



Internet of Things

Definition of Internet of Things

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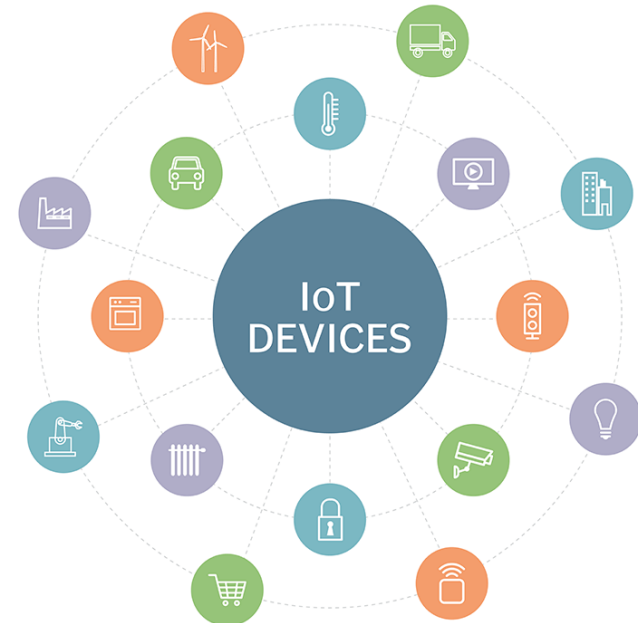
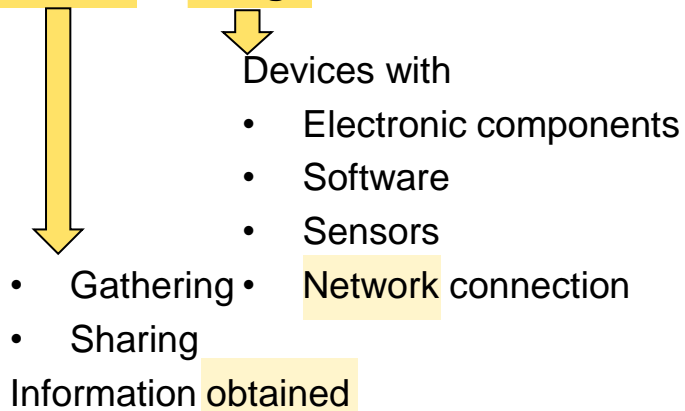
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CONTENT

1. Overview
2. Applications
3. Potential
4. Challenges
5. Performance measures

IoT overview

What is Internet of Things?



[<https://internetofthingsagenda.techtarget.com/definition/IoT-device>]

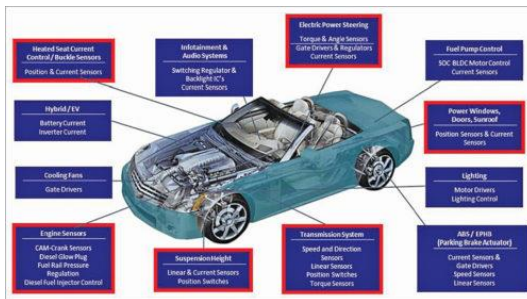
What does it allow?

- “Things” to be controlled remotely
- More direct integration between physical and virtual
- Improves:
 - Efficiency
 - Precision
 - Economical benefits

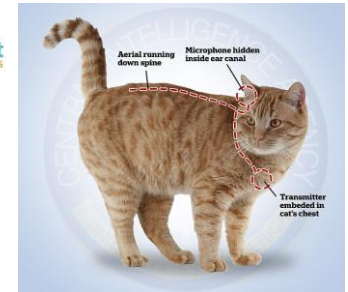
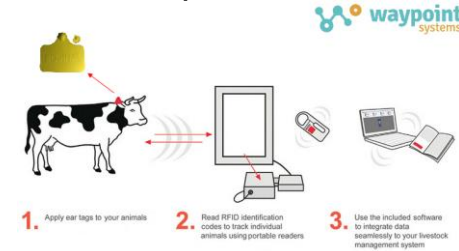
IoT Overview

What “things”?

Cars with embedded sensors



Microchips in animals



Implants that monitor heart problems



“Smart fitness” devices



Firefighter assistance devices



Sources

- <http://waypoint-systems.com/Blog/?p=133>
- <https://www.dailymail.co.uk/sciencetech/article-4455714/The-CIA-implanted-microphones-skin-CATS.html>
- <https://electronicsforu.com/technology-trends/tech-focus/automobile-industry-sensor>
- <https://venturebeat.com/2019/01/16/medtronic-debuts-first-apps-to-let-heart-patients-monitor-their-pacemakers/>
- <http://blueapp.io/blog/iot-and-fire-safety-go-hand-in-hand/>
- <https://www.mi-store.se/en/sports-health/fitness-tracker/xiaomi-mi-band-4>

IoT Overview

How does it work?

By joining different technologies

Examples:

- “Miniaturization”
- Communication
- Cooperation
- Identification
- Routing
- Location
- Sensors
- Actuators
- Embedded processing
- Graphical interfaces

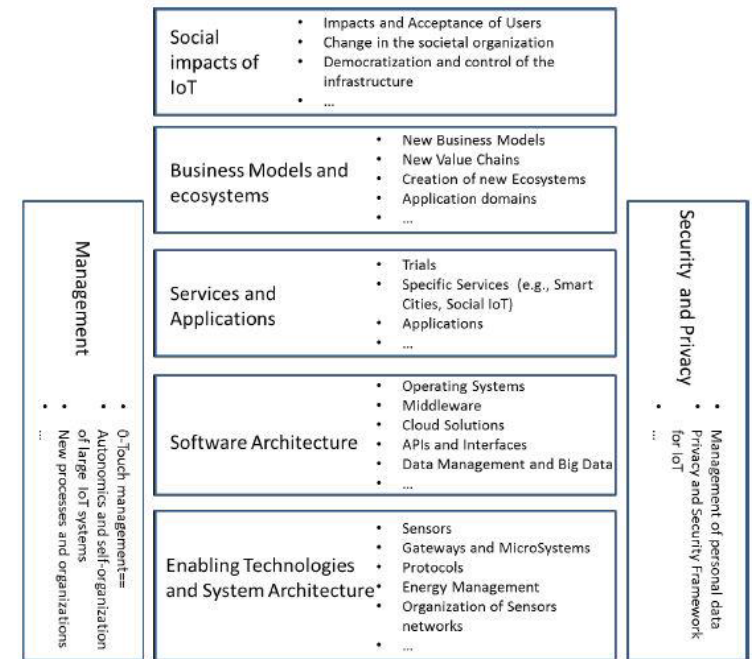
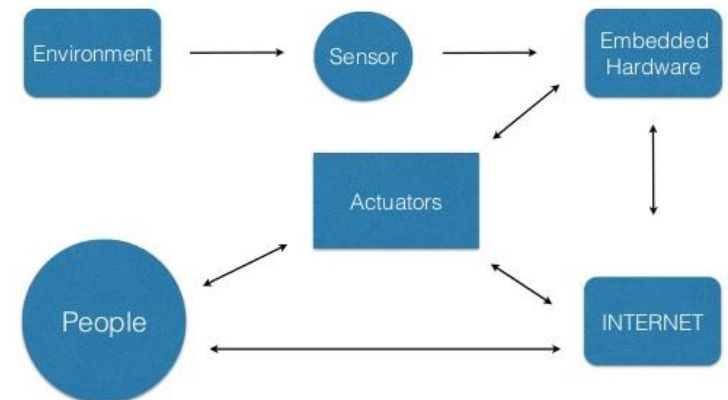


Figure 1. Technological and social aspects related to IoT

IEEE Internet of Things, “Towards a definition of the Internet of Things (IoT)”
Ver 1., 27 May 2015



[<https://www.navitrac.co.ke/iot/>]

IoT Overview



[<http://garibaldimortgage.com/the-smart-home-room-by-room-smart-home-series/>]

1) User is going out (detect user)

What kind of sensor?

Difference between father and son

Identify the reason of going out

Identify other things (example: store Schedule)

2) There is no milk (detect object)

What kind of sensor?

No milk, or not enough milk? (prediction)

3) Use the information to decide (processing)

Where is the processor?

What are the rules?

Fixed or dynamic rules (learning)

4) Inform the user (communicate)

How?

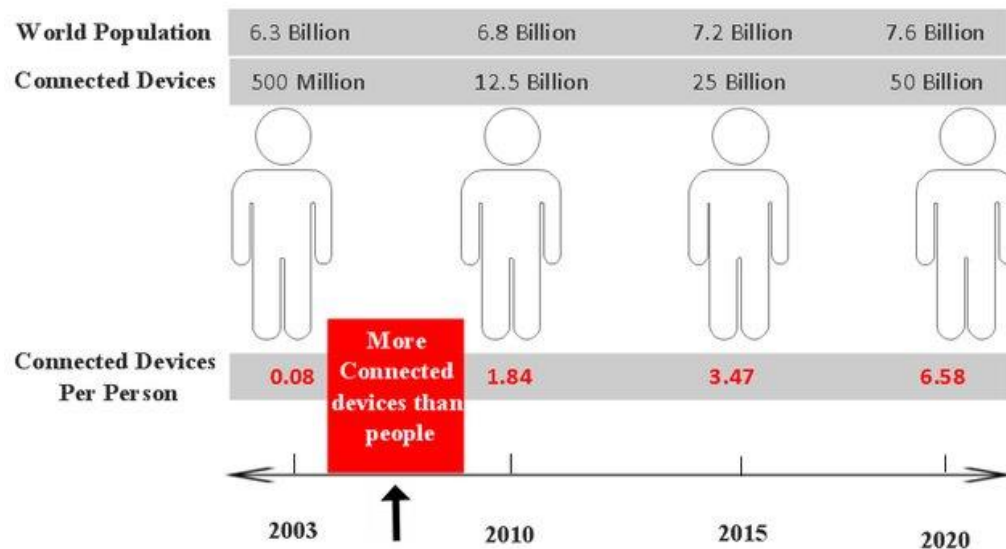
When?

Privacy?

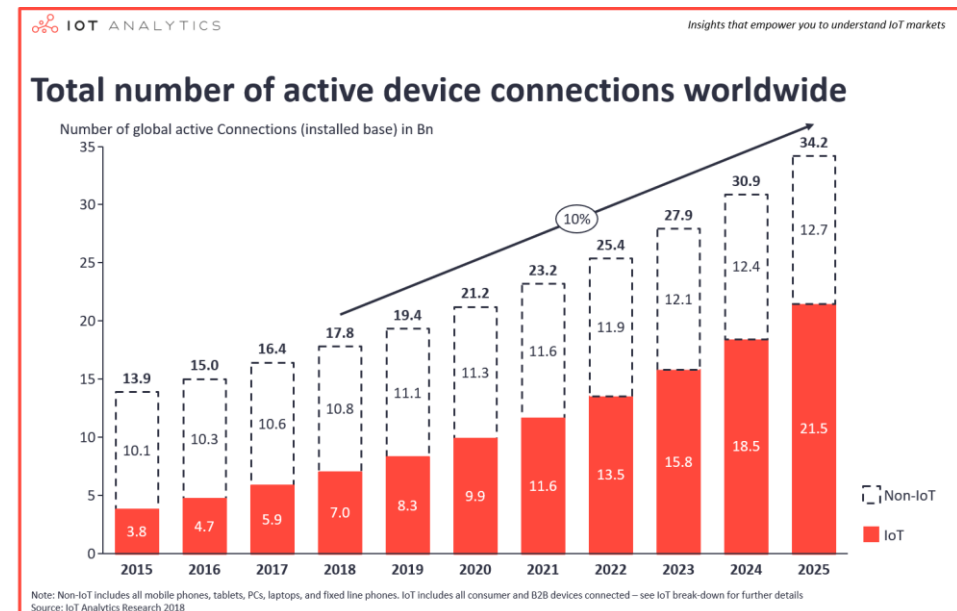
Information overload?

IoT Overview

How is the future?











Militano, L., Araniti, G., Condoluci, M., Farris, I., & Iera, A. (2015). Device-to-device communications for 5G internet of things. *EAI Endorsed Trans. Internet Things*, 1(1), 1-15.



[<https://iot-analytics.com/state-of-the-iot-update-q1-q2-2018-number-of-iot-devices-now-7b/>]

IoT Applications

<p>Transport & Logistics</p>  <p>Fleet management, Goods tracking</p>	<p>Utilities</p>  <p>Smart metering, Smart grid management</p>	<p>Smart cities</p>  <p>Parking sensors, Waste management, etc.</p>	<p>Smart building</p>  <p>Smoke detector, Home automation</p>
<p>Consumers</p>  <p>Wearables Kids/senior tracker</p>	<p>Industrial</p>  <p>Process monitoring & control, Maintenance monitoring</p>	<p>Environment</p>  <p>Food monitoring/alerts, Environmental monitoring</p>	<p>Agriculture</p>  <p>Climate/agriculture monitoring, Livestock tracking</p>

Boulogeorgos, A. A. A., Diamantoulakis, P. D., & Karagiannidis, G. K. (2016). Low power wide area networks (Ipwans) for internet of things (iot) applications: Research challenges and future trends. arXiv preprint arXiv:1611.07449.

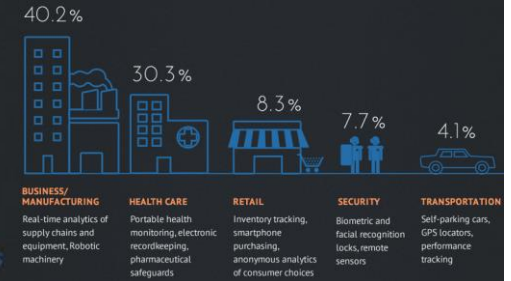
IoT potential

THE INTERNET OF THINGS EVOLUTION OR REVOLUTION?



The "Internet of Things" is exploding. It's made up of billions of "smart" devices--from miniscule chips to mammoth machines--that use wireless technology to talk to each other (and to us). Our IoT world is growing at a breathtaking pace--from 2 billion objects in 2006 to a projected 200 billion by 2020.

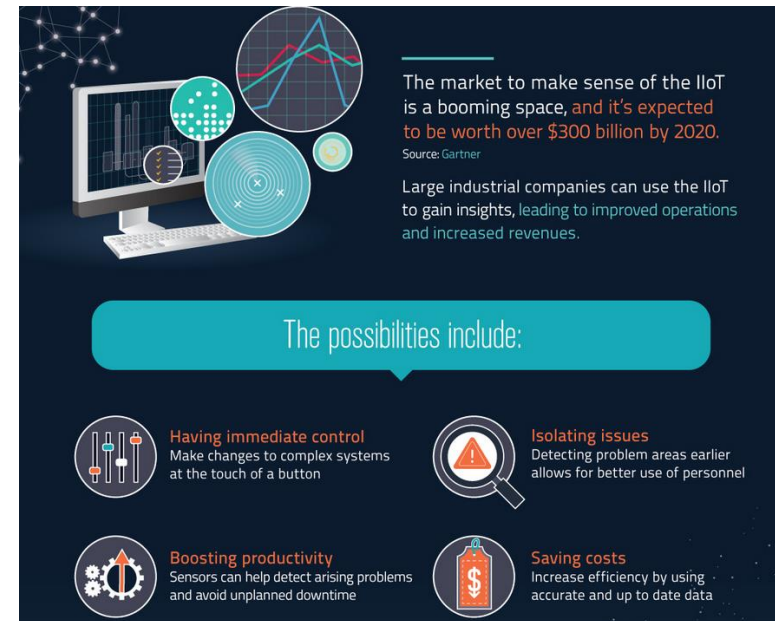
By the way, that will be around
26 SMART OBJECTS
 for every human being on Earth.



SOURCES: IDC, Intel, United Nations

The potential for IoT?

The power of IoT is not the data that already exists.
 But the potential data that can be harvested from the world.



[<https://www.visioncritical.com/blog/internet-of-things-infographics>, Last updated April 14, 2019]

IoT Challenges

Scalability
 Technological Standards*
 Interoperability
 Discovery
 Software complexity
 Data interpretation and volume
 Power source
 Interaction and short-range communication
 Wireless communication
 Error tolerance

*ex: <https://standards.ieee.org/initiatives/iot/index.html>



Farhan, L., Shukur, S. T., Alissa, A. E., Alrwag, M., Raza, U., & Kharel, R. (2017, December). A survey on the challenges and opportunities of the Internet of Things (IoT). In 2017 Eleventh International Conference on Sensing Technology (ICST) (pp. 1-5). IEEE.

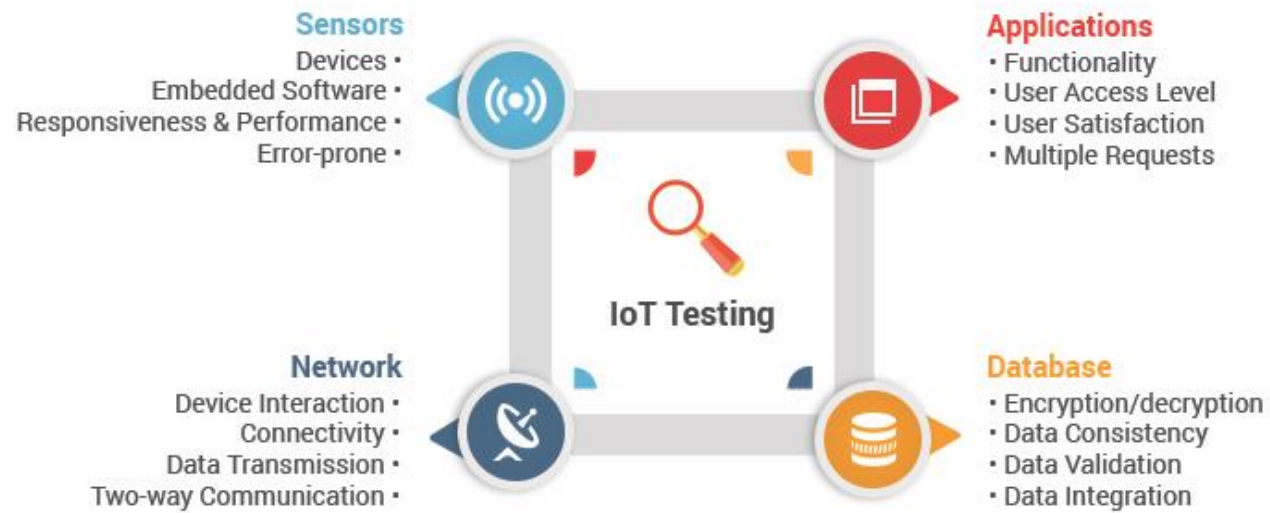
IoT Challenges

Possible problems regarding:

- Privacy
- Safety
- Autonomy and control
- Social control
- Political manipulation
- Environmental impact
- Moral decision-making influence
- ...



IoT performance metrics



Value = Connected devices + Connected users



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Do conhecimento à prática.