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We have also completed the Online Tutorial on avoiding plagiarism 'Ready, Steady, Write', located at <http://tcd-ie.libguides.com/plagiarism/ready-steady-write>.

We declare that the assignment being submitted represents our own work and has not been taken from the work of others save where appropriately referenced in the body of the assignment.

Alessandro Gatti | Gavin Pacini | Zied Brini  
Cs3103 – Business, Management and IT by Diana Wilson

University of Dublin, Trinity College  
School of Computer Science and Statistics

Monday 12<sup>th</sup> of December 2016

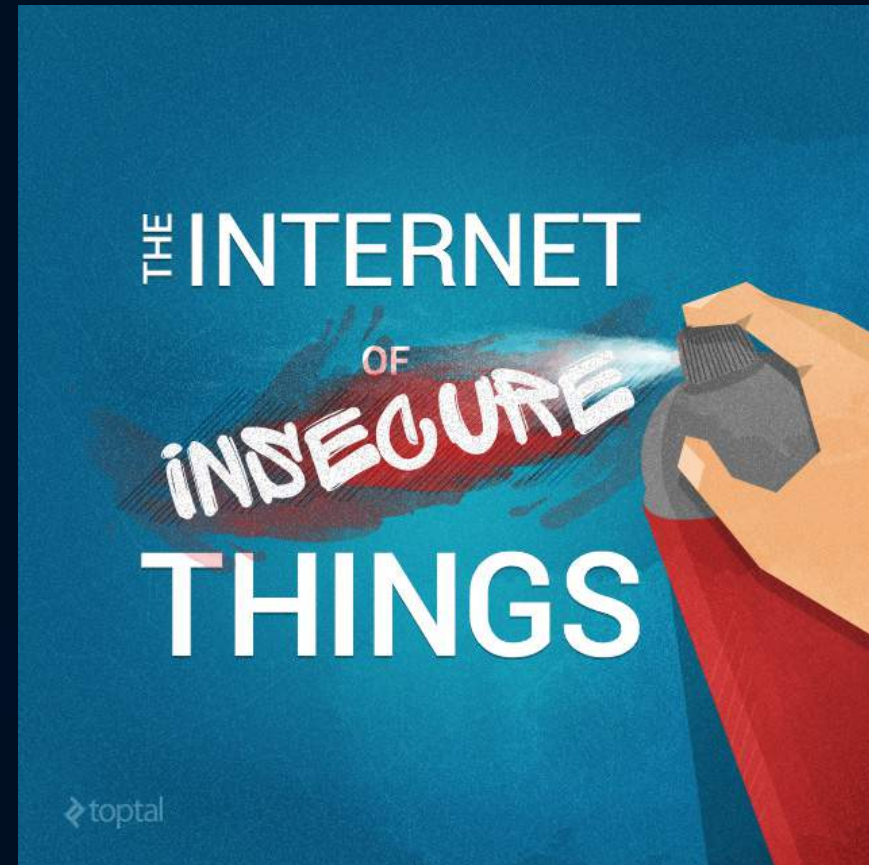
*\*\* Please find references from [slide 30](#) \*\**

# Security and IoT

The background of the slide is a dark blue gradient. On the right side, there is a complex, abstract pattern of curved, overlapping lines in various shades of blue, creating a sense of depth and movement, reminiscent of a tunnel or a digital data flow.

# Few *secure* facts about IoT insecurity

- Dick Cheney turned off the Wi-Fi of his pacemaker because he was afraid of a hack by terrorists (Cbsnews.com, 2013).
- 21<sup>st</sup> of October 2016: massive DDoS attack due to Mirai IoT botnet
  - Amazon, Netflix, GitHub, Spotify, Twitter, etc. down (Hilton, 2016).
- In the USA, from the start of the year to the 10<sup>th</sup> of December 2016:
  - 957 Data Breaches exposed 35 million personal records ;
  - 43.7% belongs to Medical / Health Care Category (Identity Theft Resource Center, 2016)



(Toptal, 2016)



# Research Question

SECURITY ISSUES SURROUNDING CRITICAL INTERNET OF  
THINGS PERSONAL MEDICAL DEVICES

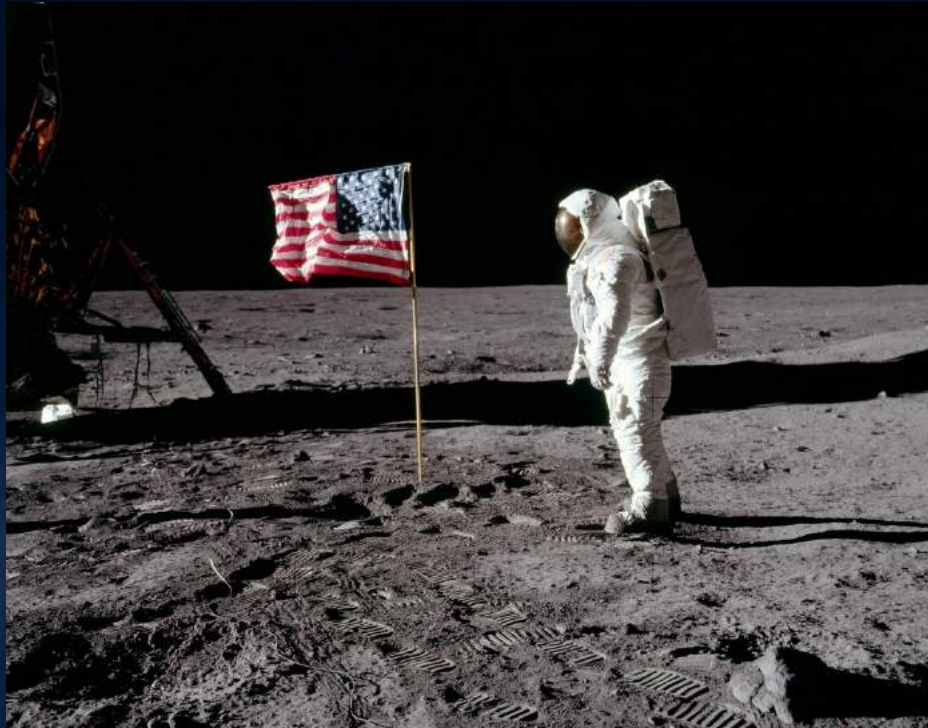
# Internet of Things

Context, definition and applications



(TIBCO Blog, 2016)

# Examples of “connected things”



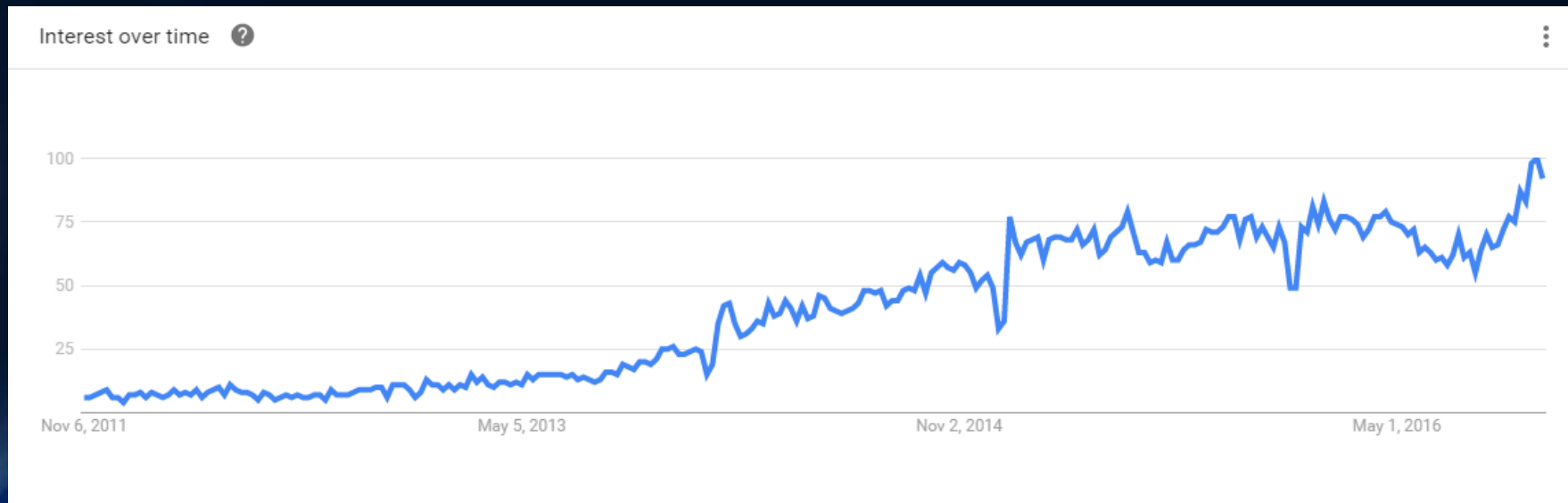
(NASA, 2016)



(Livinginternet.com, 2016)

# IoT as a concept

- Term appeared formally at the MIT in 1999 in the context of RFID technology (Ashton, 2009).
- Internet searches for this term increased exponentially in the past 5 years (Google, 2016).



(Google Trends, 2016)

# IoT, from emerging technology to mainstream adoption

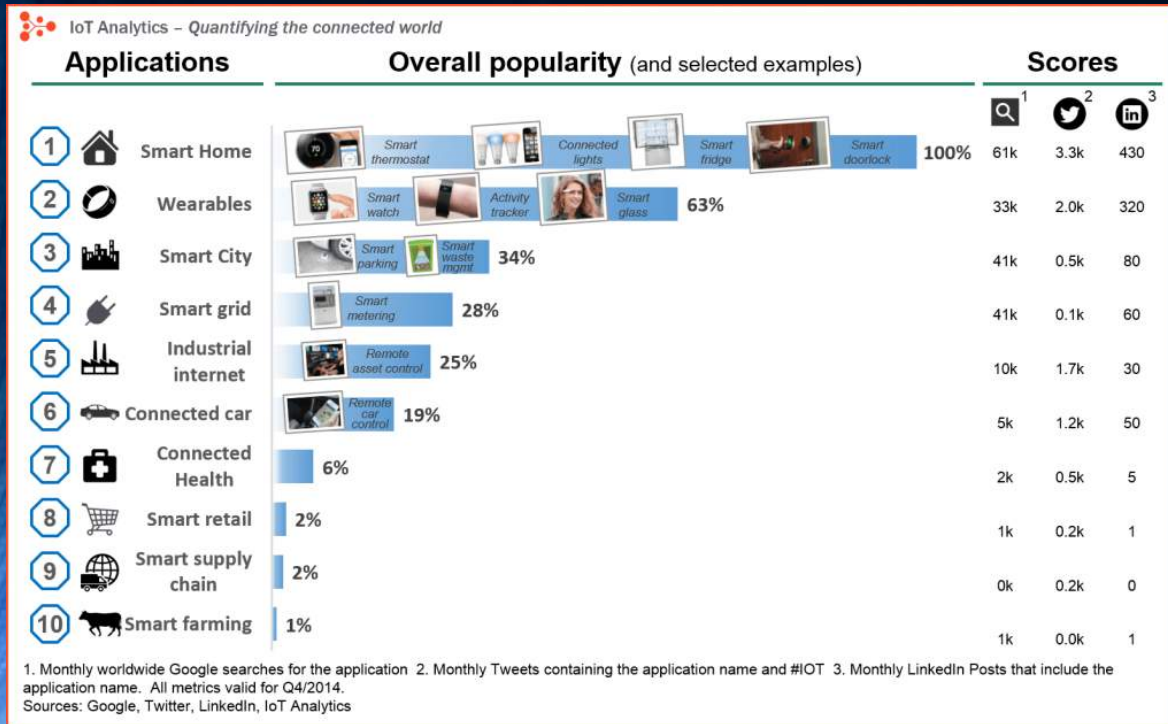
- 2011: qualified as an emerging technology – “technology trigger” (Gartner, 2011)
- 2015: 4.9 billion devices connected to the Internet (Gartner, 2015).
- 2016: not an emerging technology anymore (Gartner, 2016).
- 2020: 20.8 billion connected devices predicted (Gartner, 2015).



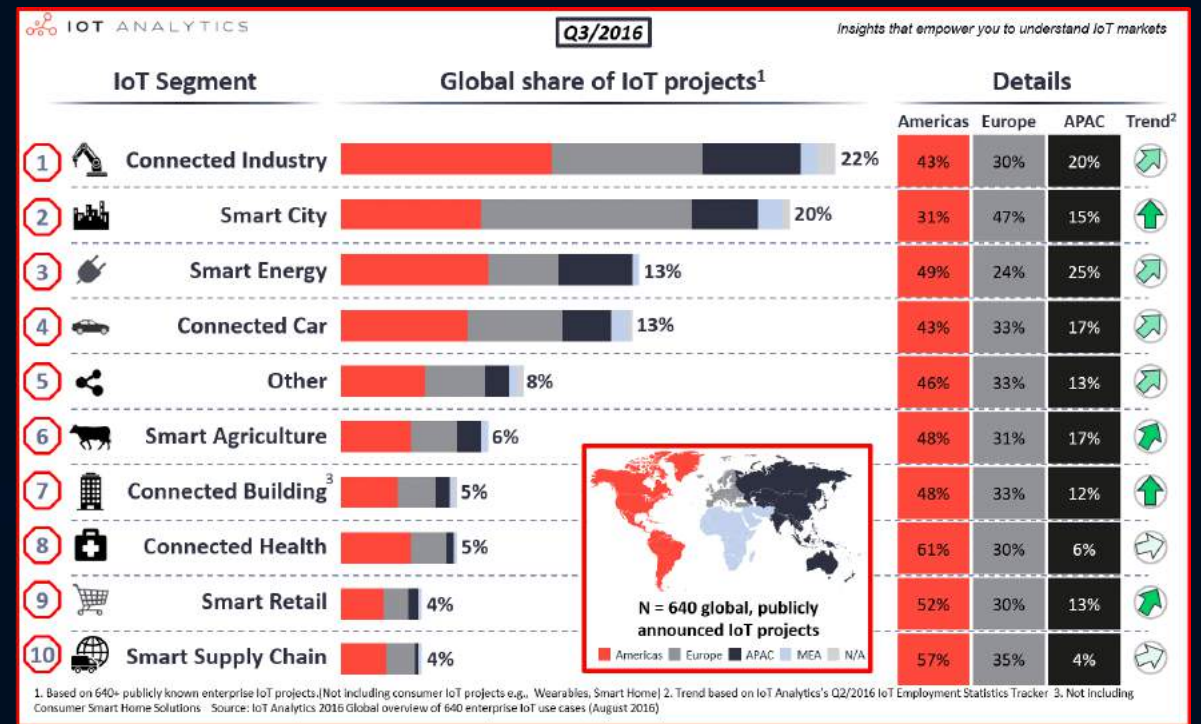
*“IoT is a system of interrelated computing devices, mechanical and digital machines, objects, animals or people that are provided with unique identifiers and the ability to transfer data over a network without requiring human-to-human or human-to-computer interaction.”*

Rouse, 2016

# Applications of IoT



(Lasse Lueth, 2015)



(Bartje, 2016)

# Critical Applications of IoT

**Smart City**

**Connected Car**

**Connected Health**

**Smart Retail**

**Smart Supply Chain**

**Smart Home**

-

**Connected Building**

**Smart Grids**

-

**Smart Energy**

**Smart Farming**

-

**Smart Agriculture**

# IoT for Medical Devices

Context and definition



(Encircle.io | Blog, 2015)



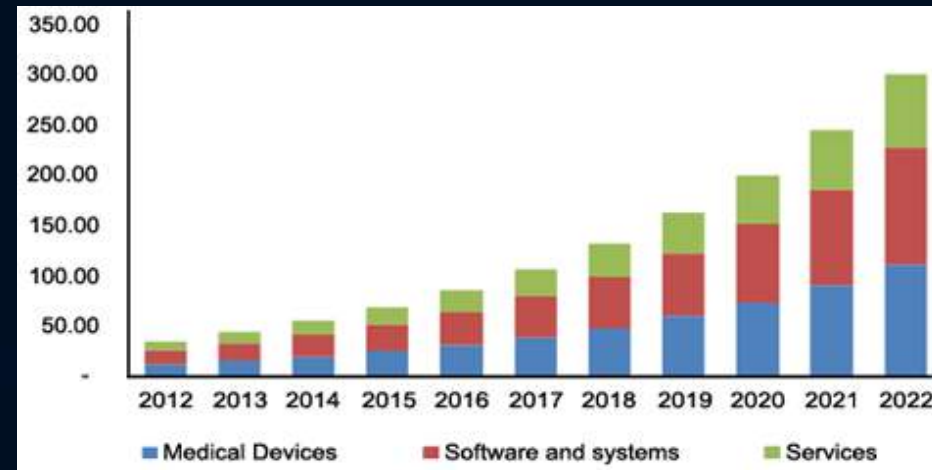
# Business Value

## GLOBAL MARKET VALUE

- 2014 - \$58.4 billion
- 2022 - \$410 billion predicted

(GrandView Research, 2016)

## NORTH AMERICA BY SEGMENT



(GrandView Research, 2016)

*"IoT-MD is about remote delivery of healthcare services over the telecommunications infrastructure".*

Rouse, 2016

# Examples of existing IoT-MD



(Owlet Baby Care, 2016)



(Med Device Online, 2016)



# New trends in IoT-MD - Airwaves



(Conseil Général du Loiret, 2015)



(VT Networks, 2016)



# IoT-MD Security issues

On-going and perspectives



(Bites and Bytes Blog, 2015)

*“There is a significant danger that [an attacker] could leverage an IoT malware or a worm to “brick,” or kill, infected medical devices in order to cause panic, extort a ransom, or as part of a multi-tiered attack”.*

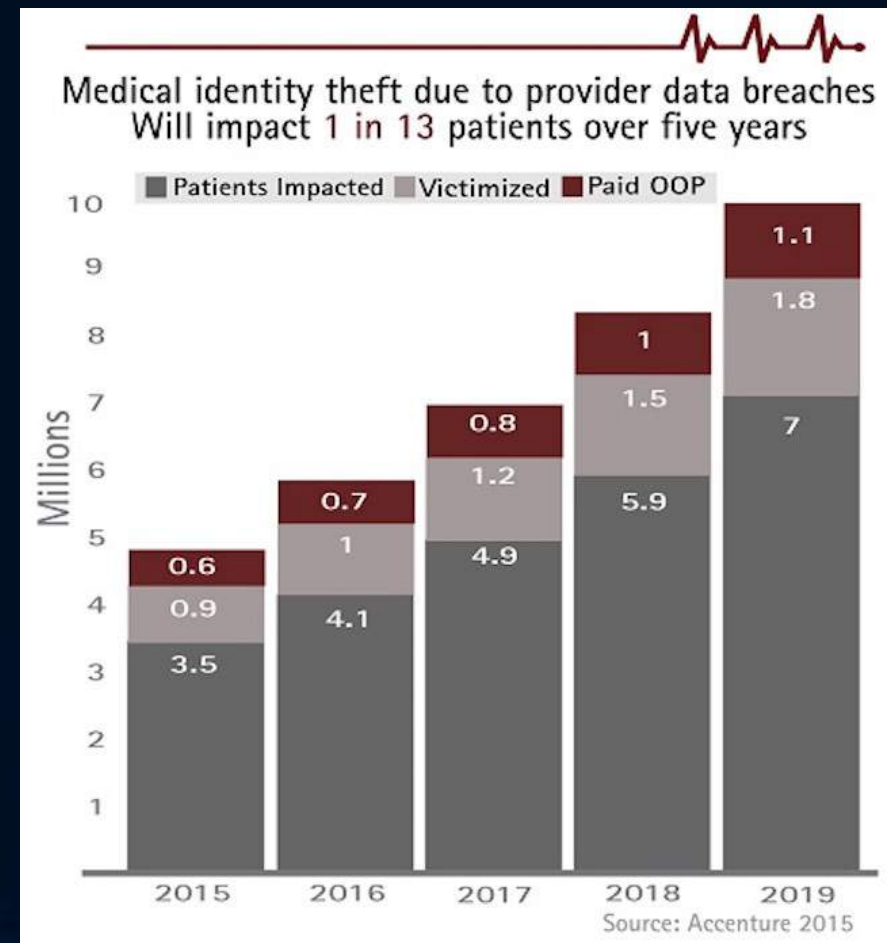
US Institute for Critical Infrastructure Technology, 2016

# Past examples of security issues

- Mainly data breaches in healthcare industry
  - 2015 78.8 millions of Anthem customers data was hacked – largest health care breach ever;
  - 2015 113 million medical records compromised;
  - Q1 2016 3.5 million medical records leaked, only in the US;
  - 2016 average of four data breaches per week (Akpan, 2016).
  - Sept 2016 World Anti-Doping Agency or [WADA](#) hack (World Anti-Doping Agency, 2016)
- IoT-MD
  - Pacemaker hacked for research purposes (Storm, 2015).

# Perspective IoT-MD security issues

- Increase of data breaches against monetisation
  - June 2016: Hacker asks for 750 BTC (\$500,000) against 9.3 million patients records (Mearian, 2016).
  - \$305 billion cost for hospitals over the next five years (Accenture, 2015)



(Accenture, 2015)



# Futuristic scenario

- Transmit fake medical information to families and medical professionals.
- Voluntarily corrupt implanted medical devices for criminal purposes.
- Radical shift in the job specifications of healthcare professionals



(Donnelly, 2015)

# Current State of Security

Law & IT



(Patterson, 2015)

*“As the chairman pointed out, there are now computers in everything. But I want to suggest another way of thinking about it in that everything is now a computer: This is not a phone. It’s a computer that makes phone calls. A refrigerator is a computer that keeps things cold. ATM machine is a computer with money inside. Your car is not a mechanical device with a computer. It’s a computer with four wheels and an engine... And this is the Internet of Things, and this is what caused the DDoS [Distributed Denial of Service] attack we’re talking about”*

Bruce Schneier, 2016

# Legislative progressions

- 2012 European Commission public consultation about IoT (Digital Single Market, 2016).
- 2013 European Commission published “Internet of Things Factsheet Privacy and Security” (Digital Single Market, 2016).
- 2016 initiative “Digitising European Industry” emerging: *work in progress*, but still no regulation (Digital Single Market, 2016).



# Technological progressions

- Private Sector: Open Web Application Security Program (OWASP) have started an “Internet of Things” project (Klein, Keane and Zdjelar, 2016).
- Public Sector: US National Institute of Standards and Technology published a report which details methods and processes of how to secure IoT systems (System Security Engineering, 2016).

# Measures for protection



(Association for Computing Machinery, 2015)

# Security of Things

## FOR CONSUMERS

- Multi-factor authentication
  - Something you are
  - Something you have
  - Something you know
- Frequent Security Updates

## FOR MANUFACTURERS

- Secure coding guidelines
- Encryption
  - Networks
  - Data at rest

# Caveat Emptor

LEGISLATION? PUBLIC AWARENESS?



Any questions?

Thank you!



(Vaschenyuk, 2015)

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RANKED ALPHABETICALLY

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