FTF FREESCALE TECHNOLOGY FORUM 2014

Future Home Gateway Empowered by "One Box" Reference

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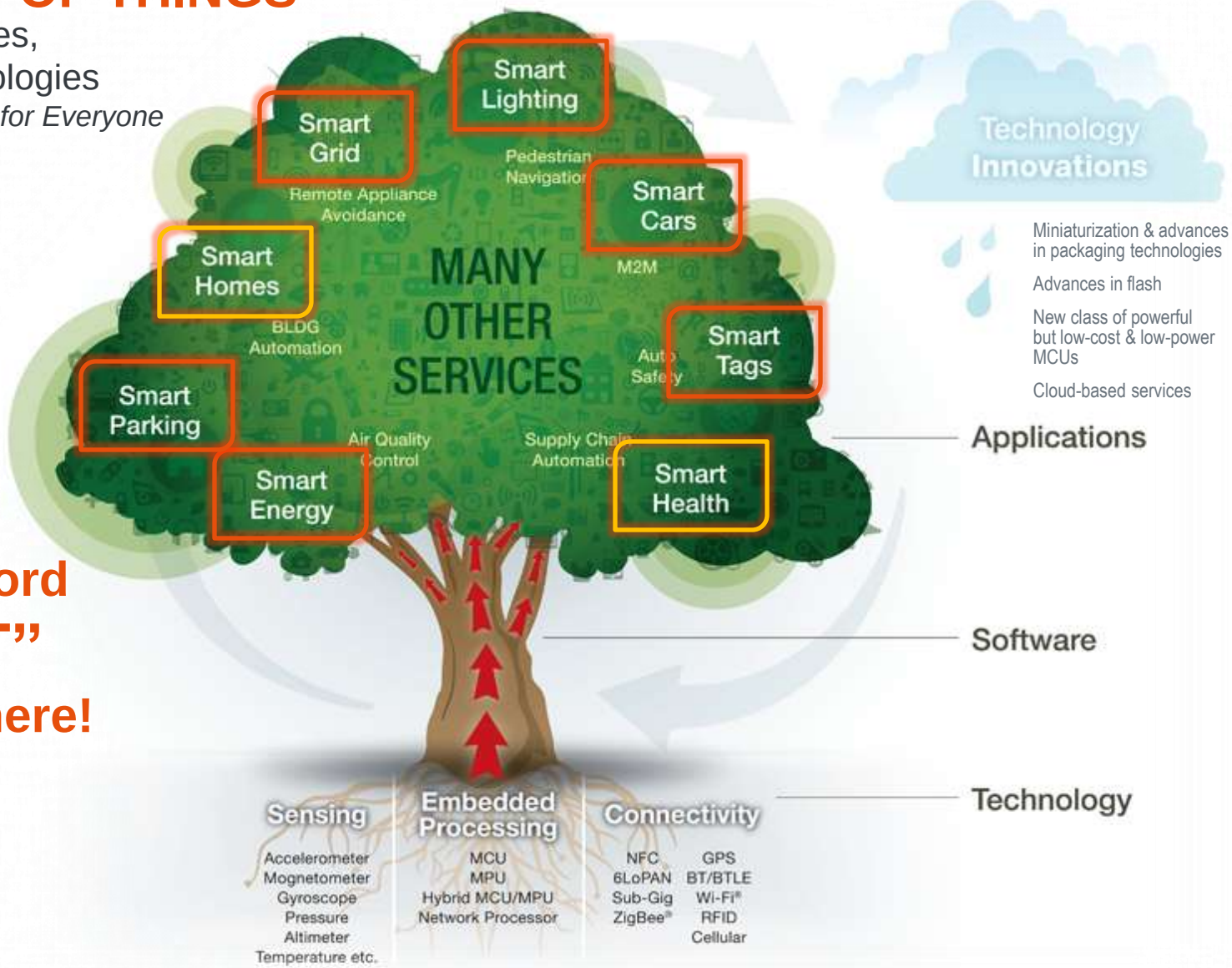
INTERNET OF THINGS

Different Services,
Different Technologies
Different Meanings for Everyone



And the Word "SMART" Is Everywhere!

IoT Is More Than M2M

The Internet of Things (IoT) is about Machine to Entity (M2E):

- **Machine to Machine:**
  - Automatic diagnostics for cars: Automatic information collection from your car's engine management system and sending real-time alerts to drivers or service centers
- **Machine to Infrastructure:**
  - Automatic bridge monitoring: Sensing and monitoring the structural integrity of a bridge in case of flooding
- **Machine to Human:**
  - Automatic health monitoring for people: Implant monitoring services or disease management via implantable electronics
- **Machine to Nature/Environment:**
  - Early detection of earthquakes: Distributed sensors to detect early tremors in specific places

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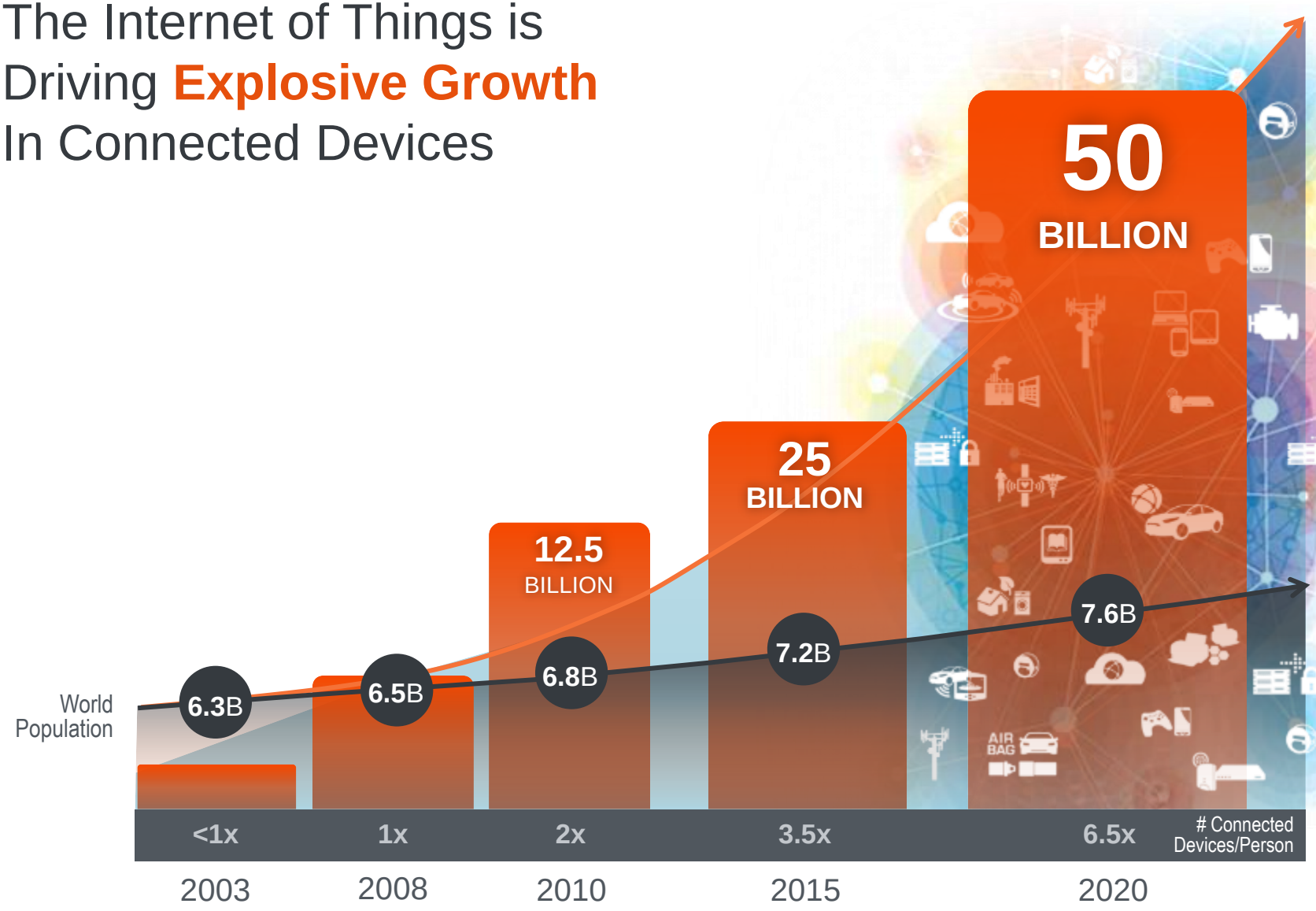
Machine to Machine (M2M)
refers to technologies that allow both wireless and wired systems to communicate with other devices of the same ability

The Internet of Things is Driving **Explosive Growth** In Connected Devices



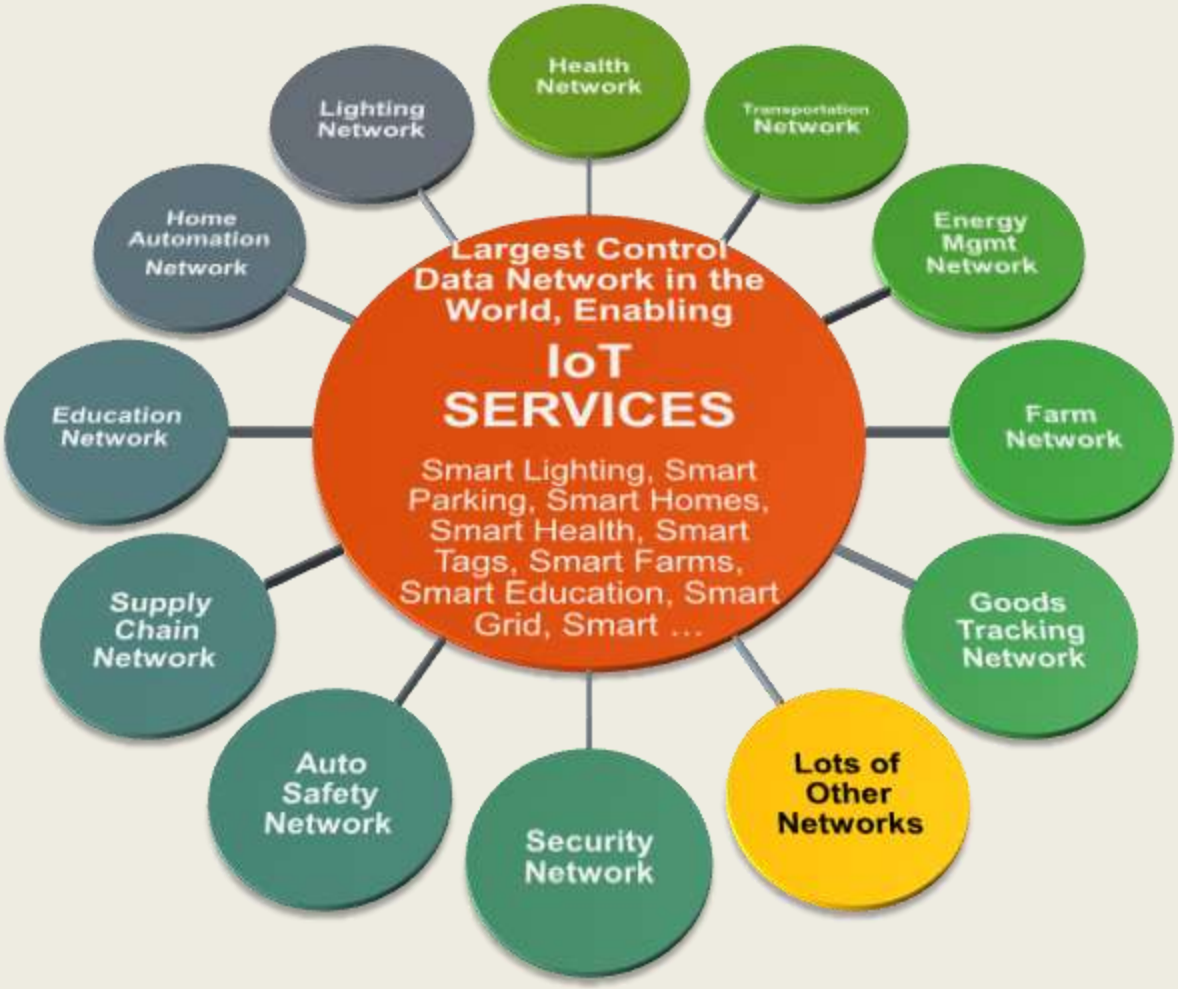
* Sources: Ericsson, February 2011; Cisco Internet Business Solutions Group (IBSG), April 2011

INTERNET of THINGS

It's the *Network of All Networks*, which will be connected through the Largest Control Data Network in the World

It's all about the service layer infrastructure, because …

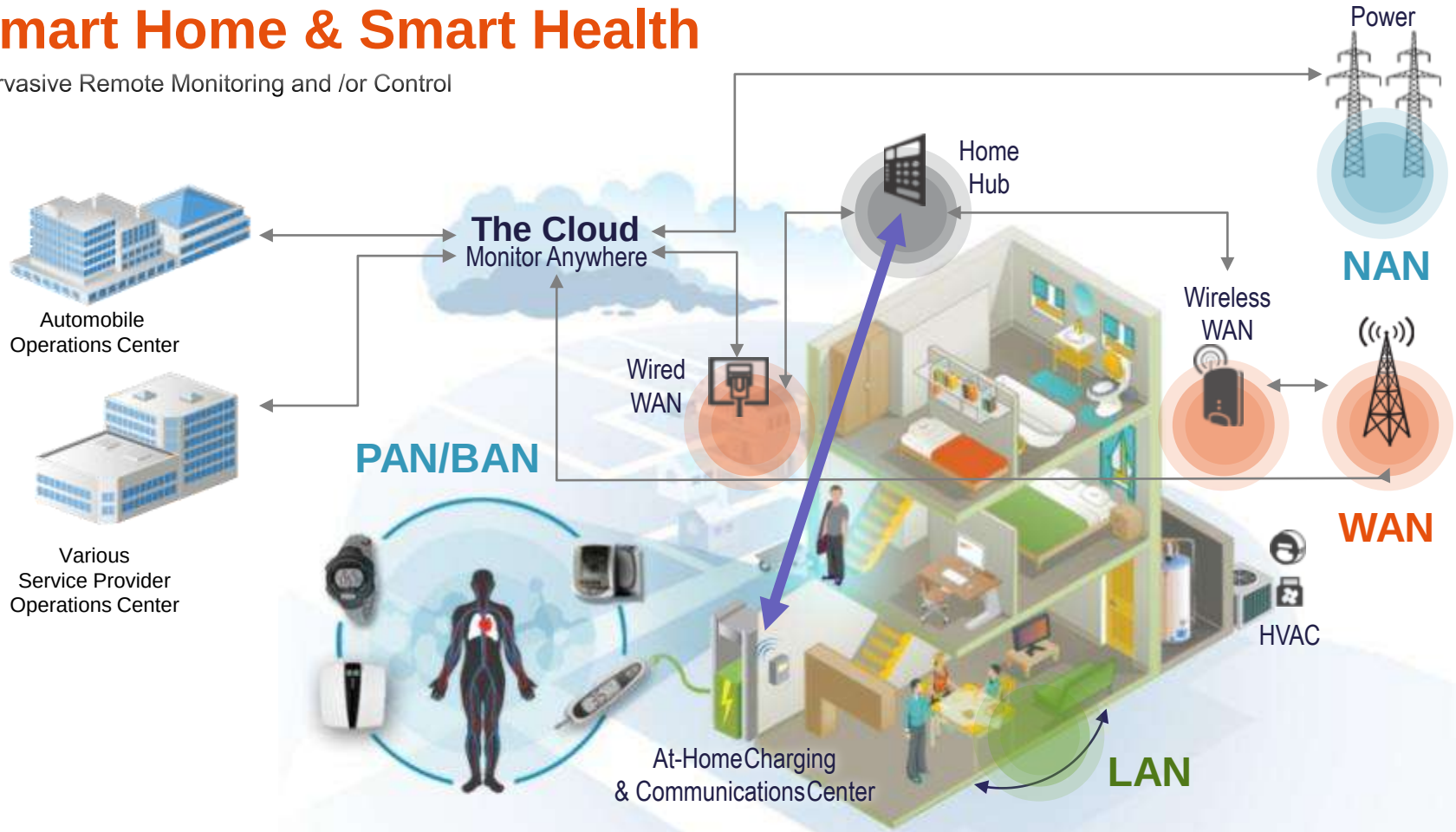
It's ALL About the Services



Rolling out the IoT is like rolling out the largest control data network in the world

Smart Home & Smart Health

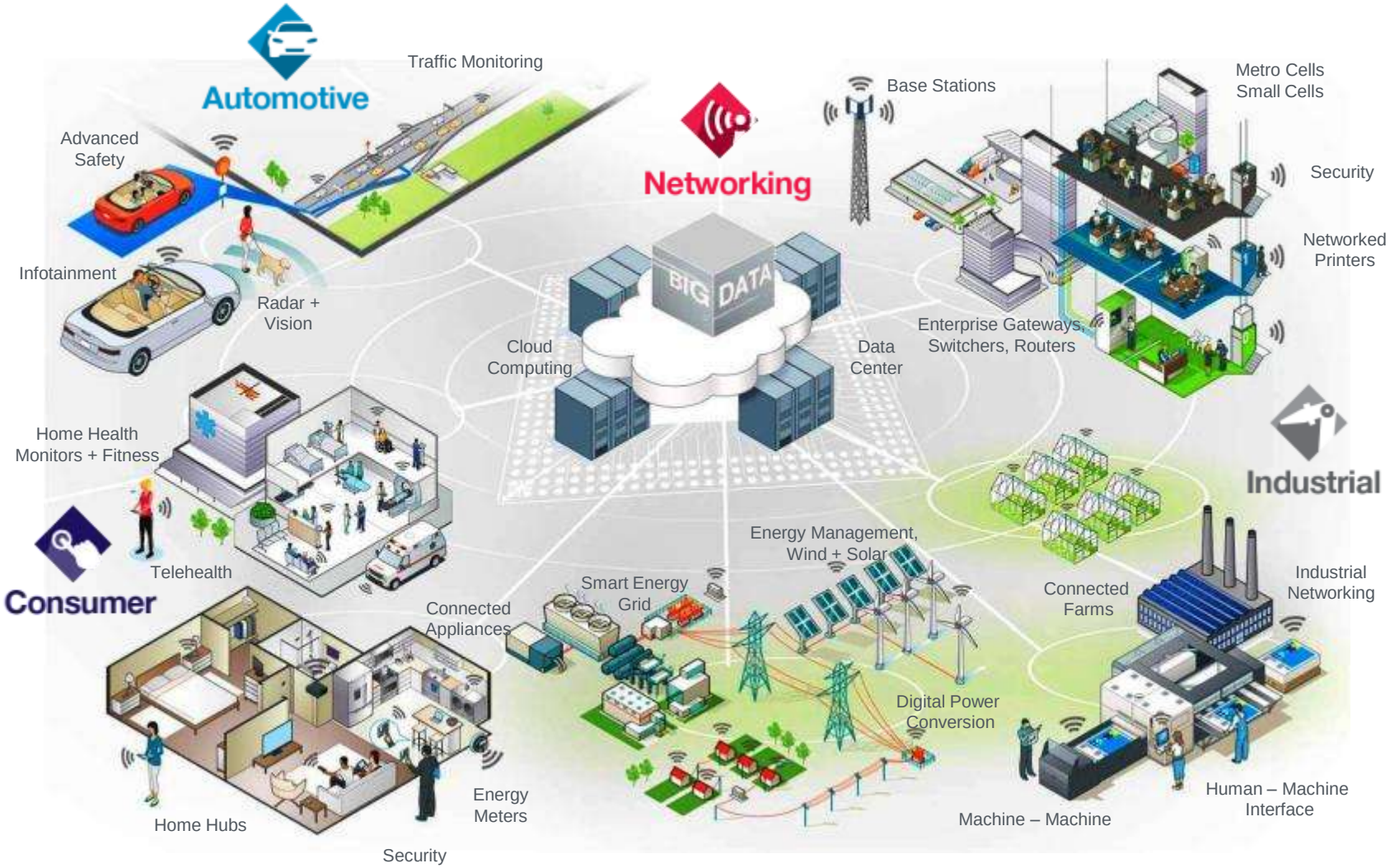
Pervasive Remote Monitoring and /or Control



- Human beings' vital statistics monitored via edge nodes communicating through body area network s(BAN) and personal area networks (PAN)
- Many other "things" in the smart home using local area network (LAN)
- All communicate with a home hub/gateway, which in turn communicates to the cloud via wide area networks (WAN)

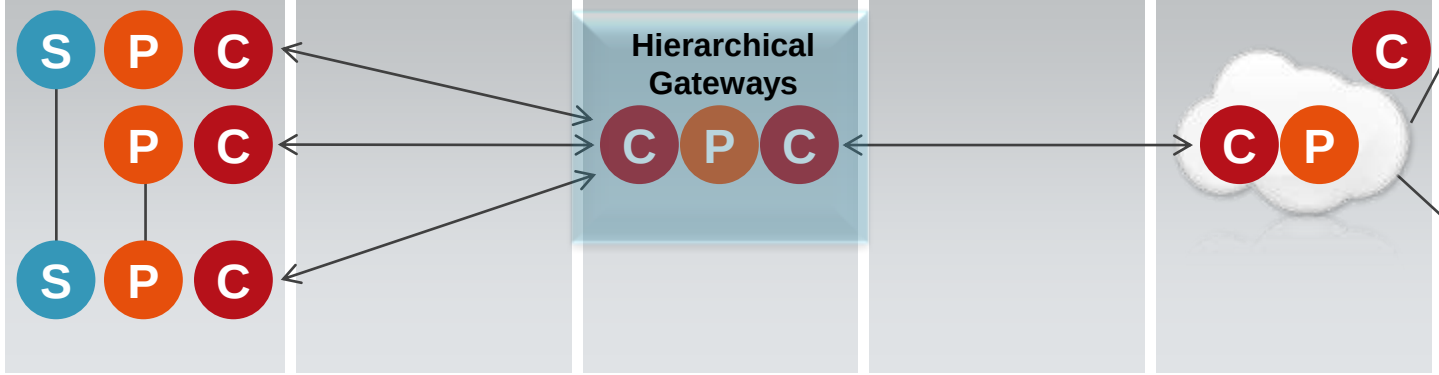
Our Products Power The Internet of Things

Microcontrollers | Digital Networking | Auto MCU | Analog and Sensors | RF



IoT 'Box-level' Product View

Edge Product	BAN/PAN/ & Wired/Wireless, Power Line LAN	Hierarchical Layers of Aggregation / Hubs / Gateways	Wired/Wireless, Power Line WAN	Remote Cloud-based Processing



Application/Action

User-driven actions via devices with screens or automatically driven actions based on data parameters

Insights/Big Data

Data analytics for business intelligence

P Layers of Embedded Processing S Sensors & Actuators C Connectivity: BAN/PAN/LAN/WAN

Medtronic's glucose monitor uses Bluetooth to "talk" to Ford Sync

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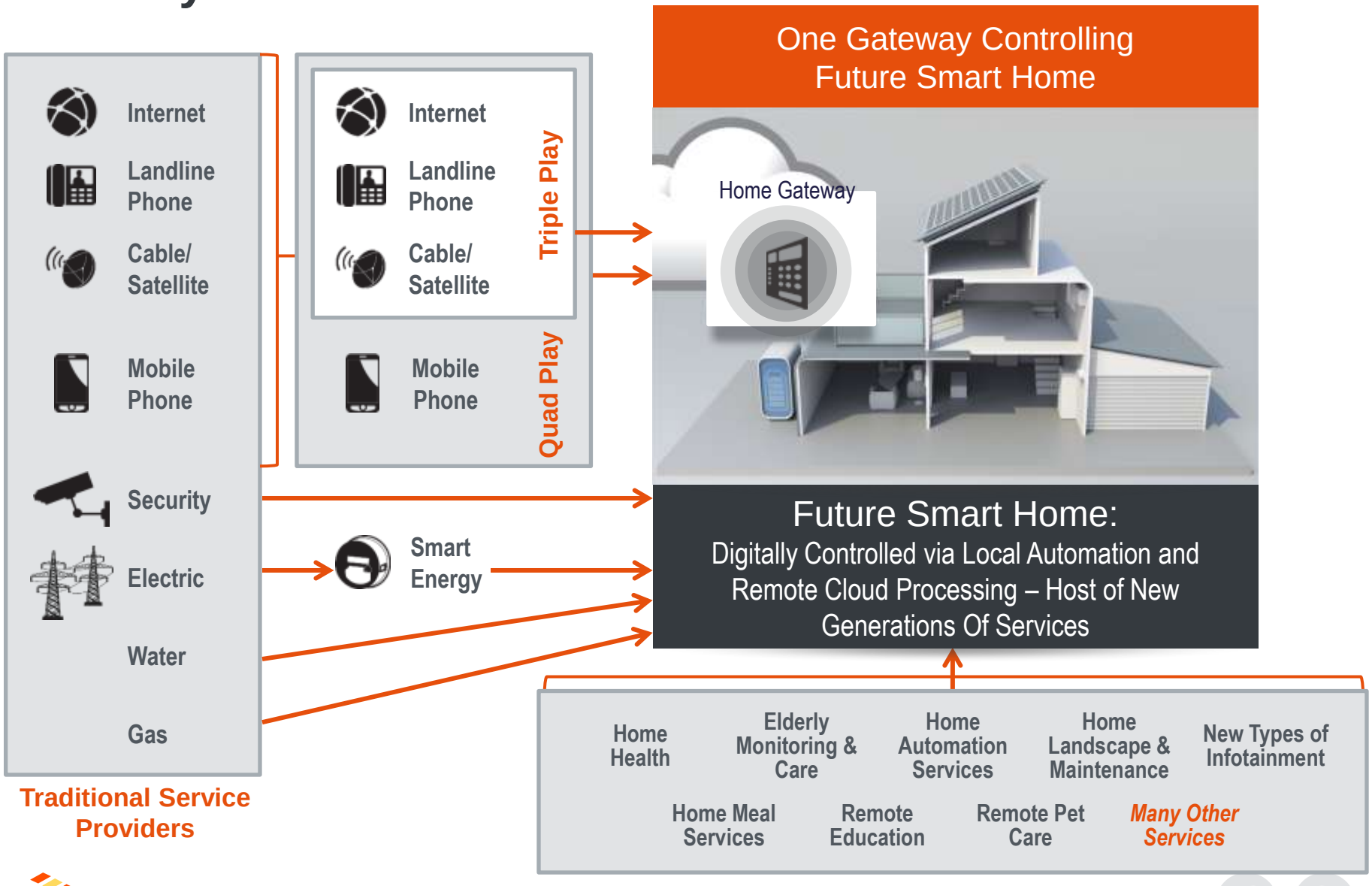
Diversity Of Service Providers For The Smart Home

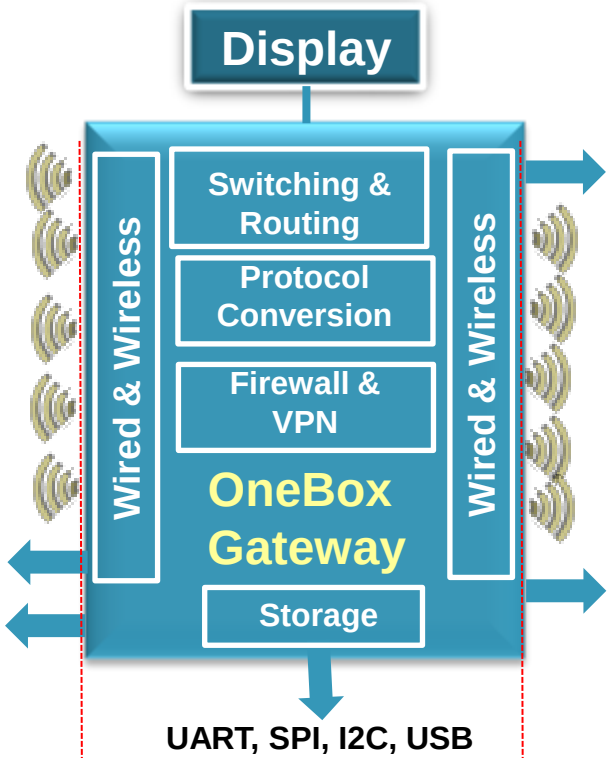


OneBox Means Integrating All "Boxes" Into One

BAN/PAN/LAN/HAN Side

Standards

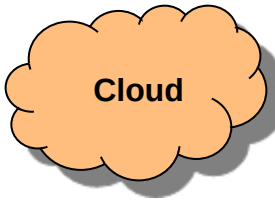
- Bluetooth
- Zigbee, 802.15.4
- WiFi, DASH7, ISA100
- Wireless HART, EnOcean
- Wireless MBus
- Ethernet, EtherCAT, Profinet, Modbus, IS485
- HPGP
- Etc.



NAN/WAN Side

Standards

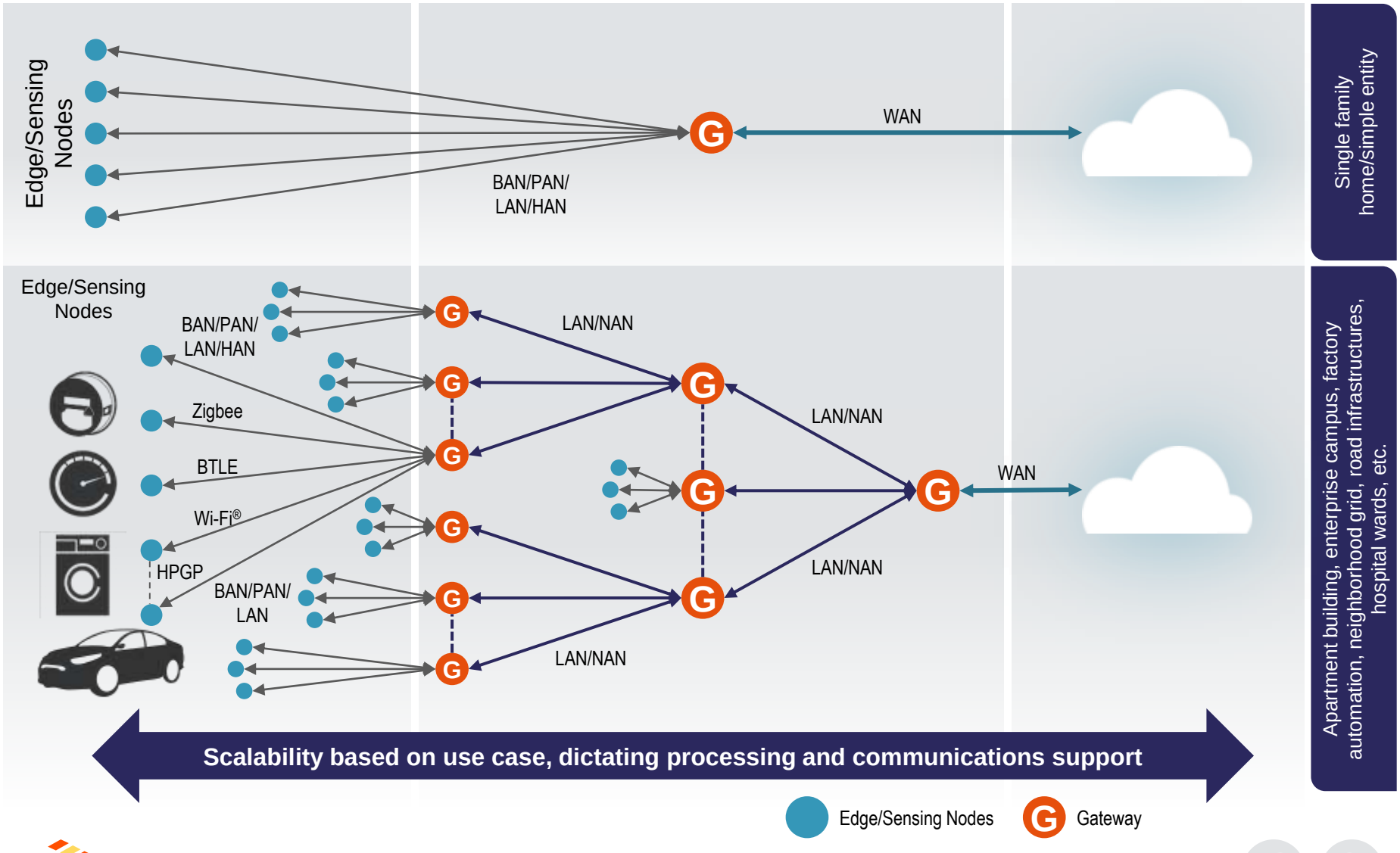
- Ethernet / Fiber
- Weightless
- 802.11ah
- Cellular
- Sub Gig
- Satellite
- PLM/PLC (G3, Prime, etc.)
- Etc.



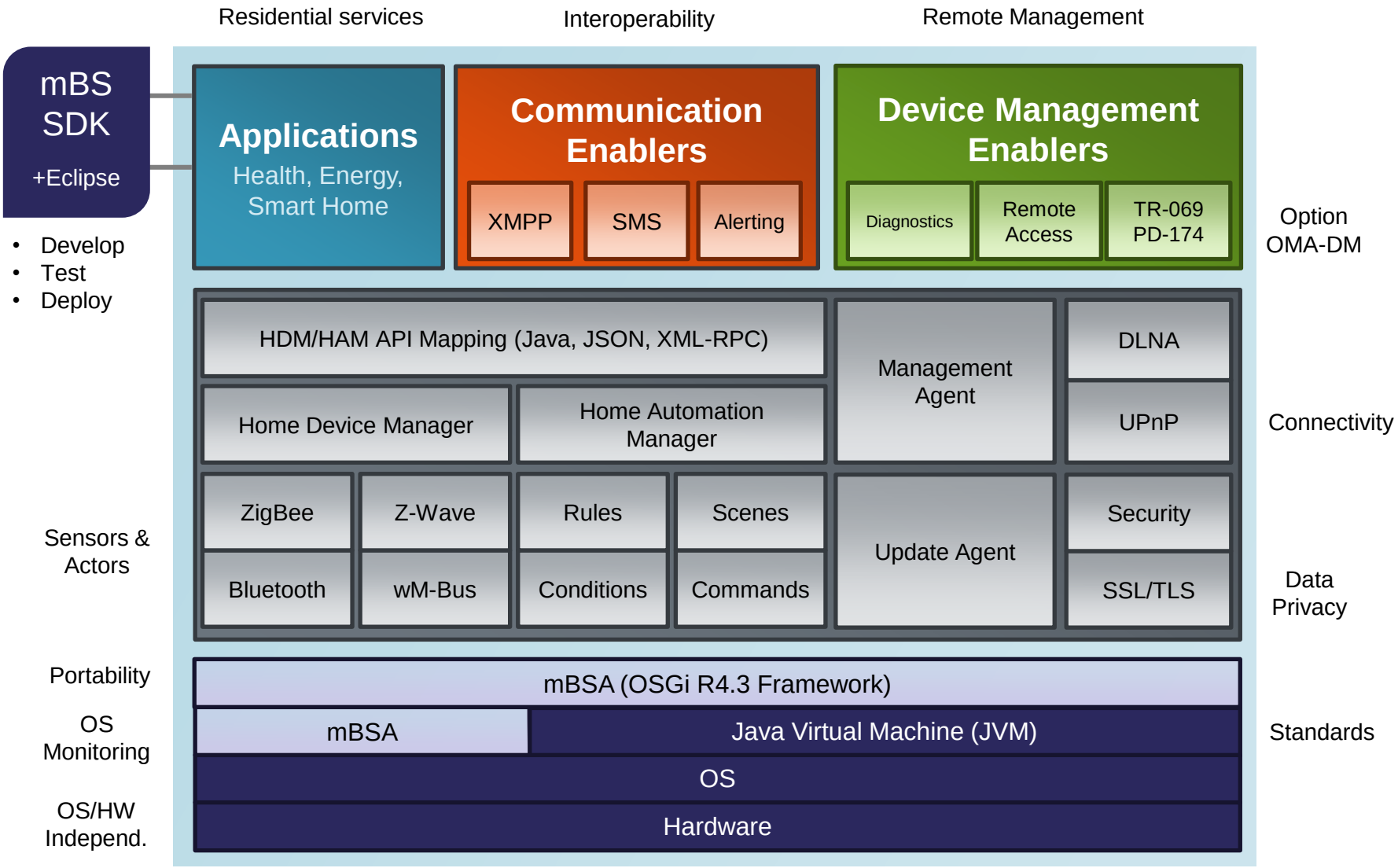
What devices to monitor/ control	What short-range device access link	Targeting CPE	What Cloud access link	

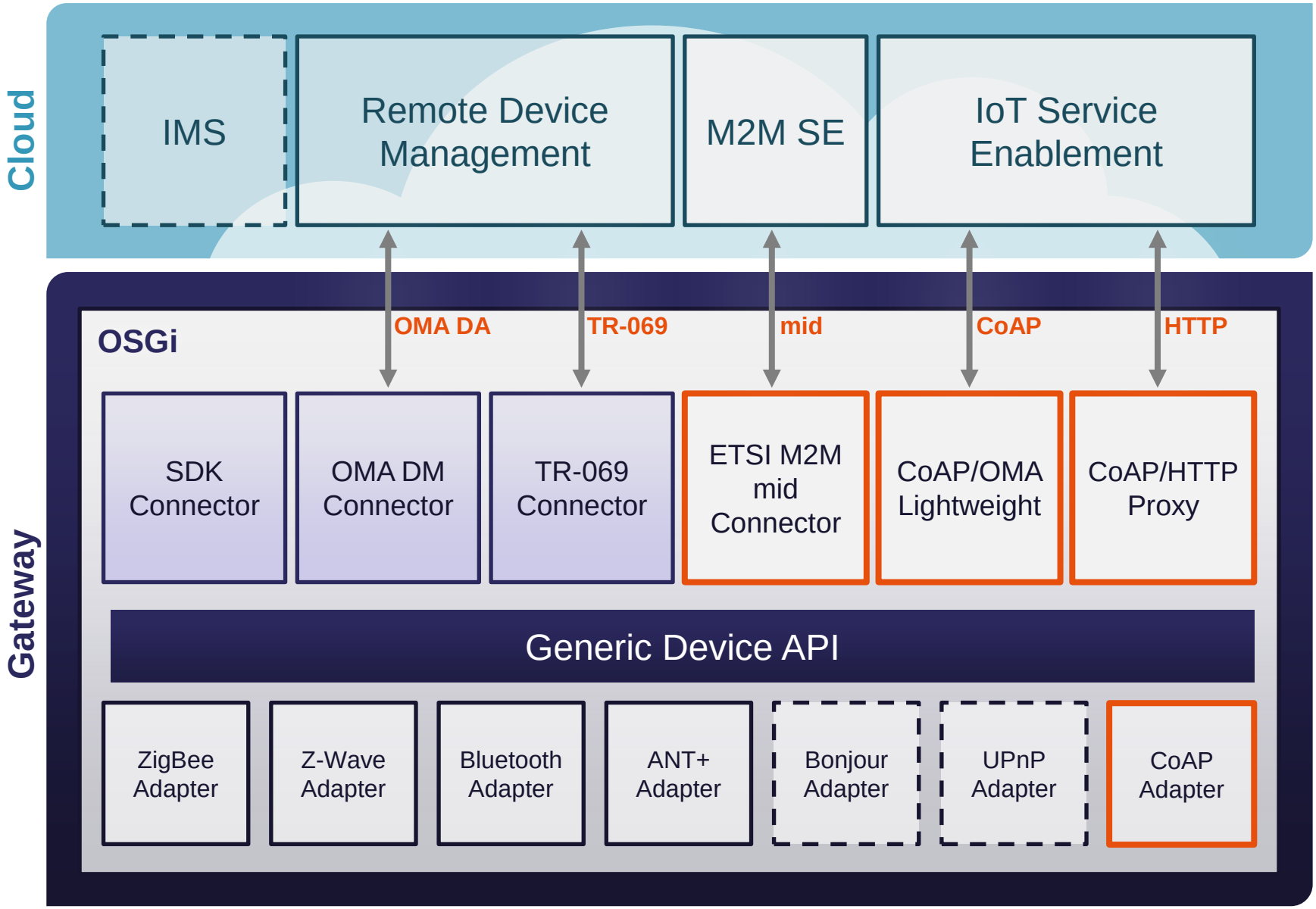
Need to optimize the communications, processing, and storage requirements of all stakeholders (i.e. teleco providers, security, utility, energy, automation, control, and other future service providers), @Home, @Factory, @Hospital, or other target facilities / environments

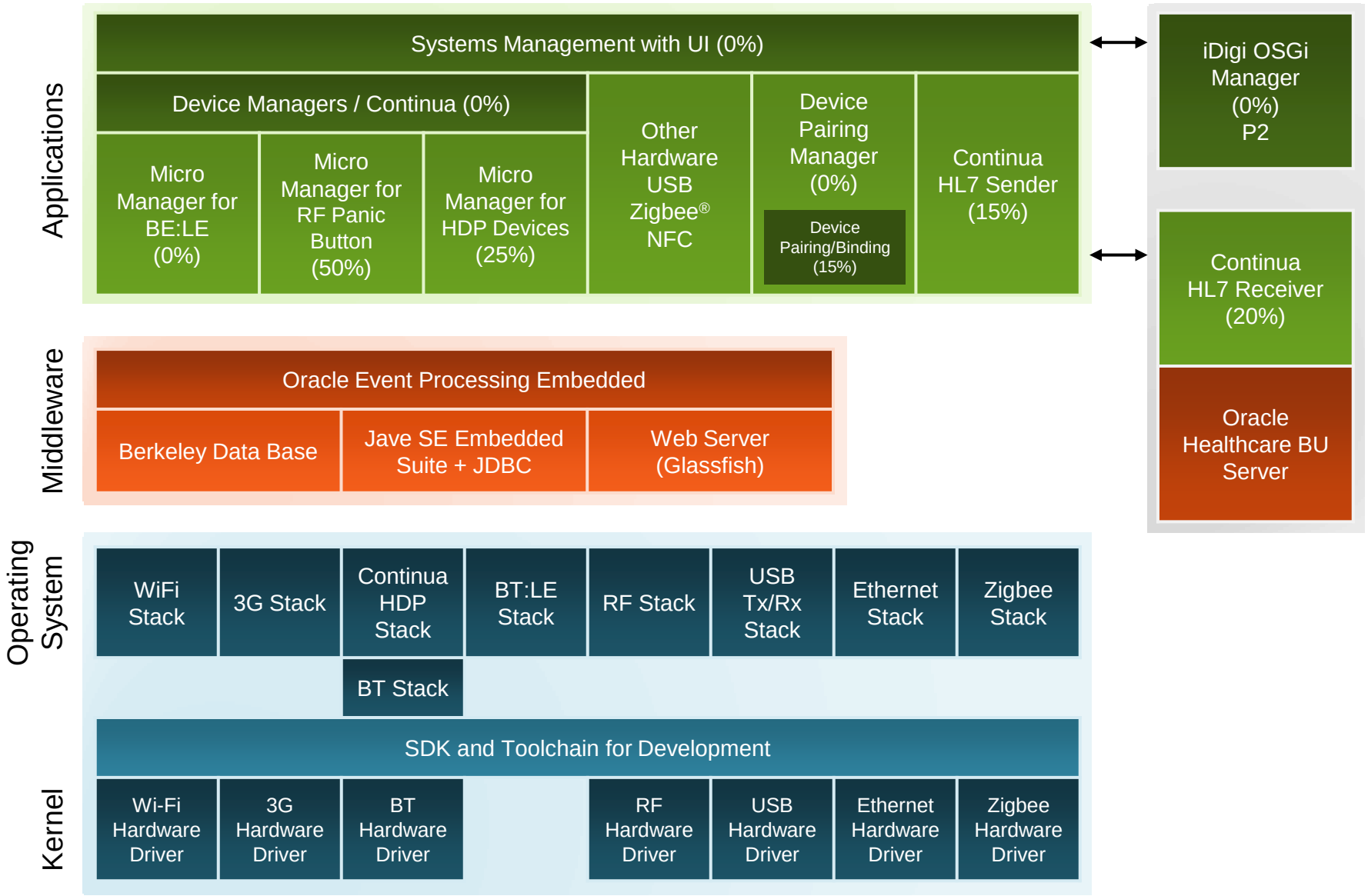
Communication Topologies Across Hierarchies

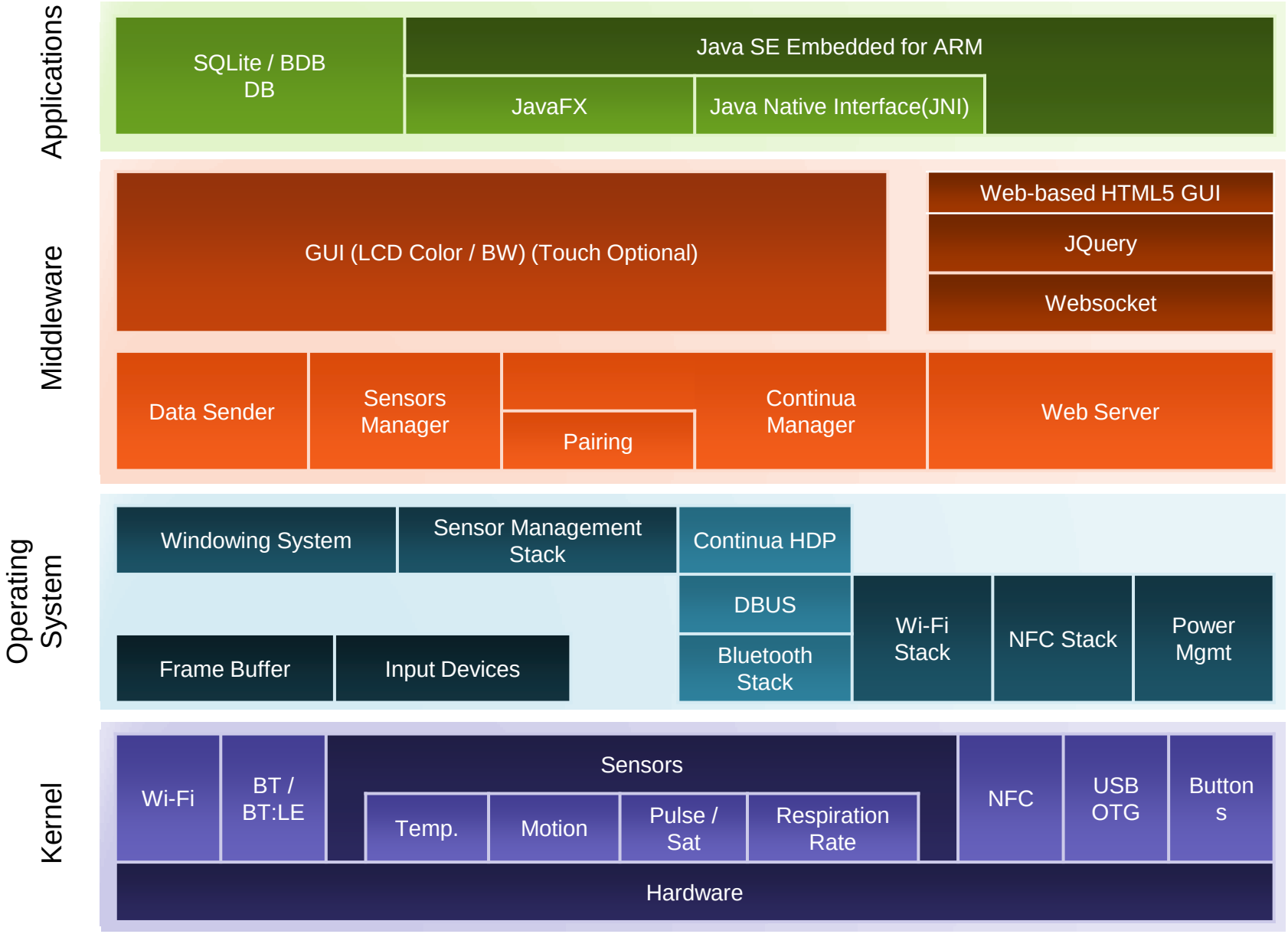


One Box Architecture

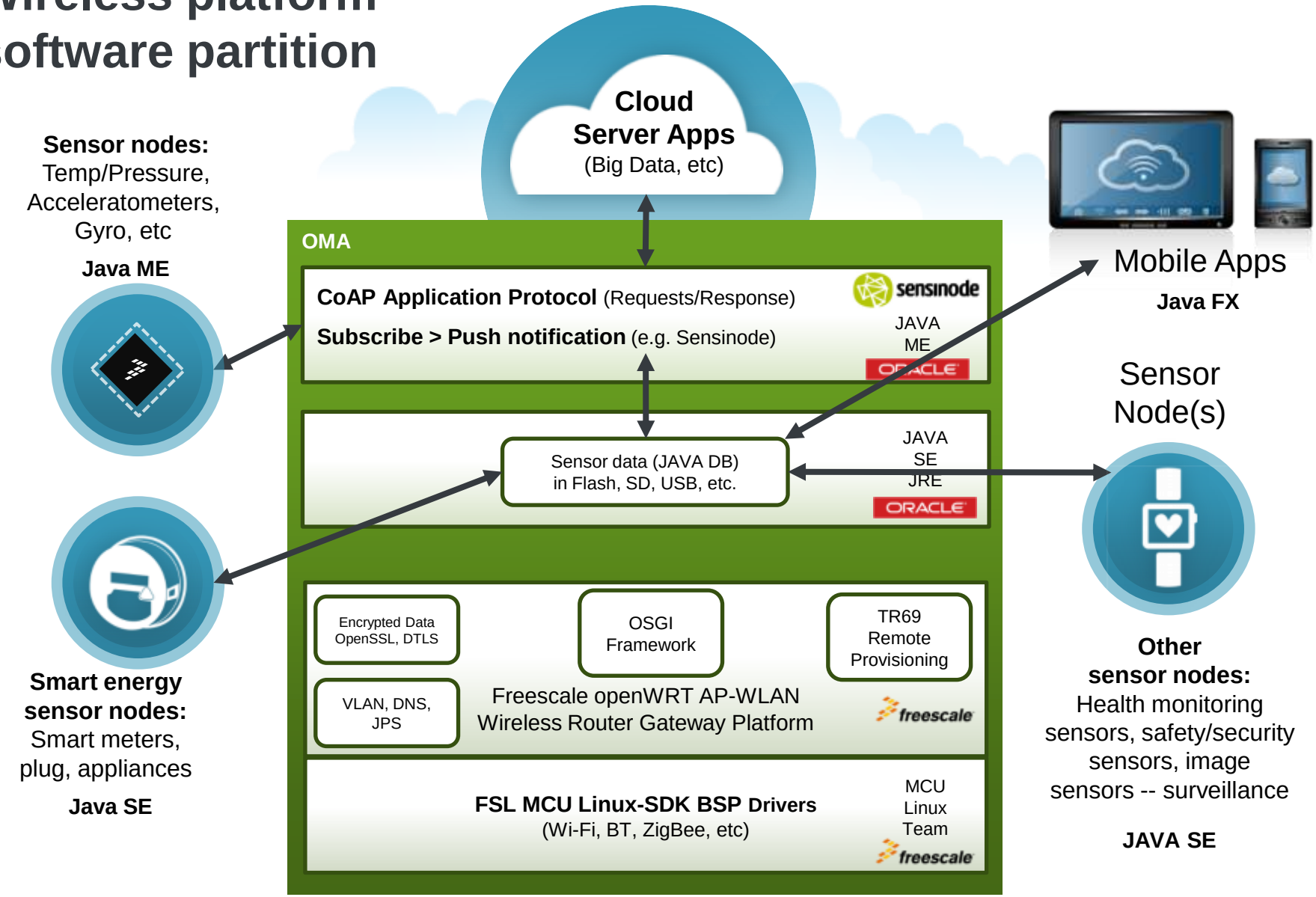



Cloud
IMS
Remote Device Management
M2M SE
IoT Service Enablement
OMA DA
TR-069
mid
CoAP
HTTP
Gateway
OSGi
SDK Connector
OMA DM Connector
TR-069 Connector
ETSI M2M mid Connector
CoAP/OMA Lightweight
CoAP/HTTP Proxy
Generic Device API
ZigBee Adapter
Z-Wave Adapter
Bluetooth Adapter
ANT+ Adapter
Bonjour Adapter
UPnP Adapter
CoAP Adapter

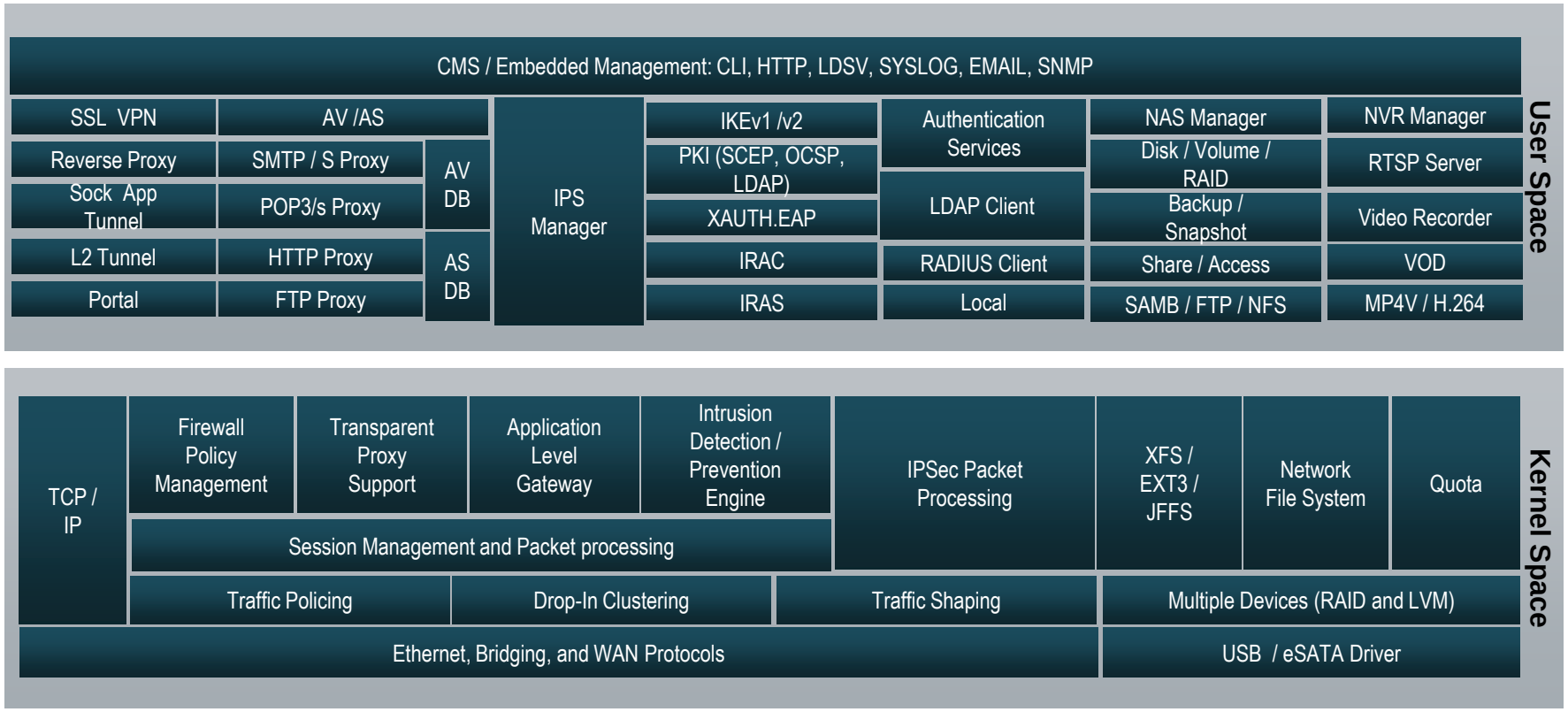

Applications
Systems Management with UI (0%)
Device Managers / Continua (0%)
Micro Manager for BE:LE (0%)
Micro Manager for RF Panic Button (50%)
Micro Manager for HDP Devices (25%)
Other Hardware USB Zigbee® NFC
Device Pairing Manager (0%)
Device Pairing/Binding (15%)
Continua HL7 Sender (15%)
iDigi OSGi Manager (0%) P2
Continua HL7 Receiver (20%)
Oracle Healthcare BU Server
Middleware
Oracle Event Processing Embedded
Berkeley Data Base
Jave SE Embedded Suite + JDBC
Web Server (Glassfish)
Operating System
WiFi Stack
3G Stack
Continua HDP Stack
BT:LE Stack
RF Stack
USB Tx/Rx Stack
Ethernet Stack
Zigbee Stack
BT Stack
SDK and Toolchain for Development
Kernel
Wi-Fi Hardware Driver
3G Hardware Driver
BT Hardware Driver
RF Hardware Driver
USB Hardware Driver
Ethernet Hardware Driver
Zigbee Hardware Driver


Applications
SQLite / BDB DB
Java SE Embedded for ARM
JavaFX
Java Native Interface(JNI)
Middleware
GUI (LCD Color / BW) (Touch Optional)
Web-based HTML5 GUI
JQuery
Websocket
Data Sender
Sensors Manager
Pairing
Continua Manager
Web Server
Operating System
Windowing System
Sensor Management Stack
Continua HDP
DBUS
Bluetooth Stack
Wi-Fi Stack
NFC Stack
Power Mgmt
Frame Buffer
Input Devices
Kernel
Wi-Fi
BT / BT:LE
Sensors
Temp.
Motion
Pulse / Sat
Respiration Rate
NFC
USB OTG
Buttons
Hardware

Wireless platform software partition



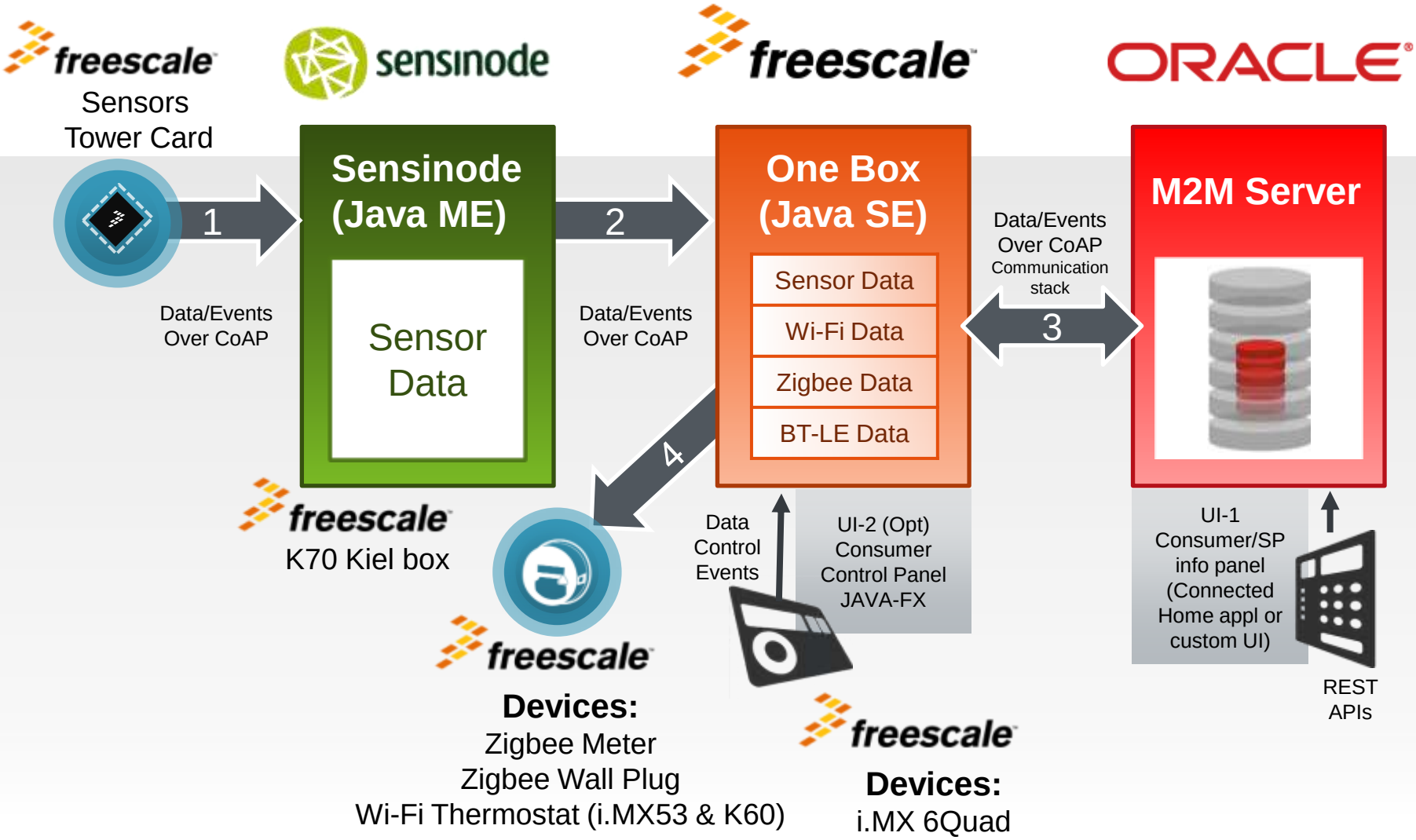
Wireless Platform Software for IOT
Linux openWRT on i.MX 6



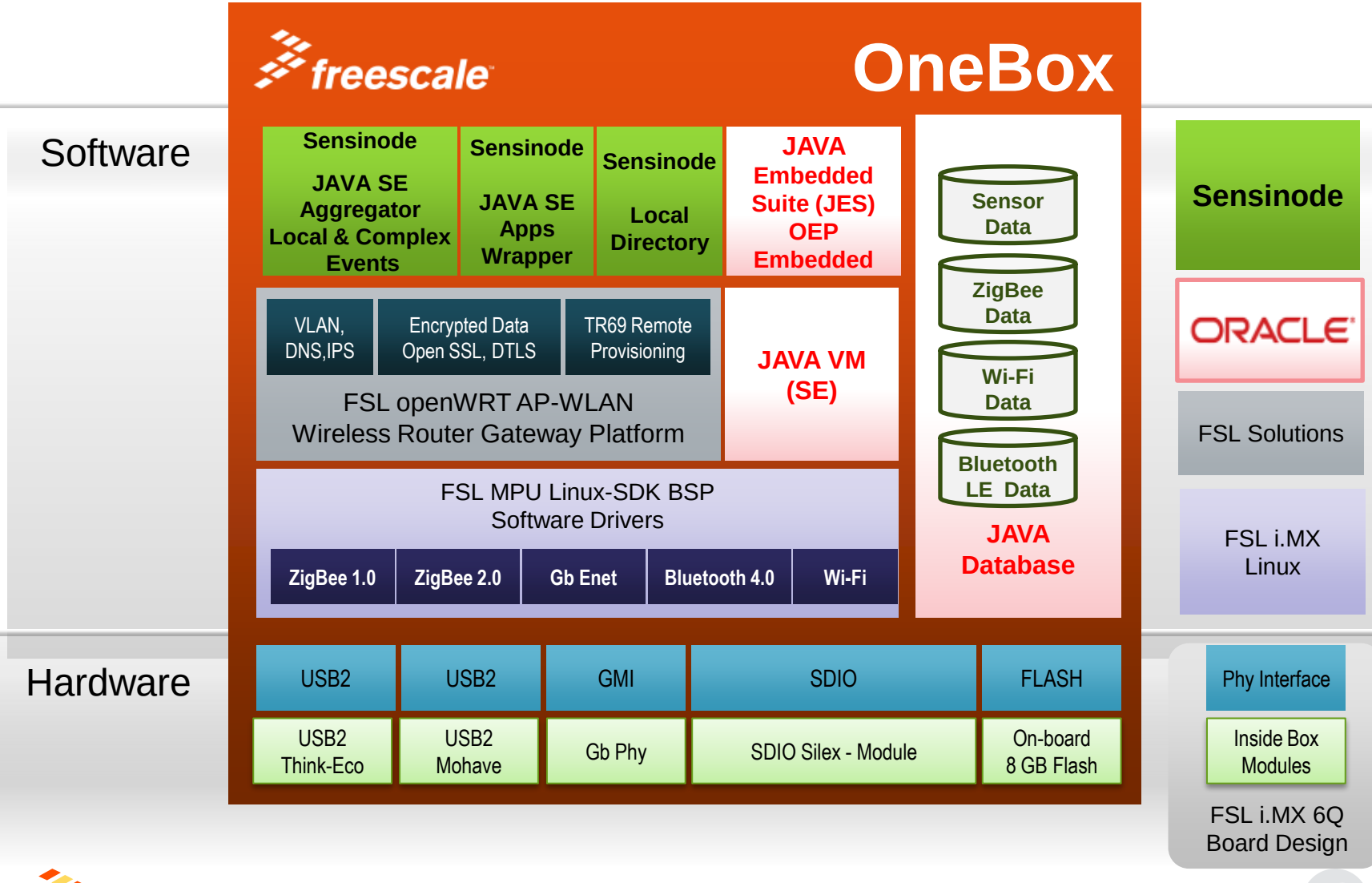
Hardware Layer

Ethernet Controllers	Crypto Accelerators	PCI-E / SDIO Controllers	USB / SATA Controllers

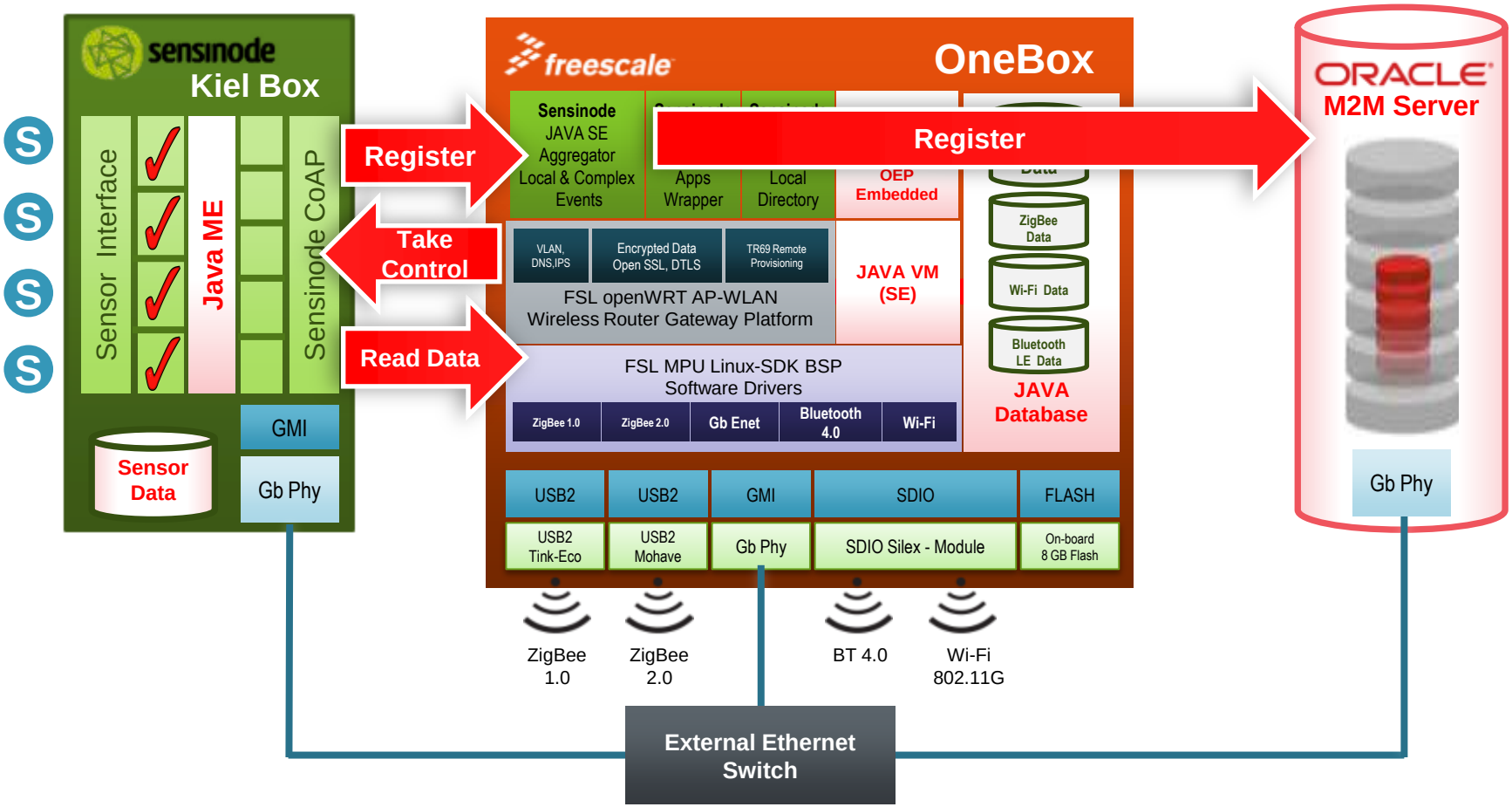
ARM TechCon Demo: Sensinode <> OneBox <> Oracle



OneBox Software/Hardware (i.MX 6 based)



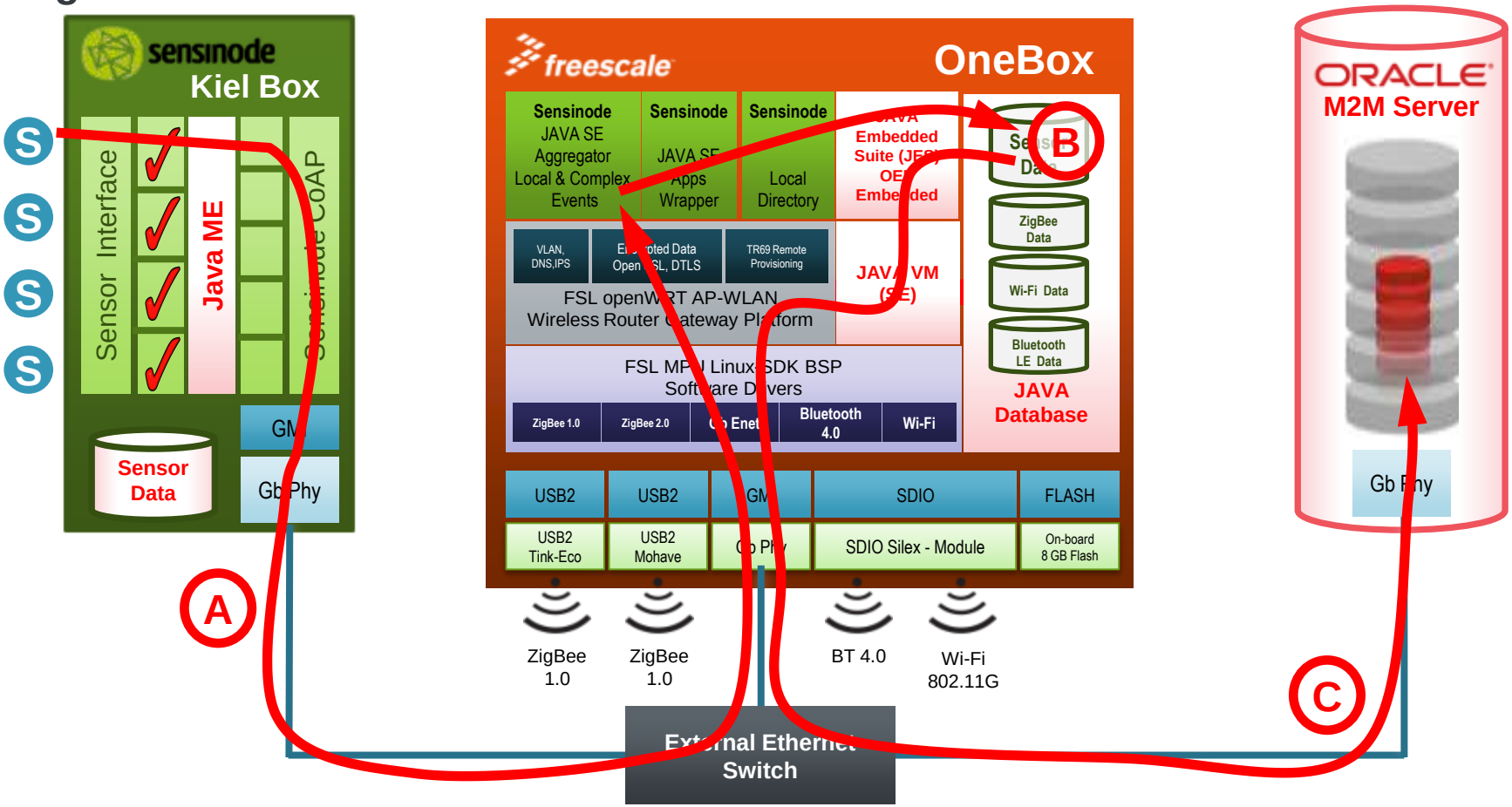
ARM TechCon Demo: Sensor Data Flow



- CoAP interface: Register sensor (S) out to Oracle DB, take control, read data
- Use of Ethernet external switch for connection (minimize noise from Wi-Fi)

ARM TechCon Demo: Sensor Data Flow

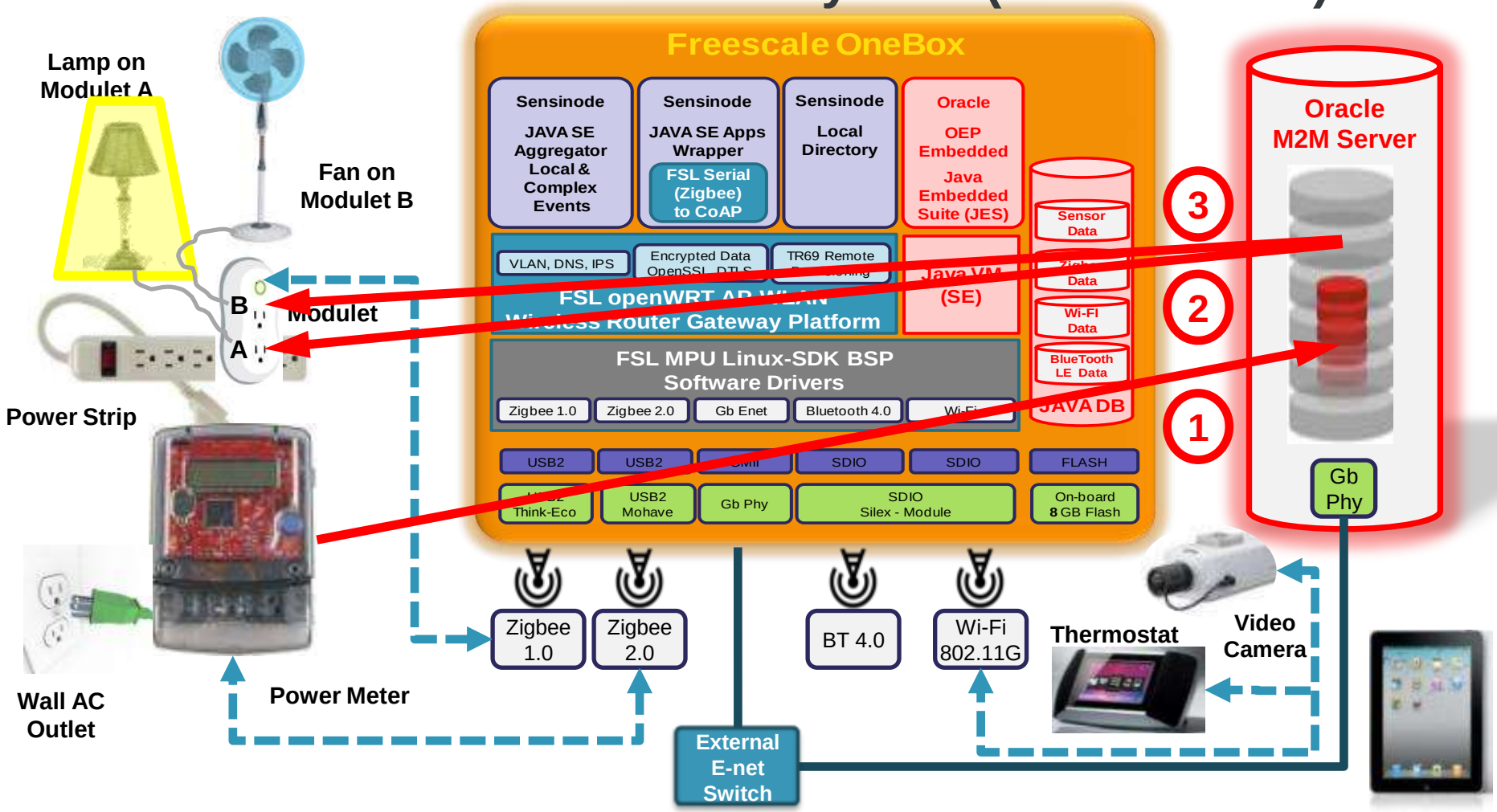
Registration of Sensor



A → B **Sensor 1 data sent to DB on OneBox via CoAP**

B → C **Sensor 1 data on Onebox sent to Oracle DB via JAVA-VM (JAVASE)**

ARM TechCon Demo: OneBox System (less sensors)



- Zigbee 2.0 Meter monitors Power Strip power
  - Lamp plugged into Zigbee 1.0 Modulet, Modulet plugged into Power Strip
  - When Meter power reaches xx Watts, Oracle DB turns off Lamp and turns on Fan
- iPAD (via Wi-Fi) monitors Wi-Fi Camera through OneBox

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2014 seminar topics include

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- Kinetis K, L, E, V series MCU product training

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