

Introduction to Mobile Computing and the IoT Wireless and Mobile Computing

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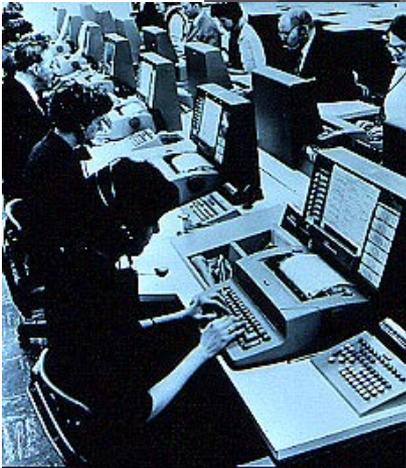
Session Overview

- The mobile computing paradigm
- The ubiquitous computing paradigm
- Elements of mobile and ubiquitous computing
- Enabling technologies
- Computer science challenges
- Applications and their role



LEO MARK I













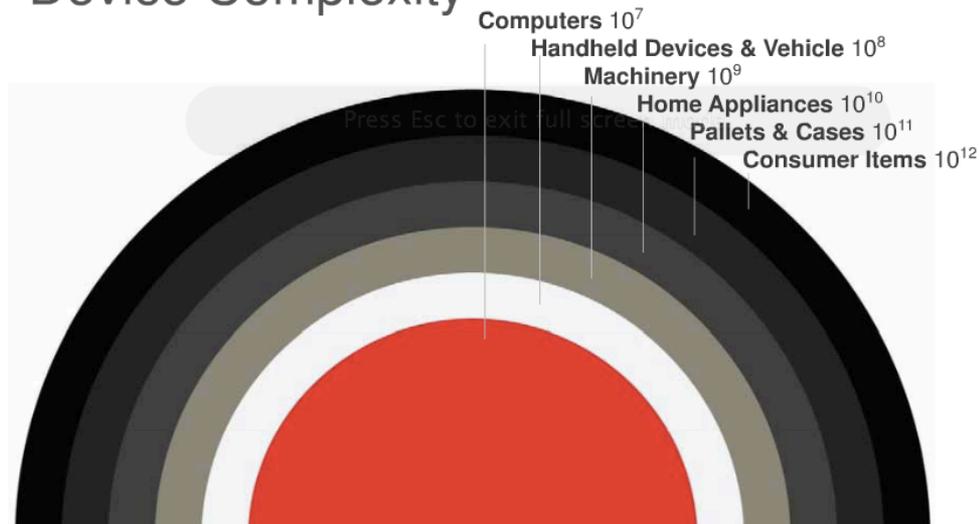


Main ingredients

- Possible due to minaturisation of computing and communication devices
- Automatic links between physical and digital worlds
- Reality embedded with and embedded in information space aka cyber-physical space
- Dual existence for
 - People
 - Places
 - Things

Device numbers vs. complexity

Device Complexity



Get in touch

3 / 42



Close

Example

- BMW 745i
- 2,000,000 LOC
- Windows CE
- 53 8-bit processors
- 11 32-bit processors
- 7 16-bit processors
- Multiple networks



What networks does this car have?
What other networks can you think of?



Mobile Computing

- The application of small, portable, and wireless computing and communication devices
- Being able to use a computing device even when being on the move (and thus changing location)
- Portability is one aspect of mobile computing
 - portable vs. mobile
- Mobile telephony in particular allows you to make and receive voice calls on the move

Mobile Computing Ingredients

- Device
 - laptop, PDA, mobile phone, tablet, smart phone
- Network
 - cellular telephony, data over cellular, wi-fi, Bluetooth, Zigbee, infra-red, 3G, 4G
- System support
 - routing, billing, voice mail, data routing
- In-depth discussion of the issues raised by mobile systems architectures later today

What does ubiquitous mean?

- Dictionary definition:
 - being or seeming to be everywhere at the same time;
 - omnipresent;
 - found in large quantities everywhere;
 - "all over the place."
- Term introduced by Mark Weiser (but others have also described the vision, notably Ken Sakamura)

machine-to-machine communications

ubiquitous computing deeply embedded computing

ambient intelligence B4G mobile Internet of Things

pervasive computing

cyber-physical systems wireless sensor networks

calm computing intelligent environments

smart cities sentient computing everywhere computing

smart planet web of things Future Internet

ubiquitous sensor networks connected objects smart homes

Cyber-physical Systems

Physical



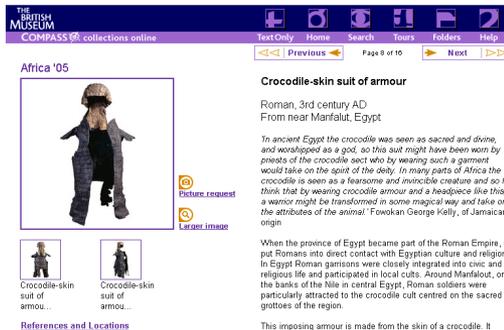
Physical (material) entities:

- People
- Objects
- Places

Digital entities:

- Object info and location
- Maps
- Person info
- Activities

Digital



Ubiquitous Computing

- Ubiquitous computing:
 - activates the world,
 - is invisible, everywhere computing that does not live on a personal device of any sort, but is in the woodwork everywhere,
 - makes a computer so imbedded, so fitting, so natural, that we use it without even thinking about it.
- Also called: pervasive, deeply embedded, 4G mobile or sentient computing, and ambient intelligence.

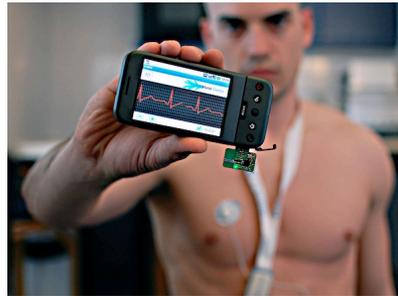
Commercial applications

Energy



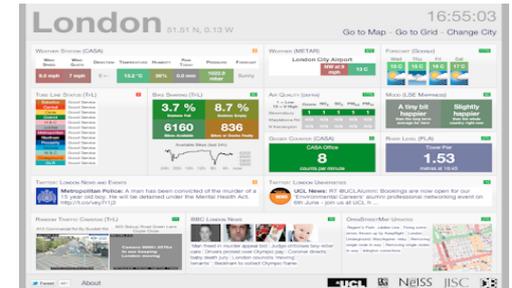
demand adaptation
micro-production

Healthcare



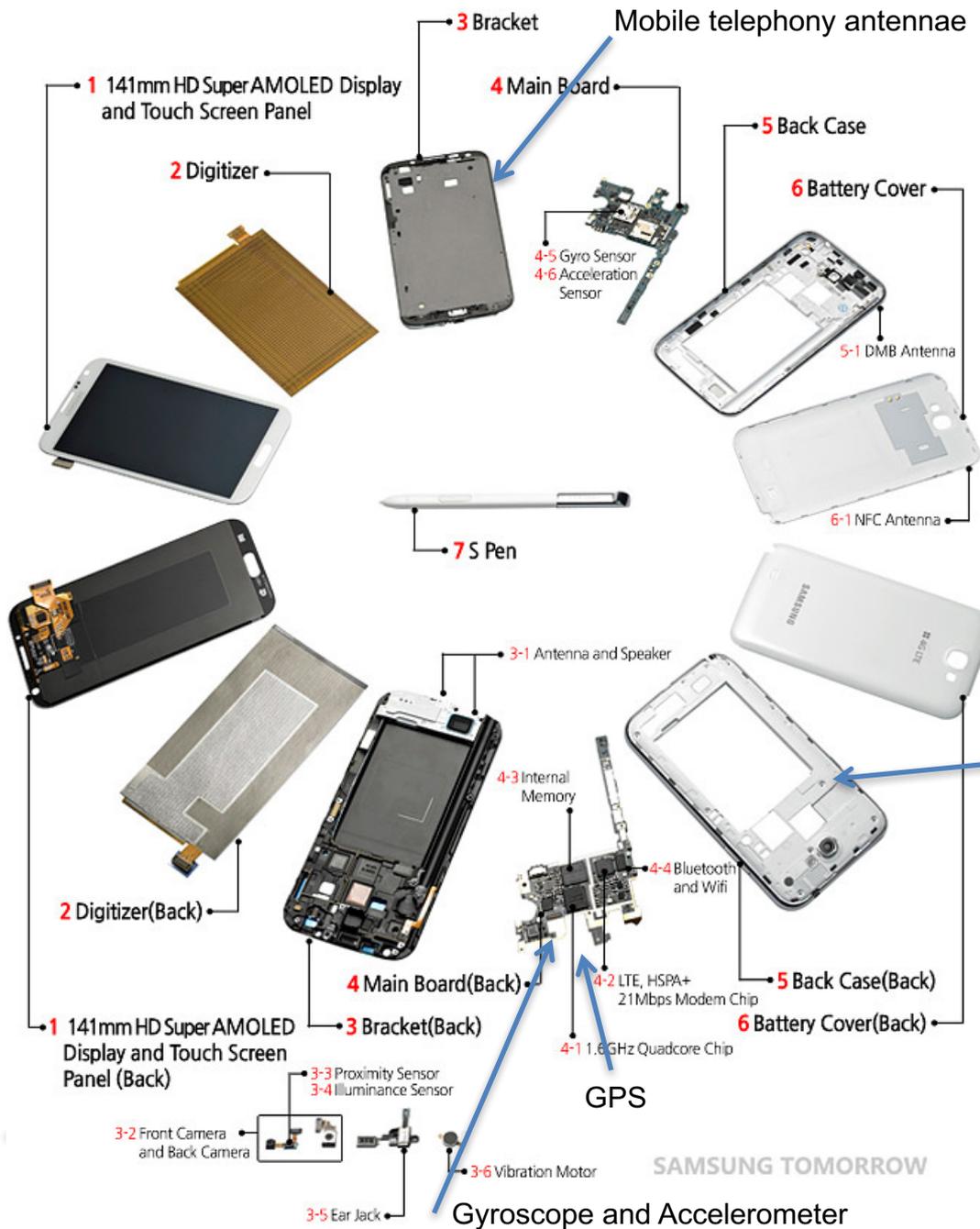
self-care
quantified self

Cities



patterns, routines
and unusual events

Samsung Galaxy Note II



GPS, Bluetooth, diversity antennae

Image source:
<http://blog.gsmarena.com/>

SAMSUNG TOMORROW



Anatomy of an IoT Device



MAIN UNIT
Contains display, sensors and controls. Plugs into the base unit.



BASE UNIT
Mounts on wall and connects to heating and cooling system wiring.

STAINLESS STEEL RING
Used to set the temperature and control the interface.

RF SHIELD FRAME
(shield removed to show components)



L.C.D. DISPLAY

SENSOR WINDOW AND LENS



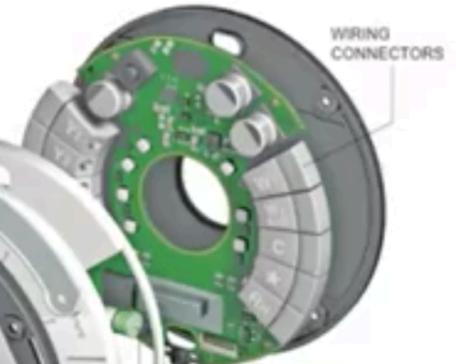
RADIO
Connects with home Wi-Fi network

NEAR-FIELD MOTION SENSOR

FAR-FIELD MOTION SENSOR

AMBIENT LIGHT SENSOR

TEMPERATURE SENSOR AND RING MOTION DETECTOR BOARD



WIRING CONNECTORS

TEMPERATURE AND HUMIDITY SENSOR

BUBBLE LEVEL
For leveling during installation.

BATTERY

MICROPROCESSOR

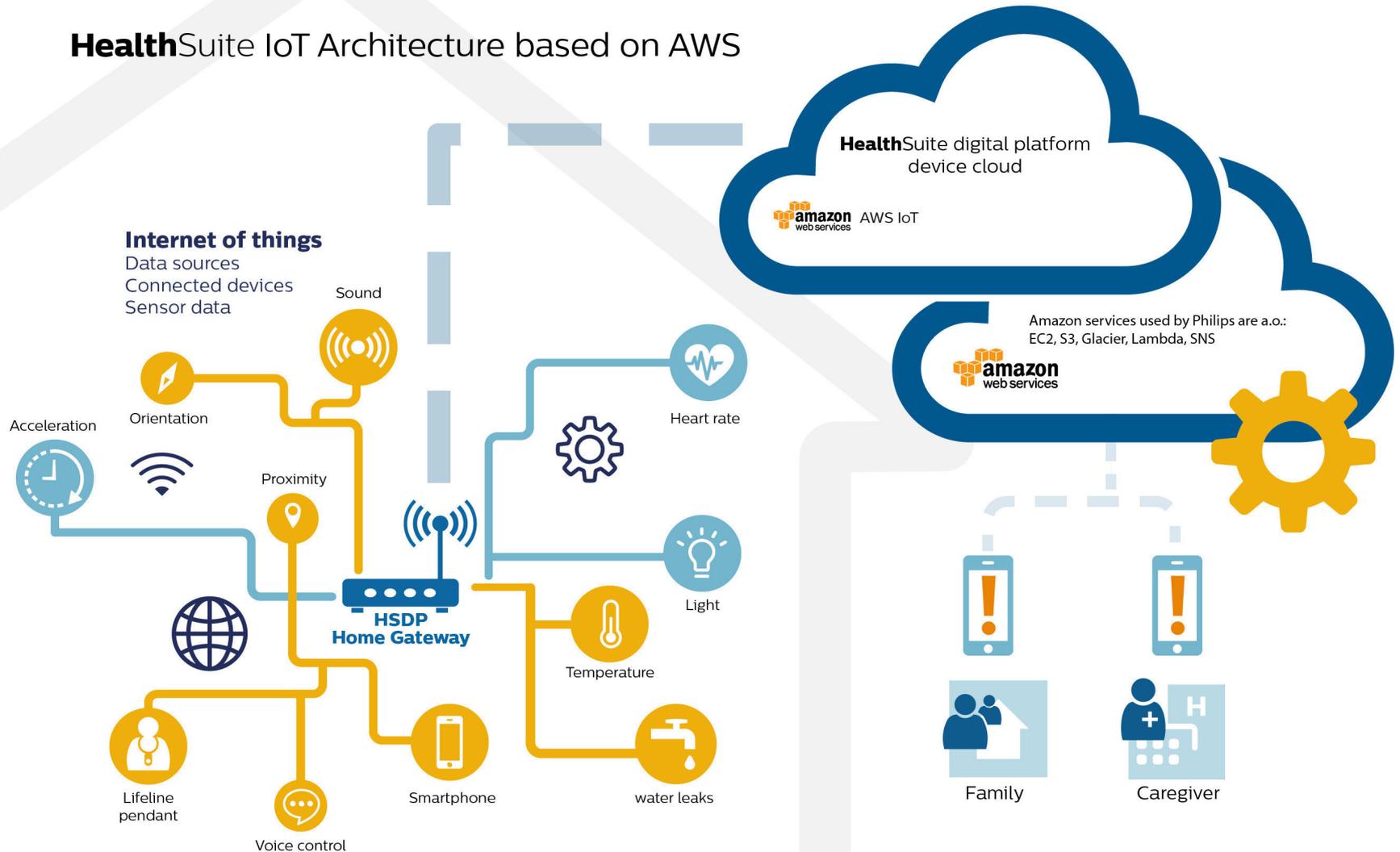
WI-FI ANTENNA

Remote Operation
Mobile apps enable Nest to be operated remotely via Wi-Fi using a smartphone, tablet or laptop. The iPad app is shown below.

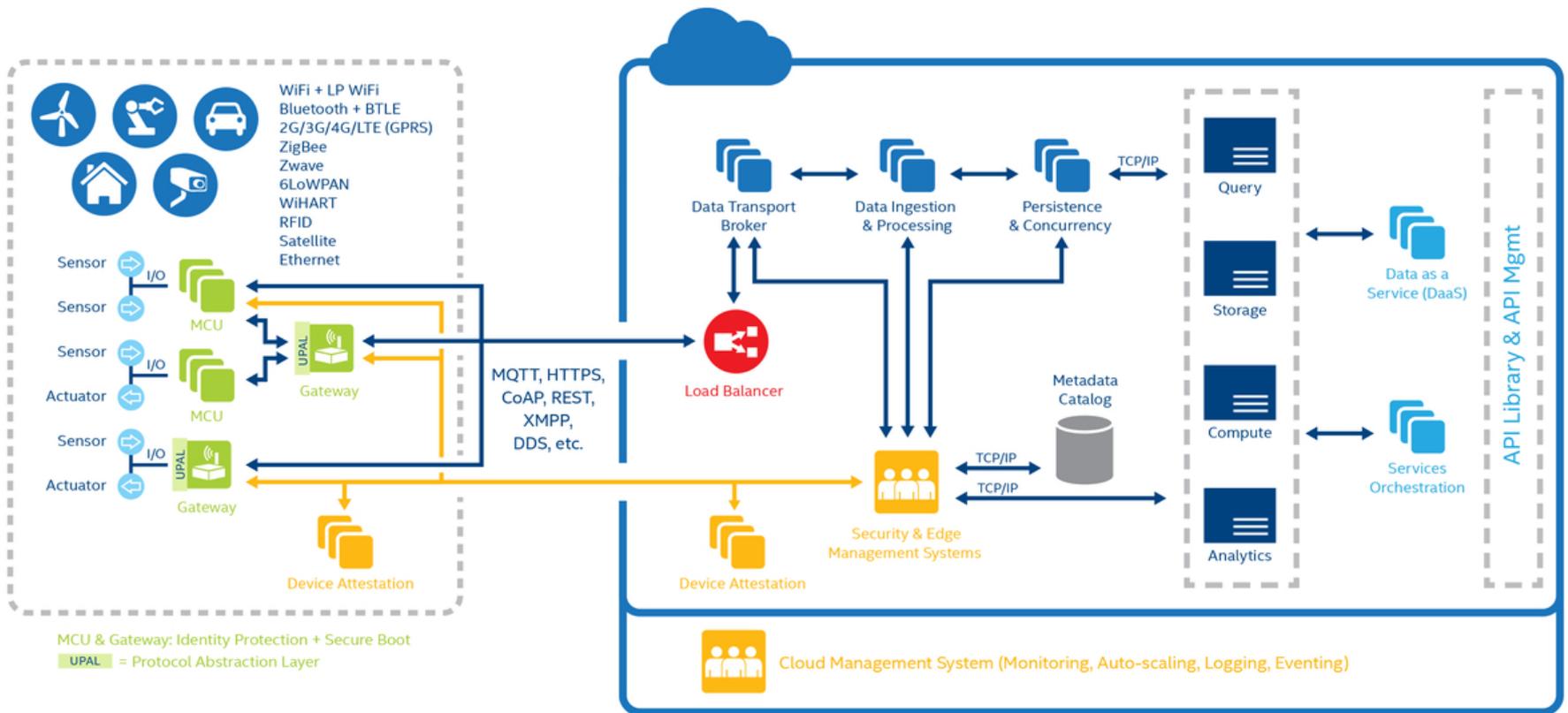


Philips IoT platform

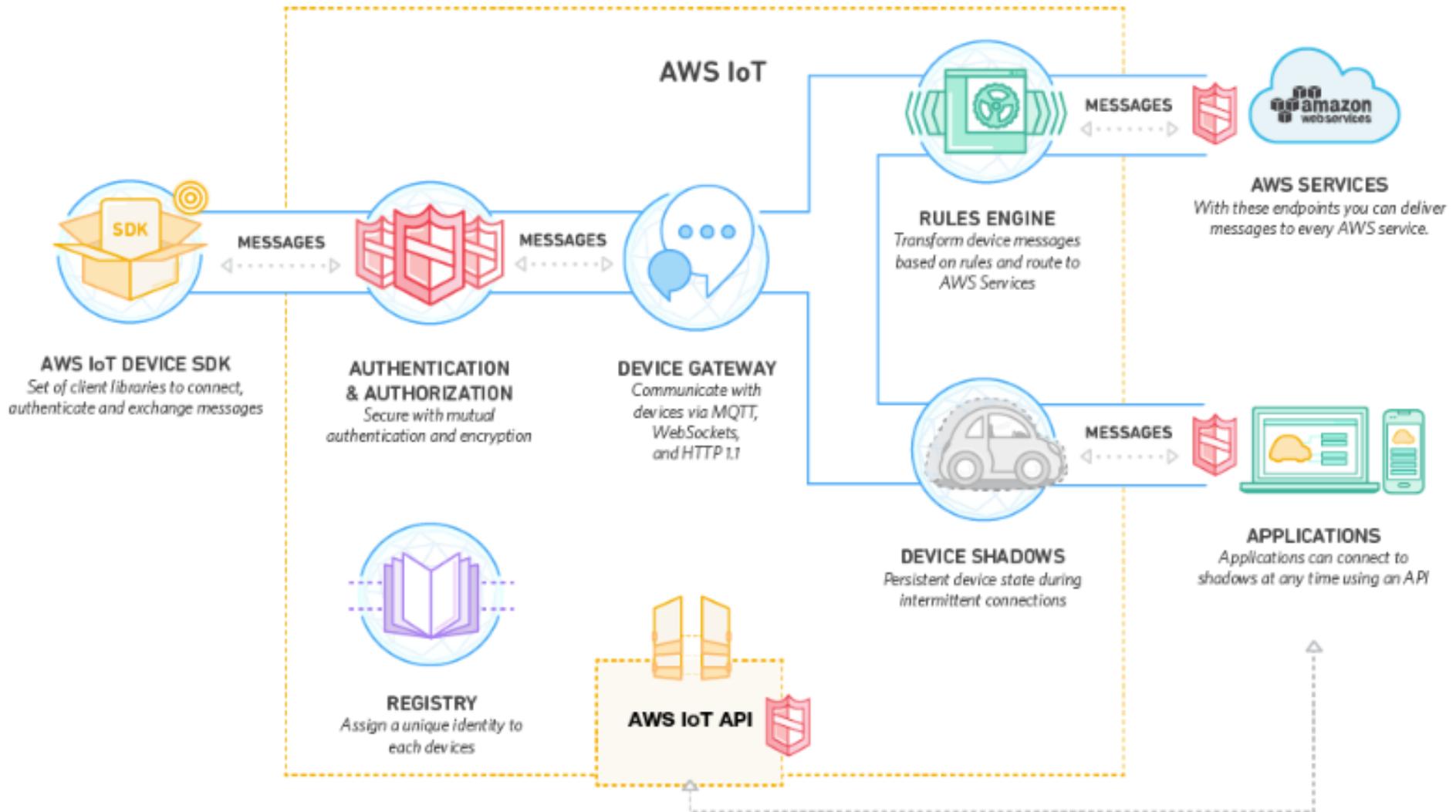
HealthSuite IoT Architecture based on AWS



Intel IoT platform

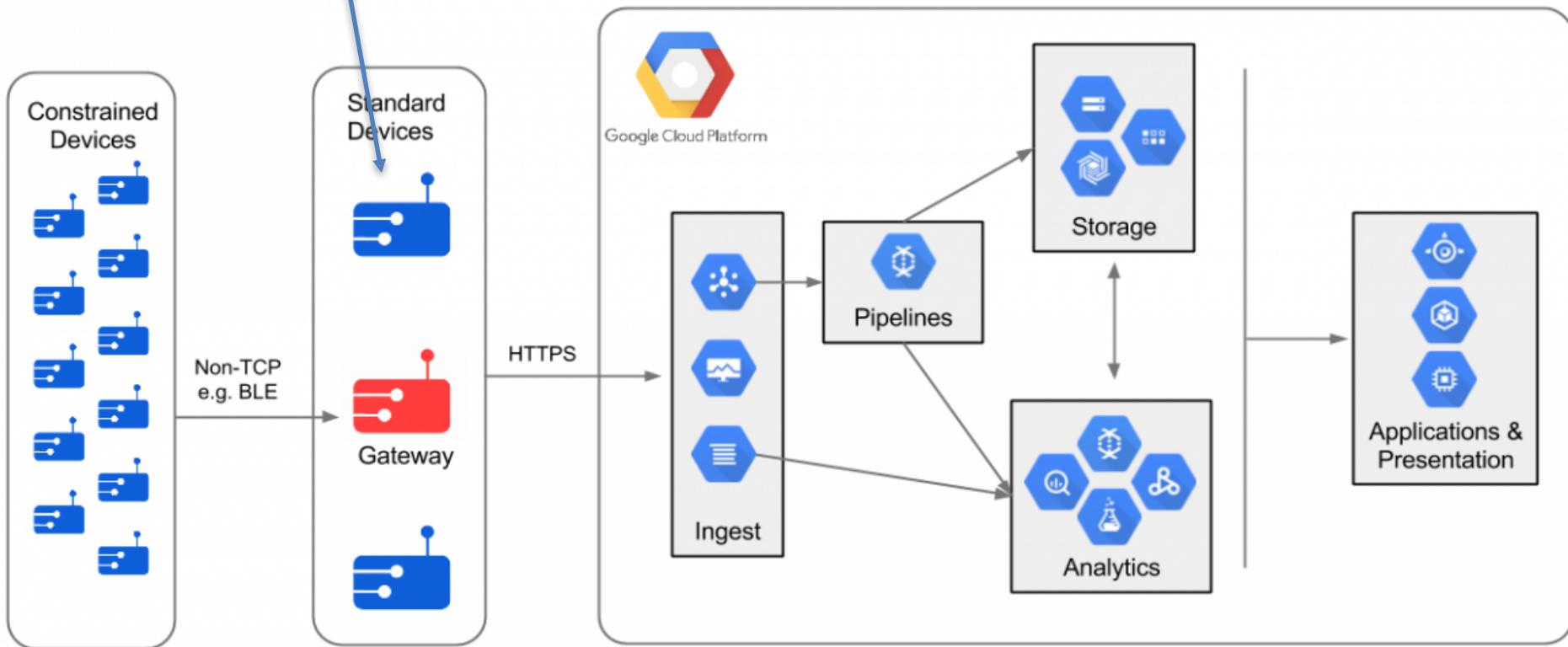


Amazon IoT platform

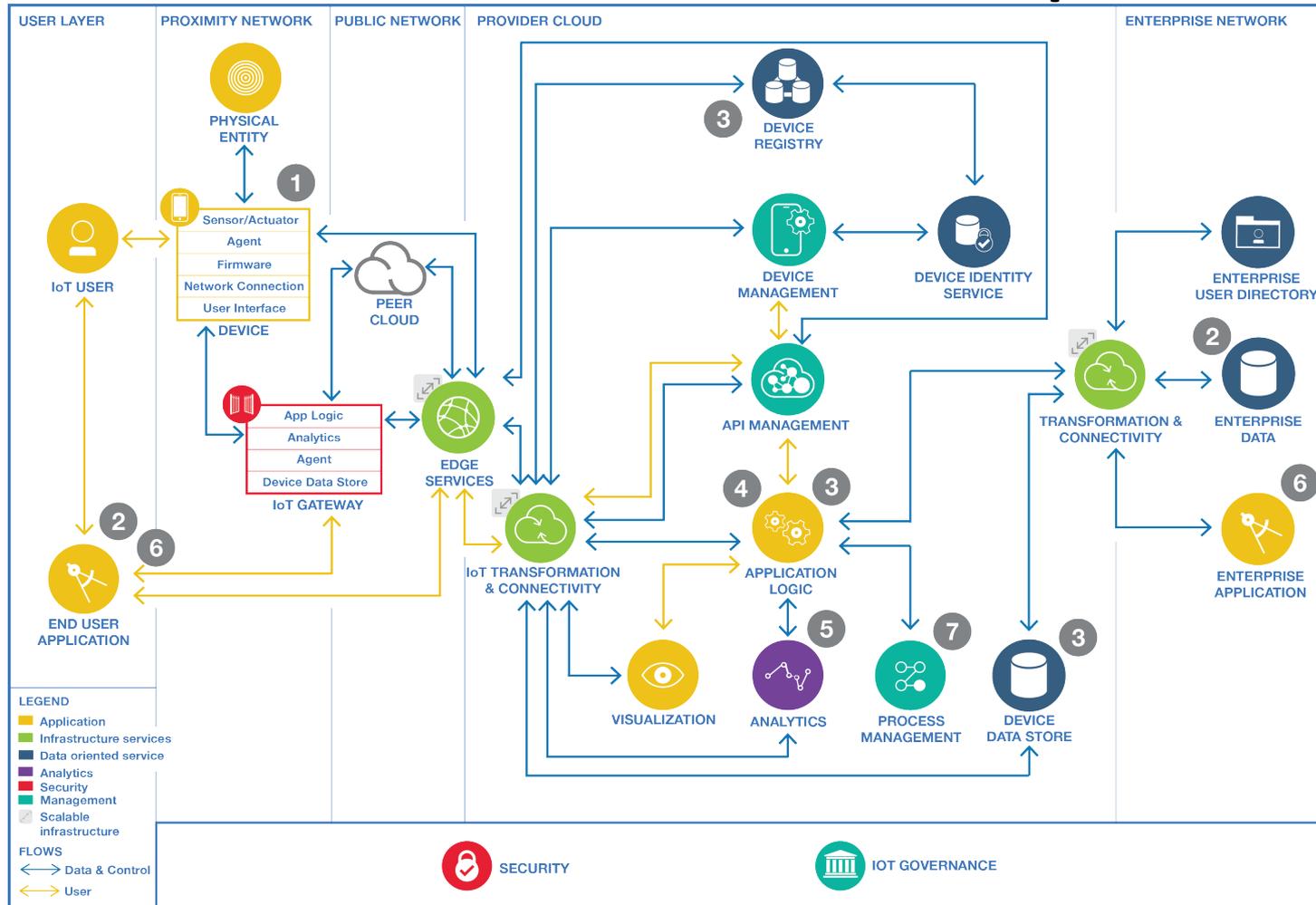


Google IoT platform

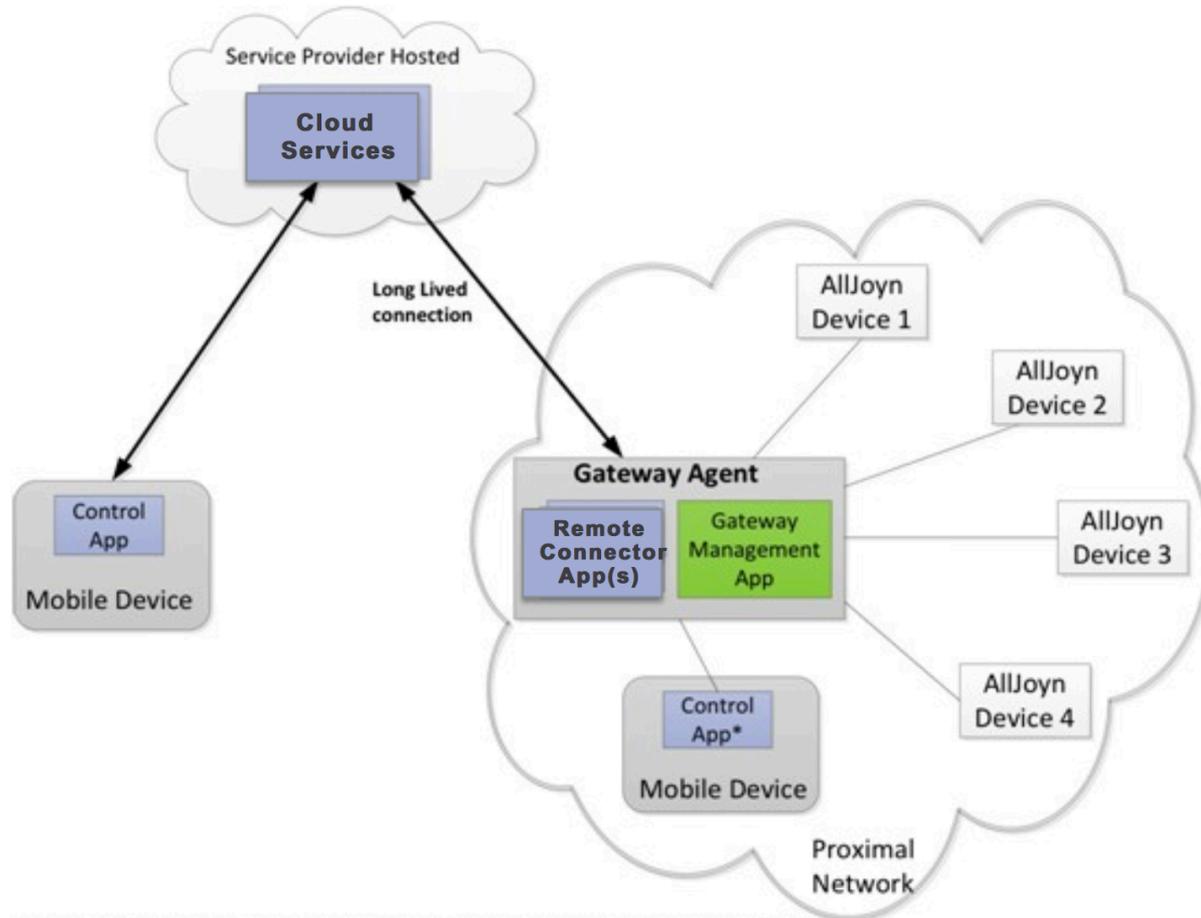
Android Things
new in 2016/17



IBM IoT platform



AllJoyn Alliance



*Direct connections between Control App and AJ Devices are not shown for simplicity sake.