Lecture 03

MEMS Internet of Things (IoT) Sensors

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What is the Internet of Things?

IoT Areas: Smart cities, Smart grid, Logistics, Industrial control, Home and building automation, E-health

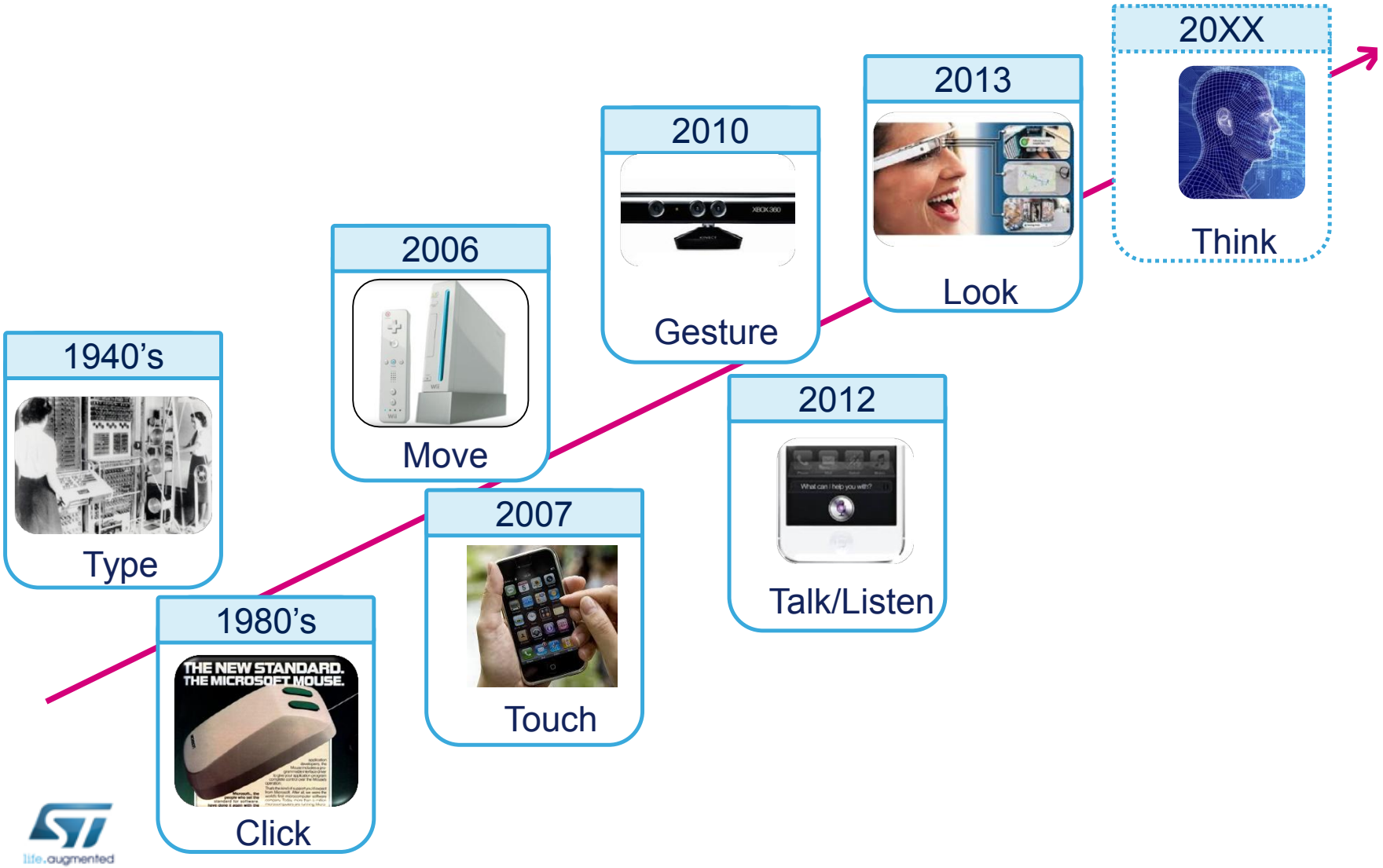
Why MEMS sensor in IoT?

Sensing the World

- Humans interact with the environment through their senses
- Sensors can enrich human interaction with the surroundings
- Sensors create a more interactive and immersive world

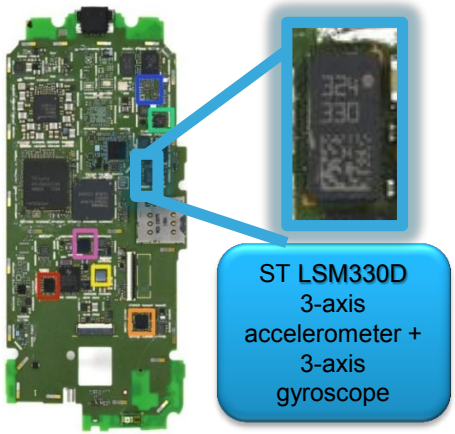
Humanization of Technology

Evolution of human interface technology

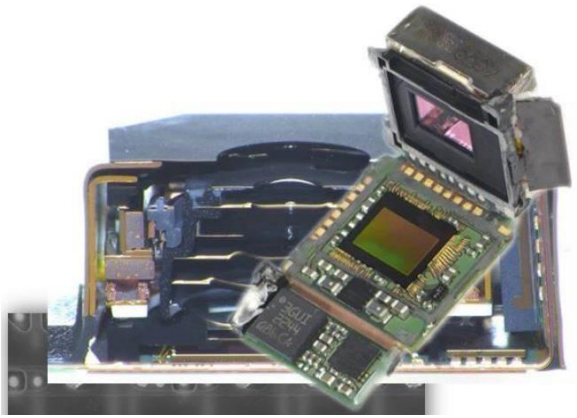


MEMS Sensors in Internet of Things (IoT)

Google Phone



Optical Image Stabilization



Microphone & Pressure Sensor

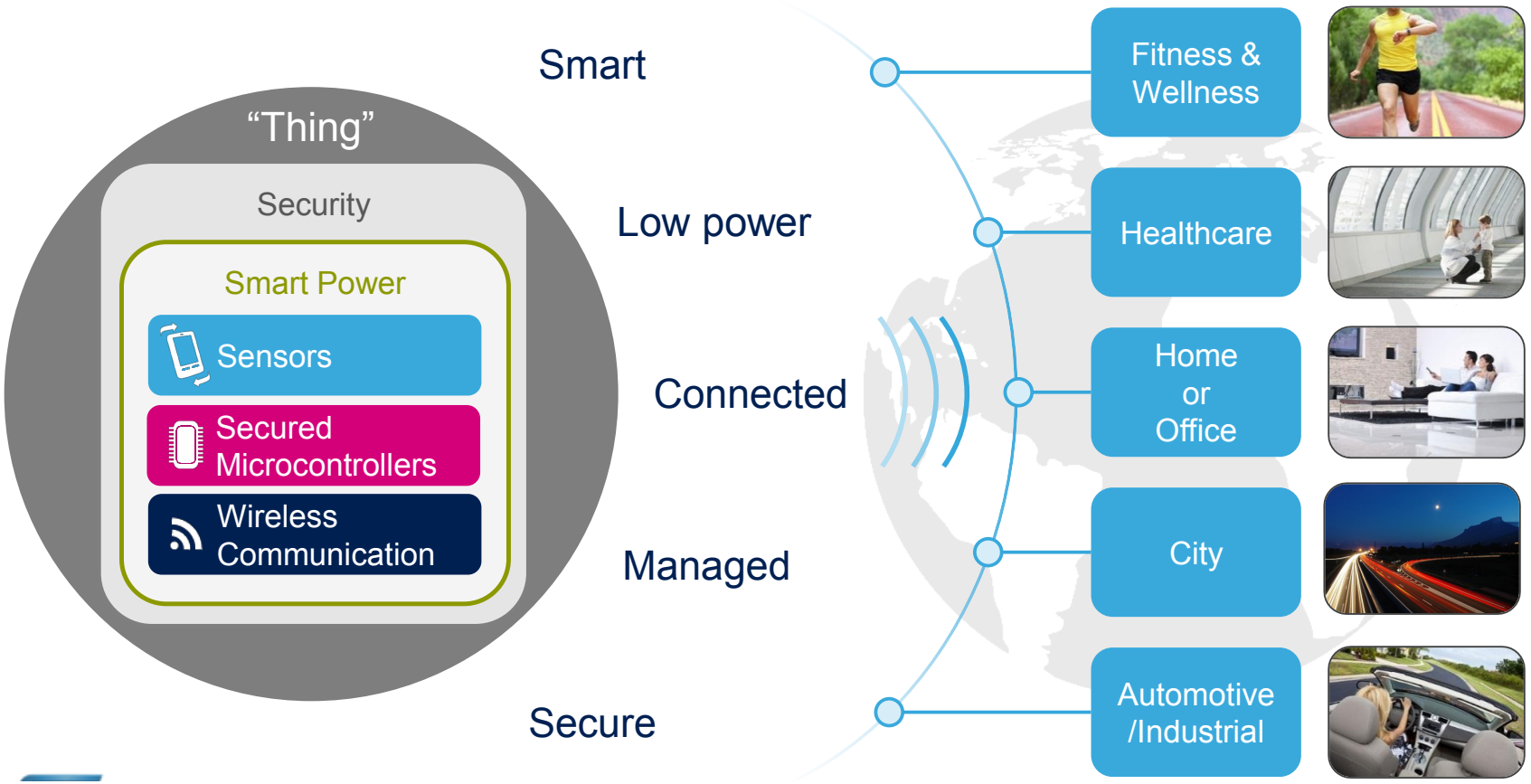
Wearable Device

Bluetooth®

Source:

MEMS Sensors in Internet of Things (IoT)

Smart sensors in smart connected systems pave the road to “Trillion Sensors”



Challenges in MEMS Sensors in IoT

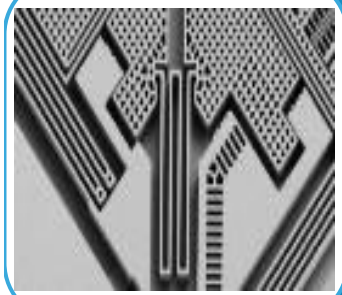
Technological challenges

- Processing capability everywhere
- Multiple sensors and data collection
- Multiple communication standards
- Data availability and integrity
- Availability of very low-power technologies
- Cost effective technology
- Reliable, long-lifetime devices

Societal challenges

- Security
- Privacy
- Environmental impact
- Safety
- Social responsibility

Enabling factors in smart systmes

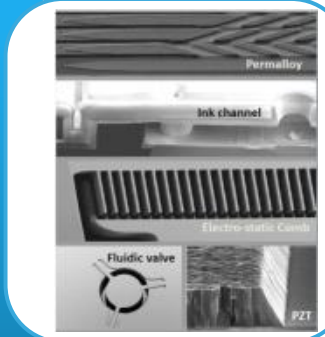


Silicon Technologies

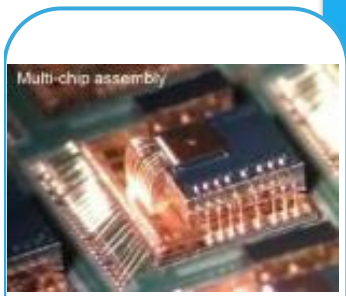
- Moore's Law: Miniaturization
- More than Moore: Functionalities
- 3D Structure : i.e. MEMS
- Through-Silicon Vias

New Materials

- Getters
- Polymers
- Shape Memory Alloy
- Piezoelectric (PZT)
- SiC & GaN
- Graphene



Heterogeneous Integration

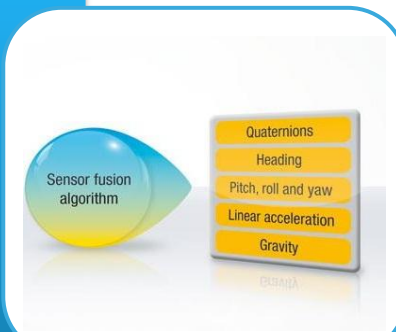


- Wafer Level Packaging (Staked Multi Dice)
- New interconnections (Bondless. Sintering, Cu on Cu)
- Smart System In Package (SiP)

Package

- Orientation & Localization Algorithms
- Embedded Predictive & Reactive Capabilities

IPs & Software



Medicine and Tele-health

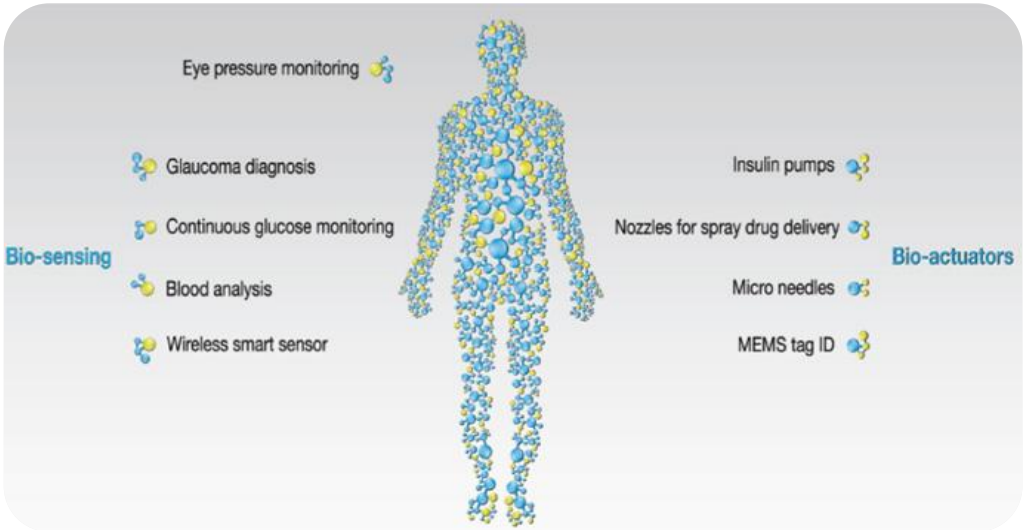
Sensors: pH, humidity, Oxygen, CO2, Blood gas analysis, Continuous Glucose Sensors, Chemical sensors

Bio-reactors, Agriculture

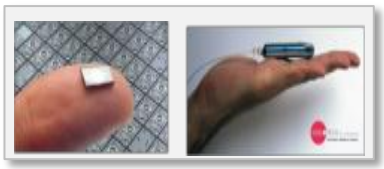
Respiratory equipment

Toxicants detection

Food monitoring



ECG (Analog)



Insulin Nano pumps (MEMS)

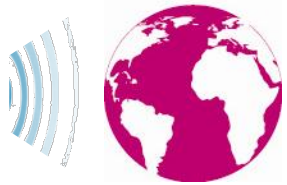
Glaucoma Lens (MEMS)

Applications of MEMS in IoT

Enabling the Internet of Things

Smart Sensors + On-Board Radio

Sensors (MEMS) → Analog (ASSP) → Wireless (RF)



Sensors — Sensors & Radio in Smart System — **RF**

Sensors (MEMS) → Analog (ASSP) → MCU → Wireless (RF)

Sport & wellness | Healthcare | House/Building | Logistics | Factory automation

In-Home Hemodynamic Monitoring