IoT Platforms

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What are IoT platforms

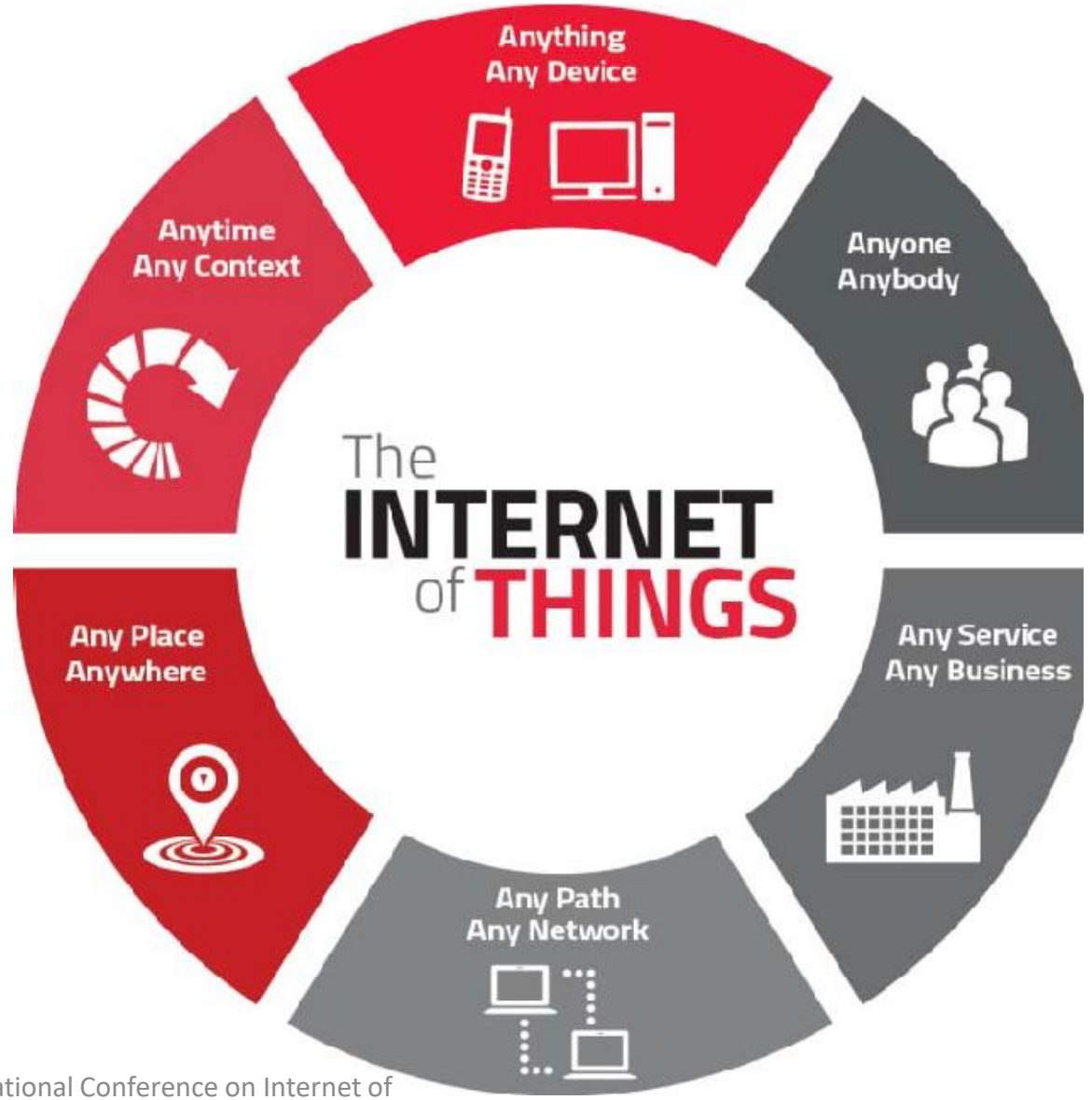
- IoT applications combine sensors, devices, data, analytics and integrations in a seamless and unified way
  - e.g. your project!
- IoT Platforms provide software tools and components to:
  - connect sensors, devices, and data networks
  - Analyse and store data
  - Integrate with other apps
- So what? We know the tech for that now (I2C, SPI, BLE, MQTT, Python...)
- Main selling point of an IoT platform is software that it
  - accelerates the IoT development process
  - Focuses on IoT: brings in best of breed features
  - Provides initial scaffolding for IoT projects

What are IoT Platform

- Many(not all) are cloud-based platforms that require subscription
- Provide device/language agnostic set of Software Development kits
  - Arduino/RPi/beagleboard
- IoT development is generally iterative:
  - Starts with initial simple use case
  - Once operational, data/insights result in new usecased
- IoT platforms should promote scalable, iterative development
  - Allow for quick app development
  - Ability to adapt/optimise apps quickly

IoT Platform Characteristics

- Manage many concurrent device connections
- Connectivity across several connection types
- "Off-the-peg" IoT protocol stack
- Manage/analyse/visualise data
- Integrations to other services/apps
- App Development



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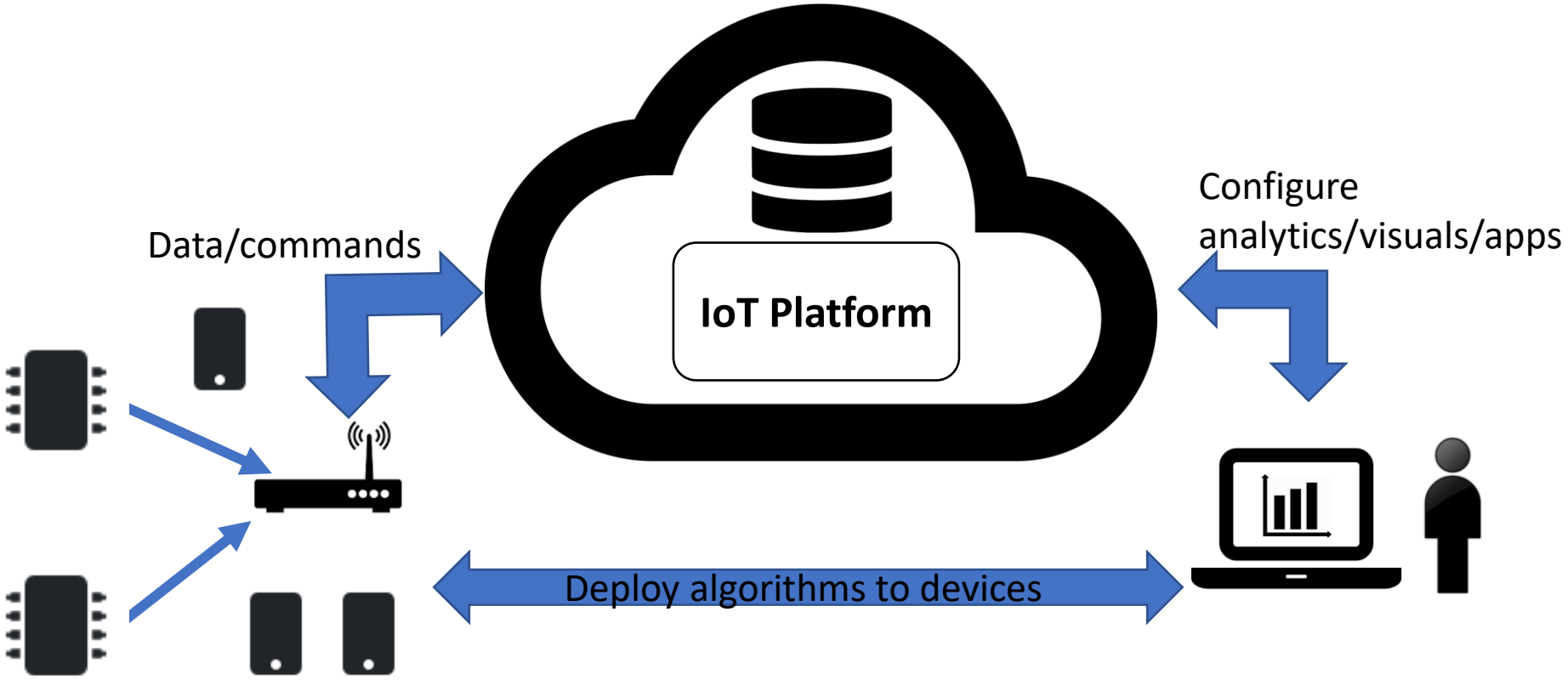
IoT Platform – general architecture



IoT Platform Advantages

- Use sofware component that has been pre-built and pre-tested. This increases the reliability of your application and reduces development effort.
- IoT frameworks constantly evolve, providing new features, integrations etc.
- Encourages better "design pattern" for your IoT app.
- Predefined APIs and docs
  - Great for collaboration
- "Baked-in" standards and features:
  - Security, authentication, scalability...

Which one?

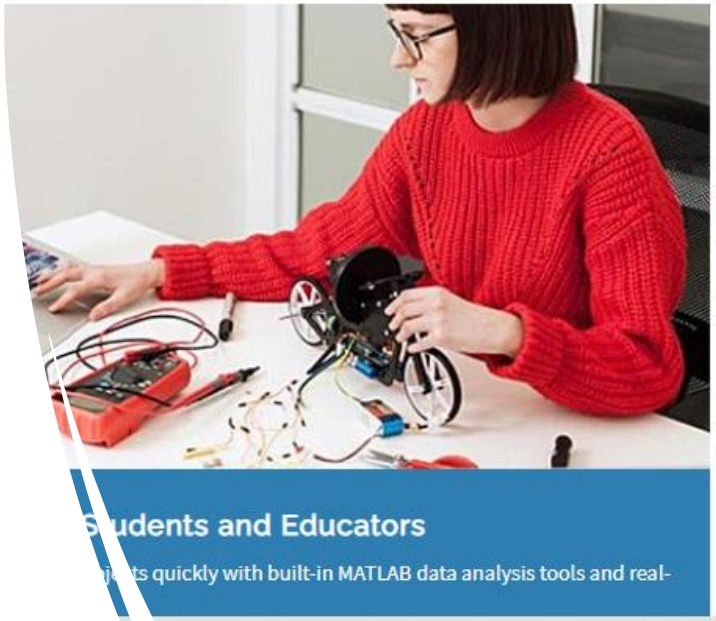
- Connectivity
  - Does the platform provide suitable capability and integrations (WiFi/Cellular/LPWan-Sigfox)
- Maturity
  - In business for long? Critical mass in developer community?
- Free
  - Is there a free tier (handy for evaluation)?
- Service type
  - Platforms try to distinguish themselves – what specialisms/USP does it have?
- Security
  - What security model do they use? Is there security issues reported in past?
- Geographic area
  - Does it operate well at your location (can you select edges/data centres)

Examples:

Thingspeak

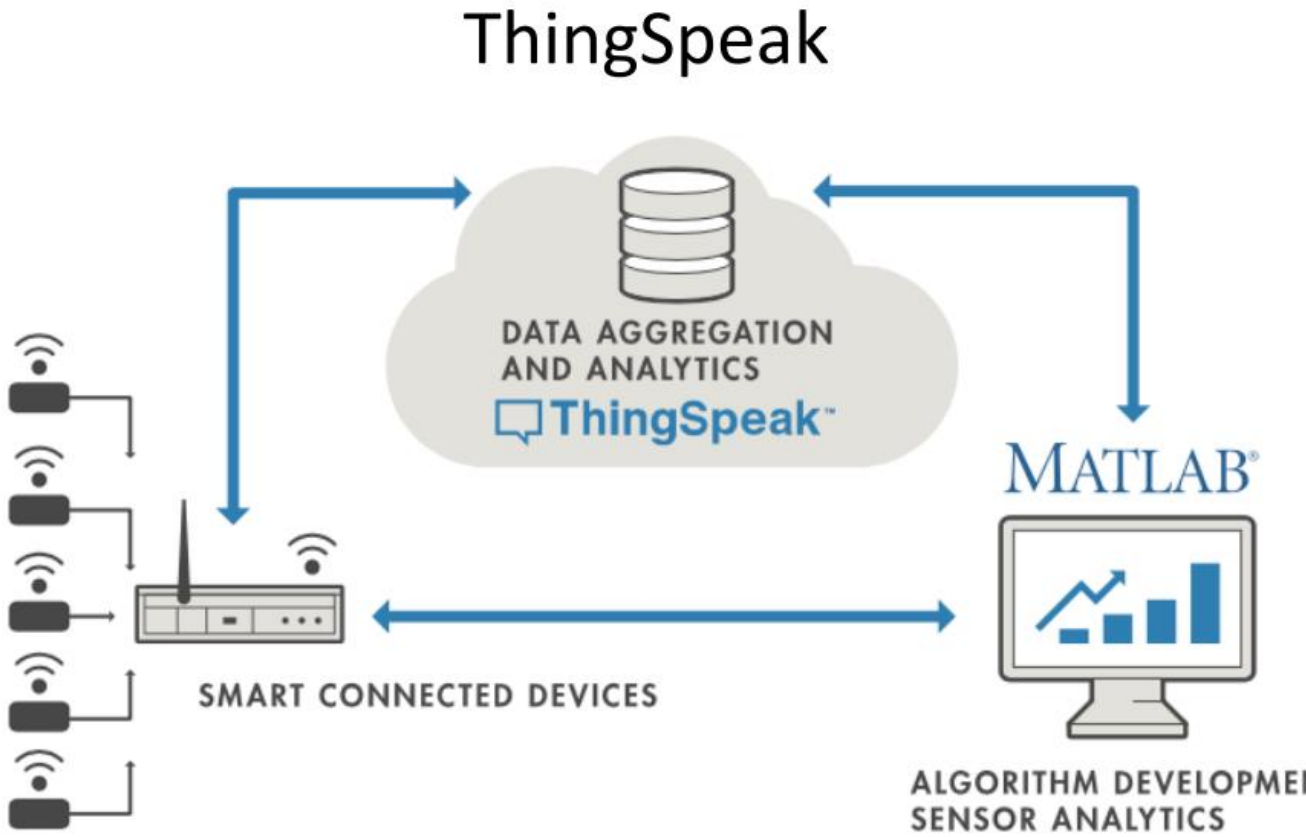
Thingspeak

- **ThingSpeak** is a cloud-based IoT platform to store and retrieve data from devices.
  - Uses HTTP protocol/Restful APIs
- "Collect and analyse data quickly and easily"



Thingspeak Overview

- Account-based
  - Can create free account online
- Brought to you by the people who made Matlab
  - Uses Matlab features/toolboxs
- SDKs/librarys for popular languages/devices
- Restful API means should work with any device



Thingspeak – basic use

Create a new channel

- Channels collect data

Collect data in the channel

- Devices write data to channels

Analyse the data

- Run analytical algorithms/visualise your data

Act on the data

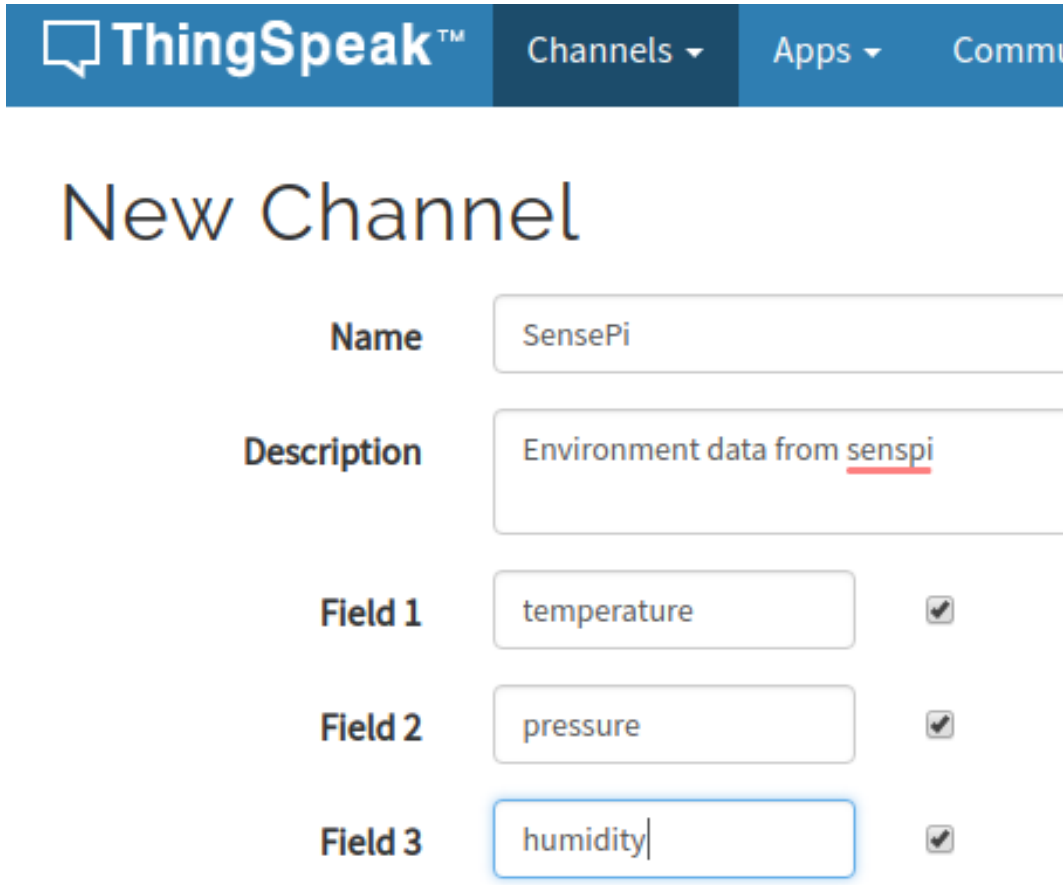
- Test for certain conditions and perform actions

ThingSpeak – Create new channel

CREATE A NEW CHANNEL TO COLLECT DATA FROM DEVICES

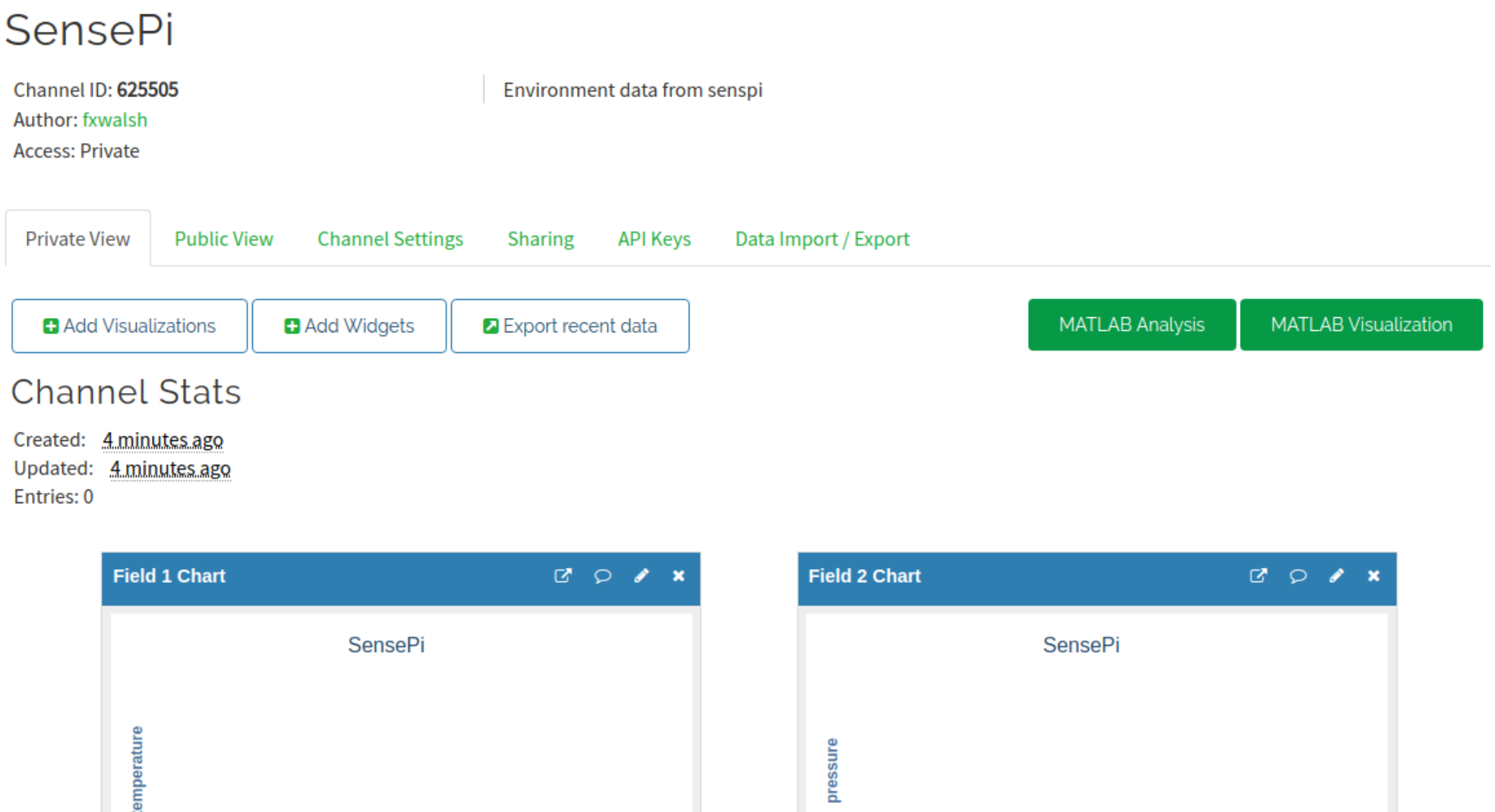
DEFINE DATA FIELDS FOR THE CHANNEL(MAX 8)

CAN ALSO INPUT LOCATION(LAT/LONG) OF CHANNEL SOURCE)



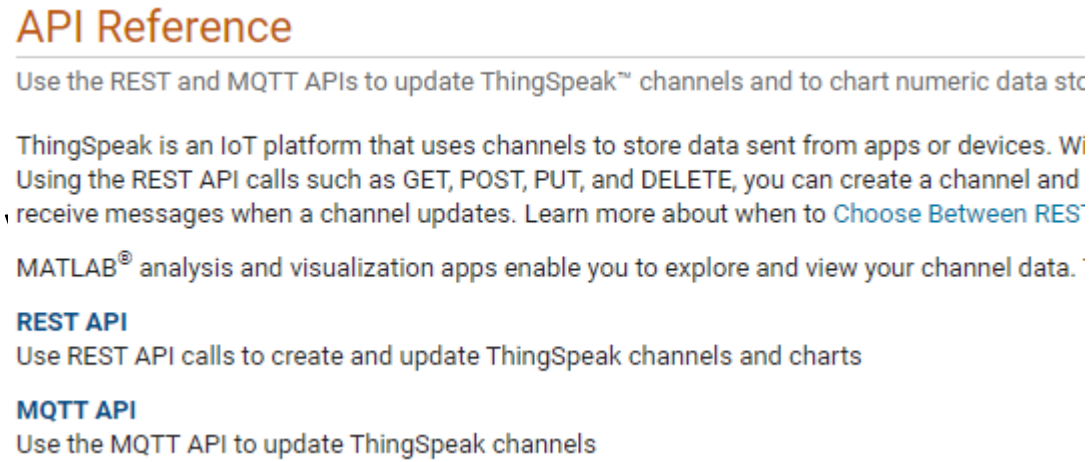
Thingspeak - New channel

- Once saved you can access channel page:



Thingspeak - Add data to channel

- Programmatically, many ways!
  - Construct HTTP GET request and include field
  - MQTT (see in Lab)



GET https://api.thingspeak.com/update?api_key=<WRITE-KEY>&field1=12

- Using HTTP GET request, can test from a browser:

Thingspeak – Add data with python

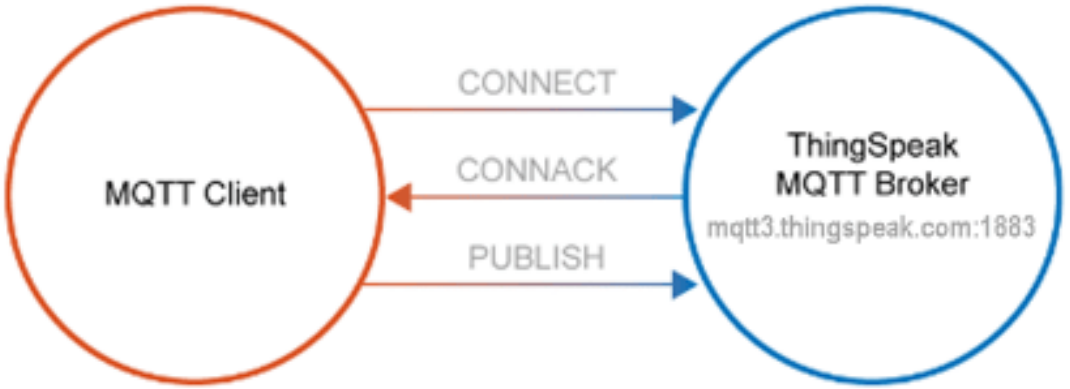
- Make HTTP request from Python:

```
def writeData(temp,press,hum):
    # Sending the data to thingspeak in the query string
    conn = urllib2.urlopen(baseURL + '&field1=%s&field2=%s&field3=%s' % (temp, hum,press))
    print(conn.read())
    # Closing the connection
    conn.close()

while True:
    temp=round(sense.get_temperature(),2)
    press=round(sense.get_pressure(),2)
    hum=round(sense.get_humidity(),2)
    writeData(temp,press,hum)
    time.sleep(60)
```

Thingspeak – Add data with python

Create a MQTT client:

```
# connect to Broker
mqttc.username_pw_set(config["username"], config["password"])
mqttc.connect("mqtt3.thingspeak.com", 1883)
mqttc.loop_start()
topic = "channels/1558158/publish"

# Publish a message to temp every 15 seconds
while True:
    try:
        temp=round(sense.get_temperature(),2)
        payload="field1="+str(temp)
        mqttc.publish(topic, payload)
        time.sleep(15)
    except:
        print('Interrupted')
        try:
            sys.exit(0)
```



1. Publish to a channel feed

channels/<channelID>/publish

2. Publish to a channel field

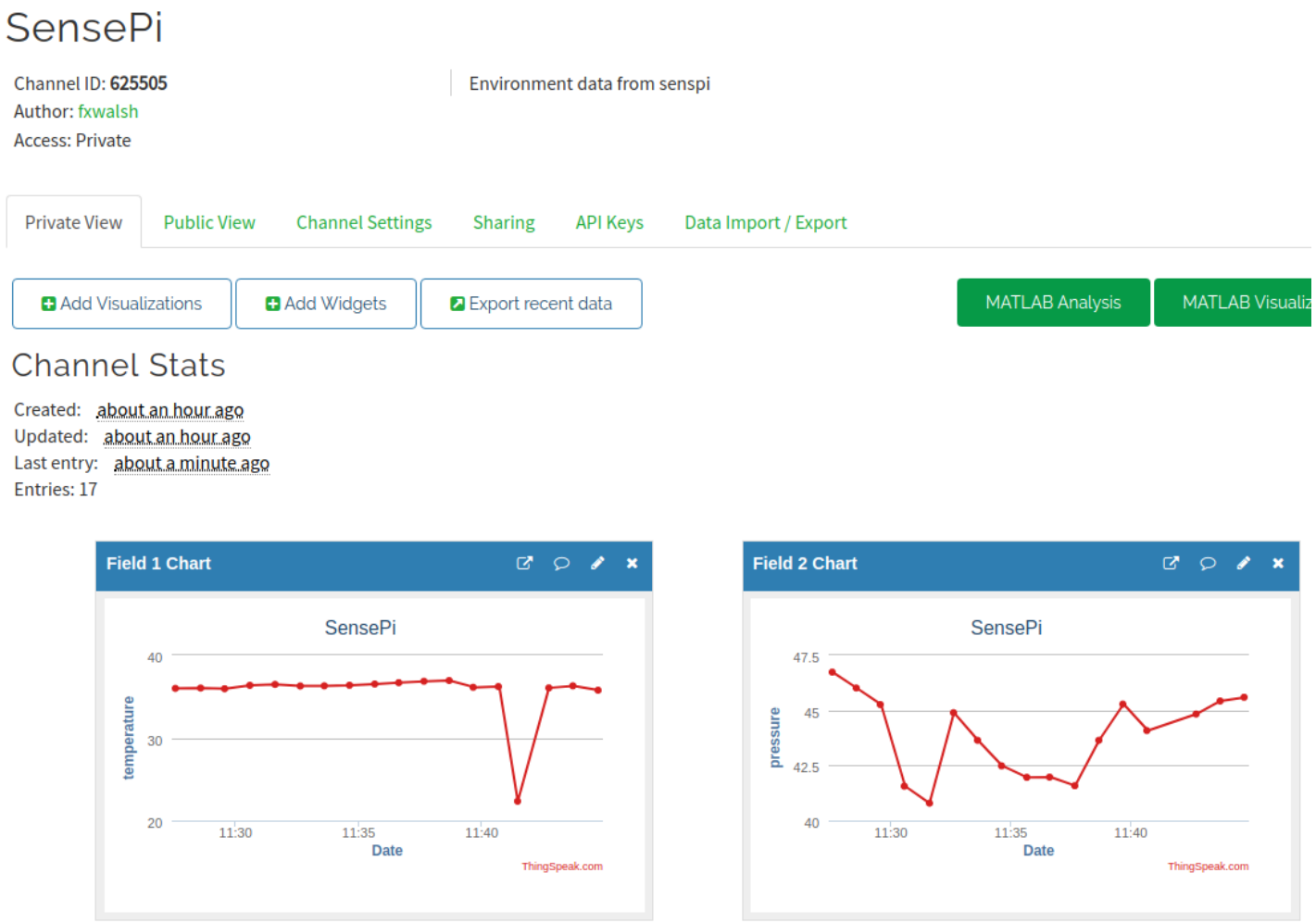
channels/<channelID/publish/fields/field<fieldnumber>

Which to use: HTTP or MQTT API

- HTTP (REST) API
  - You need to retrieve any historical data, such as data within a defined time range.
  - You want to Create Channel, Read Settings, Clear Channel, Delete Channel, or Create Chart.
  - You need a response!
- MQTT
  - Your device is power-constrained, and you want lower battery consumption to send data to ThingSpeak. Also, an MQTT PUBLISH operation is typically faster in this scenario.
  - Your device connectivity is intermittent, and you have limited bandwidth usage.
  - You want immediate updates of data posted to a channel.
  - You want messages pushed to you instead of needing to poll the server for new messages.

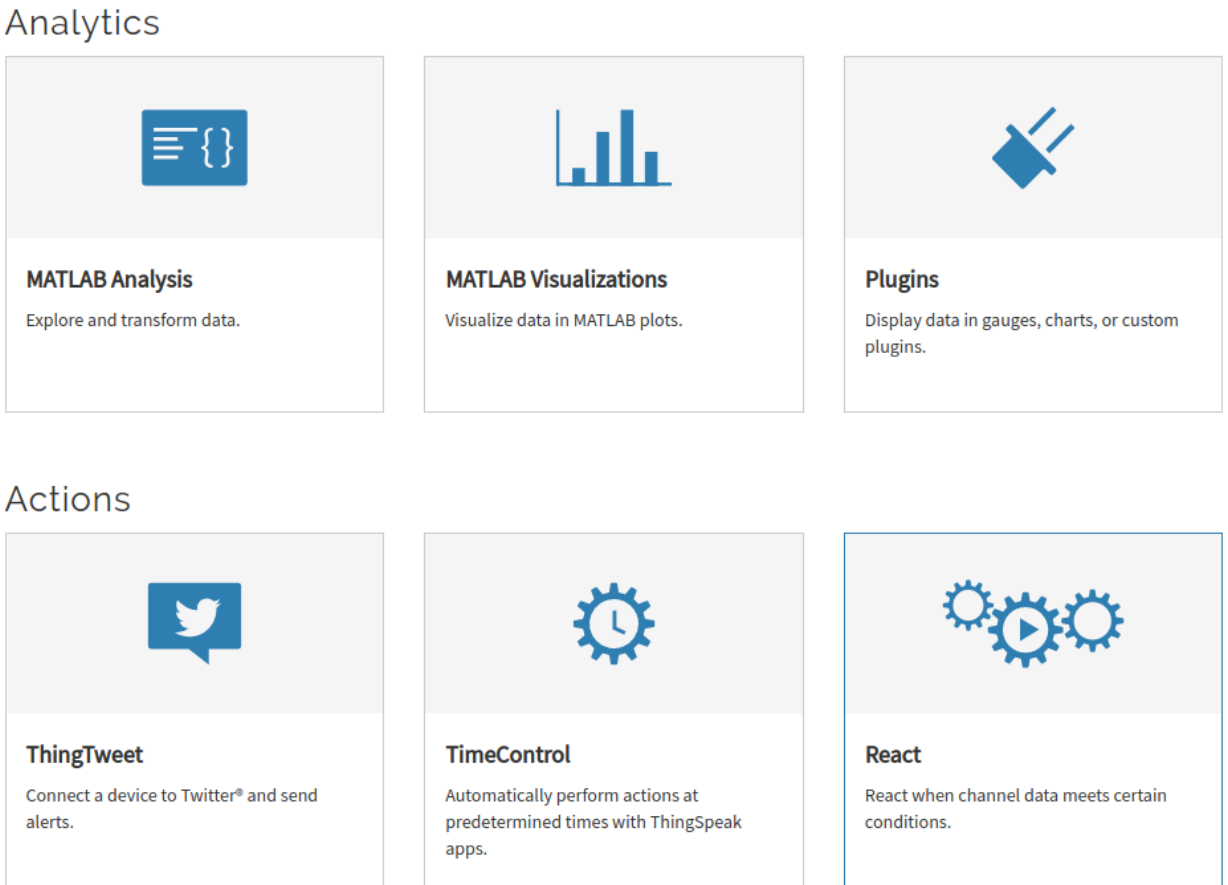
Think Speak – Analyse data

- Thingspeak will visualise each field by default in channel view



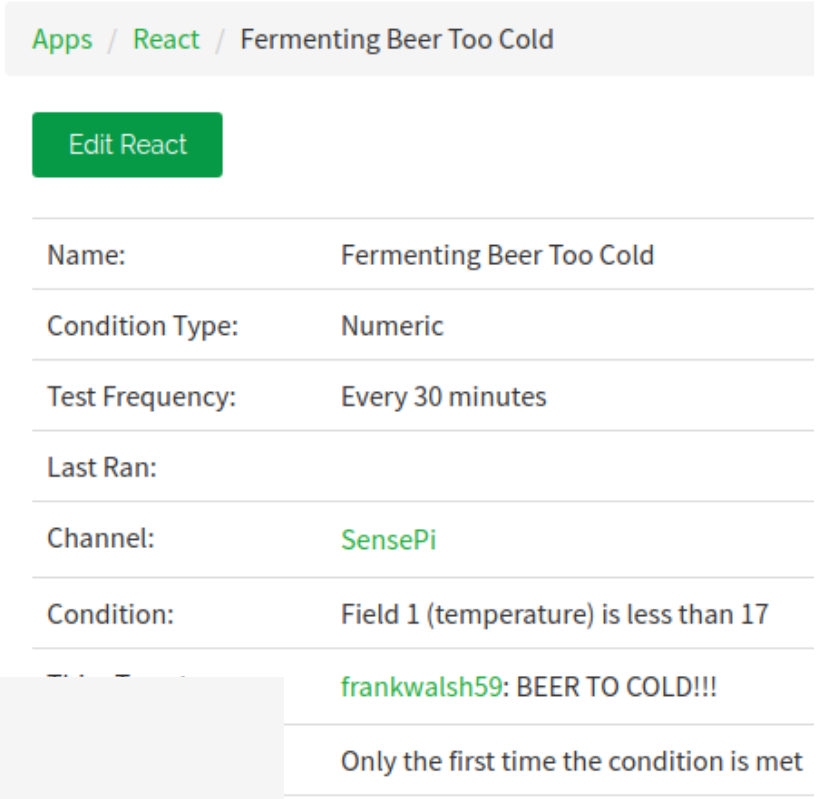
Thingspeak - Apps

- The Apps tab provides various mechanism to transform, analyse,visualise and act on data.



ThingSpeak Example: ThingTweet

- Link Twitter account to Thingspeak
- Create a **React** to tweet when a certain condition is met.
- Also tweet from device using HTTP POST:




```
POST https://api.thingspeak.com/apps/thingtweet/1/statuses/update
api_key=WLKX9PPPWCRZ6H1
status=I just posted this from my thing!
```

ThingSpeak Example: Analysis

- Can write Matlab Code to analyse and transform data
- Possible uses:
  - Clean data (remove outliers)
  - Statistical analysis
  - Transfomations
  - Data Fusion
- Generally write results to second channel for further analysis/visualisation.

Thinkspeak: Convert Celcius to Fahrenheit

Convert temperature units

MATLAB Code

```
1
2  readChannelID = 12397;
3  % Temperature Field ID
4  temperatureFieldID = 4;
5
6  readAPIKey = '';
7
8  tempC = thingSpeakRead(readChannelID,'Fields',temperatureFieldID,'ReadKey',readAPIKey);
9
10 % Convert to Fahrenheit
11 tempF = tempC*1.8+32;
12 display(tempC,'Temperature in Fahrenheit');
13
14 % Replace the [] with channel ID to write data to:
15 writeChannelID = 1234;
16 % Enter the Write API Key between the '' below:
17 writeAPIKey = 'abcd';
18
19 thingSpeakWrite(writeChannelID,[tempF,tempC],'Writekey',writeAPIKey);
```

Save and Run | Save*

Other Platforms

- Ubidots
- Amazon Web Services
- Microsoft Azure
- Evothings