

IoT Standards and Protocols

Frank Walsh

Agenda

1

IoT
Characteristics

2

IoT challenges

3

IoT Protocol
Stack?

4

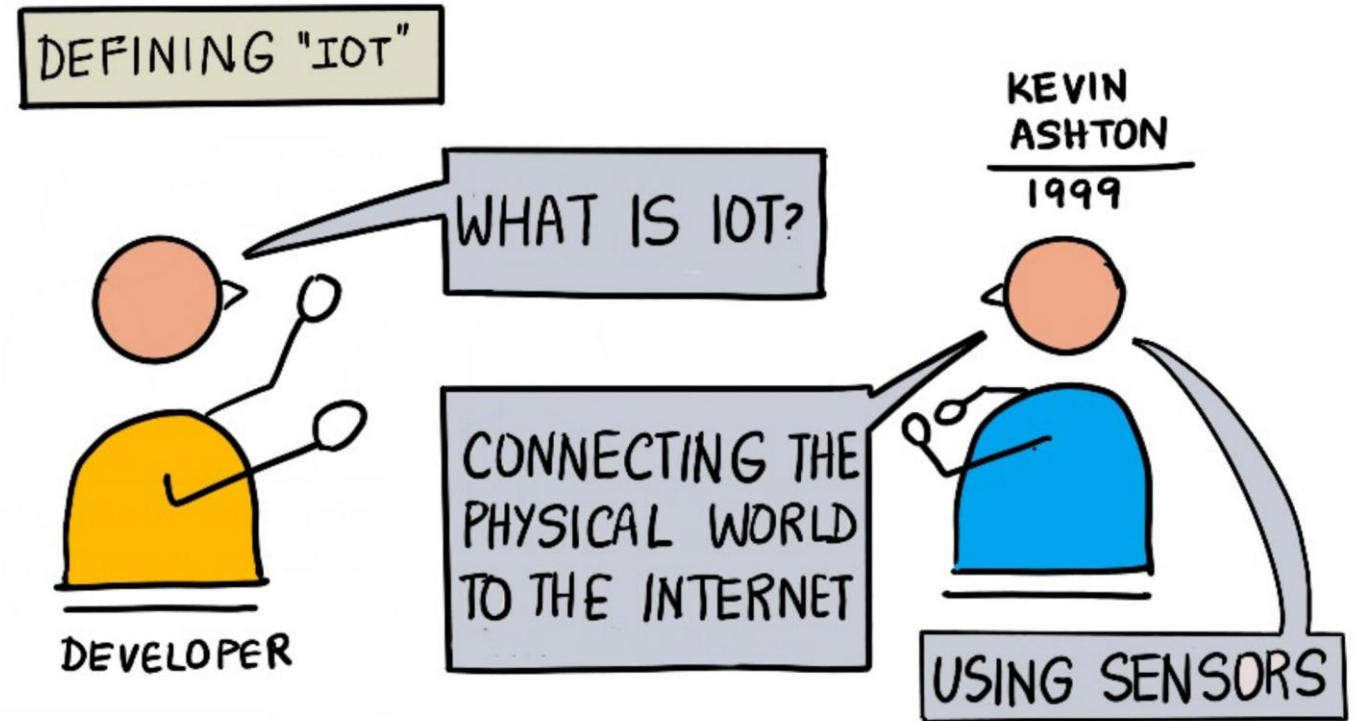
Plan for the
Future...

5

What you
need to know.




IoT Characteristics

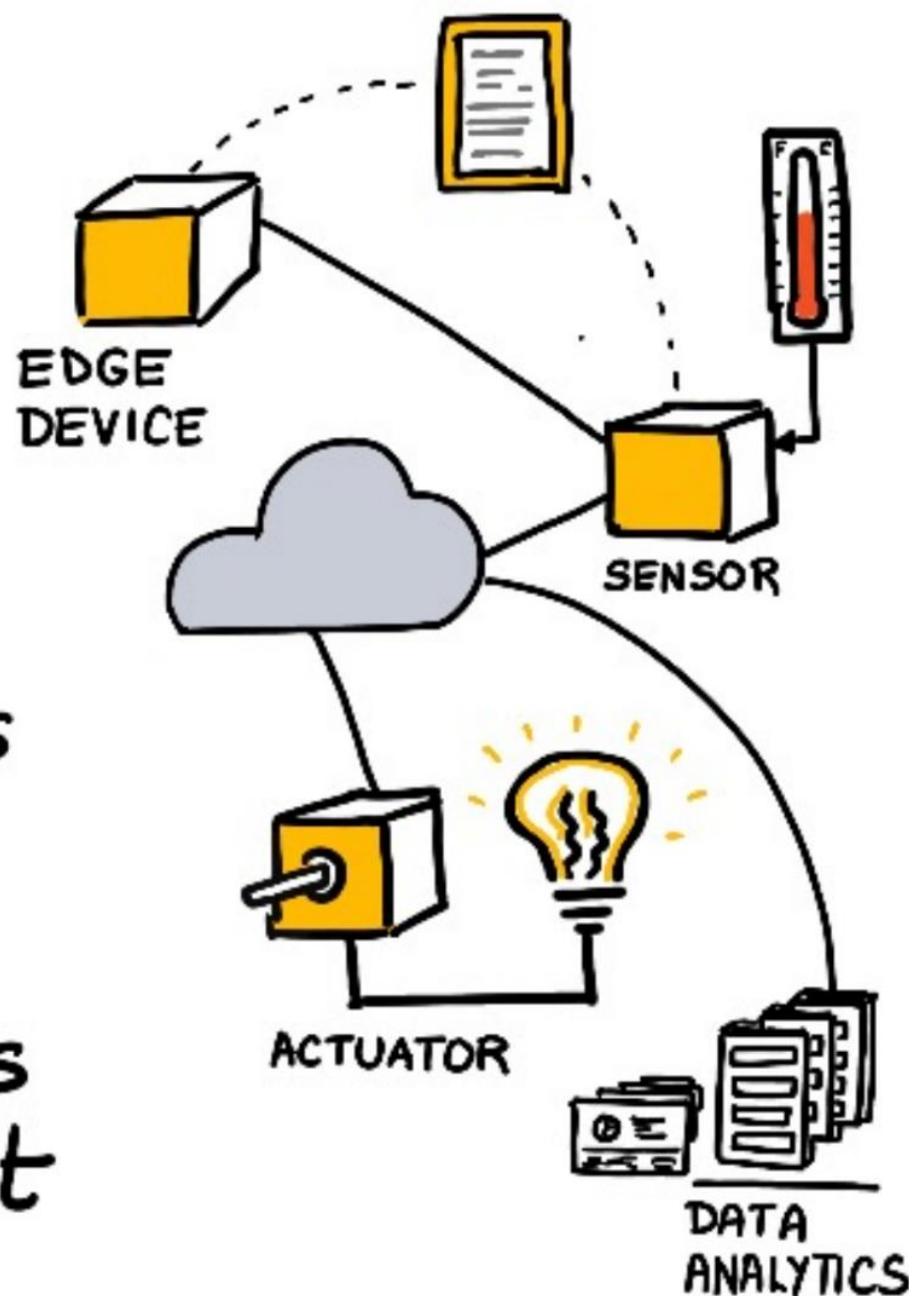
- Everyday objects with embedded technology to sense, connect, and communicate.
- Empowered by:
 - Sensors, cheap and accessible compute power (microcontrollers), ubiquitous connectivity, networking and internet protocols.
- Transforms isolated, passive things to connected things with compute power.
- Collaborate to enable ground breaking applications.



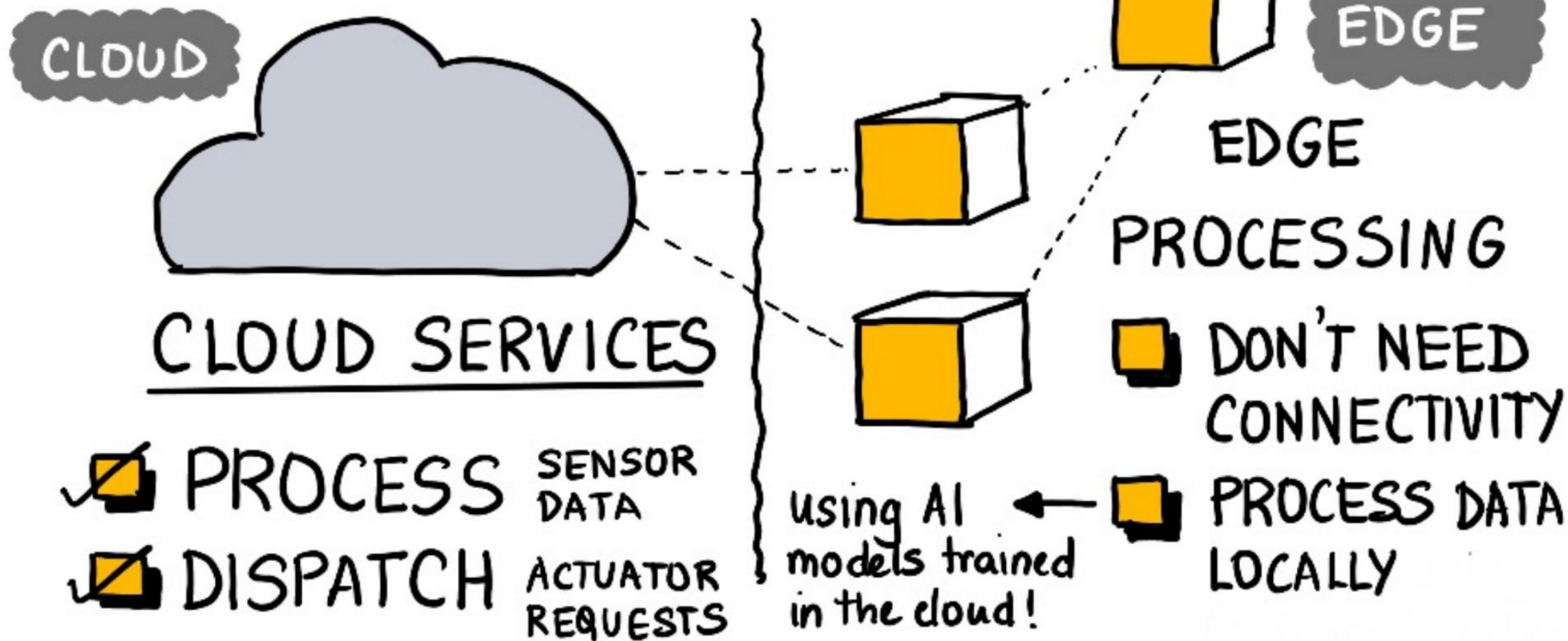
INTERNET OF THINGS...

THING OF IT AS A LARGE ECOSYSTEM WHERE DEVICES

- ✓  GATHER DATA using sensors
- ✓  INTERACT using actuators
- ✓  CONNECT with peer devices and the Internet



BUT IOT IS MORE THAN DEVICES



More characteristics...

simplilearn

WHAT IS
IOT?

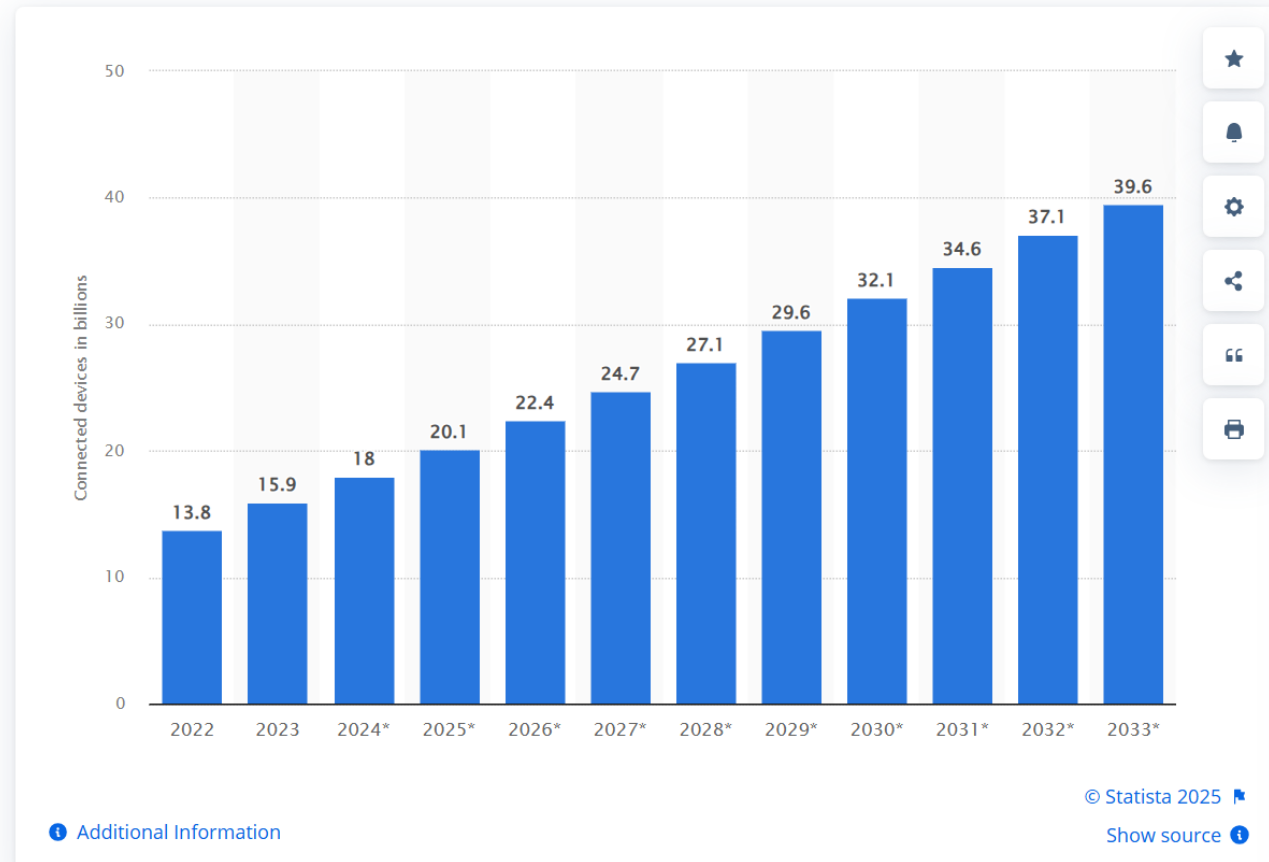


IoT Growth

- 20 Billion in 2025
- 80 ZB of data collected!
 - 1 zettabyte = **1 trillion gigabytes (GB)**
 - 10^{21} bytes
- Data is key to most IoT applications

Number of Internet of Things (IoT) connections worldwide fr forecasts from 2024 to 2033

(in billions)





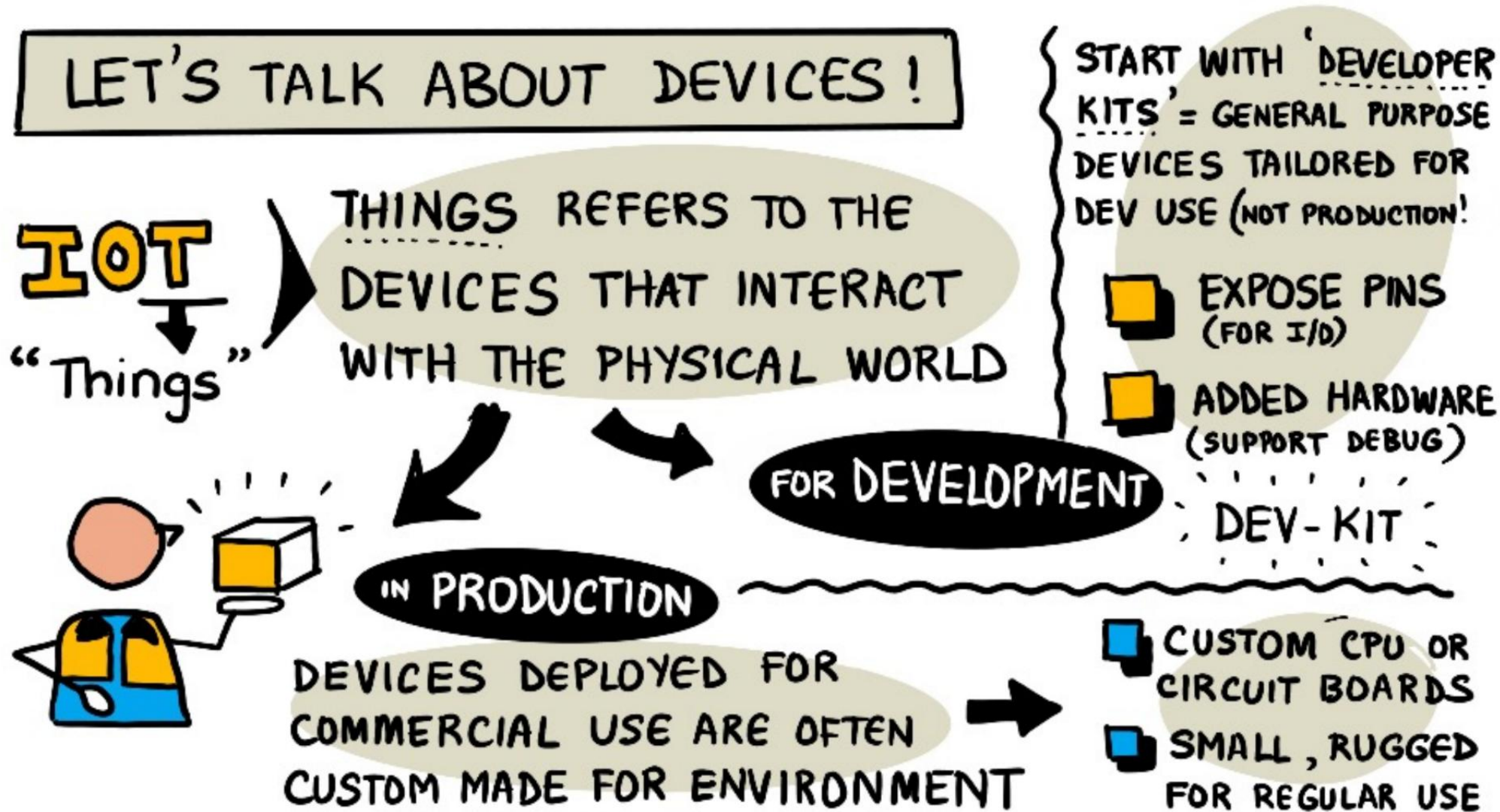
QI

Stands for Quite Interesting
(I think so anyway!)

- How much of the data created by IoT do we use?
- Is there waste?
- How can we minimise this?

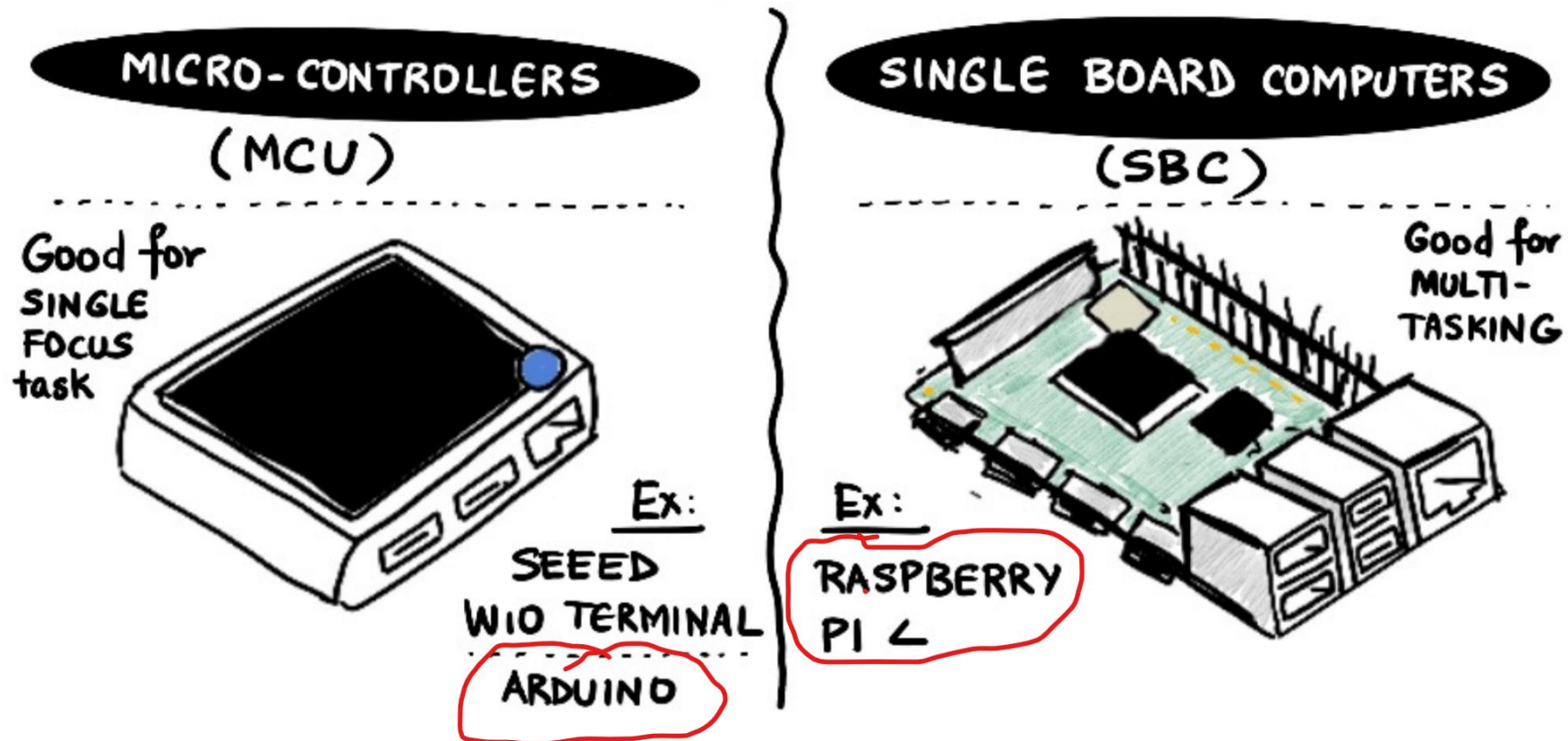


The “Thing” about IoT



IoT Development

- “kits” generally fall into 2 categories:



WHAT IS A MICRO CONTROLLER?

Special
Purpose



LOW COST COMPUTING
DEVICE WITH BASIC
SENSORS & ACTUATORS

DEV KITS CAN BE REALLY
CHEAP ($< \$4$) FOR CORE

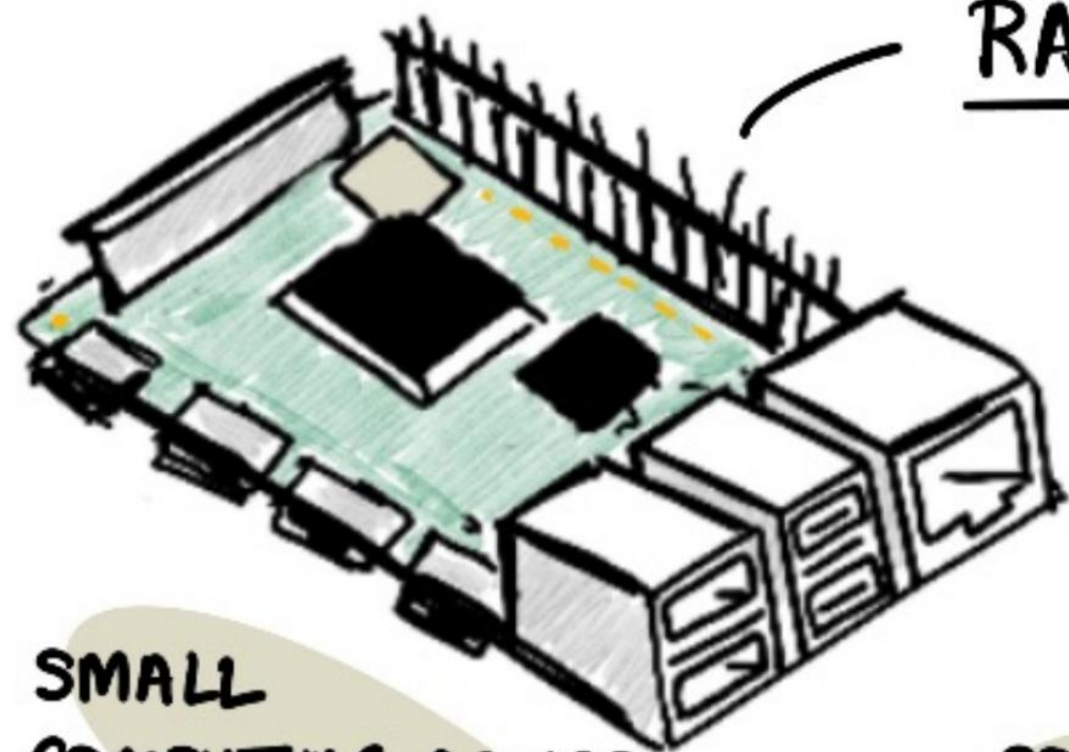
COSTS RISE WITH FEATURES

WID TERMINAL (\$30)

- * SENSORS + ACTUATORS
- * DISPLAY SCREEN
- * BLUETOOTH + WI-FI
- * ARDUINO COMPATIBLE

WHAT IS A SINGLE BOARD COMPUTER?

General
Purpose



RASPBERRY PI

- * CPU, MEMORY, I/O (like MCU)
- * **PLUS** GRAPHICS CHIP (drive display)
- * **PLUS** USB PORTS (add peripherals)
- * **PLUS** SD CARD (store code, data..)

SMALL
COMPUTING DEVICE
WITH ALL ELEMENTS OF
A COMPLETE COMPUTER

SPECS CLOSE TO
DESKTOP (MAC/PC)
BUT CHEAPER, SMALLER,
LESS POWER USAGE

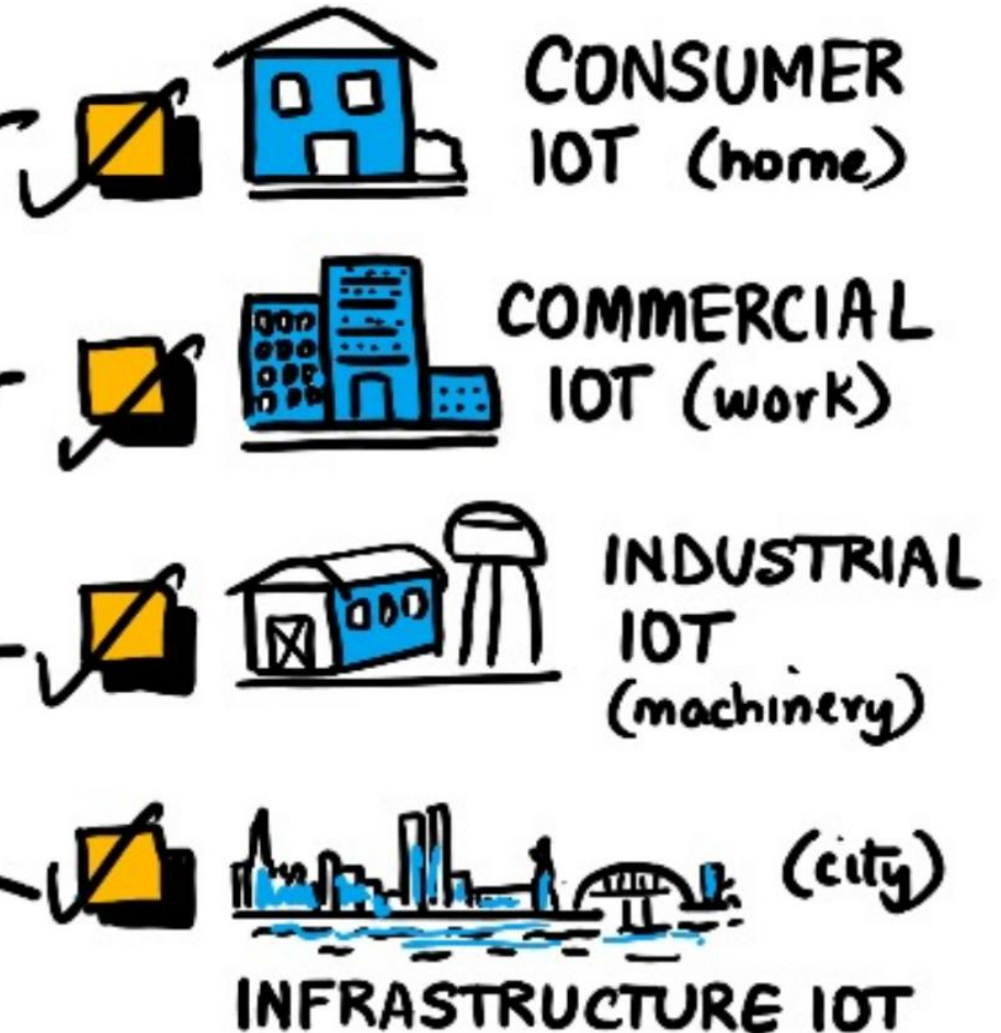
**PROGRAMMABLE
IN ANY LANGUAGE**

Python used
typically for IoT

IoT Applications

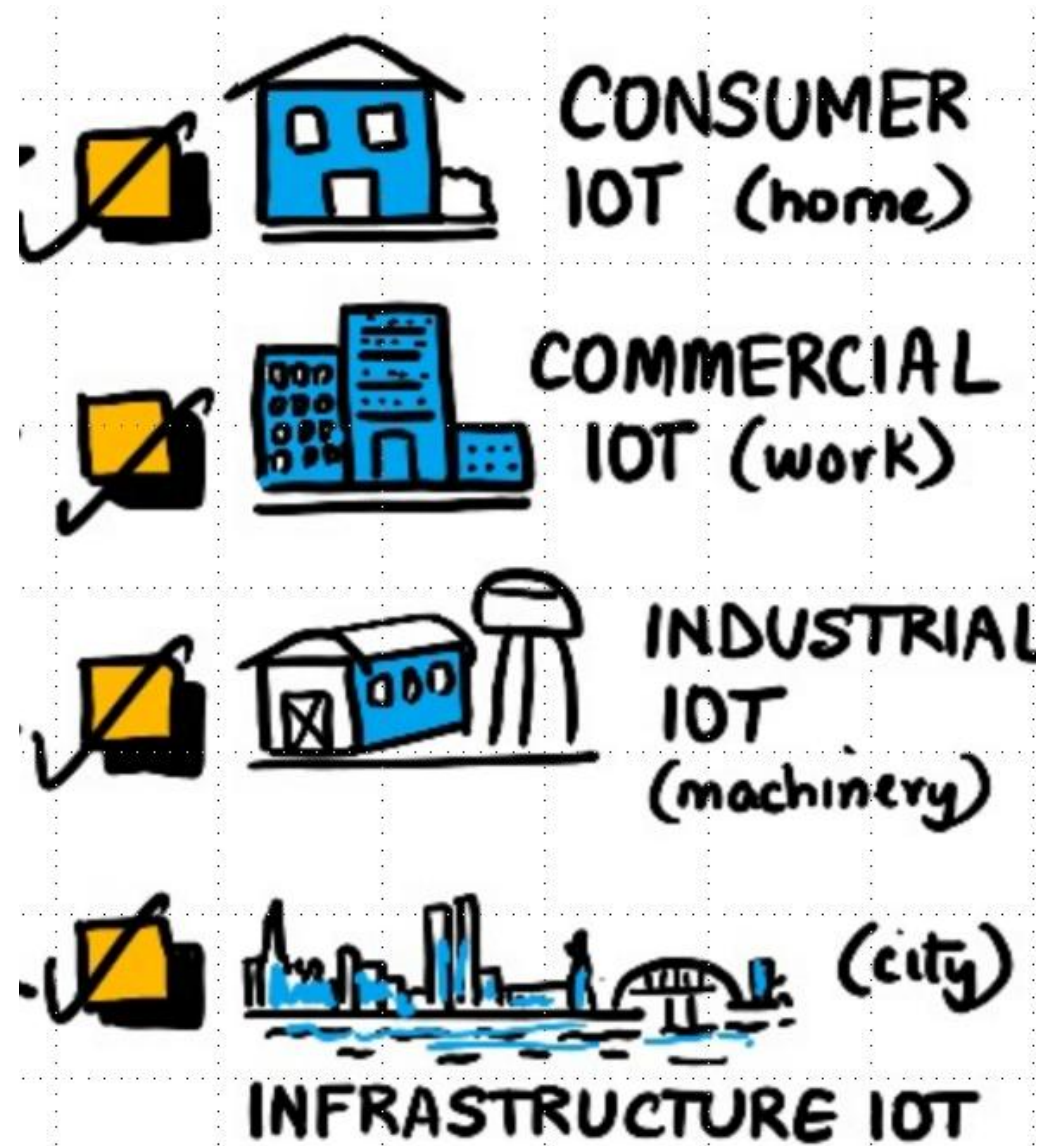
HUGE RANGE OF USE
CASES FOR IOT APPS

4 BROAD
GROUPS





- For the 4 IoT areas, find one real-world example of each.
- Do you use any Consumer IoT application?








① CONSUMER IOT

DEVICES THAT CONSUMERS
USE AROUND THEIR
HOME



EMPOWER MORE USERS
ESPECIALLY PERSONS WITH
A DISABILITY...

- ✓  SMART SPEAKERS
- ✓  ROBOTIC VACUUMS
- ✓  VOICE CONTROLLED
OVENS, TAPS etc.
- ✓  HEALTH MONITORS
- ✓  TIME TRACKERS
etc.

② COMMERCIAL IDT



COVERS USE OF IDT
IN THE WORKPLACE

- ✓ ☒ OCCUPANCY SENSORS
 - ✓ ☒ MOTION TRACKERS
 - ✓ ☒ SAFETY MONITORING
 - ✓ ☒ TEMPERATURE TRACKING
 - ✓ ☒ VEHICLE TRACKING
- etc.

③ INDUSTRIAL IOT



- ✓  PREDICTIVE MAINTENANCE
- ✓  PREDICT HARVEST READINESS
- ✓  TRACK SOIL MOISTURE,
MONITOR CROP
HEALTH AT SCALE
- ✓  SAFETY
MONITORING

CONTROL AND MANAGE MACHINERY ON
A LARGE SCALE. EX: FACTORIES, DIGITAL AGRICULTURE

④ INFRASTRUCTURE IOT

BETTER ANALYTICS : SENSING ENVIRONMENTS



SMART
GRIDS

SMART
CITIES

MONITOR & CONTROL GLOBAL
INFRASTRUCTURE PEOPLE USE **DAILY!**

☒ TRANSPORTATION

☒ PARKING

☒ POLLUTION




☒ POWER USAGE

☒ EFFICIENT USE

☒ SUSTAINABILITY

EXAMPLES OF IOT DEVICES

INCREASING NUMBER OF
INTERNET-CONNECTED OR
EDGE-BASED DEVICES AROUND US

-  SENSORS
-  ACTUATORS
-  CONNECTIVITY

DATA
COLLECTION
+
ANALYTICS



FRIDGE



DISH
WASHER



STEREO
SYSTEM



DOORBELL



VOICE
CONTROL



SMART
TV

Fundamental parts for IoT

Devices

- Send and Receive data

Network

- Data is transmitted, routed

Edge Computing

- Data is normalised, filtered,

Storage

- Databases and data stores

Applications

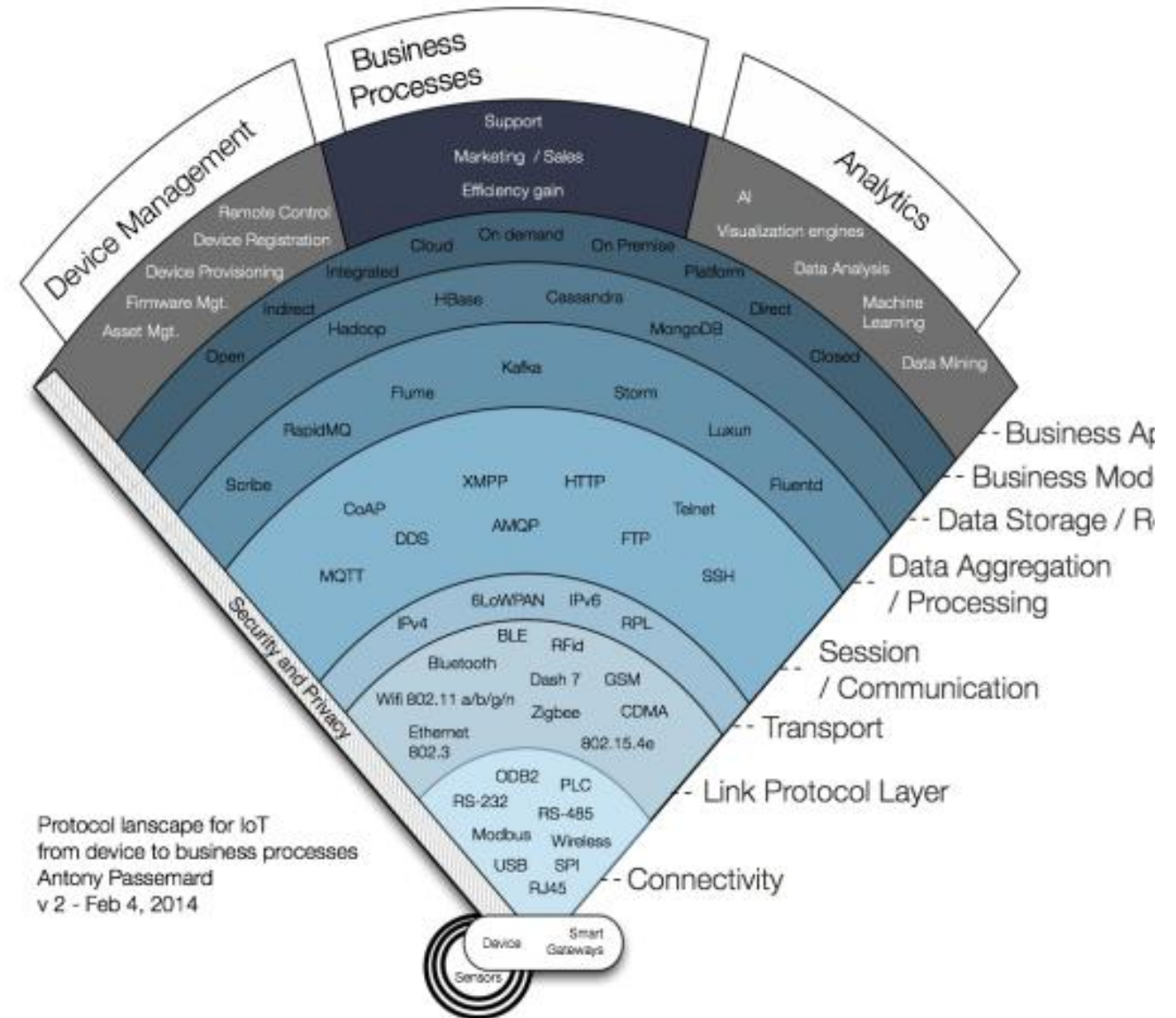
- Process and use data

People

- Act and collaborate

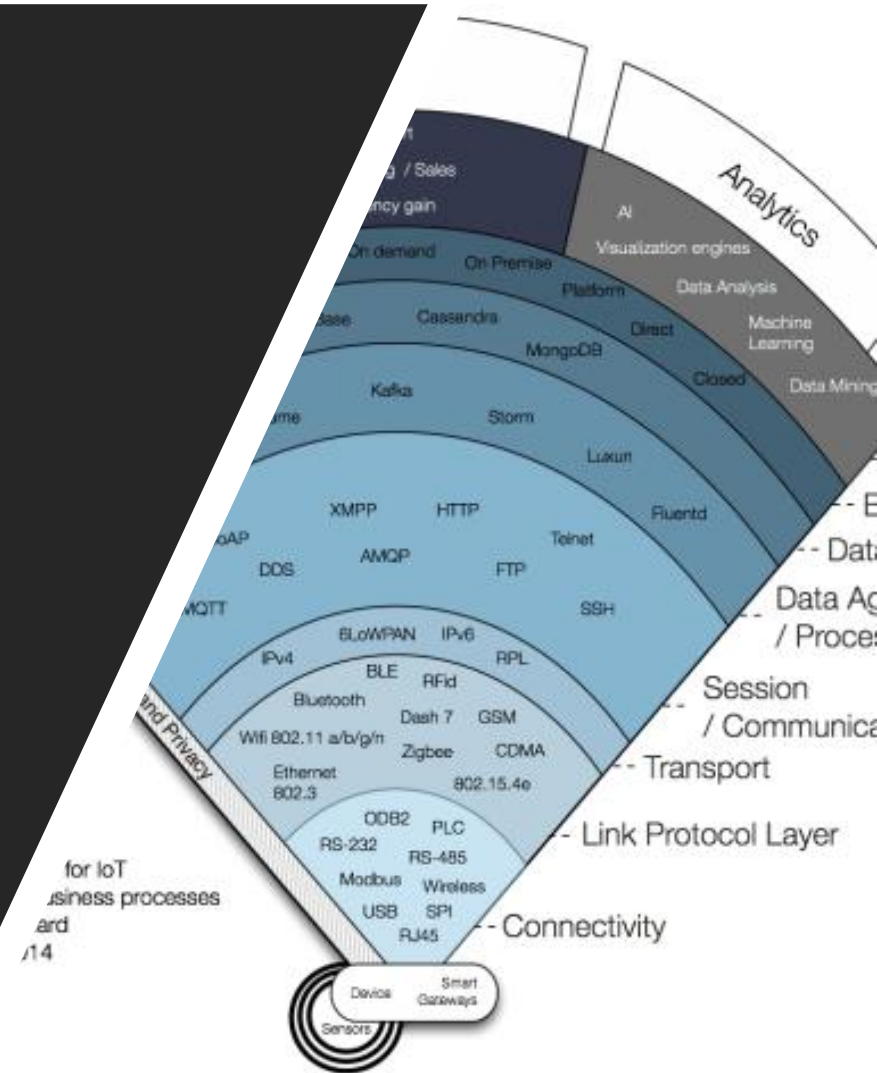
IoT Protocol Stack?

- many protocols, many standards. Starting to consolidate
- Some strong standards starting to emerge that address the IT/OT link
- We will try to look at a protocol in each layer, building a reference app that combines several.



IoT Stack Protocols.

- **Connectivity layer:** The Actual physical connectors. RJ45 (usually for Ethernet), RS-232, ModBus, USB (as a connector type, not the communication protocol), SPI, ODB2 (in Cars), and Wireless (no connector!). Gateways can convert physical connectors into wireless.
- **Link Protocol:** How do those device actually send the data. Ethernet **802.3**, Wifi 802.11a/b/g/n, BlueTooth, BLE, ZigBee, Rfid, 6LoWPAN, 802.14.5e, **CAN, SigFox, LoRa**
- **Transport:** IPv4 and **IPv6**
- **Session / Communication: MQTT**, a subscribe and publish protocol that is used by Facebook for its mobile app, XMPP and AMQP , FTP, Telnet and SSH,
- **Data Aggregation / Processing:** When device send data, lots of data, you need an end point to do something with it.
- **Data Storage / Retrieval:** The realm of Big Data backend and NoSQL solutions.



Plan for the Future...

- Idea is to realise a prototypical full stack IoT solution which uses open standards and protocols to integrates IT and OT.
- Project style approach
 - Have a working artefact that demonstrates skills from other modules on the course.
- Use things
 - Raspberry Pi + SenseHAT, SmartPhone
- Use languages
 - Python, Javascript, Shell Scripting
- Use cloud platforms
 - Thingspeak,

