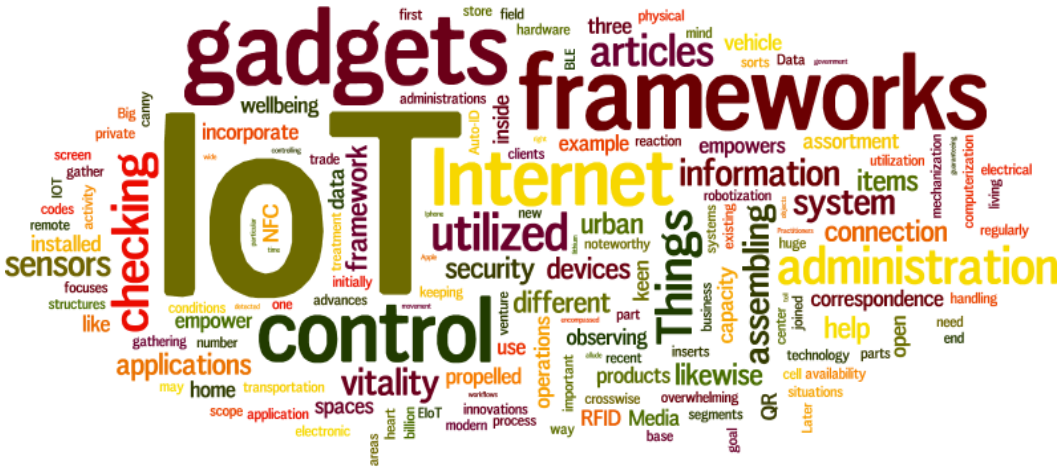
CS578: Internet of Things

Introduction to IoT

Definitions, Characteristics, Applications



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"I have no special talent. I am only passionately curious." – **Albert Einstein**

What is IoT?

- Internet of Things (IoT) is the network of physical objects — devices, vehicles, buildings and other items – embedded with electronics, software, sensors, and network connectivity that enables these objects to collect and exchange data.

- The basic premise and goal of IoT is to "connect the unconnected"
  - "Things" or objects that were not supposed to be connected to the Internet

- IoT is a technology transition in computer network
  - allow us to sense and control the physical world by making objects smarter and connecting them through network
  - Automation system and connected devices work together to provide a world where data can be collected and analyzed

Cont…

- Unifications of technologies:
  - Embedded systems,
  - Low power and low rate network,
  - Internet,
  - Big data,
  - Data analytics,
  - Cloud computing,
  - Software defined networks,
  - Etc.

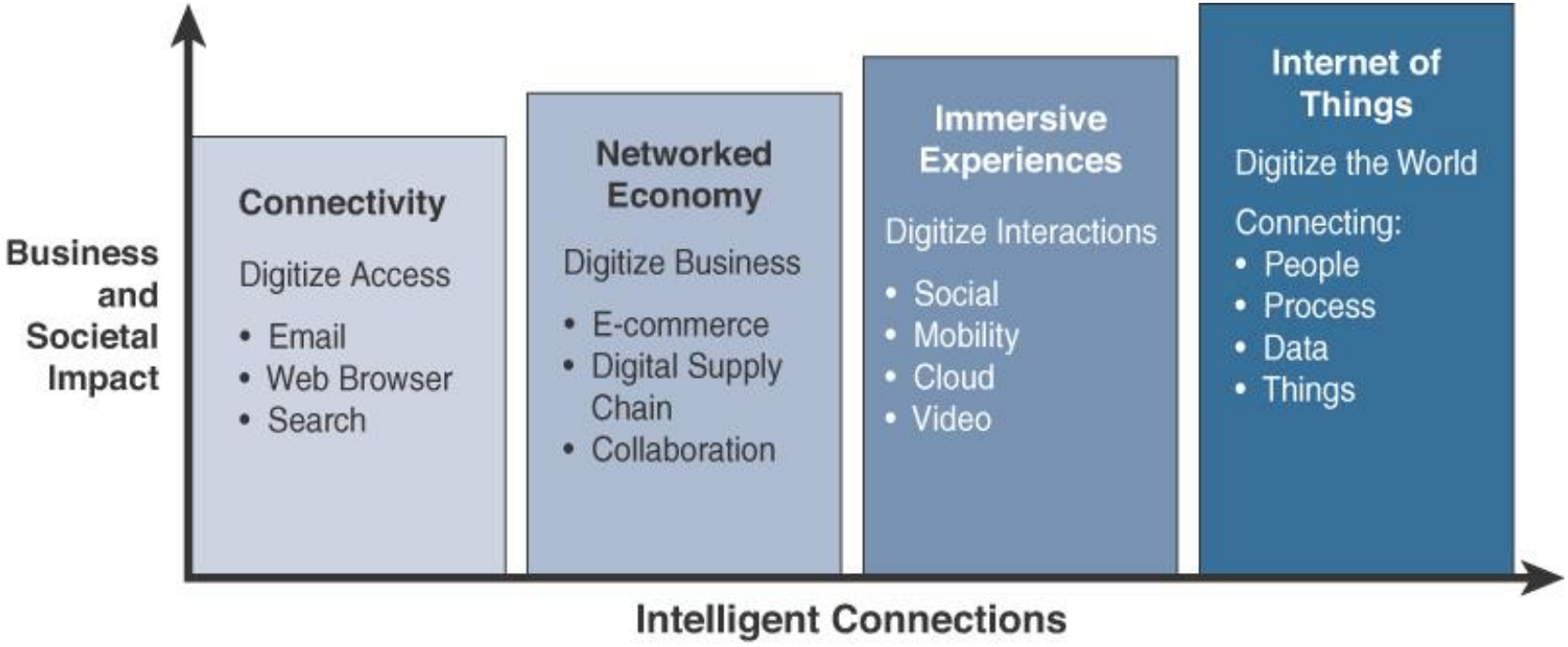
- Alternate Definition:

"The Internet of Things (IoT) is the network of physical objects that contain embedded technology to communicate and sense or interact with their internal states or the external environment." – Gartner Research*

* https://www.gartner.com/en/information-technology/glossary/internet-of-things

Genesis of IoT

- The term "Internet of things" was likely coined by Kevin Ashton of Procter & Gamble, later MIT's Auto-ID Center, in 1999.
- "In the twentieth century, computers were brains without senses – they only knew what we told them." IoT is changing this paradigm; in the twenty-first century, computers are sensing things for themselves! – Kevin Ashton



Evolutionary Phases of the Internet

Benefits of IoT

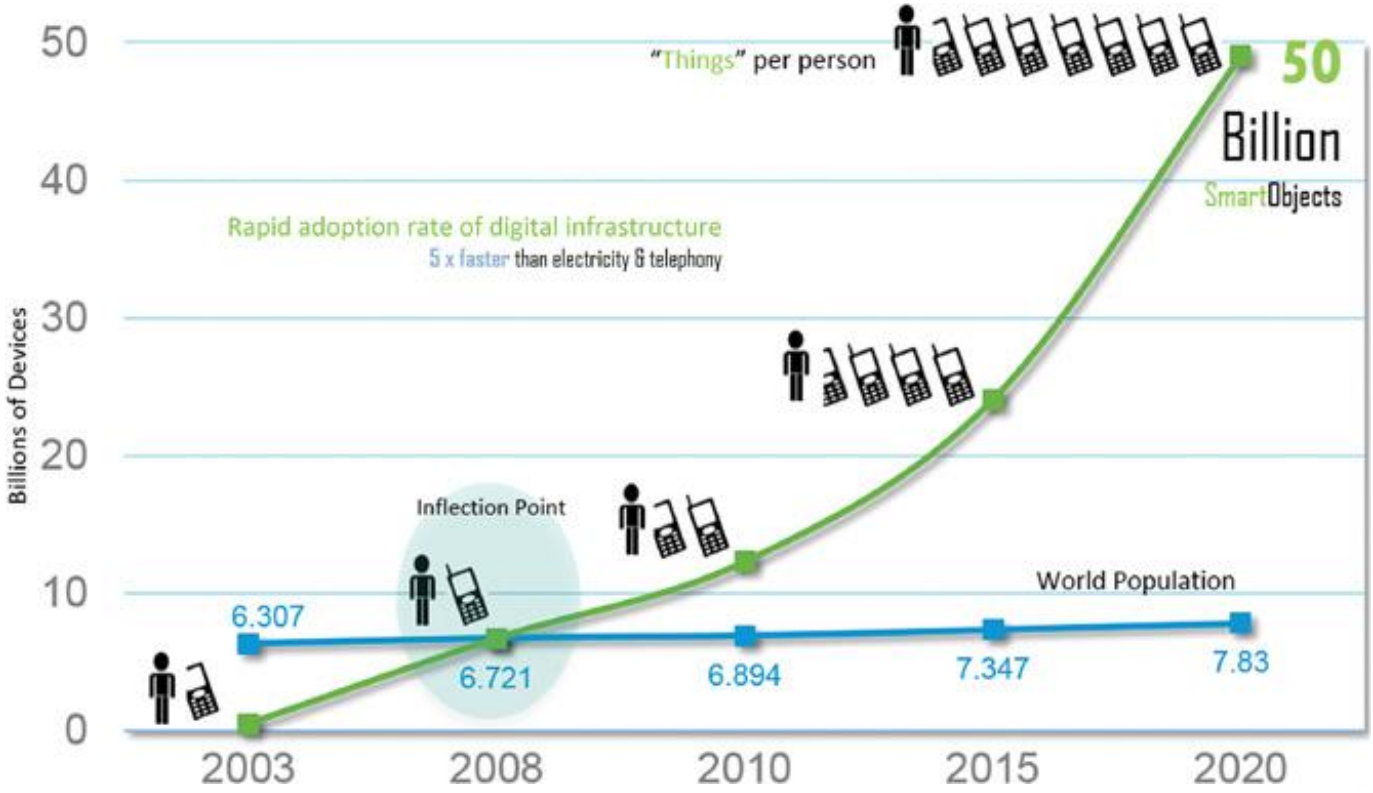
❑ To the End User

- Ease of Doing Things
- Emergency Services
- Security Services

❑ To the Businesses

- Process Improvement
- Asset Utilization
- New Market Opportunities
- Workplace Security

Growth of IoT Devices vs. Global Population



Cisco System's prediction

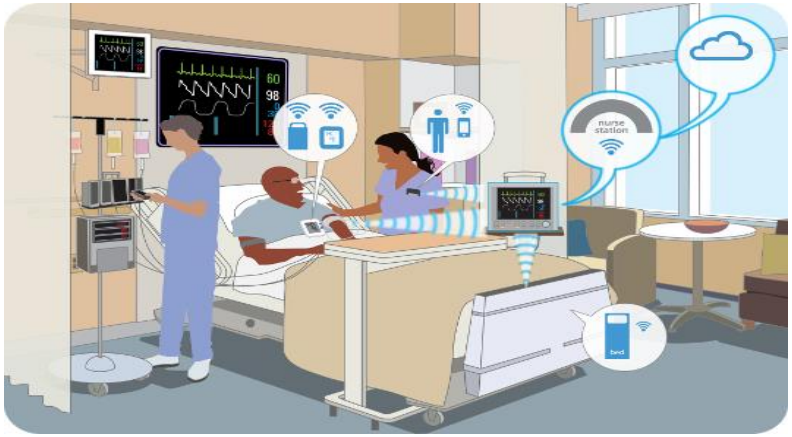
- In 2017, Cisco Systems estimates that these new connections will lead to $19 trillion in profits and cost savings

Where is IoT?

Wearable
Tech Devices

Smart Appliances

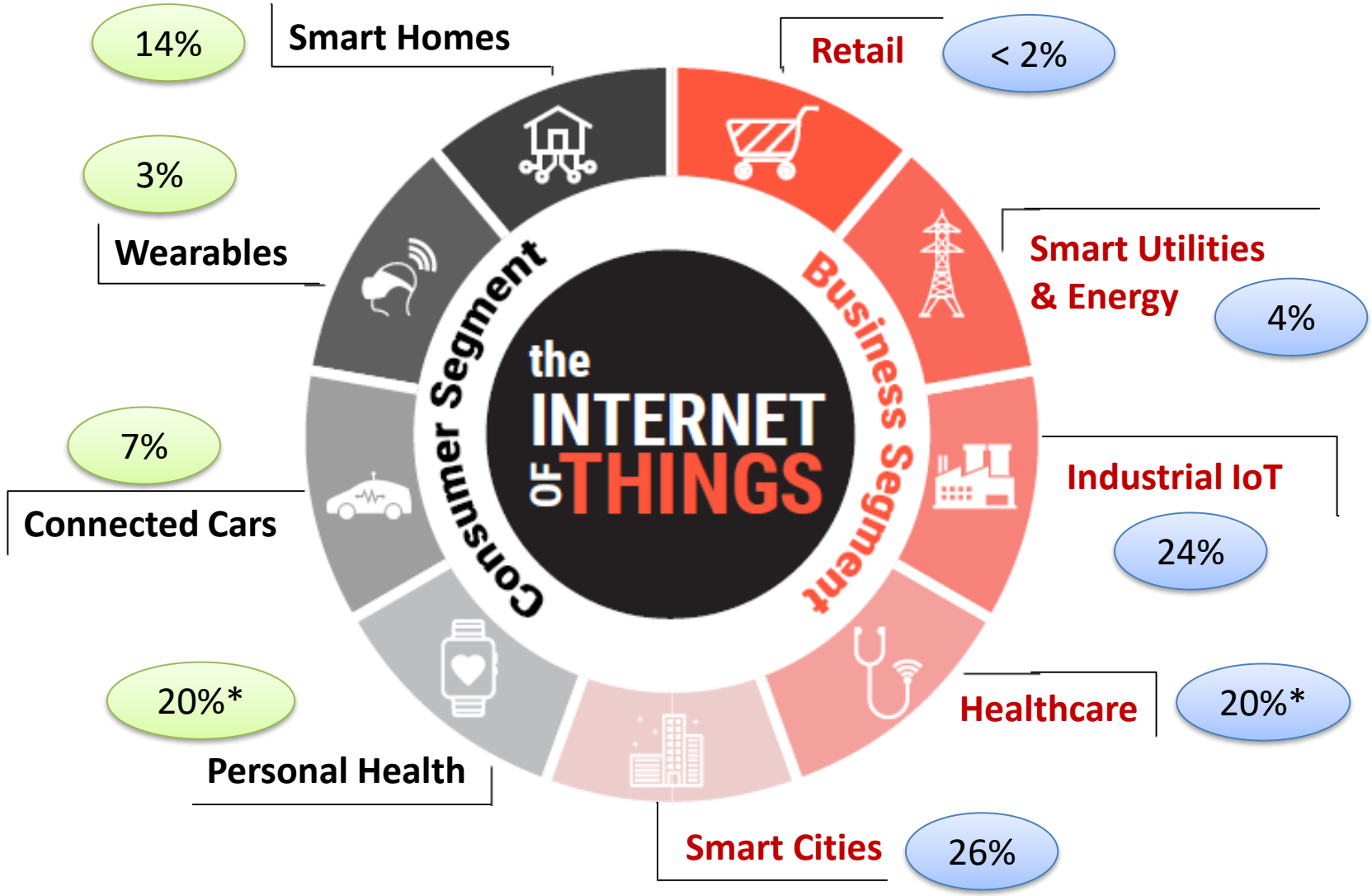
It's everywhere!



Healthcare

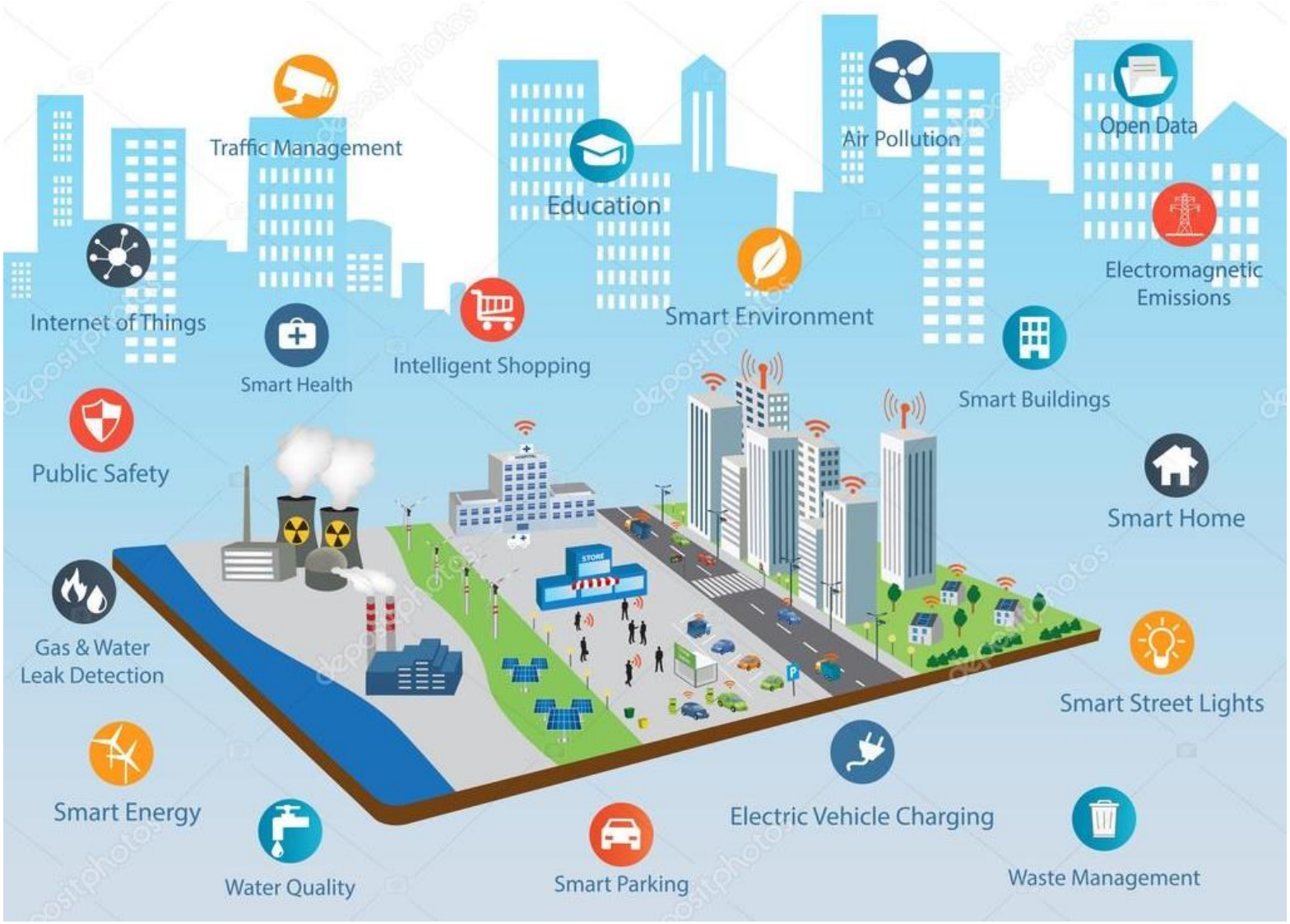
Industry Automation
and Monitoring

Global IoT Market Share



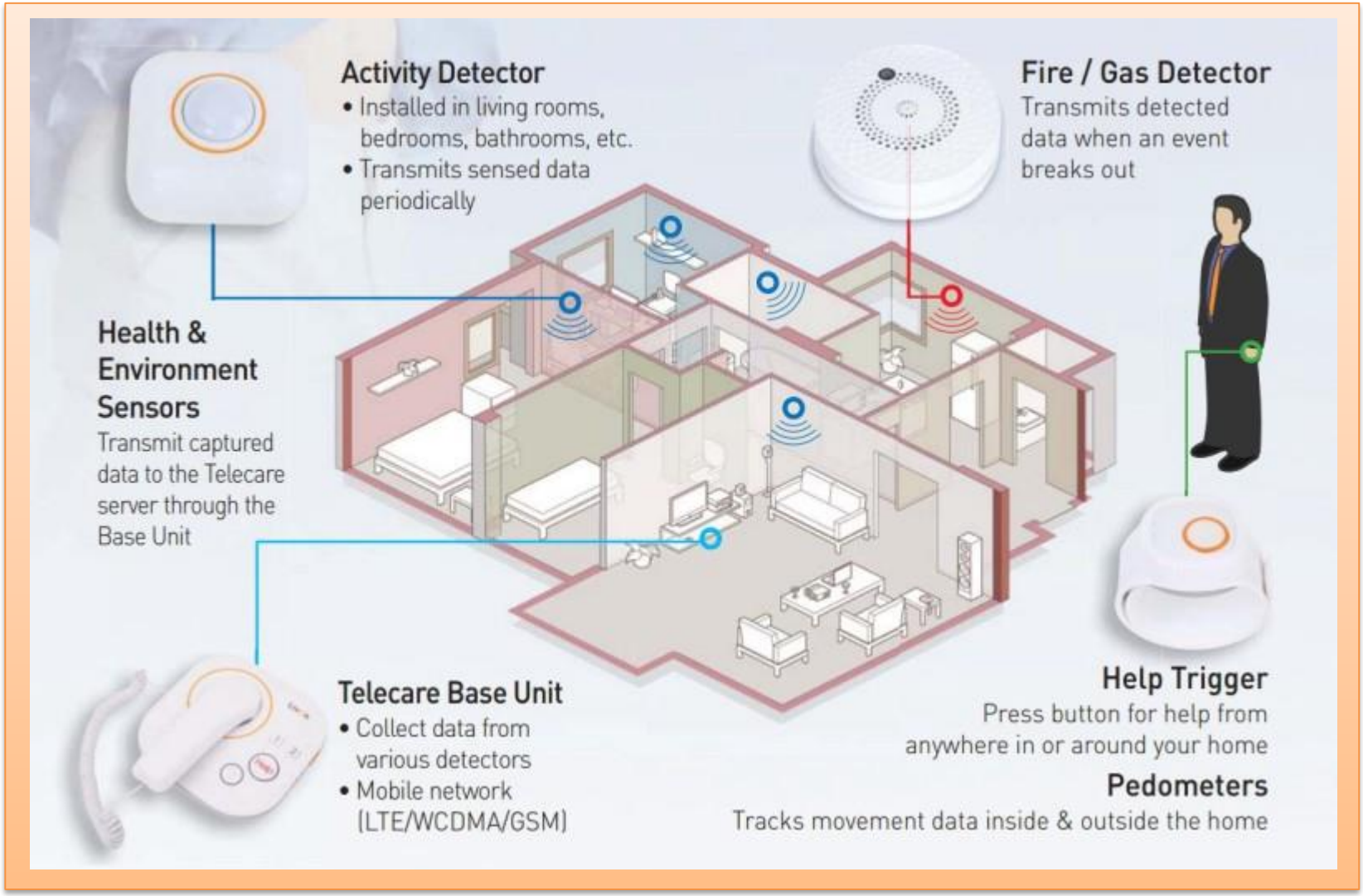
Source: https://growthenabler.com/flipbook/pdf/IOT%20Report.pdf

Smart City



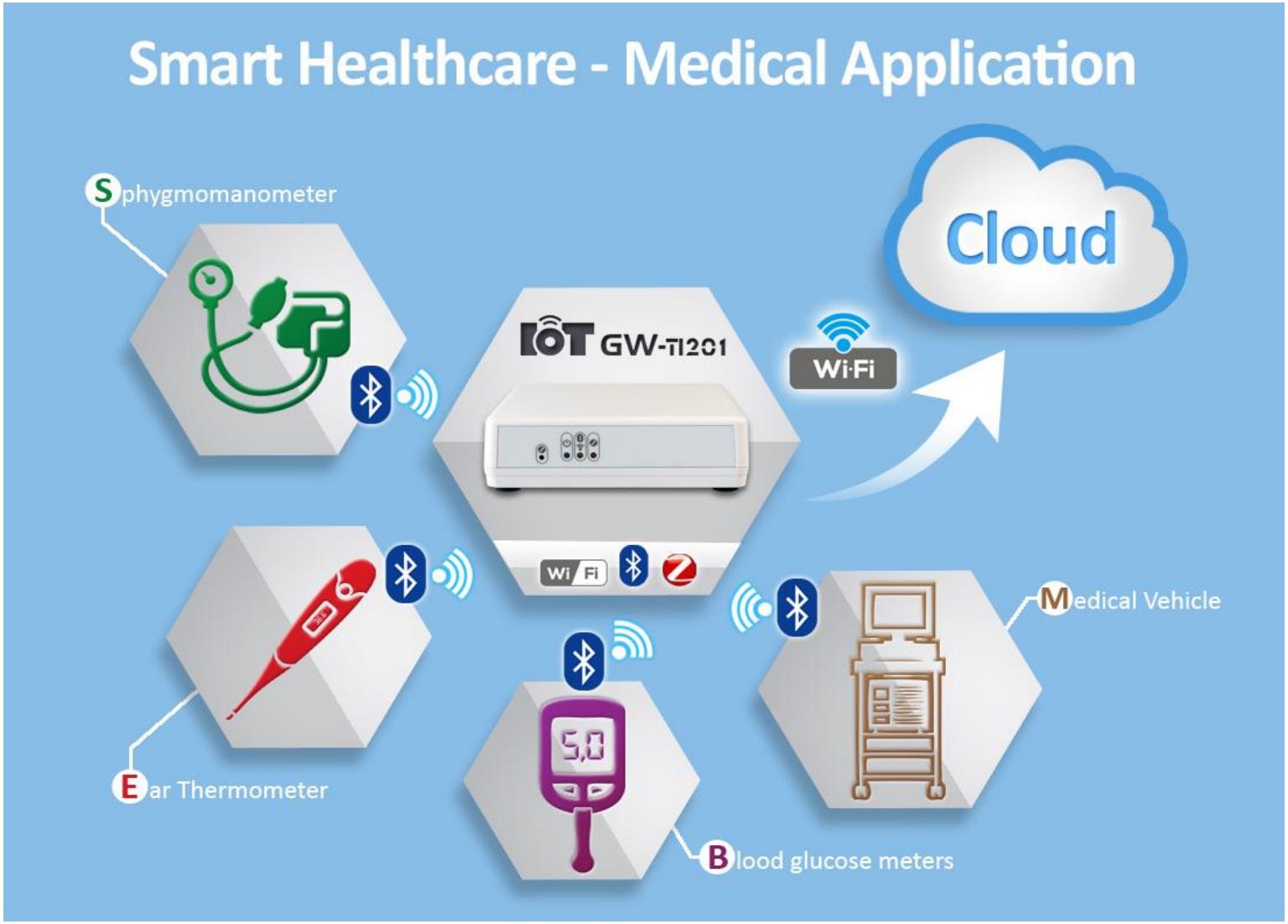
Source: https://depositphotos.com/126025652/stock-illustration-smart-city-concept-and-internet.html

Smart Home



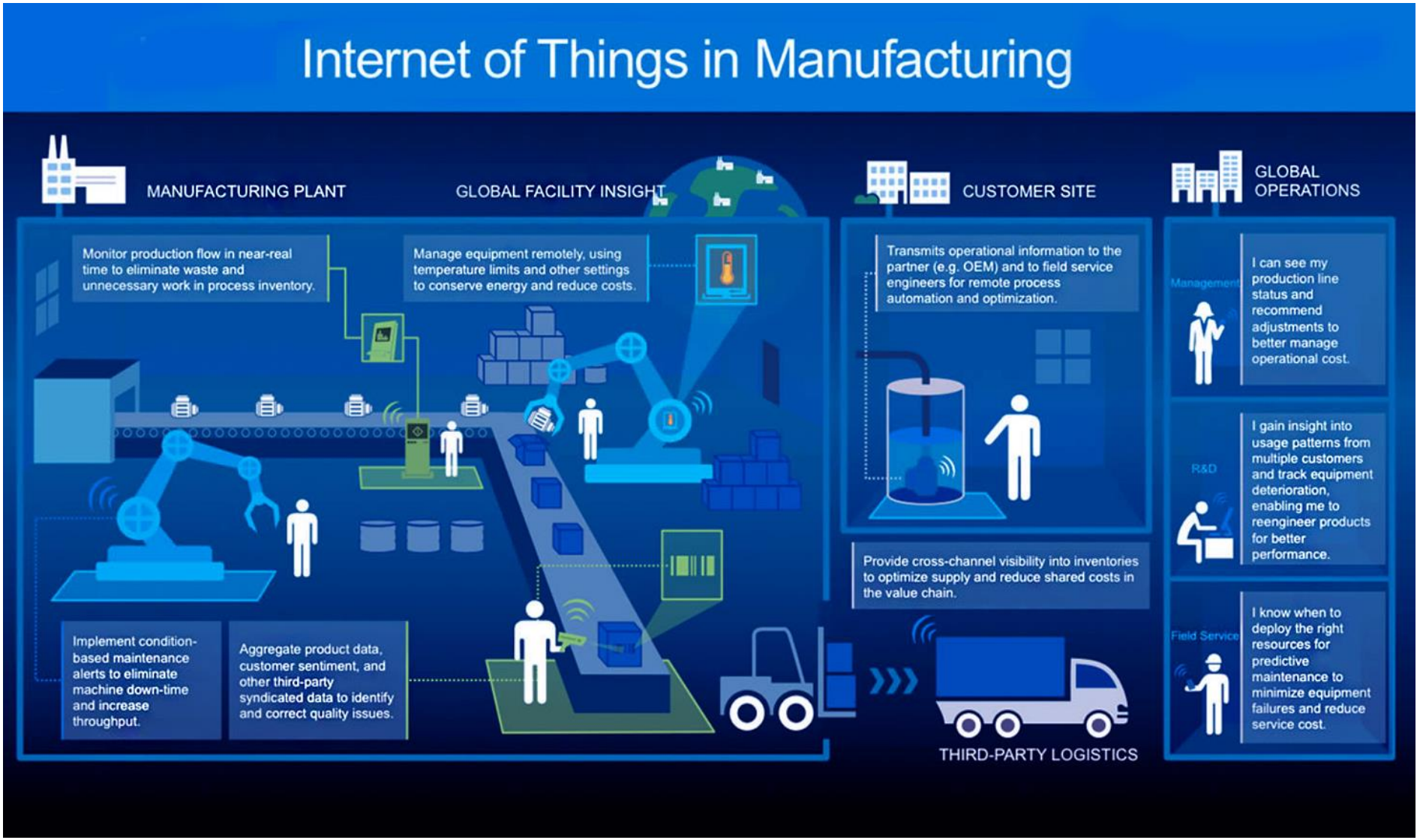
Source: https://medium.com/@globalindnews/north-america-accounted-for-major-share-in-the-global-smart-home-healthcare-market-in-2015-cc9cc1974ac5

Smart Healthcare



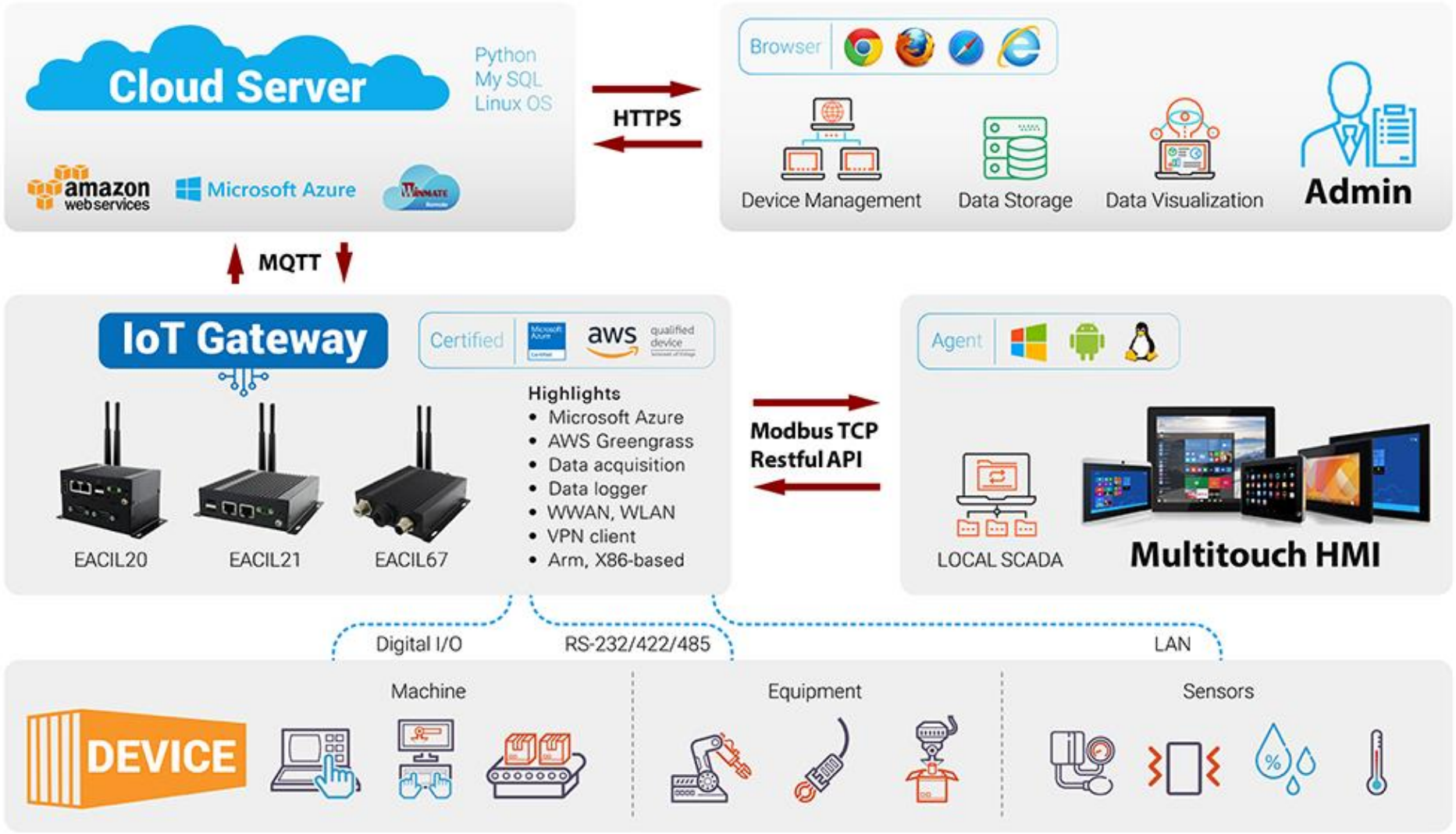
Source: http://iot.fit-foxconn.com/

Smart Manufacturing



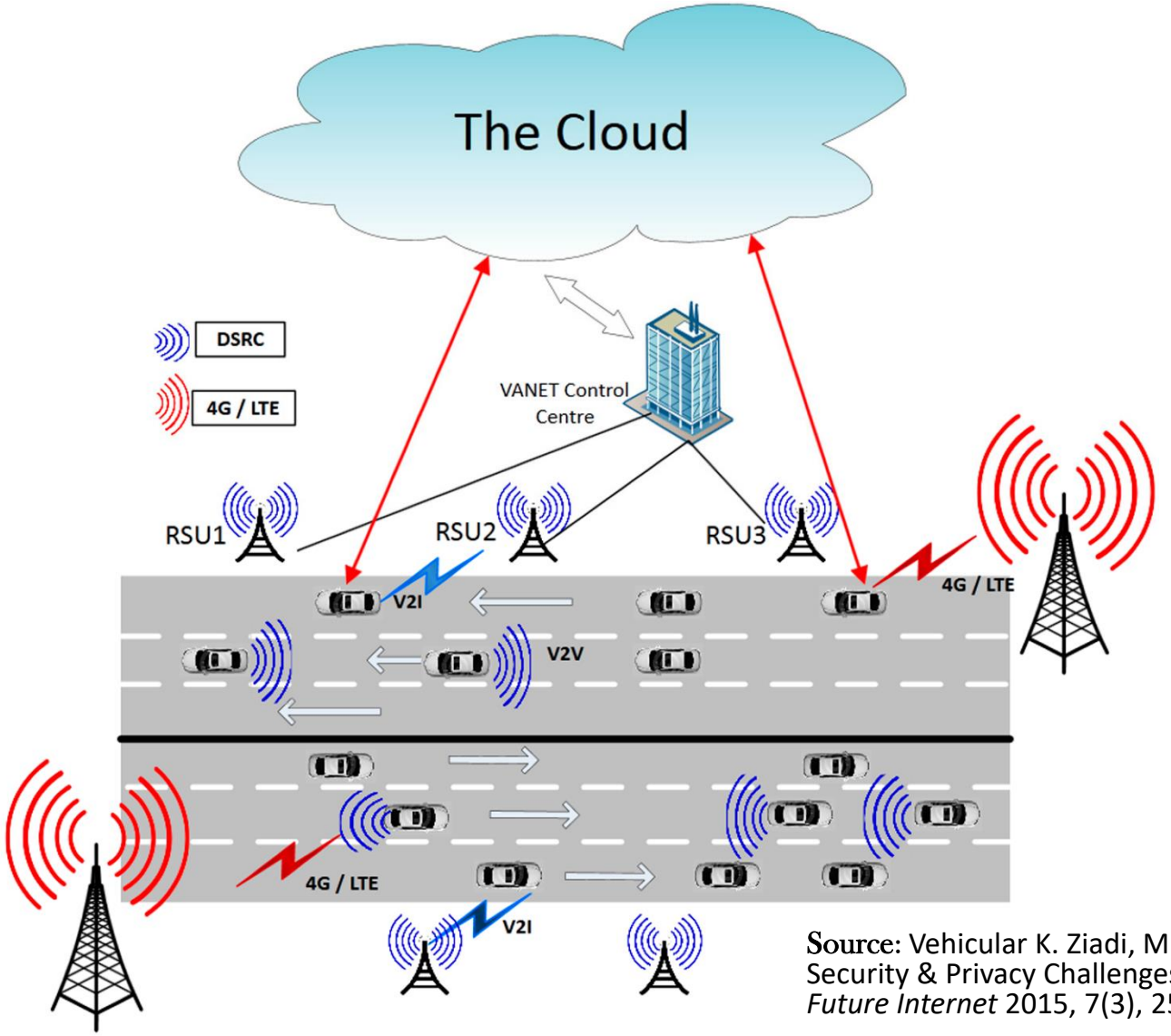
Source: https://data-flair.training/blogs/industrial-iot-applications/

Industrial IoT



Source: https://www.winmate.com/Solutions/Solutions_IoT.asp

Connected Cars



Source: Vehicular K. Ziadi, M. Rajarajan, "Internet: Security & Privacy Challenges and Opportunities", *Future Internet* 2015, 7(3), 257-275.

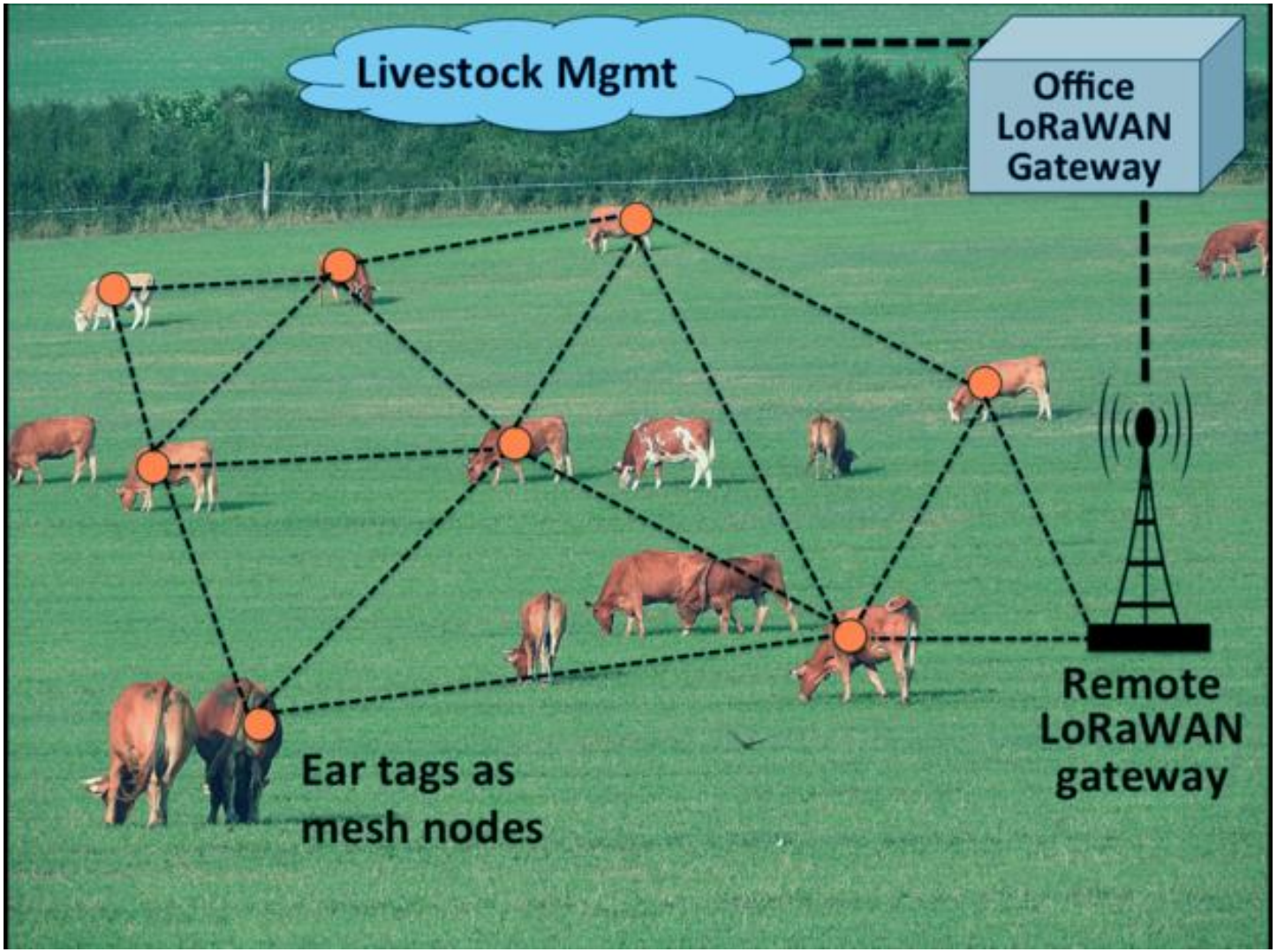
Google's Self-Driving Car

Source: https://www.google.com/

Smart Agriculture

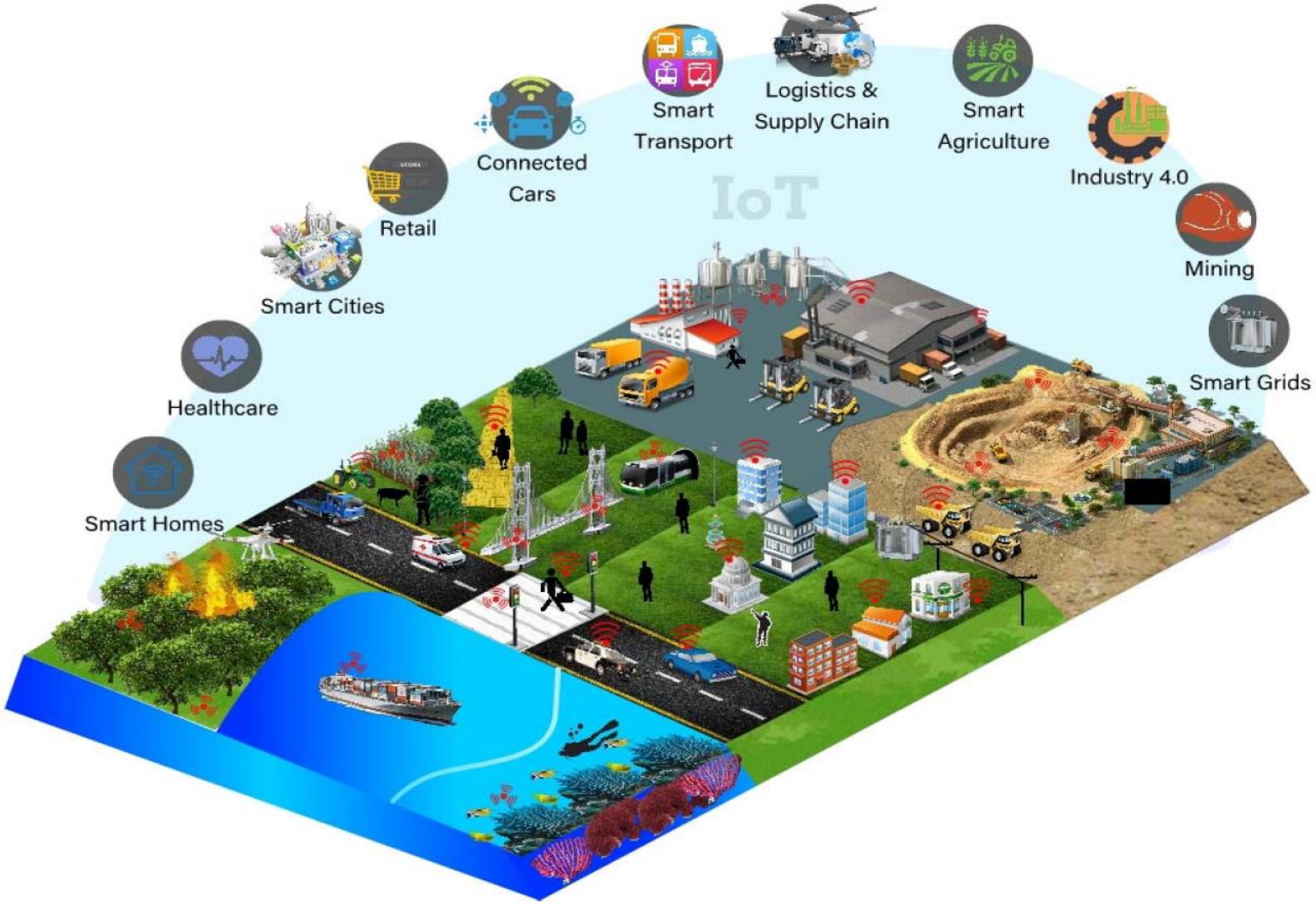
Source: https://in.pinterest.com/pin/515380751093603767/?lp=true

Livestock Management



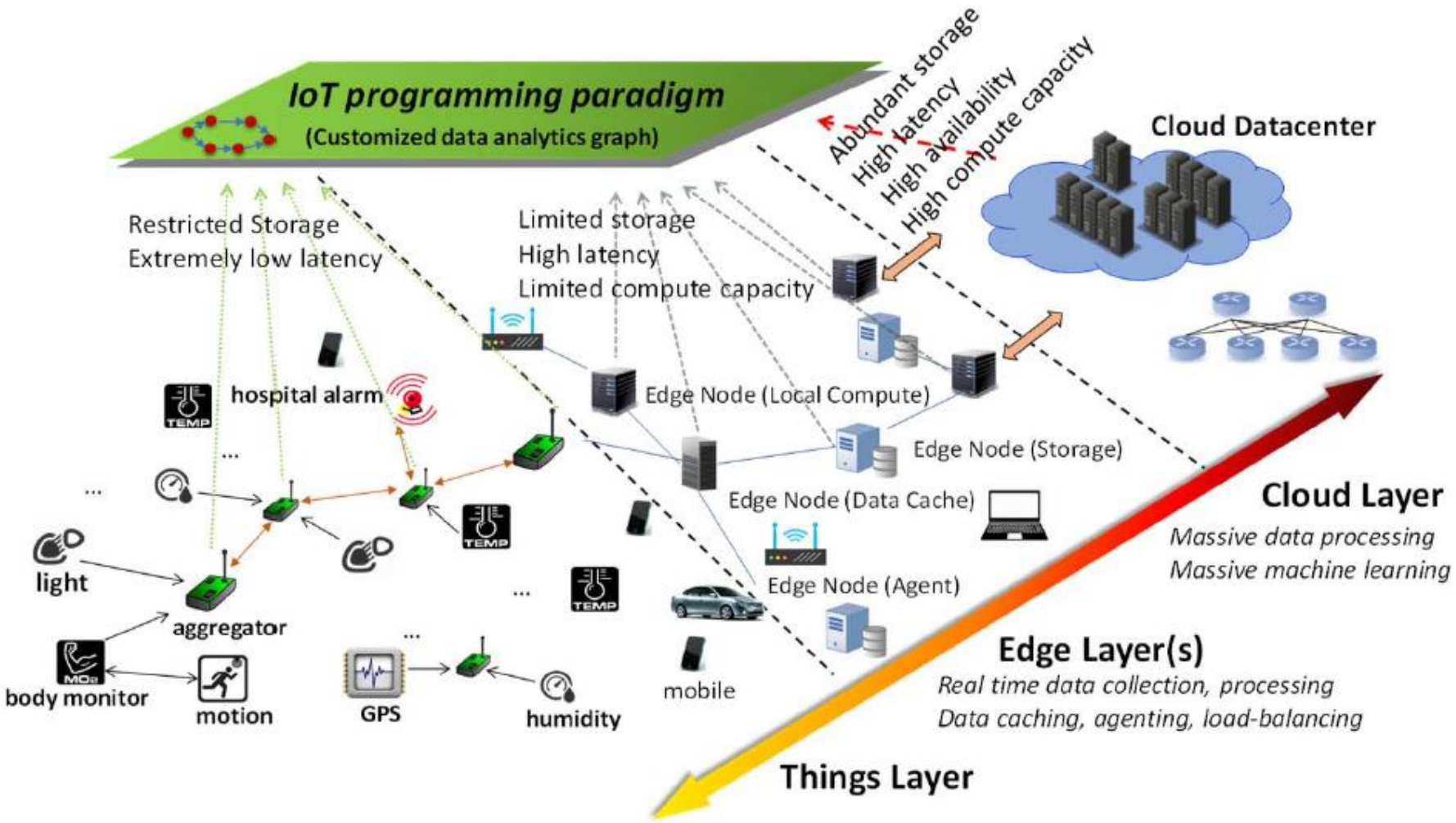
Source: https://data-flair.training/blogs/iot-applications-in-agriculture/

Many More ….



Source: Rajiv Ranjan *et. al.,* "Integrating the IoT and Data Science" *IEEE Cloud Computing*, 2018

How IoT works?



Source: Rajiv Ranjan *et. al.*, "Integrating the IoT and Data Science" *IEEE Cloud Computing, 2018*

Main Challenges in IoT

Sensors

- Limited resources
- Limited types of sensors

Scale

- millions of devices are connected to form IoT

Privacy

- which personal data to share with whom
- how to control

Security

- "things" becomes connected, so security becomes complex

Low Power Network

- Devices should remain connected to the Internet for years
- High network latency

Big data and Data analytics

- massive amount of sensor data
- different sources and various forms
- extract intelligence form the heaps of data

Interoperability

- various protocol, various architecture
- unavailability of standardized platform
- different technology leads to interoperability issue
- Recent IoT standards are minimizing this problem

Lessons Learned

- Learned about what is IoT
- Learned the genesis of IoT
- Understand the benefits of IoT
- Learned about the market share of IoT
- Understand the real world applications of IoT
- Understand various challenges IoT implementation is facing

Thanks!

Figures and slide materials are taken from the following Books:

1. David Hanes *et al.*, "**IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things**", 1st Edition, 2018, Pearson India.

2. Mayur Ramgir, "**Internet of Things: Architecture, Implementation and Security**", 1st Edition, 2020, Pearson India.