

XII CÁTEDRA INTERNATIONAL DE INGENIERÍA

The Internet of Things?



9-18 July 2018

OSCAR CARRILLO
MAROUA MEDDEB



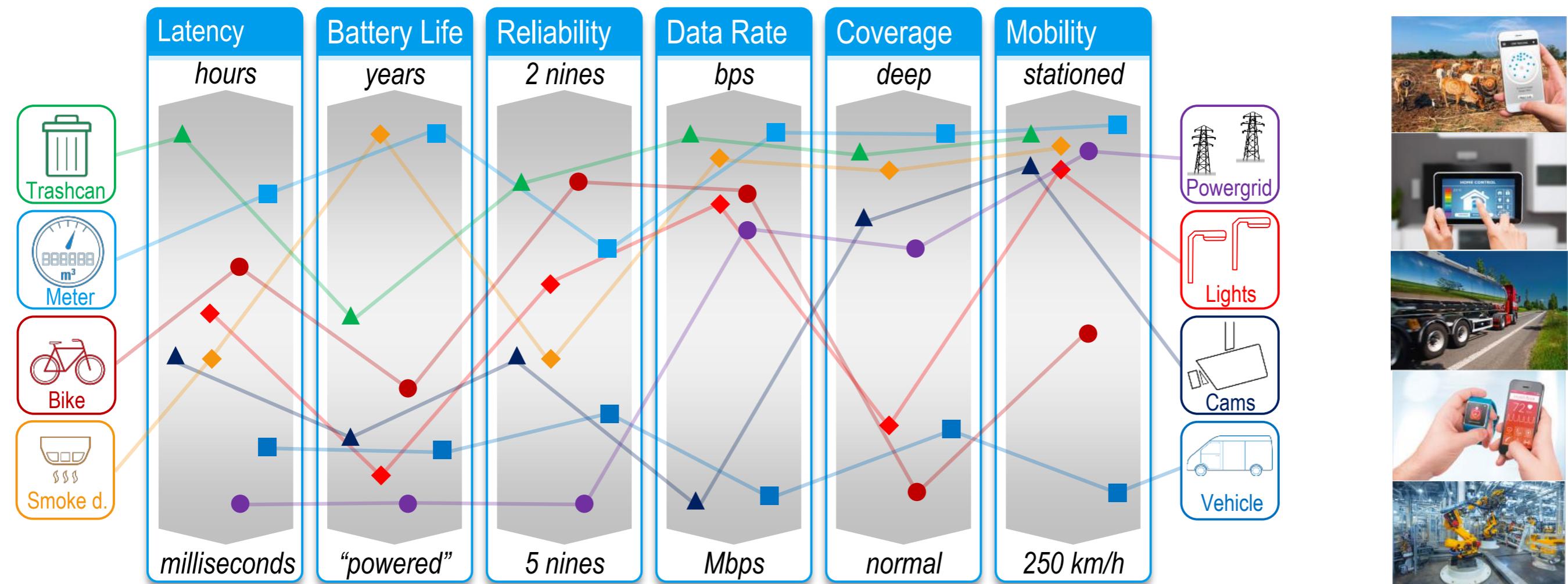
Session 3

IoT Network Protocols
Play with Docker

Network Technology Trends on IoT

Which technology should I use ?

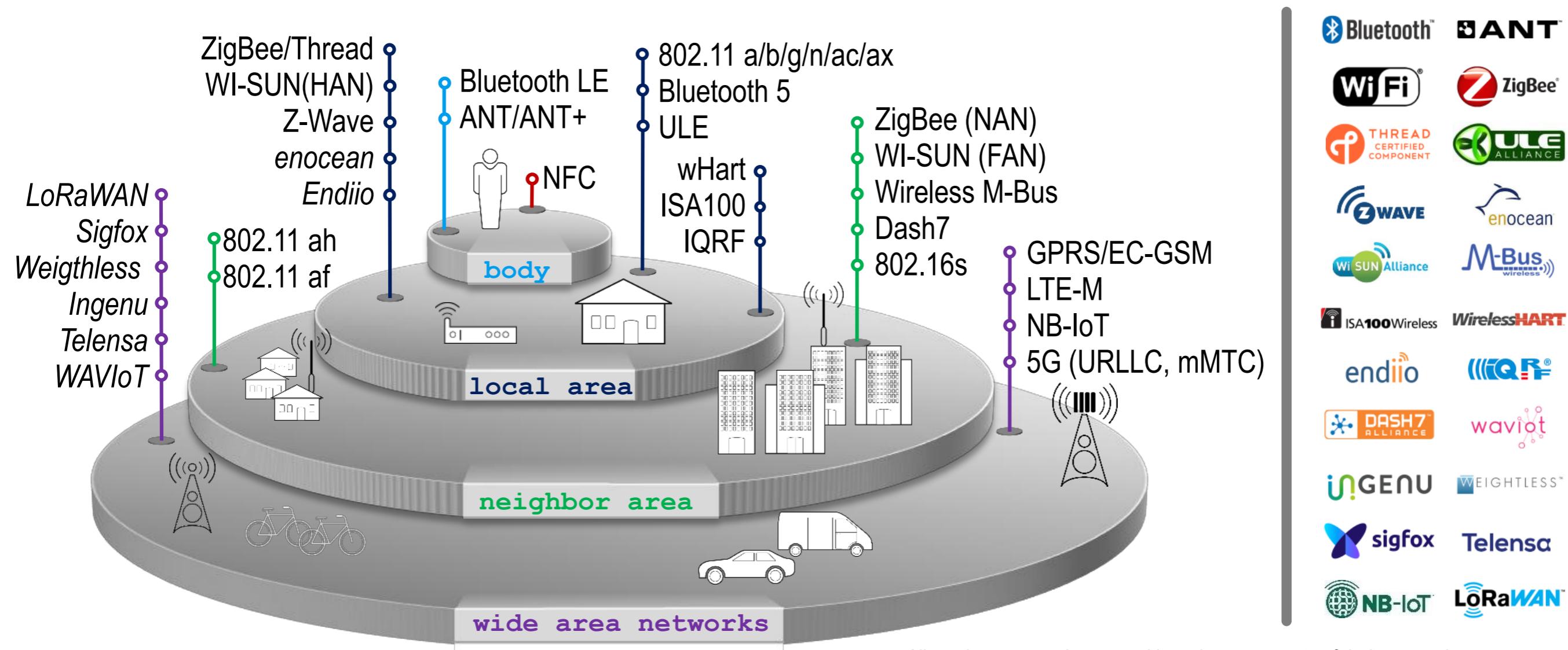
Define your requirements



“Everything that will benefit from being connected will be connected”

Ericsson, 2010

A plethora of radio technologies

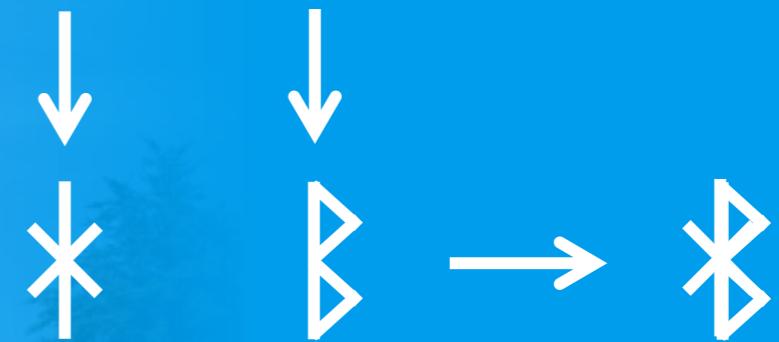


All product names, logos, and brands are property of their respective owners

Some Bluetooth History



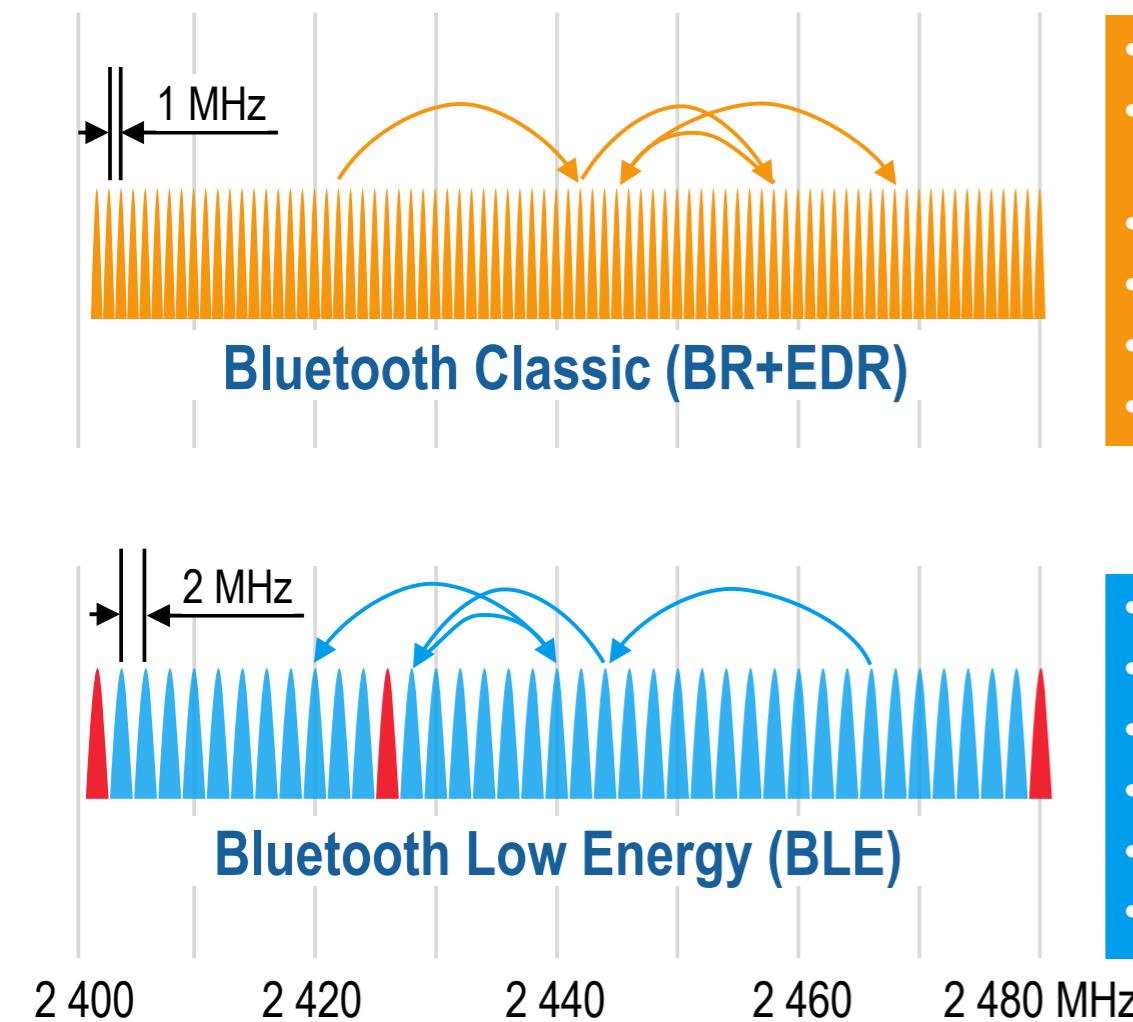
King Hagal Bjarkan (Bluetooth)



Dr. Haartsen who worked with a team of Ericsson engineers to bring Bluetooth to the market was named by the European Patent Office as the "father of Bluetooth".

The idea for the Bluetooth name came from Jim Kardach of Intel, who was reading a historical novel about Vikings and King Harald Blåtand at the time. (Courtesy: Intel Free Press)

Bluetooth Basic and Low Energy



- 2.4 GHz ISM band
- 1 Msymbol/s using GFSK modulation
- EDR: data modulation $\pi/4$ -DQPSK / 8DPSK
- 79 channels on 1 MHz spacing
- Frequency hopping (1600 hops/s)
- Voice support
- FEC

Classic BR/EDR



- 2.4 GHz ISM band
- 1 Msymbol/s using GFSK modulation
- 40 channels on 2 MHz spacing
- 3 advertising channels
- Frequency hopping (37 channels)
- CRC

Low Energy

Bluetooth IoT Features

Gateway

Connecting devices directly to the cloud

02/16



Speed

100% improvement for low latency apps

12/16 5.0



Mesh

building mesh by using relay nodes

07/17



Range

4x range to cover a smart home or office

12/16 5.0



Broadcast

Extended capabilities of advertising channel

12/16 5.0



WiFi



- Initially created by the National Cash Register

50%

42% in 2016

of all IP traffic in 2021,
will be Wi-Fi, 30% will be
wired, and 20% will be mobile.

**6fold
grow**

of Wi-Fi homespots
from 85.1 million in 2016
to 526.2 million **by 2021**.

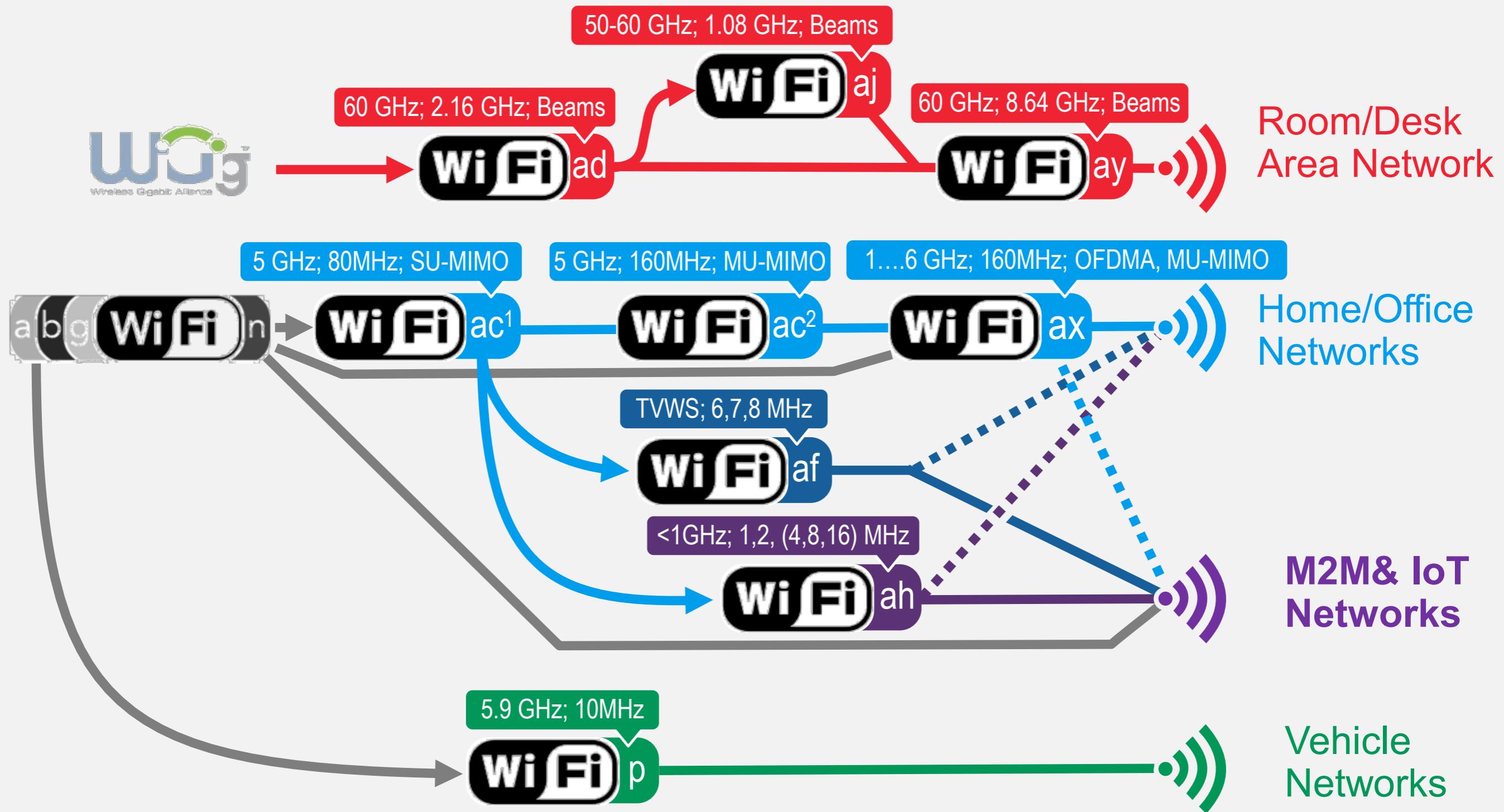
63%

60% in 2016

of total mobile data traffic
will be **offloaded** through
Wi-Fi or femtocell in 2021.



Wireless alphabet soupe



WiFi HaLow (802.11 ah)

- “New technology will extend Wi-Fi® solutions for the Internet of Things” Wi-Fi Alliance (Jan.2016)

Long range operation

Low power consumption

Large number of devices per access point

High throughput compared to e.g. ZigBee

Greenfield operation

Sensor Networks



Home Security



Wearables



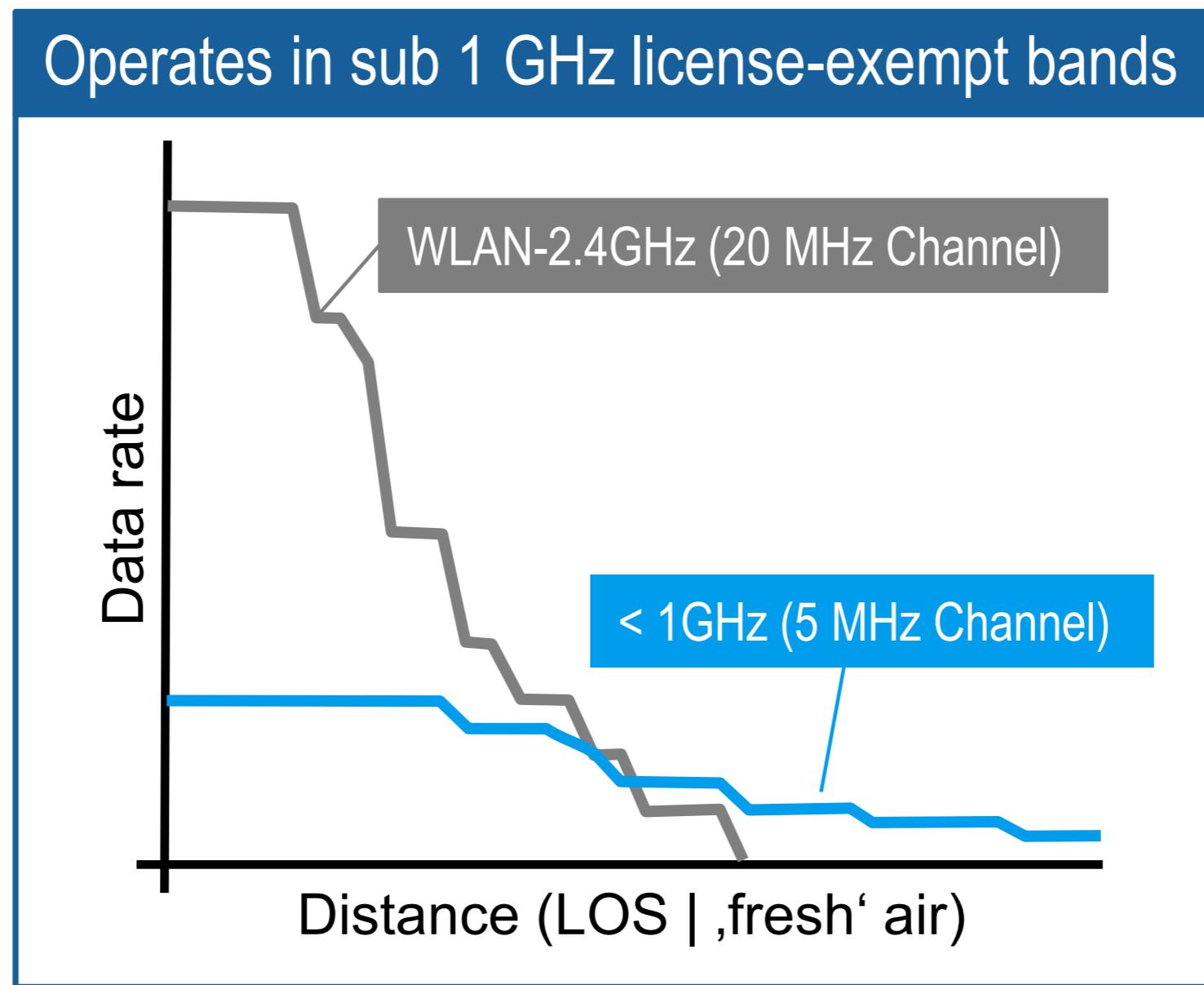
Range extension



Smart Metering

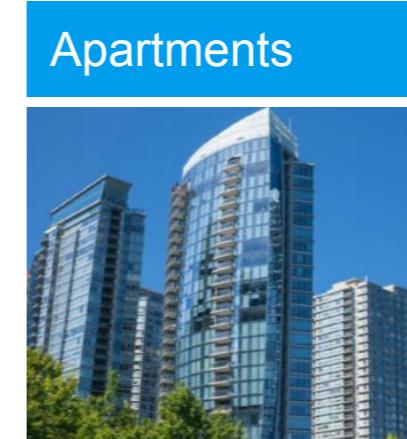
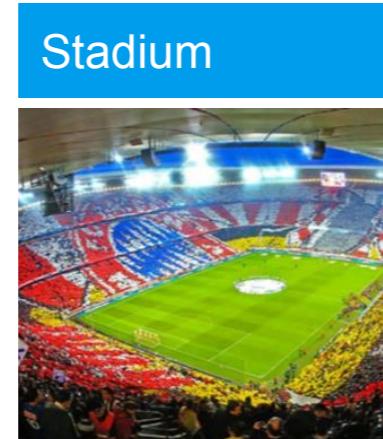


Long range, low speed, low power WiFi 802.11h



802.11ax Requirements and Applications

- Enhance operation in 2.4 AND 5 GHz bands; backward compatible and coexist with legacy 802.11 devices in the same band (11n/11ac)
- Increase average throughput per station in dense deployment scenarios
- Covering indoor AND outdoor scenarios
- Improve power efficiency of the stations



802.15.4 - for smart home, smart buildings and more



ZigBee - Protocol

ZigBee - Transport

ZigBee - Networking

802.15.4 MAC

IEEE 802.15.4
2.4 GHz ◆ O-PQSK



Protocol (e.g. CoAP)

UDP/TCP

6LoWPAN, DTLS,
Distance Vector Routing

802.15.4 MAC

IEEE 802.15.4
2.4 GHz ◆ O-PQSK



ISA Protocol

UDP

6LoWPAN

Upper data link ISA100
802.15.4 MAC

IEEE 802.15.4
2.4 GHz ◆ O-PQSK



HART: Protocol

HART: TCP like

HART Addressing/Routing

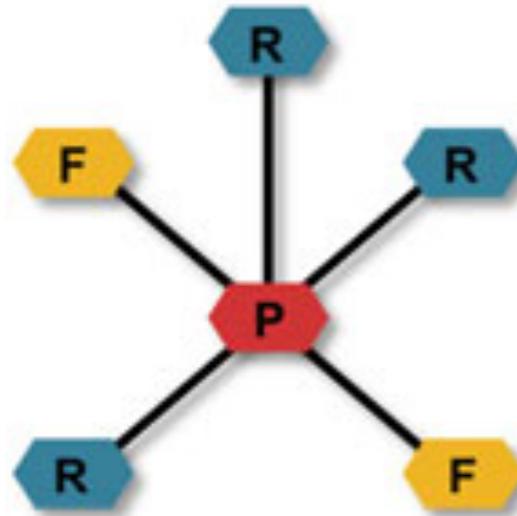
HART TDMA - hopping

IEEE 802.15.4
2.4 GHz ◆ O-PQSK



802.15.4 Topologies

Star

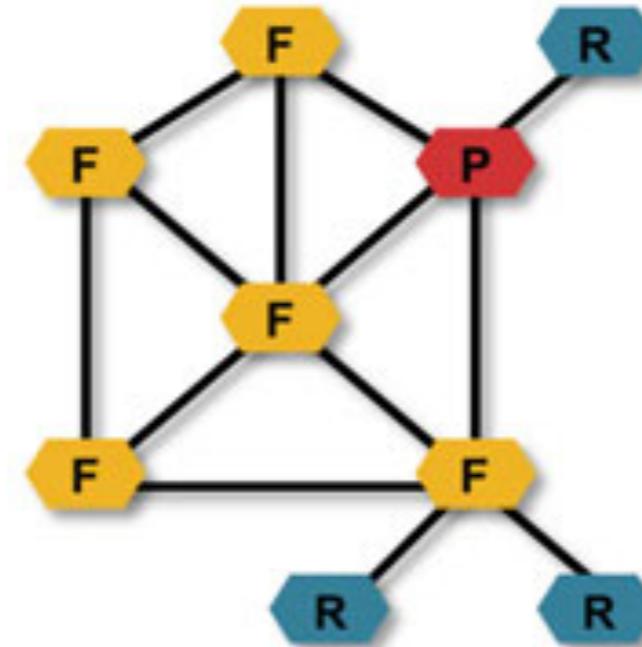


P PAN Coordinator

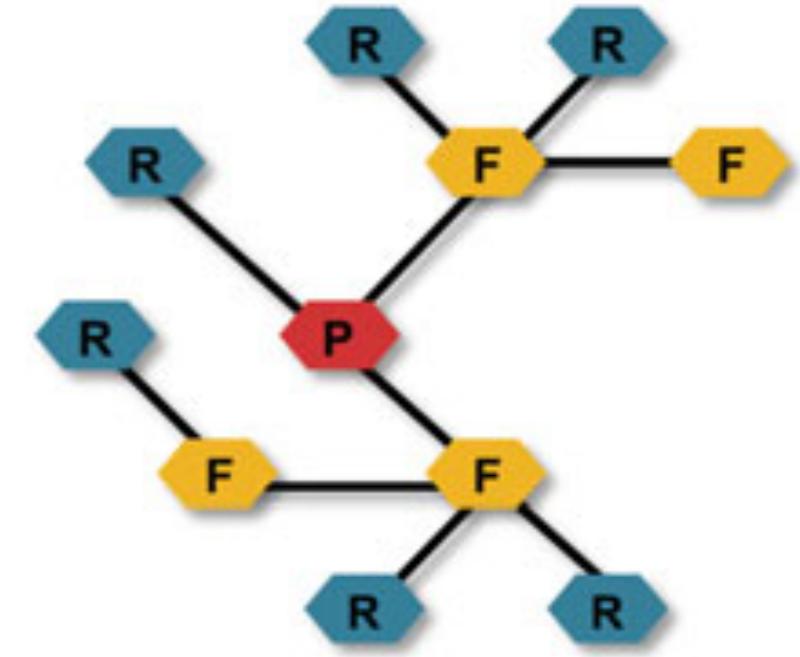
R RFD

F FFD

Mesh



Cluster Tree

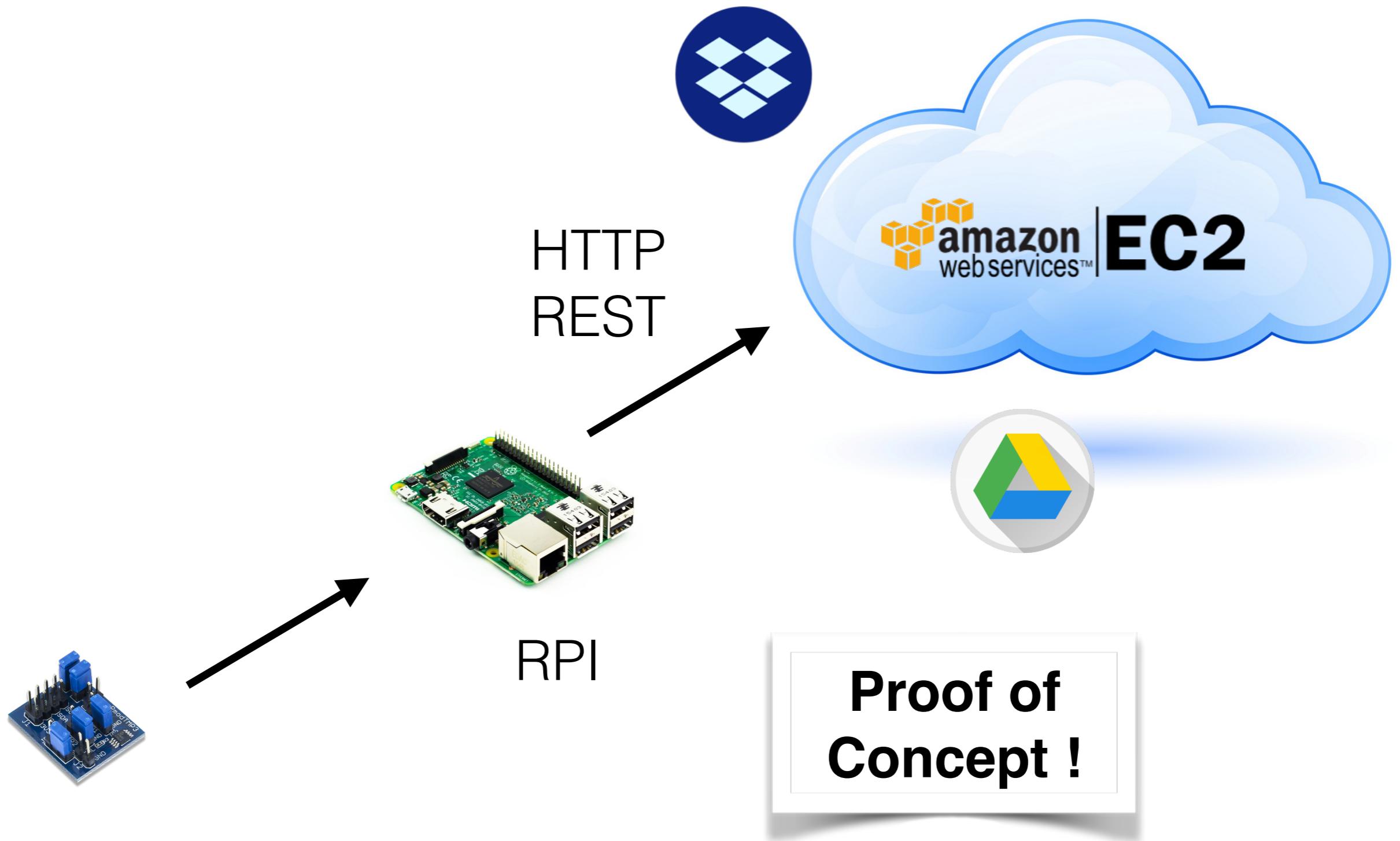


- RFD: Reduced Fonction Device
- FFD: Full-Function Device

Hands On

Build your fog IoT architecture

IoT + Cloud : easy!



OVH : down 2h30



CHRONIQUES
DES (R)ÉVOLUTIONS NUMÉRIQUES

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L'hébergeur Internet OVH touché par une importante panne

De nombreux sites Internet étaient inaccessibles jeudi matin. L'un des centres de données du leader européen de l'hébergement a perdu son alimentation électrique.

LE MONDE | 09.11.2017 à 09h54 • Mis à jour le 09.11.2017 à 17h06 |

Par Martin Untersinger

[Abonnez vous à partir de 1 €](#)

Réagir Ajouter

Partager Tweeter

« *Les emmerdes, ça vole toujours en escadrille* », a dit un jour un ancien président de la République. Les geeks, eux, citent plus volontiers la loi de Murphy, qui veut que « *tout ce qui peut mal tourner tournera mal* ». Ces deux sentences s'appliquent en tout cas parfaitement à la situation cauchemardesque qu'a vécue le leader européen de l'hébergement de données, l'entreprise française OVH, jeudi 9 novembre.

Juste après 7 heures, son centre de données (« *data center* ») de Strasbourg, où sont concentrées une partie des données de ses clients, a brusquement perdu ses deux alimentations électriques principales. Deux groupes électrogènes, qui auraient dû démarrer immédiatement pour prendre le relais, sont restés désespérément à l'arrêt.



Octave Klabo

@olesovhcom



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PUBLICITE

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- 2 Jeux paralympiques 2018 : la France a six médailles, dont trois en or, après deux journées
- 3 En Namibie, la ferme modèle où l'on sauve les guépards
- 4 Parcoursup 2018 : CV, lettre de motivation, inscription, vœux... tout ce qu'il faut savoir

Amazon : down 4h

 USA TODAY

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Massive Amazon cloud service outage disrupts sites

Elizabeth Weise, USATODAY Published 1:51 p.m. ET Feb. 28, 2017 | Updated 6:56 a.m. ET March 1, 2017



A number of websites became unavailable Tuesday after Amazon's website hosting service went down unexpectedly. Though the majority of sites affected have since gone back online, some appear to still be facing issues. USA TODAY

 SAN FRANCISCO — It didn't quite break the Internet, but a 4-hour outage at Amazon's AWS

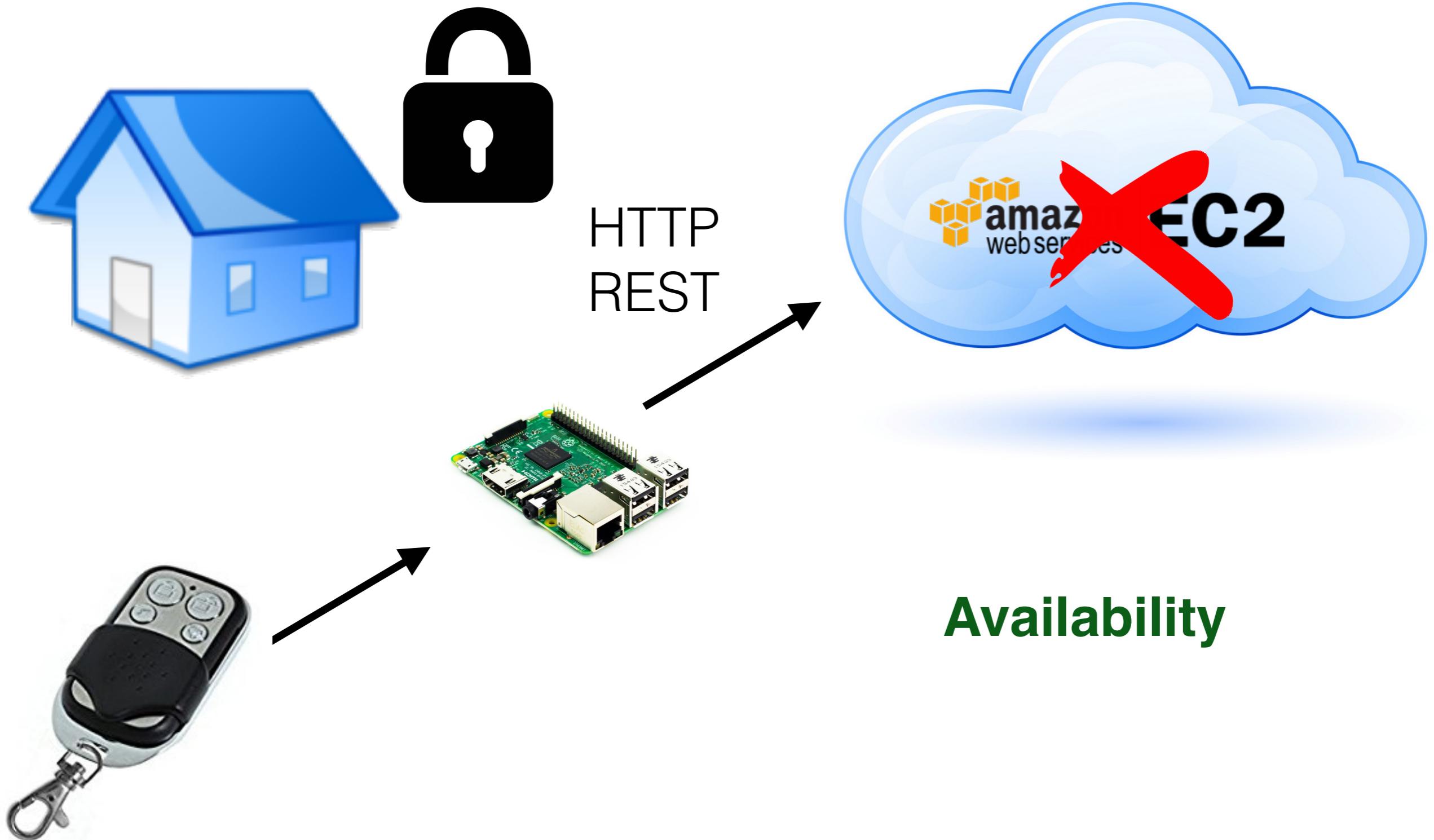
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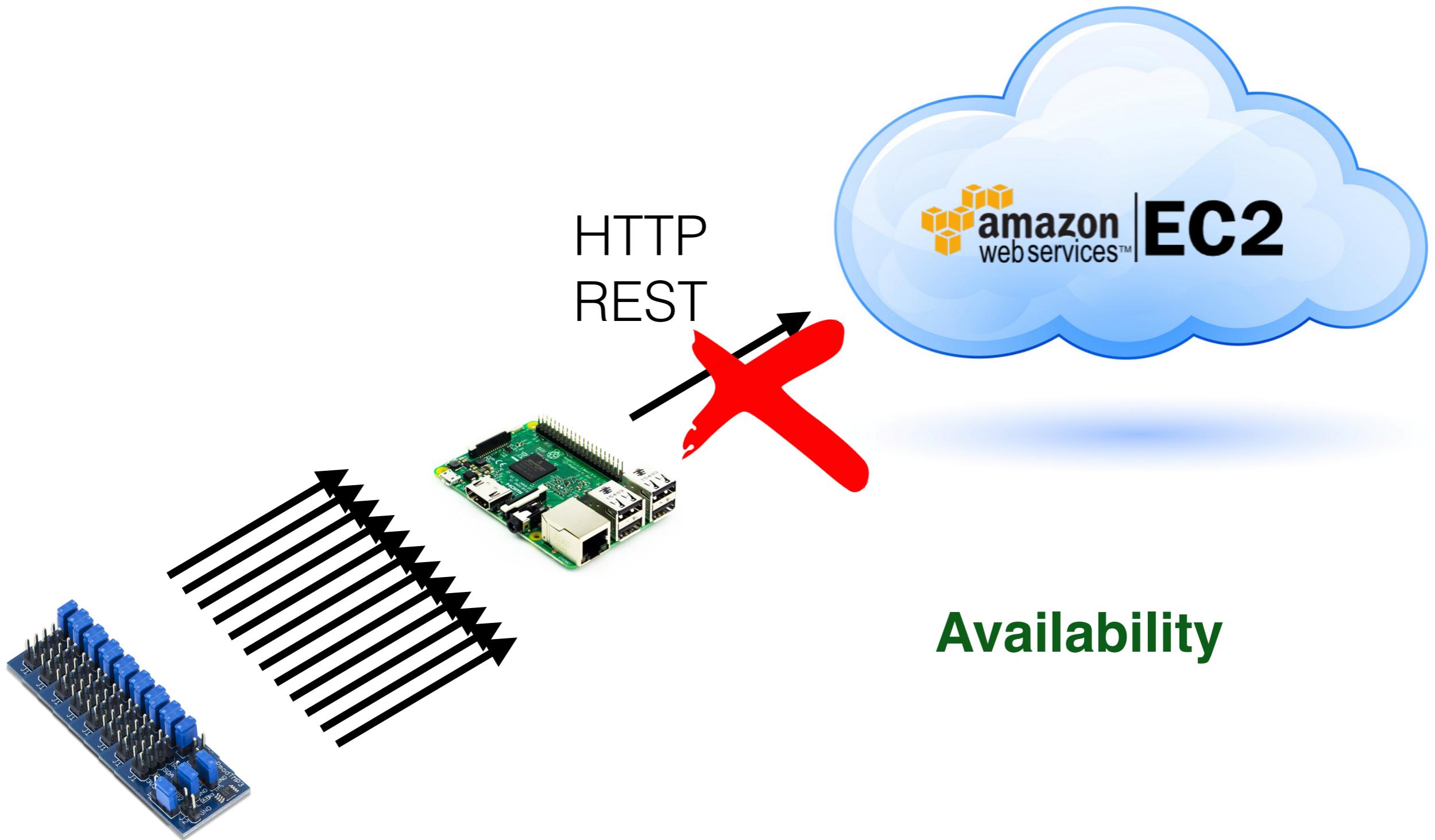

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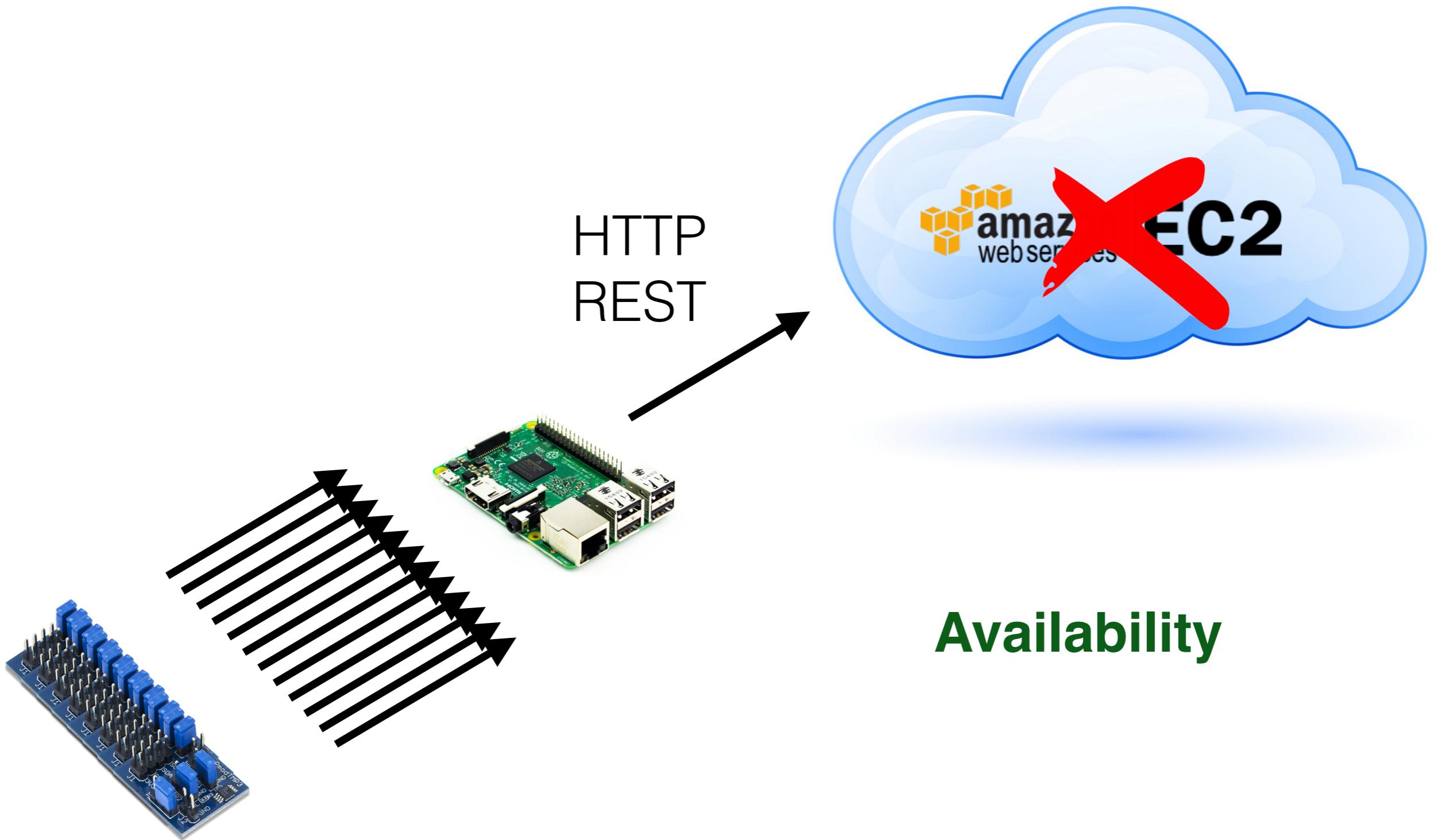
IoT + Cloud : robust ?



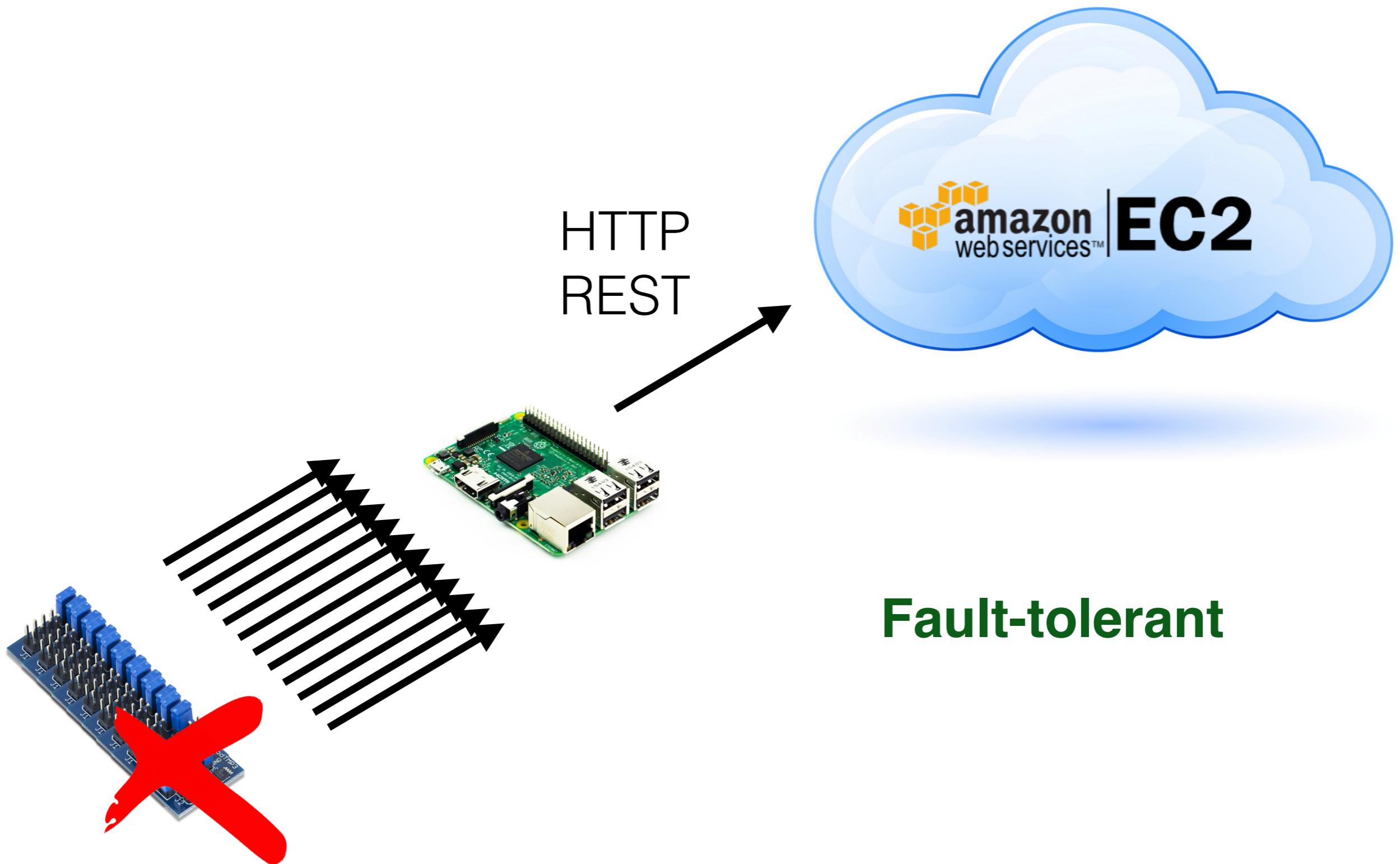
IoT + Cloud : robust ?



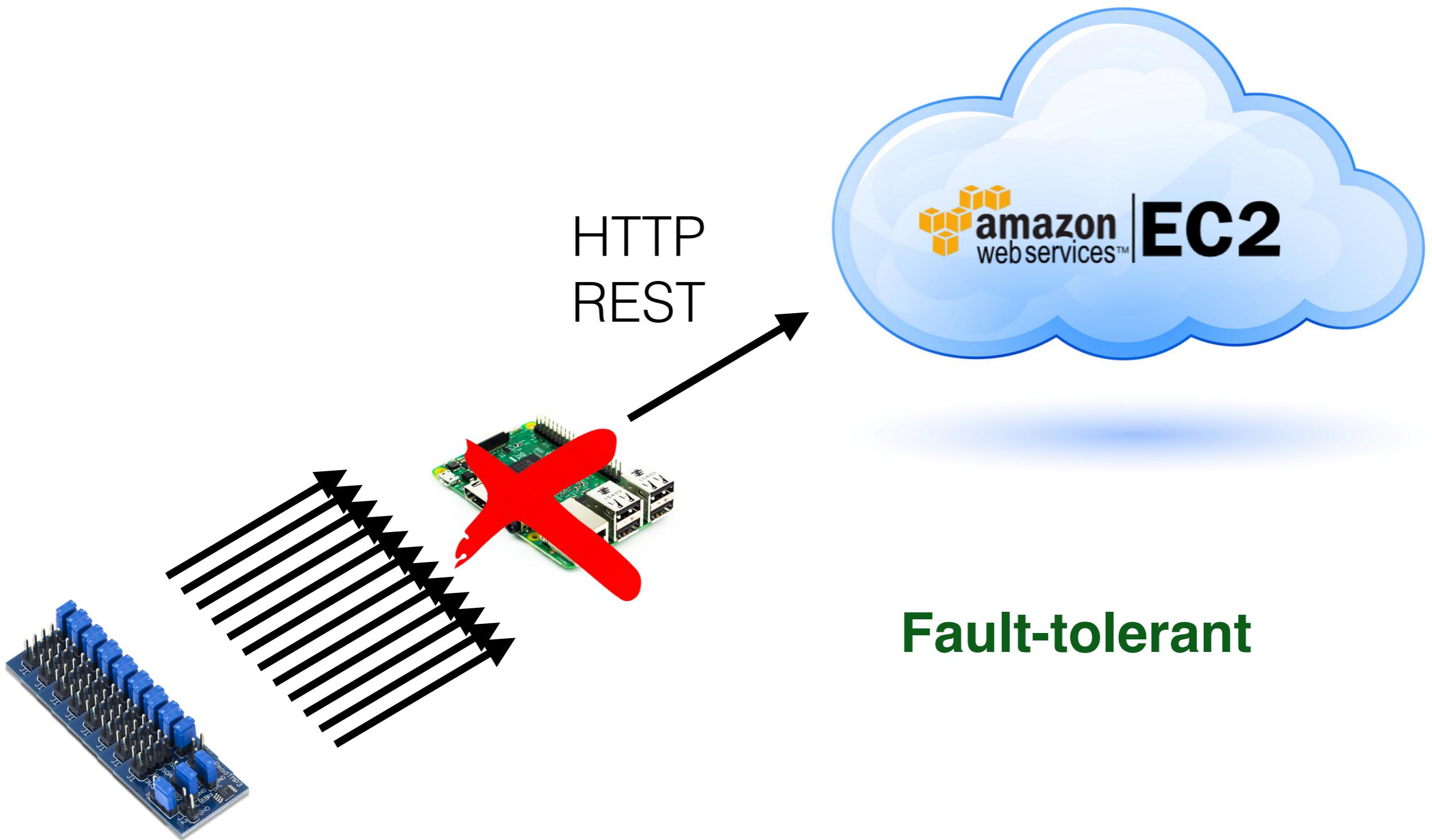
IoT + Cloud : robust ?



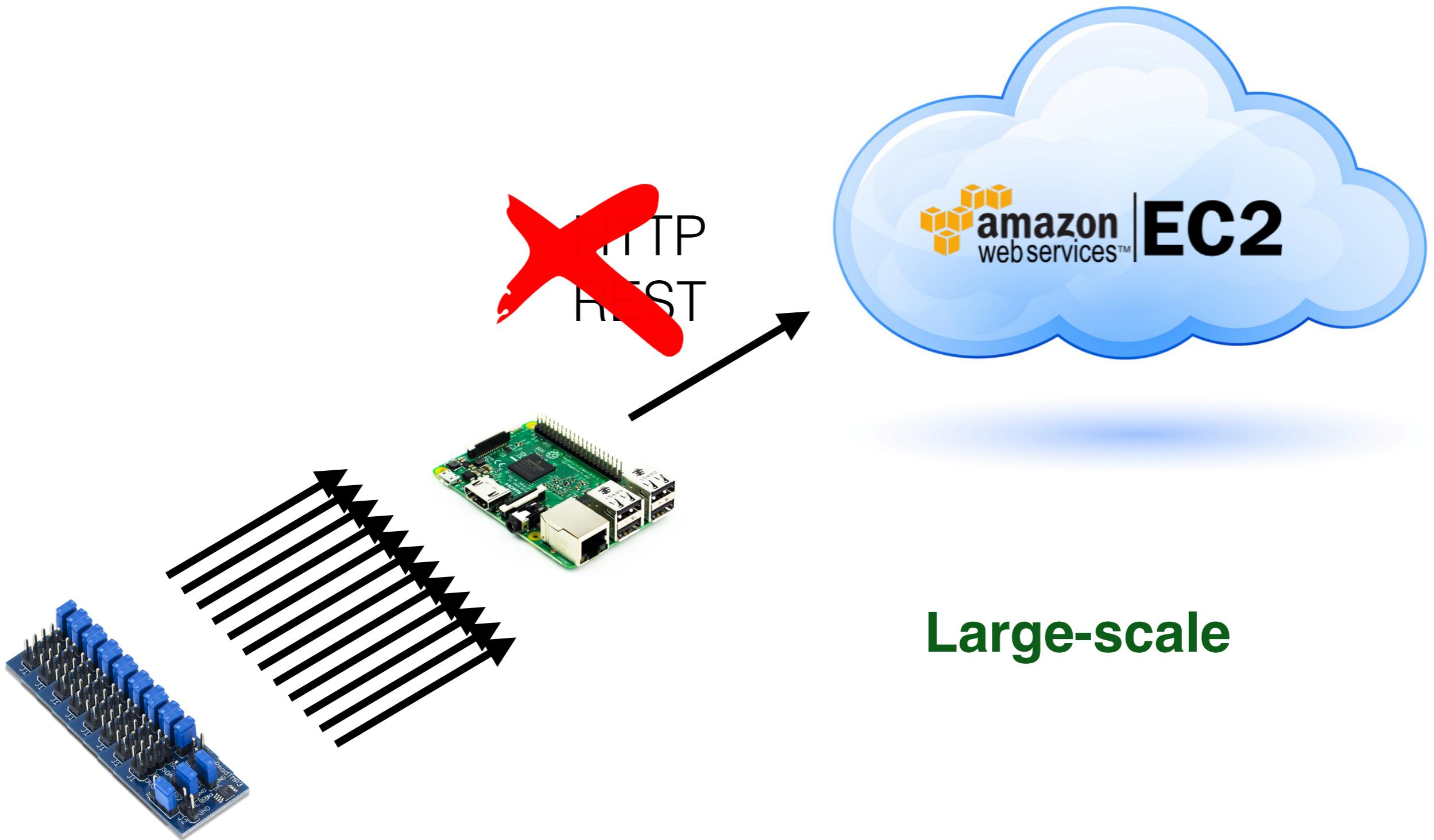
IoT + Cloud : robust ?



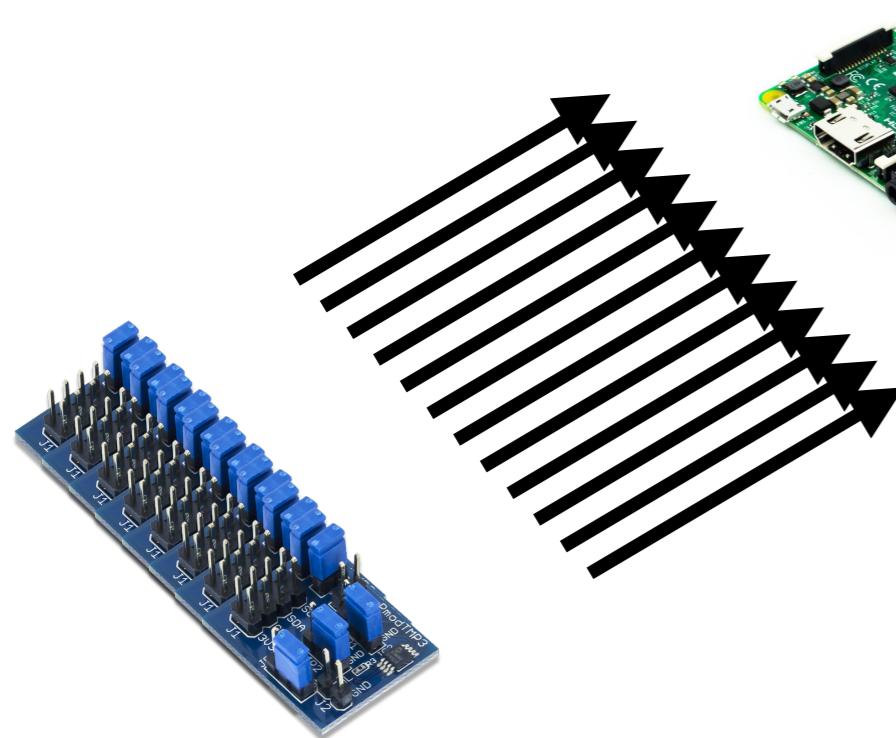
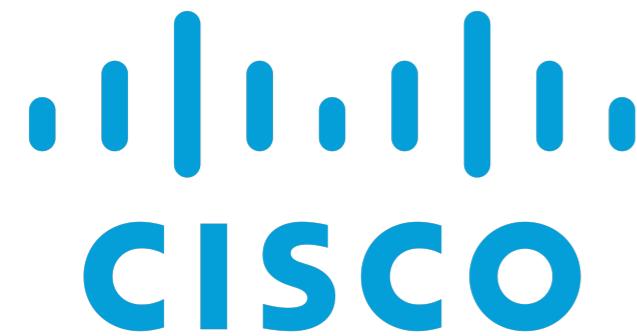
IoT + Cloud : robust ?



IoT + Cloud : robust ?



Fog Computing



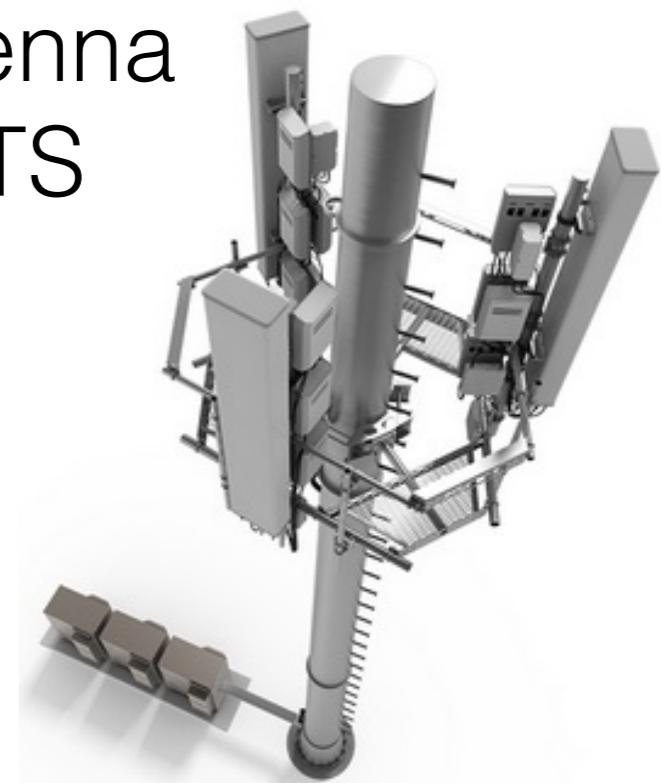
HTTP
REST



Latency

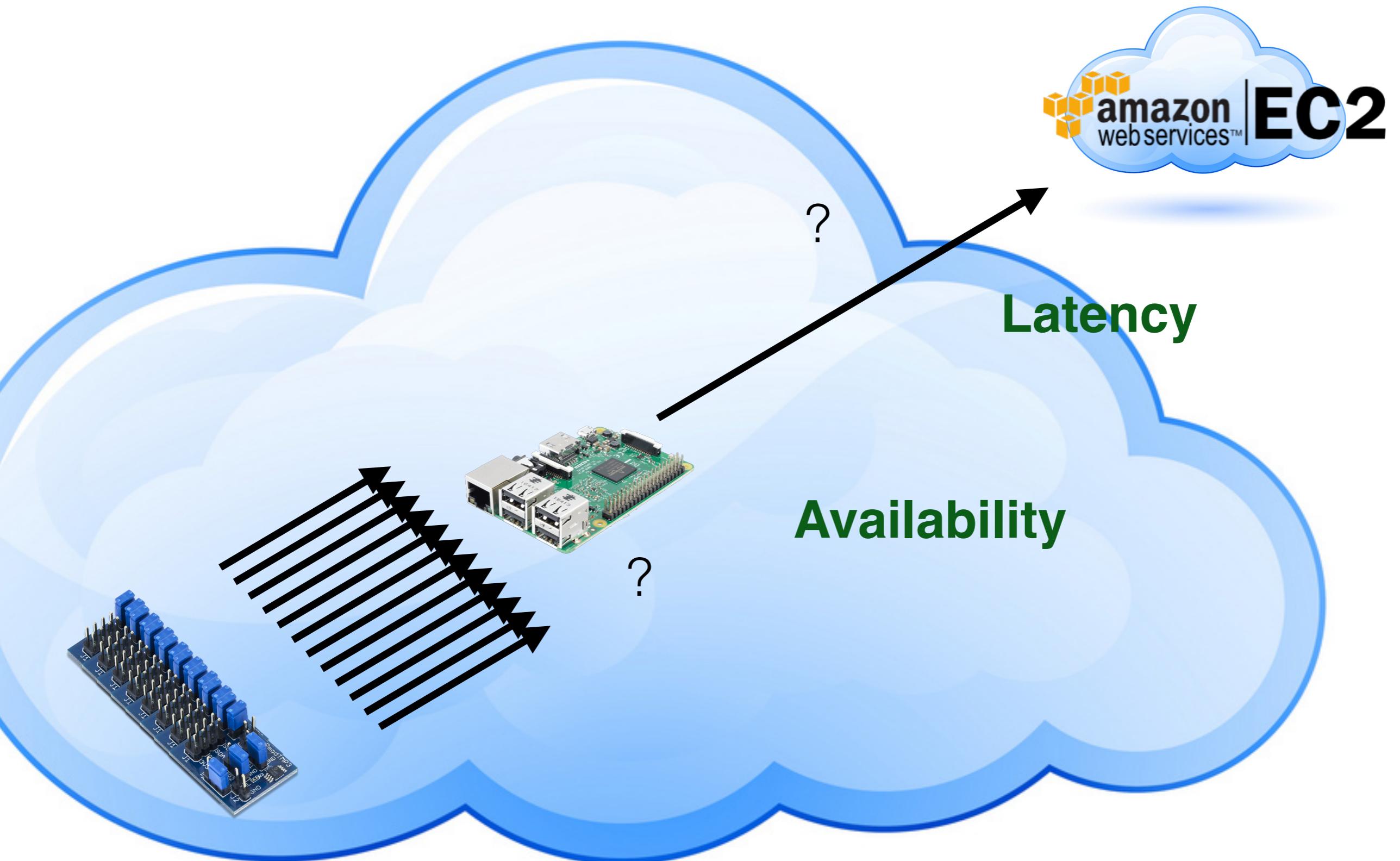


Antenna
BTS



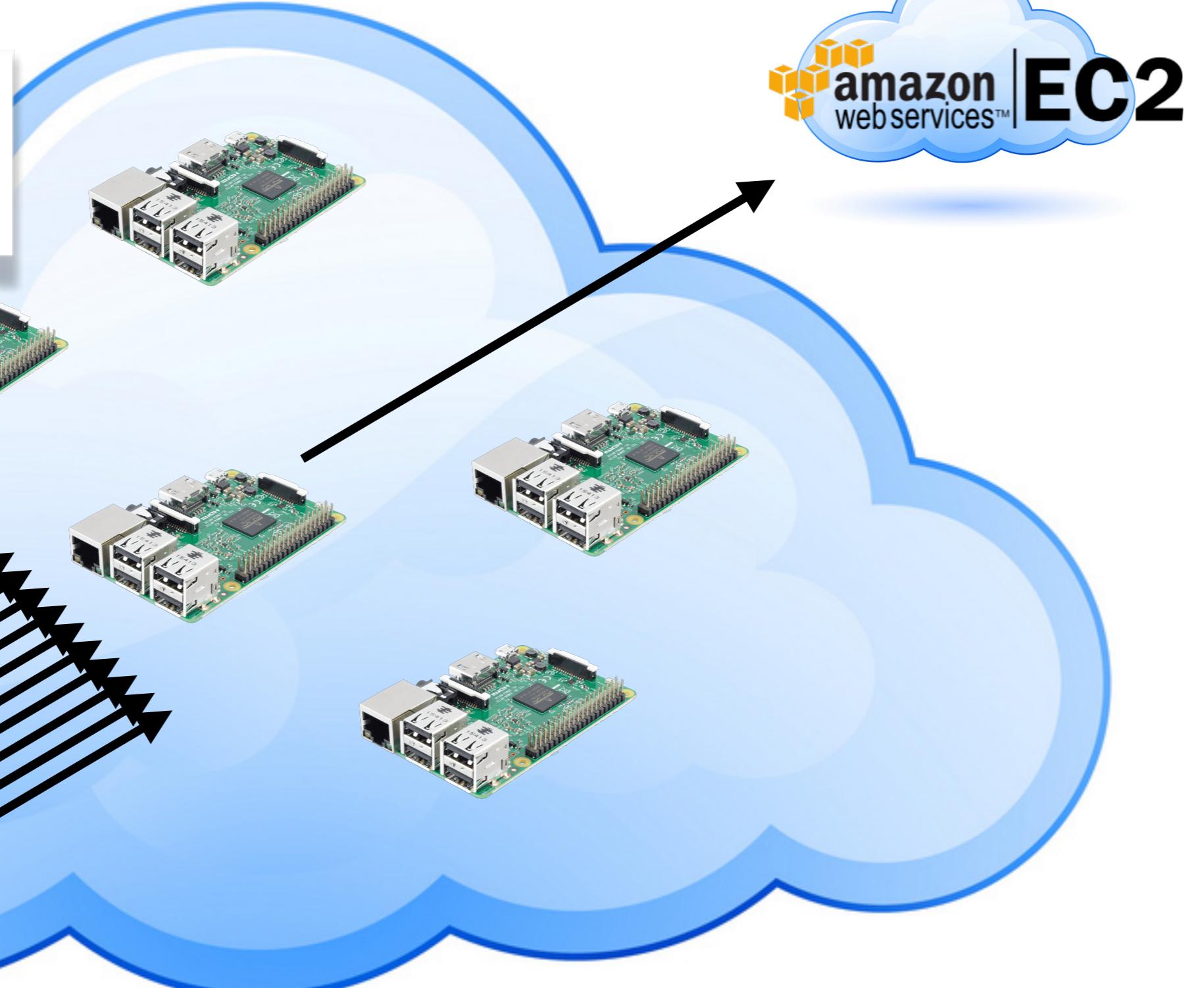
Efficient

Edge Computing

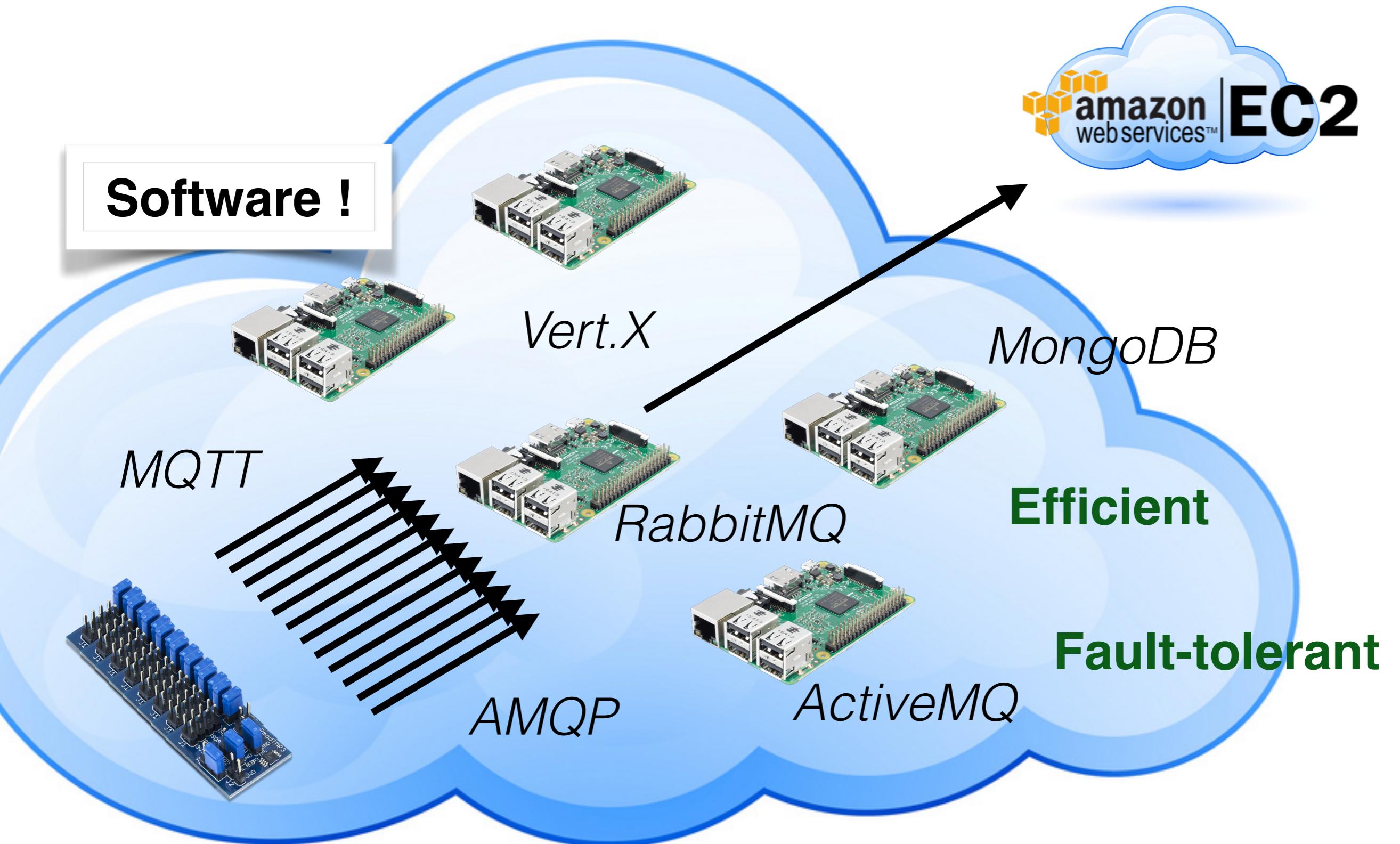


Edge Computing : CloudIoT

**Hardware
not enough!**



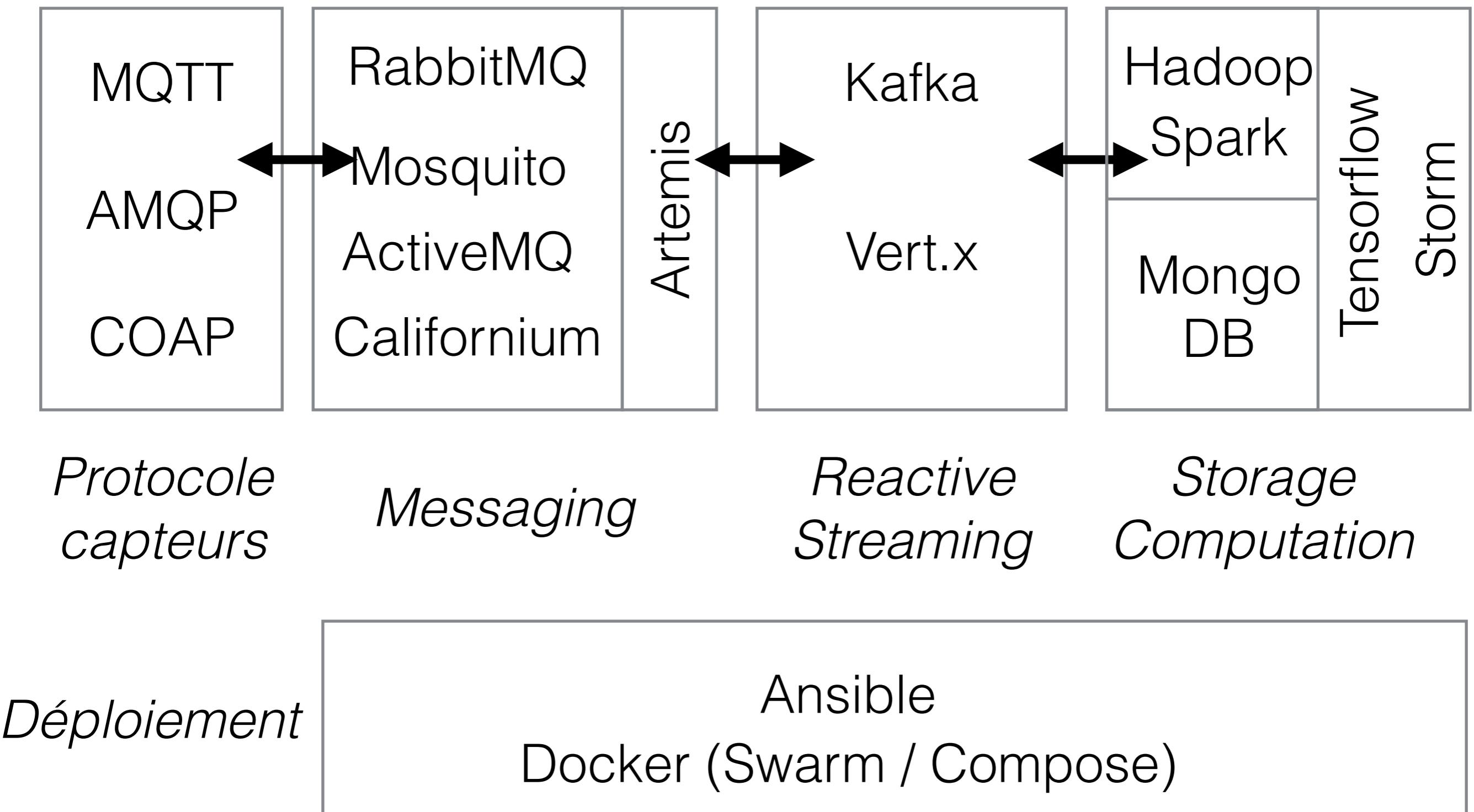
Edge Computing : CloudIoT



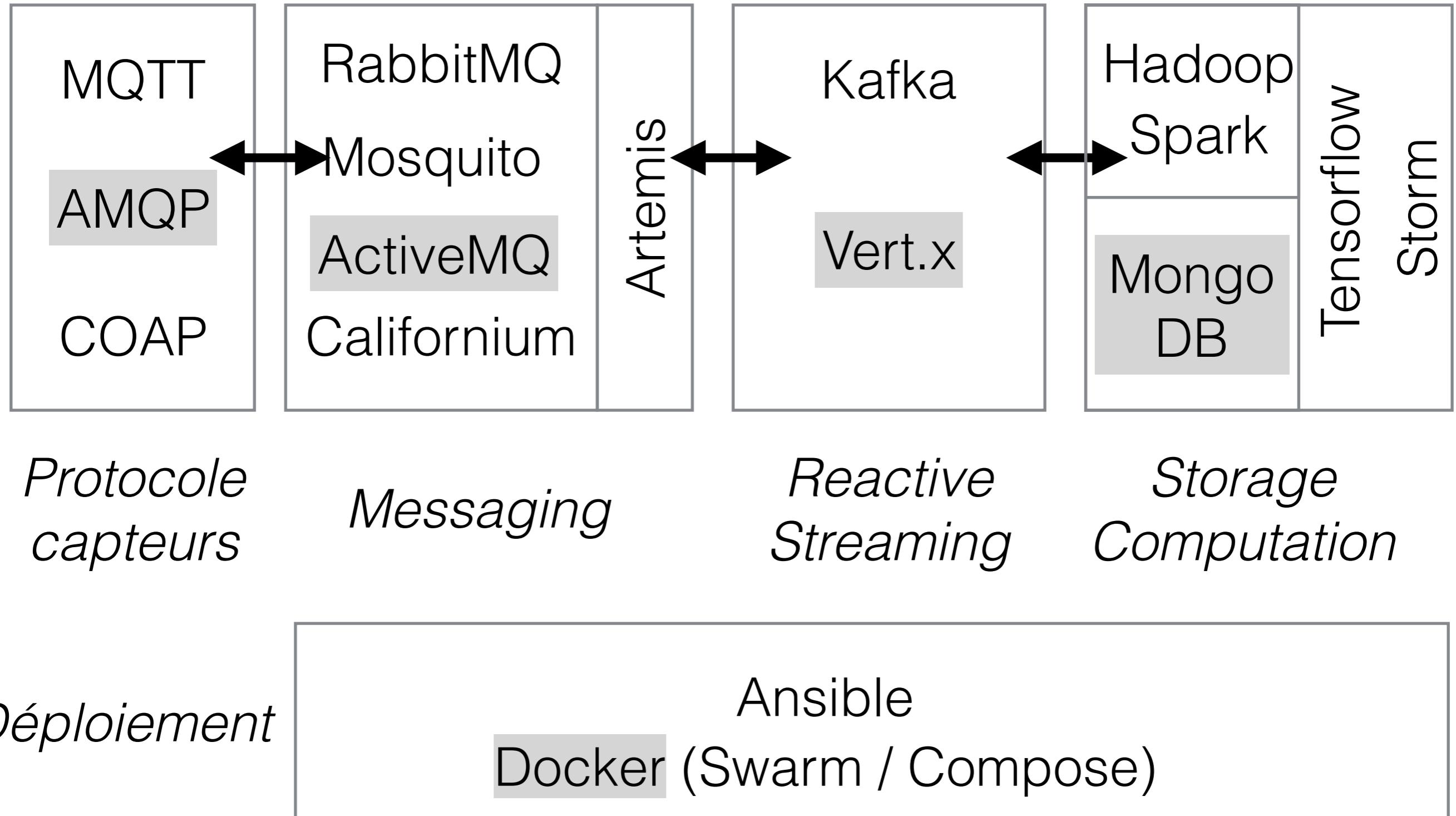
Objectives

- **Work in pairs**
 - **personal learning by experimenting**
- Raspberry PI Platform (optional in cluster)
 - Operational
 - **Local, Proximity, & Private Cloud** → reliable, efficient → distributed software and data
 - **IoT** → elastic scale, big amount of data → adapted message framework

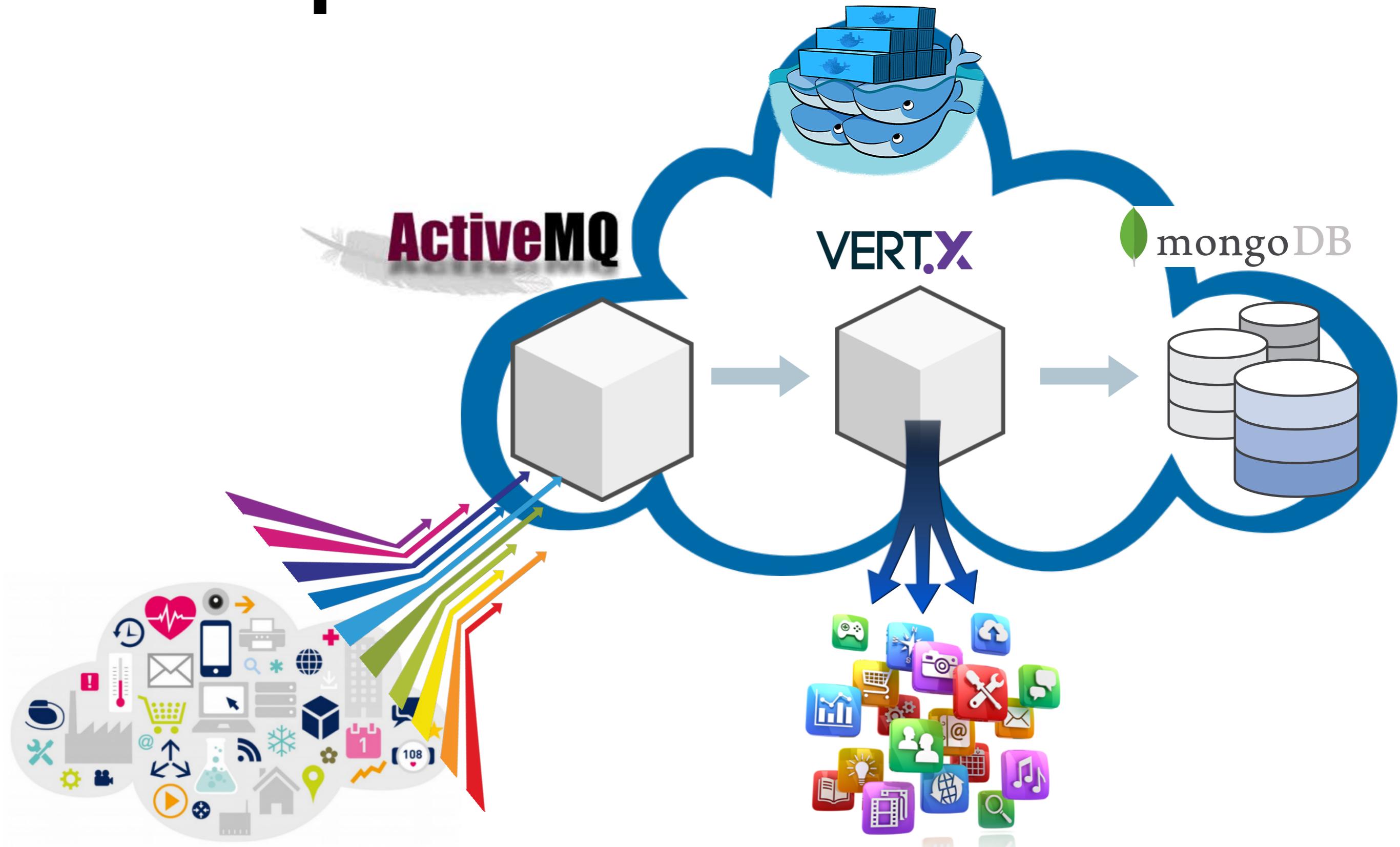
Architecture



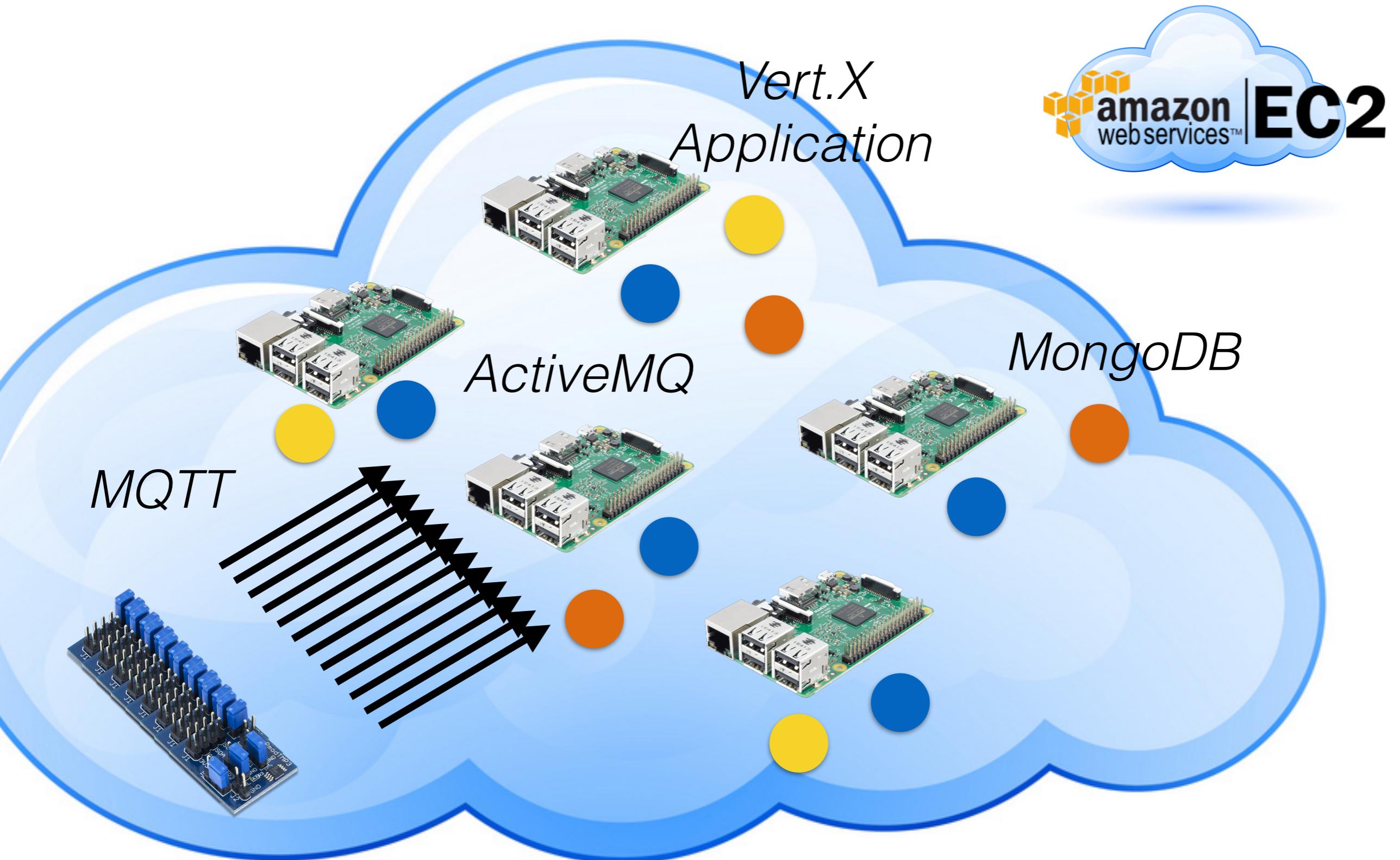
Proposed Architecture



Proposed Architecture



Fog IoT



Protocoles lecture/écriture

- Digital : HIGH - LOW
- Analogue : give a numerical value to the number of bits ADC specific to the controller.
- Bus I2C
- Bus SPI

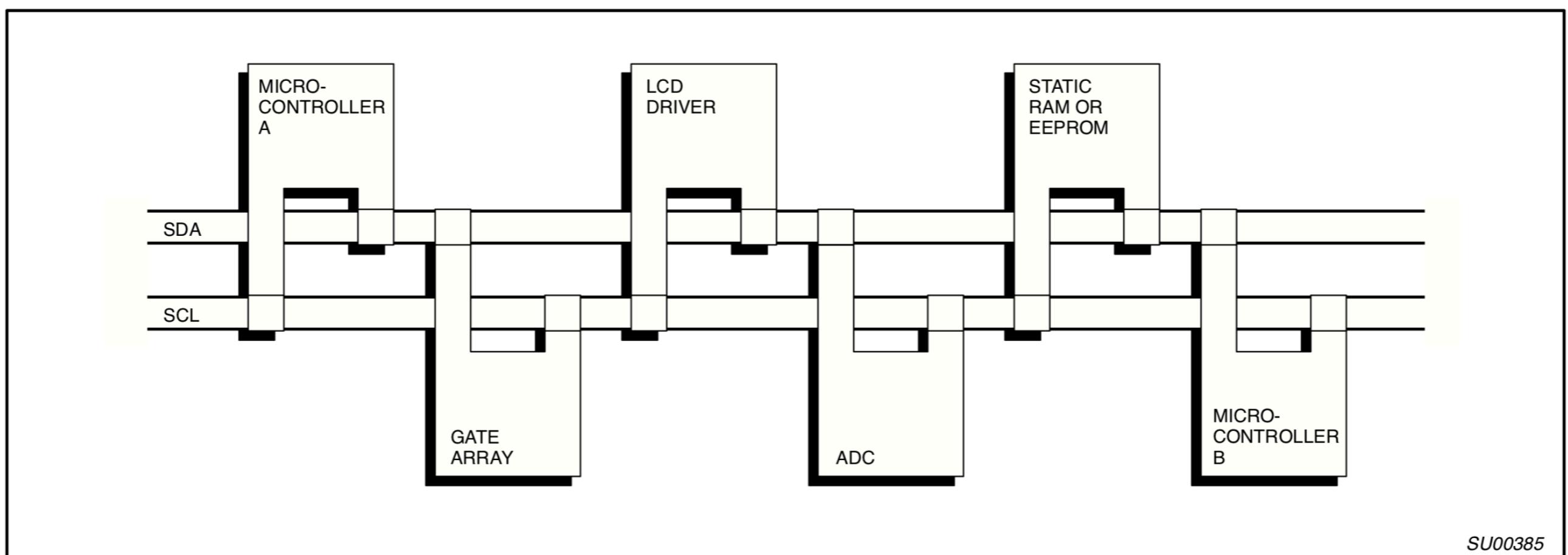
I²C

- I²C: Inter Integrated Circuit
- Developed by Philips in 1982 for TV components
- NXP in charge now
- Number of lines reduced to 2 (SDA, SCL)



I²C

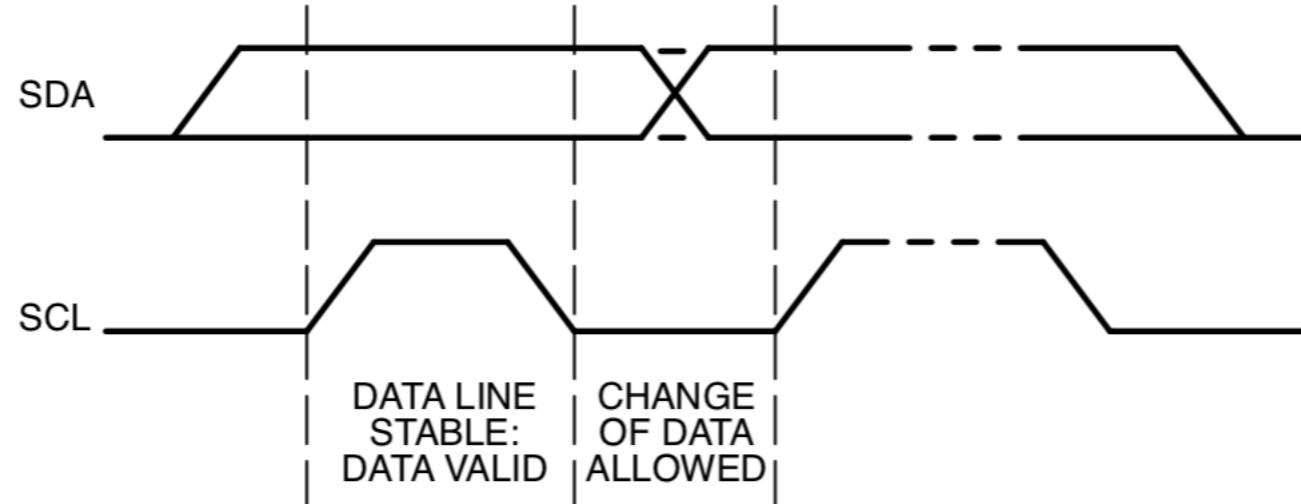
- SDA : Serial Data Line
- SCL : Serial Clock Line
- Each device has an address



I²C

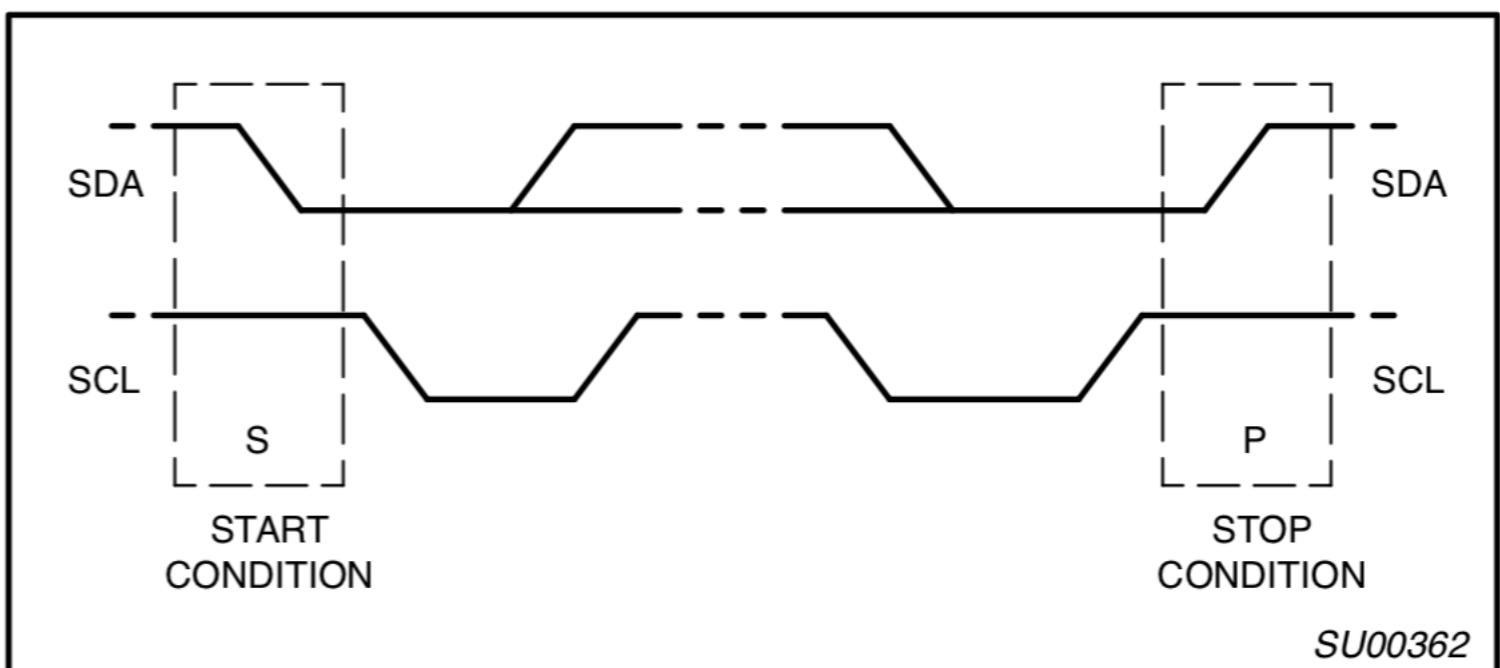
- Speed is established by master (up to 1Mbps in FM+)
- Fixed message size 8 bits
- Several master are permitted
- Only one master at each time
- Collision detection and resolution

I²C



SU00361

Sending data



SU00362

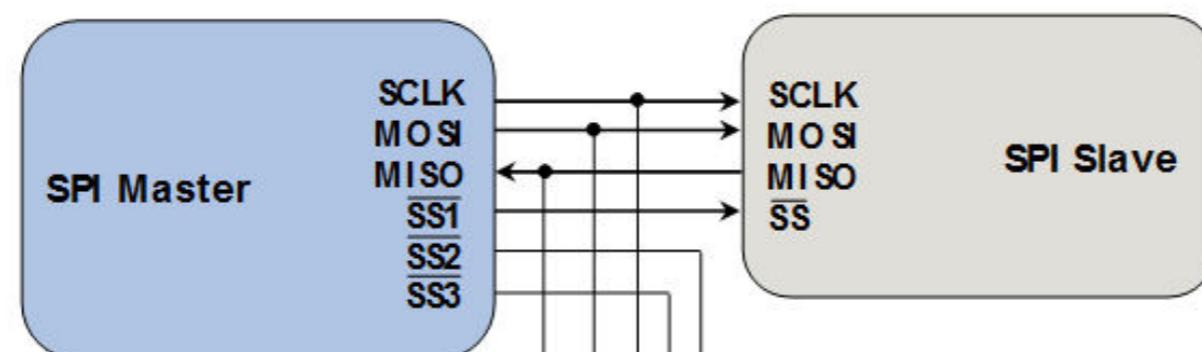
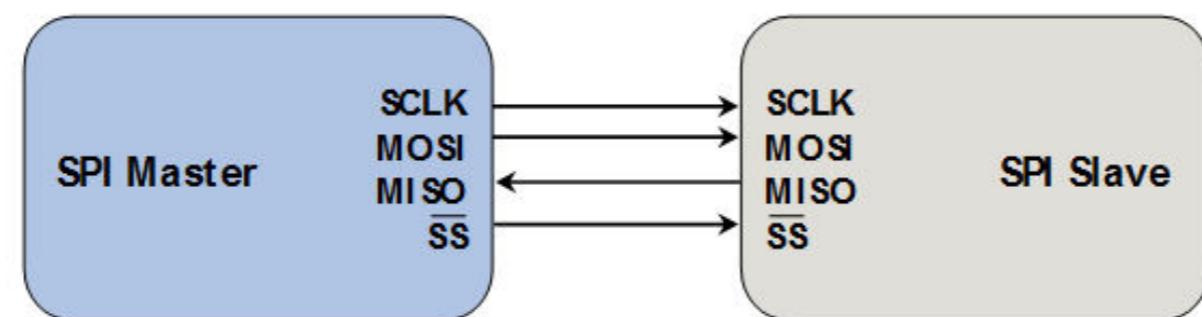
Start and end of a transmission

SPI

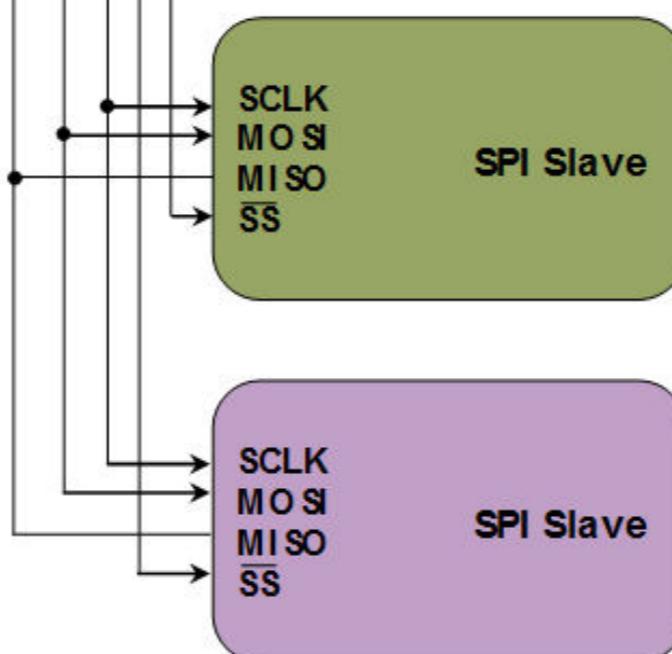
- SPI : Serial Peripheral Interface
- Developed by Motorola in the 80's
- 4 lines serial bus
 - ➡ SDO : Serial Data Out (MOSI)
 - ➡ SDI : Serial Data Input (MISO)
 - ➡ SCK : Serial Clock
 - ➡ SS : Slave Select



SPI



One SS line by device



SPI

- Full duplex communication
- Improved speed than I2C / clock cycles are not limited
- Message size not defined
- No need for device address
- *De facto* standard

C'est parti !

- Pairs : ?
- 1 Raspberry, 1 sensor by group
- Configure Raspberry
- Configure Sensor
<https://github.com/ocrozo/iot-unal>
- Configure software as you want (on host or on container) and use the programming language of your preference (python?, java?, C?)

Questions ?

