
Anything
Any Device
Anyone
Anybody
Any Service
Any Business
Any Path
Any Network
Any Place
Anywhere
Anytime
Any Context
Workshop
The
INTERNET
of THINGS
version 3.0

Forsk Team

Abhishek
Sr. Developer

Sourabh
Sr. Developer

Dr. Sylvester
Manager

Rohit C
Developer

Rohit M
Developer

Abul
Sr. Developer

Usha
Sr. UX Designer

Yogendra
Lead

Devendra
Developer

Kunal
Developer

IoT Bootcamp ?

- End to End coverage on the applications of IoT
- Understanding Business, Opportunity & Developments
- Covering the entire architecture of IoT
- Special emphasis on technologies in ecosystem

At the end of it ….

- You will have understanding of IoT, verticals, market potential, Alliances and Industry updates

- Understanding the hardware side of the IoT (Sensors, development Boards, Embedded Systems, protocols)

- Excellent understanding of the communication protocols & software technologies (Cloud, JSON, Web Services, Big Data, Analytics)

INTERNET of PEOPLE

What exactly is the "INTERNET of THINGS"?

1 SENSORS & *ACTUATORS*

We are giving our world a digital nervous system. Location data using GPS sensors. Eyes and ears using cameras and microphones, along with sensory organs that can measure everything from temperature to pressure changes.

2 CONNECTIVITY

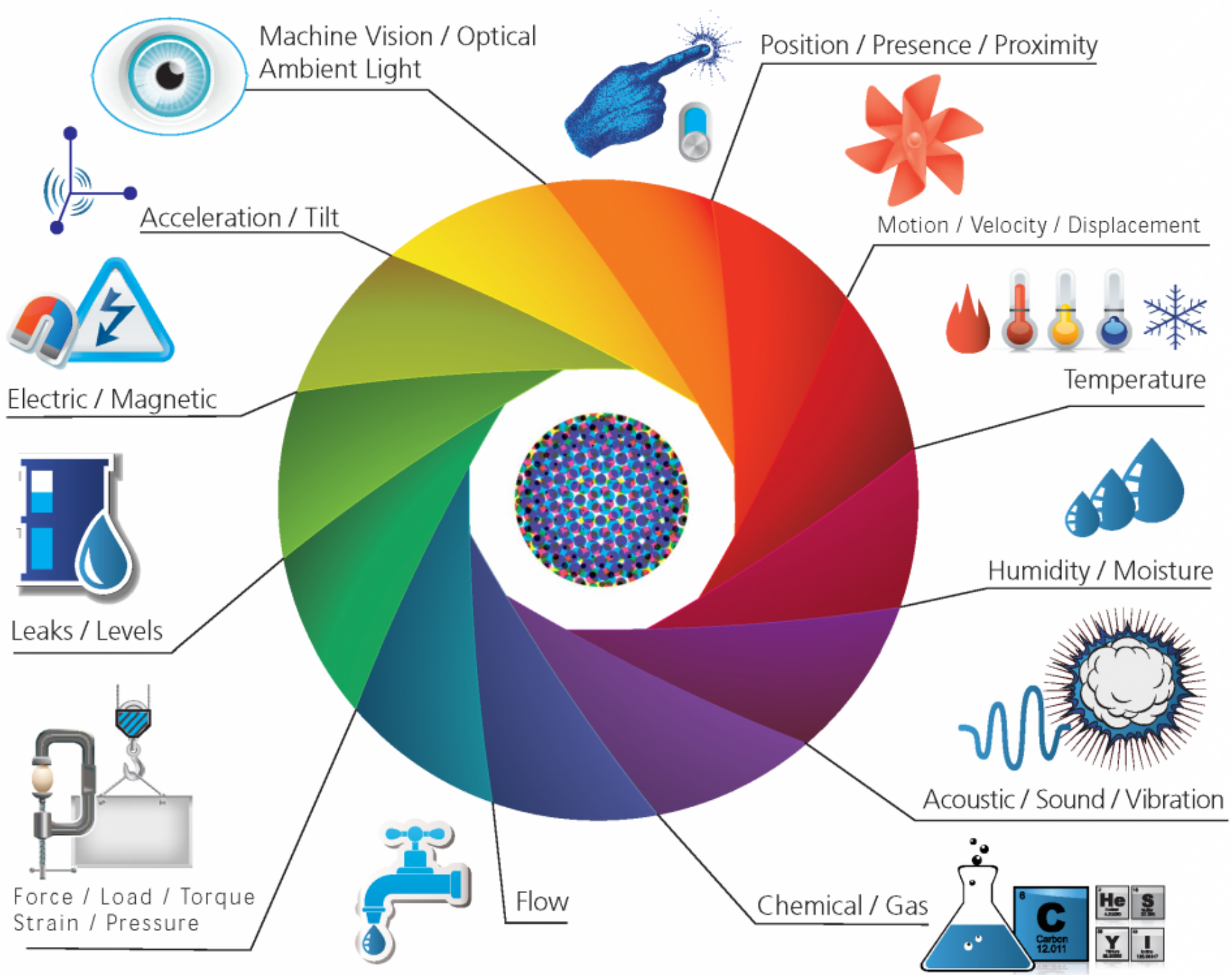
These inputs are digitized and placed onto networks.

3 PEOPLE & *PROCESSES*

These networked inputs can then be combined into bi-directional systems that integrate data, people, processes and systems for better decision making.

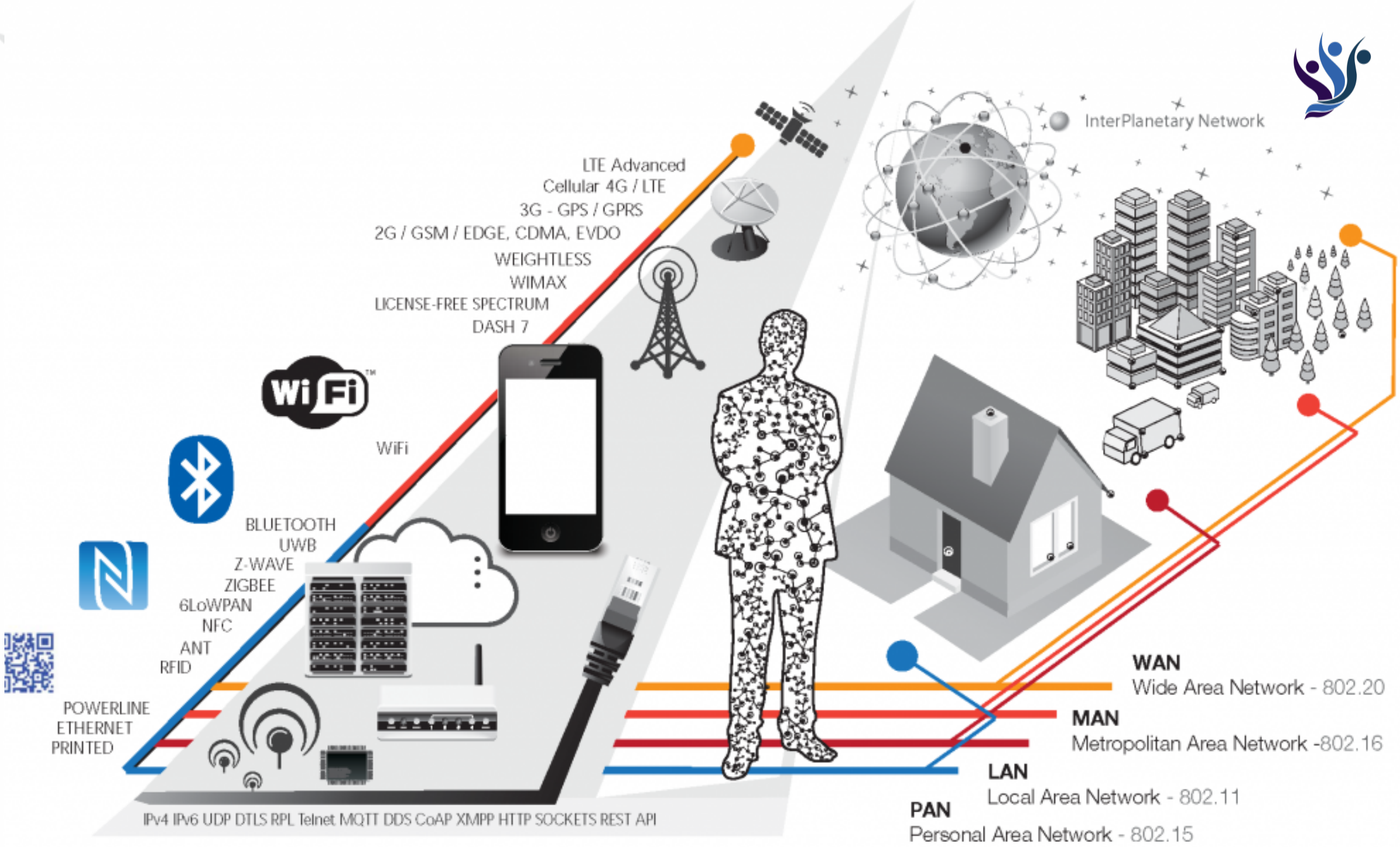
1 SENSORS & *ACTUATORS*

We are giving our world a digital nervous system. Location data using GPS sensors. Eyes and ears using cameras and microphones, along with sensory organs that can measure everything from temperature to pressure changes.



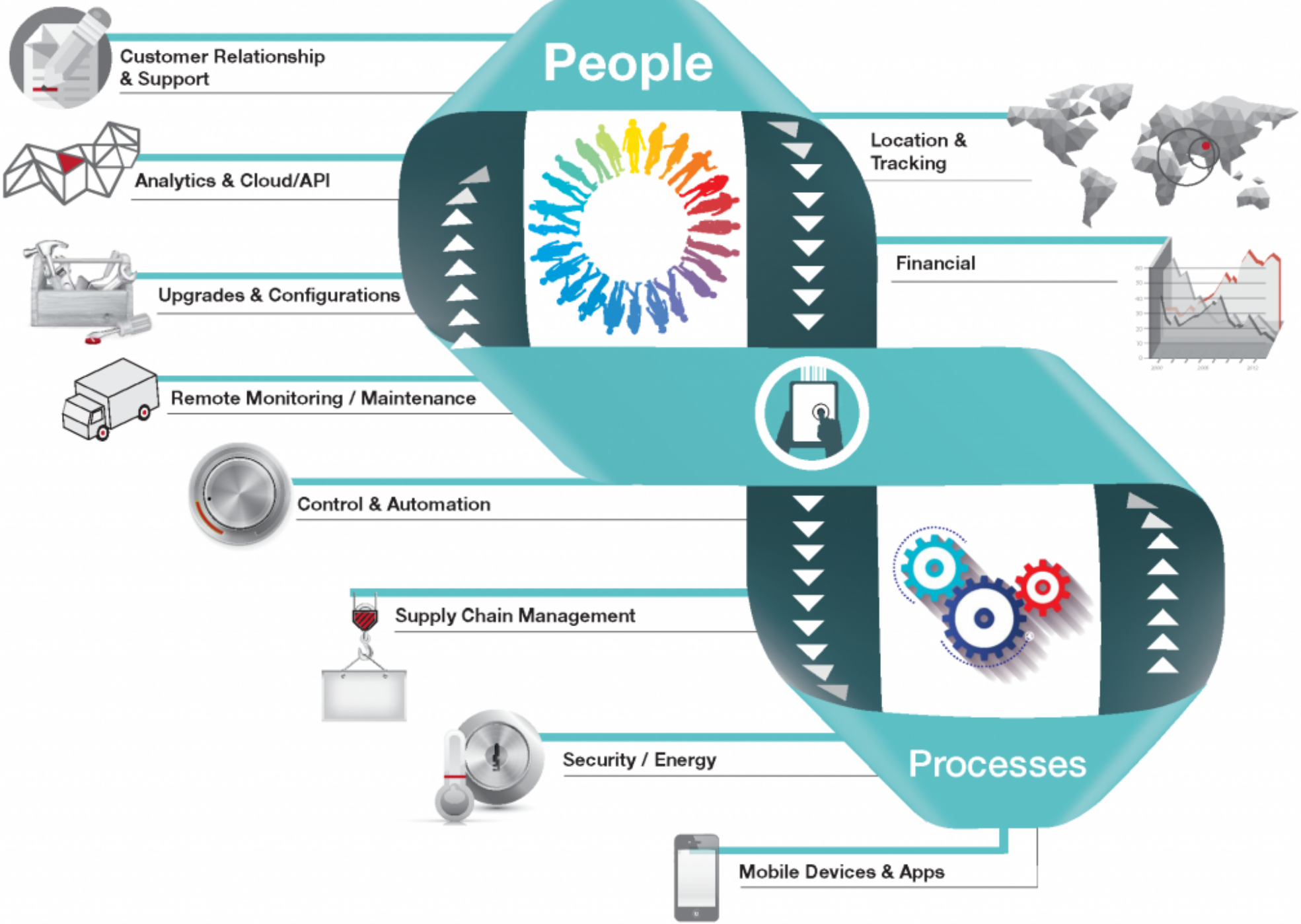
2 CONNECTIVITY

These inputs are digitized and placed onto networks.



3 PEOPLE & *PROCESSES*

These networked inputs can then be combined into bi-directional systems that integrate data, people, processes and systems for better decision making.

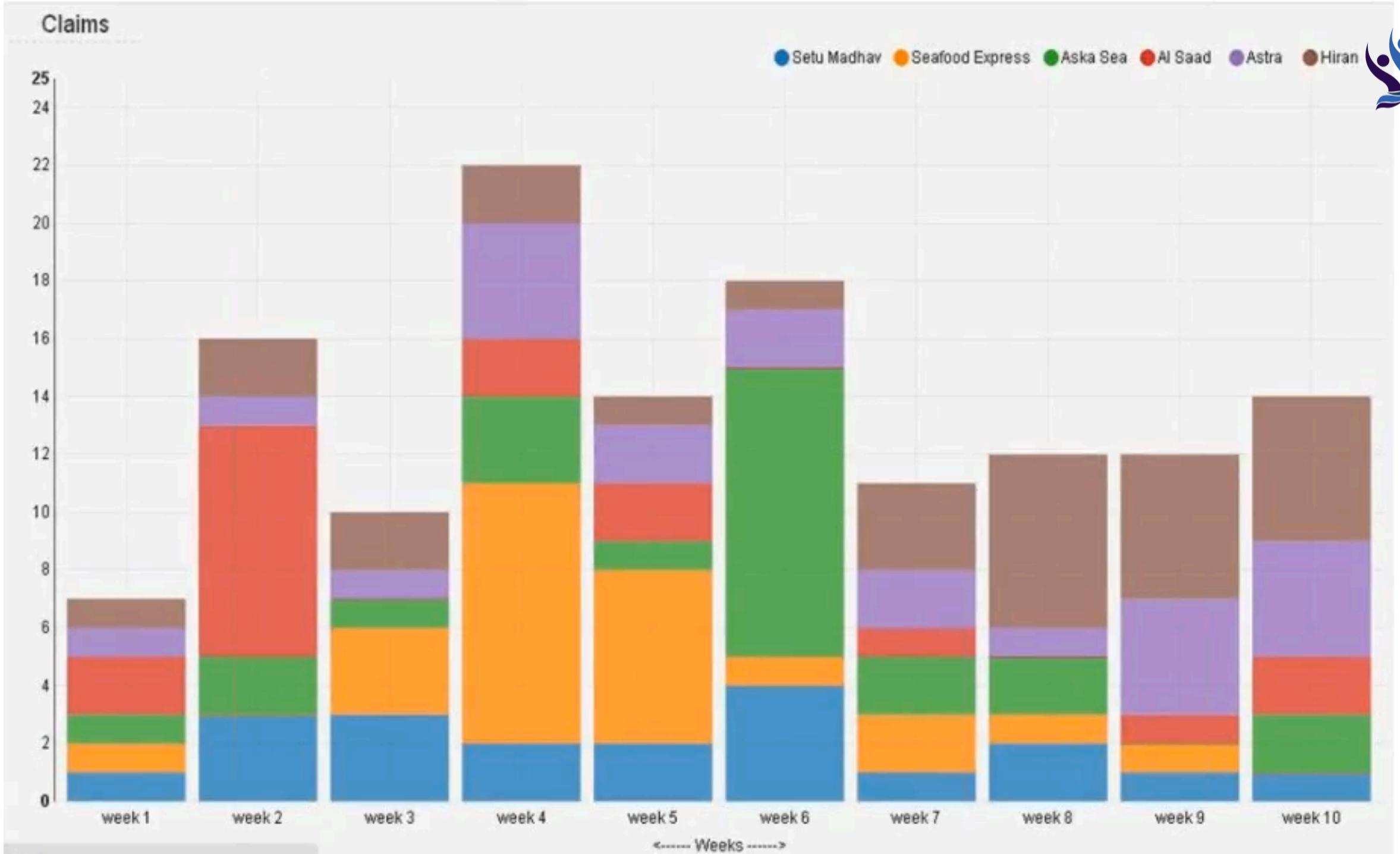


Problem Statement

When technology leads the way,
freshness follows.

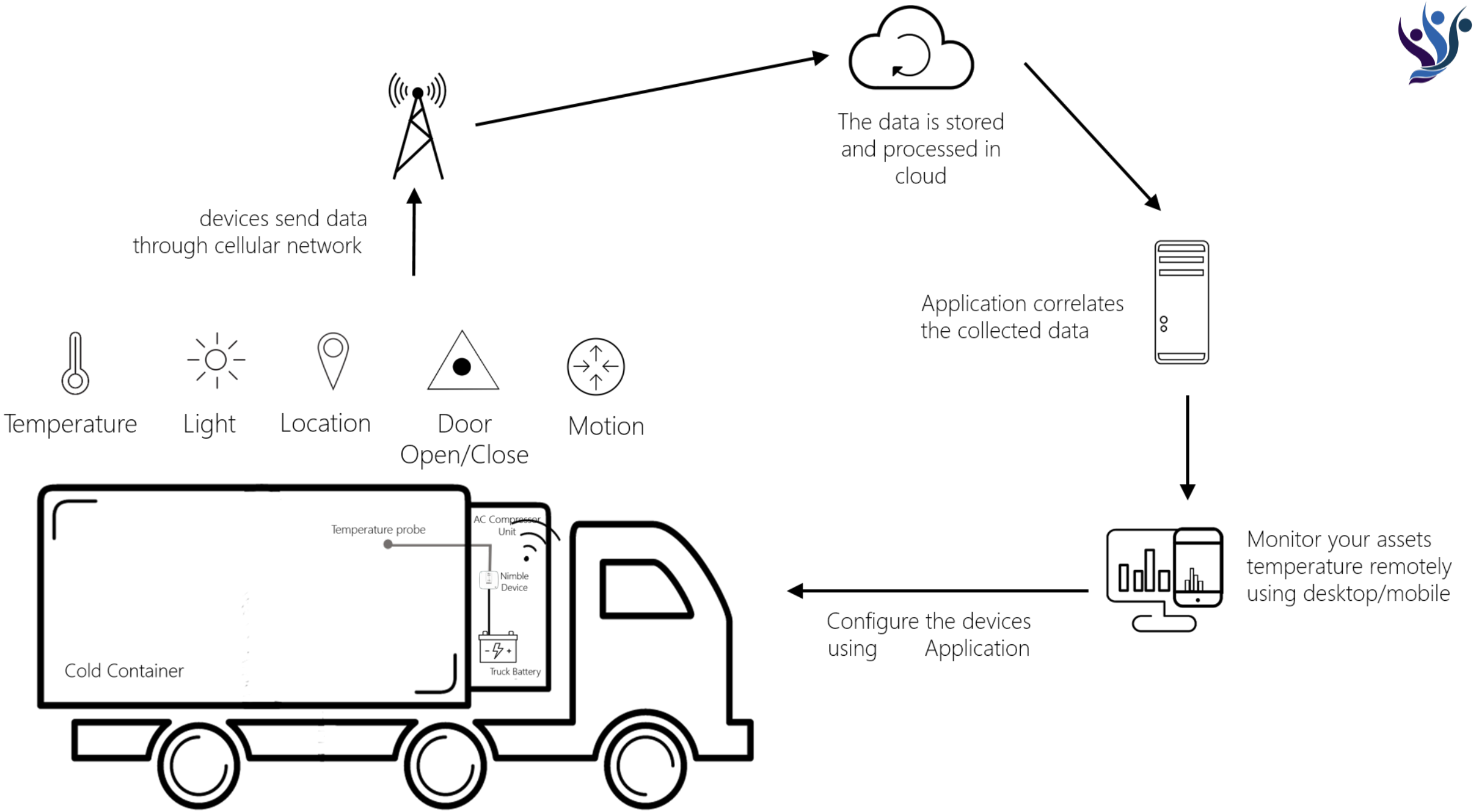
From Pickup to Destination:
Delivered Fresh, Delivered Safe.

Claims from Clients


Claims
Setu Madhav
Seafood Express
Aska Sea
Al Saad
Astra
Hiran
25
24
22
20
18
16
14
12
10
8
6
4
2
0
week 1
week 2
week 3
week 4
week 5
week 6
week 7
week 8
week 9
week 10
<------ Weeks ------>

How To Filter False Claims

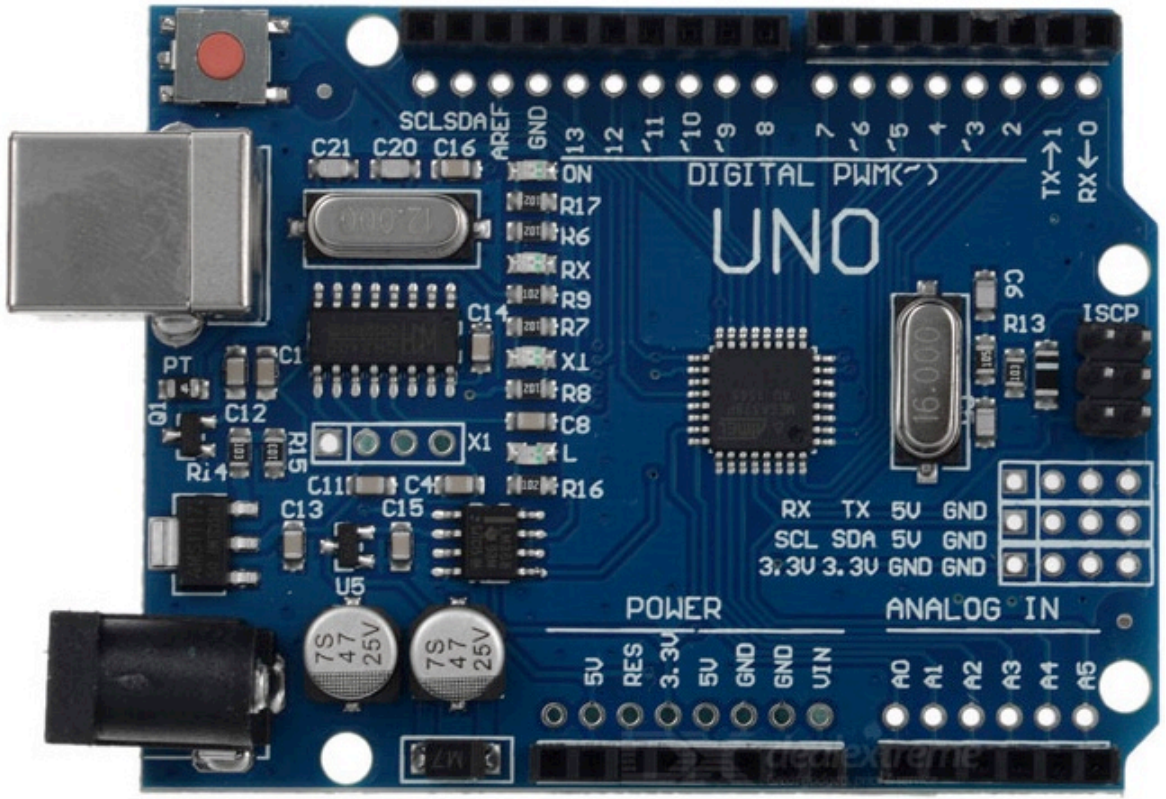
Solution


devices send data
through cellular network
The data is stored
and processed in
cloud
Application correlates
the collected data
Monitor your assets
temperature remotely
using desktop/mobile
Configure the devices
using Application
Temperature
Light
Location
Door
Open/Close
Motion
Temperature probe
AC Compressor
Unit
Nimble
Device
Truck Battery
Cold Container

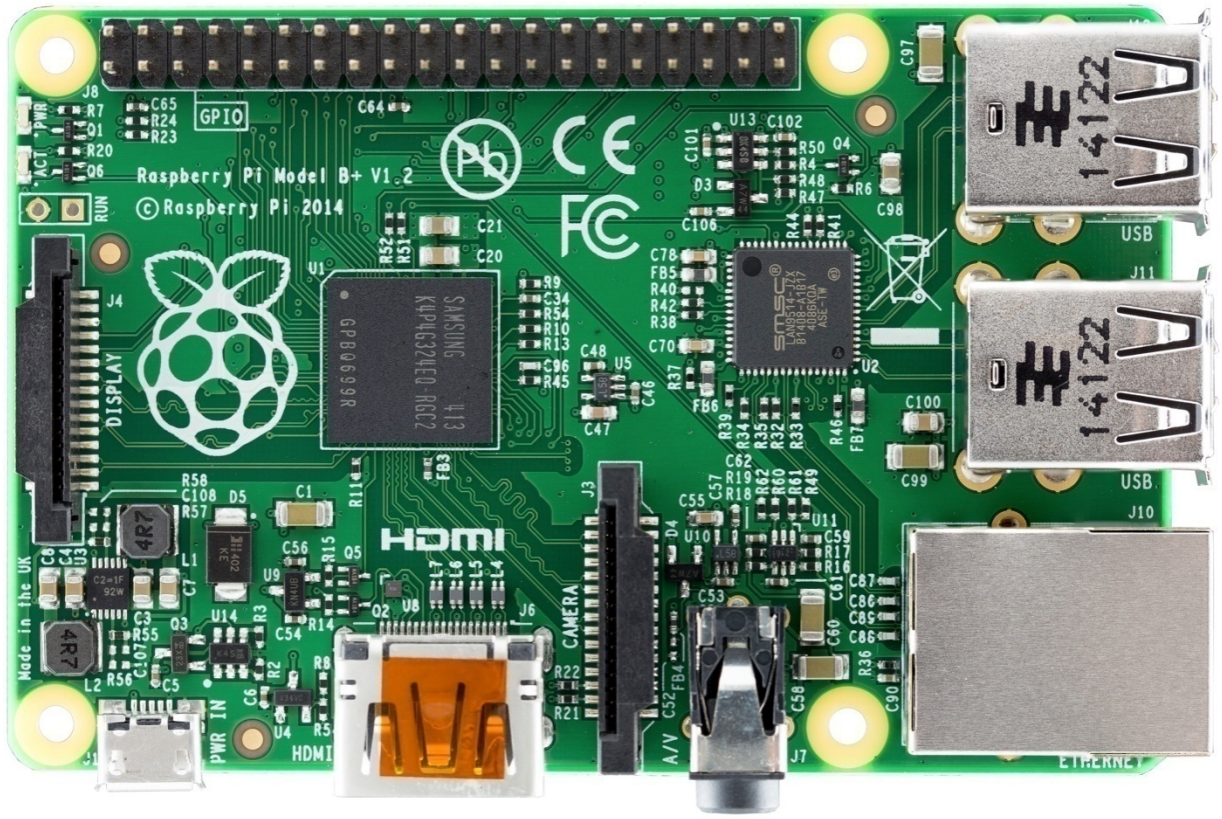
Execution

Development Boards

ARDUINO



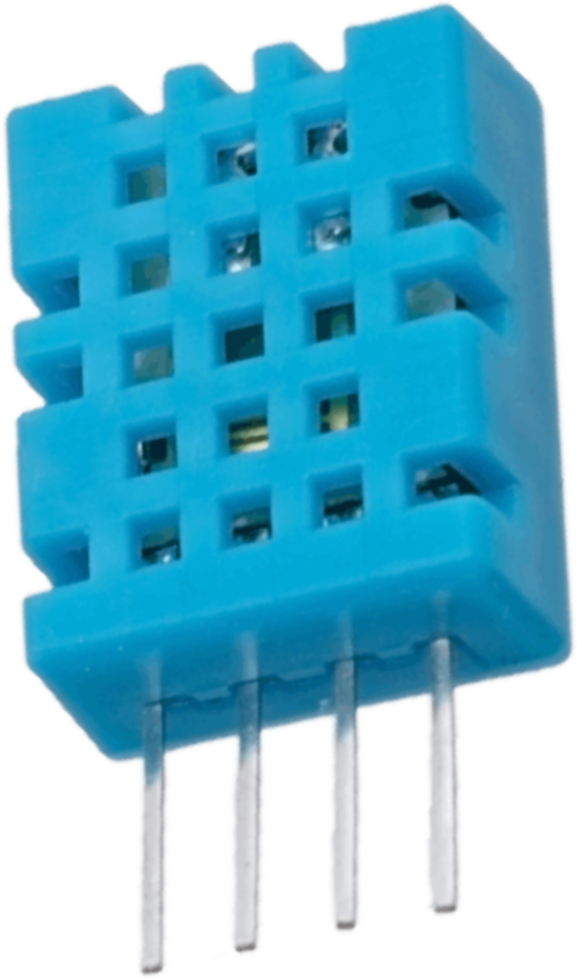
RaspberryPi



Hardware Requirements

LDR

LM35D



DHT11

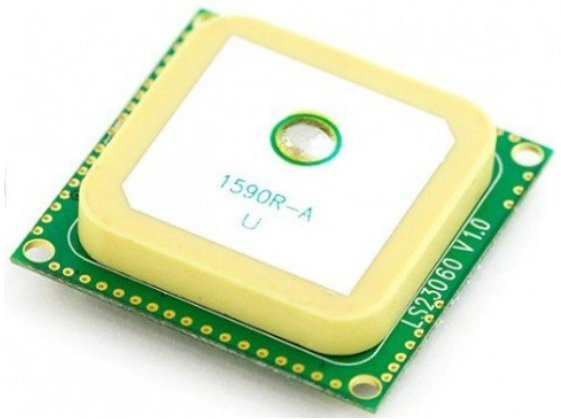
Hardware Requirements

PIR

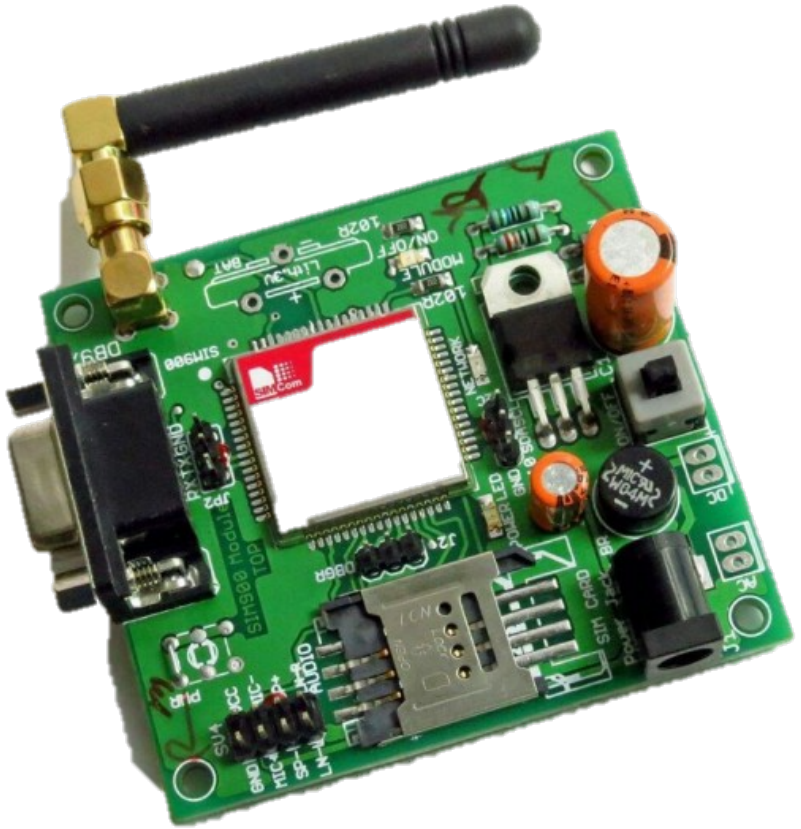
PC817

REED

Hardware Requirements

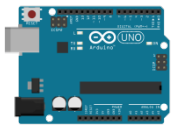
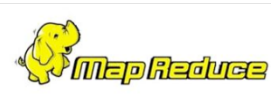
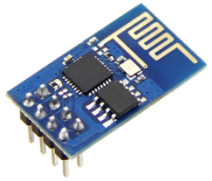
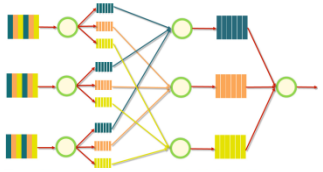
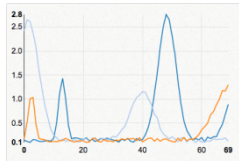
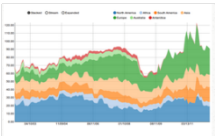


GPS



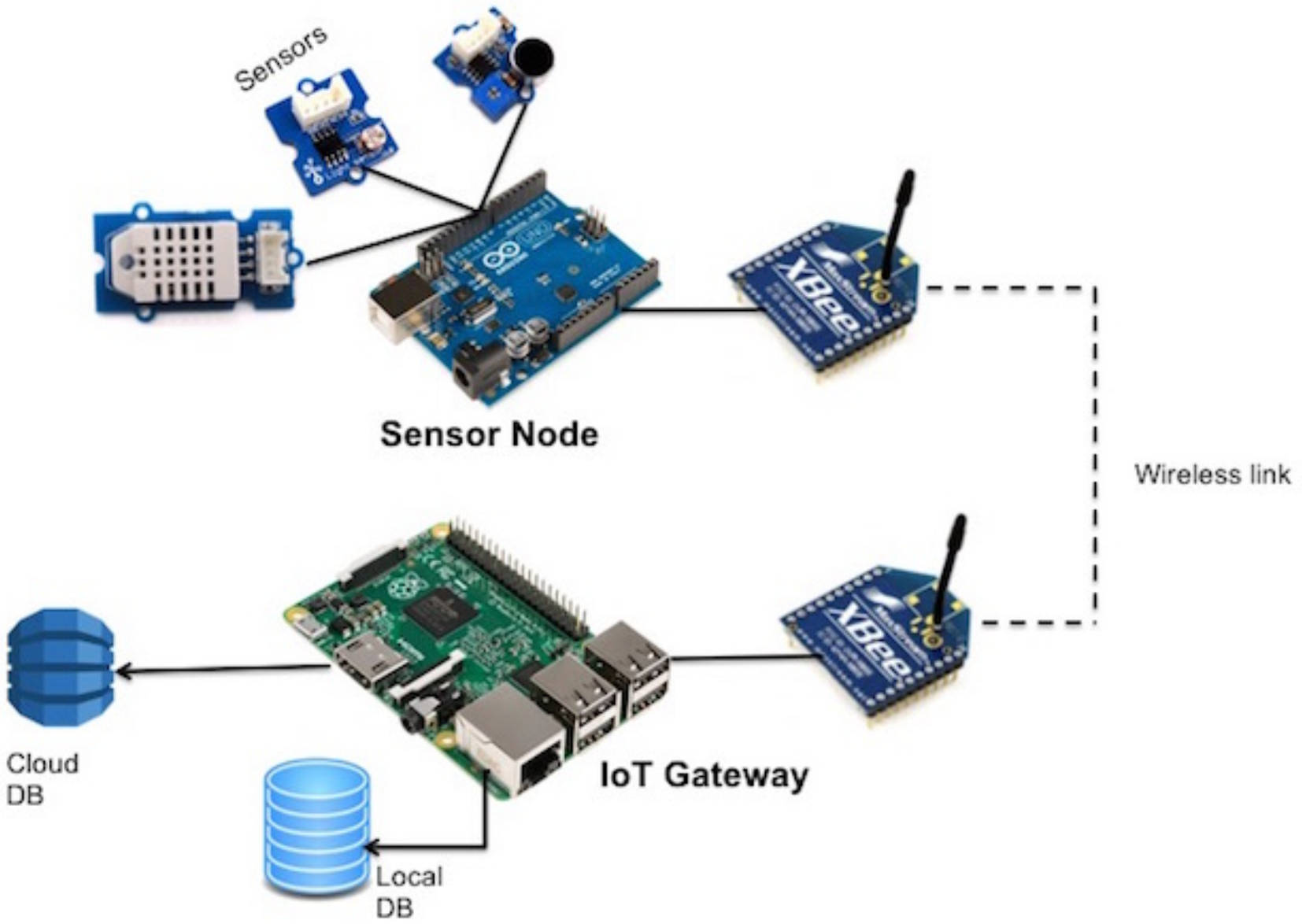
SIM800

Practical Flow for Best Cold Chain Problem

Sensors	Nodes	Gateway	Web Services	Data Stores	Analytics	Visualization
				mongoDB		NVD3.js
Read, Calibrate and Display data from sensors  	Develop code for reading SMS through Arduino and trigger the Alarm.	Send the data to cloud using GPRS  Send the data to cloud using WiFi	Create a REST based Web Service to send truck sensor data on the cloud amazon web services™ IBM Bluemix™ Microsoft Azure Learn how to create cloud based programs	Write the program to store the truck sensor data in NoSql Database.	Analyze the data to solve business problem.  	Generate a neat report to visualize the data for management.  View and Control from Mobile App  

Introduction to Sensor, Nodes & Gateway

Sensor Node and Gateway



IoT Clouds

- Device management and integration support
- Information security
- Data collection protocols
- Data analytics

IoT Software Platforms (Cloud)

Artik Cloud

Autodesk Fusion Connect

AWS IOT

GE Predix

Google Cloud IoT

Microsoft Azure IoT Suite

IBM Watson IoT

ThingWorx

Salesforce IoT Cloud

Telit DeviceWise

Xively

Zebra Zatar Cloud

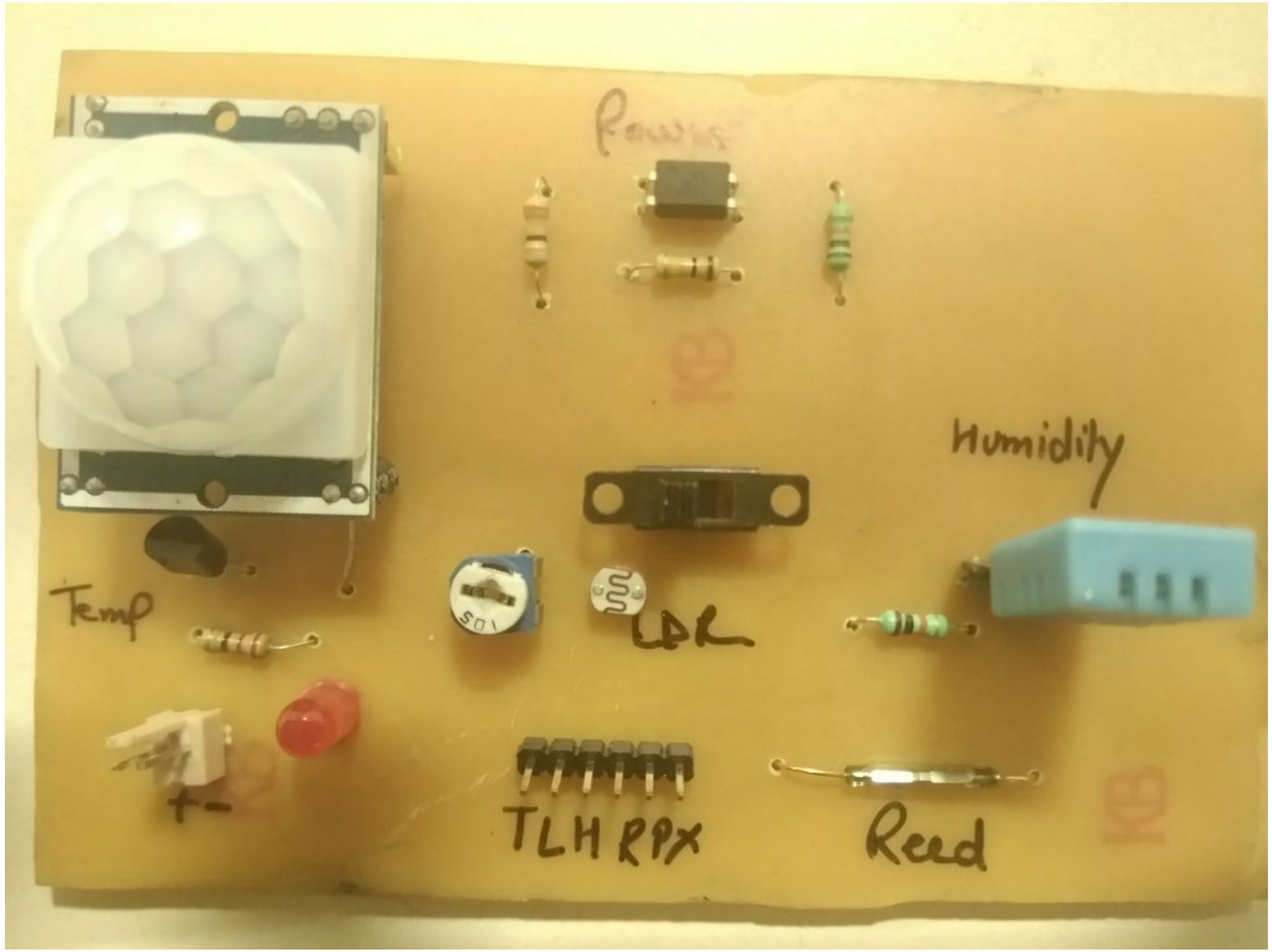
Kaa (Open Source)

✓ ThingSpeak (Open Source)

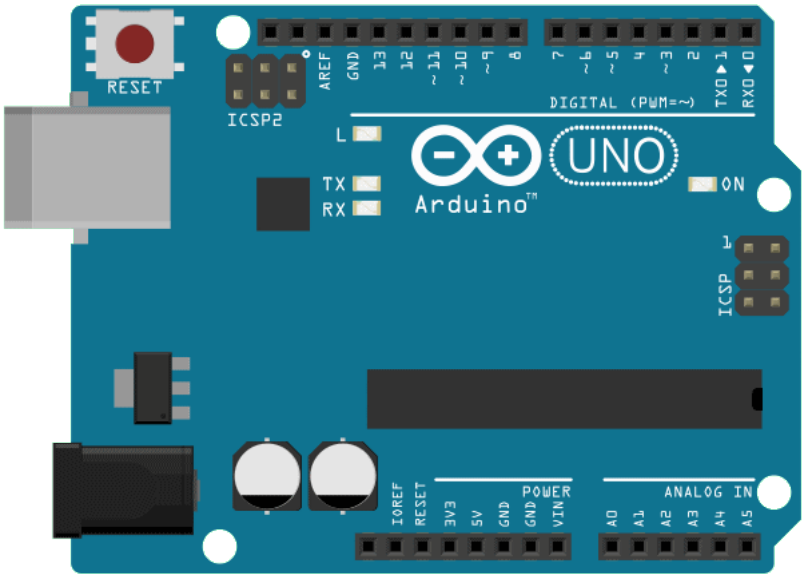
Hands On

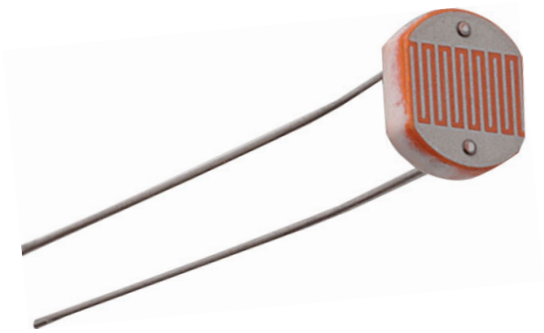
Introduction to Sensor Board

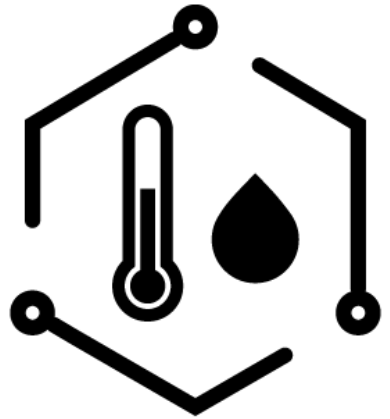
Sensor Board

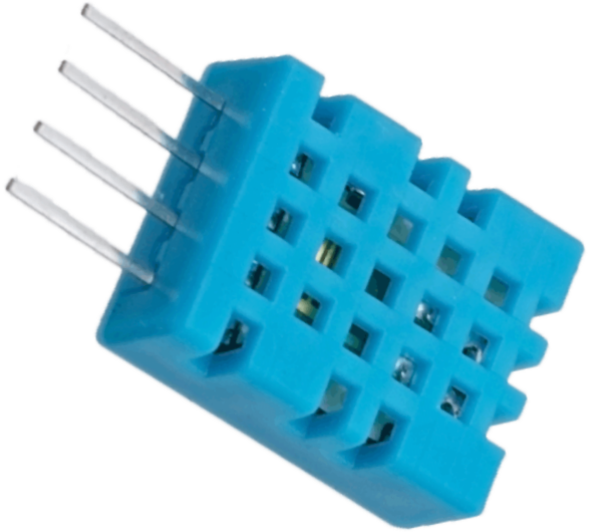


Analog Sensors

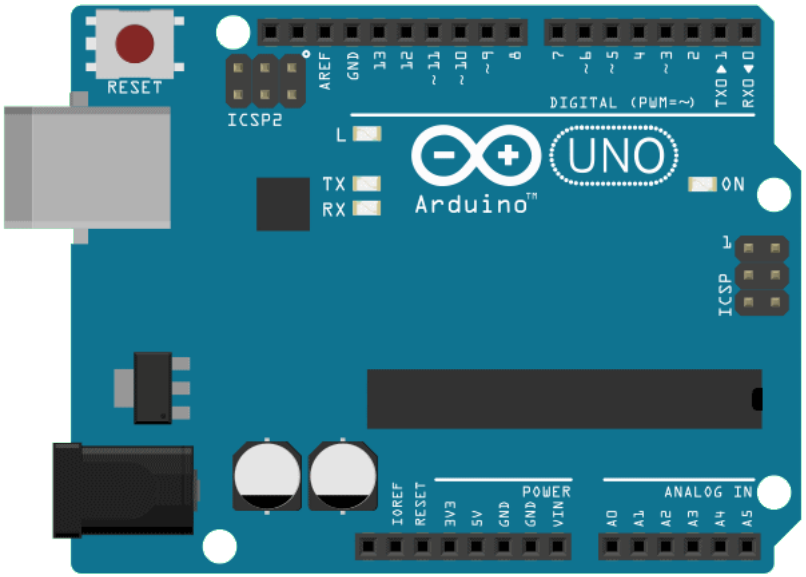


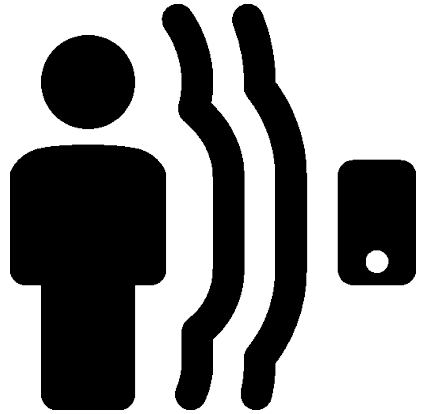




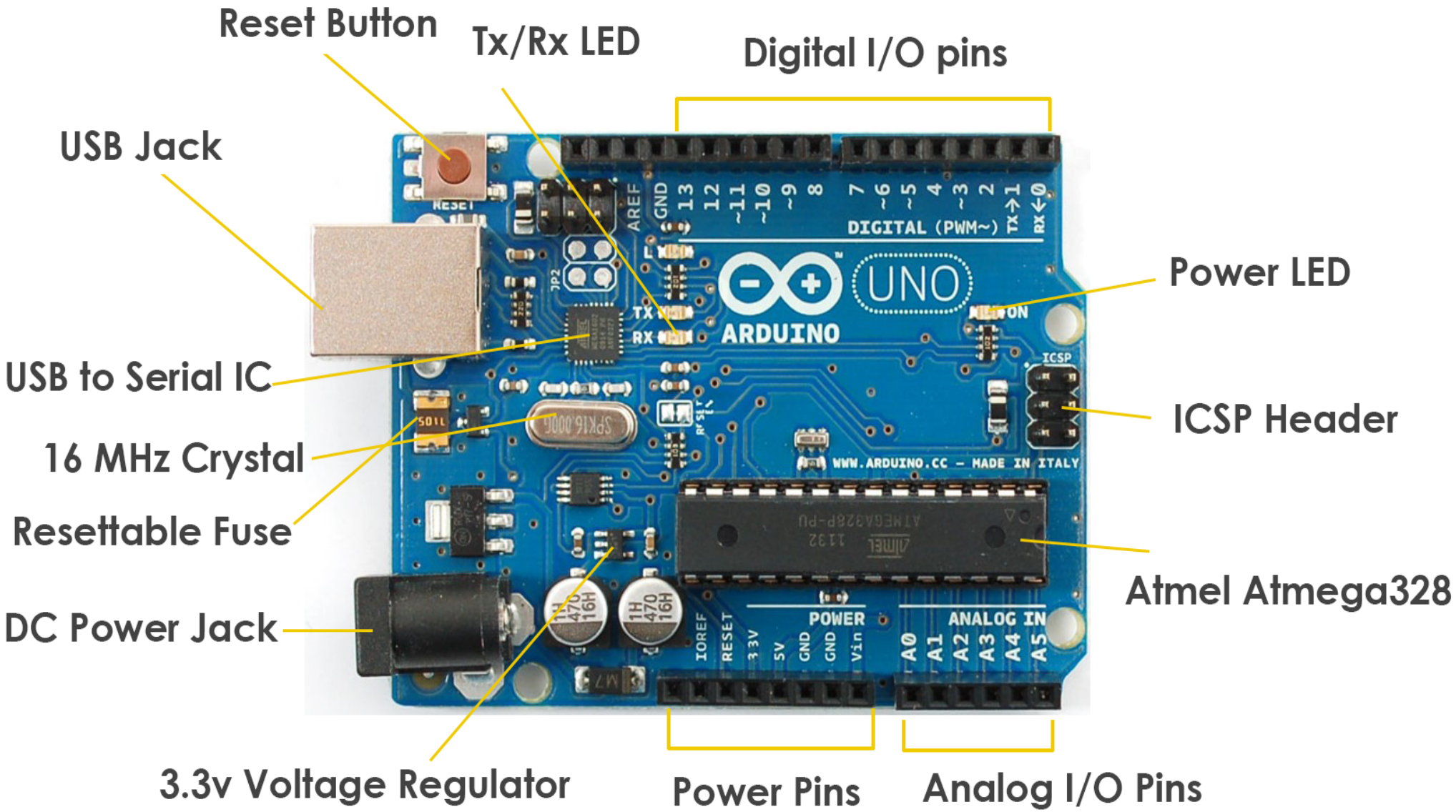


Digital Sensors





Introduction to Arduino


Reset Button
Tx/Rx LED
Digital I/O pins
USB Jack
Power LED
USB to Serial IC
ICSP Header
16 MHz Crystal
Resettable Fuse
Atmel Atmega328
DC Power Jack
3.3v Voltage Regulator
Power Pins
Analog I/O Pins
UNO
ARDUINO
DIGITAL (PWM~)
POWER
ANALOG IN
WWW.ARDUINO.CC – MADE IN ITALY

Programming Language Components

Structure	Variables	Functions
Basic syntax	Constants	Digital I/O
Arithmetic operators	Data types	Analog I/O
Control structures	Scope	Math
Comparison Operators		Serial communication
Boolean Operators		Defining your own

Programming Language Components

Structure	Variables	Functions
Basic syntax	Constants	Digital I/O
Arithmetic operators	Data types	Analog I/O
Control structures	Scope	Math
Comparison Operators		Serial communication
Boolean Operators		Defining your own

Structure: Basic Syntax

; Each statement ends in a semicolon.
For example: `int a = 13;`

{ } Curly braces always come in pairs; they are used to define the start and end of functions, loops, and conditional statements.
For example:

```
while (boolean expression)
  {
     statement(s)
  }
```

// Single line comment

/* */ Multi-line comment

#define Used to give a name to a constant value.
For example:

```
#define ledPin 3
```

Structure: Arithmetic Operators

Assignment operator stores the value to the right of the equal sign in the variable to the left of the equal sign: `sensorVal = analogRead(FSRPin);`

Addition, subtraction, multiplication, and division. For example:

```
+     result     = value1 + value2;
-     result     = value1 - value2;
*     result     = value1 * value2;
/     result     = value1 / value2;
```

where `value1` and `value2` are any variables or constants

Tips:

- Choose variable sizes that are large enough to hold the largest calculated result
- For math that requires fractions, use float variables (but there are drawbacks)
- Check for order of operations; use parentheses to enforce order

Structure: Control Structures

`if` Tests whether a certain condition has been reached. Used in conjunction with a comparison operator.
For example:

```
if (someVariable > 50)
{
  // do something here
}
```

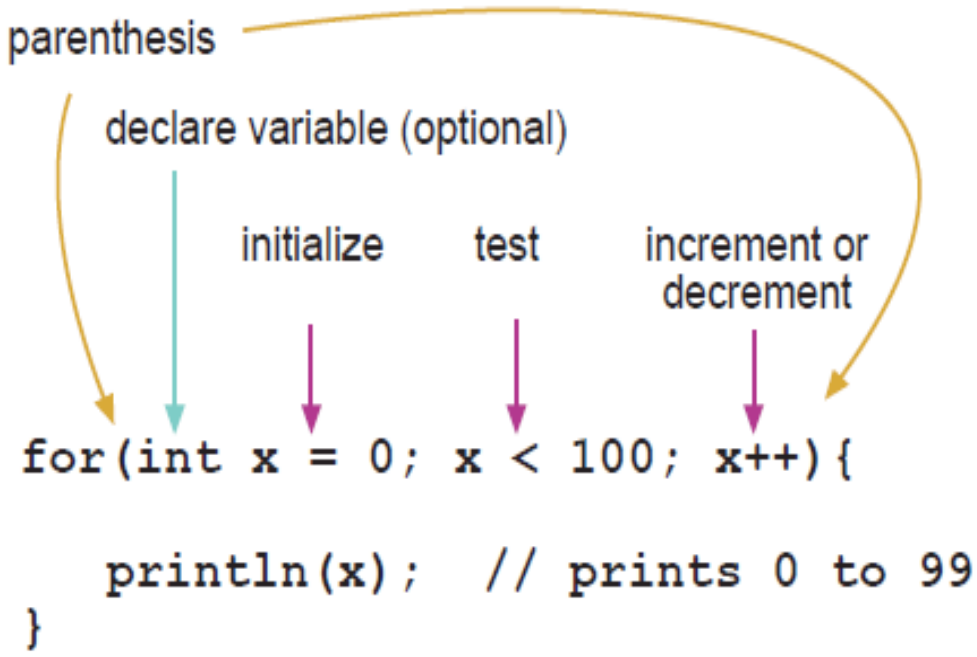
`if...else` Allows you to do multiple tests.
For example:

```
if (force > 1)
{
  // action A
}
else
{
  // action B
}
```

Structure: Control Structures

`for` Creates a loop for repetitive operations.

```
for (initialization; condition;  increment) {
  //statement(s);
}
```



Structure: Control Structures

`switch case` Allows you to specify different code that should be executed in various conditions. For example:

```
switch (var)
  {  case 1:
    //do something when var equals 1
    break;
  case 2:
    //do something when var equals 2
    break;
  default:
    // if nothing else matches, do the default
    // default is optional
}
```

Tips:

- Be careful not to accidentally use the assignment operator = instead of ==.
- Cannot use statements such as `0 < x < 1`; need to do each comparison separately

Structure: Comparison Operator

The result of a statement with a comparison operator is either TRUE (1) or FALSE (2)

```
x == y (x is equal to y)
x != y (x is not equal to y)
x <  y (x is less than y)
x >  y (x is greater than y)
x <= y (x is less than or equal to y)
x >= y (x is greater than or equal to y)
```

Tips:

- Be careful not to accidentally use the assignment operator `=` instead of `==`.
- Cannot use statements such as `0 < x < 1`; need to do each comparison separately

Structure: Boolean Operator

`&&` Logical AND. True only if both operands are true, e.g.

```
if (digitalRead(2) == HIGH  && digitalRead(3) == HIGH) {
  // do this only if both inputs are high
}
```

`||` Logical OR. True if either operand is true, e.g.

```
if (x > 0 || y > 0) {
  // do this if either x or y is greater than 0
}
```

`!` NOT. True if the operand is false, e.g.

```
if (!x) {
  // do this if x is false (0)
}
```

Programming Language Components

Structure	Variables	Functions
Basic syntax	Constants	Digital I/O
Arithmetic operators	Data types	Analog I/O
Control structures	Scope	Math
Comparison Operators		Serial communication
Boolean Operators		Defining your own

Variables: Constants

`HIGH` / `LOW` — When reading or writing to a digital pin, there are only two possible values a pin can take (or be set to): HIGH and LOW

`true` / `false` — Logical levels (result of a comparison):
false is defined as 0
true is defined as 1 (but more broadly, anything but 0)

In addition, integer and floating-point constants can be used:

Decimal integers

```
2
101
3200
```

Floating point

```
10.0
2.34E5
67e-12
```

Variables: Data Types

`void` Used in function delcarations to indicate that the function returns no information. For example:

```
void setup()
{
  // ...
}
```

```
void loop()
{
  // ...
}
```

`boolean` A boolean holds one of two values, true or false.For example:

```
boolean running = false;
if (running) {
// do something
}
```

Variables: Data Types

`char` A data type that stores a character value. For example:

```
char myChar = 'A';
char myChar = 65;     // both are equivalent
```

Coding is in this ASCII chart: http://arduino.cc/en/Reference/ASCIIchart

`float` Datatype for floating-point numbers, a number that has a decimal point.

`double` Floating-point numbers are often used to approximate analog and continuous values because they have greater resolution than integers. Floats have 6-7 decimal digits of precision. On the Hapkit board, `double` is the same as `float`.

Variables: Scope

Global vs. Local:

- A **global** variable is one that can be seen by every function in a program. Define it outside a function.
- A **local** variable is only visible to the function in which it is declared. Define it inside a function.
- For complex programs, local variables can help prevent programming errors. However, global variables are an easy way to share information across functions.

The **static** keyword is used to create variables that are visible to only one function. However unlike local variables that get created and destroyed every time a function is called, static variables persist beyond the function call, preserving their data between function calls.

For example: `static int a;`

Programming Language Components

Structure	Variables	Functions
Basic syntax	Constants	Digital I/O
Arithmetic operators	Data types	Analog I/O
Control structures	Scope	Math
Comparison Operators		Serial communication
Boolean Operators		Defining your own

Functions: Digital I/O

For a description of the roles of different pins on the Arduino/Hapkit,see
http://arduino.cc/en/Tutorial/DigitalPins

`pinMode(pin, mode)`	Configures the specified pin to behave either as an input or an output. `pin` is the pin number.
`digitalWrite(pin, value)`	Write a `HIGH` or a `LOW` value to a digital pin.
`digitalRead(pin)`	Reads the value from a specified digital pin. The result will be either HIGH or LOW.

Functions: Analog I/O

`analogReference(type)`	The default reference voltage is 5V. This can be changed to a different `type` and different resolution using this function.
`analogRead(pin)`	Reads the value from the specified analog pin and returns a value between 0 and 1023 to represent a voltage between 0 and 5 volts (for default). It takes about 0.0001 seconds to read an analog pin.
`analogWrite(pin,value)`	Writes an analog value (PWM wave) to a pin. `value` is the duty cycle: between 0 (always off) and 255 (always on). Works on pins 3, 5, 6, 9, 10, and 11.

Functions: Math

`min(x, y)`	Calculates the minimum of two numbers
`max(x, y)`	Calculates the maximum of two numbers
`abs(x)`	Computes the absolute value of a number
`pow(base, exponent)`	Calculates the value of a number raised to a power
`sqrt(x)`	Calculates the square root of a number
`map(value, fromLow, fromHigh, toLow, toHigh)`	Re-maps a number from one range to another. That is, a value of `fromLow` would get mapped to `toLow`, a value of `fromHigh` to `toHigh`, values in between to values in between.

Trigonometric functions such as `sin`, `cos`, and `tan` are also available.

Functions: Serial Communication

Typically used for communication between an Arduino board and a computer via the USB port. Use the **serial monitor** to communicate with the board.

`Serial.begin(9600);` Used to begin serial communications, typically at a 9600 baud rate (bits per second)

`Serial.print(val,format);` Prints data to the serial port as human-readable ASCII text. Examples:

```
Serial.print(78) gives "78"
Serial.print(1.23456) gives "1.23"
Serial.println(1.23456, 4) gives "1.2346"
Serial.print("Hello world.") gives "Hello world."
```

`Serial.println(val);` Prints `val` followed by carriage return

Functions: Defining your own

- Many other functions have been created by Arduino users; some are posted at http://playground.arduino.cc/Main/GeneralCodeLibrary

- You can also define your own function.
- This could be used to make your code more organized and efficient.

```
int find_text(String needle, String haystack)
{
```

This is a function that searches for a given string within another string. If the search string is found its position is returned, otherwise -1 is returned.

```
}
```

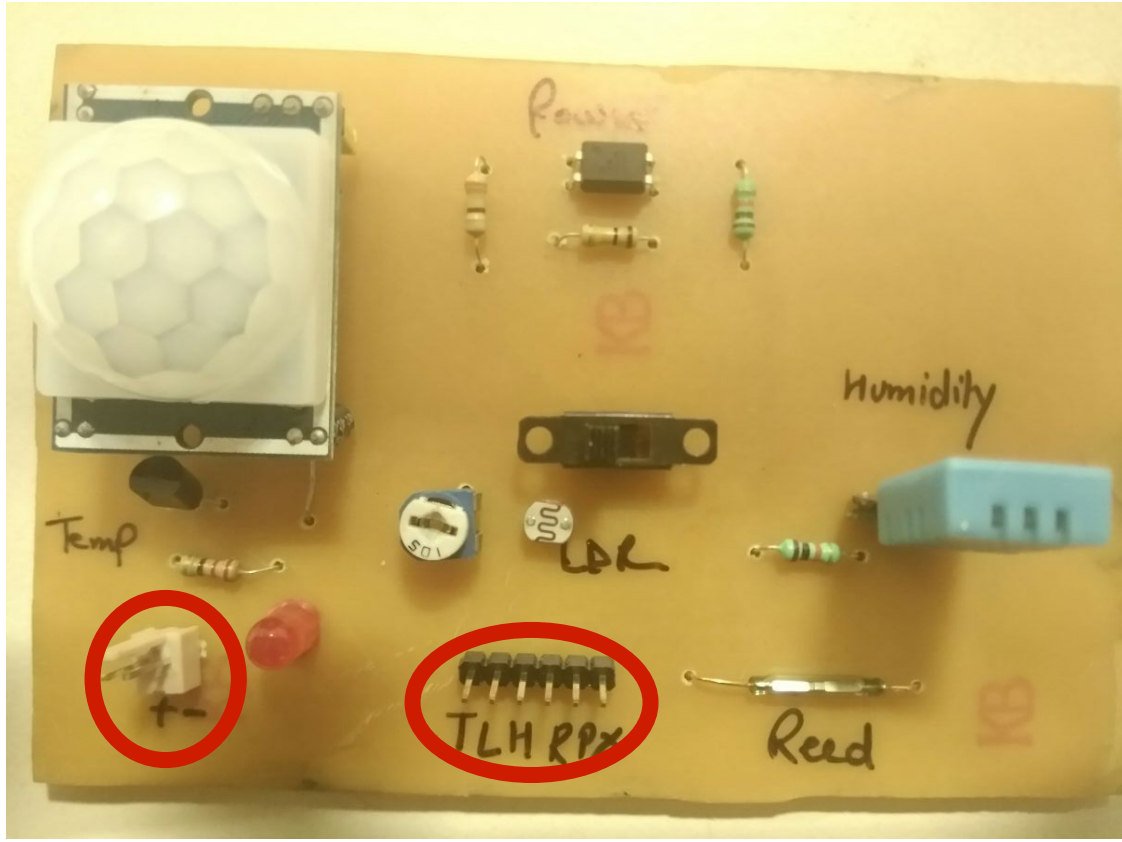
Installation of Arduino

Hello World for Arduino

Sensor Board Wiring

(+) to Arduino +5V

(–) to Arduino GND



Analog Line

T – Temperature Sensor (A2)

H – Humidity Sensor (A5)

L – Light Sensor (LDR) (A4)

Digital Line

P – Power Switch based on Optocoupler (4)

R – Magnetically operated Reed Switch (5)

X – PIR (Passive Infrared Sensor) (3)

Analog vs Digital

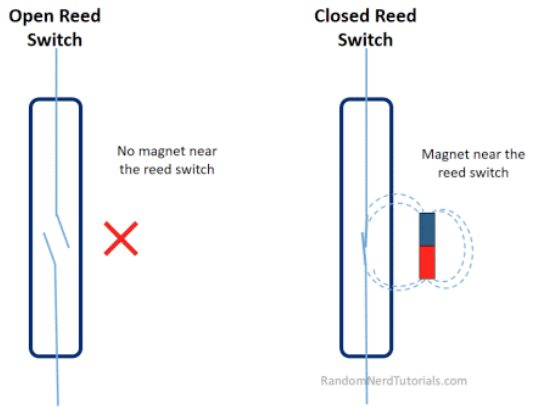
23:59:59

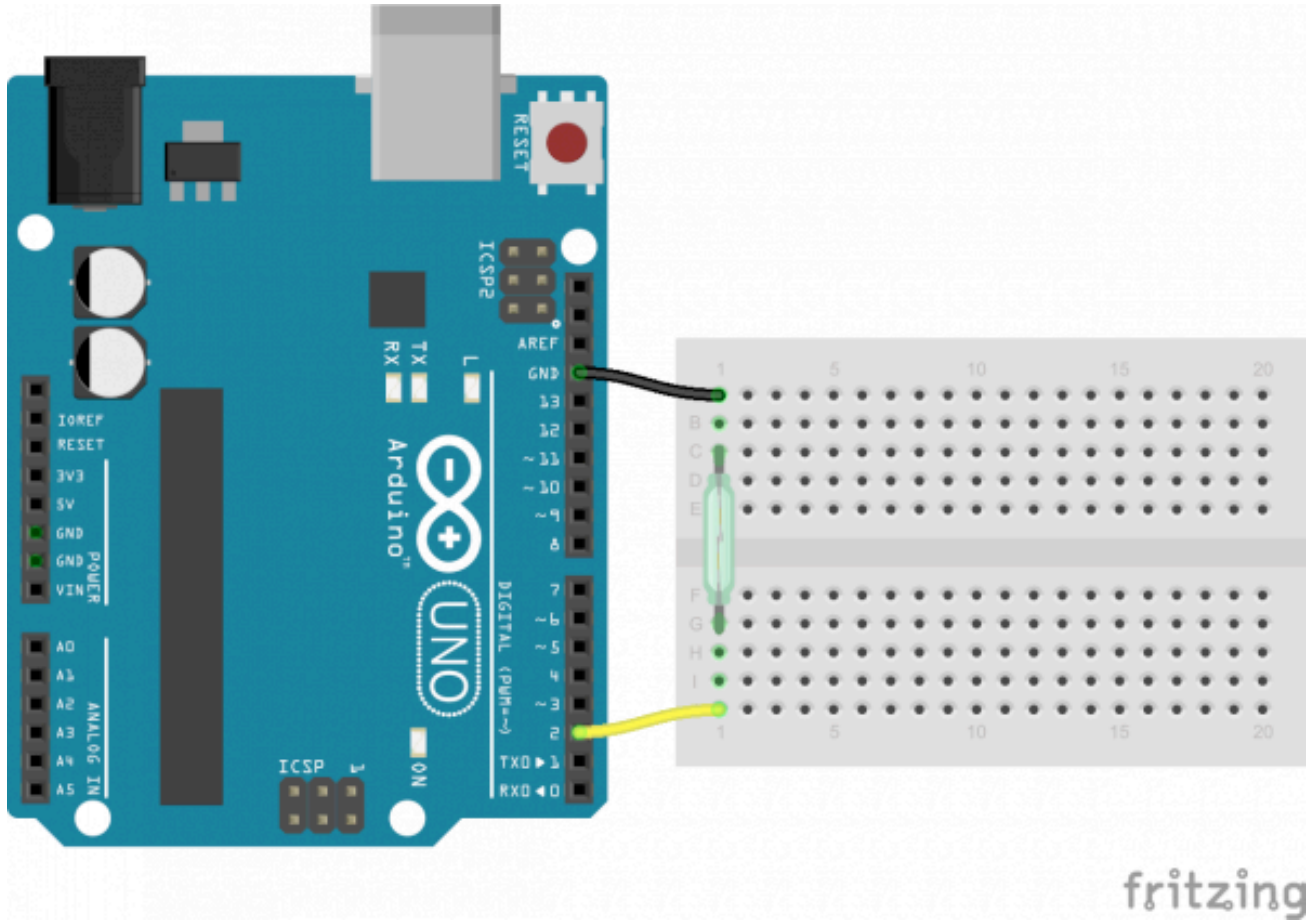
PIR Sensor

Pin Wiring

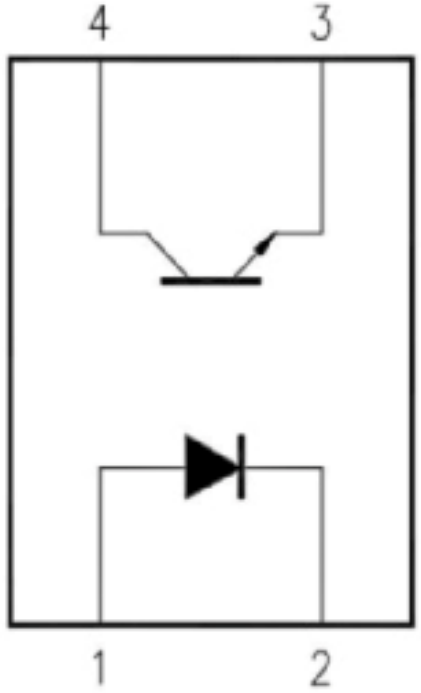
Pin Name	Wiring to Arduino Uno
OUT	Digital Pin 2
GND	GND
VCC	5V

Reed Sensor


Open Reed Switch
No magnet near the reed switch
Closed Reed Switch
Magnet near the reed switch
RandomNerdTutorials.com


RESET
ICSP2
AREF
GND
13
12
~11
~10
~9
8
7
~6
~5
4
~3
2
TX→1
RX←0
DIGITAL (PWM~)
TX
RX
L
ON
ICSP
IOREF
RESET
3V3
5V
GND
GND
VIN
POWER
A0
A1
A2
A3
A4
A5
ANALOG IN
Arduino
UNO
fritzing

PC817 Power Sensor



1. Anode
2. Cathode
3. Emitter
4. Collector

Pin Name	Wiring to Arduino Uno
D0	Digital Pins
GND	GND
VCC	5V

Analog vs Digital

23:59:59

What is ADC ?

The ADC on the Arduino is a 10-bit ADC meaning it has the ability to detect 1,024 (2^{10}) discrete analog levels.

Some micro-controllers have 8-bit ADCs (2^8 = 256 discrete levels).

Some have 16-bit ADCs (2^{16} = 65,536 discrete levels).

The ADC reports a ratiometric value. This means that the ADC assumes 5V is 1023 and anything less than 5V will be a ratio between 5V and 1023.

$$\frac{Resolution\ of\ the\ ADC}{System\ Voltage} = \frac{ADC\ Reading}{Analog\ Voltage\ Measured}$$

$$\frac{1023}{5} = \frac{ADC\ Reading}{Analog\ Voltage\ Measured}$$

What is ADC ?

If the analog voltage is 2.12V what will the ADC report as a value ?

$$\frac{1023}{5.00V} = \frac{x}{2.12V} \qquad \frac{1023}{5.00V} * 2.12V = x \qquad x = 434$$

If your system is 3.3V and your ADC is reporting 512, what is the voltage measured ?

What is ADC ?

What happens if you connect an analog sensor to a regular digital pin ?

int x = analogRead(8);

//Try to read the analog value on digital pin 8 - compiles but does not give right value !

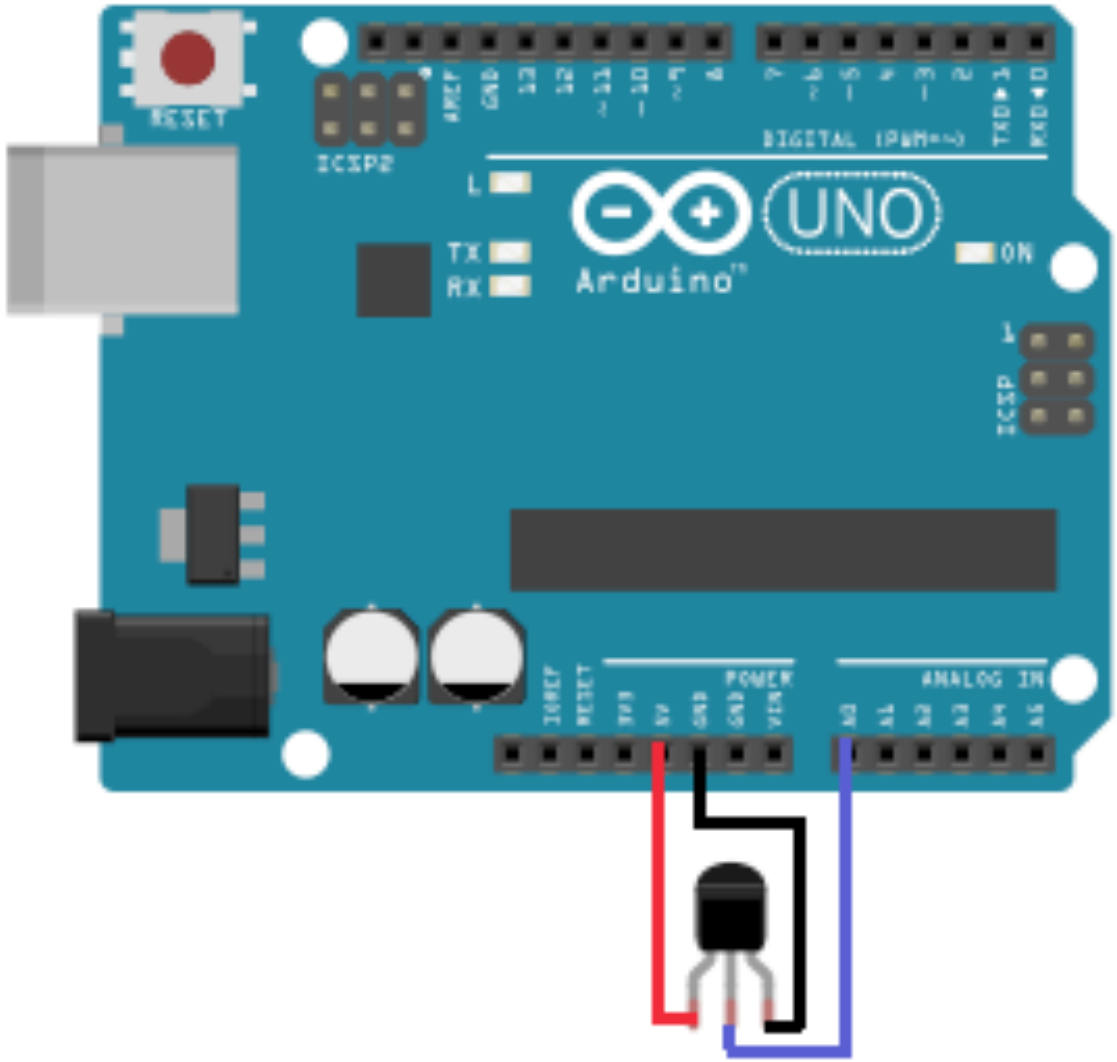
What happens if I connect digital sensor to an analog pin ?

If you do an analog-to-digital conversion on a button, you will most likely see ADC values very close to 1023 (or 5V which is binary 1)

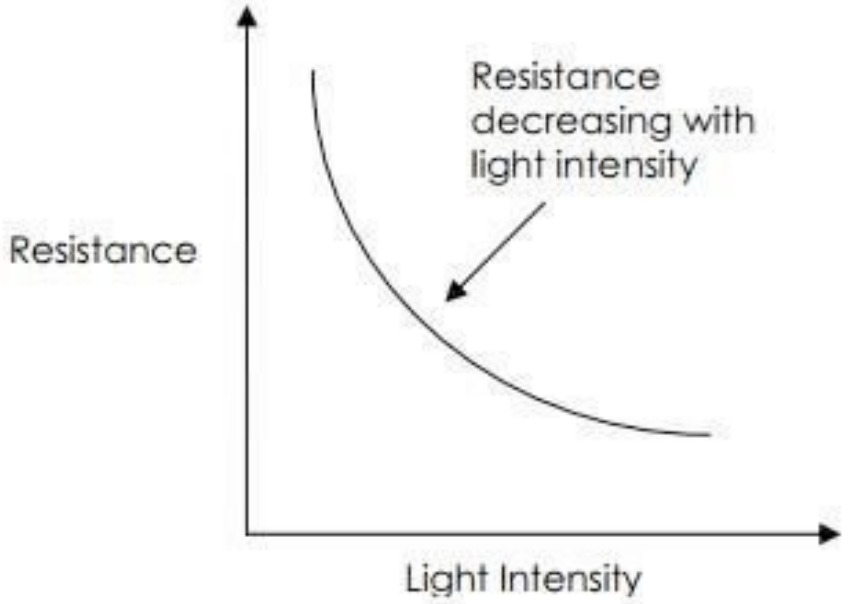
or very close to 0 (or 0V which is binary 0).

```
pinMode(A3, INPUT); // Setup the pin mode
int x = analogRead(A3); //Reads the analog value on pin A3 into x
Serial.print("Analog value: ");
Serial.println(x);  // Prints the value on the Serial Monitor
```

LM35 Temperature Sensor



LDR Light Sensor

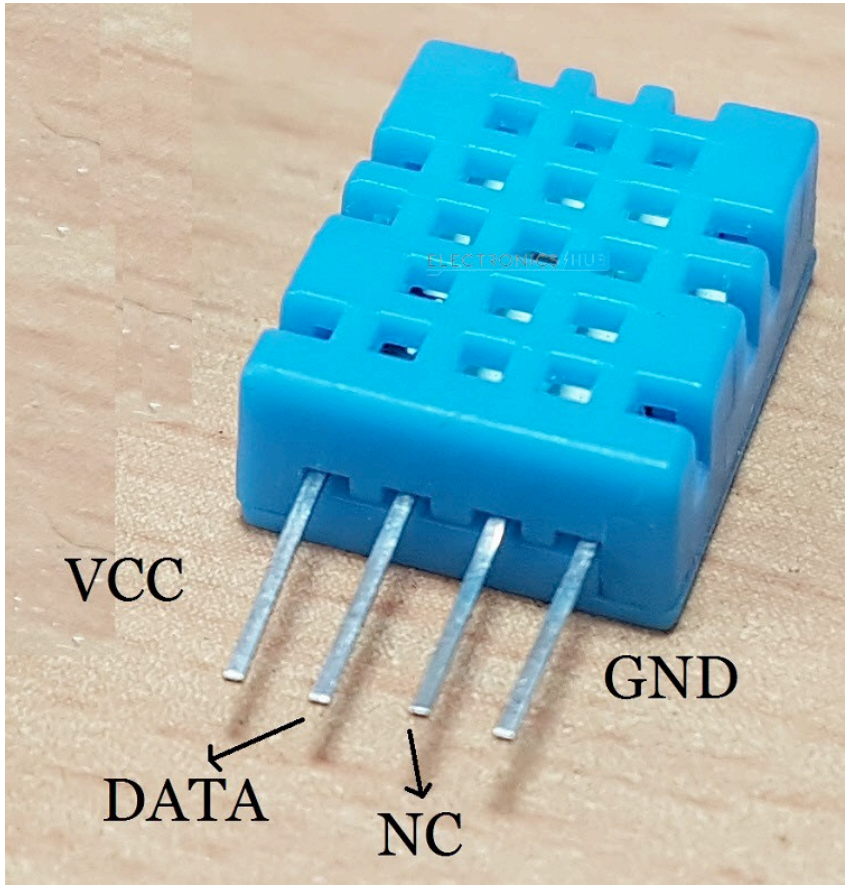


Pin Wiring

Wiring your sensor to the Arduino is pretty simple:

Pin	Wiring to Arduino Uno
Right Pin	Analog Pin
Left Pin	5V

DHT11 Humidity Sensor



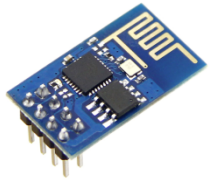
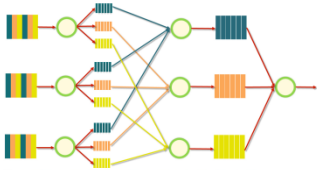
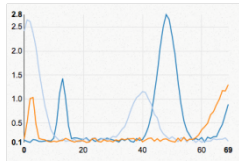
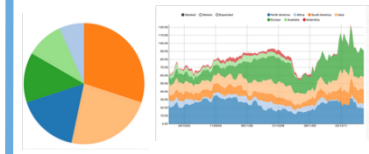
Pin Wiring

Wiring your sensor to the Arduino is pretty simple:

Pin	Wiring to Arduino Uno
Data	Analog Pin(A0-A5)
NC	Not Used
GND	GND
VCC	5V

Installation of Third Party Libraries (DHT11.zip)

Practical Flow for Best Cold Chain Problem

Sensors ✓	Nodes	Gateway	Web Services	Data Stores	Analytics	Visualization
Read, Calibrate and Display data from sensors 	Develop code for reading SMS through Arduino and trigger the Alarm.	Send the data to cloud using GPRS  Send the data to cloud using WiFi	Create a REST based Web Service to send truck sensor data on the cloud amazon web services™ IBM Bluemix™ Microsoft Azure Learn how to create cloud based programs	Write the program to store the truck sensor data in NoSql Database.	Analyze the data to solve business problem.  	Generate a neat report to visualize the data for management. View and Control from Mobile App 

Experiments

1. digital_sensor_check.ino
2. all_digital_sensor_check.ino
3. analog_sensor_check.ino
4. all_analog_sensor_check.ino
5. all_sensor_check.ino

Data Exchange Mechanisms

Data Exchange

JSON

- JavaScript Object Notation
- Used to send data between server and mobile app
- Simple data interchange format
- Human readable
- Programming language independent

JSON Data Structure

- Object
  - { "key1": "value1", "key2": "value2" }
- Array
  - [“first“, “second“, “third“, “fourth"]
- Number
  - 42, 3.21
- String
  - “This is string”
- Boolean
  - True, False
- Null
  - Null

JSON Example

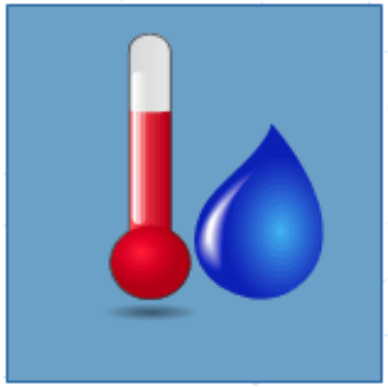
```
{
"door_operation":"1",
"power_status":"1",
"temperature":"30.5",
"humidity":"37",
"trip_id":"120",
"device_type":"ColdChain",
"device_no":"9928492120",
"type":"transaction"
}
```

```
{
"field1":"1",
"field2":"1",
"field3":"30.5",
"field4":"37",
"field5":”120",
"field6":”ColdChain",
"field7":"9928492120",
"field8":”transaction"
}
```

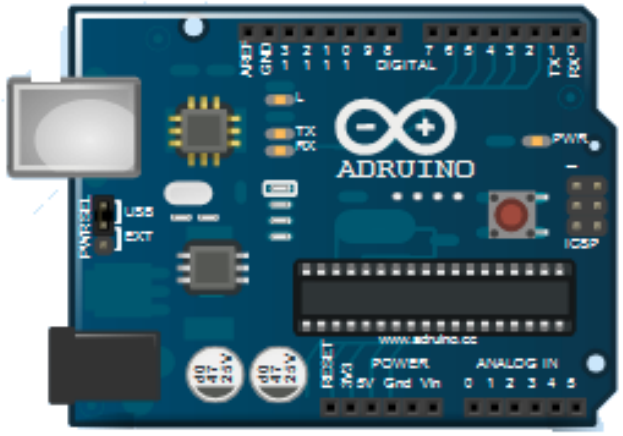
Summary

Visualize

Send /JSON



Read



Sensor

Arduino

How to use REST API ?

REST APIs – Weather Details

- **OpenWeatherMap** is an online service that provides weather data, including current weather data, forecasts, and historical data to the developers of web services and mobile applications

- http://openweathermap.org/api

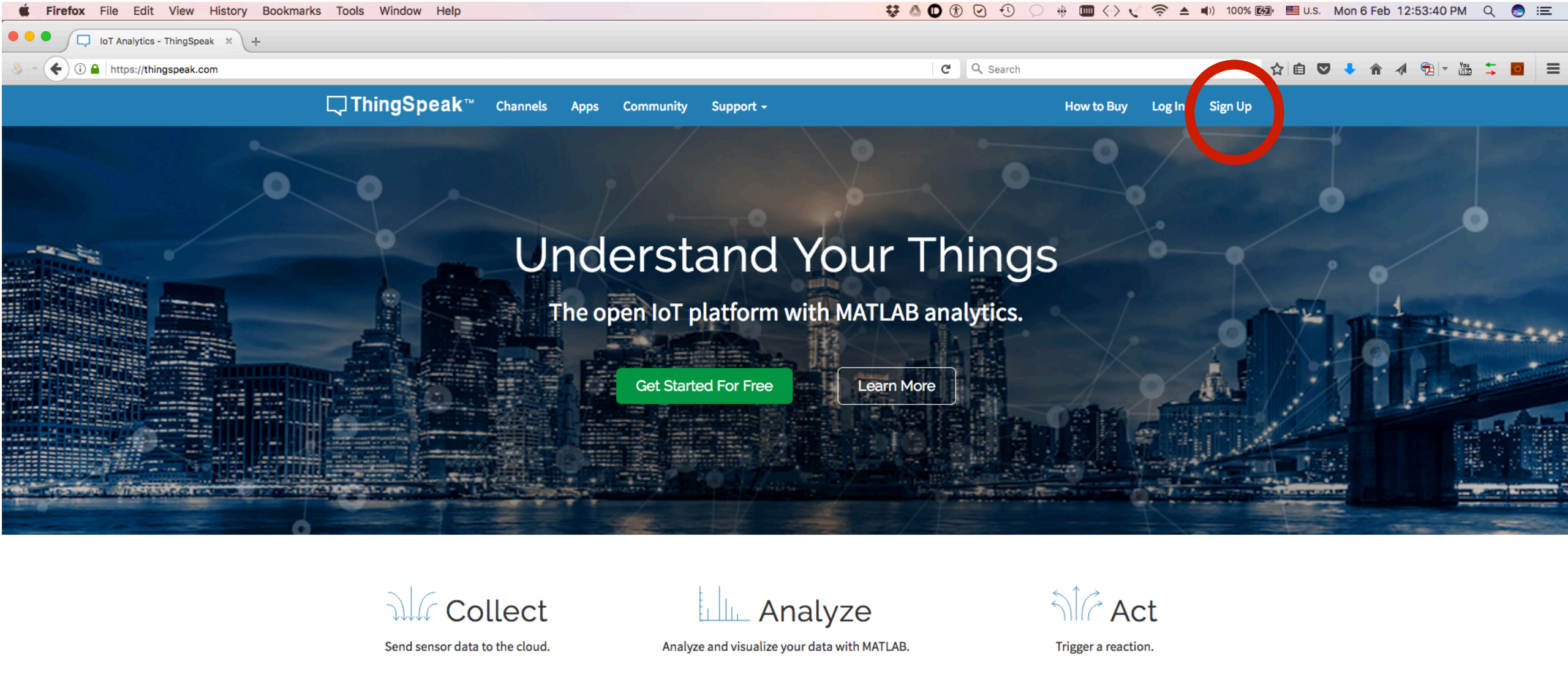
- To access the API you need to sign up for an API key

Jaipur Weather Data – By Name

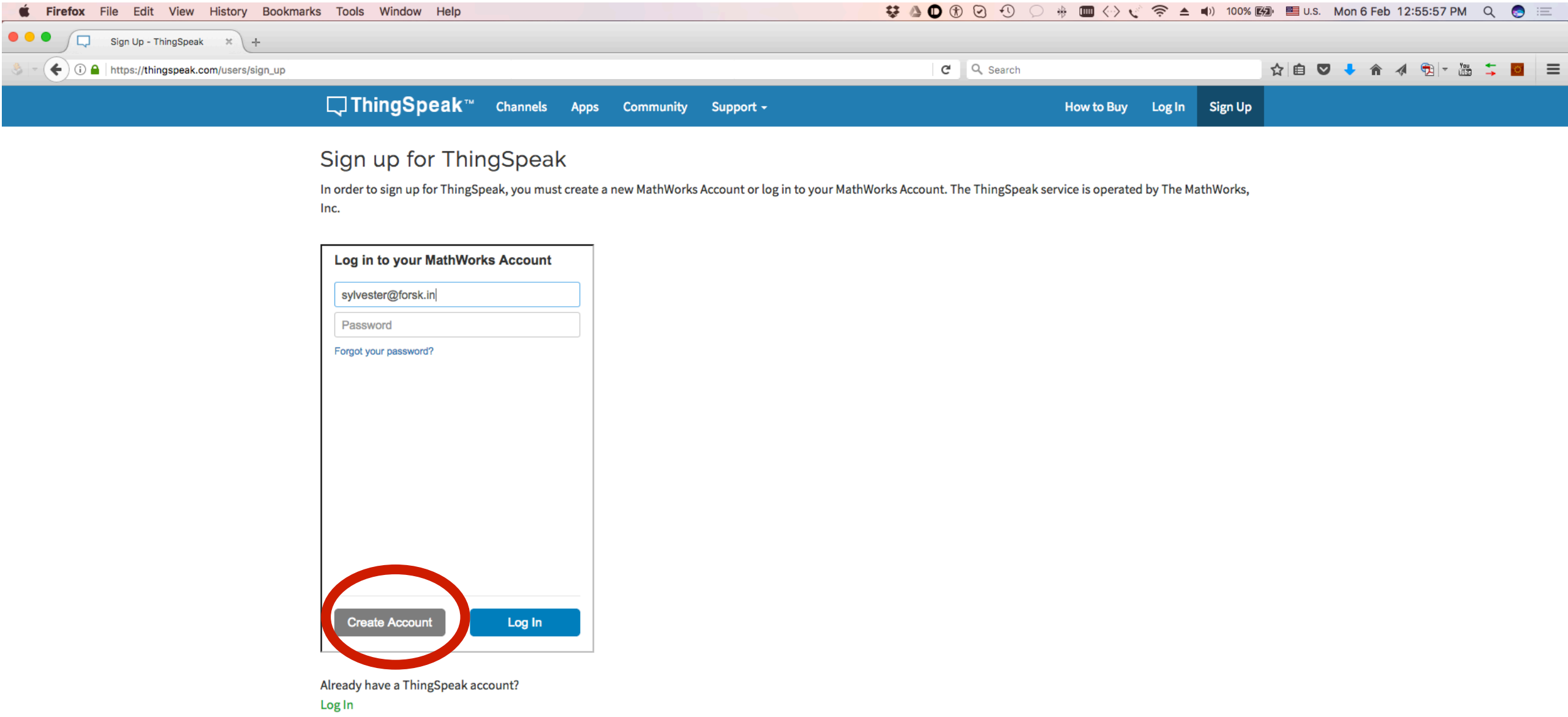
- **Calling API with City Name**
  - http://api.openweathermap.org/data/2.5/weather?q=Jaipur&appid=e9185b28e9969fb7a300801eb026de9c
- Use your API Key to get the data in your browser
- Re**sponse**
  - {"coord":{"lon":75.82,"lat":26.92},"weather":[{"id":800,"main":"Clear","description":"clear sky","icon":"01d"}],"base":"stations","main":{"temp":306.323,"pressure":975.65,"humidity":30,"temp_min":306.323,"temp_max":306.323,"sea_level":1021.8,"grnd_level":975.65},"wind":{"speed":3.49,"deg":315.504},"clouds":{"all":0},"dt":1476778298,"sys":{"message":0.0114,"country":"IN","sunrise":1476752290,"sunset":1476793496},"id":1269515,"name":"Jaipur","cod":200}

Cloud Signup

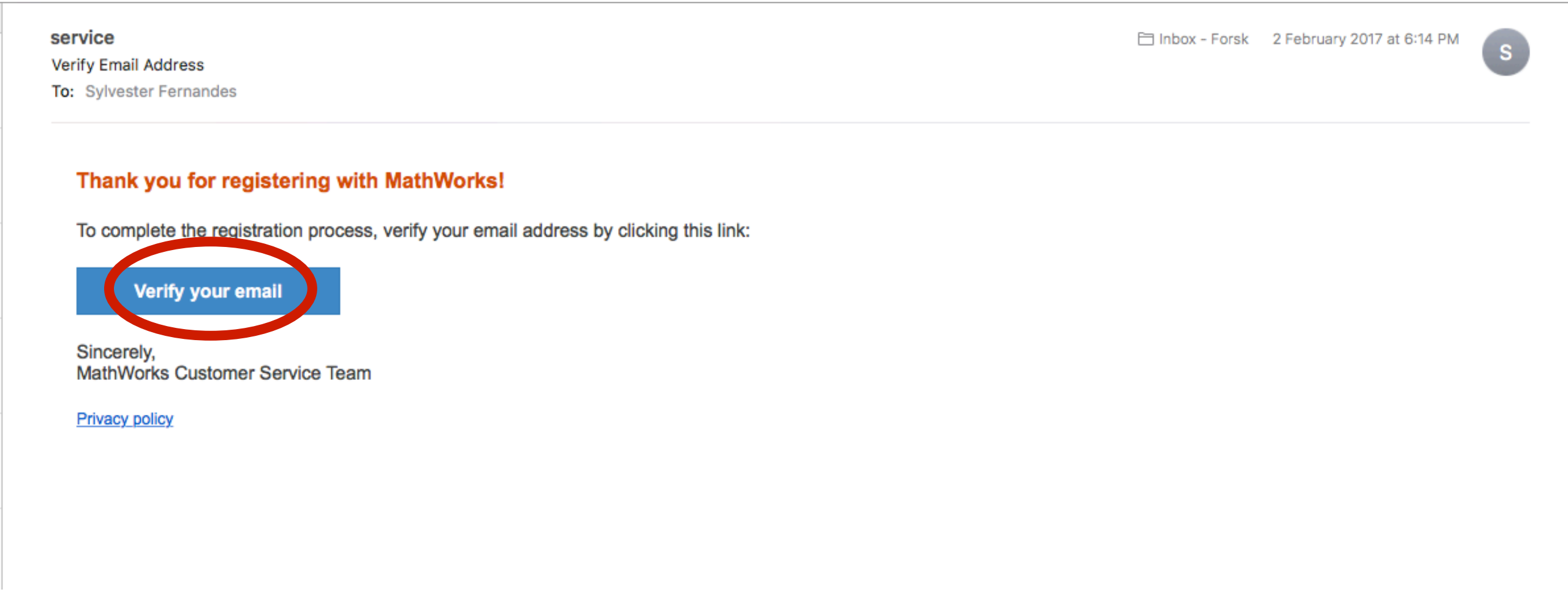
Step 1: Open https://thingspeak.com/



Step 2: SignUp



Step 3: Verify your email



service
Verify Email Address
To: Sylvester Fernandes

Inbox - Forsk 2 February 2017 at 6:14 PM

S

Thank you for registering with MathWorks!

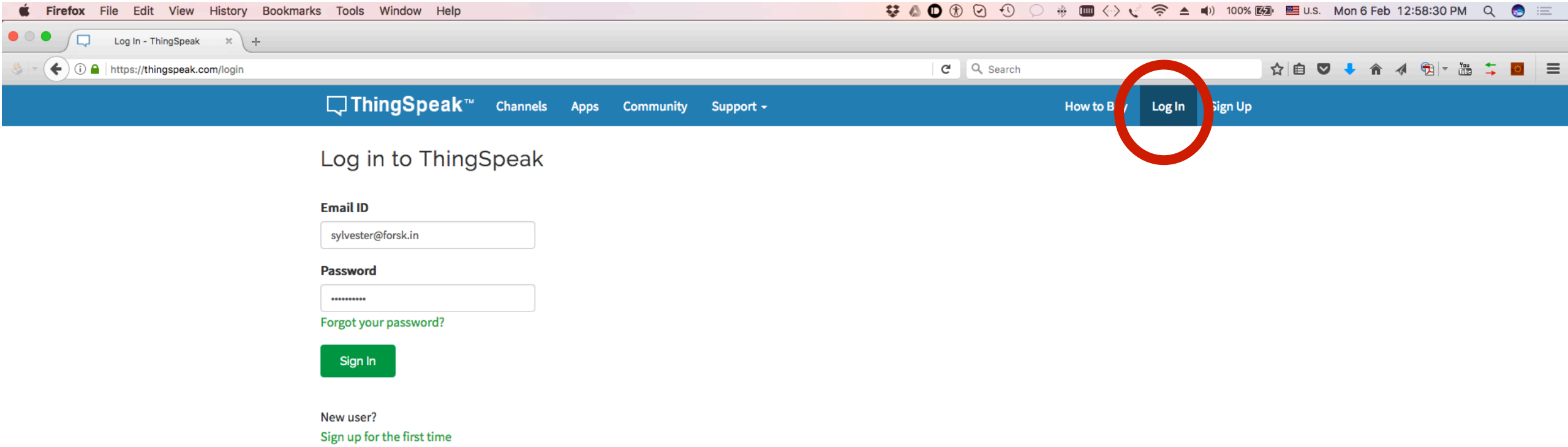
To complete the registration process, verify your email address by clicking this link:

Verify your email

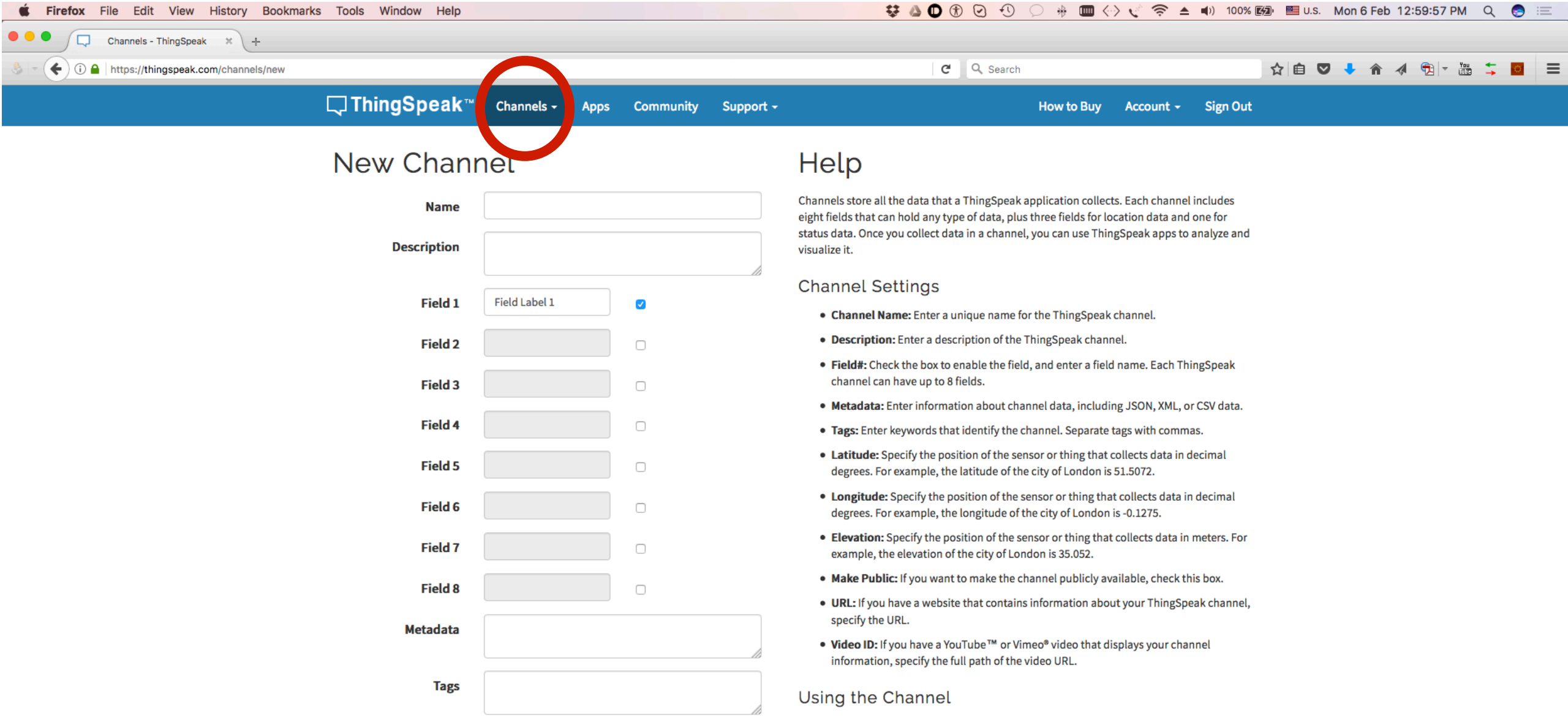
Sincerely,
MathWorks Customer Service Team

Privacy policy

Step 4: Login


Firefox File Edit View History Bookmarks Tools Window Help
100% U.S. Mon 6 Feb 12:58:30 PM
Log In - ThingSpeak
https://thingspeak.com/login
Search
ThingSpeak™ Channels Apps Community Support
How to B
Log In
Sign Up
Log in to ThingSpeak
Email ID
sylvester@forsk.in
Password
Forgot your password?
Sign In
New user?
Sign up for the first time

Step 5: Create a New Channel



Mapping

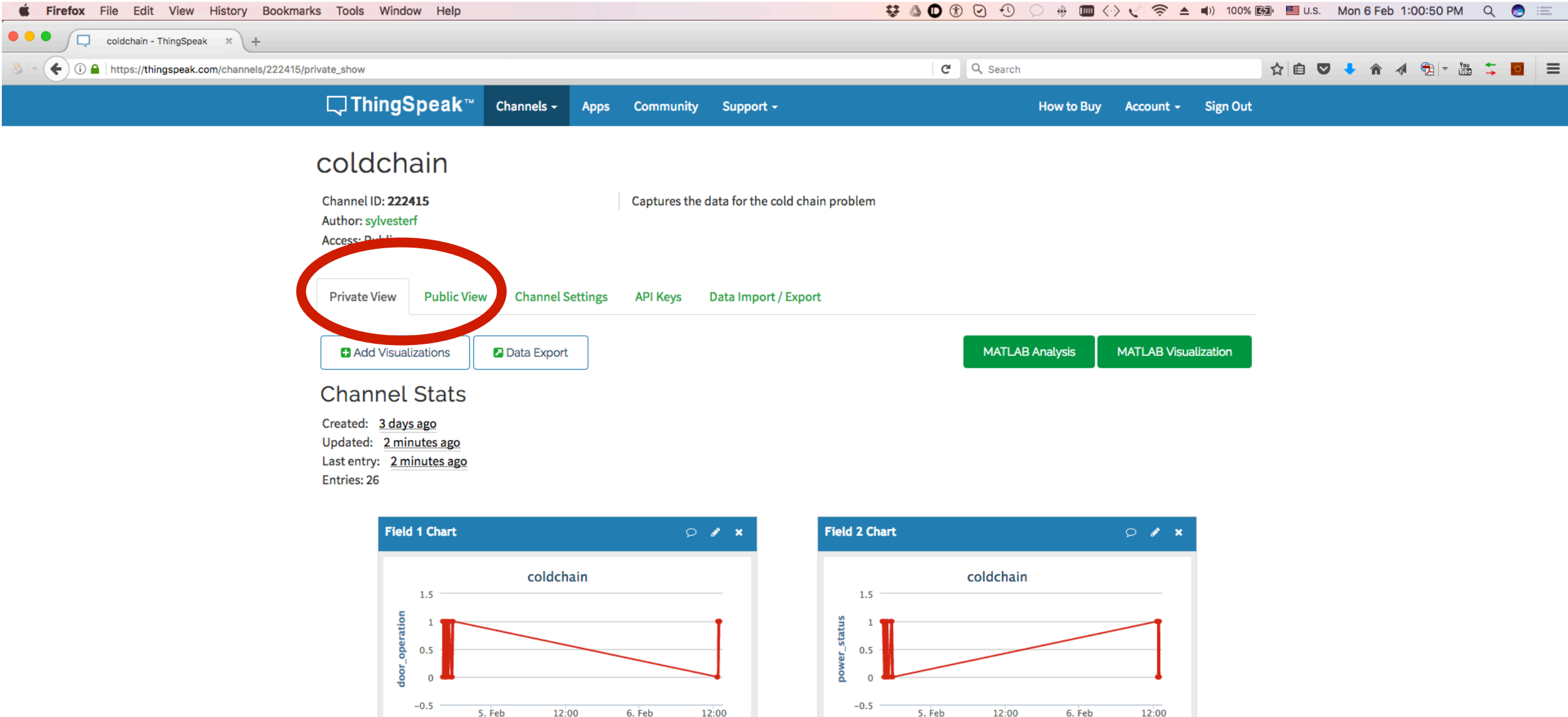
Field 1	id
Field 2	start_location
Field 3	end_location
Field 4	driver_name
Field 5	customer
Field 6	material
Field 7	device_no
Field 8	type

trips

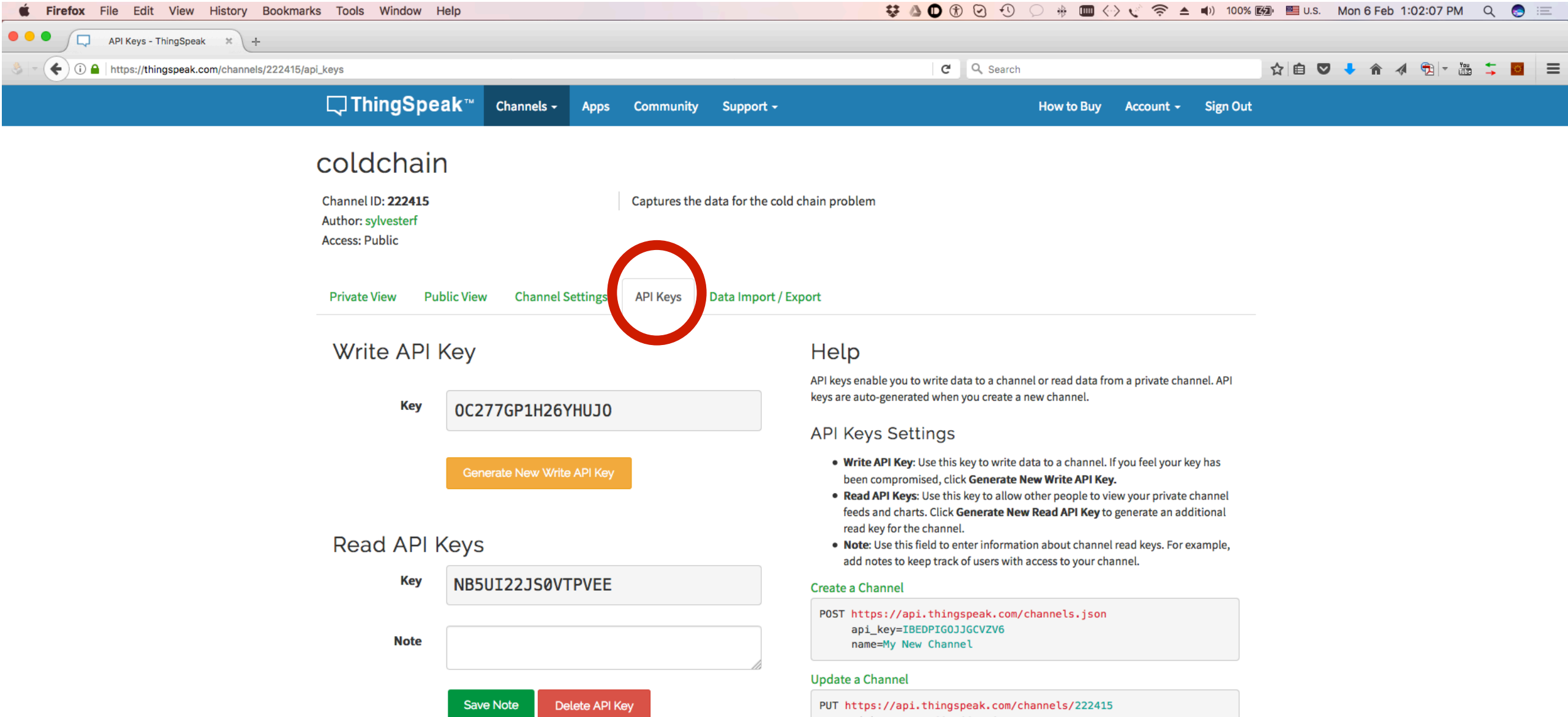
Field 1	door_operation
Field 2	power_status
Field 3	temperature
Field 4	humidity
Field 5	trip_id
Field 6	device_type
Field 7	device_no
Field 8	type

transaction

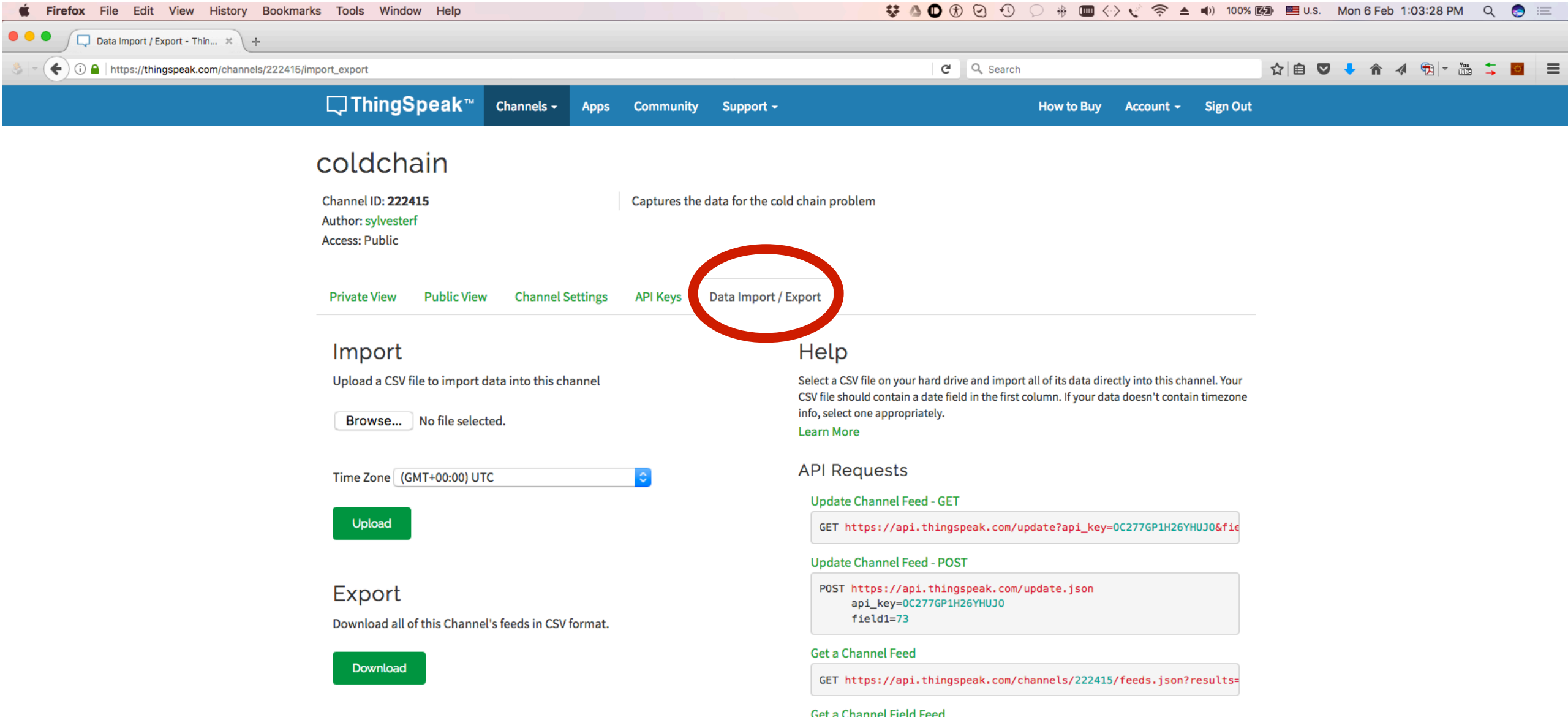
Step 6: View Channel Status



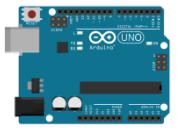
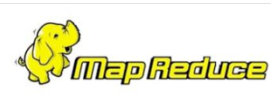
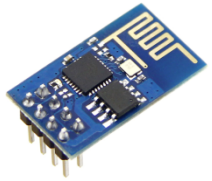
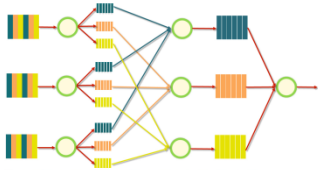
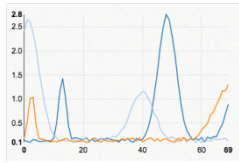
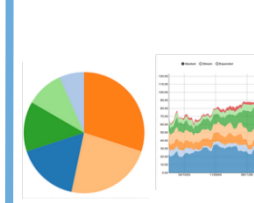
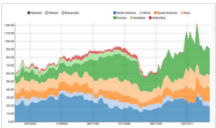
Note : Write API Keys



How to Export Data in csv Format



Practical Flow for Best Cold Chain Problem

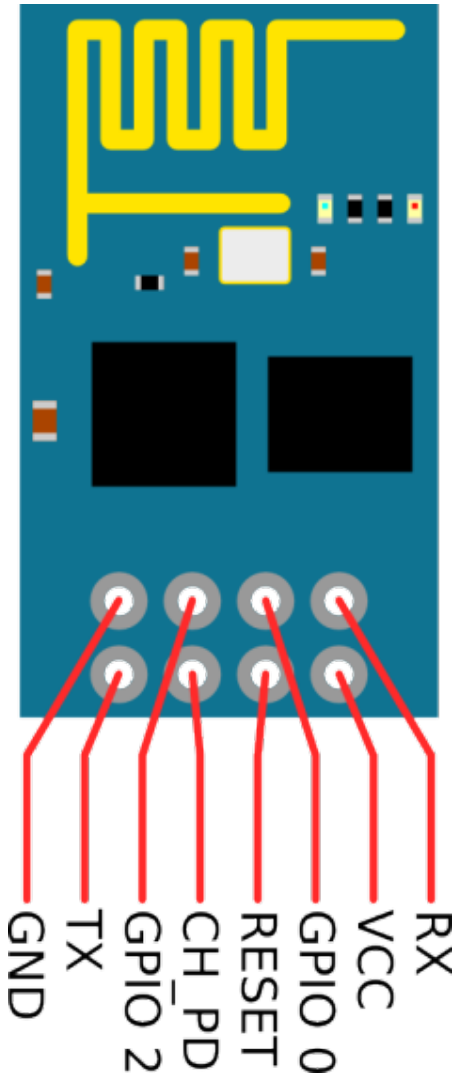
Sensors	Nodes	Gateway	Web Services	Data Stores	Analytics	Visualization
				mongoDB		NVD3.js
Read, Calibrate and Display data from sensors	Develop code for reading SMS through Arduino and trigger the Alarm.	Send the data to cloud using GPRS	Create a REST based Web Service to send truck sensor data on the cloud	Write the program to store the truck sensor data in NoSql Database.	Analyze the data to solve business problem.	Generate a neat report to visualize the data for management.
 		Send the data to cloud using WiFi 	amazon web services™ IBM Bluemix™ Microsoft Azure Learn how to create cloud based programs		 	View and Control from Mobile App  

Gateway using WiFi

To View the Public Data

https://thingspeak.com/channels/223662

ESP8266 (WiFi) Notation

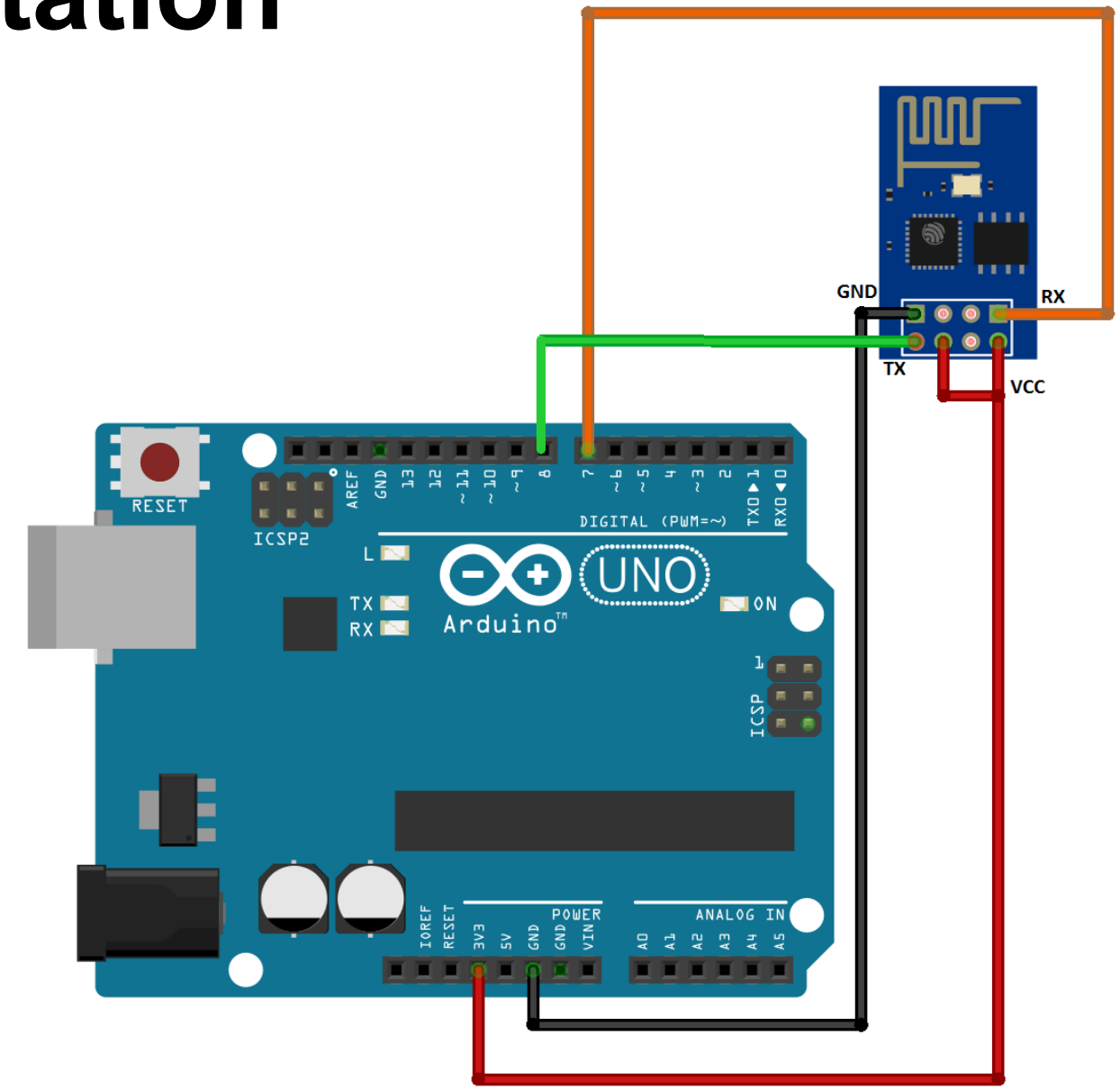


VCC to 3.3V of Arduino

GND to GND of Arduino

Rx – to Arduino PIN 7

Tx – to Arduino PIN 8



Logical Steps for WiFi

wifi_init()

connect_wifi()

void prepareData()

postToThingsSpeak();

Gateway using GSM

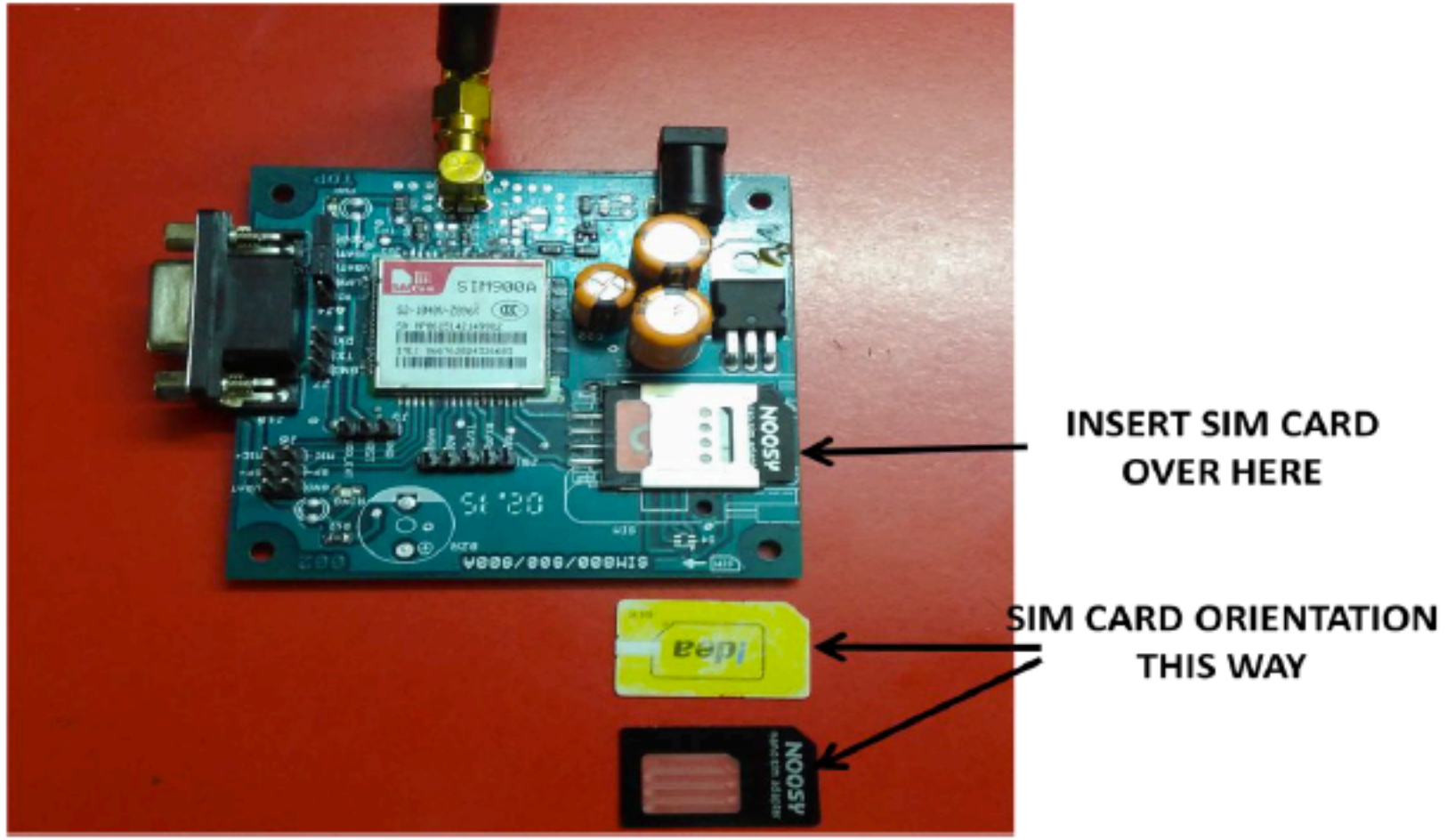
To View the Public Data

https://thingspeak.com/channels/223662

Inserting the SIM to Board

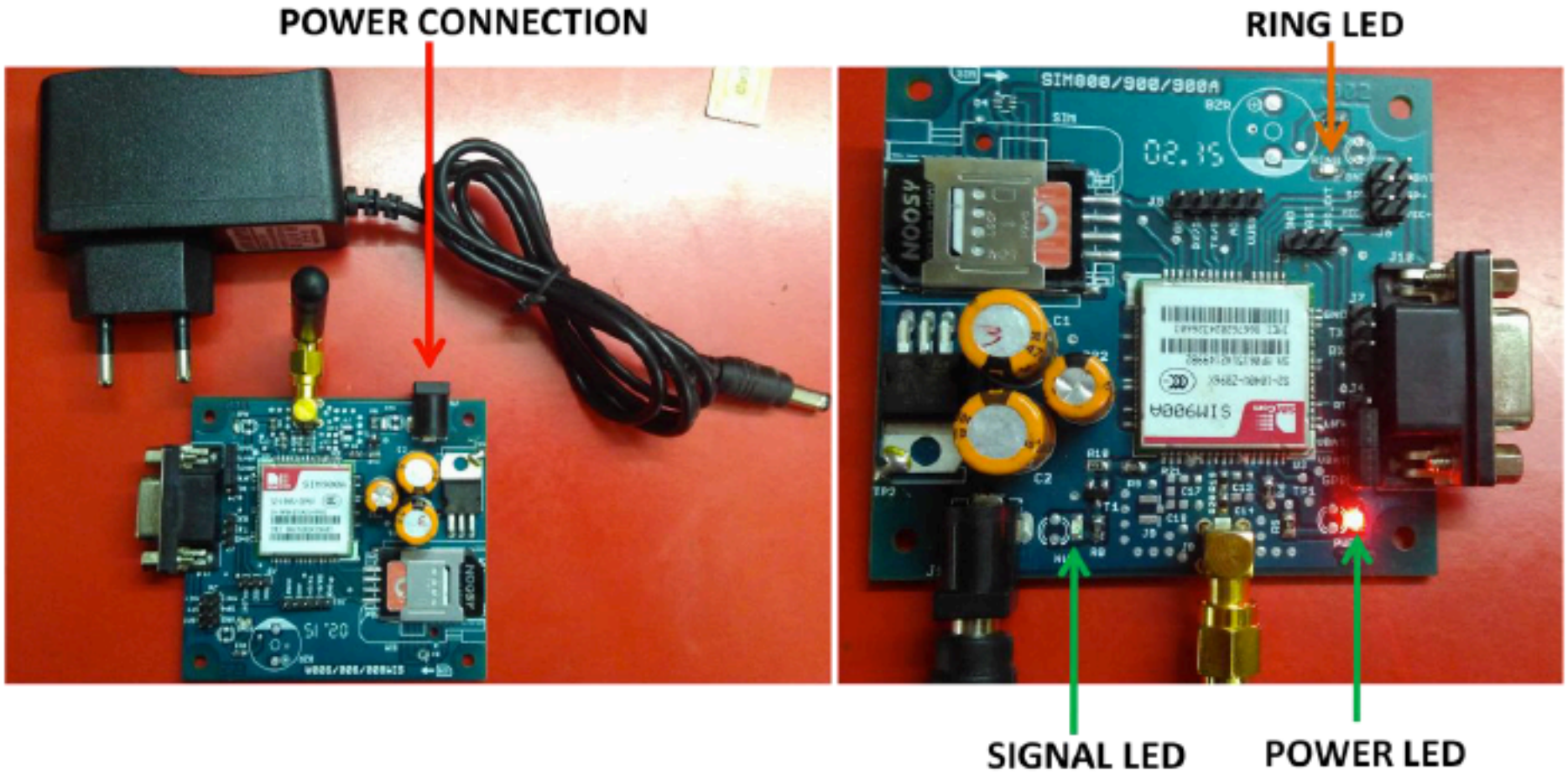
Step 1: Converting the GSM SIM

Step 2: Installing the GSM SIM



Note: Make sure to follow the Orientation of the SIM card with the copper pads of the SIM card touch the pins on the GSM Board.

Step 3: Power the GSM Board

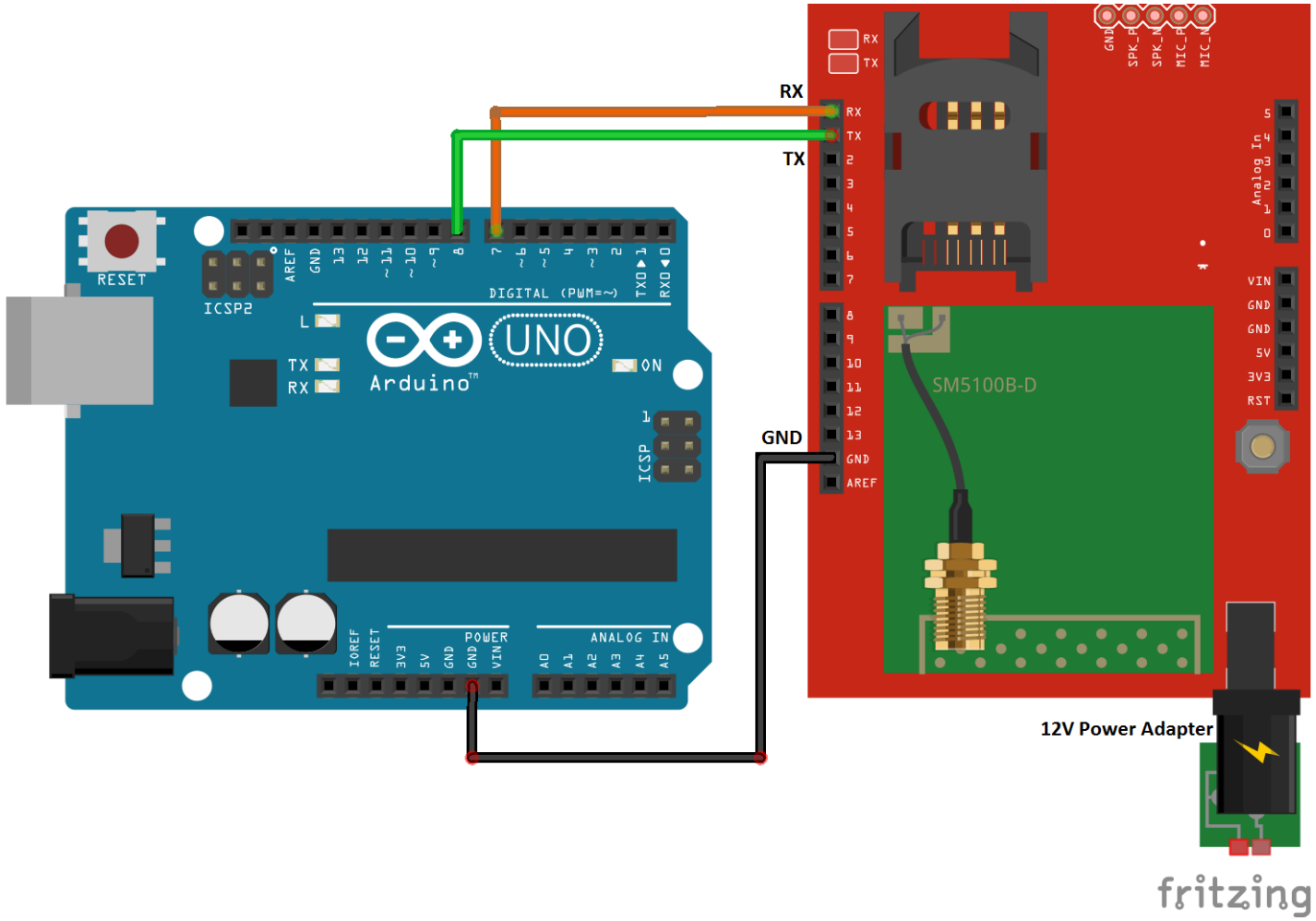


Step 4: Connecting the GSM to Arduino

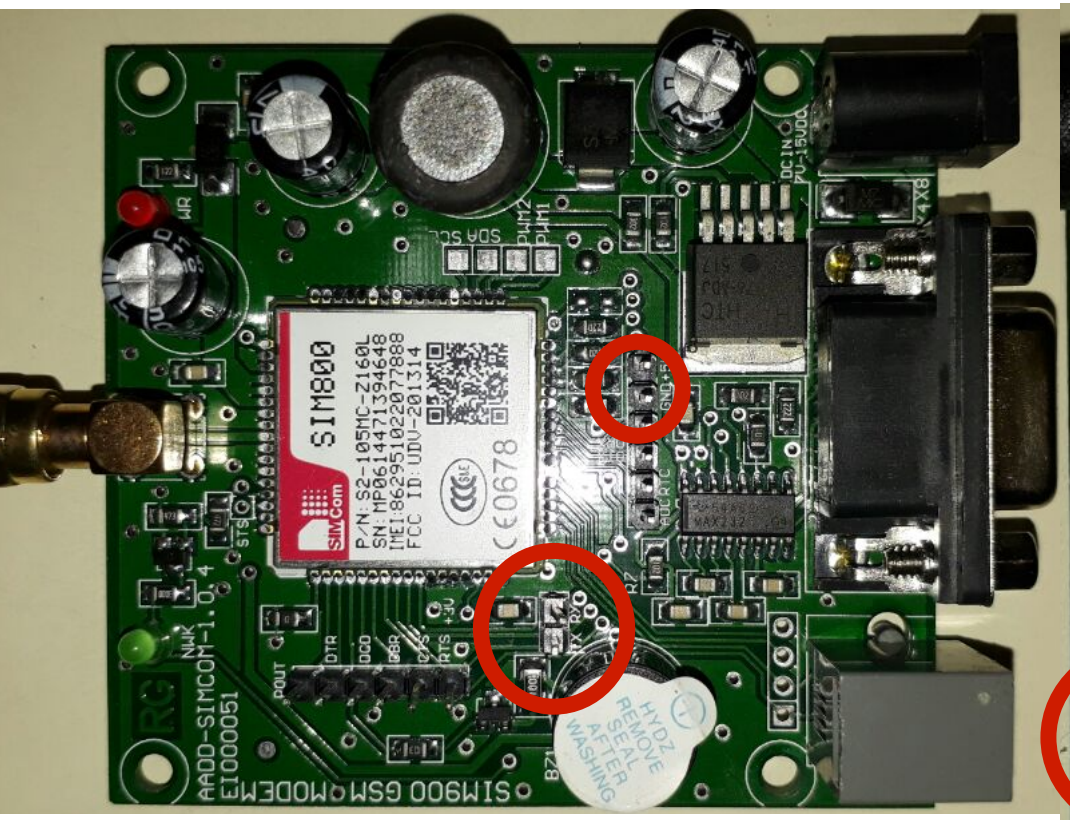
– to **GND** on Arduino Board

Rx of GSM Board to **PIN 7** on Arduino Board

Tx of GSM Board to **PIN 8** on Arduino Board



Step 5: Different Type of GSM



Logical Steps for GSM

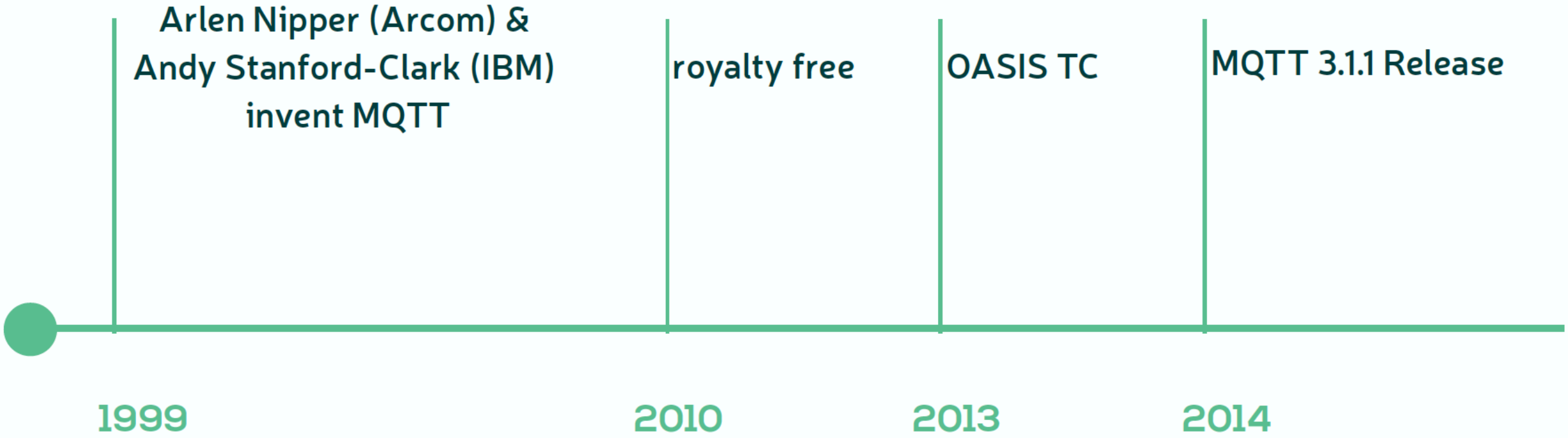
setup_gsm()

createJSONandPostData()

Experiments

6. wifi_http.ino (with hardcoded data)
7. wifi_http_sensor.ino
8. gsm_http.ino (optional)
9. gsm_http_sensor.ino (optional)

MQTT - History



MQ Telemetry Transport (MQTT)

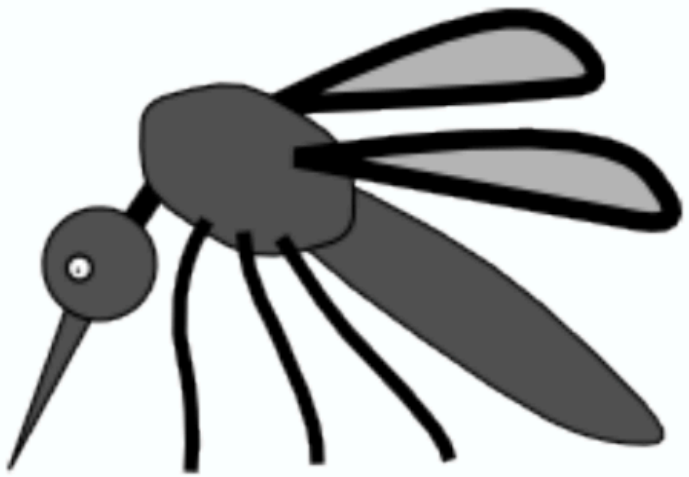
- Lightweight messaging protocol for M2M communication
- Telemetry = Tele-Metering = Remote measurements
- Invented and sponsored by IBM.
  Now Open source. Open Source libraries available.
- MQ originated from “message queueing (MQ)” architecture used by IBM for service oriented networks. There is **no** queueing in MQTT.
- Telemetry data goes from devices to a server or broker.
  Uses a publish/subscribe mechanism.
- Lightweight = Low network bandwidth and small code footprint
- Many open source implementations of clients and brokers are available

  Really small message broker (RSMB): C
  Micro Broker

Eclipse Paho

- Open Source
- “Reference Implementation”
- Active Community
- Sync und Async API
- Java, C, C++, C#, Go, Javascript, Python

Mosquitto

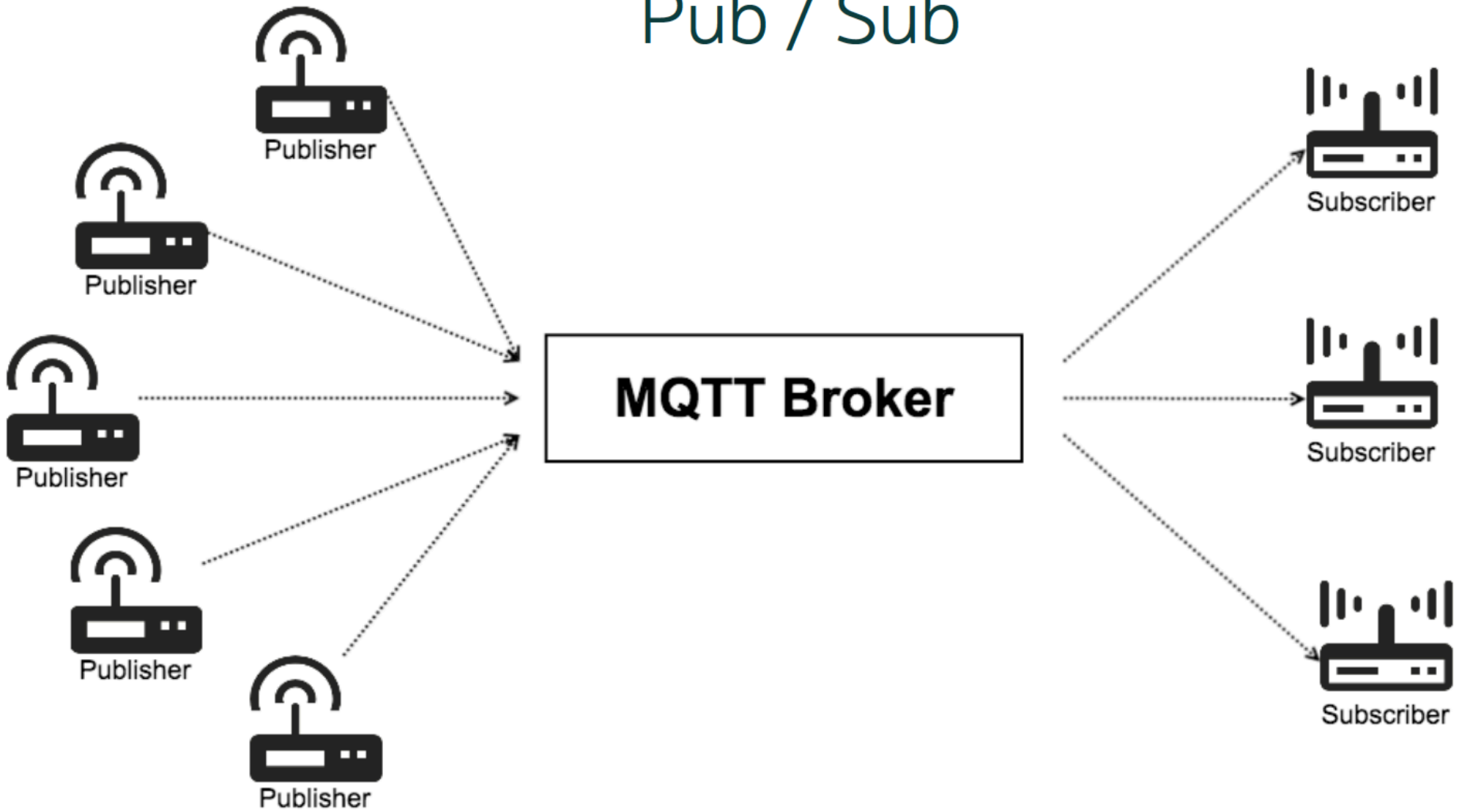


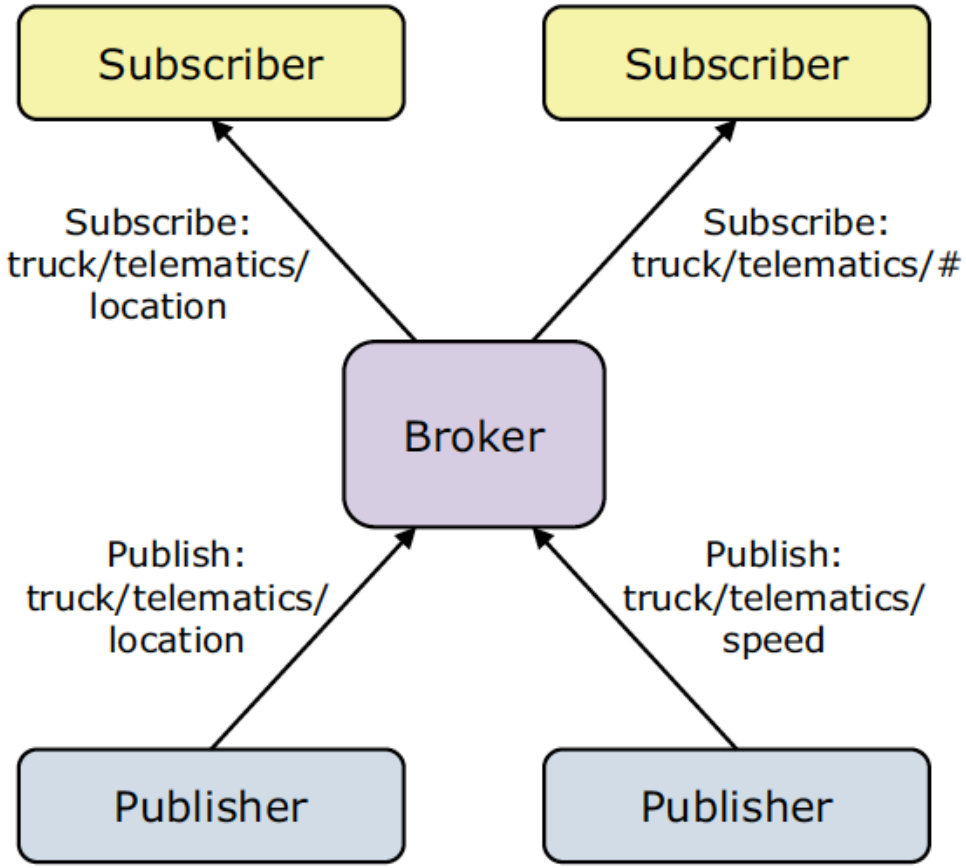
- Open Source
- Ideal for constrained devices
- Supports bridging
- Implemented in C

HiveMQ

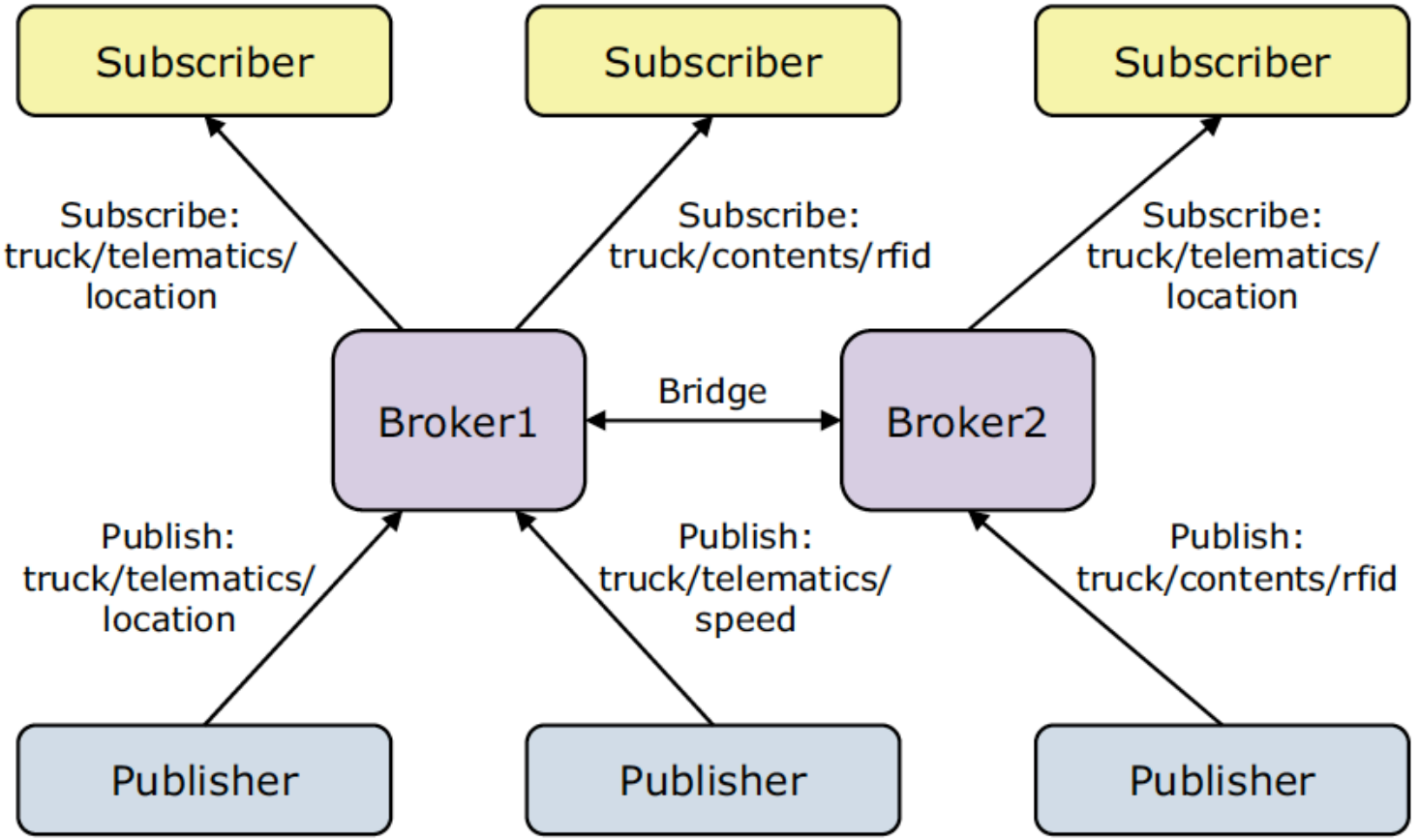
- High Performance MQTT Broker
- Built with security in mind
- Open Source Java Plugin System
- Supports Bridging
- Supports Clustering
- Designed for enterprise use

Pub / Sub

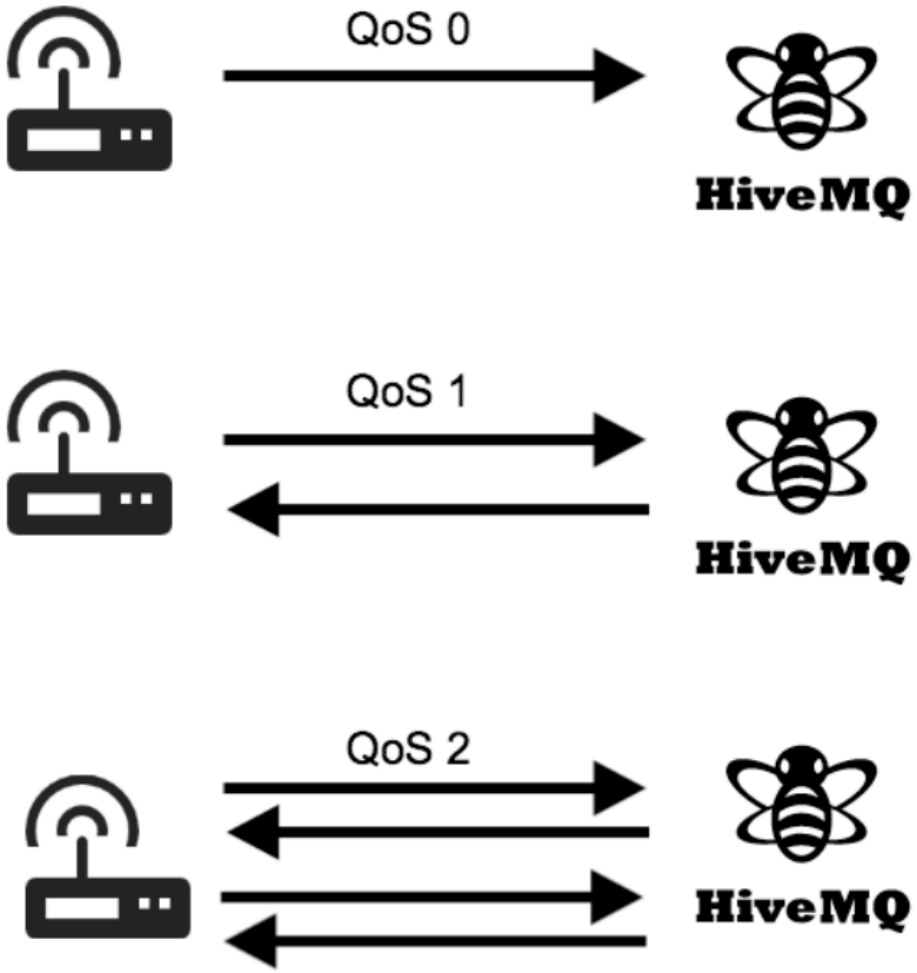

Publisher
Publisher
Publisher
Publisher
Publisher
MQTT Broker
Subscriber
Subscriber
Subscriber



Simple



Extended



QoS 0

At most once delivery

(Best effort, No Ack)

QoS 1

At least once delivery

(Acked, retransmitted if ack not received)

QoS 2

Exactly once delivery

Request to send (Publish)
Clear-to-send
(Pubrec), message (Pubrel)
ack (Pubcomp)

Retained Messages: Server keeps messages even after sending it to all subscribers. New subscribers get the retained messages

Experiments

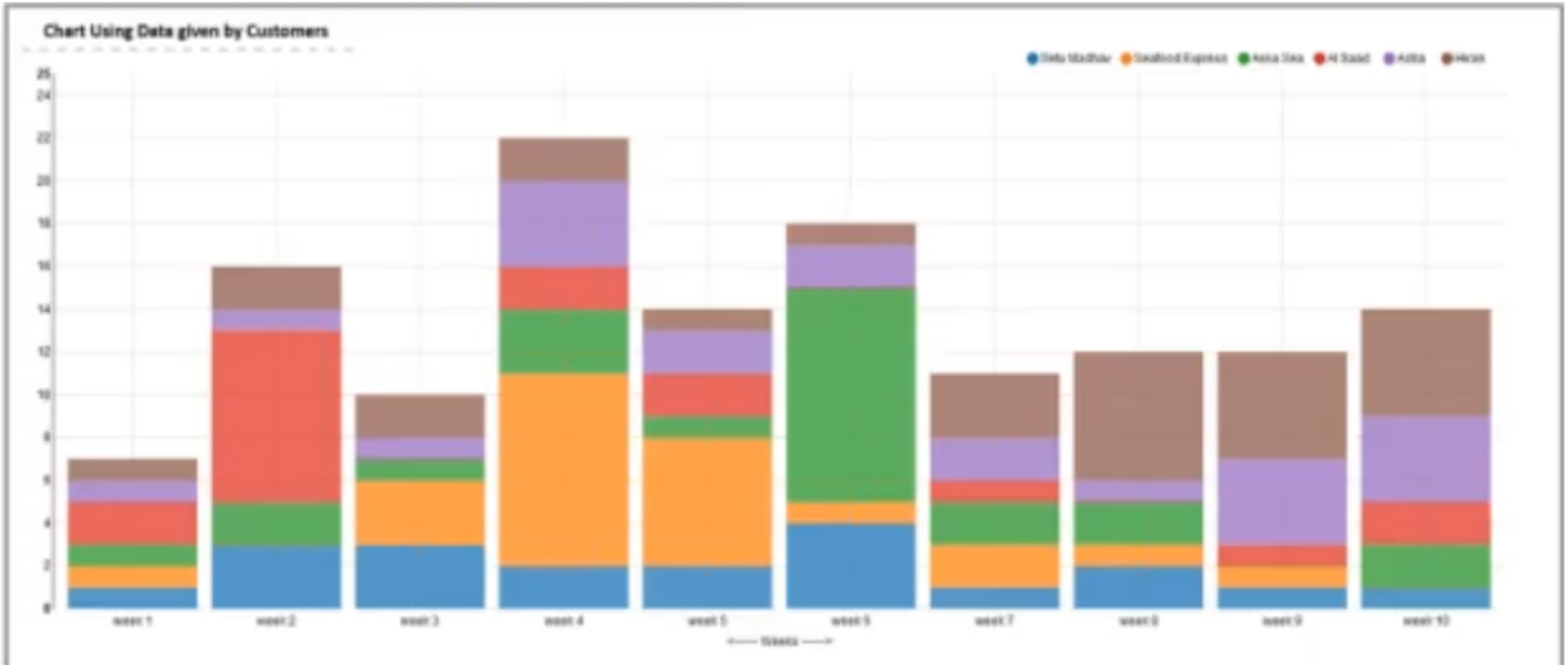
10. wifi_mqtt.ino (optional)

Practical Flow for Best Cold Chain Problem

Sensors	Nodes	Gateway	Web Services	Data Stores ✓	Analytics	Visualization
Read, Calibrate and Display data from sensors	Develop code for reading SMS through Arduino and trigger the Alarm.	Send the data to cloud using GPRS Send the data to cloud using WiFi	Create a REST based Web Service to send truck sensor data on the cloud Learn how to create cloud based programs	Write the program to store the truck sensor data in NoSql Database.	Analyze the data to solve business problem.	Generate a neat report to visualize the data for management. View and Control from Mobile App

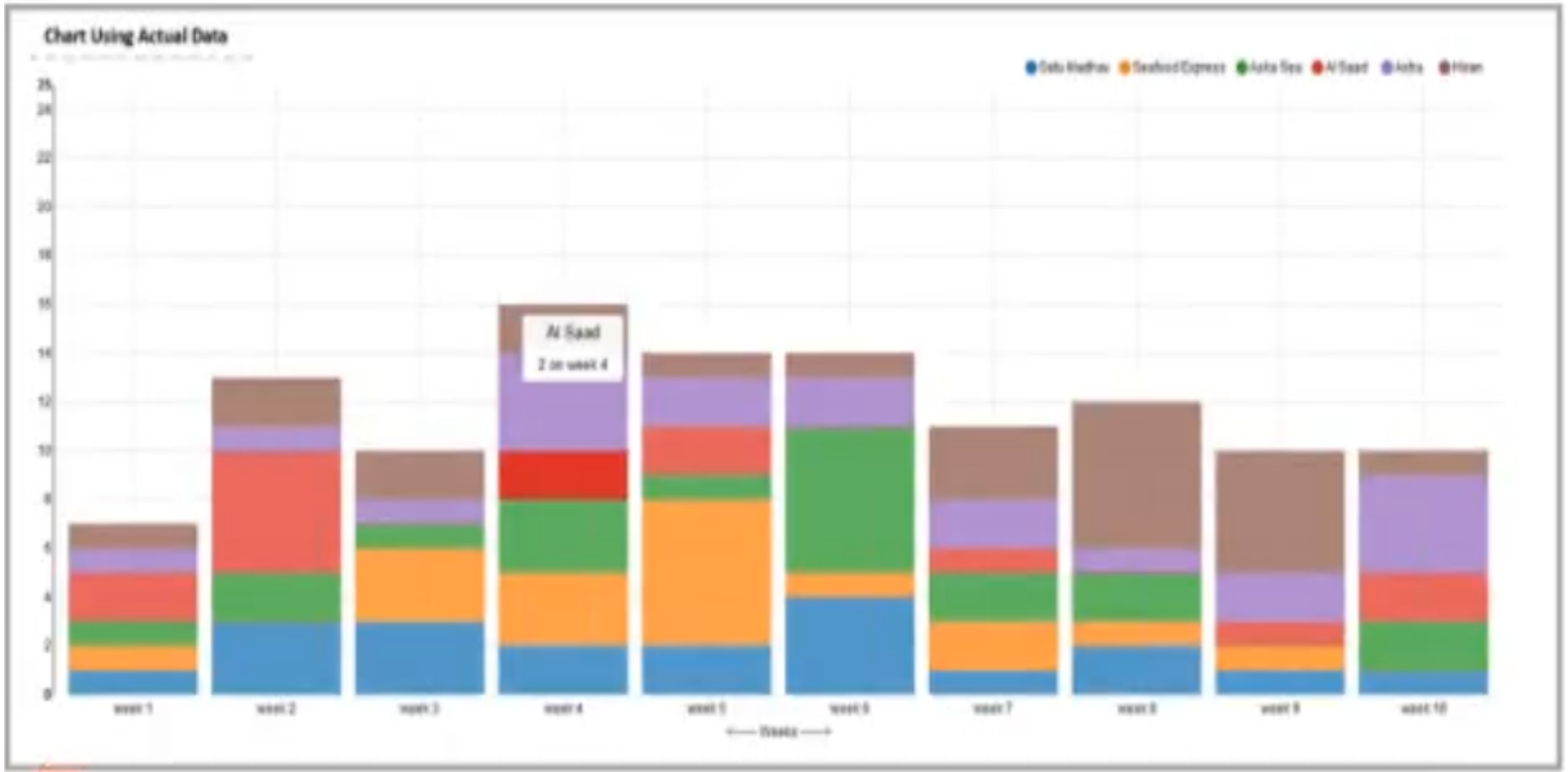
Business Scenario

Below Chart describes the number of claims received in last 10 weeks



Business Scenario

Below chart describes the genuine claims which we got from the Cloud platform

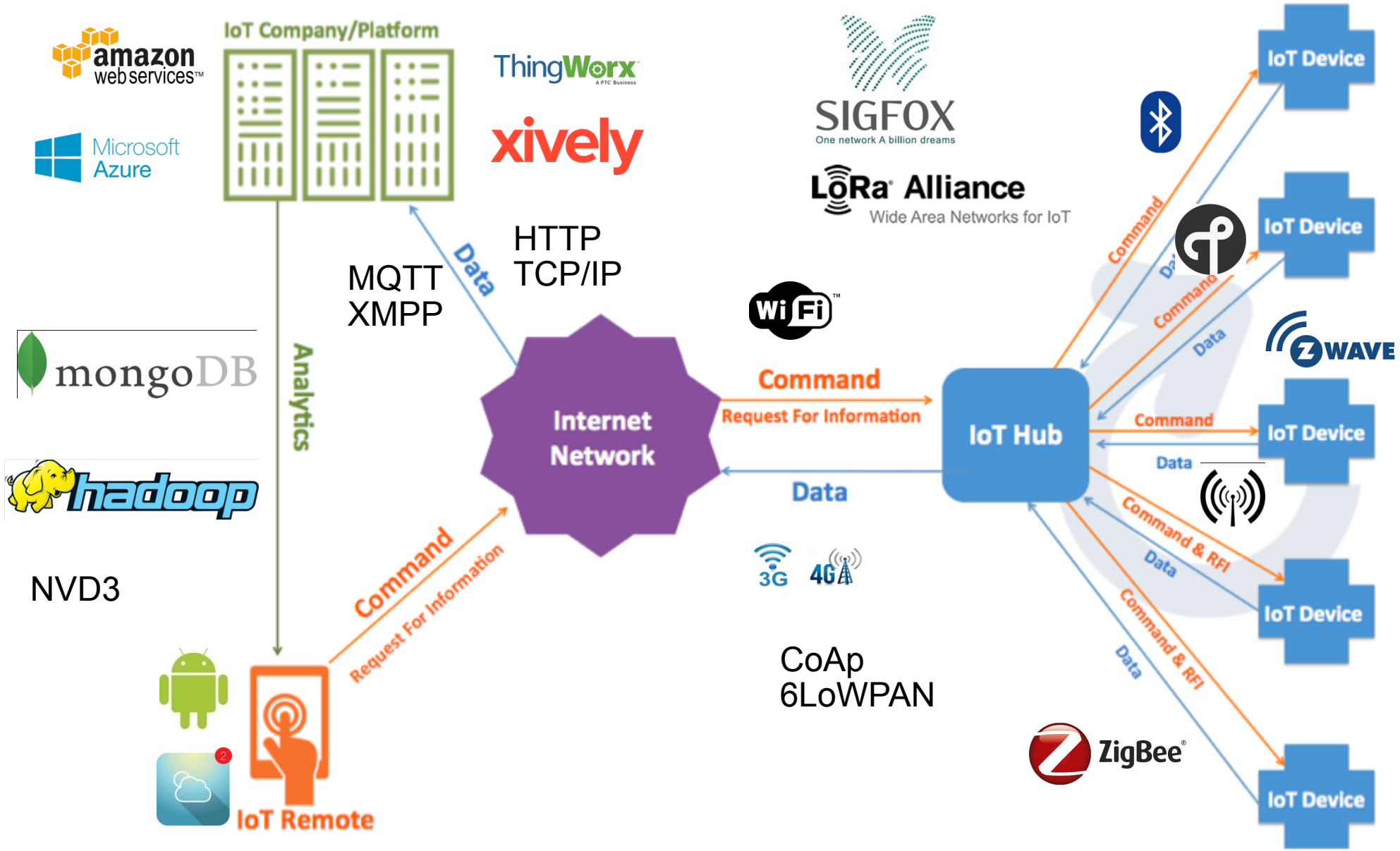


Business Scenario

Below chart describes the fault claims

Enterprise IoT
(Bigger Picture)

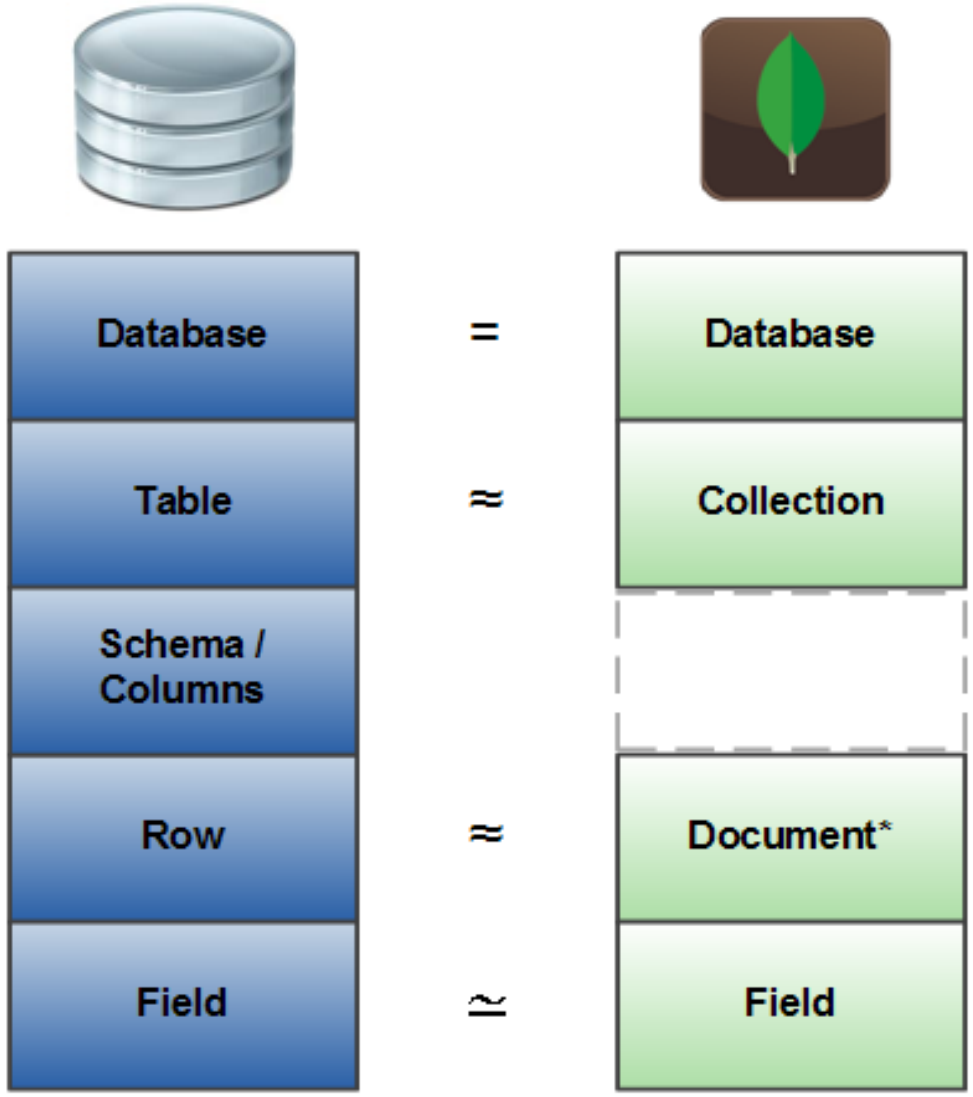
IoT Solution Architecture



Introduction to Python

Introduction to matplotlib

RDBMS Vs MongoDB



Introduction to mlab

Demo of Raspberry Pi