Technologies & Sensors for the Internet of Things

Businesses & Market Trends 2014 - 2024

The Internet of Things (IoT) provides big opportunities for technologies. The device business will reach $45B in 2024, contributing to a total IoT market of $400B.

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Dr. Eric Mounier co-founded Yole Développement in 1998. He oversees technology analysis for MEMS-related manufacturing technologies and Optical MEMS (including micromirrors, micro-displays, autofocus and IR micro-bolometers) applications within the company. Eric has also developed a unique cost modeling tool, called "MEMSCoSim", which is able to evaluate the cost of MEMS module manufacturing.
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Companies Listed in this Report

ACOEM, AdvanticSys, Amazon, Apple, AT&T, Atmel, Ayla Networks, AVAGO Technologies, Blackberry, BOSCH, BLUECHIIP, Cambridge CMOS Sensors, CEA Liten, China Mobile, Cisco, DataVeyes, DG Logik, DISCERA, Enfucell, EnOcean, EPCOS, FitBit, Flutura, Fraunhofer Institute, FREESCALE Semiconductor, GE, Georgia Institute of Technology, Google, HEWLETT PACKARD, Hillcrest Labs, HITACHI, Honeywell, HTC, IBM, Infomotion Sports Technologies, ioBridge, INTEL, Intellisense.io, InterSoft, INVENSENSE, Jabra, Jasper Wireless, Jawbone, Kionix, Kistler, KNOWLES Electronics, Koubachi, KTH, KwikSet, KWJ Engineering, Lenovo, Lightning Switch, Lime Microsystems, LogBar Inc., LumoBack, M2M Cyber Security, M2Mi, MC10 Inc., Marlow Industries, MEMSIC, Micropelt, Misfit, MURATA, MYO, Navisens, Nest, Netatmo, Newco, Nike, Nintendo, Nokia, NXP Semiconductors, OnFarm Systems, Optoi MicroElectronics, Oracle, Pebble, Purdue University, Rosemount, Samsung, SemTech, Sensaris, Sensata, Sensirion, Sensonor, SensorSuite, Sharp, Si Time, SiLabs, SmartThings, Sony, STMicroelectronics, Synkera Technologies, TeledyneDALSA, Texas Instruments, ThinFilm Electronics, TriQuint, Tronics MicroSystems, TSMC, Variable Technologies, UCLA, University of Harvard, VitalConnect, VTT MEMS, WiSpry, Withings, X-Fab MEMS Foundry, Xymox technologies Inc.

Key Features

- The objectives of this report is to provide:

– **Understanding of IoT value chain structure (device, data cloud), application areas and technologies involved**

– **Technology trends and evolution of IoT device in the coming years**

– **Market forecast for IoT devices in Munits and $M for 2014 – 2024, with a focus on sensors**

– **IoT applications and examples overview (building automation, transportation, healthcare, industry, etc.) with a focus on wearable electronics**

– **The technological challenges faced by IoT devices, with a focus on wireless, energy, power, RF and sensing modules**

Who Should Be Interested in this Report ?

- **R&D, Components Manufacturers Companies**
  - Evaluate market potential of future IoT technologies and products for new applicative markets
  - Spot new opportunities and define diversification strategies
  - Position your company in the ever changing IoT market structure
- **OEMs & Integrator Companies**
  - To evaluate benefits of integrating sensors in IoT devices
  - Get the list of key players and emerging start-ups in this industry
- **Cloud & Telecommunications Companies**
  - Understand the evolution of IoT devices and the market structure
  - Understand the differentiated value of products and services in this market
  - Identify new business opportunities and prospects
- **Financial & Strategic Investors**
  - Understand the potential of incoming Internet of Things revolution
  - Get the list of key players and emerging start-ups in this industry

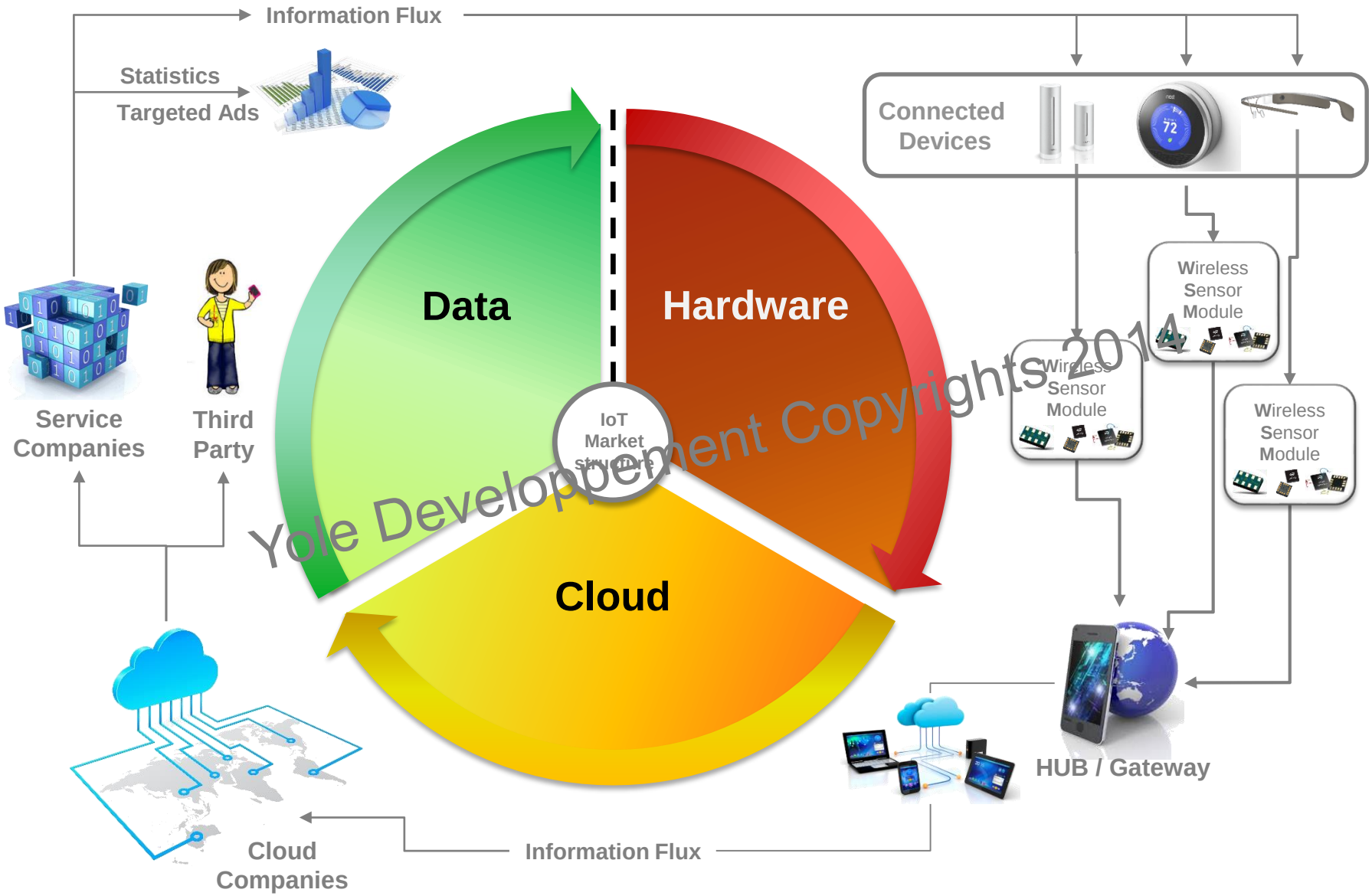
Report Scope

- **Yole's definition of the Internet of Things is as follows:**
  - **Internet of Things devices is the aggregation of all the sensing modules that are linked to the Cloud – either directly or through a gateway – and which data is processed and valorized in any manner (through selling to a third party, through monitoring of a piece of equipment, etc.).**

- **This report looks at the Internet of Things market in general, but with a strong focus on sensing modules. We do not detail the cloud computing industry nor the data processing services.**

- **We do not include in our valorizations the benefit brought by IoT solutions through productivity gains. The values estimated are from hardware, cloud computing processing services and data processing services charging.**

IoT Global Market Structure (1/3)



Area Of Application

Building Automation

Retail& Logistics

Consumer & Home automation

Healthcare & Life Science

Industrial

Transportation

Security & Public Safety

Environment

Summary of Technologies of IoT
Markets and Sensors

- **Here are the main applications of IoT devices and sensors associated with.**

Legend: Sensor — Level of demand

THE INTERNET OF THINGS — SENSORS OF

Building Automation
- Light (IR, visible)
- Contact
- Temperature
- Chemical (CO_2)
- Accelero

Healthcare & Life science
- Pressure
- Bio Sensors
- Temperature
- Inertial
- Chemical
- Light (IR, X-Ray)

Consumer & Home automation
- Gyroscope
- Temperature
- Accelero
- Chemical
- Magneto
- Pressure

Transportation
- Gyroscope
- Pressure
- Accelero
- Temperature
- Magneto
- Chemical

Industrial
- Pressure
- Hall Effect
- Light (IR,Optical)
- Accelero
- Chemical
- Temperature

Environment
- Chemical
- Humidity
- Temperature
- Light (IR, visible)
- Pressure

Security & Public Safety
- Gyro
- Light (IR,XRay,THz)
- Accelero
- Magneto
- Chemical

Retail & Logistics
- Light (IR/Optical)
- Magneto
- Pressure
- Temperature
- Chemical

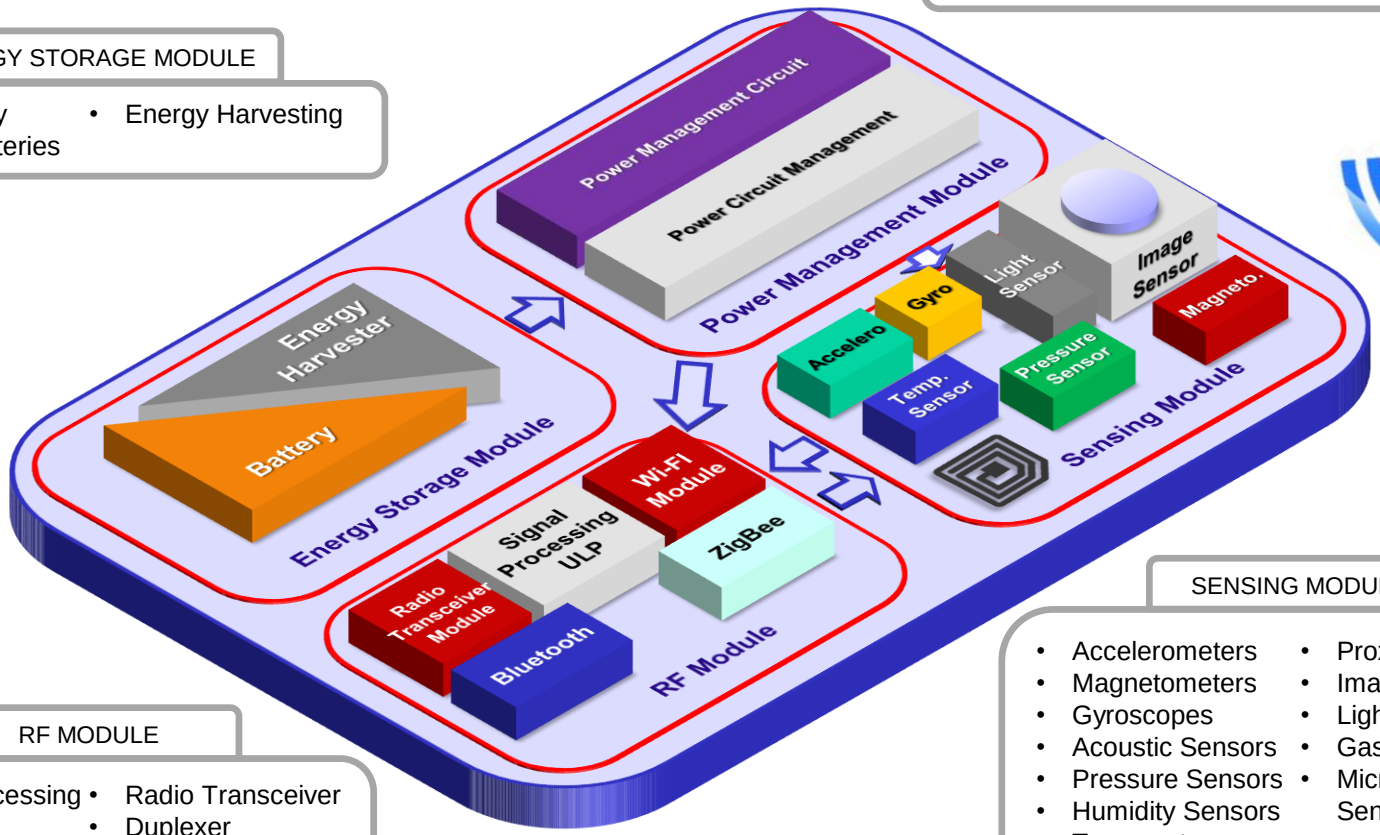
IoT Wireless Sensors Map

POWER MANAGEMENT MODULE

- Ultra-capacitors
- Microbatteries
- PMU

ENERGY STORAGE MODULE

- Li-Ion battery
- AAA/AA Batteries
- Energy Harvesting



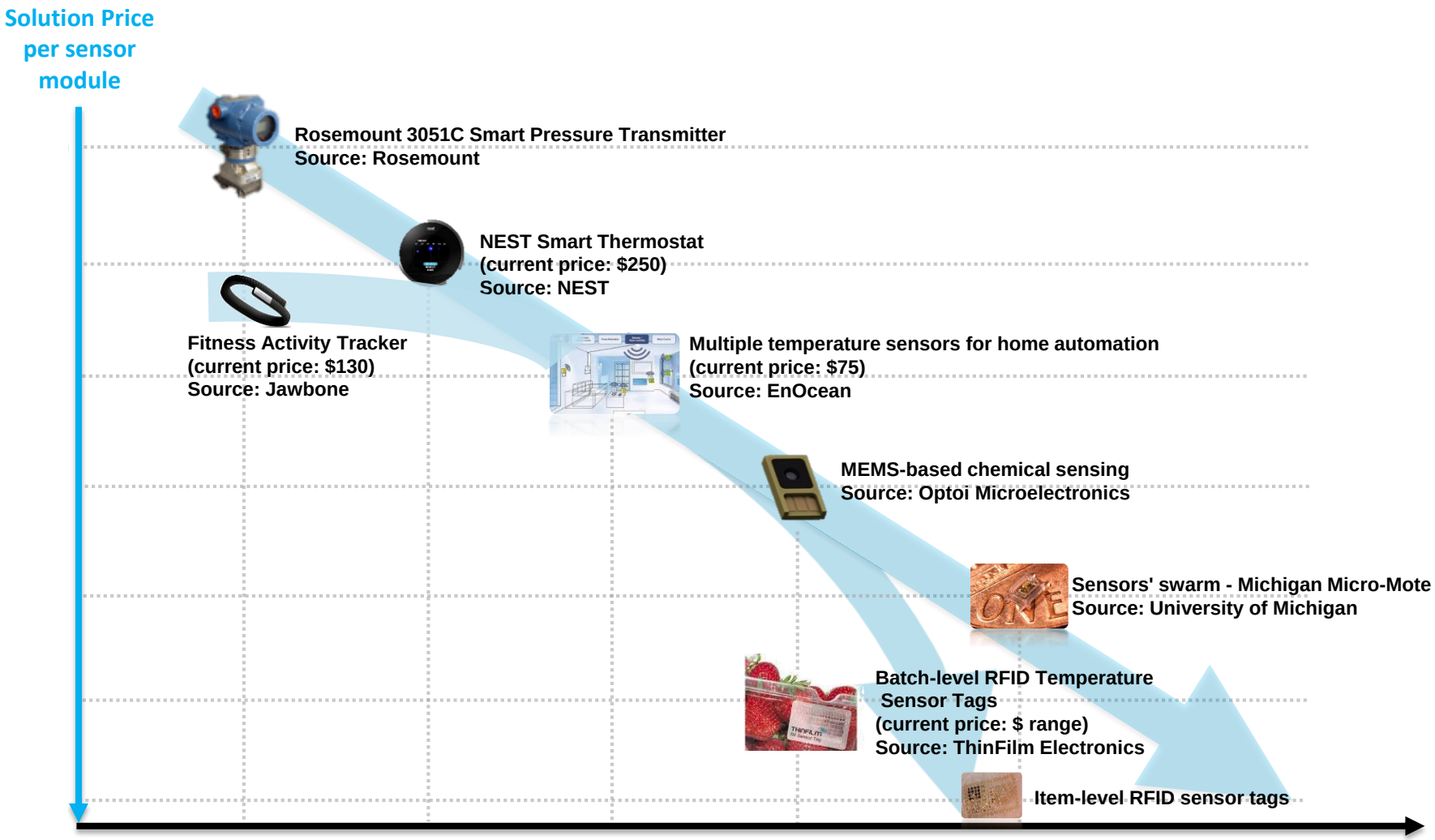
SENSING MODULE

- Accelerometers
- Magnetometers
- Gyroscopes
- Acoustic Sensors
- Pressure Sensors
- Humidity Sensors
- Temperature Sensors
- Proximity Sensors
- Image Sensors
- Light Sensors
- Gas RFID Sensors
- Micro Flow Sensors

RF MODULE

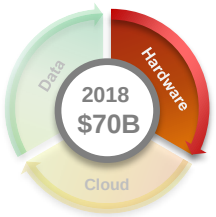
- Signal Processing Unit
- Wifi
- ZigBee
- Bluetooth LE
- Radio Transceiver
- Duplexer
- BAW

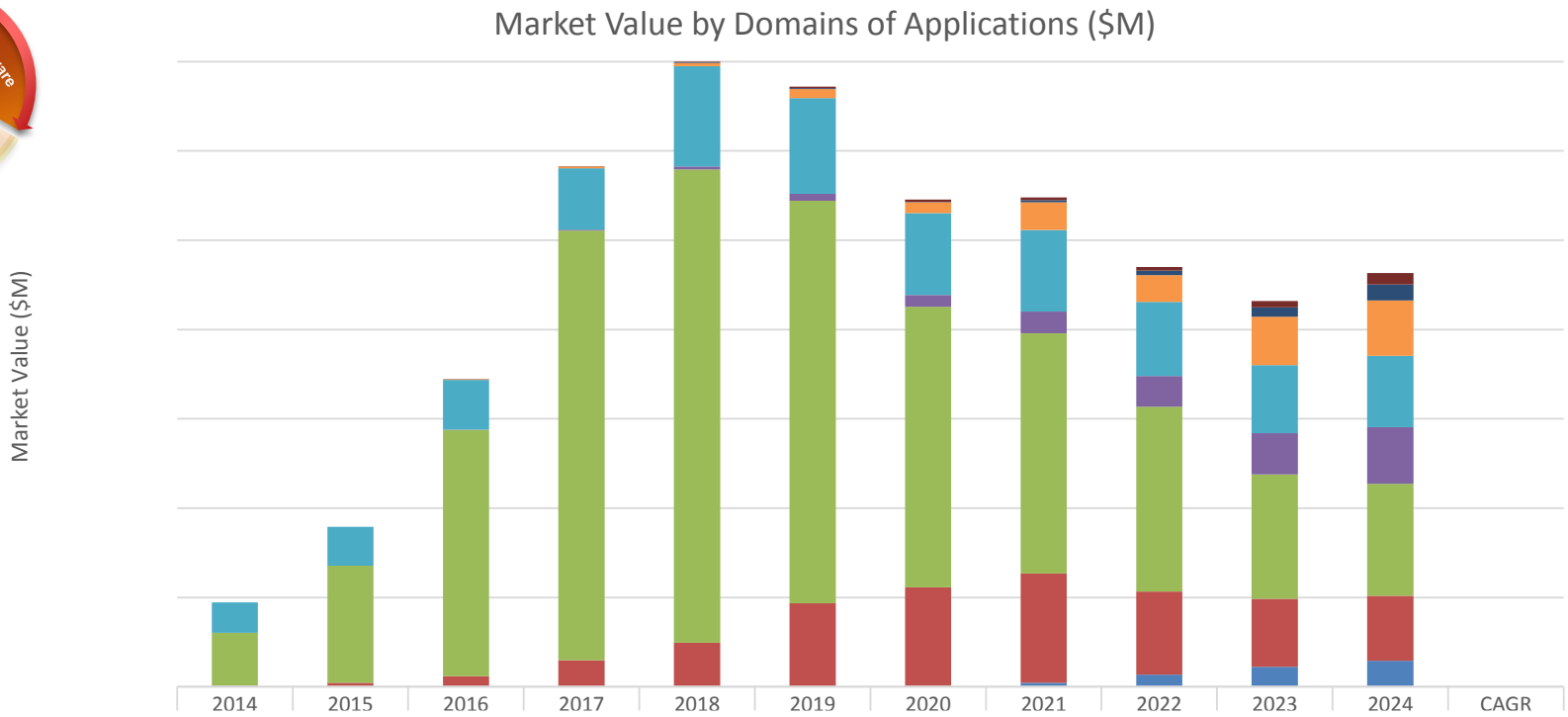
Solution Price IoT Roadmap



Summary of Technologies of IoT

Forecast : Hardware Market Value by Application Domain

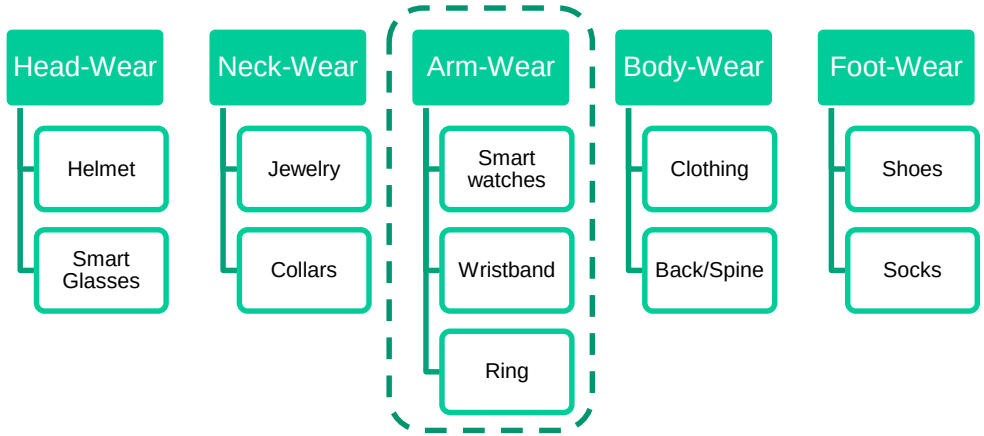


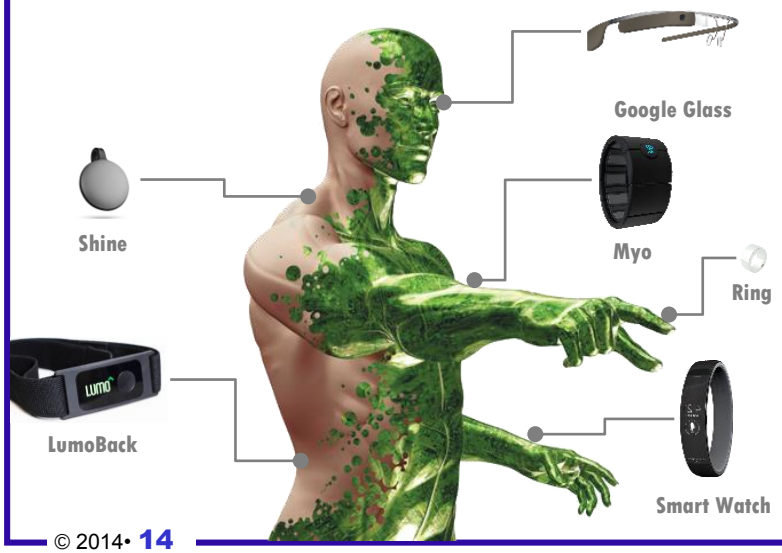


Wearable Electronic Market

- **The global wearable electronics market can be segmented in 5 categories. Head-Wear category includes helmet product and vision aid. There's also a category of products for neck-wear, with collars and necklace products that cover up electronics with jewels. Arm-Wear category is the most burgeoning category with multiples devices expected wristband, smart watches, ring, armband, etc. Body-Wear products include smart clothing, and devices monitoring back/spine position. And the last category concerns foot-wear.**

Wearable Electronic Market Segmentation:





Arm-Wear market is one of the most promising market and many actors are targeting it.

Wearable Electronic

A new opportunity for sensor fusion / processing

- **Wearable electronics is a new big opportunity for sensors**
  - **Fitness / activity monitoring, healthcare, sports applications**
  - **In many cases the sensor acts as a hub**
    - **Basic calculations can be done at the device level**
    - **After transmission (enabled by low energy Bluetooth) : advanced software / fusion can be done by the smartphone**
  - **Bellow are many examples of such developments:**

I'm watch (2012)

- **Integrates accelerometer + magnetometer**

Moto 360 by Motorola (End 2014)

- **Other connected watches are currently in development by major OEMs (LG G Watch, rumors about Apple iWatch…)**

Pebble Watch (0,4 MUnits sold in 2013)

→ **Features STMicroelectronics accelerometer**

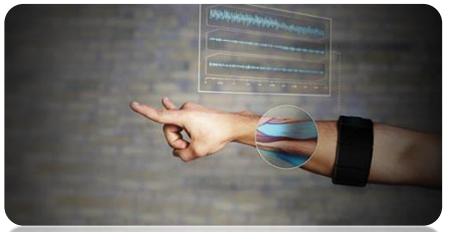
Wearable Electronic / Connected Devices

Examples of new devices (2/4)

BodyMedia

(Acquired by Jawbone in 2013)

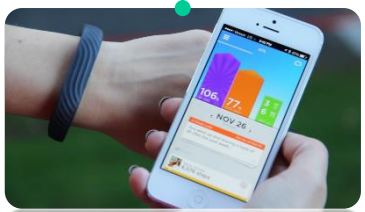
- Integrates MEMS accelerometer (from Kionix and STMicroelectronics) in its systems for fitness application
- We note that no gyroscopes are used presently. This would enable more precise monitoring and new sport applications, however power consumption would be too high. It could be part of larger systems in the future.



MYO by ThalmicLabs

- Proprietary EMG muscle activity sensors
- Nine-axis IMU containing:
  - three-axis gyroscope
  - three-axis accelerometer
  - three-axis magnetometer

Cell Phone as a Hub



Jawbone Up24

NodeKore from Variable Technologies