



APRIL 2015

INTERNET OF THINGS

Market Overview

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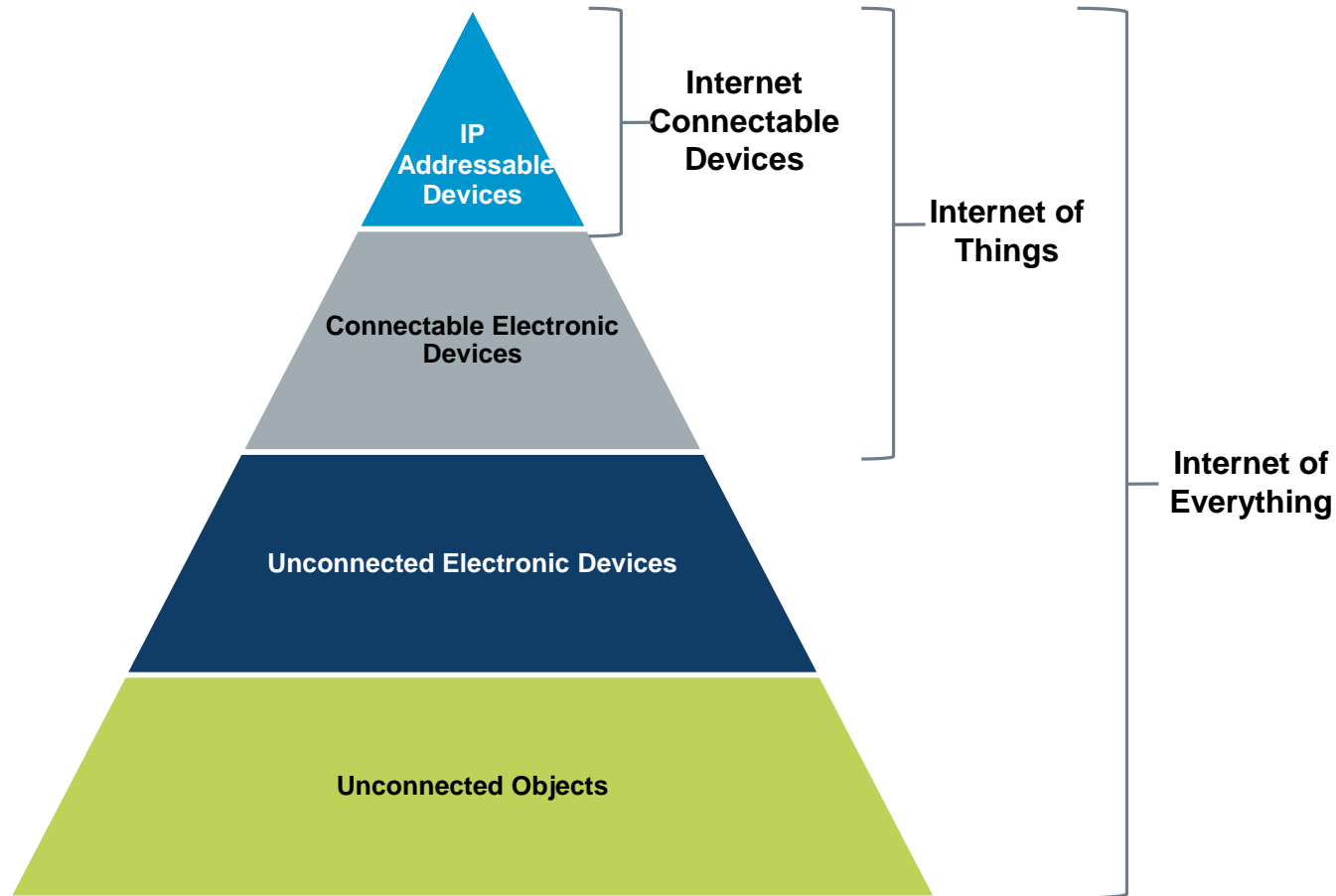
The Internet of Things

What is the “Internet of Things”?

- IoT is a conceptual framework
- It's about enabling connectivity and embedded intelligence in devices
- Some of these devices are connected today, but **MANY** are not...
- Not strictly machine-to-machine (M2M) – also machine-to-people, people-to-machine, machine-to-objects, people-to-objects
- Creates the ability to collect data from a broad range of devices
- Data can be accessed via the cloud and analyzed using “big data” techniques

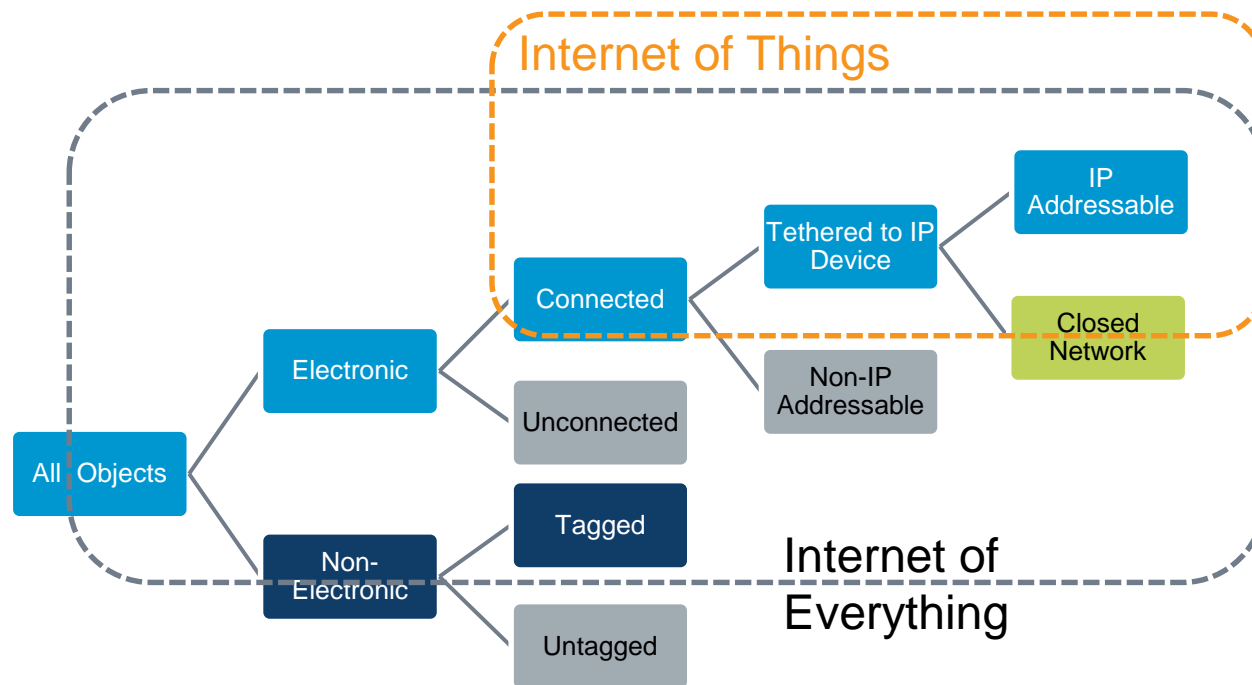
IoT can be used to provide unique value propositions and create complex information systems which are greater than the sum of the individual components.

Internet of Things Hierarchy



- This figure represents the potential TAM for IoT & IoE.
- Not all devices/objects in each category are expected to become IoT/IoE enabled.

IoT vs. Internet of Everything



- **Unconnected Objects:** Desk, chair, soda can, fire hydrant, animal collar, shipping pallet, buildings, etc.
- **Unconnected Electronic Devices:** Calculator, streetlight, vending machine, coffee maker, blood pressure monitor, etc.
- **Connected/Tethered Electronic Devices:** Audio headset, printer, computer monitor, DVD player, licensed mobile radio unit, etc.
- **IP-addressable Devices:** Tablet PC, smartphone, Infotainment head unit, smart meter, EV charging station, home health hub, etc.

IoT Application Segments



Automotive

- Infotainment
- Under-the-hood



Industrial

- Building Automation
- Commercial Transportation
- Retail & Commercial
- Industrial Automation
- Lighting
- Power & Energy
- Security
- Test & Measurement
- Other Industrial & Commercial



Communications

- Consumer CPE
- Enterprise CPE
- Last-mile Access
- Backbone
- Mobile Handsets and Infrastructure



Computers

- Desktop
- Server
- Portable Computing
(Netbook, Notebook & Tablet)



Consumer

- Home Appliance
- Home Automation
- Home Consumer Electronics
- PC Peripherals & Office Equipment
- Portable CE
- Smart Toys
- Sports & Fitness
- Other Consumer



Medical

- Consumer/Health & Wellness
- Imaging
- Clinical



Military & Aerospace

- Commercial aerospace
- Military equipment

IoT Technologies

Wired

- Ethernet, Coax, Fiber, etc. considered as a single category

WPAN

- ANT+
- *Bluetooth* ®® – Classic & Smart Ready
- *Bluetooth* ®® Smart

W-Mesh

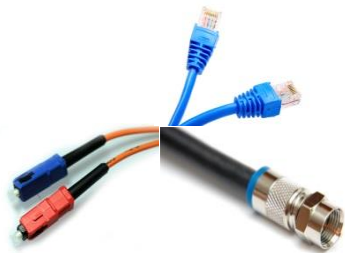
- ZigBee PRO
- ZigBee RF4CE
- ZigBee Multi-Protocol
- EnOcean
- ISA100.11a
- WirelessHART
- Z-Wave
- Other 802.15.4

WLAN

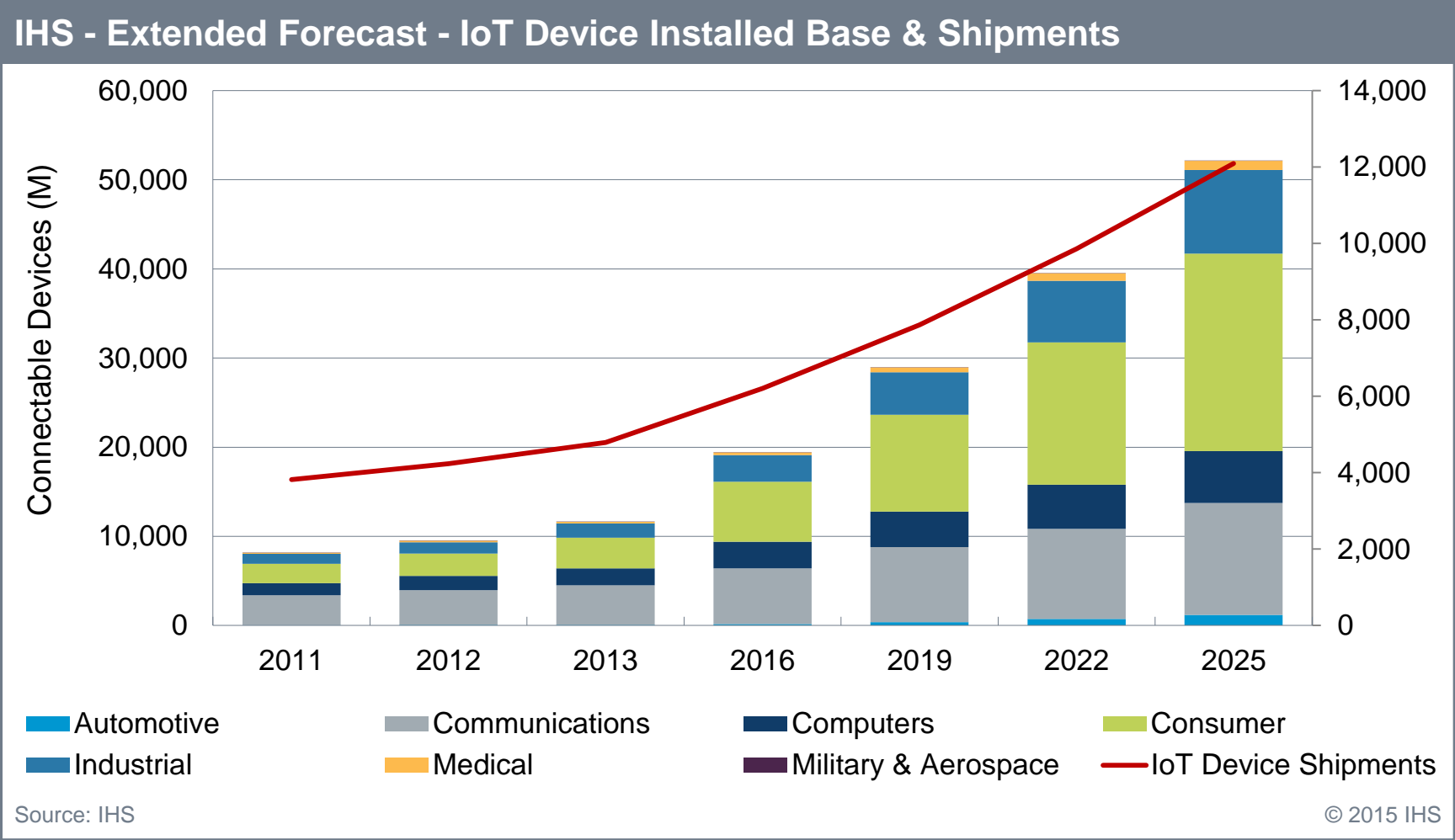
- 802.11a/b/g
- 802.11n
- 802.11ac
- 802.11ad
- Other 802.11
- DECT ULE
- Other 2.4GHz
- Other Sub-GHz

WWAN

- 2G Cellular
- 3G Cellular
- 4G Cellular

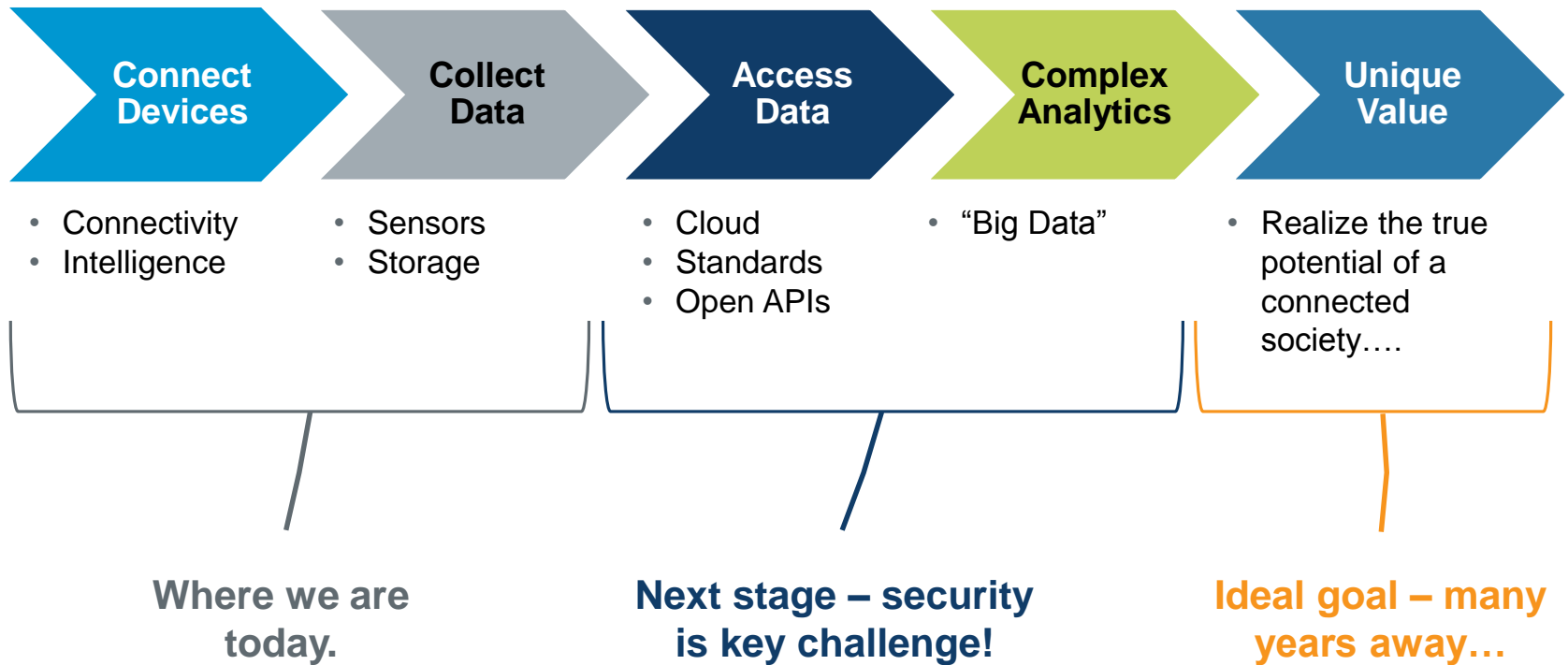


Internet of Things: 2011 - 2025



Internet of Things Evolution

Internet of Everything (IoE): represents the open access to data from one or more monitoring and control systems by third-party applications to provide unique, additional value to stakeholders.



IoT Market Drivers & Enablers

Expanding Capacity

- IPV6 Implementation
- Network upgrades (LTE & fiber)
- Efficient/improved Backhaul
- Data Centers

Ultra-Low Power

Very low power processors which can be implemented in a wide range of industrial (and novel) applications will be increasingly important.

Market Penetration

As IP-addressable devices become more commonplace and IoT use cases better understood, the commercial benefits are expected to drive increased connectivity.

IoT Market Challenges & Restraints

Global Economy

Many IoT initiatives rely on significant infrastructure investments. The next 2-3 years are expected to see slow uptake as a result of tighter consumer budgets, a sluggish housing market, and lower overall Industrial CapEx.

Business Models

A compelling business case with a solid ROI is required for equipment manufacturers, end-users, or service providers who are considering investment in the internet connected devices market.

Security & Privacy

Benefits of IoT for consumers and businesses include more personalized goods and services. However, to gain user acceptance this information sharing must balance personalization with privacy, and must be highly secure

IoT Enabling Technologies

Core components of IoT devices:

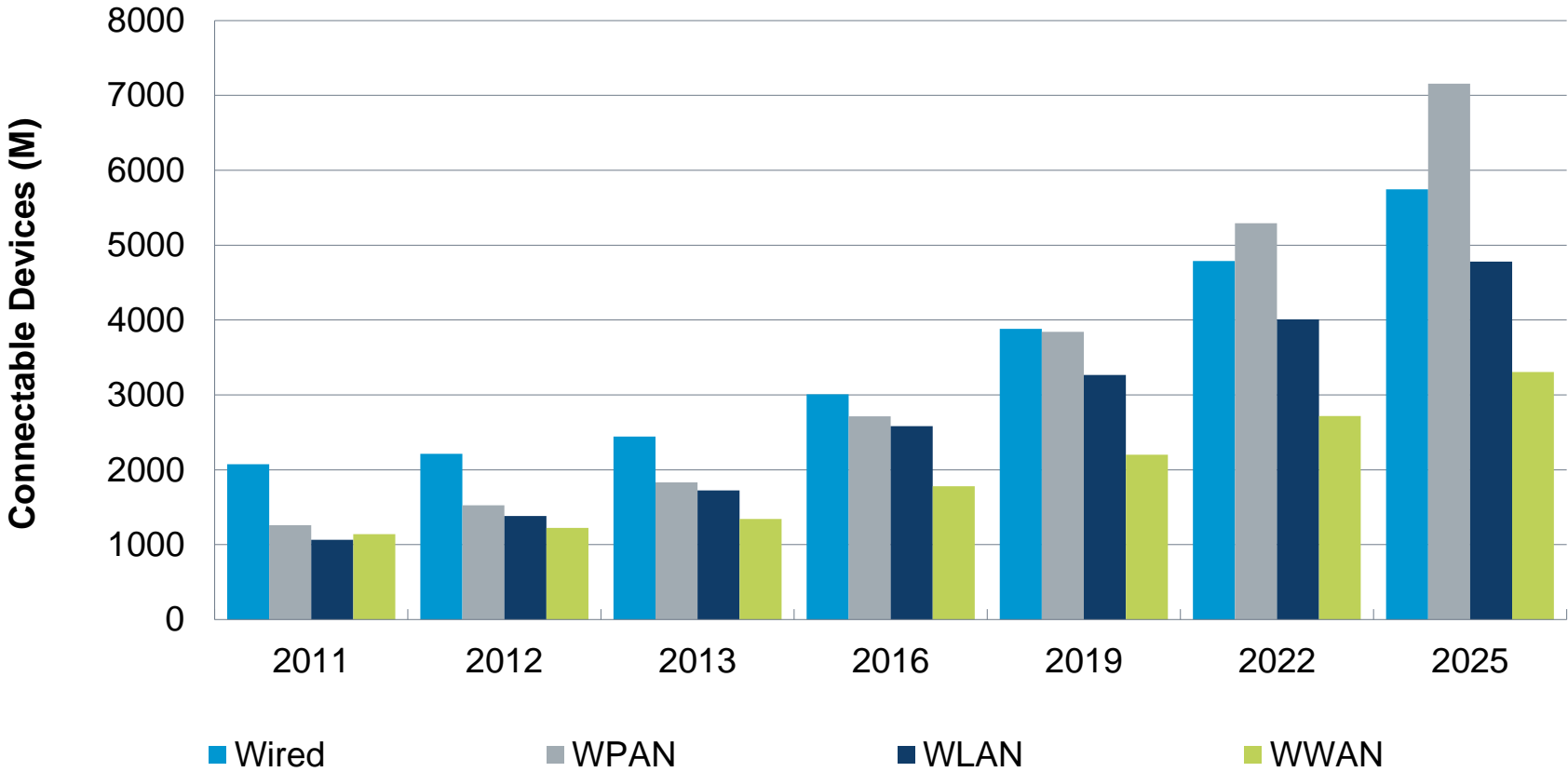
- Connectivity
- Embedded Processing
- Sensors

Connectivity in IoT

	Common Features	Example Applications	Example Technologies
WPAN	Low Power, short range, low data rates	Connecting node to a hub/gateway, e.g. sensor to a smartphone	Bluetooth, Bluetooth Smart
W-MESH	Low Power, local area range, low data rates	Connecting nodes to hub/controller. Often where the hub is not a standard consumer device – standalone gateways.	Zigbee PRO, Z-Wave, Insteon
WLAN	High speed data, applications where low power consumption isn't as critical	Connecting consumer media devices to hub/controller (e.g. router, TV, smartphone)	802.11a/b/g 802.11n 802.11ac 802.11ad
WWAN	Wireless connection over long range. Usually high speed.	Connecting a hub/controller to Internet	LTE, HSPA, W-CDMA, PAN GPRS/EDGE
Wired	Two types. WAN and LAN. Features vary.	WAN – connecting hub/controller to Internet. LAN – connecting nodes to hub/controller	Ethernet, Fieldbus, DALI, KNX, Powerline, DSL

Connectivity in IoT

Internet Connectable Devices - New Shipments by Connectivity



Source: IHS

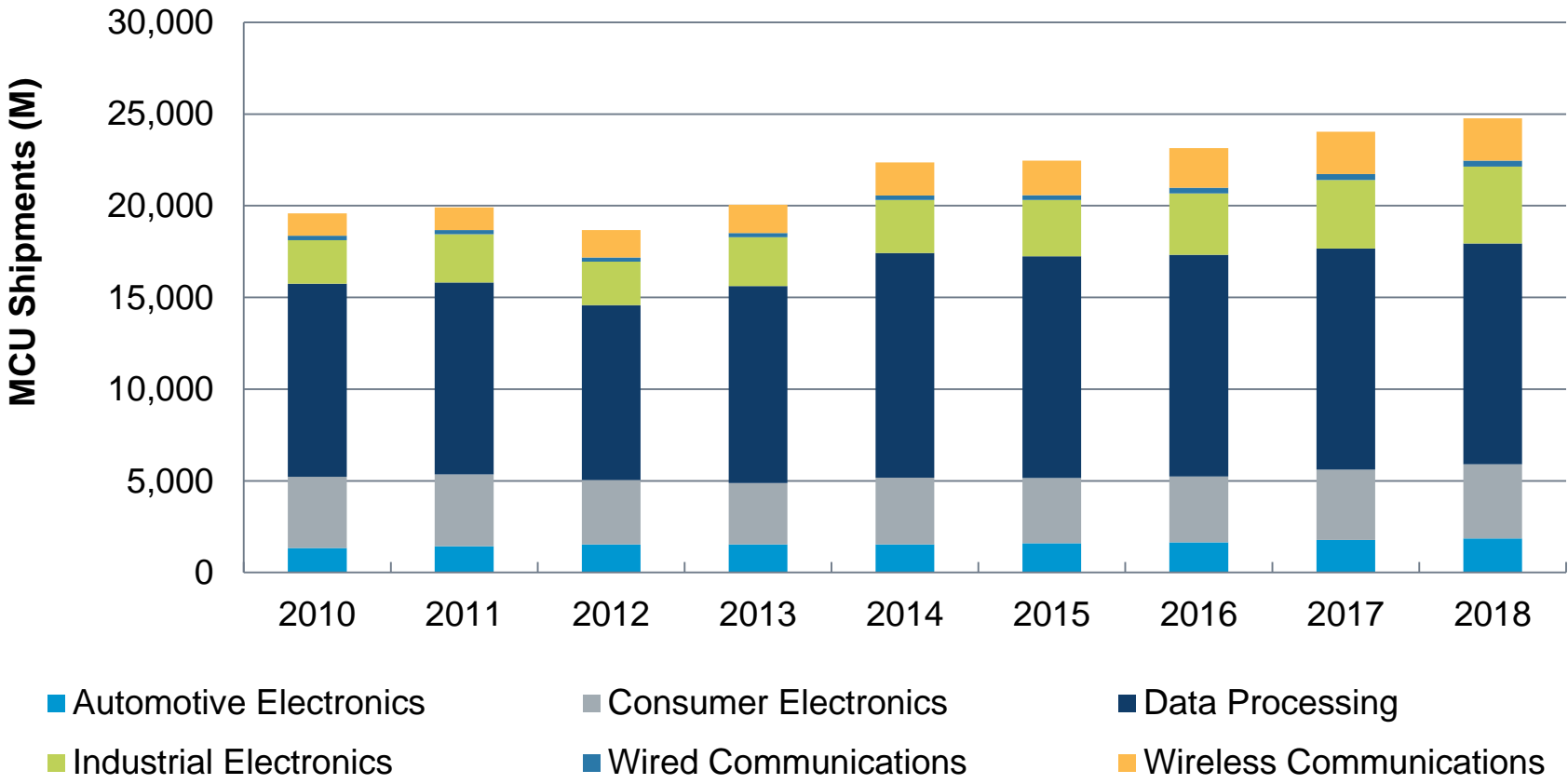
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Embedded Processing in IoT



Embedded Processing in IoT

Embedded Processing - Microcontroller Forecast



Source: IHS

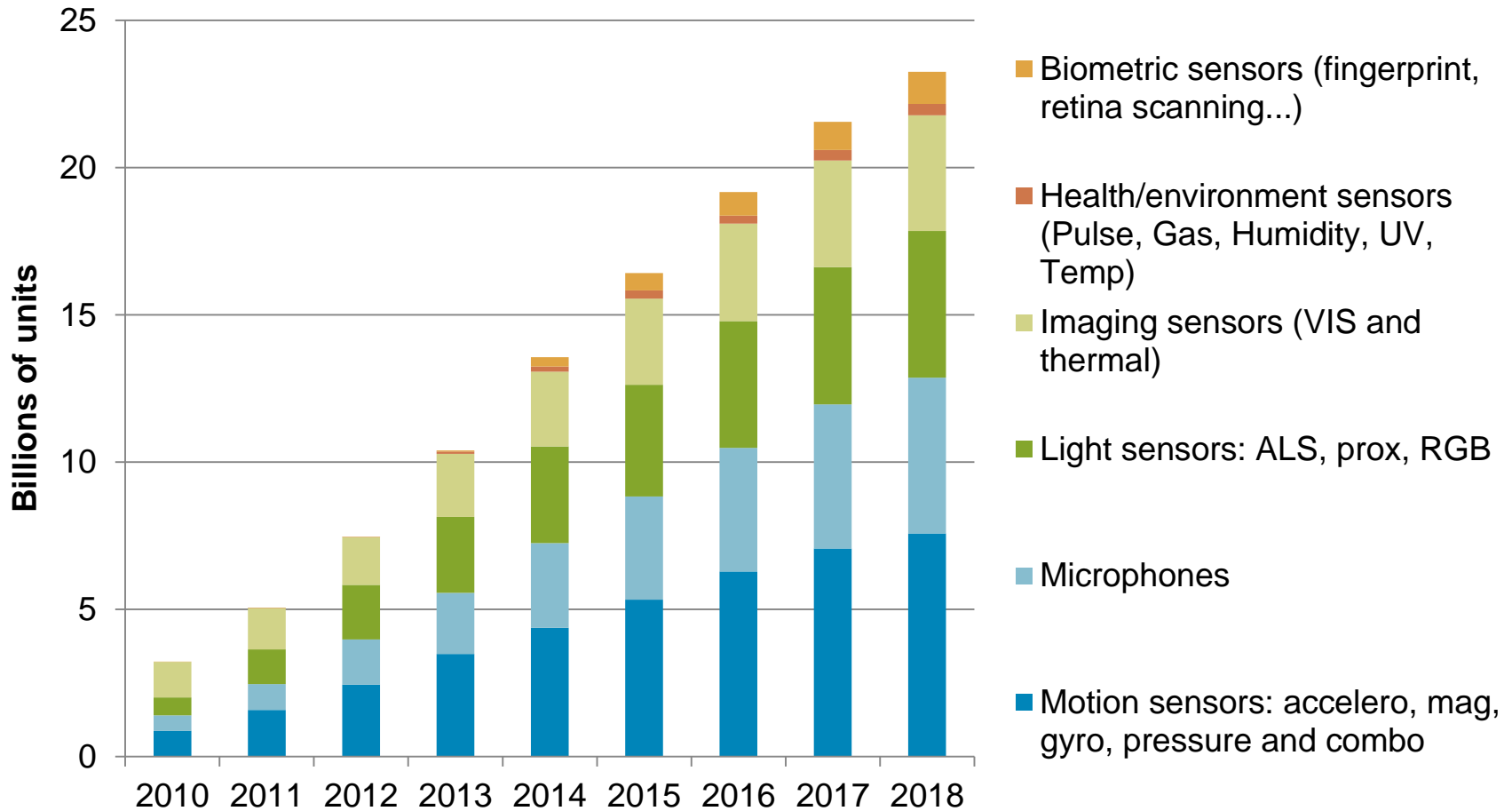
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Sensors in IoT

- Handsets and tablets will still make up for most of connected sensors in next 10 years
 - Sensor shipment more than doubling in 5 years from 10.4 billion sensors in 2013 to 23.2 billion in 2018
- Automotive
 - 6 billion sensors in 2018
 - ADAS and E-Call sensors are first sensors to support IoT scenarios
 - As cars are becoming connected car OEMs are exploring how to create value by leveraging “6 billion connected sensors”
- Industrial IoT
 - Sensor opportunity generated by IoT in the range 10s to 100s of millions, not billions
 - Other areas of interest include smart home, asset management, industrial process, smart grid, health...

Sensors in IoT (today)

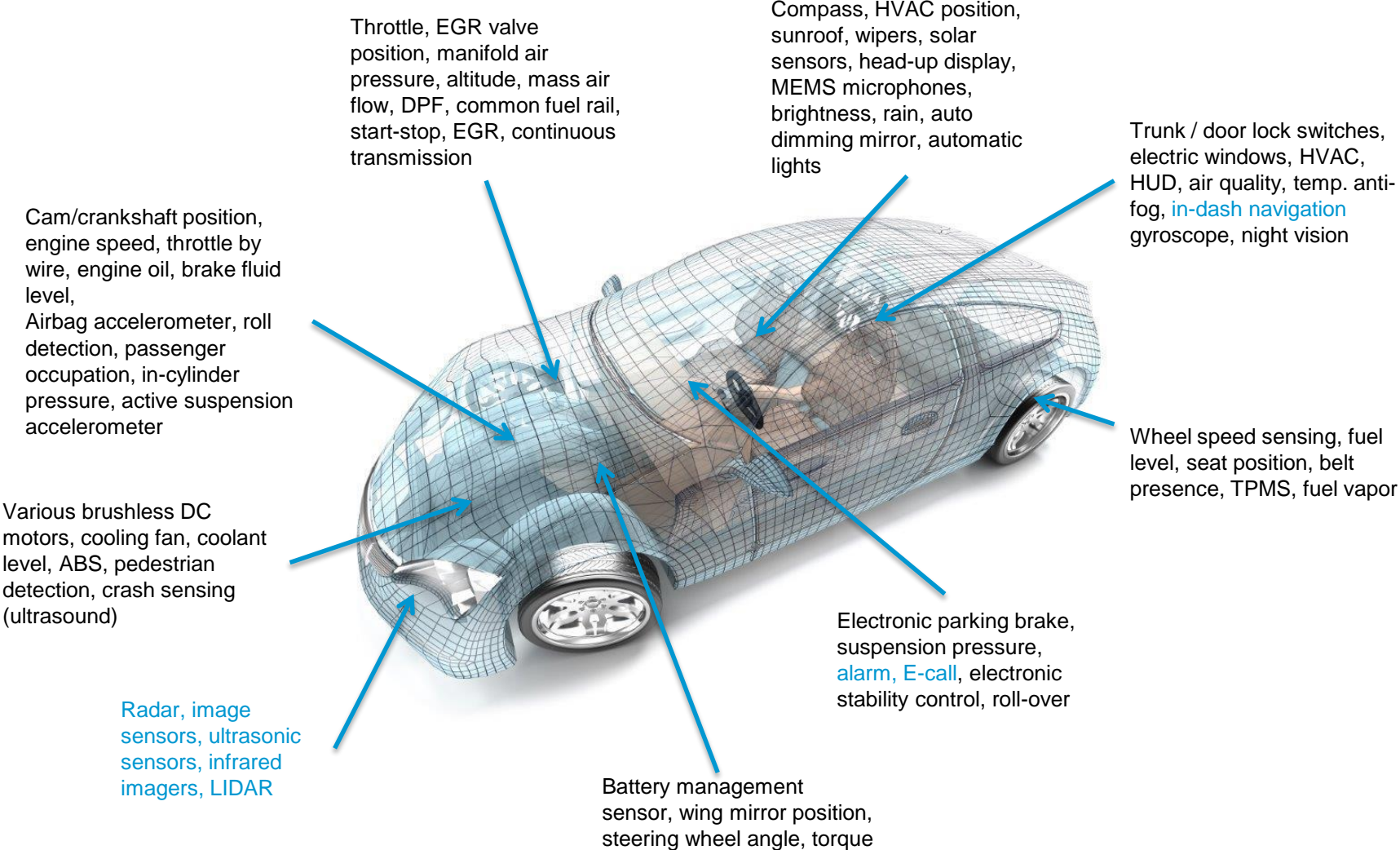
Shipment of sensors which are relevant for IoT scenario in handsets and tablets (touch sensor not included)



Source: IHS MEMS Market Tracker – Q2 2014, Light Sensors report – 2014, Emerging sensors for handsets & tablets – 2014, Image sensor market tracker – Q2 2014

Sensors in IoT (tomorrow)

Obvious sensors in IoT scenario

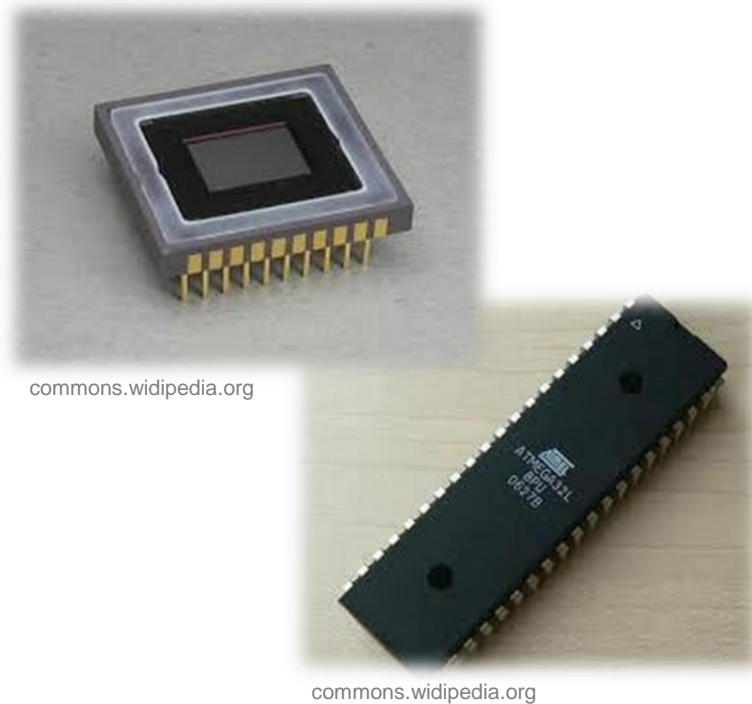


Sensors & Embedded Processing:

Situational Intelligence

Environmental Intelligence

- Behind the proliferation of sensors, there is a new strategy that is enabling situational intelligence:
 - An increasing quantity and variety of sensors
 - Microcontrollers or other low-power logic component
 - Power management to maintain battery life.
 - Efficient software code fusing data from multiple sources while the applications processor, “the active intelligence”, sleeps.
- Sensors provide the IoT device with a new understanding of it’s environment.



These components comprise the concept of sensor fusion, the crucial element of situational intelligence



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