owner, manager name and description for your farm and click on "**+Create Region**" icon.

Adding a new Zone

- Once you login to the Gateway, Click on "**+Zone**" icon to create a new zone.

- Go to the area you are interested in and draw a zone there on the map using the drawing tool which is next to the hand icon on the map.

- Enter some name your Zone and click on "**+Create Zone**" button.

- You will see your newly created zone in the zone list which is present in right side of UI.

Adding a new Sensor Hub

- If you have only one sensor hub and planning to use that sensor hub for your zone then you can delete the sensor hub from sample zone by going to SampleZone and select the Sensor Hub and delete it by pressing on **"Delete Sensor Hub"** button.

- Now you can click on **"+ Sensor Hub"** button scroll on the map to go to your zone and then click on add marker icon present on top right side of the map.

- Move the marker so that the sensor hub is within the zone you created, enter the mac address of the sensor hub which you can find on the sensor hub, and enter some name for your sensor hub and click on "**+ Create Hub**" button.

Adding new Sensor

- Click on the sensor hub on the map or select the sensor hub present under the newly created zone in "**ZoneList**".

- Add new soil moisture sensor in the sensor table as shown in images below, enter ID as 1, select type as Soil Moisture sensor, enter min, max and Radius as 10, 300, 50 and click on **"add" icon** next to it. If your sensor hub has additional sensors you can add those sensors in this table.

- If the sensor hub is powered on you should start seeing sensor values on graph in few minutes

- Lastly the newly created regions, zones, sensor hub and calibrated sensor value can also be viewed on Cloud Agri Application.

Links

- Setup Guide - https://atomiton.atlassian.net/wiki/spaces/TQLDocs/pages/44367892/TQL+AGRI+DEV+KIT+SETUP
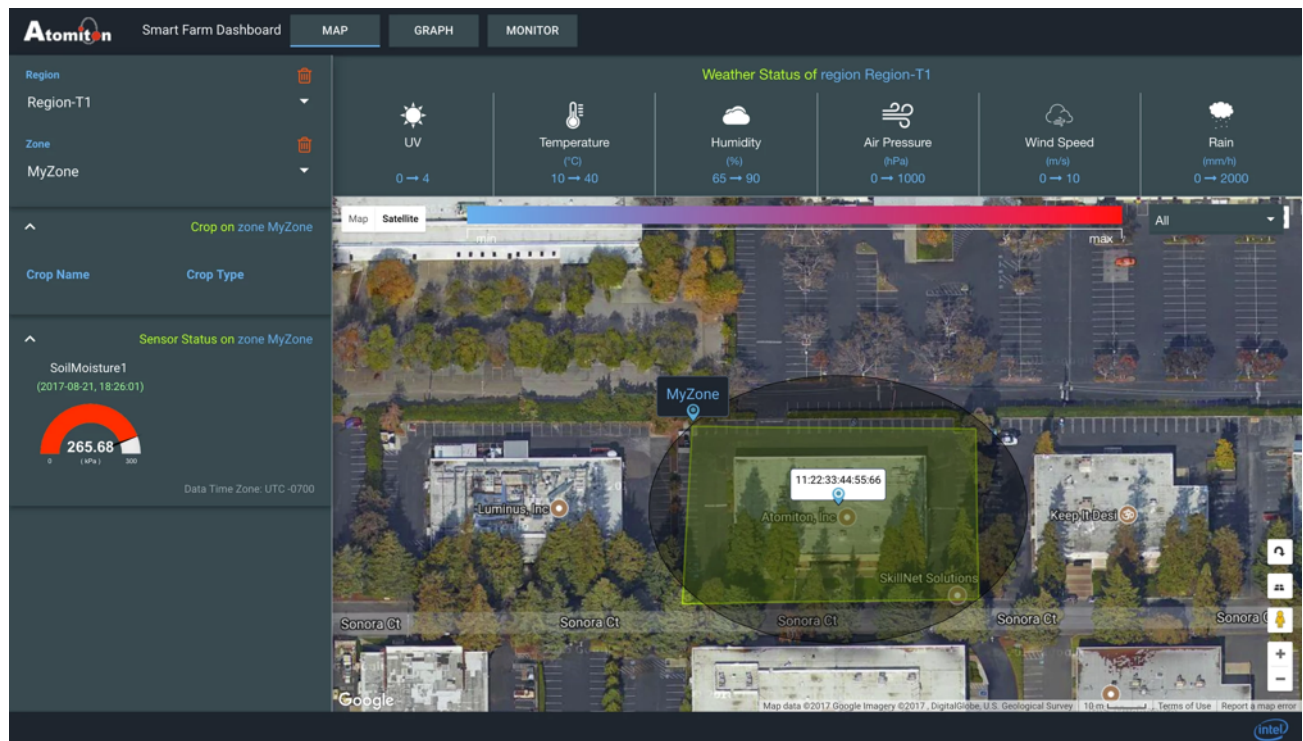
- Adding new regions, zones and sensor hubs- https://atomiton.atlassian.net/wiki/spaces/TQLDocs/pages/64684038/Smart+Farm+Creating+Your+Own+Zones+and+Sensor+Hubs

- Adding new sensors- https://atomiton.atlassian.net/wiki/spaces/TQLDocs/pages/50495538/Adding+Additional+Sensors+to+TQL+Sensor+Hub

Analysis and Usage

Models

- A model is a **definition** of a container, which represents the functionality or knowledge about some kind of entity. At run time, a model can be instantiated into model instances.

- In Smart Farm Project we have various models like
  - Region
  - Zones
  - Polygon
  - MCUModel (Sensor Hubs)
  - SensorModel
  - SensorHistoryModel
  - ZoneAggInfoHistoryModel ..,etc.

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Queries

- In TQL, a query is any operations on the model instance data (or model data), which includes filtering, joining, and manipulations. Model instances are incarnations of the Models (or model definitions) through instantiation.

- The A-Stack stores the latest version of the model instance data, which is accessible to TQL Queries.

- TQL queries have the following standard structures:
  - FIND
  - CREATE
  - SAVE
  - UPDATE
  - DELETE
  - DELETEALL

- **Query end points** the listeners within A-Stack which is ready to take any TQL Query requests (CRUD Queries) and send the response back to the user.

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A-Stack Console and Queries

- Connect to **SmartFarmGateway** Wi-Fi network and go to the URL http://192.168.0.1:8080/fid-smartfarmui/index.html

- Login to A-Stack Web console using credentials User Name=TQLEngine@atomiton.com password=tql123
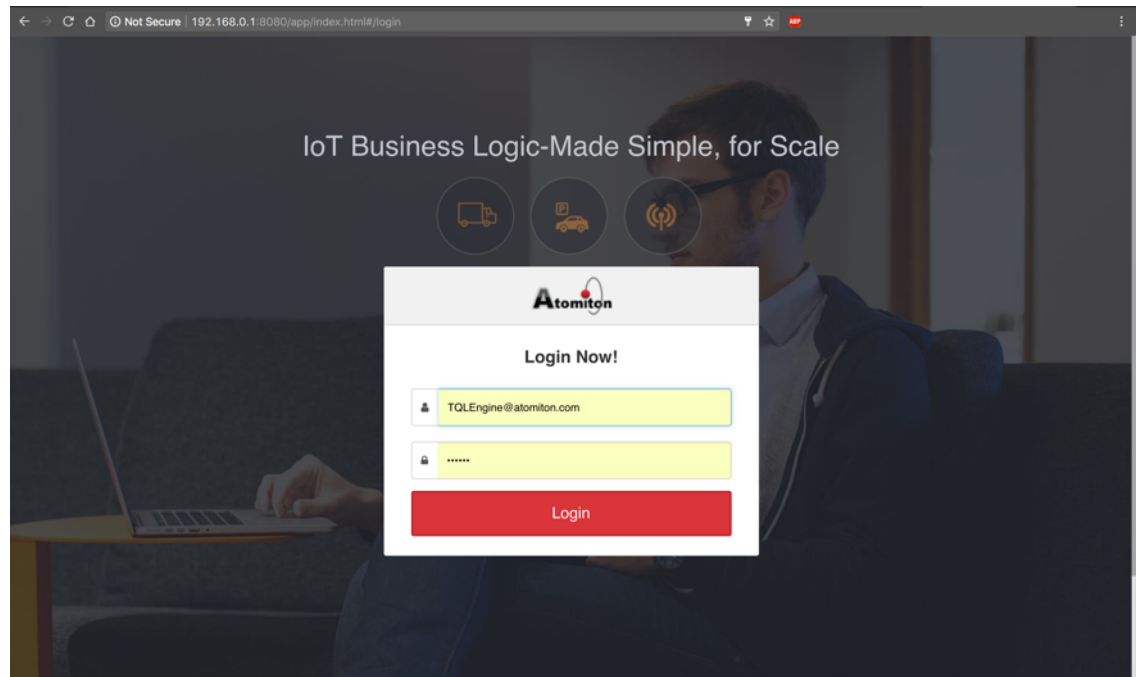
- After Logging into the console you will see two or more projects, Select **SmartFarm** Project among them.
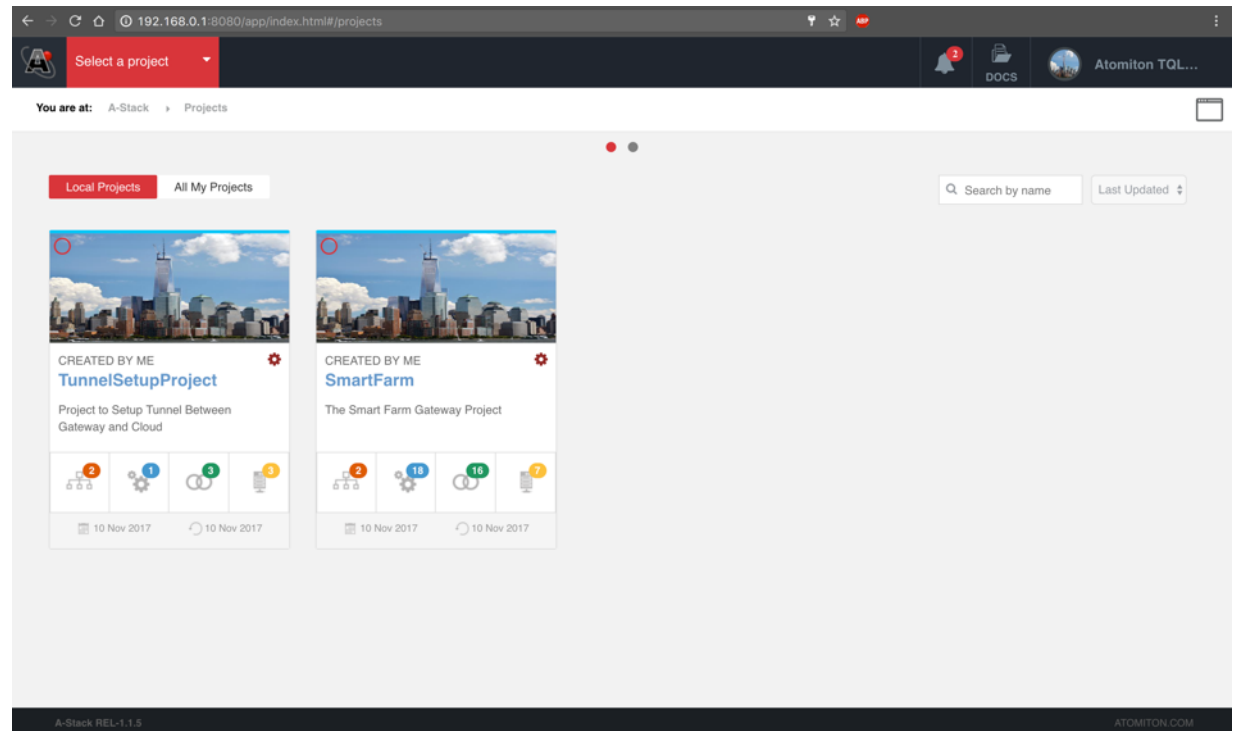
- You will find three sections or tabs on the top, for every project.

- **Models Tab** - Contains various models, facets, macros and other details, this is source code of the project.

- **Thing Spaces Tab –** Once you had made some changes to the source code or project settings, you can un deploy and redeploy a project here.

- **Queries Tab –** This tab will have some queries related to this project.
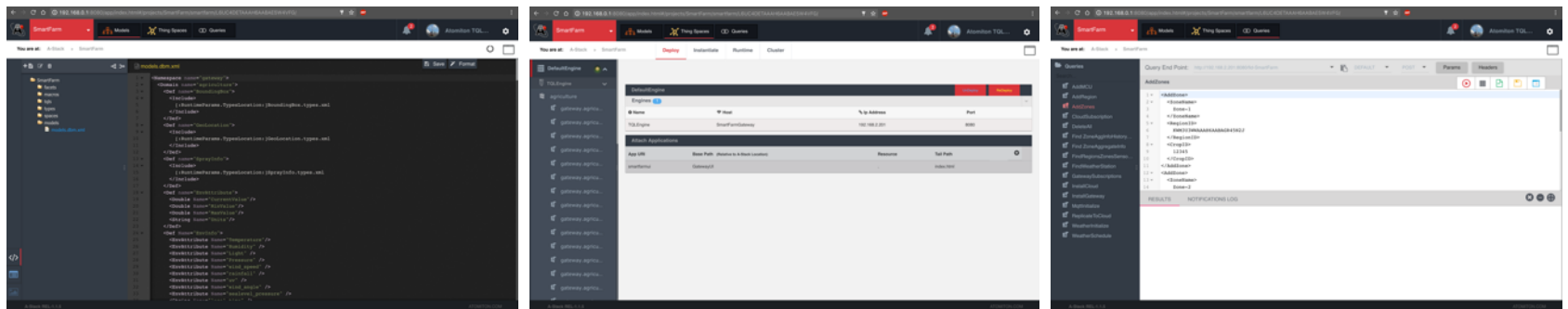
Find Regions Query

Query	Response

`<Query>`
 `<Find>`
   `<Region>`
  `<RegionID ne="" />`
  `</Region>`
 `</Find>`
`</Query>`
	`<Find Status="Success">`
	  `<Result>`
	    `<Region>`
	     `<RegionID>L64GNV54AAAH6AABAFIOLTTO</RegionID>`
	     `<RegionEnvData>`
	      `<Pressure>`
	       `<MaxValue>1000.0</MaxValue>`
	       `<CurrentValue/>`
	       `<MinValue>0.0</MinValue>`
	       `<Units>hPa</Units>`
	      `</Pressure>`
	      `<Humidity>`
	       `<MinValue>65.0</MinValue>`
	       `<MaxValue>90.0</MaxValue>`
	       `<Units>%</Units>`
	       `<CurrentValue/>`
	      `</Humidity>`
	      `<wind_speed>`
	       `<MinValue>0.0</MinValue>`
	       `<CurrentValue/>`
	       `<MaxValue>10.0</MaxValue>`
	       `<Units>m/s</Units>`
	      `</wind_speed>`
	      `<Light>`
	       `<MinValue>0.0</MinValue>`
	       `<MaxValue>0.0</MaxValue>`
	       `<CurrentValue/>`
	       `<Units/>`
	      `</Light>`
	      `<uv>`
	       `<Units/>`
	       `<MaxValue>4.0</MaxValue>`

Find SensorHistoryModel Query

Query	Response
| ```
<Query>
    <Find>
        <SensorHistoryModel>
            <Name>SoilMoisture1</Name>
            <RecordDate  lt="2017-11-16T24:00:00Z"/>
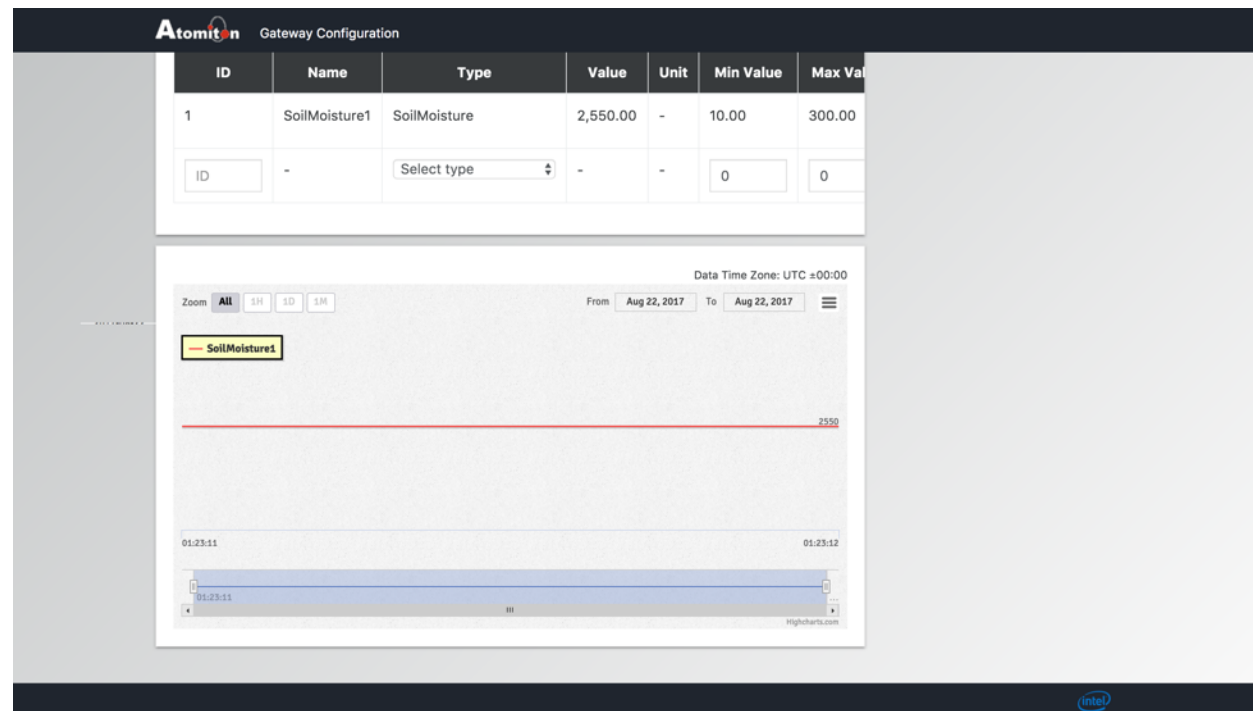            <RecordDate  gt="2017-11-16T00:00:00Z"/>
        </SensorHistoryModel>
    </Find>
</Query>
``` | ```
<Find Status="Success">
    <Result>
      <SensorHistoryModel>
        <ID>L7B22ZOJAAAH6AABAGWYMUPJ</ID>
        <SensorType>SOIL</SensorType>
        <Name>SoilMoisture1</Name>
        <RecordDate>2017-11-16T07:14:01Z</RecordDate>
        <MCUName>fc:db:b3:97:d4:50</MCUName>
        <SensorValue>2431</SensorValue>
      </SensorHistoryModel>
    </Result>
    <Result>
      <SensorHistoryModel>
        <ID>L7CPIPXTAAAH6AABAECIWRI3</ID>
        <RecordDate>2017-11-16T13:11:02Z</RecordDate>
        <MCUName>fc:db:b3:97:d4:50</MCUName>
        <SensorValue>2434</SensorValue>
        <SensorType>SOIL</SensorType>
        <Name>SoilMoisture1</Name>
      </SensorHistoryModel>
    </Result>
</Find>
``` |

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Find ZoneAggInfoHistoryModel Query

| Query	Response
``` <Query> <Find> <ZoneAggInfoHistoryModel> <ID ne=""/> <RecordDate gt="2017-11-16T00:00:00Z" /> <RecordDate lt="2017-11-16T24:00:00Z" /> </ZoneAggInfoHistoryModel> </Find> </Query> ```	``` <Find Status="Success"> <Result> <ZoneAggInfoHistoryModel> <ID>L6UEUR4AAAAH6AABAE4366HQ</ID> <ZoneName>SampleZone</ZoneName> <AvgValue>18.0000000000</AvgValue> <SensorName>AirTemperature2</SensorName> <SensorType>TCB</SensorType> <RecordDate>2017-11-16T23:36:00Z</RecordDate> <Unit>C</Unit> </ZoneAggInfoHistoryModel> </Result> <Result> <ZoneAggInfoHistoryModel> <ID>L6UEYGV6AAAH6AABAE7FAAVN</ID> <SensorType>TCB</SensorType> <RecordDate>2017-11-16T23:38:00Z</RecordDate> <Unit>C</Unit> <ZoneName>SampleZone</ZoneName> <SensorName>AirTemperature2</SensorName> <AvgValue>18.0000000000</AvgValue> </ZoneAggInfoHistoryModel> </Result> <Result> <ZoneAggInfoHistoryModel> <ID>L6UEYGQSAAAH6AABAFSUOFJX</ID> <AvgValue>2450.0000000000</AvgValue> ```

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Web Socket Subscription

- A subscription allows the requester (either you, your app, or a TQL component, such as a TQL model instance) to receive messages on any change of a "topic".

- A "topic" can be any model, any model instance, or any attribute of a model or model instance.

- We can use web socket protocol to subscribe to models like SensorHistoryModel, whenever there is a creation of update of sensorHistoryModel instance we will get a notification.

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SensorHistoryModel Subscription

Subscription request	Notification
```<Query Storage='TqlSubscription'> <Save> <TqlSubscription Label='SensorHistoryModel' sid='20'> <Topic> gateway.agriculture.SensorHistoryModel. * </Topic> </TqlSubscription> </Save> </Query>```	```<TqlNotification> <Create> <L7DQFLFIAAAH6AABAGGQEHAM> <gateway.agriculture.SensorHistoryModel.SensorType Value="TCB" Version="1" Timestamp="1510872362152"/> <gateway.agriculture.SensorHistoryModel.SensorValue Value="24.0" Version="1" Timestamp="1510872362152"/> <gateway.agriculture.SensorHistoryModel.MCUName Value="fc:db:b3:97:d4:50" Version="1" Timestamp="1510872362152"/> <gateway.agriculture.SensorHistoryModel.RecordDate Value="2017-11-16T22:46:02Z" Version="1" Timestamp="1510872362156"/> <gateway.agriculture.SensorHistoryModel.Name Value="AirTemperature2" Version="1" Timestamp="1510872362156"/> </L7DQFLFIAAAH6AABAGGQEHAM> </Create> </TqlNotification>```

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Policies

- A *Policy* is a combination of a *Trigger* and an *Action.*

- Trigger is a mechanism to specify **conditions** when given action needs to be **executed**. You can think about triggers as [complex] Boolean expressions over various *events* and *constraints.*

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CreatePolicy

Policy

```xml
<Query>
    <DeleteAll nested="*">
        <TqlPolicy>
            <PolicyId ne=""/>
        </TqlPolicy>
    </DeleteAll>
    <Save nested="*">
        <TqlPolicy>
            <PolicyId>
                1234
            </PolicyId>
            <Trigger>
                <gateway.agriculture.SensorHistoryModel>
                    <SensorValue value="$Created()" gt='3000'/>
                    <SensorType value="$Created()" eq='SOIL'/>
                    <MCUName value="$Created()" eq='12345'/>
                </gateway.agriculture.SensorHistoryModel>
            </Trigger>
            <Action>
                <Log Message="====== Warning Soil Moisture Sensor Value is greater than 3000 =====" Level="Info"/>
            </Action>
        </TqlPolicy>
    </Save>
</Query>
```

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Activate Policy

Policy

`<ReactivateTriggers>`
 `<Find>`
  `<TqlPolicyTrigger not.TriggerId=""/>`
 `</Find>`
`</ReactivateTriggers>`

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Troubleshooting Guide

- The Edison in the sensor hub has issues in reconnecting to the Wi-Fi when you reboot the Gateway, hence restart the Edison when you reboot the Gateway.

- Make sure Wi-Fi and Lora Senor Hub are within the respective ranges of the Advantech and Multitech Gateway.

- If you are able to see sensor data on Gateway UI but not on Cloud UI, check the Ethernet Connection of Advantech and also make sure there isn't any firewall or proxy issues.

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Links

- Smart Farm Queries - https://atomiton.atlassian.net/wiki/spaces/TQLDocs/pages/61379234/Smart+Farm+Queries

- TQL Docs –

- https://atomiton.atlassian.net/wiki/spaces/TQLDocs/pages/55672846/The+Atomiton+Stack

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Thank You.