

Internet of Things Starter Workshop

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Who am I?

I majored in engineering
because a degree for
“awesome genius rock star”
wasn’t an option.



EDN
NETWORK
www.edn.com

- Danil Borchevkin;
- 28 years;
- Married;
- Master of EE (IKBFU, 2014);
- Owner Lab409 LLC;
- More a engineer than businessman =((
- Main skills – Electrical Engineering, PCB Design, Firmware Engineering, Electronic Design.
- Points of interest: RF, ARM, MSP43x, Tiva C, EFM32, STM32, Cloud-backends

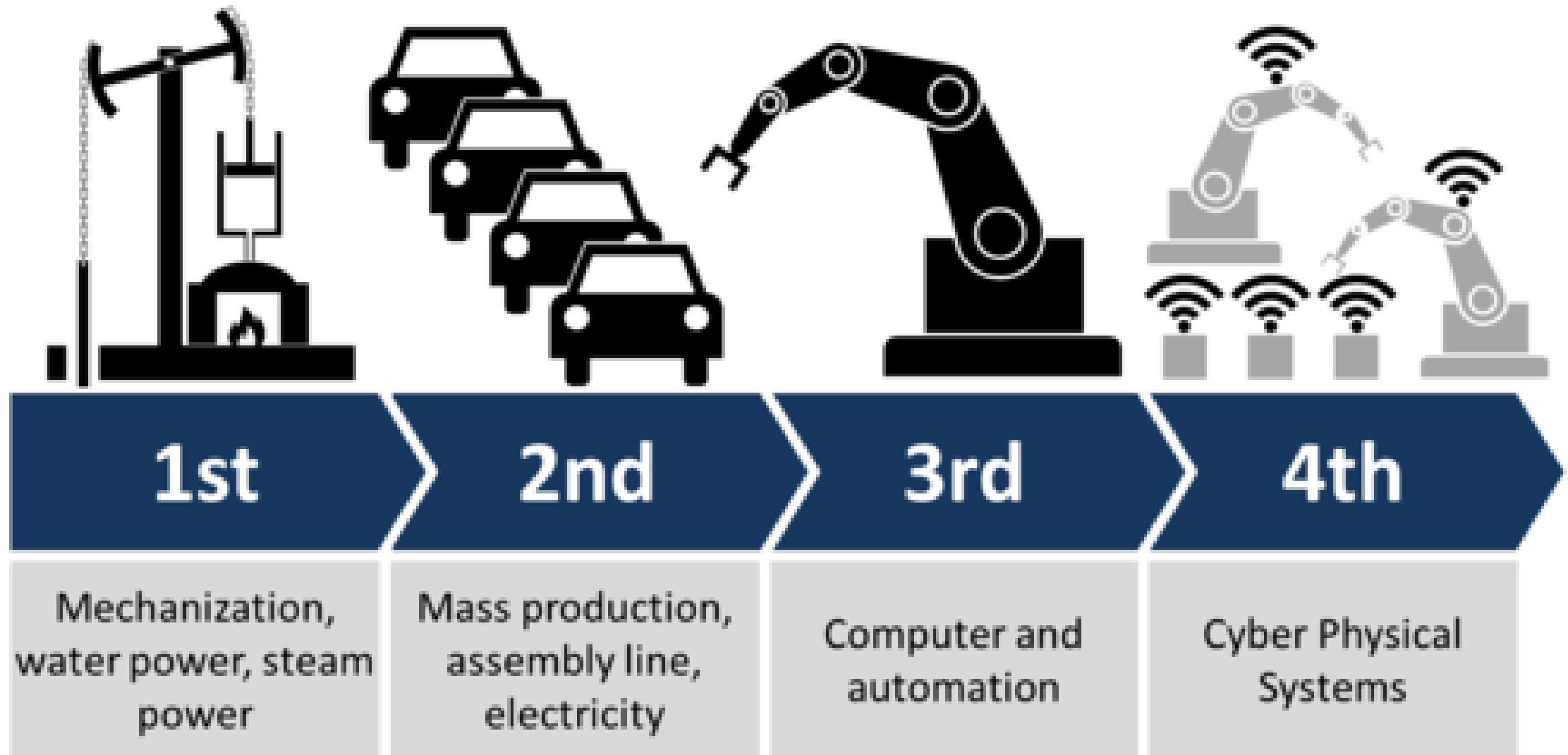


Part 1

What is IoT exactly

#history #technology #people

Evolution of Industry



History of IoT

- 198x – D2D conception.
- 1990 – first connected thing – a toaster with embedded TCP/IP abilities.
- 1990 – several guys in Sun Microsystems start develop new language for embedded systems.
- 199x – M2M expansion (POS, ATM, banking).
- 1999 – IoT named IoT by Kevin Ashton (MIT, Auto-ID) during presentation for Procter & Gamble (RFID for logistics).
- 2004 – article in Scientific American about IoT conception.
- 2008 – USIC named IoT one of six dangerous technologies.
- 2009 - birth of IoT – amount of things exceeded people's population.
- 2011 - Gartner named IoT as «tech trigger» with 10 years time of shaping.

M2M is a complex of techs but not a concept

Machine-to-Machine, M2M is a common name of technologies which purposed to machine connect with other machine (simplex/duplex):

1. Security systems.
2. POS.
3. ATM.
4. Vending.
5. Fleet tracking.

Main techs: GSM/GPRS, GNSS (GPS, Galileo, Glonass and so on), Wired/Wireless common and industry-specific protocols.

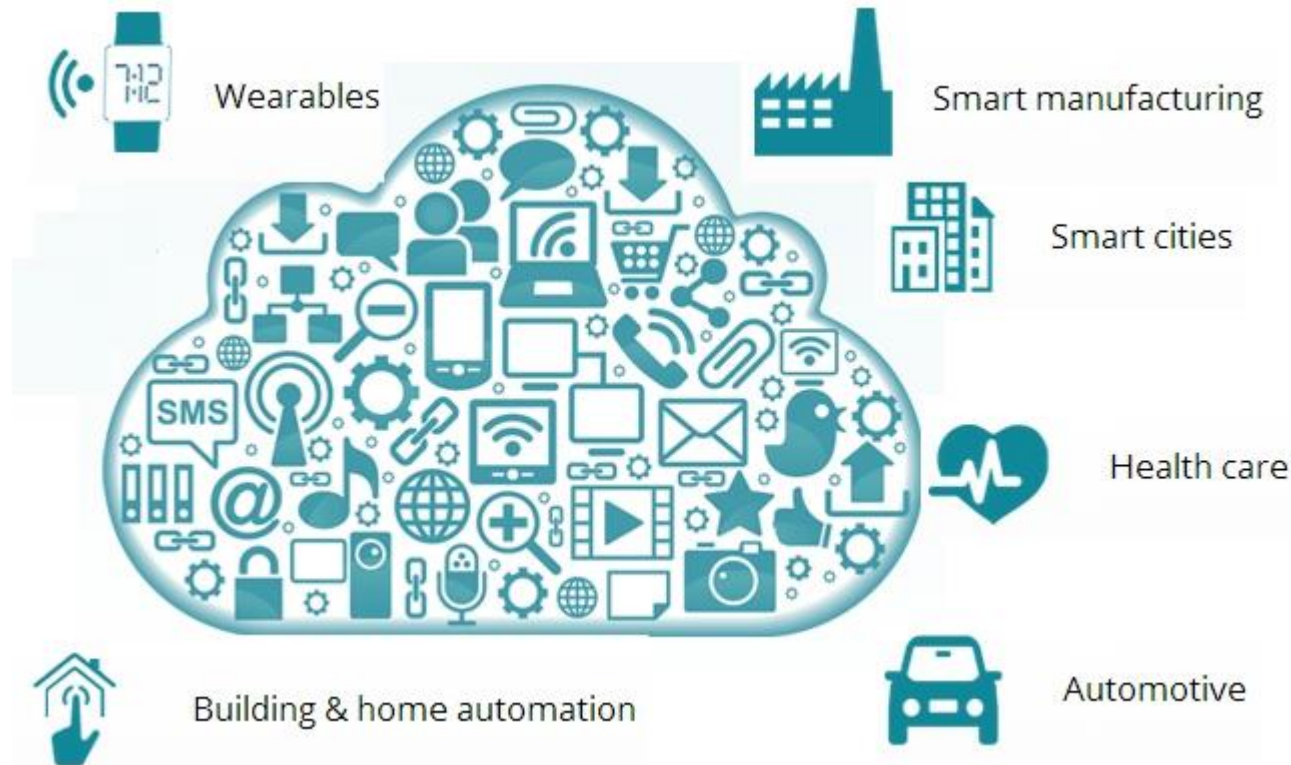
IoT is a conception but not a technology

IoT is a conception of network consist of physical objects(«*things*») which enable these objects to collect and exchange data. The IoT allows objects to be sensed or controlled remotely across existing network infrastructure creating opportunities for more direct integration of the physical world into computer-based systems, and resulting in improved efficiency, accuracy and economic benefit in addition to reduced human intervention.

IoT based on:

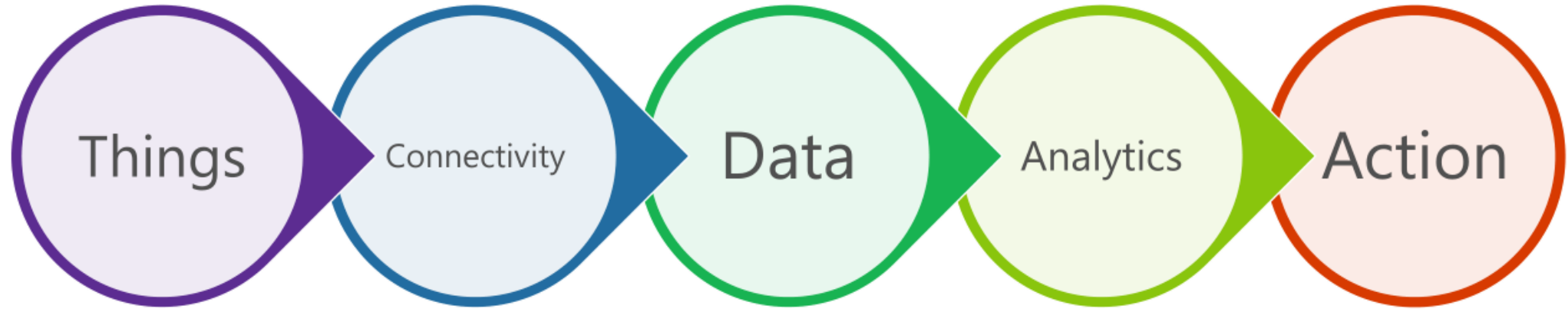
1. Embedded systems (electronics+firmware+mechanics+optics+chemistry)
2. Connectivity (Wired and Wireless protocols and high-level protocols).
3. M2M.
4. Internet.
5. Data analytics.

IoT is a... infrastructure. A network of networks



- *"Instruct the children not to dream of toys or sweets. Instruct them to dream of infrastructure."*
- Vadim Kozlov, Axioms from the Minutes of the Central Directorate*
- Civilization. Beyond the Earth*

Pillars of IoT



- The “Thing” is only 20% of the solution
 - Often, far too much emphasis on the “thing”, not the “solution”
- If you are not doing analytics; you are not doing IoT
 - Device level engineers often miss the “big picture”
 - Success comes from device engineers working with back-end cloud architects, business analysts and data scientists

Cold and Hot Path Processing

- Cold

- Data stored for later processing
 - Structured
 - SQL
 - Unstructured
 - NoSQL
 - BLOB
 - File
 - TXT, CSV
- Batch

- Hot

- Data processed in real-time
 - Reactive to device behavior
 - Streaming analytics
 - Live dashboards
- Stream processing
 - Hadoop, Spark
 - Machine Learning
 - Predictive, Prescriptive analytics
- Event-driven processing

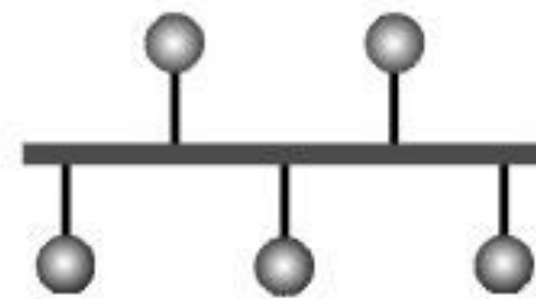
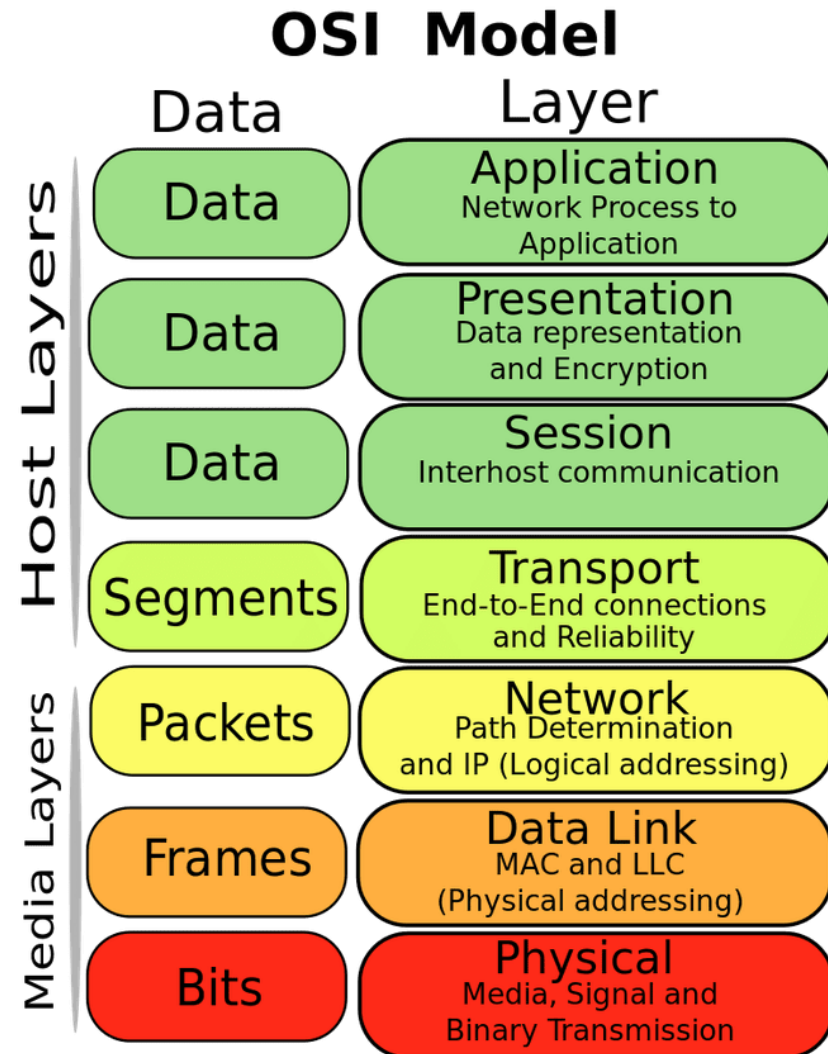


Part 2

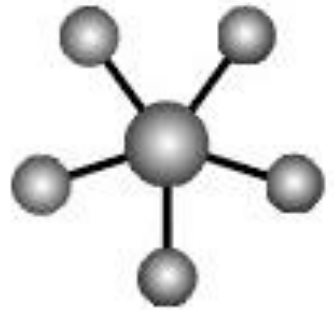
Ground Level of IoT

#embedded #things #connectivity

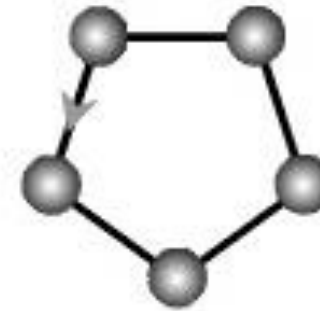
Some theory



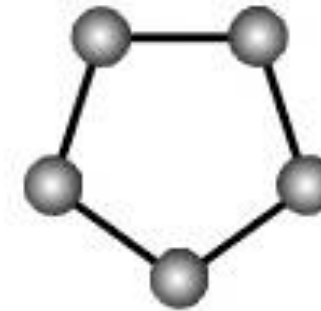
Bus



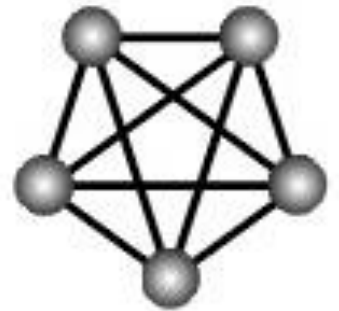
Star



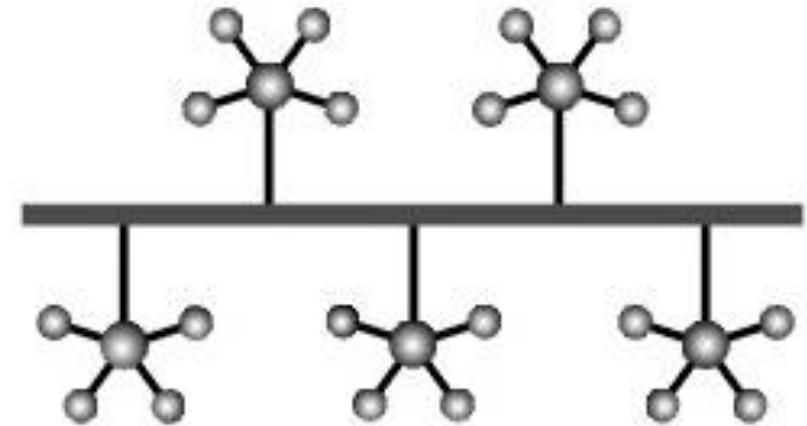
Token ring



Ring



Mesh



Tree

Embedded systems

Typical embedded system consist of:

1. Electronics;
2. Firmware;
3. Chemical things;
4. Mechanical things;
5. Optical Things.

“Thing” is embedded system with M2M abilities (wired/wireless protocol)

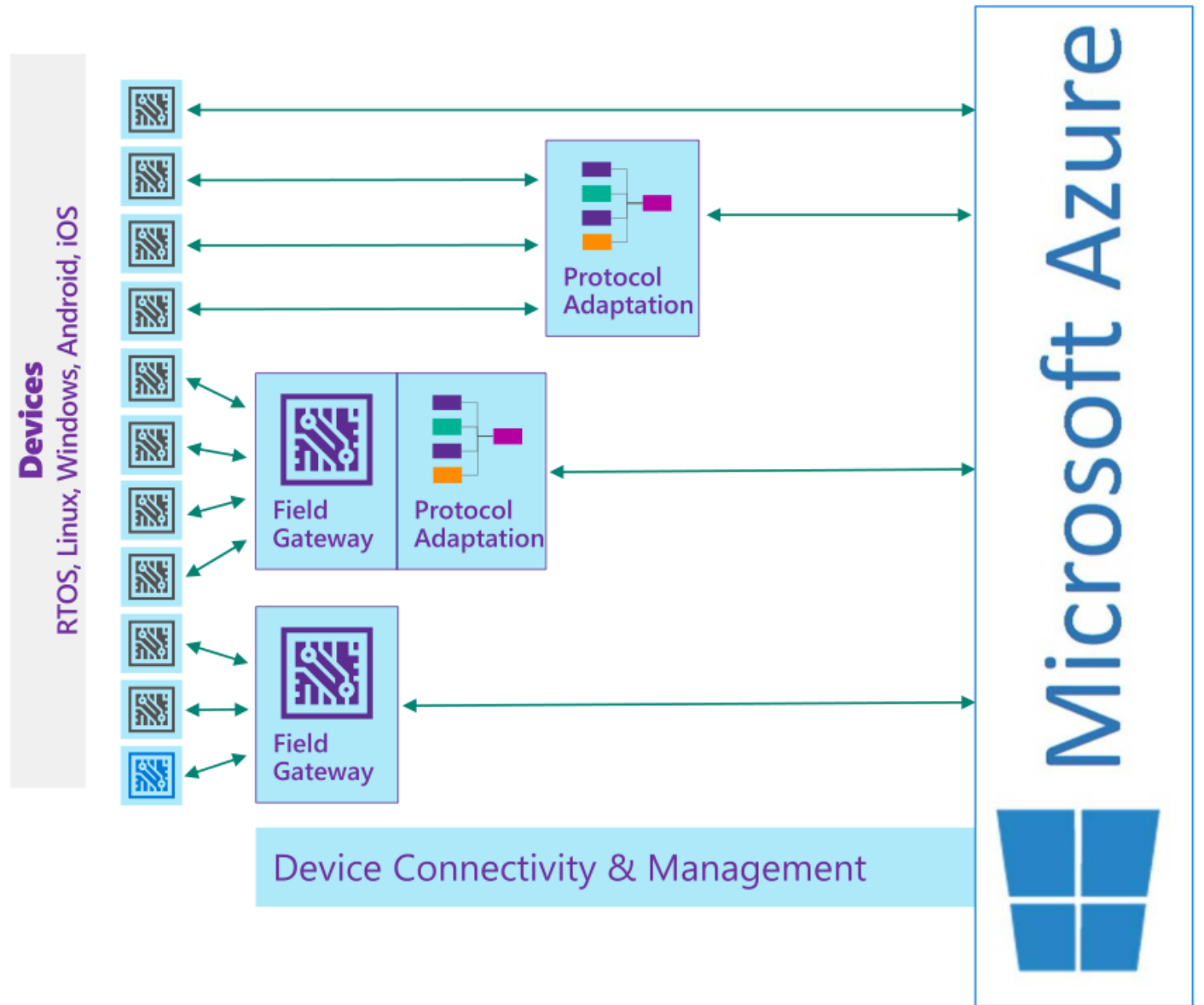


Connecting ways

IoT not mean what all things have direct internet connection.

Many things have to connect to cloud over gateways and adaptation servers.

It's all about economy and processing issues.



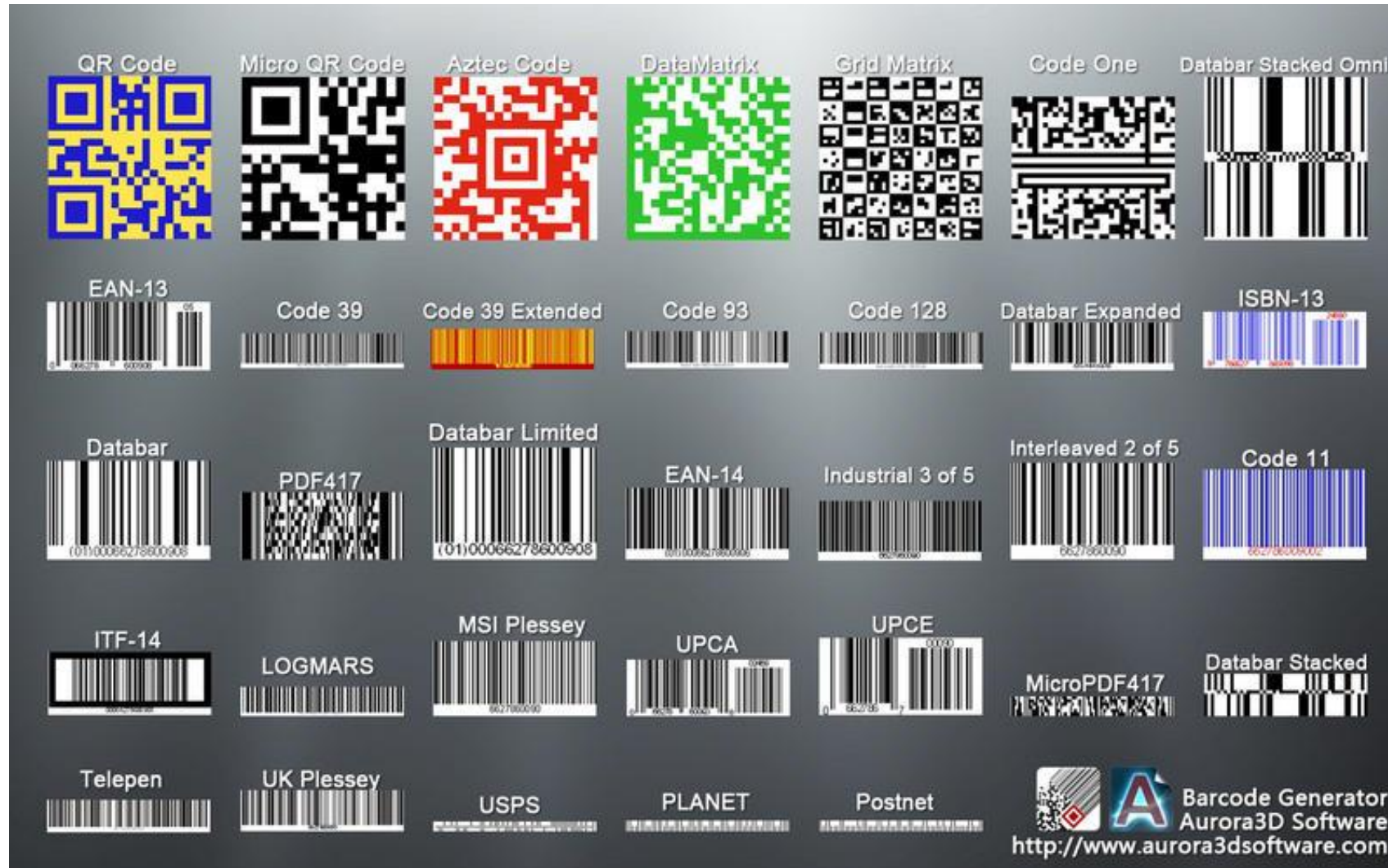
Wired protocols (low-levels)

- Ethernet;
- RS-422;
- RS-485;
- Fiber Optics;
- CAN;
- And Industry-specific.

Wireless protocols (all levels)

- Out of category – all types of barcodes;
- RFID/NFC;
- Bluetooth (Classic and Smart);
- 802.11 based – WiFi, etc;
- 802.15.4 based noIP – ZigBee, etc;
- 802.15.4 IP-based – 6LoWPAN – Thread, etc;
- Proprietary RF in 2.4 GHz
- Proprietary RF in ISM (Sub 1GHz) – 433, 868/915 MHz – Z-Wave, etc;
- GSM/GPRS 2G/3G/4G/5G;
- Latest WAN – LoRA, NB-IoT, SigFox.

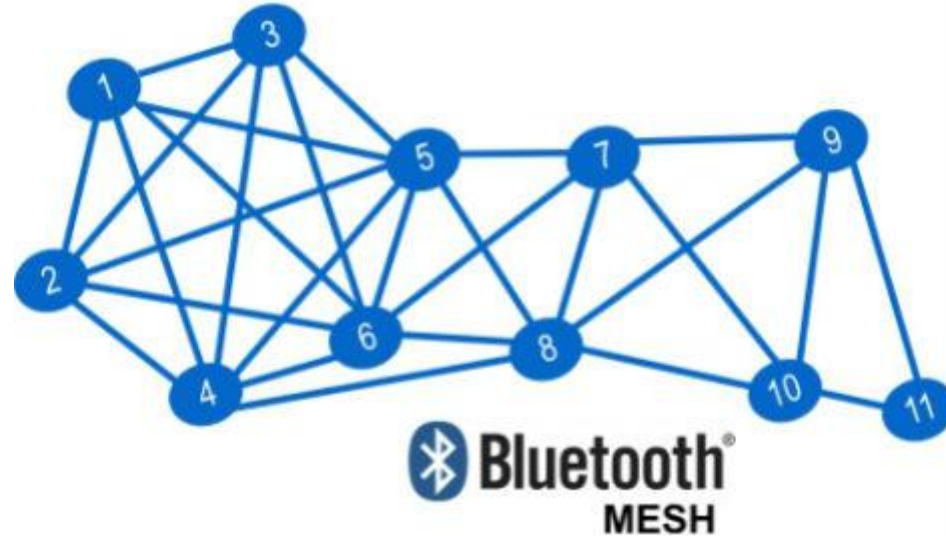
Barcodes



RFID/NFC



Bluetooth



Heart monitors, sensors, other
low-power applications

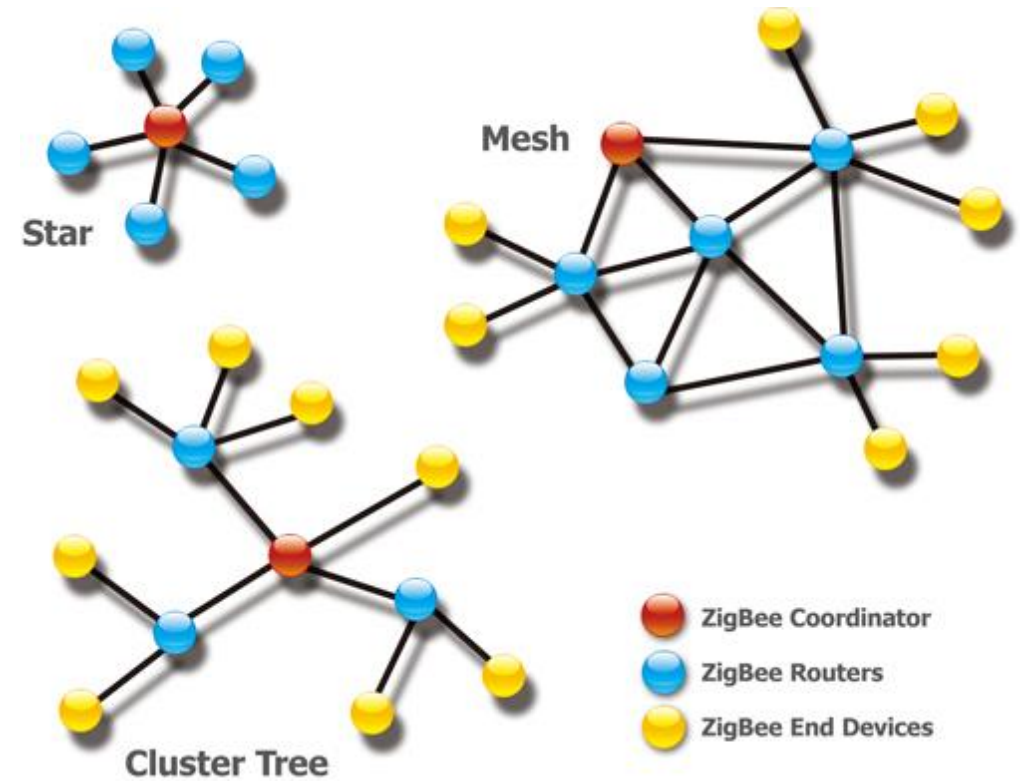


PCs, tablets, smartphones
(Communicate with Smart AND Classic)

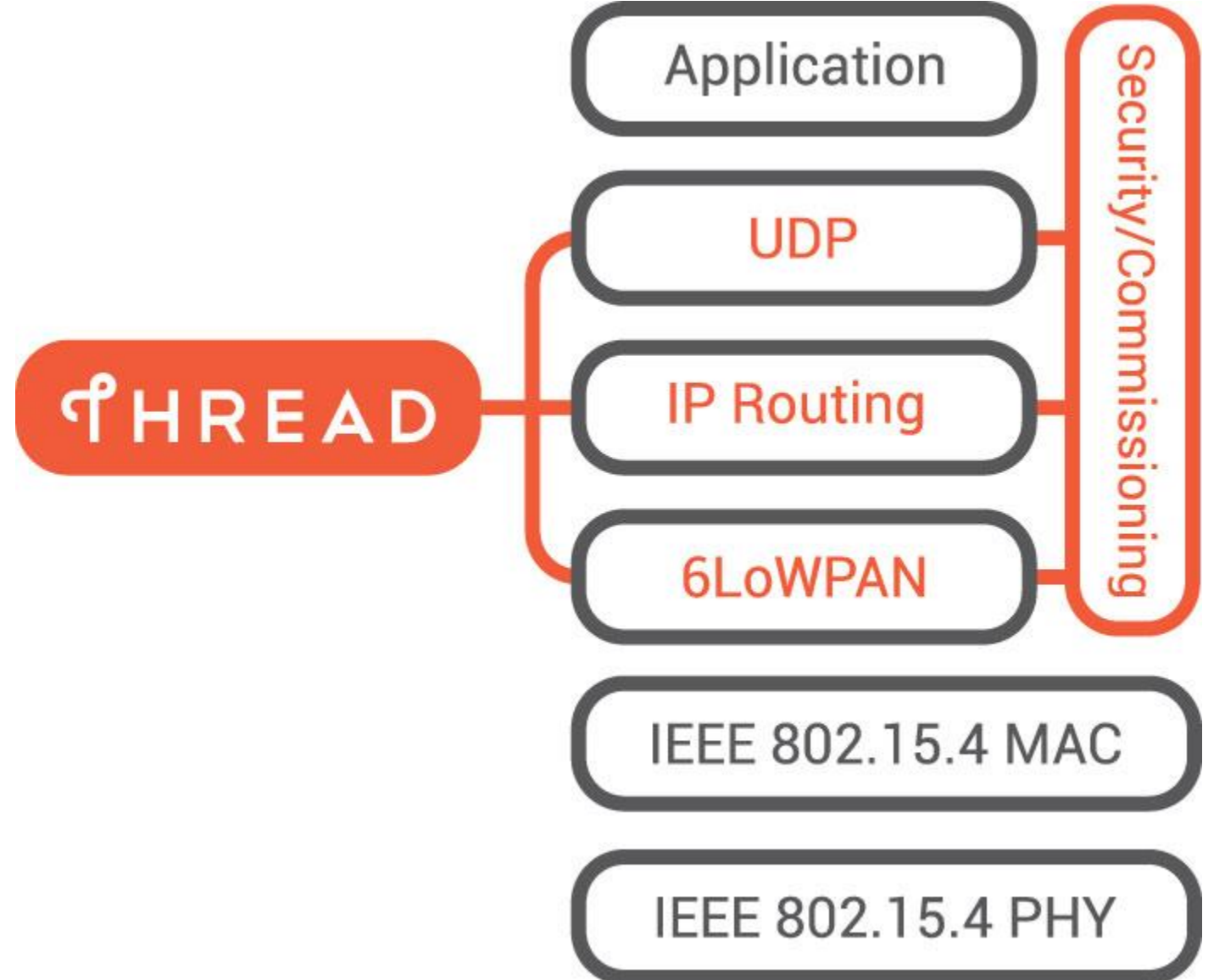


Audio headsets, hands-free
calling, file / video transfer

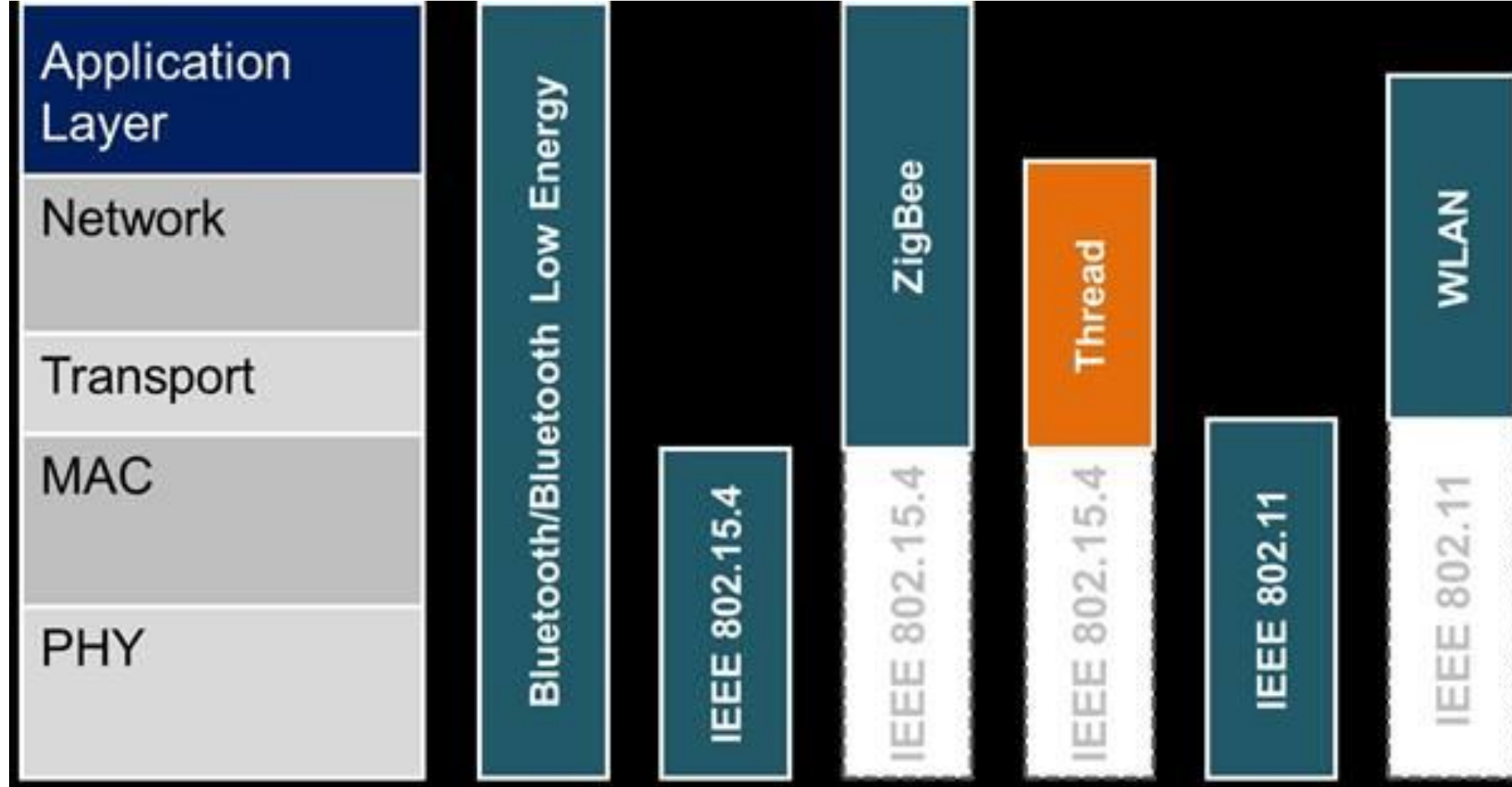
ZigBee – 802.5.14 most popular protocol



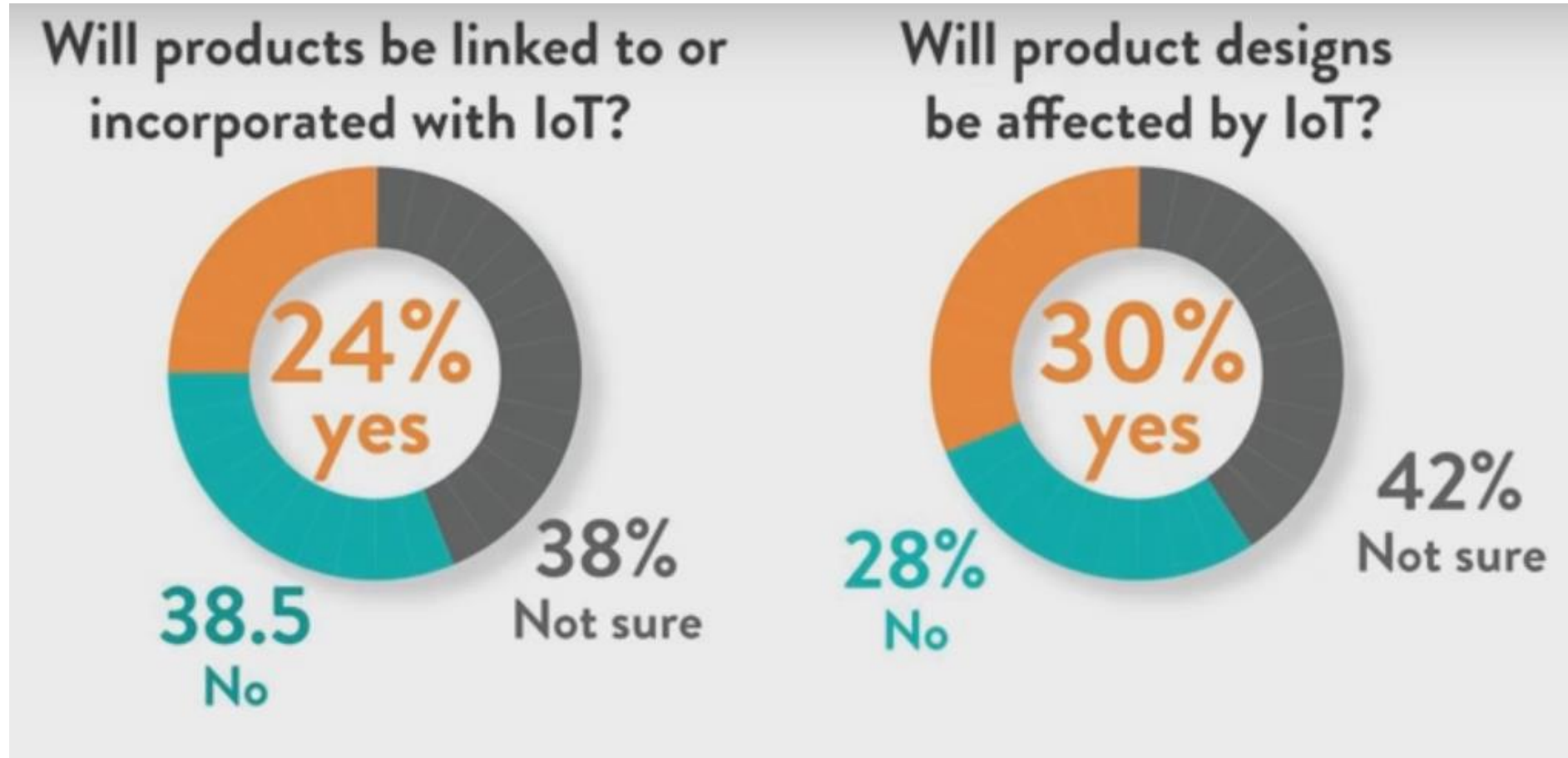
6LoWPAN and based on it. Thread



About protocols



What engineers think about IoT



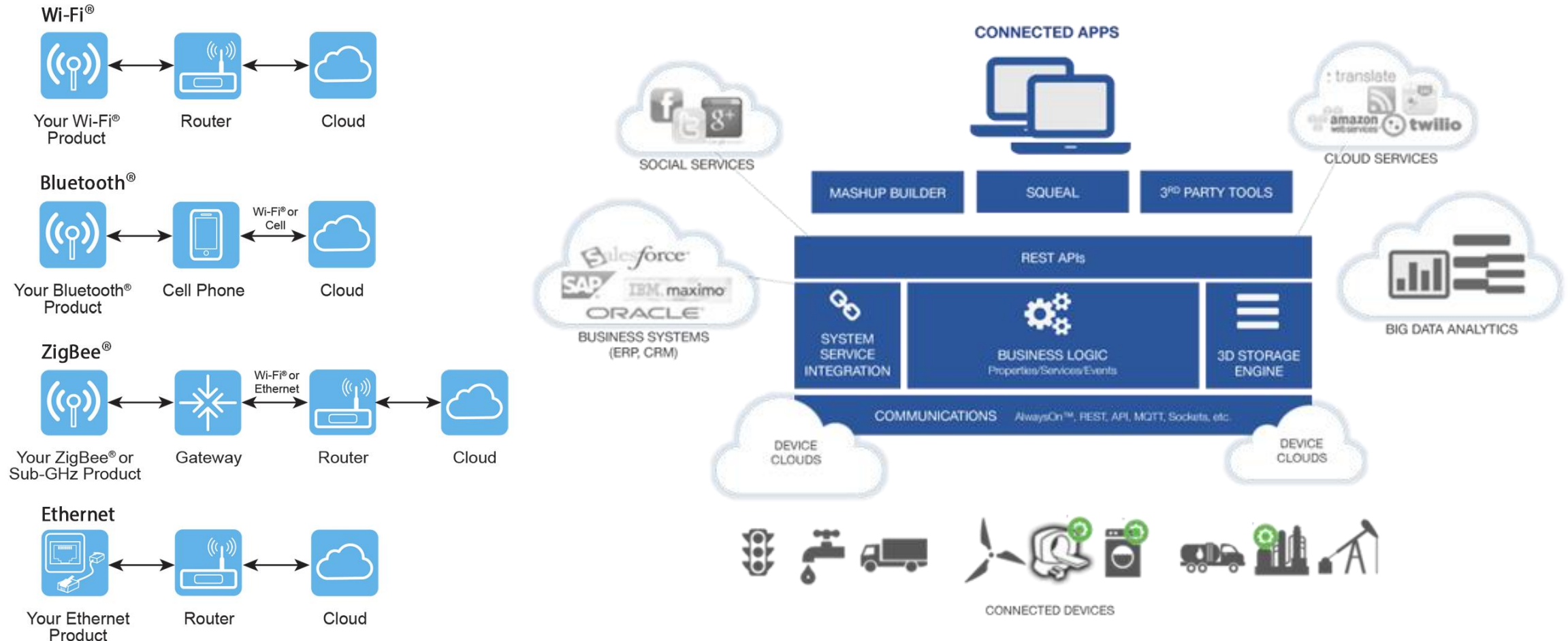


Part 3

Cloud services for IoT

Do Internet of Things but not a Thing-in-itself

How clouds implement systems for IoT



Popular IoT clouds



Samsung
ARTIK[™] Cloud



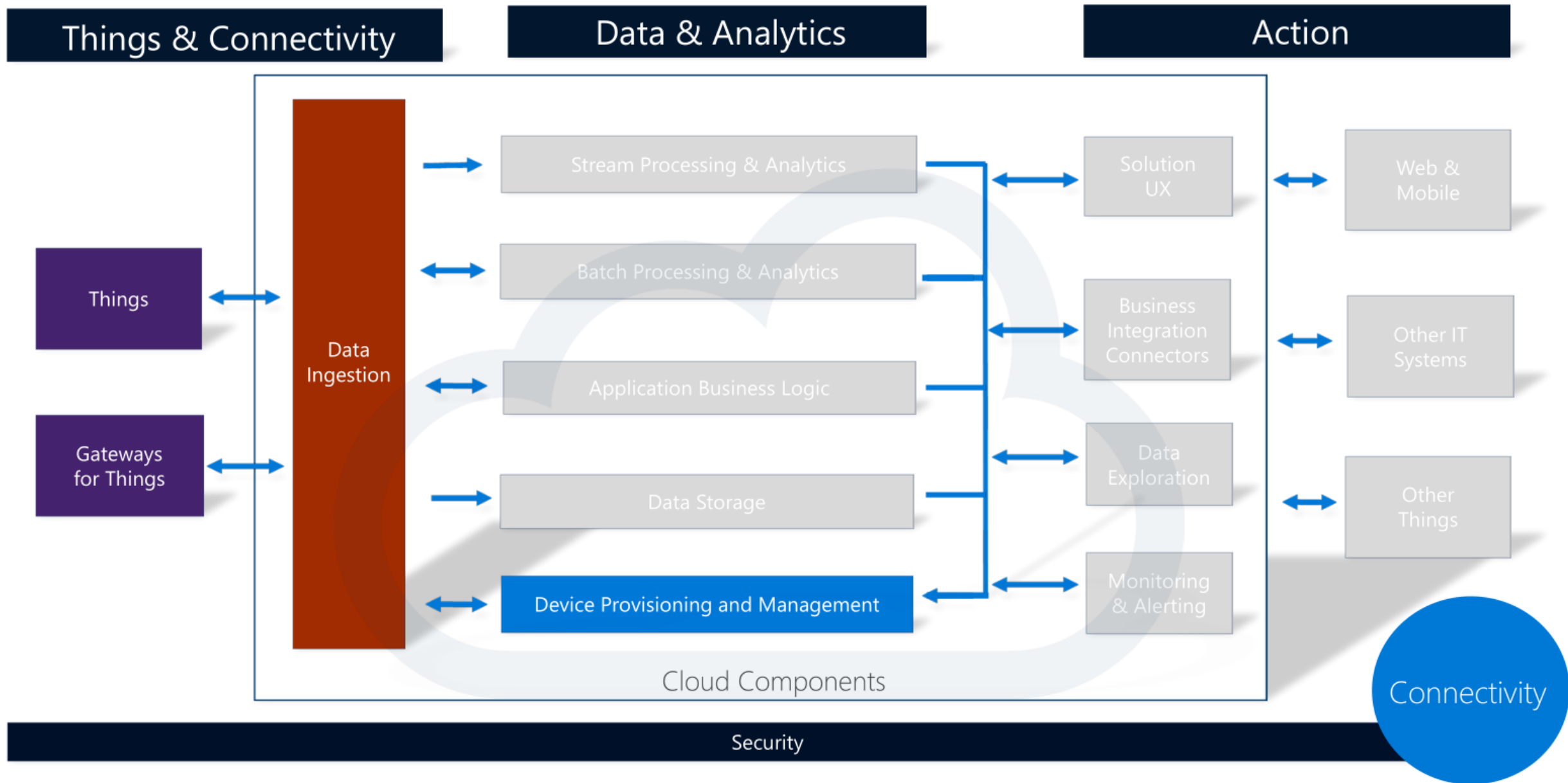
ThingWorx



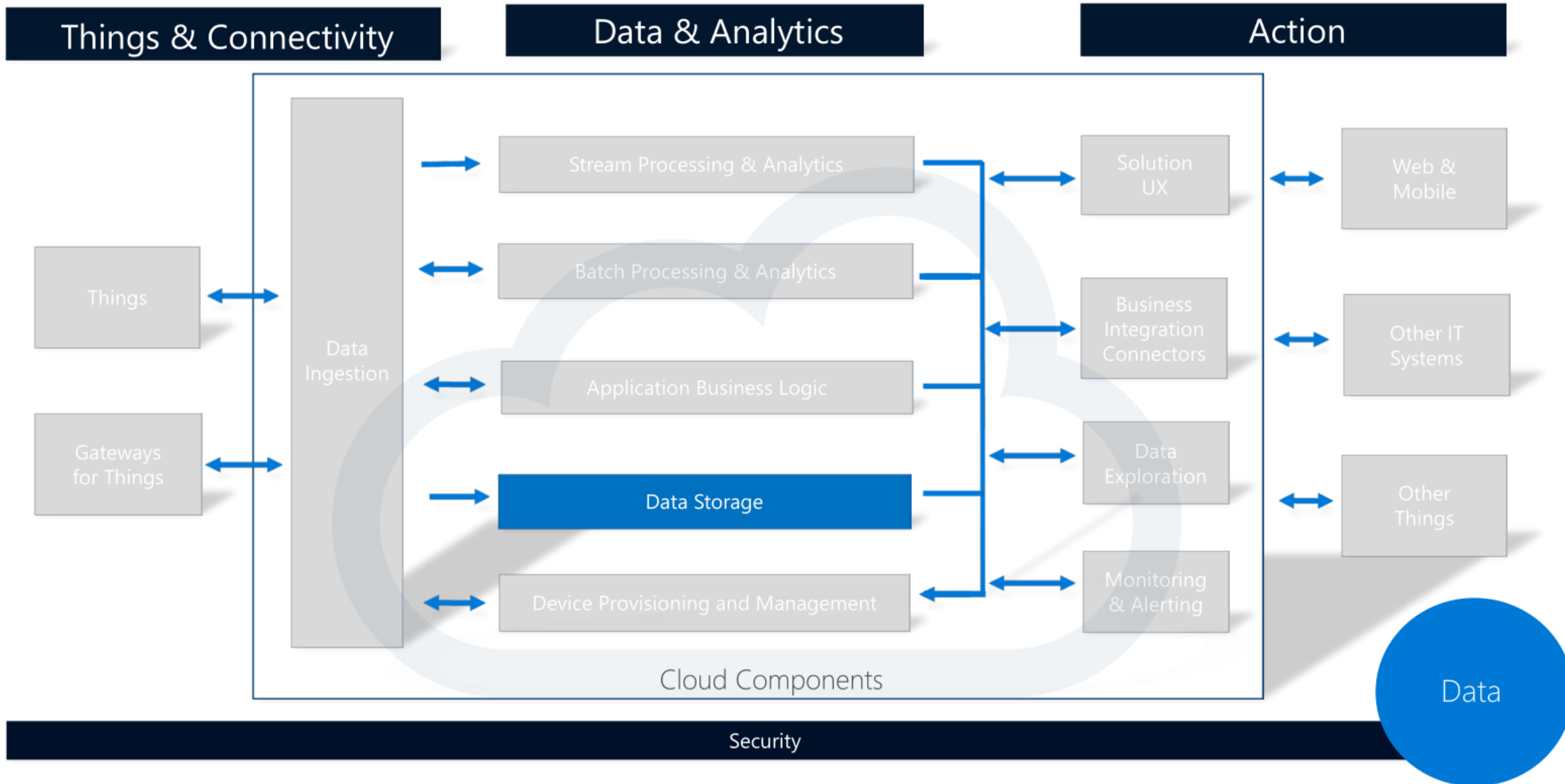
Google Cloud Platform



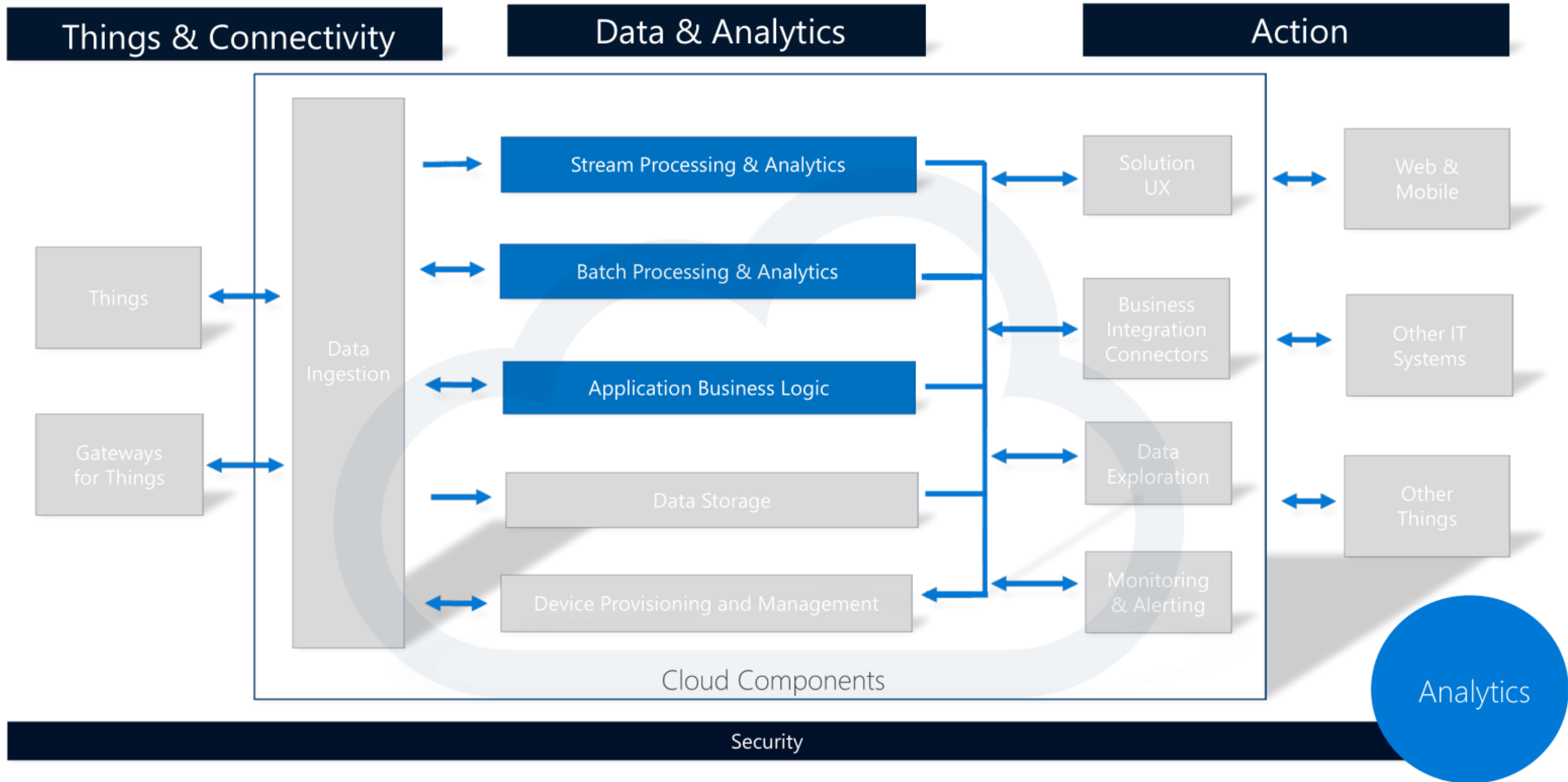
IoT anatomy from the top down



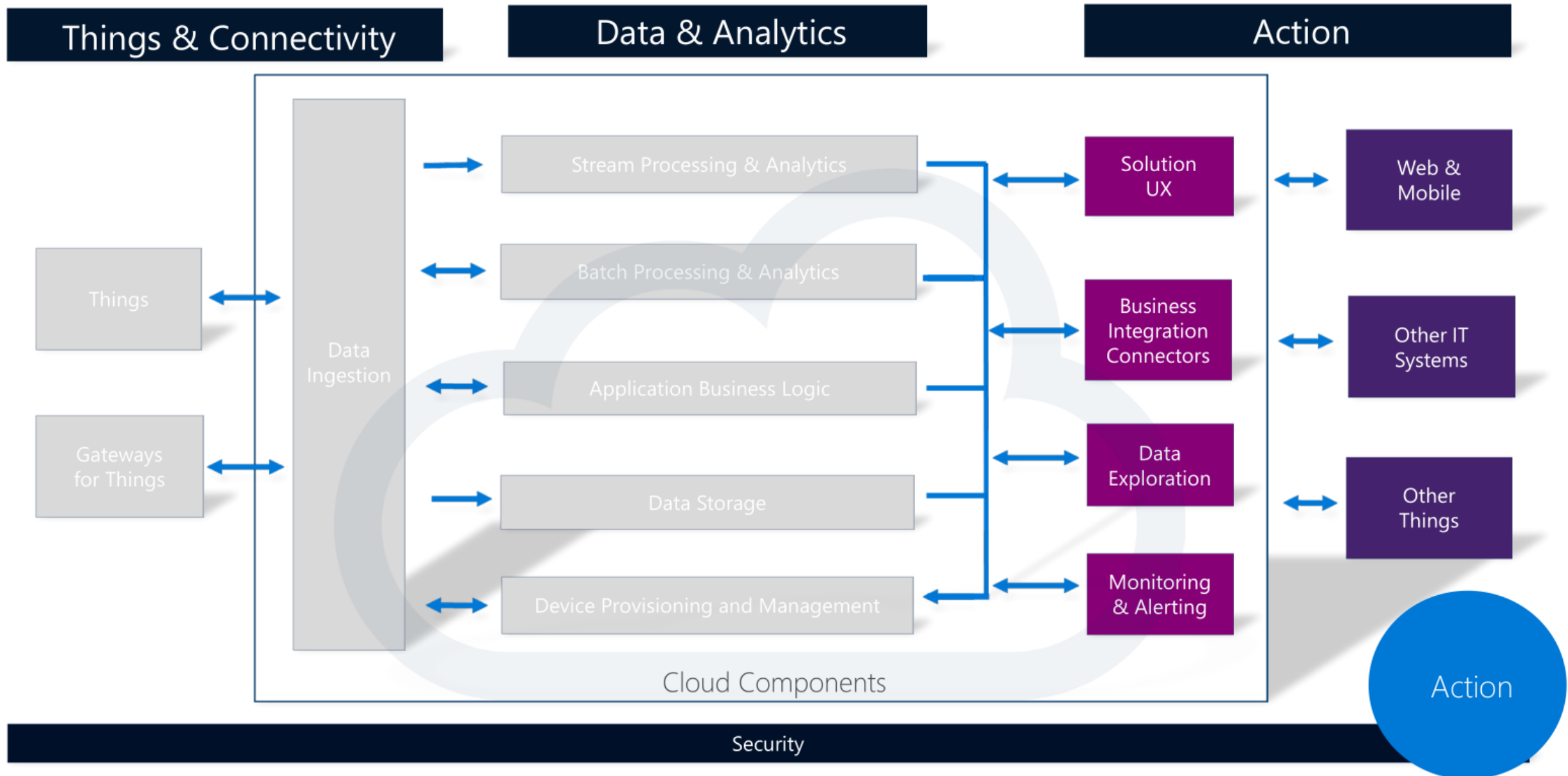
IoT anatomy from the top down























IoT anatomy from the top down



IoT anatomy from the top down



Microsoft Azure IoT services

Devices	Device Connectivity	Storage	Analytics	Presentation & Action
	 Event Hub	 SQL Database	 Machine Learning	 App Service
	 IoT Hub	 Table/Blob Storage	 Stream Analytics	 Power BI
	 Service Bus	 DocumentDB	 HDInsight	 Notification Hubs
	 External Data Sources	 3rd party Databases	 Data Factory	 Mobile Services
			 Data Lake	 BizTalk Services

Some issues in Russia

- No alternatives to GSM/GPRS (upd. NB-IoT is coming) as a WAN;
- Customs issues;
- “Strange” logistic;
- “Russian business”;
- High prices of components, devkits;
- There are no Russian competitors on a microelectronic market;
- Availability of new components (domestic resellers): +1 year from release.

Part 3 Labs

#lab #mediatek #OpenWRT



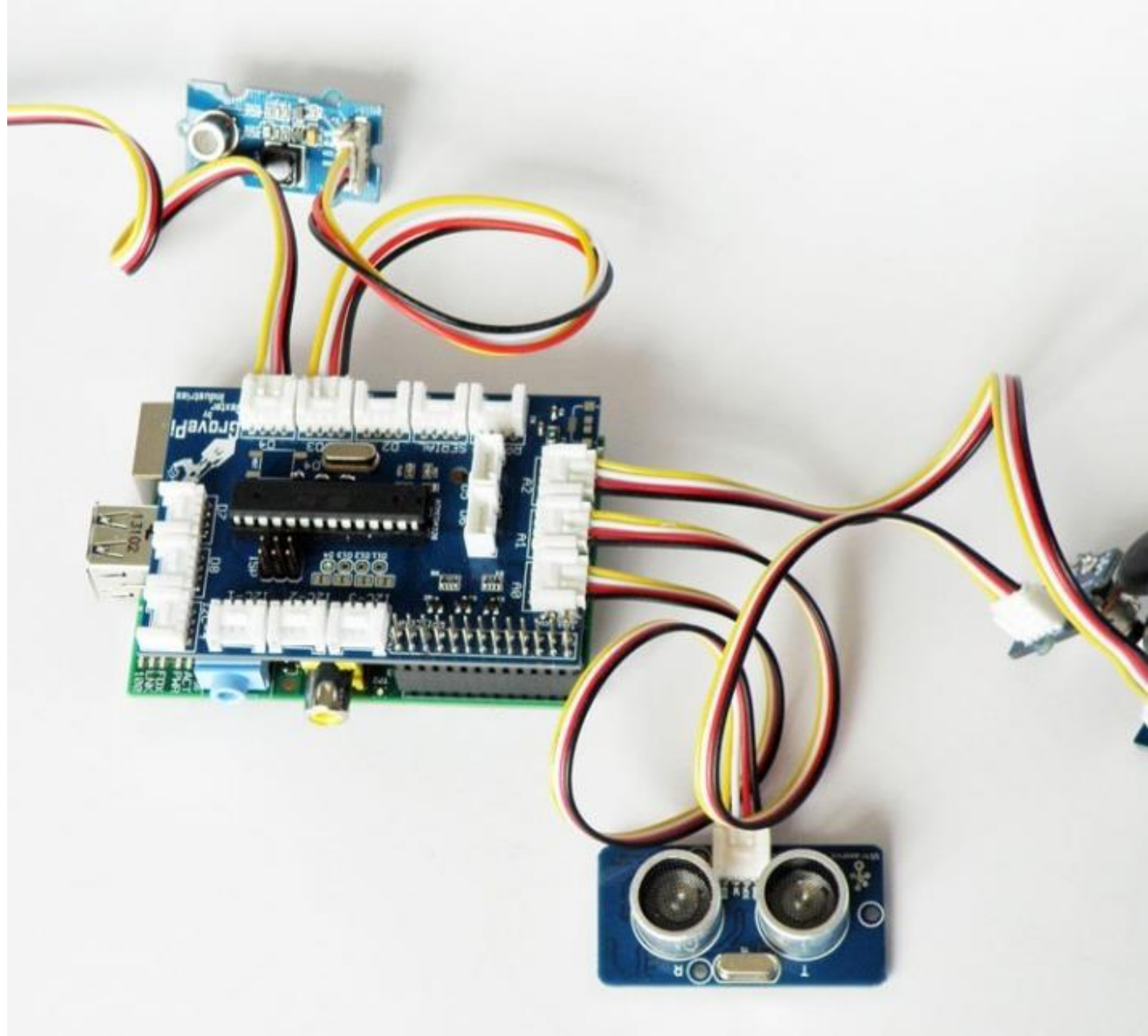
Core of your “thing” – MediaTek LinkIt Smart 7688

- OpenWRT
- Single input single output(1T1R)
Wi-Fi 802.11 b/g/n.
- Pin-out for GPIO, I2C, I2S, SPI,
UART, PWM and Ethernet Port.
- 580 MHz MIPS CPU.
- 32MB flash and 128MB DDR2
RAM.
- USB host.
- Micro SD slot.



Grove actuators and sensors

- 150+ ready sensors and actuators
- Ready code and examples for main platforms
- No PCB development and soldering needed
- Good to quick start and PoC



Software

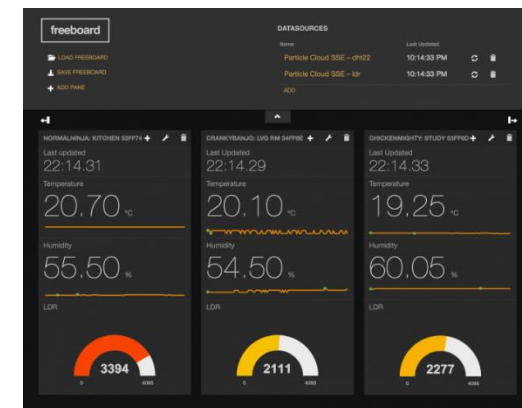
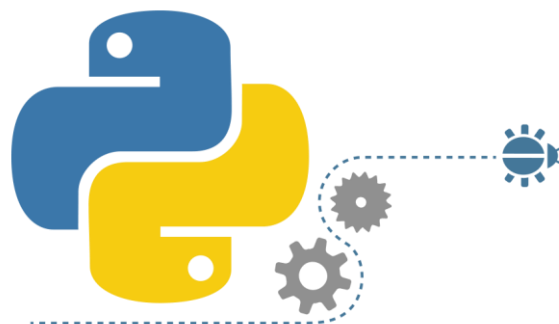
- Your “thing” has a OS OpenWRT. It’s a good news for start!
- For your “thing” you can write code on high-level languages – Python, Node.JS, Lua...
- For own workshop we will use free cloud backend dweet.io with visualizing tool freeboard.io
- As we have OS so we can connect to own “thing” by SSH



CHAOS CALMER (15.05, r46767)

```
* 1 1/2 oz Gin           Shake with a glassful  
* 1/4 oz Triple Sec      of broken ice and pour  
* 3/4 oz Lime Juice      unstrained into a gobl  
* 1 1/2 oz Orange Juice  
* 1 tsp. Grenadine Syrup
```

root@OpenWrt:/#



Lab 01 - Blink

- Your script placed at ***~/ws_iotstarted/lab01/lab01.py***
- Change directory by ***cd*** command
- Open the script by ***nano***
- Following instruction in the code
- Then exit from nano by pressing ***Ctrl+X***
- Run code by ***./lab01.py***
- If you want to exit from script press ***Ctrl+C***
- Finish!

Lab 02 – First sensor

- Your script placed at ***~/ws_iotstarted/lab02/lab02.py***
- Change directory by ***cd*** command
- Open the script by ***nano***
- Following instruction in the code
- Then exit from nano by pressing ***Ctrl+X***
- Run code by ***./lab02.py***
- If you want to exit from script press ***Ctrl+C***
- Finish!

Lab 03 – Send data to cloud

- First – finish registration on <http://freeboard.io>
- Your script placed at `~/ws_iotstarted/lab03/lab03.py`
- Change directory by **cd** command
- Open the script by **nano**
- Following instruction in the code
- Then exit from nano by pressing **Ctrl+X**
- Run code by **./lab03.py**
- If you want to exit from script press **Ctrl+C**
- Go to <http://dweet.io> and verify data ingestion
- Go to <http://freeboard.io> and build your dashboard
- Finish!

Lab 04 – Be connected

- Show your soft-skills – if you have sensor find another participant with actuator and vice versa
- Your script placed at **`~/ws_iotstarted/lab04/lab04_actuator.py`** or **`~/ws_iotstarted/lab04/lab04_sensor.py`** (dependence from your “thing”)
- Change directory by **`cd`** command
- Open the script by **`nano`**
- Following instruction in the code
- Then exit from nano by pressing **`Ctrl+X`**
- Run code by **`./lab04_sensor.py`** or **`./lab04_actuator.py`**
- If you want to exit from script press **`Ctrl+C`**
- Finish!



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