



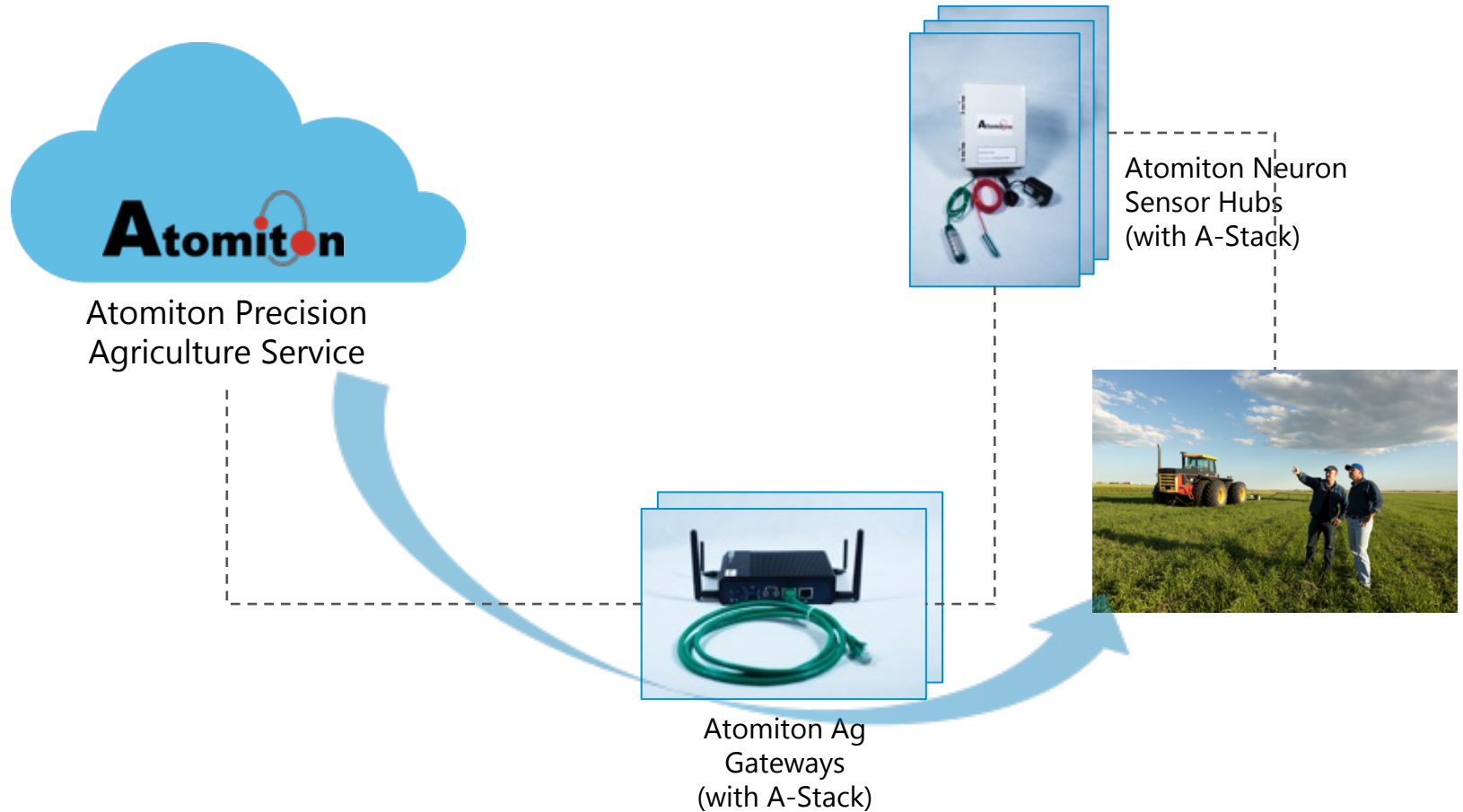
Precision Agriculture Solution Technical Track

Atomiton External

Technical Track Agenda

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

Atomiton Precision Agriculture Solution



A young green seedling with two leaves growing out of dark soil, with rain falling around it.

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

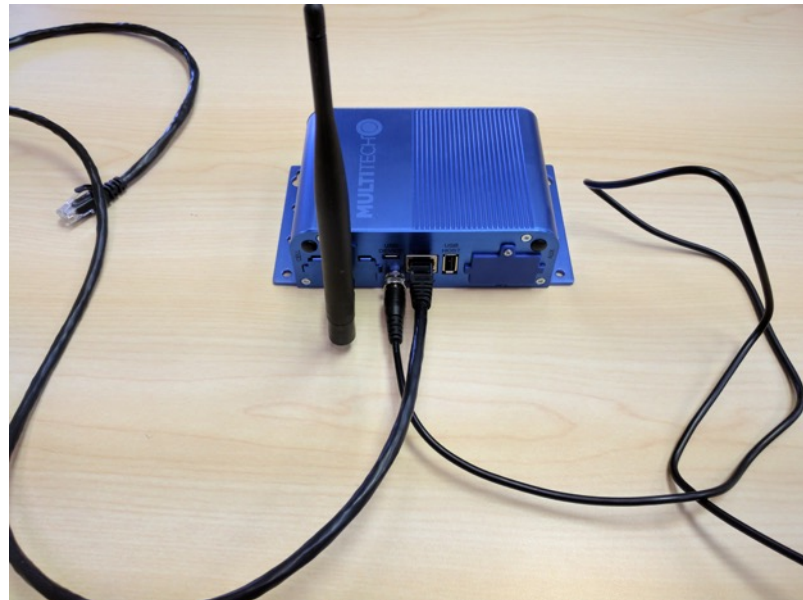
Advantech Setup

- 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.



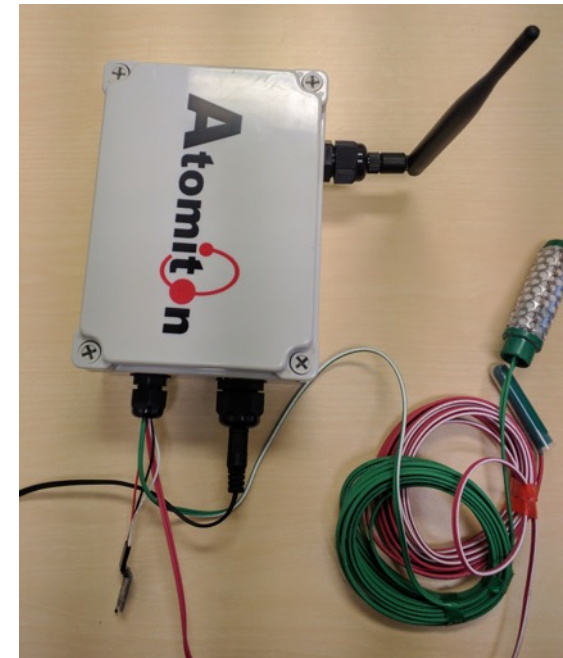
Multitech Setup

- 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.

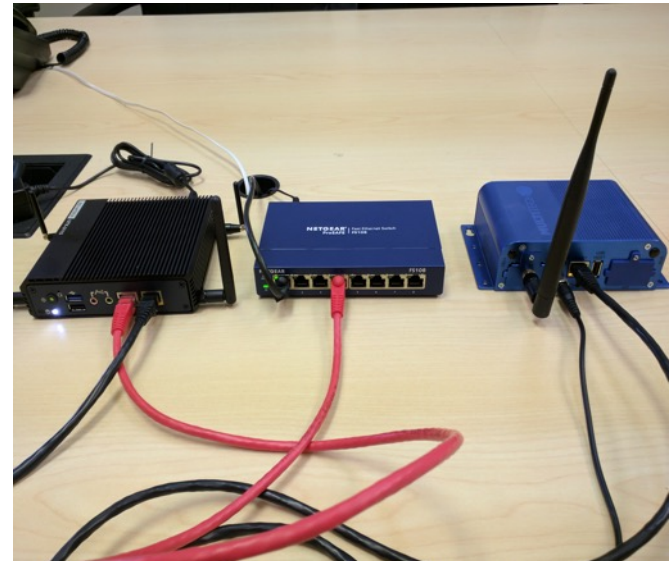


Assembly

- 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.



-
- 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.



-
- Step 3
 - After powering on Advantech and Multitech conduit wait for two minutes and power on Neuron.



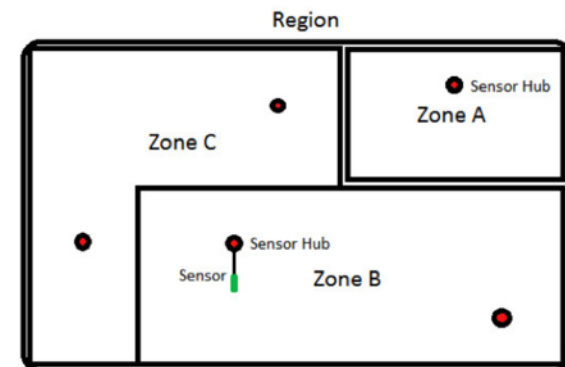
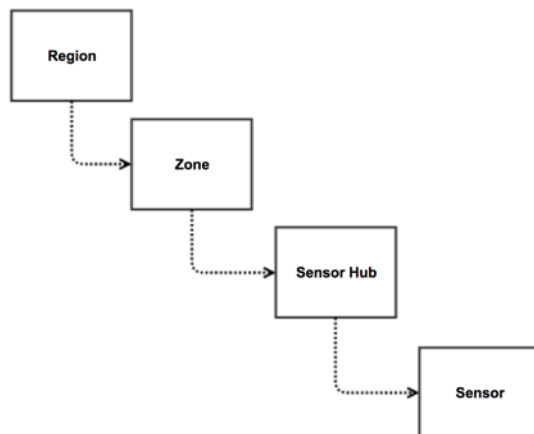


Agri Application Overview

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.

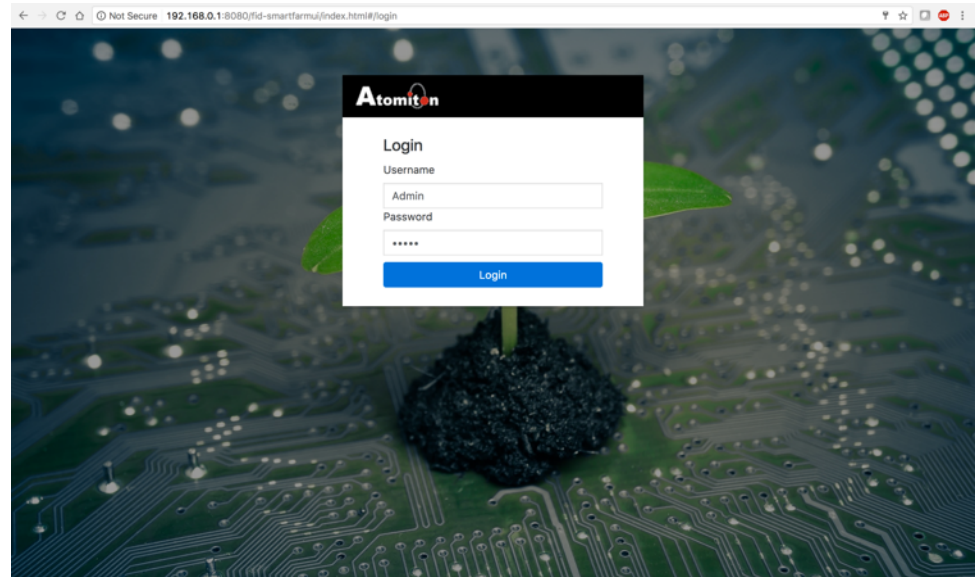


Gateway Configuration Application

- Creation of new regions, zones, sensor hubs, sensor types.
- Addition of new sensors to sensor hubs.
- Graph to view uncalibrated and raw sensor values.

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.

The screenshot displays the Atomiton Gateway Configuration web interface. The browser address bar shows the URL: 192.168.0.1:8080/fid-smartfarmui/index.html#/region/Region-T1. The page title is "Atomiton Gateway Configuration".

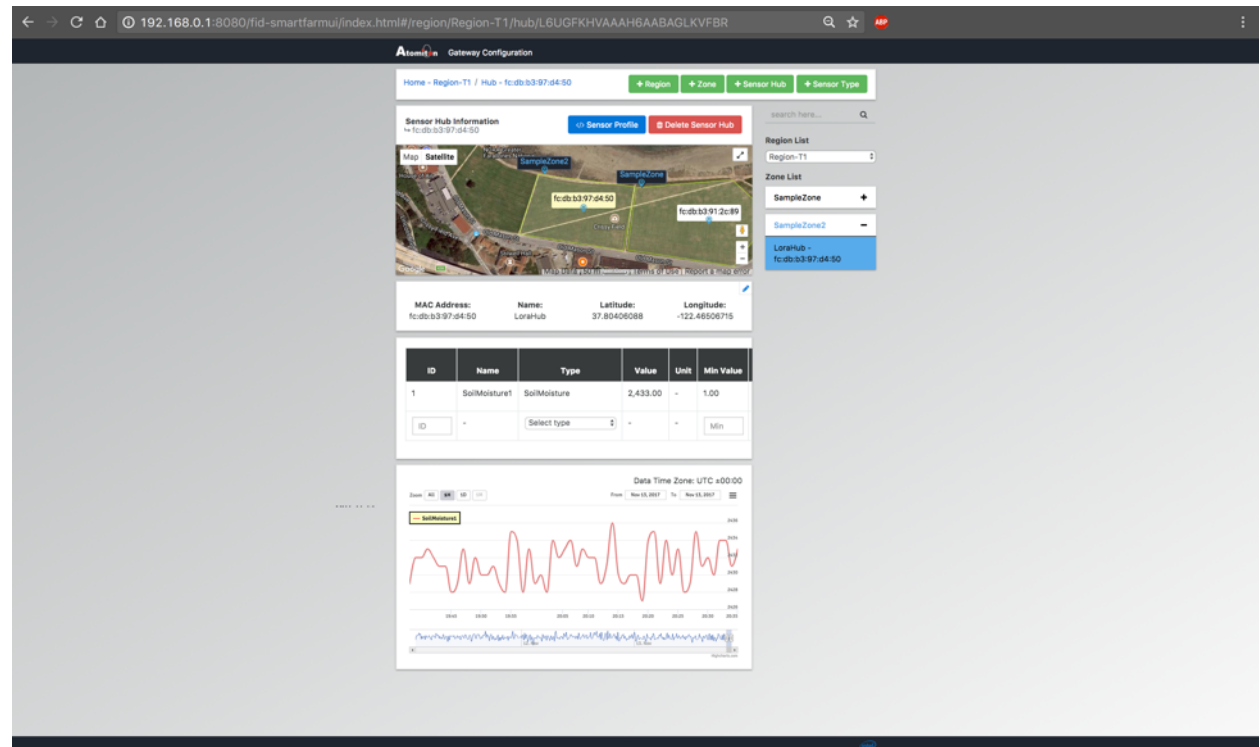
At the top, there are navigation buttons: "+ Region", "+ Zone", "+ Sensor Hub", and "+ Sensor Type". Below this, the "Region Information" section shows "Region-T1" with a "Delete Region" button. A map view shows a green field divided into two zones: "SampleZone" and "SampleZone2". Two sensor hubs are marked with blue pins and labels: "fc:db:b3:97:d4:50" and "fc:db:b3:91:2c:89". The map includes street names like "Old Mason St" and "Stiwell Hall", and landmarks like "Crissy Field" and "Fort Point Beer Company".

On the right side, there is a search bar and two lists: "Region List" (showing "Region-T1") and "Zone List" (showing "SampleZone" and "SampleZone2").

Below the map, the "Region Name" is "Region-T1". The "Manager Name" is "Atomiton" and the "Owner Name" is "Atomiton". The "Description" is "Sample Region for Smart Farm".

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.

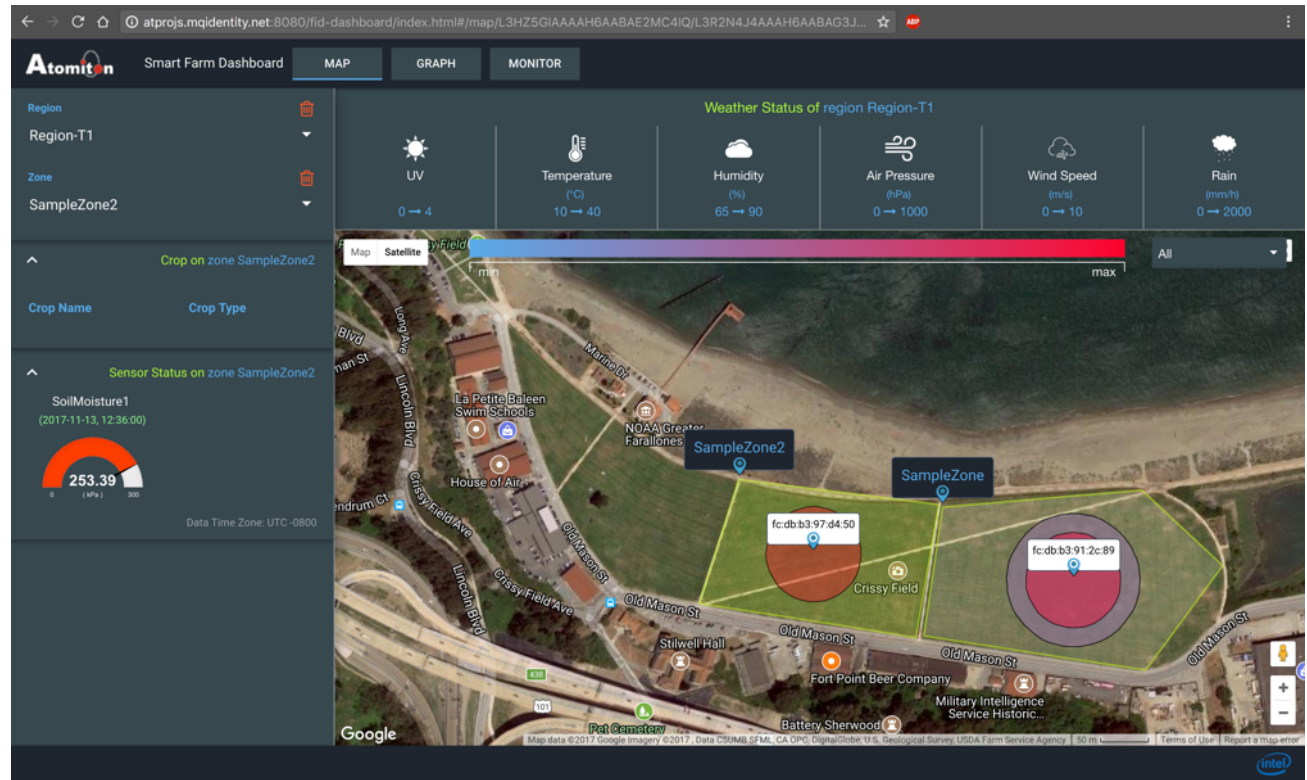


Cloud Agri Application

- Viewing all regions and zones created by multiple gateways.
- Calibrated and aggregated sensor values.
- Deletion of obsolete zones and regions.

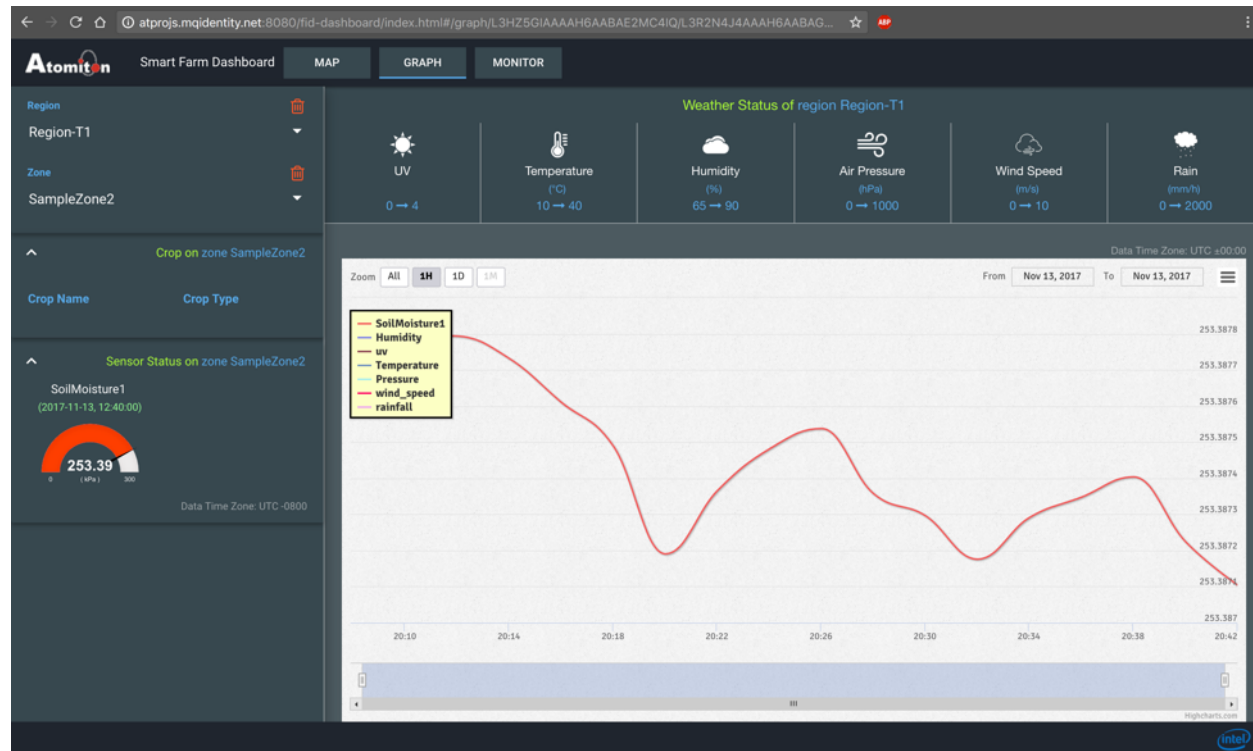
Cloud Agri Application Home

- 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.

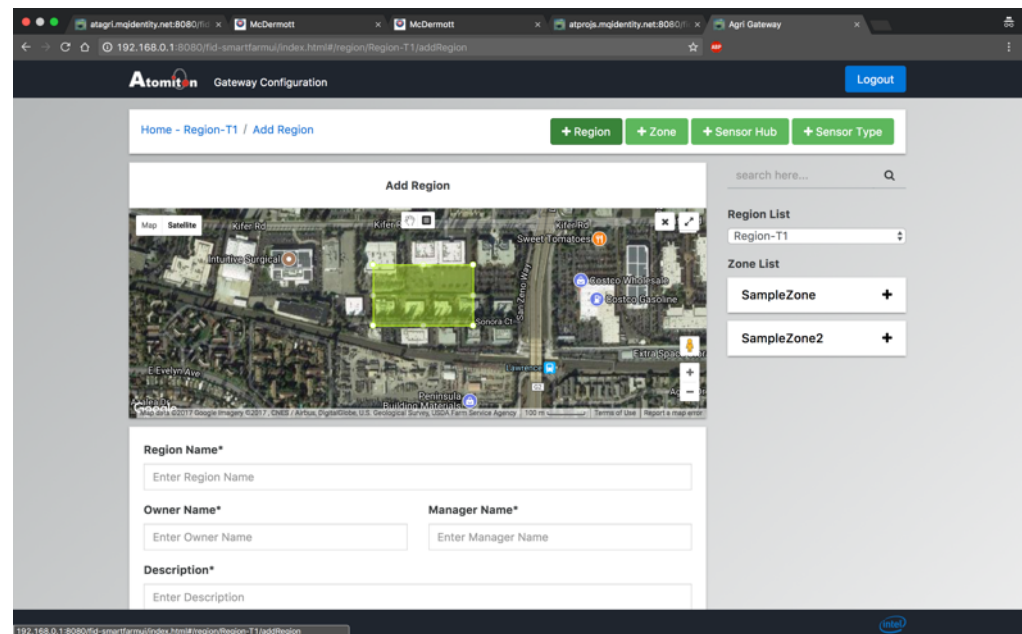




Advanced Topics

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.

The screenshot shows the Atomiton Gateway Configuration web application. The browser address bar displays the URL: 192.168.0.1:8080/fid-smartfarmui/index.html#/region/Region-T1/addRegion. The page header includes the Atomiton logo and the text "Gateway Configuration". A "Logout" button is located in the top right corner. The main content area features a Google Map of a residential area with a green polygon overlaid on it. Below the map is a form for creating a new region. The form contains the following fields:

- Region Name***: A text input field containing "AtomitonRegion".
- Owner Name***: A text input field containing "Atomiton".
- Manager Name***: A text input field containing "Atomiton".
- Description***: A text area containing "My Apple Farm".
- Bounds**: A table with two rows and three columns. The columns are "Latitude" and "Longitude". The rows are "South-West" and "North-East".

	Latitude	Longitude
South-West	37.37143527413386	-122.00139820575714
North-East	37.3729184105817	-121.99831902980804

A green "+ Create Region" button is located at the bottom right of the form. The Intel logo is visible in the bottom right corner of the page.

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.





The screenshot displays the Atomiton Gateway Configuration web interface. At the top, the navigation bar includes the Atomiton logo and the text 'Gateway Configuration'. Below this, a breadcrumb trail shows 'Home - Region-T1 / Add Zone'. A secondary navigation bar contains four green buttons: '+ Region', '+ Zone', '+ Sensor Hub', and '+ Sensor Type'. The main content area is titled 'Add Zone' and features a Google Maps interface. A green polygon is drawn on the map, covering an area with buildings and trees. The map includes labels for 'Luminus, Inc.', 'Atomiton, Inc.', 'SkillNet Solutions', and 'Keep It Best'. The location is identified as 'Sonora Ct'. To the right of the map is a search bar and two dropdown menus: 'Region List' (set to 'Region-T1') and 'Zone List' (showing 'SampleZone' with a plus sign). Below the map, there is a 'Name*' field with the placeholder text 'Enter Zone Name'. Underneath is a 'Polygon Details' section containing a table with the following data:

Order	Latitude	Longitude	Action
1	37.37216780250769	-122.00053989887238	

At the bottom right of the interface, there is an Intel logo.

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

The screenshot displays the Atomiton Gateway Configuration web interface. The top navigation bar includes the Atomiton logo and the text 'Gateway Configuration'. Below this, there are navigation links: 'Home - Region-T1 / Zone - MyZone' and buttons for '+ Region', '+ Zone', '+ Sensor Hub', and '+ Sensor Type'. The main content area is divided into two sections. On the left, the 'Zone Information' section shows a map with a green polygon labeled 'MyZone' overlaid on a satellite view of a city street. Below the map, there are fields for 'Name: MyZone', 'Area: 0.00', 'Height: 0.00', and 'Width: 0.00'. At the bottom of this section is a table with columns for 'Order', 'Latitude', 'Longitude', and 'Action'. The table contains two rows of data. On the right side of the interface, there is a search bar and two lists: 'Region List' with 'Region-T1' selected, and 'Zone List' with 'SampleZone' and 'MyZone' listed. The 'MyZone' entry is highlighted in blue. The bottom of the page shows a browser address bar with the URL 'localhost:8080/fid-smartfarmui/index.html#/region/Region-T1/addHub' and an Intel logo.

Order	Latitude	Longitude	Action
1	37.37216780250769	-122.00053989887238	 
2			 

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.

The screenshot displays the Atomiton Gateway Configuration web interface. At the top, the navigation bar includes the Atomiton logo and the text 'Gateway Configuration'. Below this, a breadcrumb trail shows 'Home - Region-T1 / Add Hub'. A secondary navigation bar contains four green buttons: '+ Region', '+ Zone', '+ Sensor Hub', and '+ Sensor Type'. The main content area is titled 'Add Hub' and features a Google Maps interface. The map shows a satellite view of a building complex with a yellow rectangular selection box around a specific area. A search bar is located at the top right of the map area. To the right of the map, there are two dropdown menus: 'Region List' (currently set to 'Region-T1') and 'Zone List' (with options 'SampleZone' and 'MyZone'). Below the map, there is a form with the following fields: 'MAC Address*' (with a placeholder 'Enter MAC Address'), 'Name*' (with a placeholder 'Enter name'), 'Location' (a section header), 'Latitude*' (with a placeholder 'Enter Latitude'), and 'Longitude*' (with a placeholder 'Longitude'). The Intel logo is visible in the bottom right corner of the interface.

-
- 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.

Atomiton Gateway Configuration

Map Satellite MyZone

Atomiton, Inc. SkillNet Solutions Keep IT Cool

Sonora Ct Sonora Ct Sonora Ct Sonora

Google Map data ©2017 Google Imagery ©2017, DigitalGlobe, U.S. Geological Survey 10 m Terms of Use Report a map error

Region List
Region-T1

Zone List
SampleZone
MyZone

MAC Address*
11:22:33:44:55:66

Name*
MySensorHub

Location

Latitude*
37.37189132629635

Longitude*
-122.00010972976685

+ Create Hub

Adding new Sensor

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

The screenshot displays the Atomiton Gateway Configuration interface. At the top, the title is "Atomiton Gateway Configuration" and the page is titled "Sensor Hub Information" with the ID "11:22:33:44:55:66". There are two buttons: "Sensor Profile" and "Delete Sensor Hub".

The central part of the interface features a Google Map with a yellow box highlighting a sensor hub location. The map shows streets like "Lawrence Expwy" and "San Zeno Way". A blue pin labeled "MyZone" is placed on the highlighted area.

Below the map, there is a table with sensor hub details:

MAC Address:	Name:	Latitude:	Longitude:
11:22:33:44:55:66	MySensorHub	37.37189133	-122.00010973

Below this table is a configuration table for the sensor:

ID	Name	Type	Value	Unit	Min Value	Max Value	Rate
1	-	SoilMoisture	-	-	10	300	50

At the bottom right, there is a "Data Time Zone: UTC ±00:00" label.

On the right side of the interface, there are two lists:

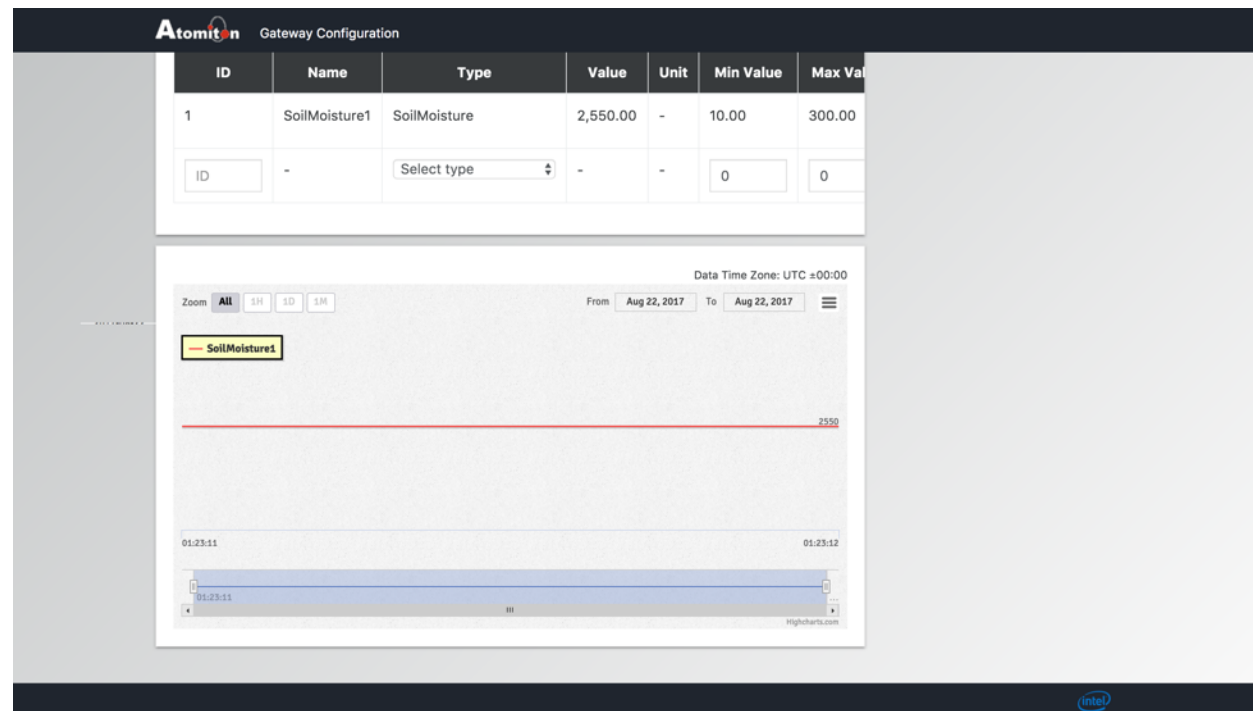
- Region List:** A dropdown menu showing "Region-T1".
- Zone List:** A list of zones including "SampleZone", "MyZone", and "MySensorHub - 11:22:33:44:55:66". The "MySensorHub" entry is highlighted in blue.

- 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.

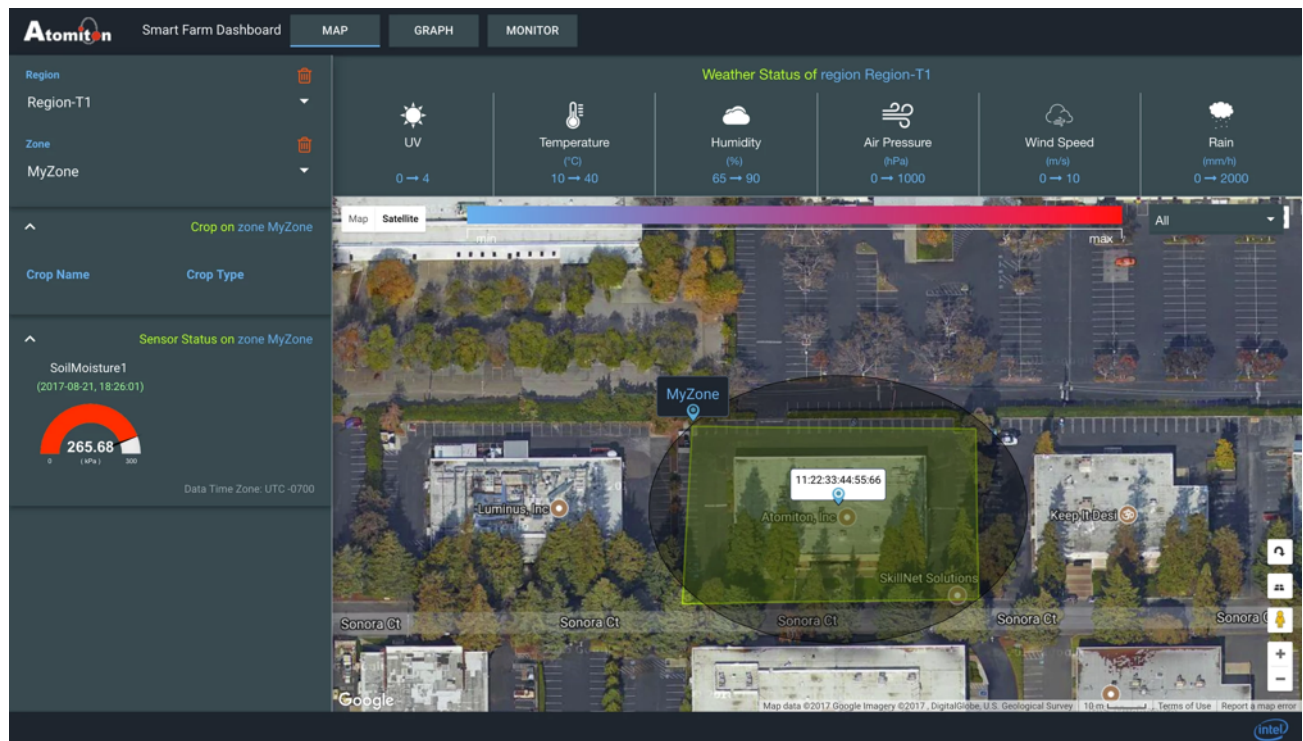
The screenshot displays the Atomiton Gateway Configuration interface. At the top, it shows 'Sensor Hub Information' for ID '11:22:33:44:55:66'. Below this is a satellite map with a yellow box highlighting a location labeled 'MyZone' with the same ID. To the right of the map is a 'Region List' showing 'Region-T1' and a 'Zone List' showing 'SampleZone' and 'MyZone'. Below the map, there are fields for 'MAC Address: 11:22:33:44:55:66', 'Name: MySensorHub', 'Latitude: 37.37189133', and 'Longitude: -122.00010973'. At the bottom, there is a table for adding sensors.

Type	Value	Unit	Min Value	Max Value	Radius	Action
SoilMoisture	-	-	10	300	50	Add

- 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>

A young green seedling with two leaves growing out of dark soil, with rain falling around it. The background is a bright, hazy green, suggesting a sunny day. The seedling is the central focus, with its stem and leaves clearly visible. The soil is dark and textured, and the rain is captured as white streaks falling from the top of the frame.

Analysis and Usage

Models

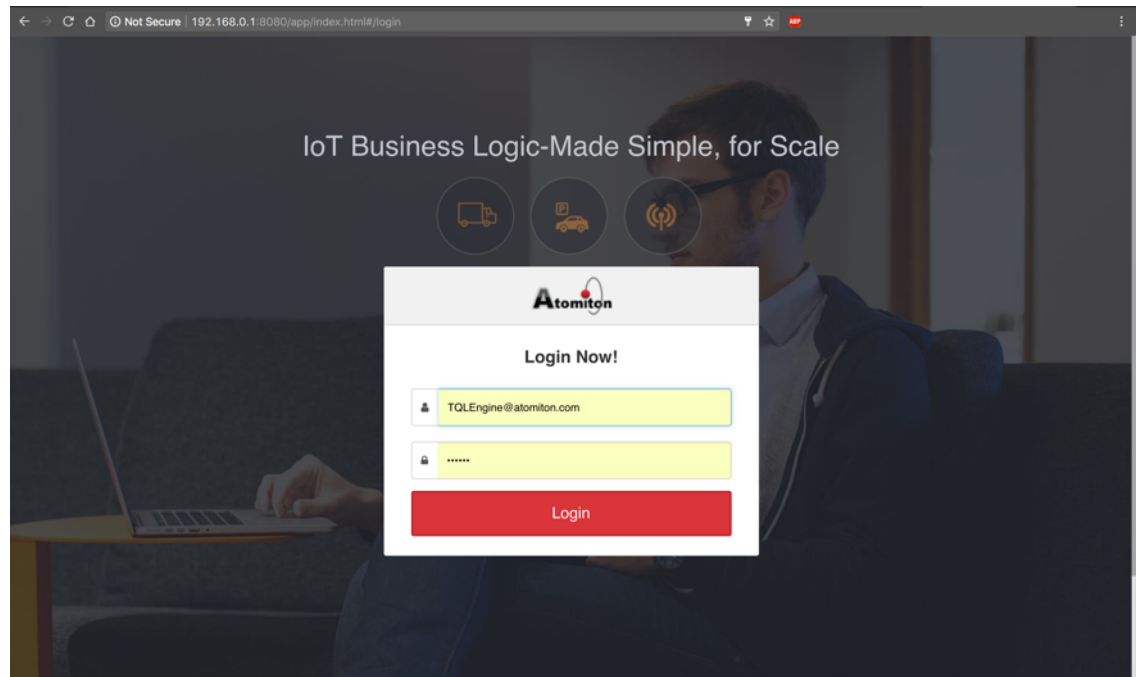
- A model is a **definition** of a container, which represents the functionality or knowledge about some kind of entity. At run time, a model can be instantiated into model instances.
- In Smart Farm Project we have various models like
 - Region
 - Zones
 - Polygon
 - MCUModel (Sensor Hubs)
 - SensorModel
 - SensorHistoryModel
 - ZoneAggInfoHistoryModel ..,etc.

Queries

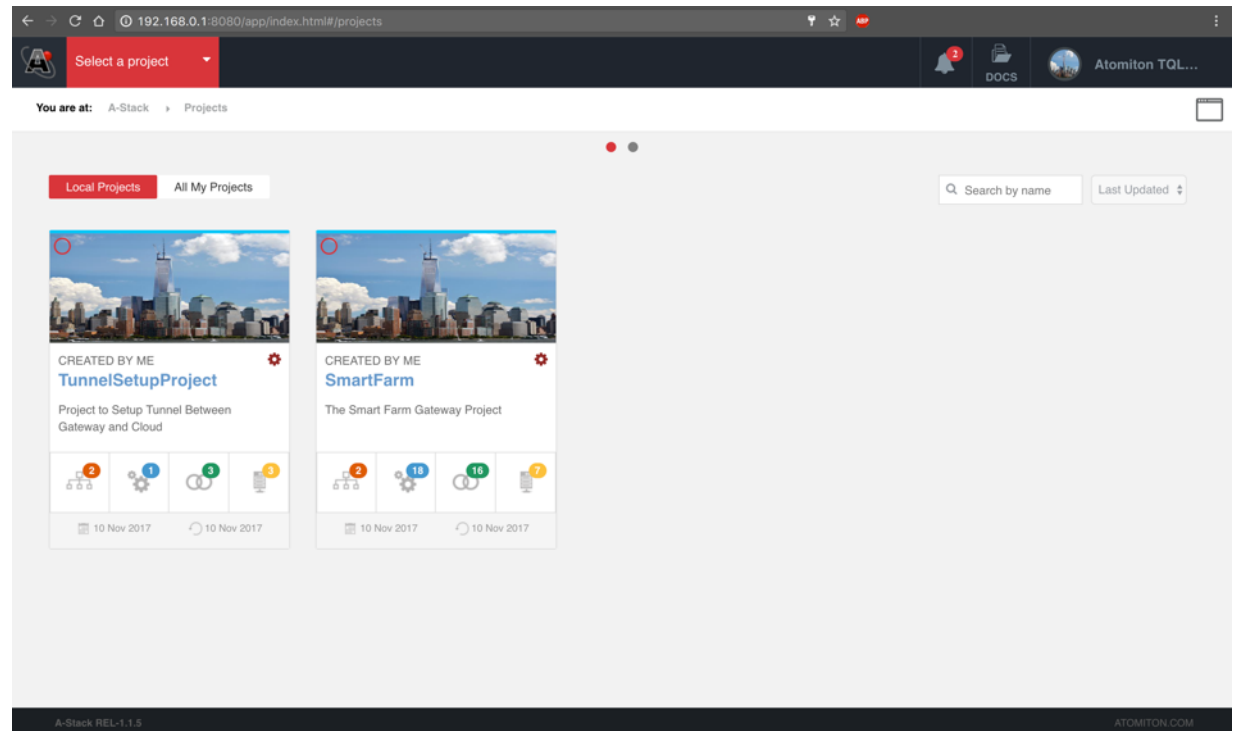
- In TQL, a query is any operations on the model instance data (or model data), which includes filtering, joining, and manipulations. Model instances are incarnations of the Models (or model definitions) through instantiation.
- The A-Stack stores the latest version of the model instance data, which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

A-Stack Console and Queries

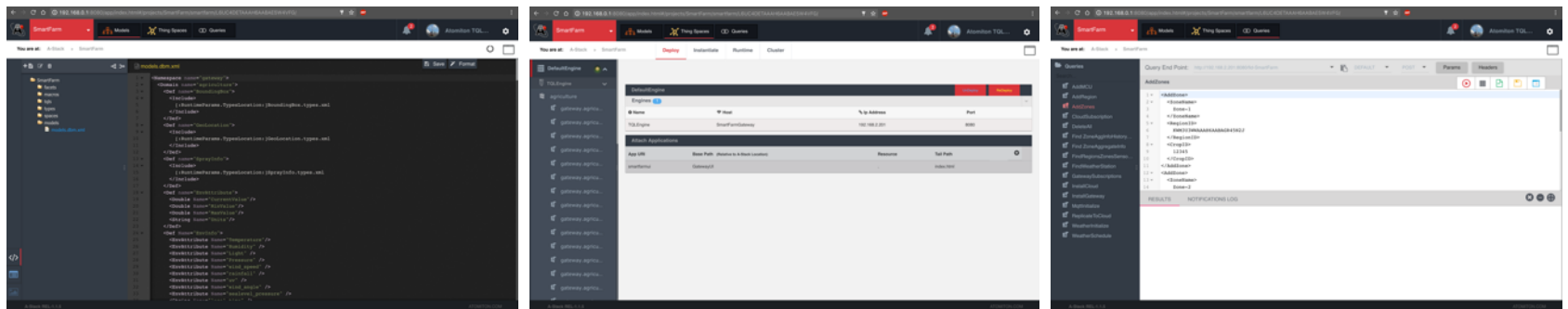
- Connect to **SmartFarmGateway** Wi-Fi network and go to the URL <http://192.168.0.1:8080/fid-smartfarmui/index.html>
- Login to A-Stack Web console using credentials User Name=TQLEngine@atomiton.com
password=tql123



- 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
<pre><Query> <Find> <Region> <RegionID ne="" /> </Region> </Find> </Query></pre>	<pre><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></pre>

Find SensorHistoryModel Query

Query	Response
<pre><Query> <Find> <SensorHistoryModel> <Name>SoilMoisture1</Name> <RecordDate lt="2017-11-16T24:00:00Z"/> <RecordDate gt="2017-11-16T00:00:00Z"/> </SensorHistoryModel> </Find> </Query></pre>	<pre><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></pre>

Find ZoneAggInfoHistoryModel Query

Query	Response
<pre><Query> <Find> <ZoneAggInfoHistoryModel> <ID ne="" /> <RecordDate gt="2017-11-16T00:00:00Z" /> <RecordDate lt="2017-11-16T24:00:00Z" /> </ZoneAggInfoHistoryModel> </Find> </Query></pre>	<pre><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>L6UEYGV6AAA6AABAE7FAAVN</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>L6UEYGQSAAA6AABAFSUOFJX</ID> <AvgValue>2450.0000000000</AvgValue></pre>

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 or update of sensorHistoryModel instance we will get a notification.

SensorHistoryModel Subscription

Subscription request	Notification
<pre><Query Storage='TqISubscription'> <Save> <TqISubscription Label='SensorHistoryModel' sid='20'> <Topic> gateway.agriculture.SensorHistoryModel. * </Topic> </TqISubscription> </Save> </Query></pre>	<pre><TqINotification> <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> </TqINotification></pre>

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*.

CreatePolicy

Policy

```
<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>
```

Activate Policy

Policy

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

A young green seedling with two leaves growing out of dark soil, with rain falling around it. The background is a bright, hazy green, suggesting a sunny day with rain. The seedling is the central focus, with its stem and leaves clearly visible against the blurred background. The soil is dark and textured, with some small particles visible. The overall mood is one of growth and resilience.

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 Sensor 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.

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>

An aerial photograph of a vast agricultural field, likely a cornfield, showing distinct rows of crops. A combine harvester is visible in the upper-middle section, moving from left to right, leaving a trail of harvested grain. Below it, a blue truck is parked or moving slowly. The overall scene is bathed in warm, golden light, suggesting late afternoon or early morning.

Thank You.