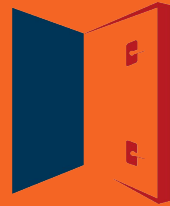


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# IoT: Internet of things Opportunities and challenges



#CoderBunker

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# Ricky Ng-Adam

## Founder of Coderbunker

✉ [ricky@coderbunker.com](mailto:ricky@coderbunker.com)

in [Ricky Ng-Adam](#)

## Specialties

- 20 years experience in software development
- Architecture, design, R&D
- Team recruitment, building and coaching
- Javascript, Python, C/C++, bash, plpgsql
- API: REST, Websockets, GraphQL
- Deployment (Linux, Ansible, Cloud, Docker)
- Database (PostgreSQL)



**ATLAS A.I.**

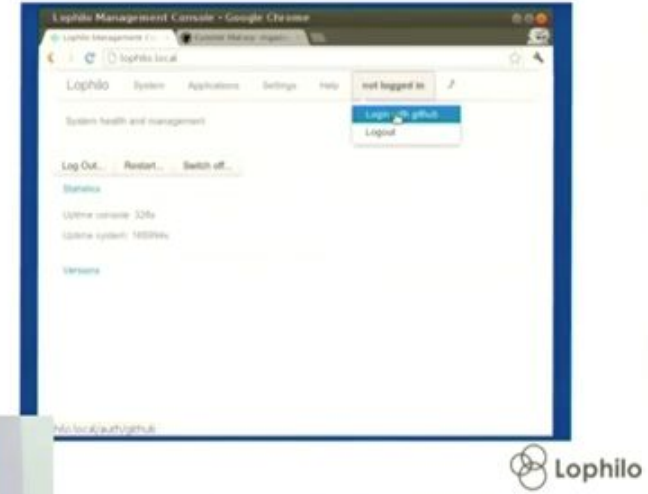


### Lophilo Software Stack

- mboot: low-level hardware initialization
- Grid: FPGA image
- Linux: kernel
- Debian GNU/Linux Wheezy: operating system
- debugfs-based driver with memory mapped FPGA
- v8 Javascript engine with Lophilo API add-on
- Node.js: client/server-side apps
- Management Console: web system administration
- Cloud9: web-based IDE



### The Lophilo Management Console



Ricky Ng-Adam's Lophilo, presented at [linux.conf.au 2013](http://linux.conf.au 2013):  
NodeJS / Linux / ARM + FPGA with web interface... built 2012. Stopped 2013.

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# Agenda - IoT Opportunities and Challenges

- What is IoT?
- Why should you care?
- Recap of the different subsystems
- What are the challenges?

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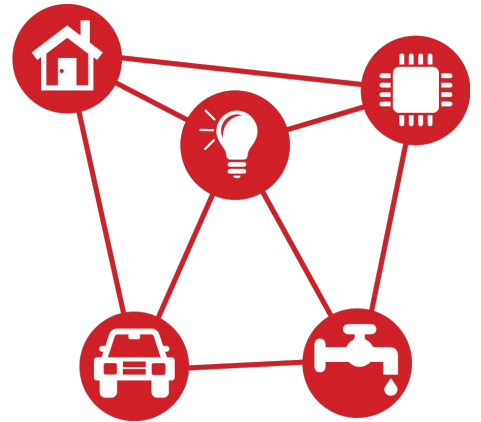
# IoT: Internet of Things

Sensing and controlling  
the environment  
through Internet connected  
devices

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# | IoT: Internet of Things

The Internet of things (IoT) is the internetworking of physical devices, vehicles, buildings, and other items—embedded with electronics, software and network connectivity that enable these objects to collect and exchange data.



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# Opportunities



# | IoT: enabler for better, faster, cheaper

- Gain new business insights faster
- Increase efficiency of processes
- Enable just-in-time actions and decisions
- Real-time monitoring of devices
- Protection of assets against misuse and theft
- Opportunities for new, richer user interfaces
- Deeper customer engagement



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# How was the opportunity created?

- Data is the future (well, information is)
  - Cheap, widespread wireless networks
  - Inexpensive “smart” electronics
  - Smartphones as mini-computers in our pockets
-

# | Example IoT Solution Benefits



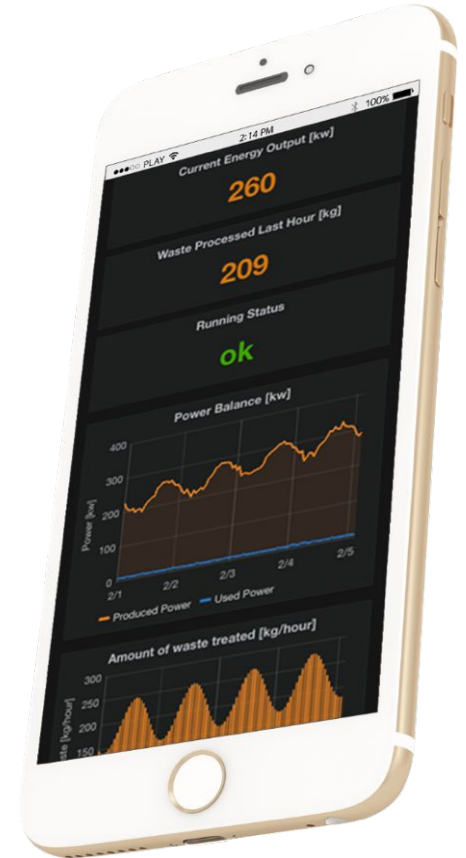
24H/day remote monitoring and analysis



Remote control and optimization

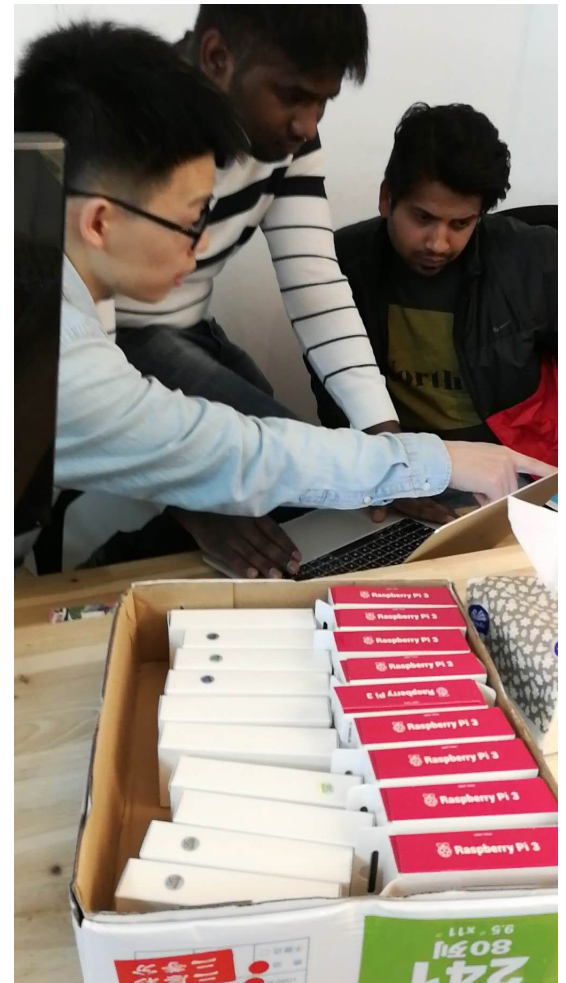


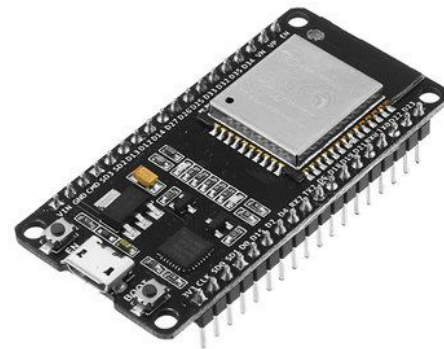
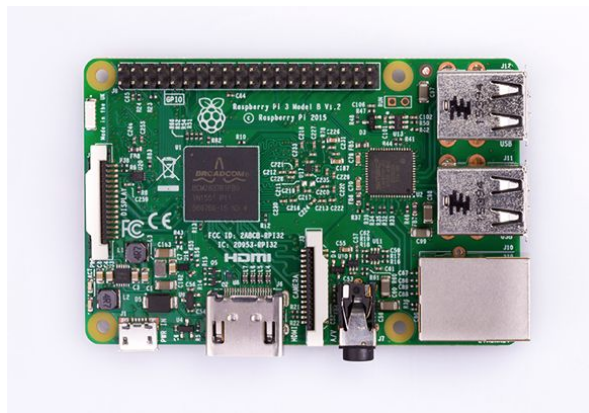
Predictive maintenance



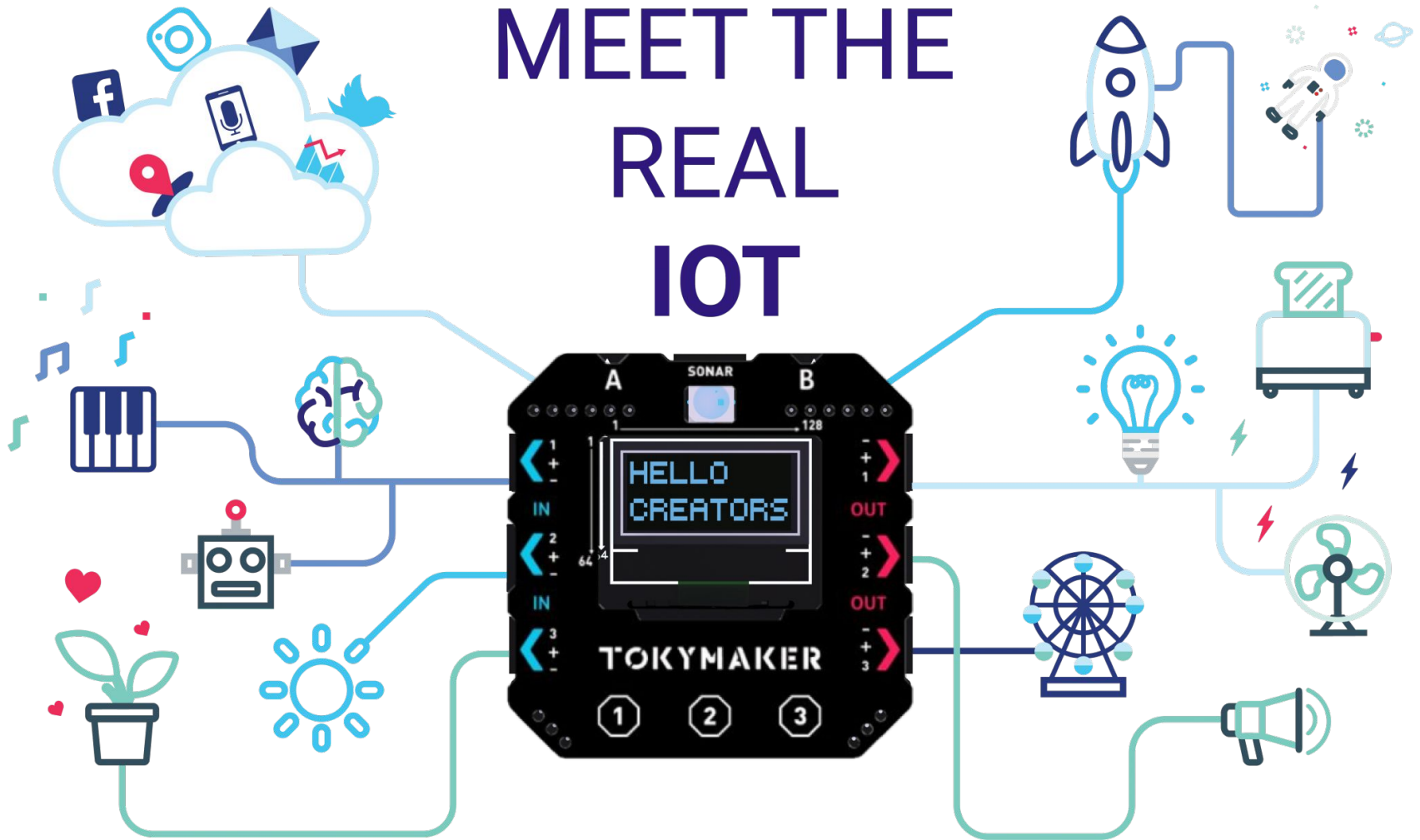


# How to build the Internet of Things





# MEET THE REAL IOT





Node-RED

filter nodes

input

inject

catch

status

link

http

websocket

tcp

udp

Watson IoT

output

debug

link

http response

websocket

Flow 1

Flow 2

+

Simple time inject to Watson IoT

timestamp

Generate time data

event

connected

msg.payload

LocalServer

connected

127.0.0.1:8086/coderbunker payload

Deploy

info

debug

config

all

unused

On all flows

3 hidden

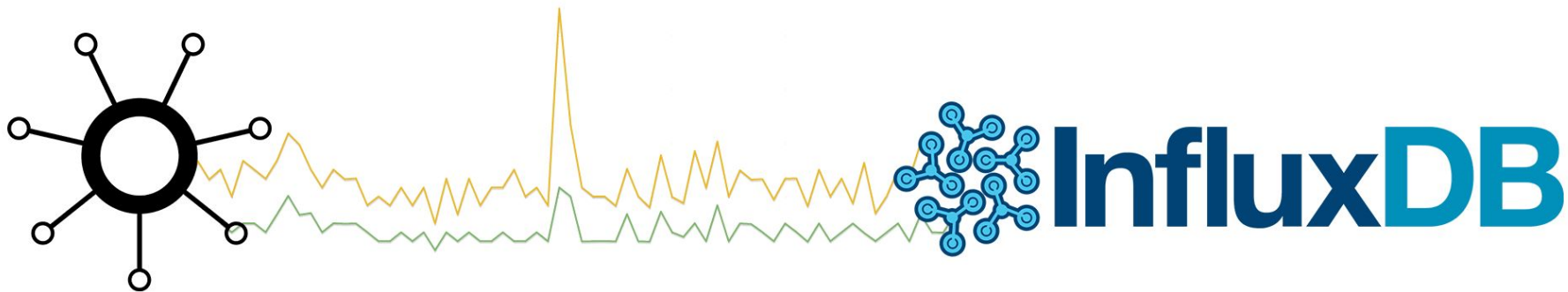
wiotp-credentials

SensorsBox/Number

0

Flow 1

Flow 2





# From devices to server to browser

```
received: {"topic":"","payload":14211,"_msgid":"a67a52c9.cc0f2"}
received: {"topic":"","payload":14212,"_msgid":"266f3977.9c84c6"}
received: {"topic":"","payload":14213,"_msgid":"6d85840b.74c5ec"}
```

Edit websocket out node

Delete

Cancel

Done

Type

Connect to

URL

ws://localhost:8080

Name

LocalServer

```
received: {"topic":"","payload":14
```

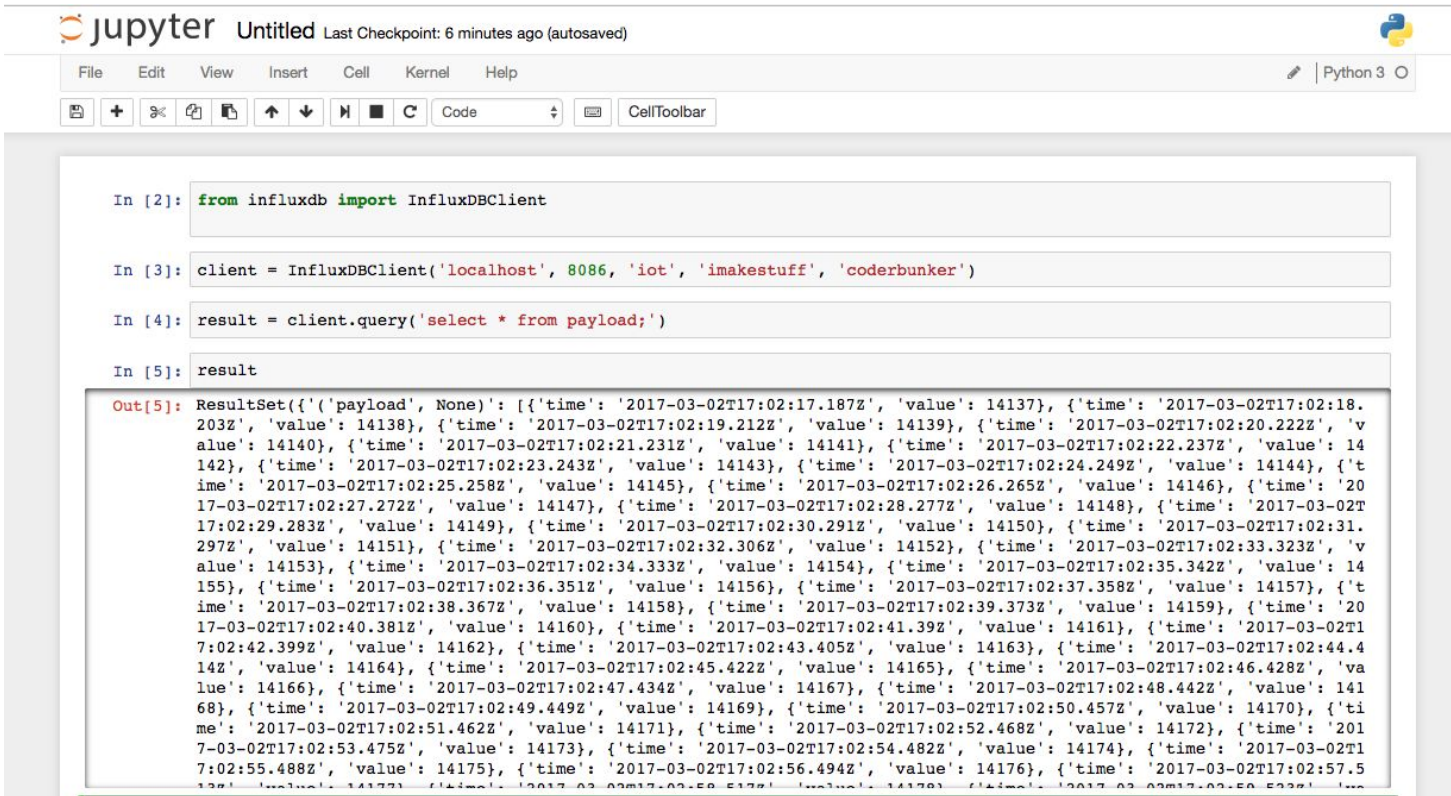
```
sgid":"cc256231.13419"}
sgid":"58c40442.e96f3c"}
sgid":"1e85a55f.0707cb"}
sgid":"d063b09c.d21df"}
sgid":"71ef970d.7e5f58"}
sgid":"5e6b6d72.751c54"}
sgid":"d2725b02.ad4ba8"}
sgid":"fa90f643.e45ca8"}
sgid":"2d039204.00028e"}
```

```
const WebSocket = require('ws');

const wss = new WebSocket.Server({ port: 8080 });

wss.on('connection', function connection(ws) {
  ws.on('message', function incoming(message) {
    console.log('received: %s', message);
  });
});
```

# From data in to structured information



```
Jupyter Untitled Last Checkpoint: 6 minutes ago (autosaved)
File Edit View Insert Cell Kernel Help Python 3
In [2]: from influxdb import InfluxDBClient

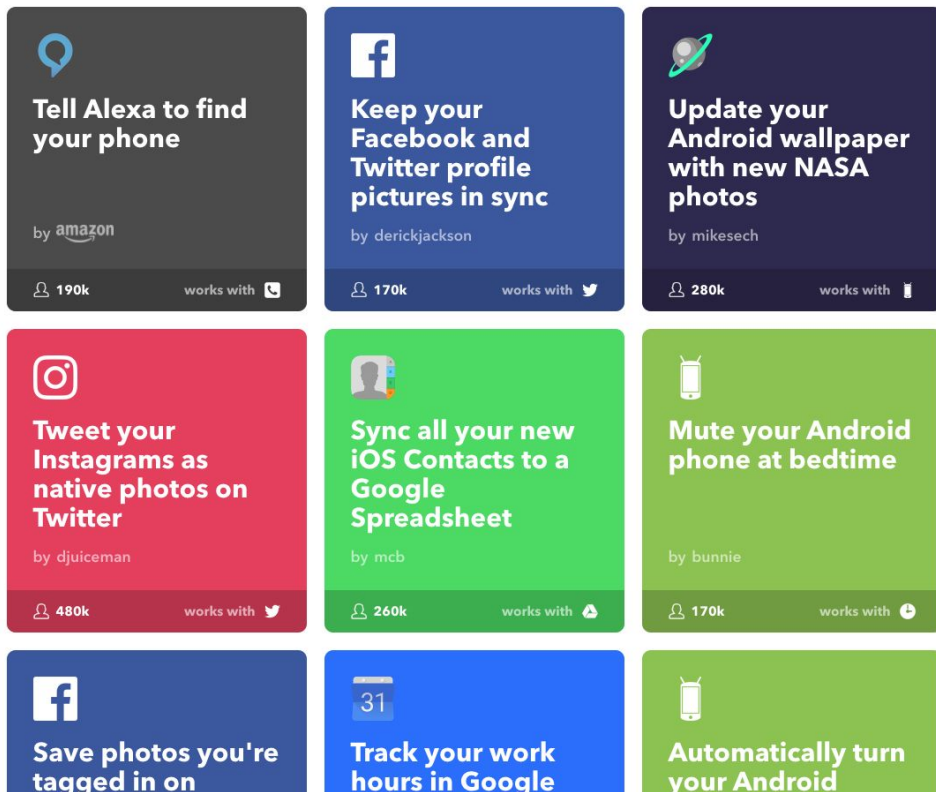
In [3]: client = InfluxDBClient('localhost', 8086, 'iot', 'imakestuff', 'coderbunker')

In [4]: result = client.query('select * from payload;')

In [5]: result

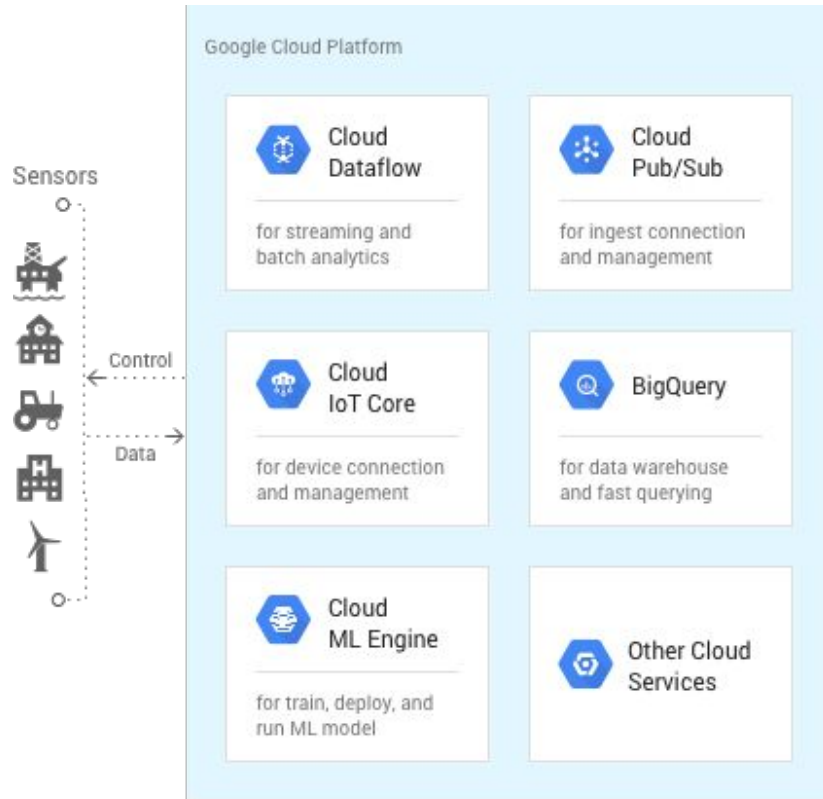
Out[5]: ResultSet([('payload', None)]: [{'time': '2017-03-02T17:02:17.187Z', 'value': 14137}, {'time': '2017-03-02T17:02:18.203Z', 'value': 14138}, {'time': '2017-03-02T17:02:19.212Z', 'value': 14139}, {'time': '2017-03-02T17:02:20.222Z', 'value': 14140}, {'time': '2017-03-02T17:02:21.231Z', 'value': 14141}, {'time': '2017-03-02T17:02:22.237Z', 'value': 14142}, {'time': '2017-03-02T17:02:23.243Z', 'value': 14143}, {'time': '2017-03-02T17:02:24.249Z', 'value': 14144}, {'time': '2017-03-02T17:02:25.258Z', 'value': 14145}, {'time': '2017-03-02T17:02:26.265Z', 'value': 14146}, {'time': '2017-03-02T17:02:27.272Z', 'value': 14147}, {'time': '2017-03-02T17:02:28.277Z', 'value': 14148}, {'time': '2017-03-02T17:02:29.283Z', 'value': 14149}, {'time': '2017-03-02T17:02:30.291Z', 'value': 14150}, {'time': '2017-03-02T17:02:31.297Z', 'value': 14151}, {'time': '2017-03-02T17:02:32.306Z', 'value': 14152}, {'time': '2017-03-02T17:02:33.323Z', 'value': 14153}, {'time': '2017-03-02T17:02:34.333Z', 'value': 14154}, {'time': '2017-03-02T17:02:35.342Z', 'value': 14155}, {'time': '2017-03-02T17:02:36.351Z', 'value': 14156}, {'time': '2017-03-02T17:02:37.358Z', 'value': 14157}, {'time': '2017-03-02T17:02:38.367Z', 'value': 14158}, {'time': '2017-03-02T17:02:39.373Z', 'value': 14159}, {'time': '2017-03-02T17:02:40.381Z', 'value': 14160}, {'time': '2017-03-02T17:02:41.39Z', 'value': 14161}, {'time': '2017-03-02T17:02:42.399Z', 'value': 14162}, {'time': '2017-03-02T17:02:43.405Z', 'value': 14163}, {'time': '2017-03-02T17:02:44.414Z', 'value': 14164}, {'time': '2017-03-02T17:02:45.422Z', 'value': 14165}, {'time': '2017-03-02T17:02:46.428Z', 'value': 14166}, {'time': '2017-03-02T17:02:47.434Z', 'value': 14167}, {'time': '2017-03-02T17:02:48.442Z', 'value': 14168}, {'time': '2017-03-02T17:02:49.449Z', 'value': 14169}, {'time': '2017-03-02T17:02:50.457Z', 'value': 14170}, {'time': '2017-03-02T17:02:51.462Z', 'value': 14171}, {'time': '2017-03-02T17:02:52.468Z', 'value': 14172}, {'time': '2017-03-02T17:02:53.475Z', 'value': 14173}, {'time': '2017-03-02T17:02:54.482Z', 'value': 14174}, {'time': '2017-03-02T17:02:55.488Z', 'value': 14175}, {'time': '2017-03-02T17:02:56.494Z', 'value': 14176}, {'time': '2017-03-02T17:02:57.501Z', 'value': 14177}, {'time': '2017-03-02T17:02:58.507Z', 'value': 14178}, {'time': '2017-03-02T17:02:59.513Z', 'value': 14179}, {'time': '2017-03-02T17:03:00.52Z', 'value': 14180}]]
```

# Integration with IFTT

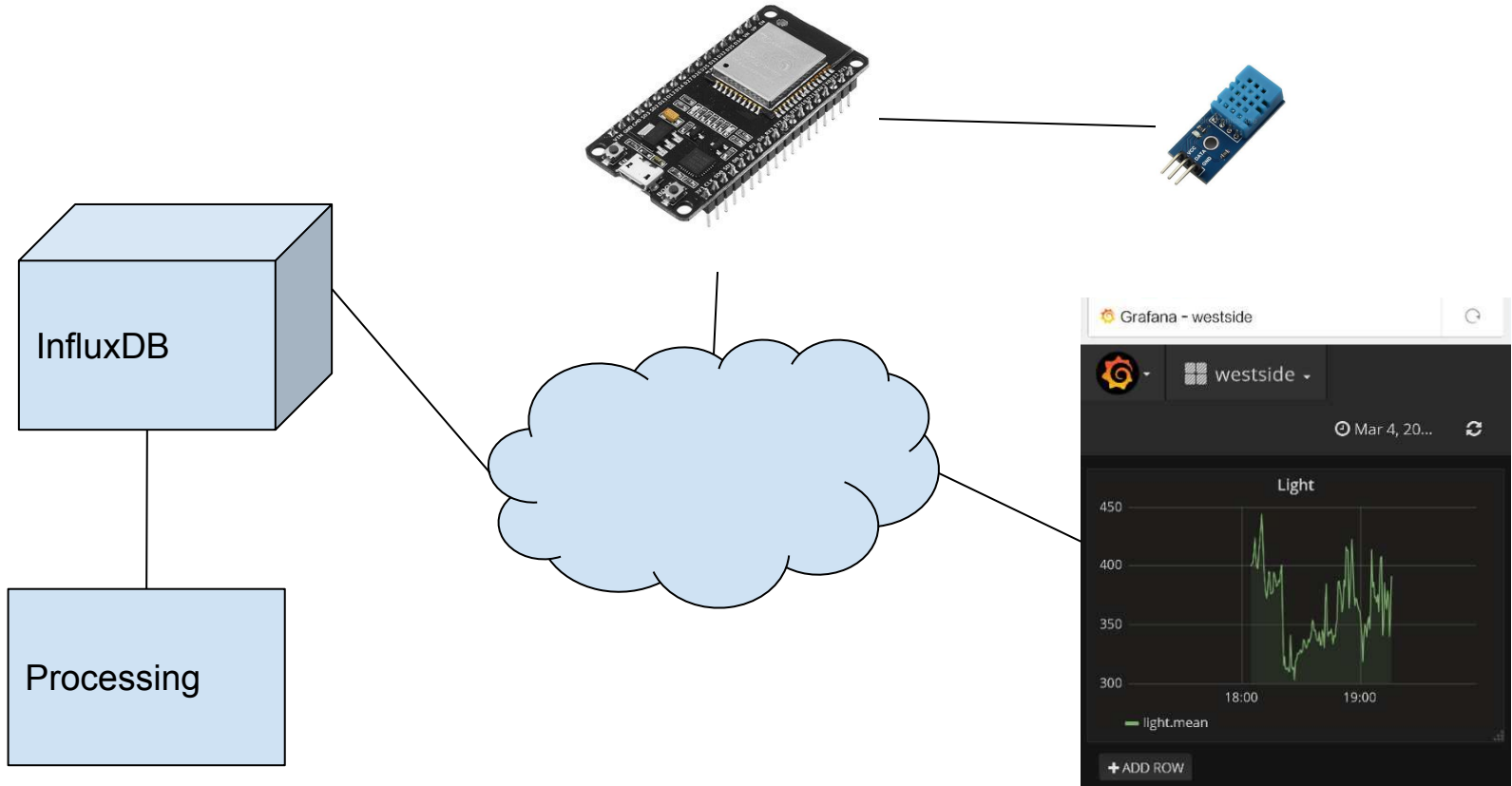


- hundreds of actions on events through the web
- Incoming and outgoing actions to IoT device
- <https://ifttt.com/maker>

# Processing data “intelligently”



Build & train ML models in the cloud



Integration example: sensors -> Arduino -> Raspberry Pi (Node-RED) -> influxdb

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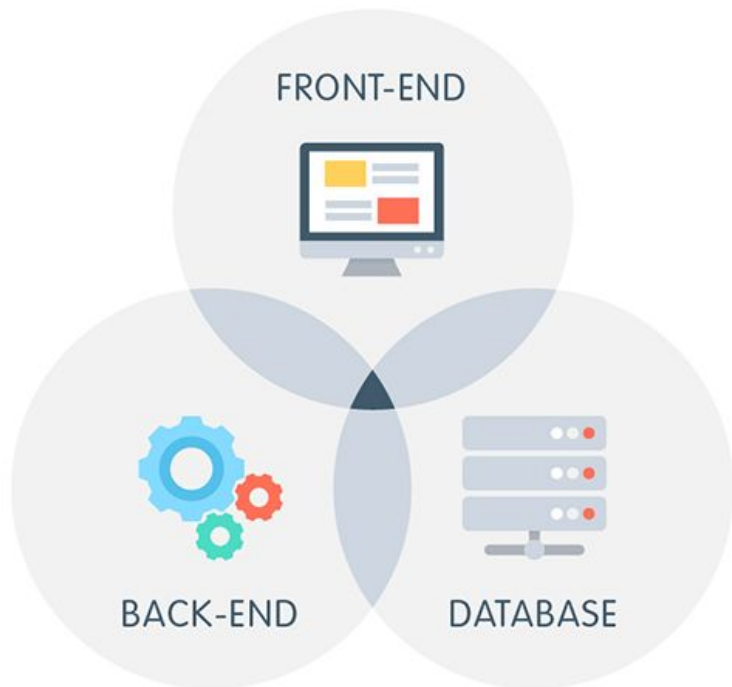
# Components of IoT systems

- Sensors (and actuators)
  - Devices
  - Networking
  - Cloud services
  - Processing pipeline
  - Frontend
  - Orthogonal concerns
    - Security
    - Device management
    - Deployment
    - Automated Testing
-

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# Challenges

# FULL-STACK DEVELOPMENT

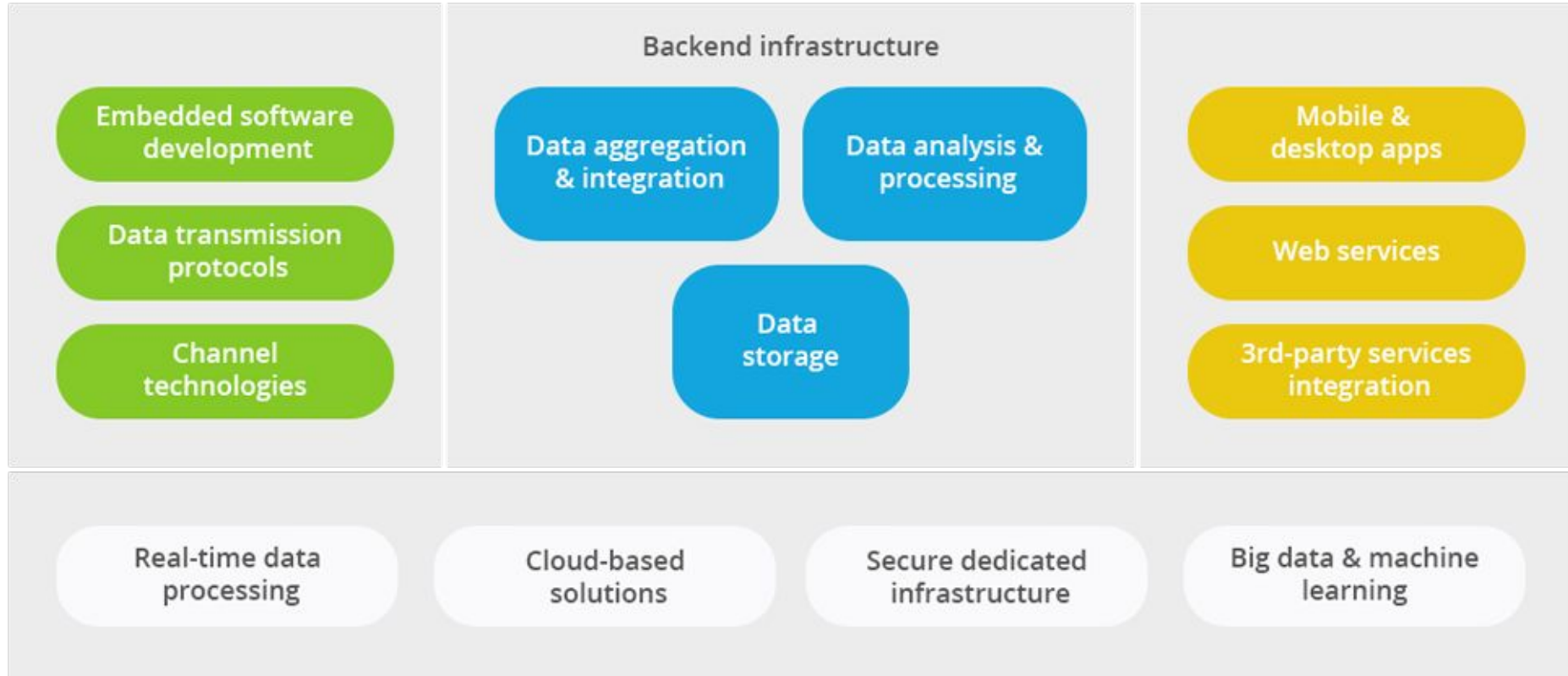




# The Magical Fullstack Developer



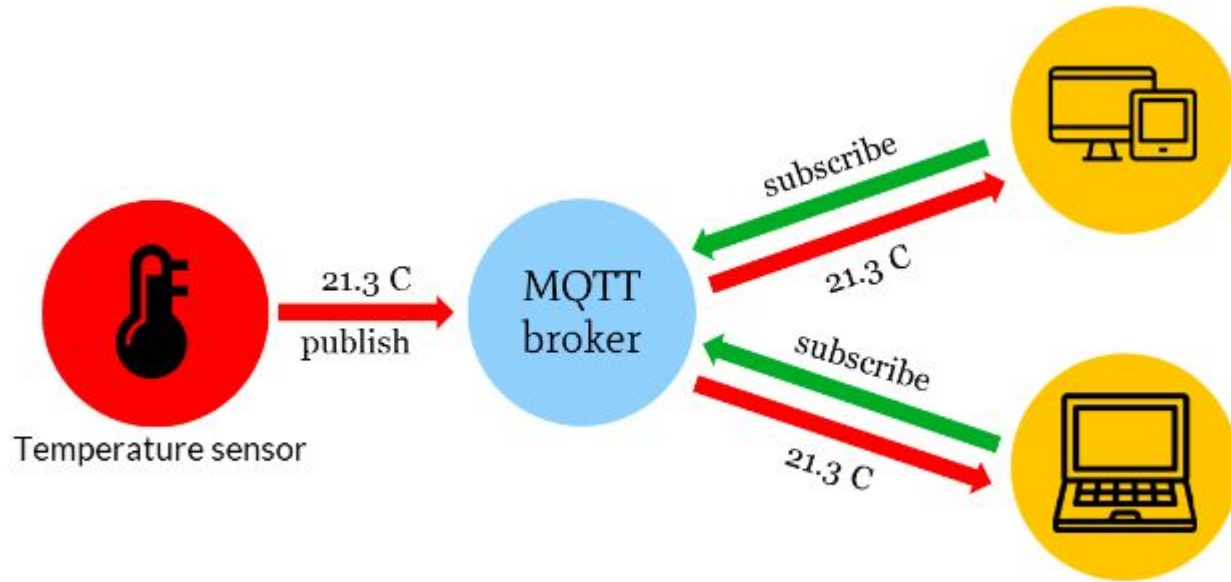
# A little bit more complicated...



# | An IoT engineering team

- Hardware design & development
- Embedded system engineering
- Backend & Frontend development (mobile & web)
- Data Science (ETL, reporting, analysis and prediction)
- Network engineering
- Product Management
- Quality assurance
- Security engineering

# Messaging



Schematic data flow from sensor (machine) to devise (machine)

# | Engineering Challenges

- Hardware production is hard
- Embedded software development is hard
- Networking small chunks of data at large scale is hard
- Turning data into information is hard
- Managing a large set of devices is hard
- Securing so many devices outside of our control is hard

## | What to look out for

- Focus on insights understandable by the business
- Secure access, transfer and storage of sensitive data
- Reliability of services, hardware, networking
- Redundancy and disaster recovery
- Testing and quality assurance
- Monitoring and escalation

# | What to think about before getting started

- Is there a large scale application? A profitable business?
- Are there regulatory rules preventing us from achieving it?
- Do we have enough budget?
  - Minimum 1 million RMB for hardware development
  - Minimum 1 million RMB for hardware production
  - Minimum 1 million RMB for software
- Are we planning for enough iterations?
- Can we assemble the engineering team?

# Coderbunker IoT

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