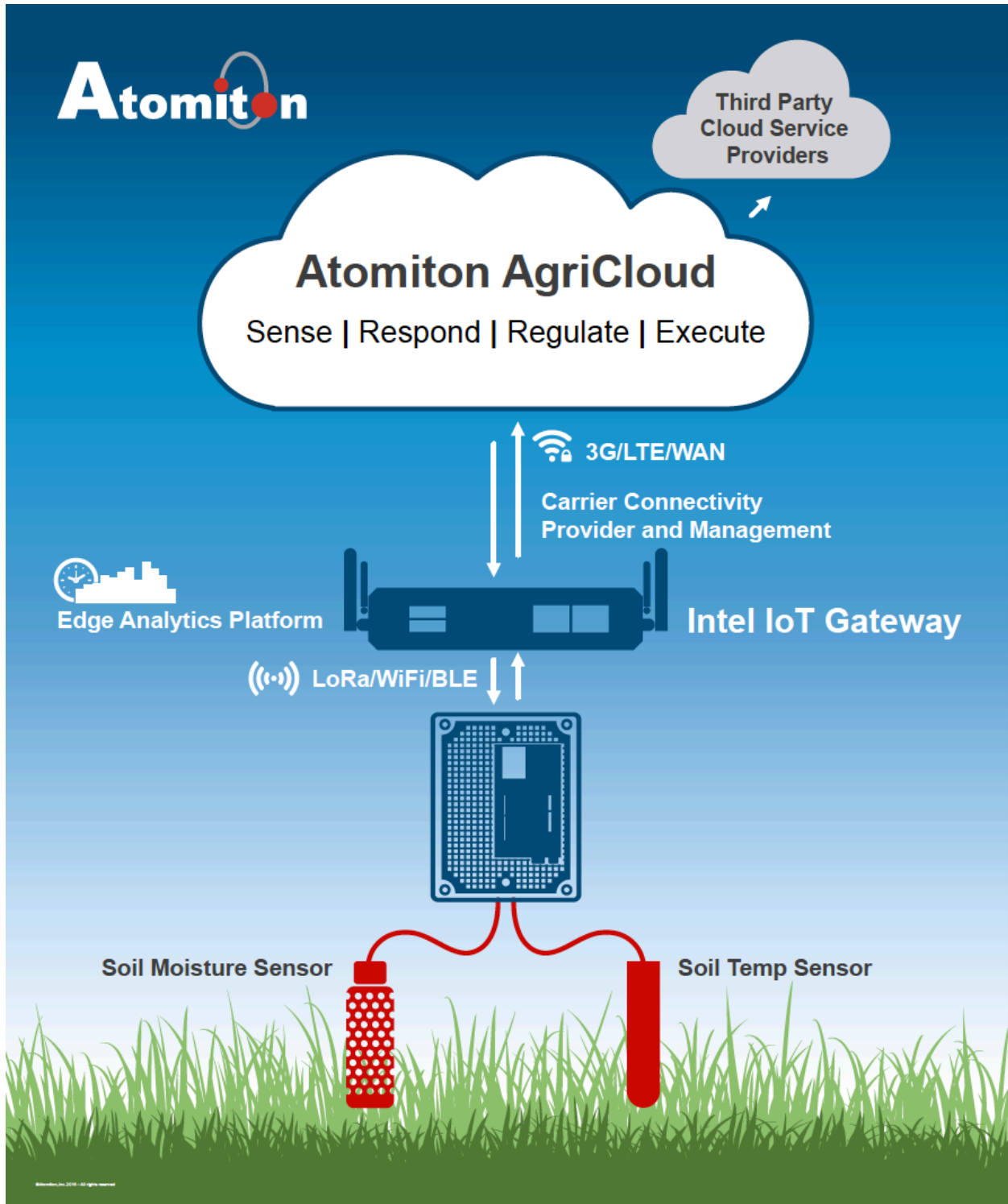# TQL Precision Agriculture Development Kit with WiFi and LoRa Option

TQL Precision Agri Dev Kit provides WiFi or **WiFi with LoRa** option to collect multi sensors data from the field and process them in the Agri gateway. Maintains limited history on the gateway and syncs up normalized data on agri cloud connected through Ethernet or 3G (option need to be activated with the carrier). Agri solution contains following major components

TQL Agri Dev Kit with LoRa/WiFi: Agri Sensor Hub with LoRa Option

Provides multi-sensor node to connect wired analog and digital sensors and actuators as well as BLE sensors. Upstream communication is supported through BLE, WiFi and LoRa.
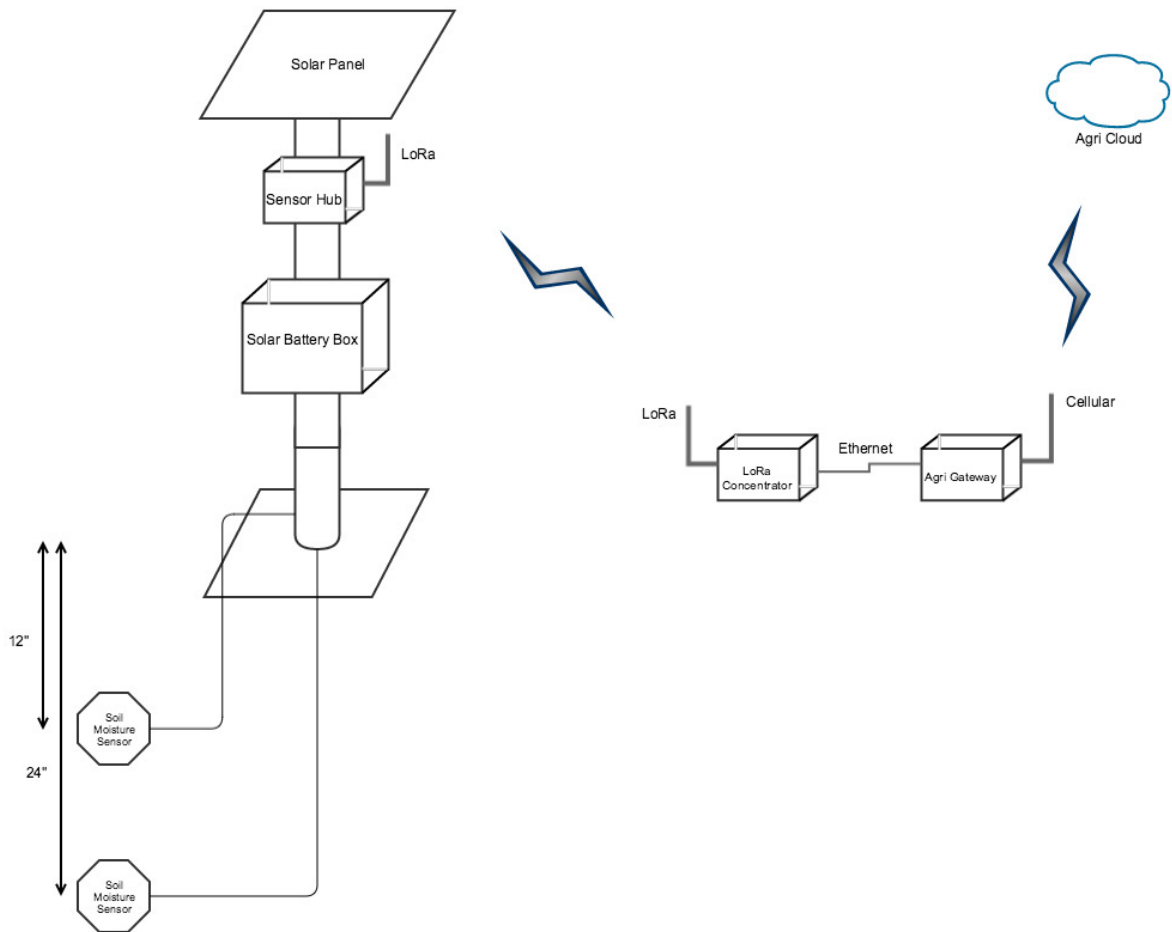

TQL Agri Dev Kit with LoRa/WiFi: Agri Gateway with LoRa Option

Provides a connection between LoRa or WiFi to upstream Ethernet or 3G. Gateway has Atomiton stack with Agri application running, which normalizes the data locally. If any policies defined, they are executed locally.

TQL Agri Dev Kit with LoRa/WiFi: Agri Cloud Service

Provides Agri management and data services through cloud. Current cloud service run on AWS. Other clouds like Azure, GCP, etc are supported as well.

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Solar Panel

LoRa

Sensor Hub

Solar Battery Box

12"

Soil Moisture Sensor

24"

Soil Moisture Sensor

Agri Cloud

LoRa

LoRa Concentrator

Ethernet

Agri Gateway

Cellular

Note: Second Soil Moisture sensor and Solar kit not included

Multiple Agri Sensor Hubs can connect to one Agri Gateway (on WiFi or LoRa network). Agri Gateways are connected to cloud through Ethernet or 3G (add-on service).

Component Content & Descriptions

This section describes all major components which makes the Agri Dev Kit Solution.
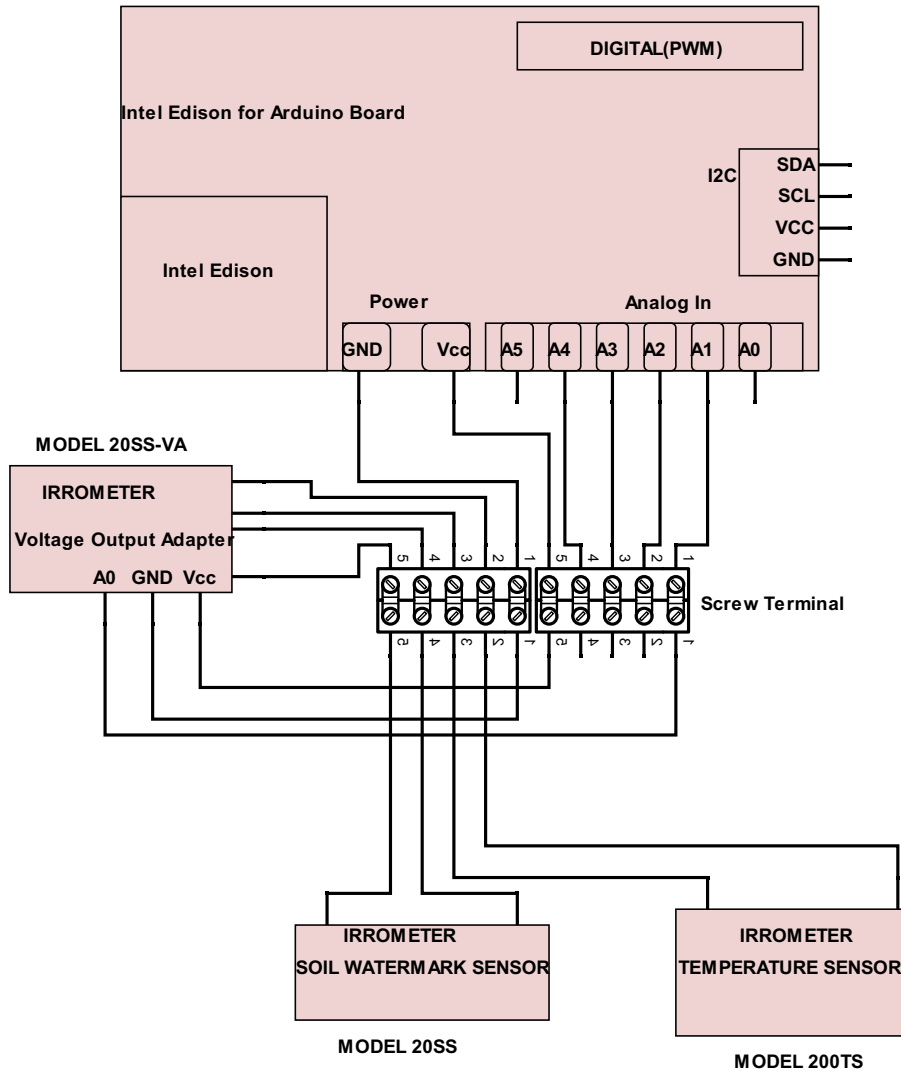
Agri Sensor Hub with LoRa Option

Item #	Part	Description	Units	Vendor Link
1	TQL Precision Agriculture Sensor Hub			
		Intel Edison Compute Module	1	https://software.intel.com/en-us/iot/hardware/edison
		Atomiton Stack (core based license)	2	http://www.atomiton.com /InVivoStore/index.html#/tqlDownload
		Precision Agriculture Application	1	http://www.atomiton.com /InVivoStore/index.html#/project/ LIMDD4W5AAAAUAAB5TPGTQYL
2	TQL Precision Agriculture Sensor Hub LoRa Option			
		MultiConnect® mDot™	1	http://www.multitech.com /brands/ multiconnect-mdot
3	Soil Moisture Sensor Kit			
		Watermark Soil Moisture Sensor w/15' Cable	1	http://www.irrometer.com/sensors.html
		Watermark Soil Temperature	1	http://reviteqgrow.com/product/watermark-soil-temperature-sensor/
		Watermark Voltage Adapter 200SS-VA	1	http://www.irrometer.com/sensors.html

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Sensor Hub Schematic Architecture

Current model supports upto four sensors.

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Agri Gateway with LoRa Option

Item #	Part	Description	Units	Vendor Link
1	TQL Precision Agriculture Gateway			
		Advantech UTX-3115SA4-S6A2E, Emb. sys.UTX-3115 w/4ante./8G RAM/500GB HDD/Wifi Module/3G Module, incl Power Cord	1	http://www.advantech.com /products/92d96fda-cdd3-409d-aae5-2e516c0f1b01/utx-3115/mod_fa00d5cd-7d2b-430b-8983-c232bfb9f315
		Atomiton Stack (Core based license)	2	http://www.atomiton.com /InVivoStore/index.html#/tqlDownload
		Precision Agriculture Application	1	http://www.atomiton.com /InVivoStore/index.html#/project/ LIMDD4W5AAAAUAAB5TPGTQYL
2	TQL Precision Agriculture Gateway LoRa Option			
		MultiConnect® Conduit™	1	http://www.multitech.com /brands/multiconnect-conduit

Agri Cloud Service

Item #	Part	Description	Units	Vendor Link
1	TQL Precision Agriculture Cloud			
		AWS Infrastructure	1	www.aws.com
		Atomiton Stack (Core based license)	8	http://www.atomiton.com /InVivoStore/index.html#/tqlDownload
		Precision Agriculture Application	1	http://www.atomiton.com /InVivoStore/index.html#/project/ LIMDD4W5AAAAUAAB5TPGTQYL

Parts Specifications & Datasheets

This section describes all major hardware parts used in the Agri Kit.

Advantech UTX-3115

Intel® Atom™ Dual Core E3826 1.46 GHz processor

Palm-size form factor: 138.5(W) x 35.98(H) x 116.4(D) mm

Supports 1 xCOM port, 1 xHDMI, 1 x micro HDMI, 1 xVGA, 1 xUSB3.0 and 2xUSB2.0ports,TPMonboard

Built-in1xHalf sizeMiniPCIeexpansionslot(i.e.:Wi-Fi module) and 1xFullsizeMiniPCIeexpansionslot(i.e.:mSATAor3G/4Gmodule)

Supports 1 2.5" HDD or SSD storage

Wide operating temperature -20 ~ 60°C support

Optional VESA / DIN-Rail / Wall mounts

Datasheet: http://downloadt.advantech.com/ProductFile/PIS/UTX-3115/Product%20-%20Datasheet/UTX-3115%20A2_DS(07.26.16)201607261431442016120 2154735.pdf

MultiTech MultiConnect® Conduit™

Asset management range - up to 10 miles line of sight, 1 to 3 miles into buildings

Datasheet: http://www.multitech.com/documents/publications/data-sheets/86002170.pdf

Intel Edison

Form factor Board with 70-pin connector

Dimensions $35.5 \times 25.0 \times 3.9$ mm ($1.4 \times 1.0 \times 0.15$ inches) max

C/M/F Blue PCB with shields / No enclosure

Connector Hirose DF40 Series (1.5, 2.0, or 3.0 mm stack height)

Operating temperature 32 to 104°F (0 to 40°C)

EXTERNAL INTERFACES

Total of 40 GPIOs, which can be configured as:

SD card 1 interface

UART 2 controllers (1 full flow control, 1 Rx/Tx)

I2C 2 controllers

SPI 1 controller with 2 chip selects

I2S 1 controller

GPIO Additional 12 (with 4 capable of PWM)

Datasheet:

http://www.intel.com/content/dam/support/us/en/documents/edison/sb/edison_pb_331179002.pdf

MultiTech MultiConnect® mDot™

Up to 10 miles / 16 km range

Deep in-building penetration - 1 to 3 miles / 2 km

Developer friendly to integrate and quickly deploy assets

Run for years on battery power

Datasheet: http://www.multitech.com/documents/publications/data-sheets/86002171.pdf

WATERMARK Soil Moisture Sensor — MODEL 200SS

 Proven stable calibration
 Range of measurement from 0 to 239 cb (kPa)
 Fully solid-state
 Will not dissolve in soil
 Not affected by freezing temperatures
 Internally compensated for commonly
 found salinity levels
 Inexpensive, easy to install and use
 Compatible with AC or DC reading devices
 (specialized circuit required) – INCLUDED IN KIT
 NO maintenance required
Datasheet: http://www.irrometer.com/pdf/sensors/403%20WATERMARK%20Sensor-WEB.pdf

Solar Kit for Sensor Hub

 Continuous Power Generation 1.25W
 Enclosure type Die Cast
 Battery voltage 12VDC
 POE output voltage 12VDC
 Battery capacity 18Ah
 Solar Panel Size 5W
Datasheet: https://www.streakwave.com/mmSWAVE1/Video/RemotePro.pdf

Atomiton Stack

Provides the infrastructure for thing computing.

TQL is how one develop applications for Things on the Atomiton Stack. It is

1. Thing Query Language - a programming language for things.

2. TQL Application Framework is a model-oriented framework that offers a distributed, parallel, non-dual (event and data not separate), and compose able programming paradigm.

3. TQL queries are the standard query for things. TQL is the standard interface on the Atomiton Stack.

4. Runtime environment for TQL applications is Atomiton Stack (A-Stack).

5. TQL Studio is the distributed development, management, and collaboration environment for TQL Applications.

Among the services provided by TQL are:

1. Communication with things (such as sensors, actuators, devices and machines)
2. Abstraction of the behaviors/functions of things
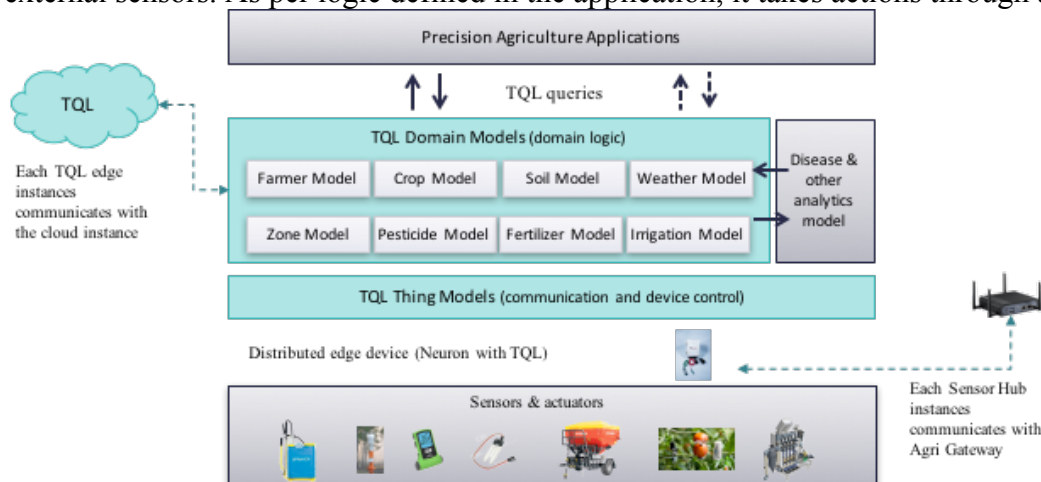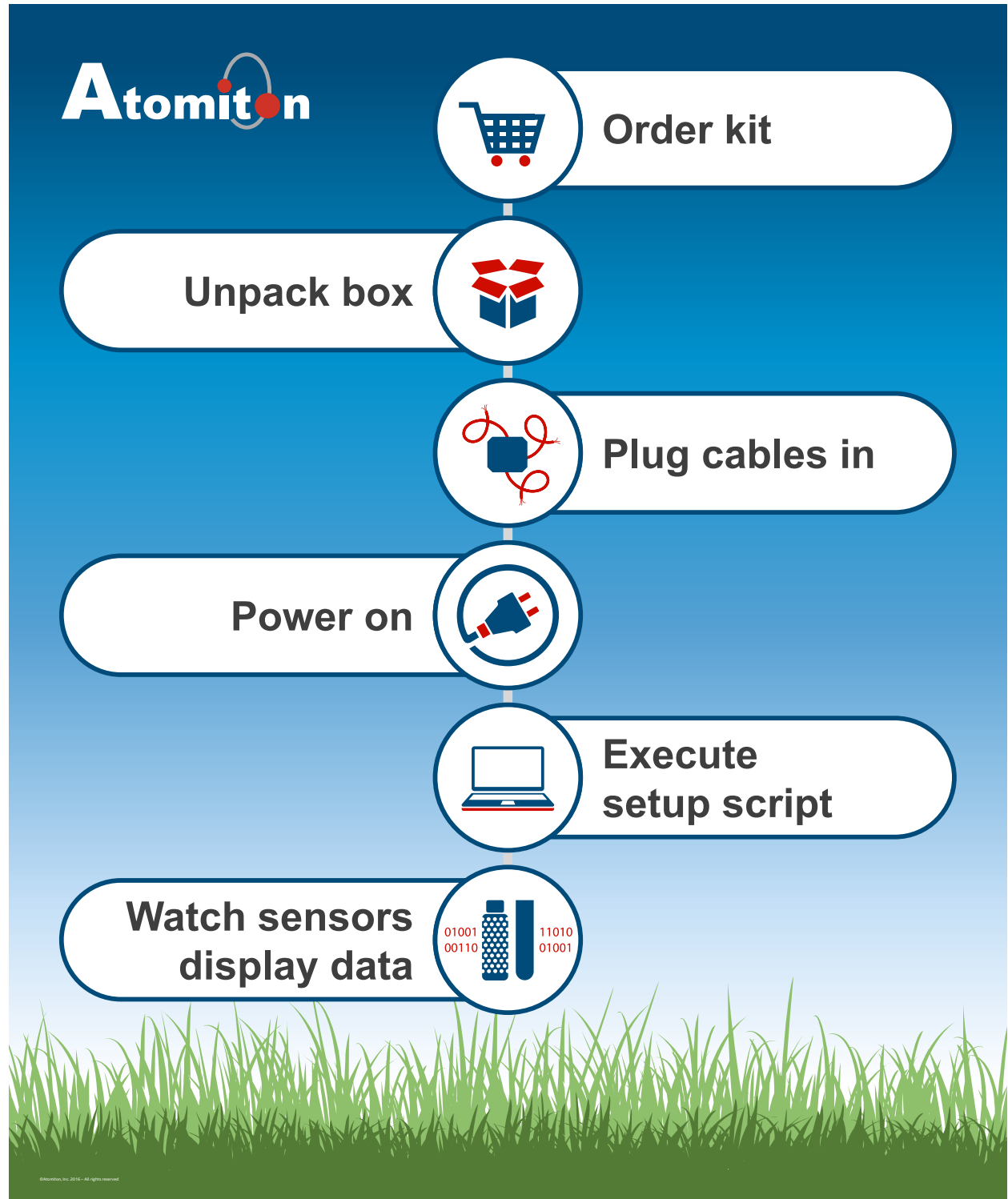3. Modeling of things and systems of things

4. Single pane of glass to interact with things and data
5. Resource management across multiple things and databases
6. State management for things and processes
7. Jobs/process management
8. Files and data management
9. Security

Precision Agriculture Application on Atomiton Stack

Precision Agriculture application is implementation of Agriculture concepts like Crop, Zone, Farmer, etc. It maintains the inter-relationships among these entities and populate them through external sensors. As per logic defined in the application, it takes actions through actuators

Atomiton

Order kit

Unpack box

Plug cables in

Power on

Execute setup script

Watch sensors display data

01001 00110   11010 01001