IoT Standards and Protocols

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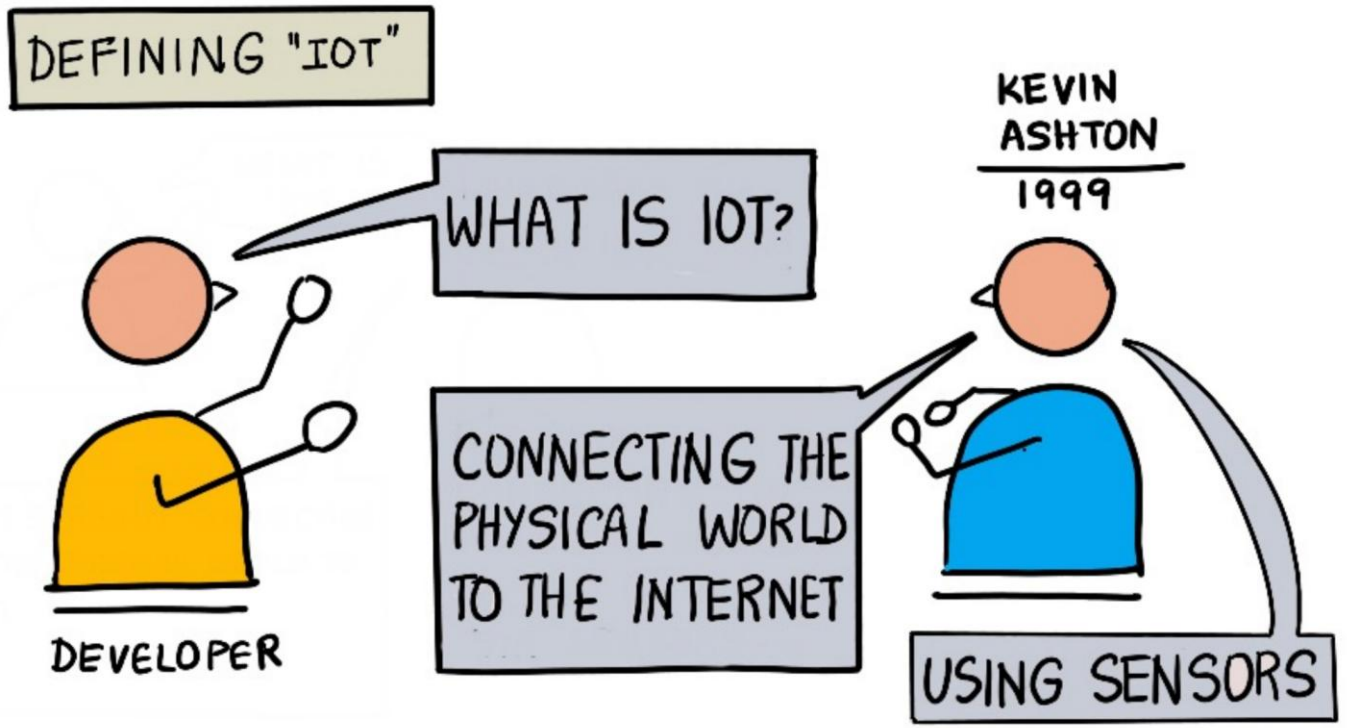
Agenda

1. IoT Characteristics
2. IoT challenges
3. IoT Protocol Stack?
4. Plan for the Future…
5. What you need to know.

IoT Characteristics

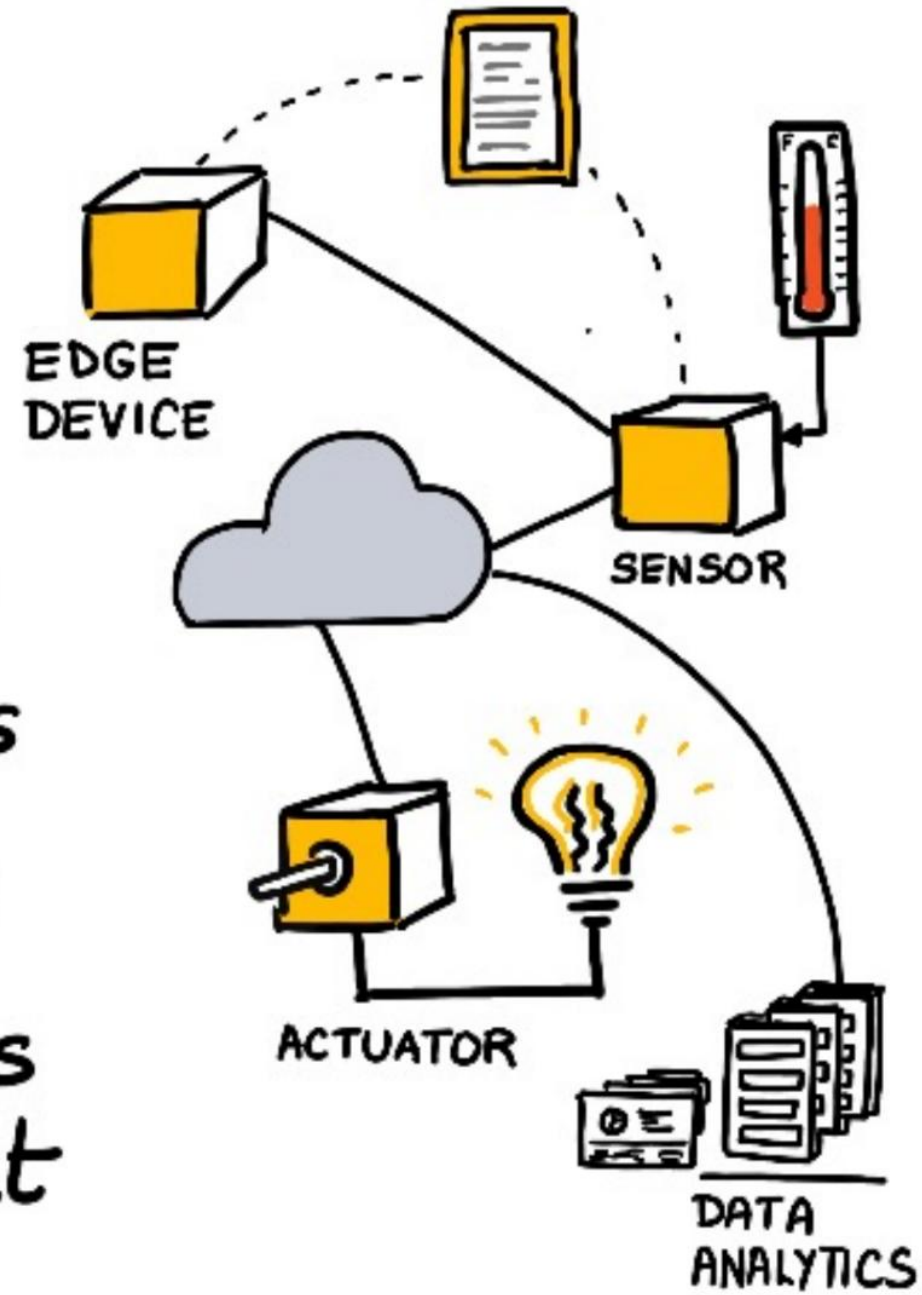
- Everyday objects with embedded technology to sense, connect, and communicate.
- Empowered by:
  - Sensors, cheap and accessible compute power (microcontrollers), ubiquitous connectivity, networking and internet protocols.
- Transforms isolated, passive things to connected things with compute power.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

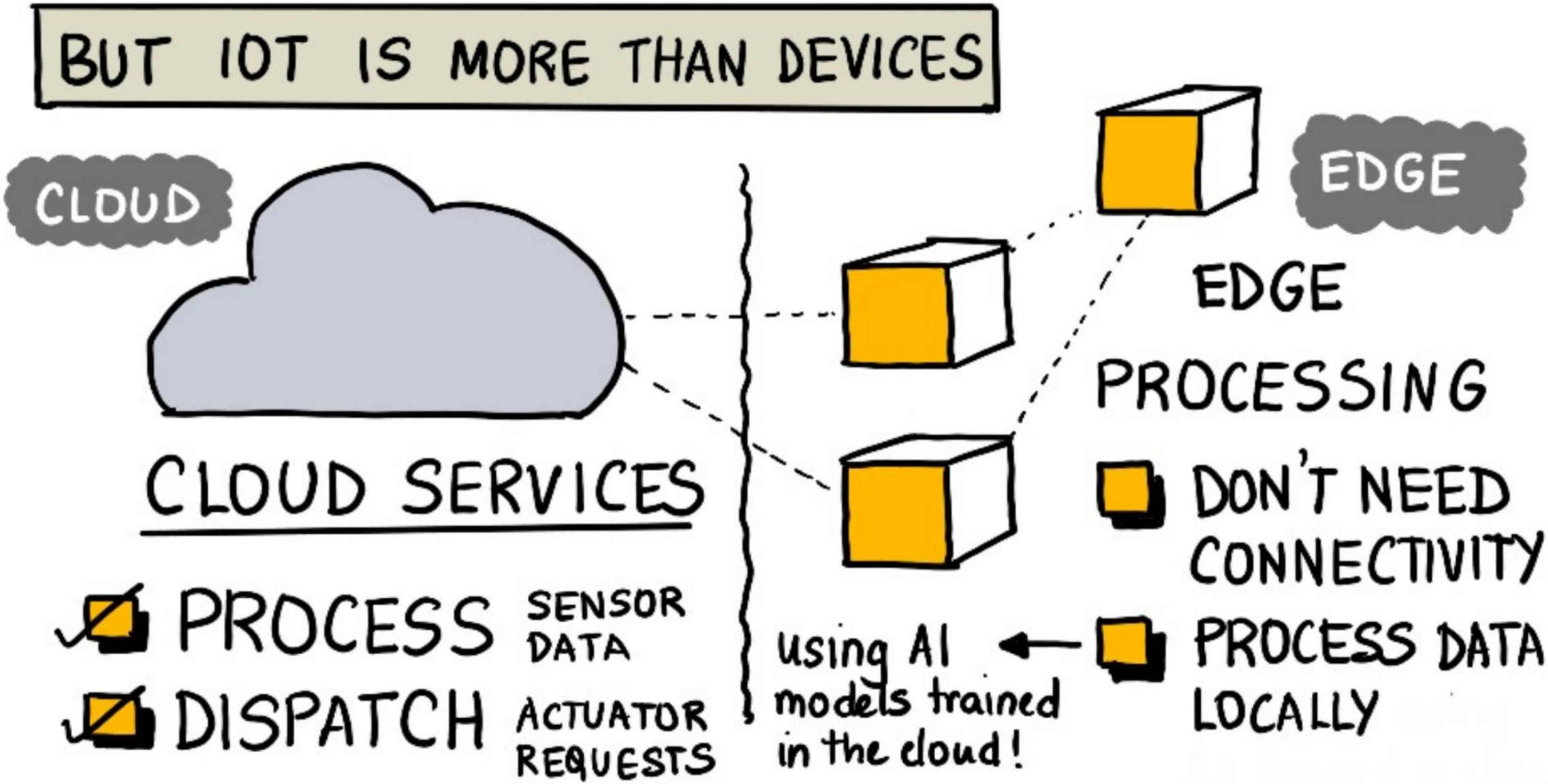


INTERNET OF THINGS...

THING OF IT AS A LARGE ECOSYSTEM WHERE DEVICES

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

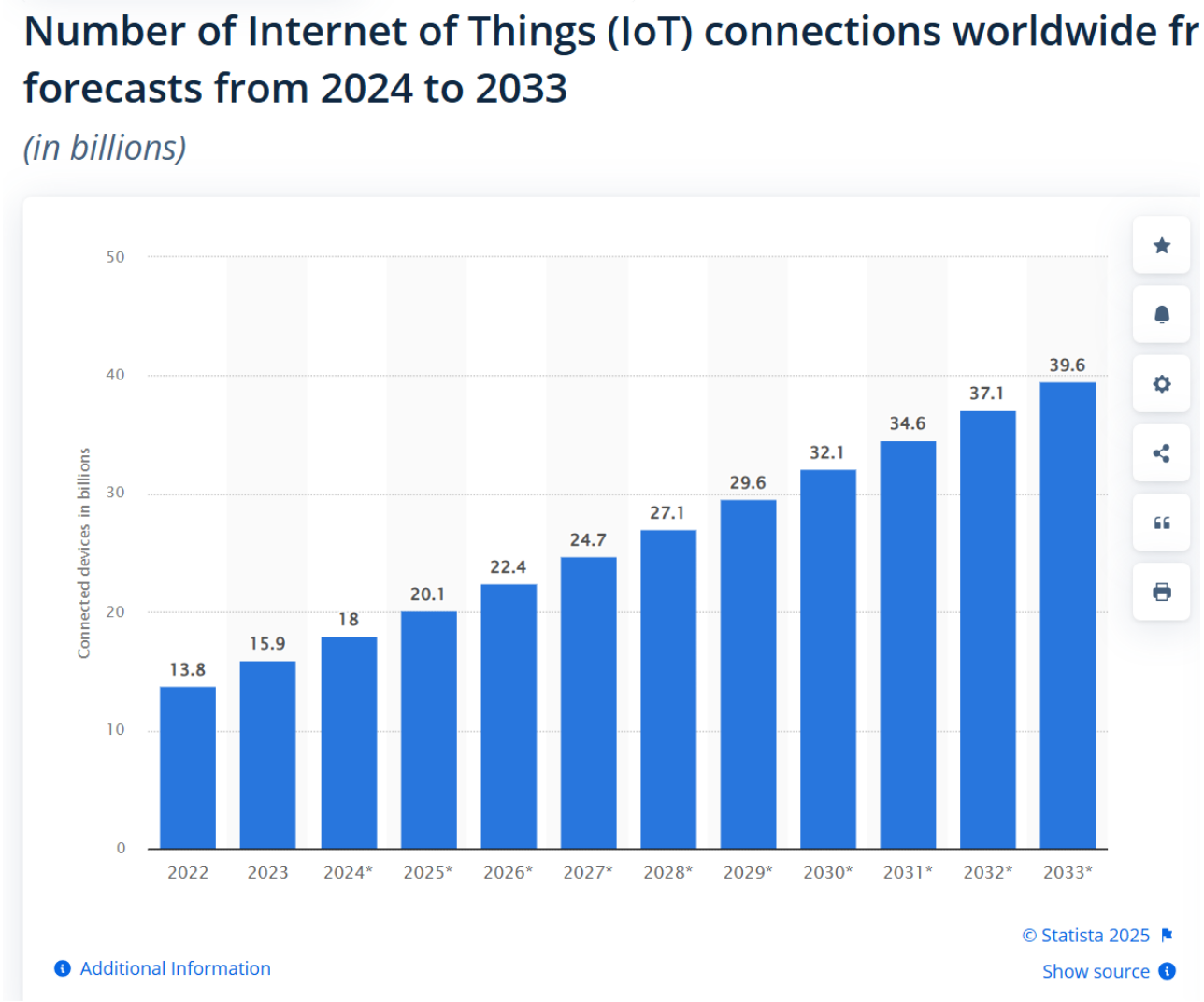



BUT IOT IS MORE THAN DEVICES
CLOUD
EDGE
CLOUD SERVICES
EDGE PROCESSING
PROCESS SENSOR DATA
DISPATCH ACTUATOR REQUESTS
using AI models trained in the cloud!
DON'T NEED CONNECTIVITY
PROCESS DATA LOCALLY

More characteristics…

IoT Growth

- 20 Billion in 2025
- 80 ZB of data collected!
- Data is key to most IoT applications



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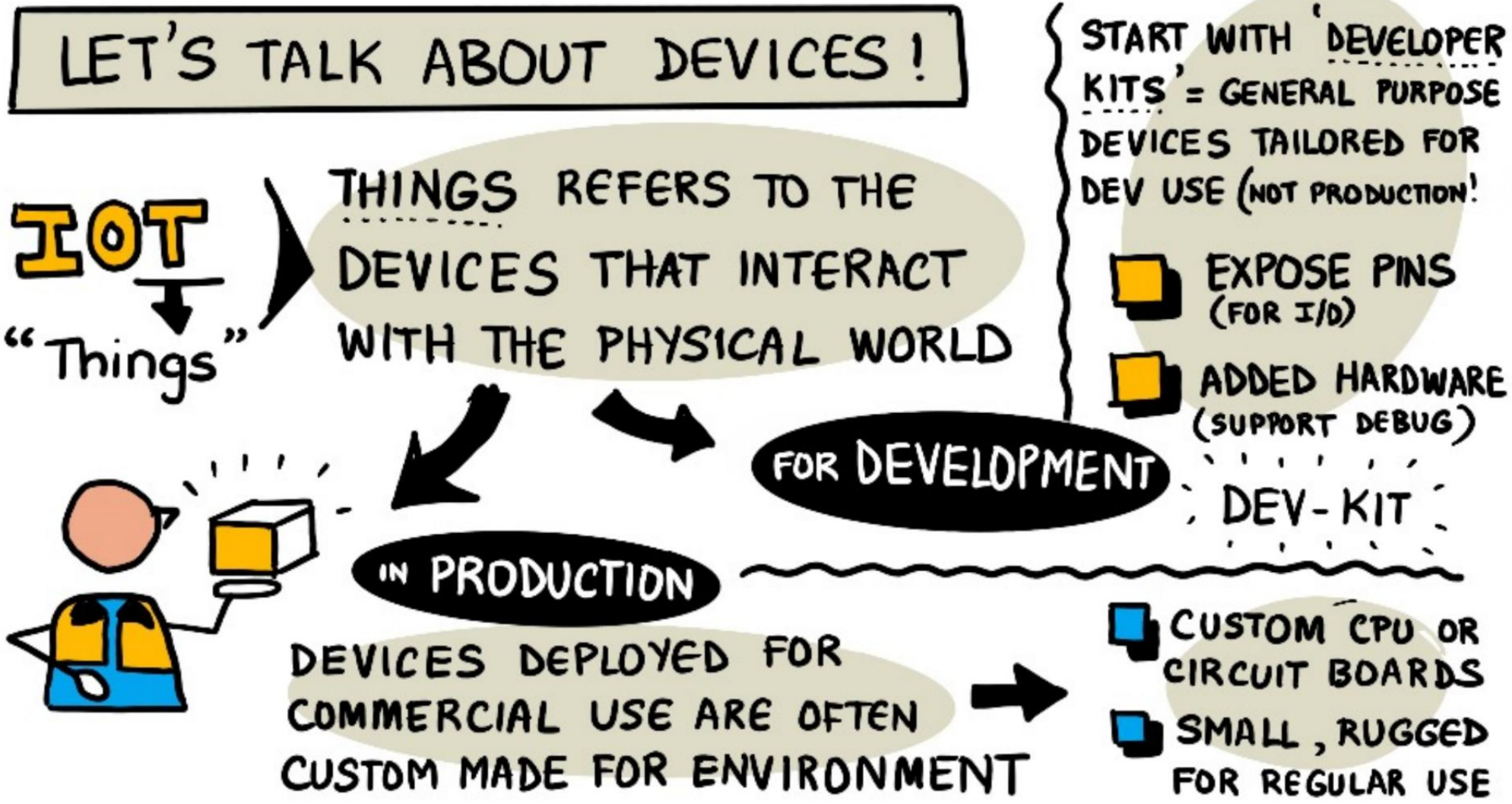
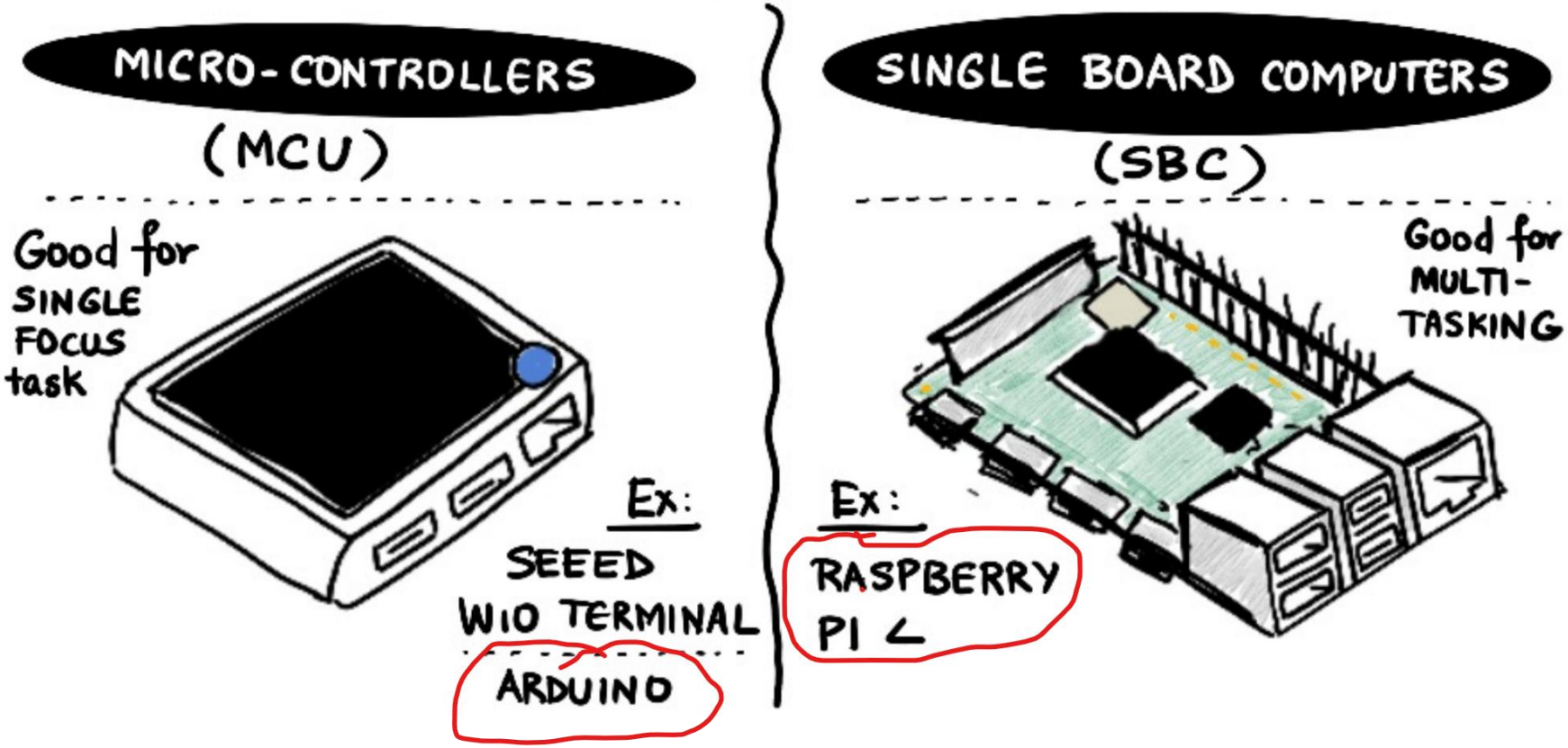
- How much of the data created by IoT do we use?
- Is there waste?
- How can we minimise this?

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

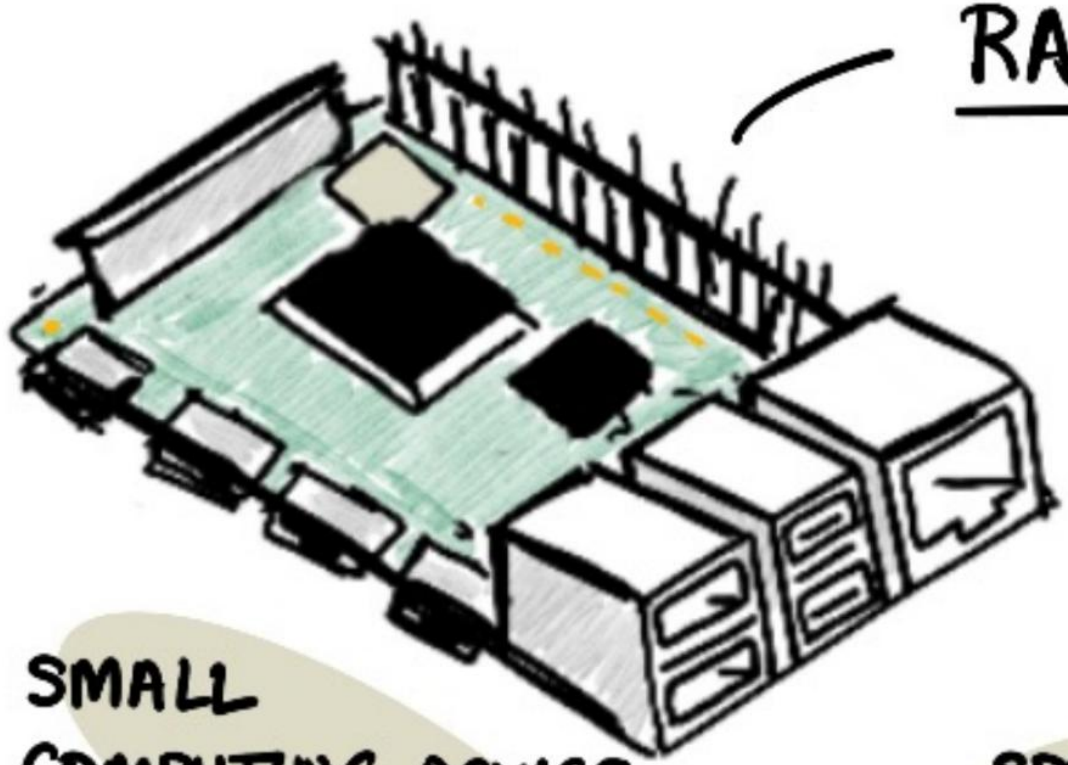
WIO TERMINAL ($30)

* 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 ..)

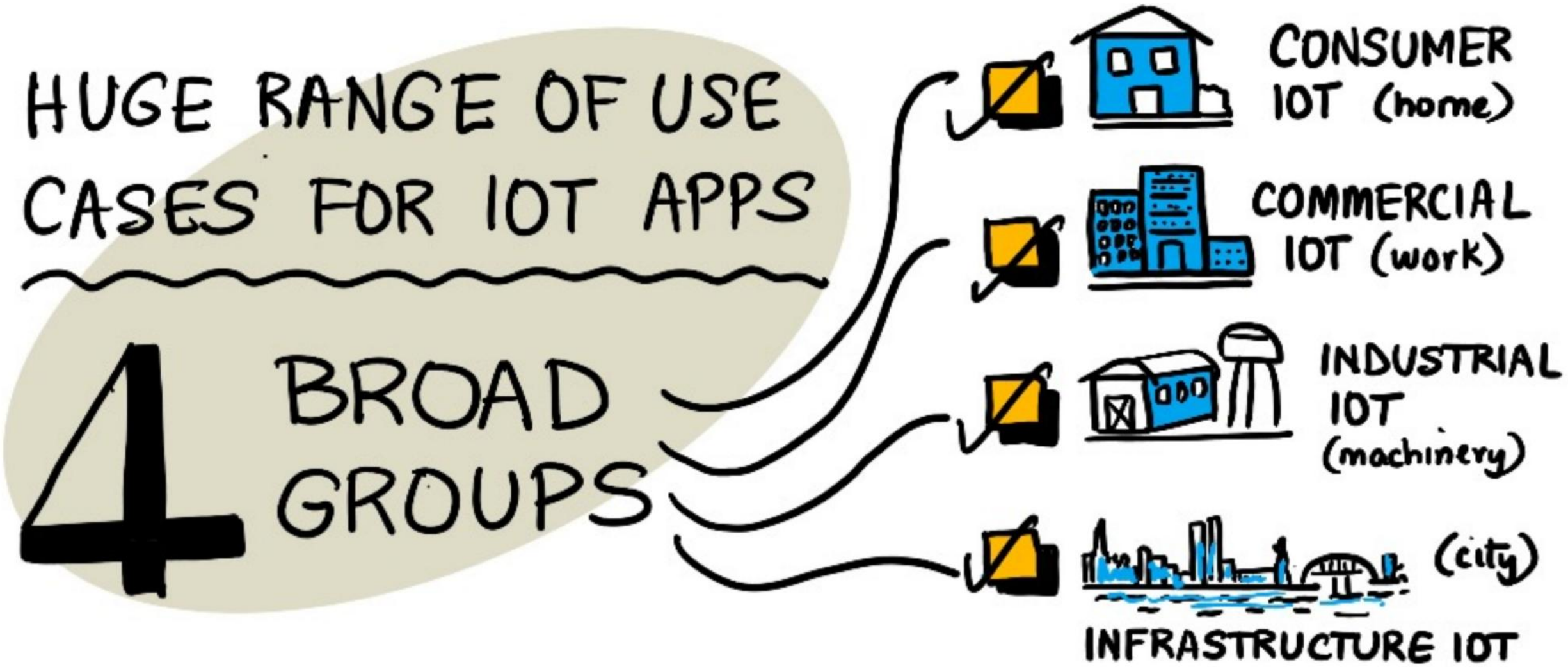
SMALL COMPUTING DEVICE WITH ALL ELEMENTS OF A COMPLETE COMPUTER

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

PROGRAMMABLE IN ANY LANGUAGE

Python used typically for IOT

IoT Applications



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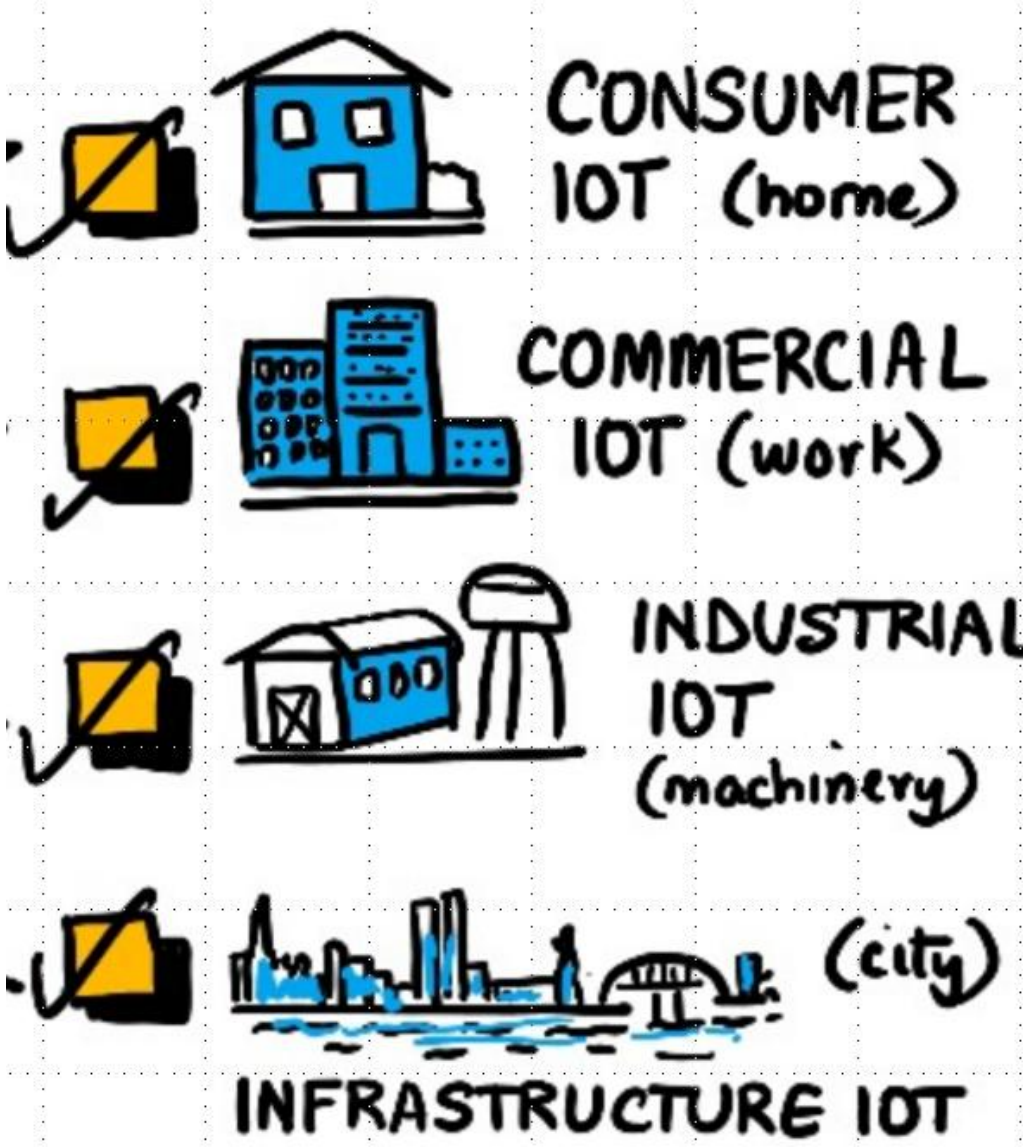
- For the 4 IoT areas, find one real-world example of each.
- Do you use any Consumer IoT application?



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 IOT

- OCCUPANCY SENSORS
- MOTION TRACKERS
- SAFETY MONITORING
- TEMPERATURE TRACKING
- VEHICLE TRACKING

etc.

COVERS USE OF IOT IN THE WORKPLACE

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

- TRANSPORTATION
- PARKING
- POLLUTION

SMART GRIDS

SMART CITIES

- POWER USAGE
- EFFICIENT USE
- SUSTAINABILITY

MONITOR & CONTROL GLOBAL INFRASTRUCTURE PEOPLE USE DAILY!

EXAMPLES OF IOT DEVICES

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

- SENSORS
- ACTUATORS
- CONNECTIVITY

DATA COLLECTION + ANALYTICS

FRIDGE

MICROWAVE

DISH WASHER

STEREO SYSTEM

DOORBELL

VOICE CONTROL

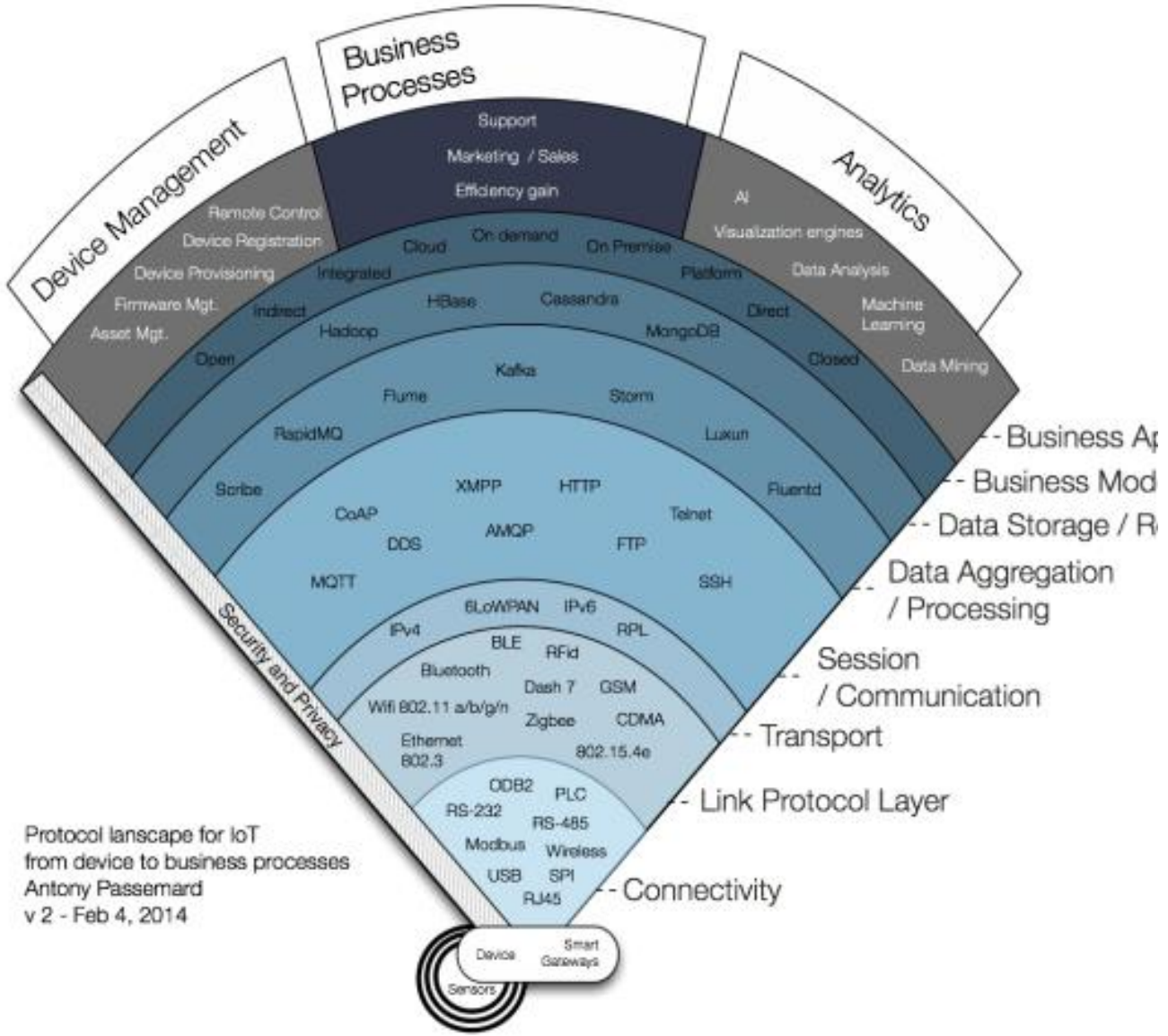
SMART TV

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

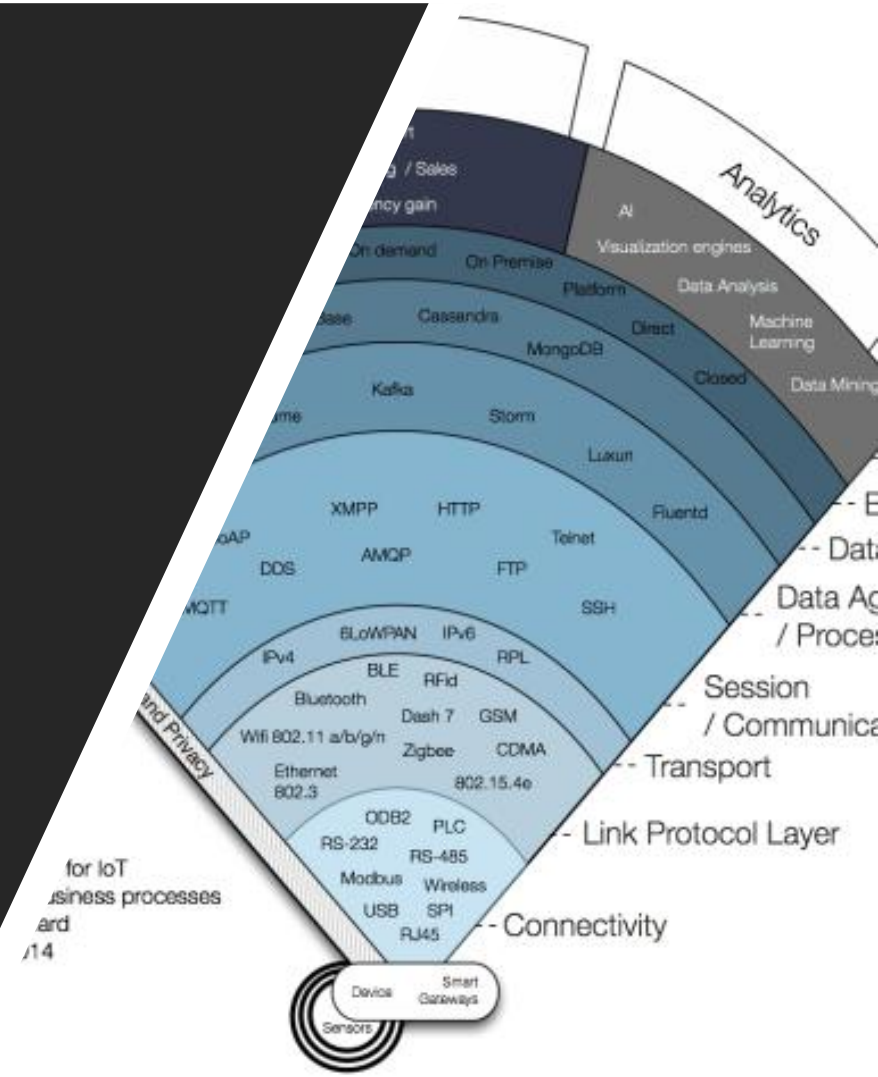
IoT Protocol Stack?

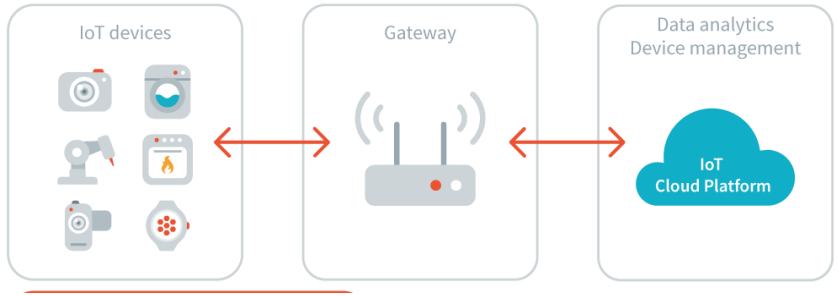
- many protocols, many standards. Starting to consolidate
- Some strong standards starting to emerge that address the IT/OT link
- We will try to look a protocol in each layer, building a reference app that combines several.



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,