INSTITUCIÓN UNIVERSITARIA DE ENVIGADO
Ciencia , educación y desarrollo
Vigilada Mineducación

IoT - Introduction

Prof. Jaime A. Riascos

Internet-of-Things

University Institution of Envigado (Colombia)

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Definitions

Internet

Internet

/ˈɪntənɛt/

noun

a global computer network providing a variety of information and communication facilities, consisting of interconnected networks using standardized communication protocols.
"the guide is also available **on the Internet**"

Definitions

Internet of Things

Internet of things

noun

the interconnection via the Internet of computing devices embedded in everyday objects, enabling them to send and receive data.
"if one thing can prevent the Internet of things from transforming the way we live and work, it will be a breakdown in security"

Definitions

Components of a typical computer

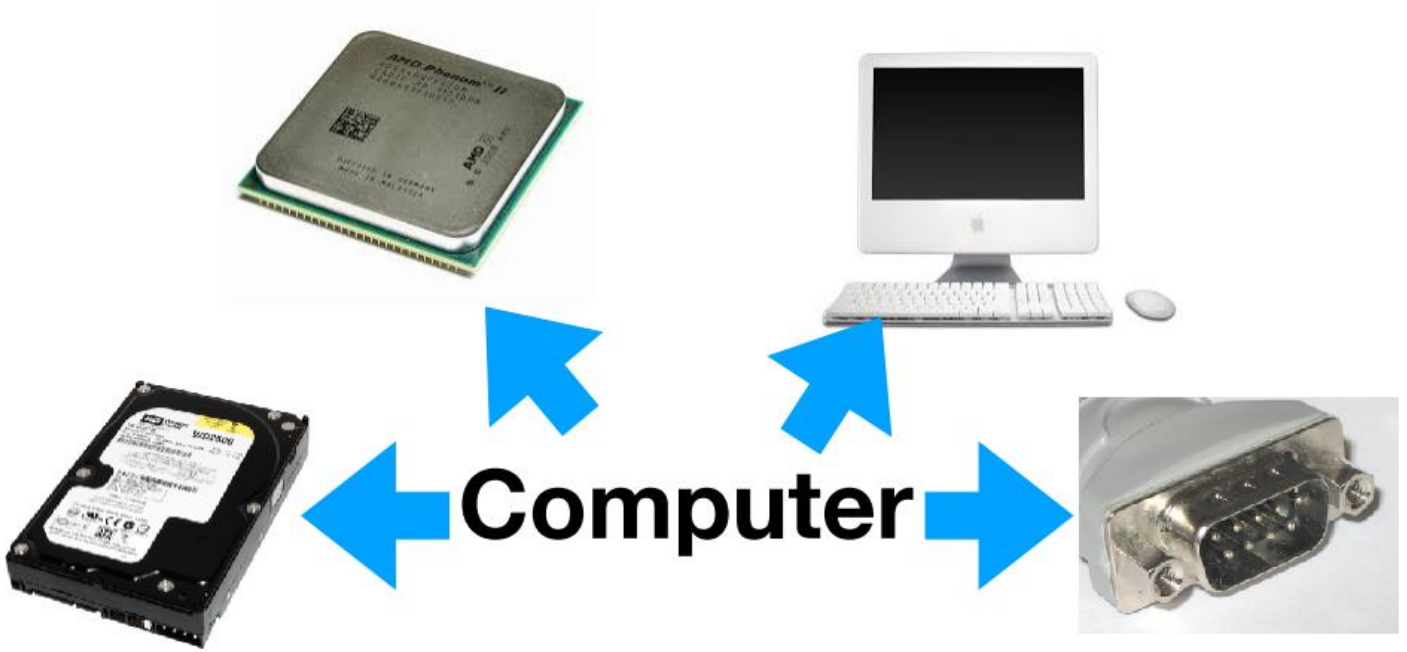
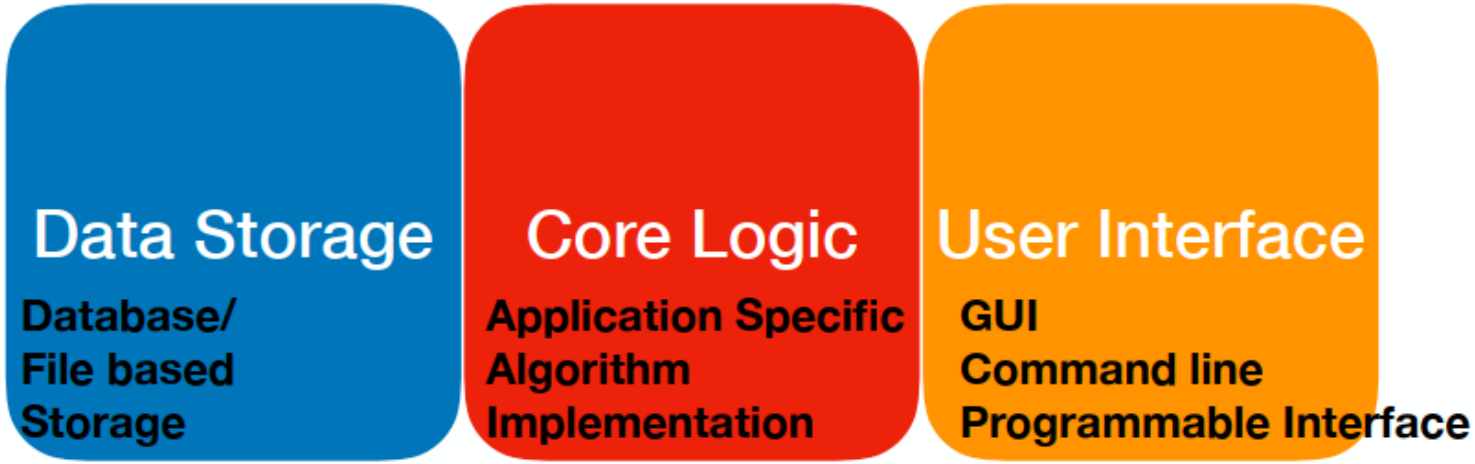


Image Sources: Wikipedia, Wikimedia

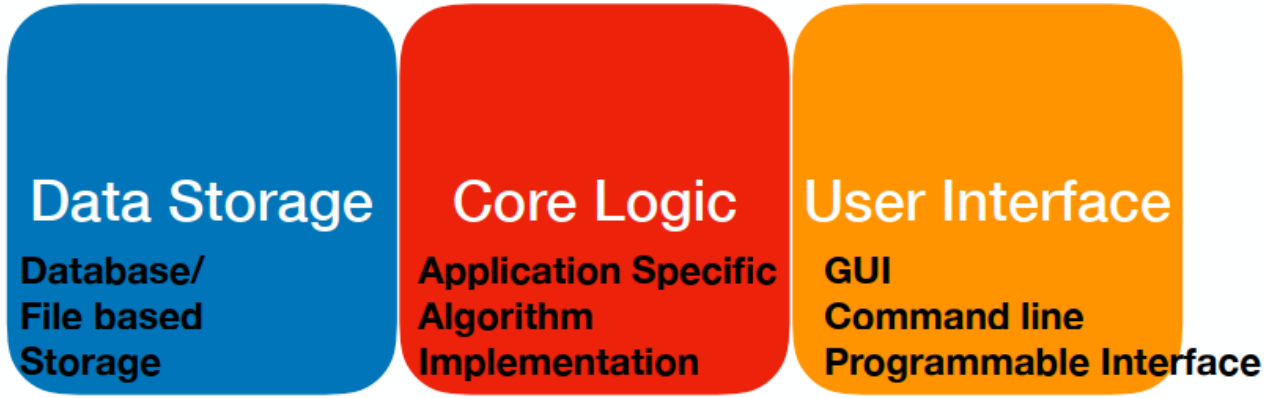
Definitions

Components of a typical software application



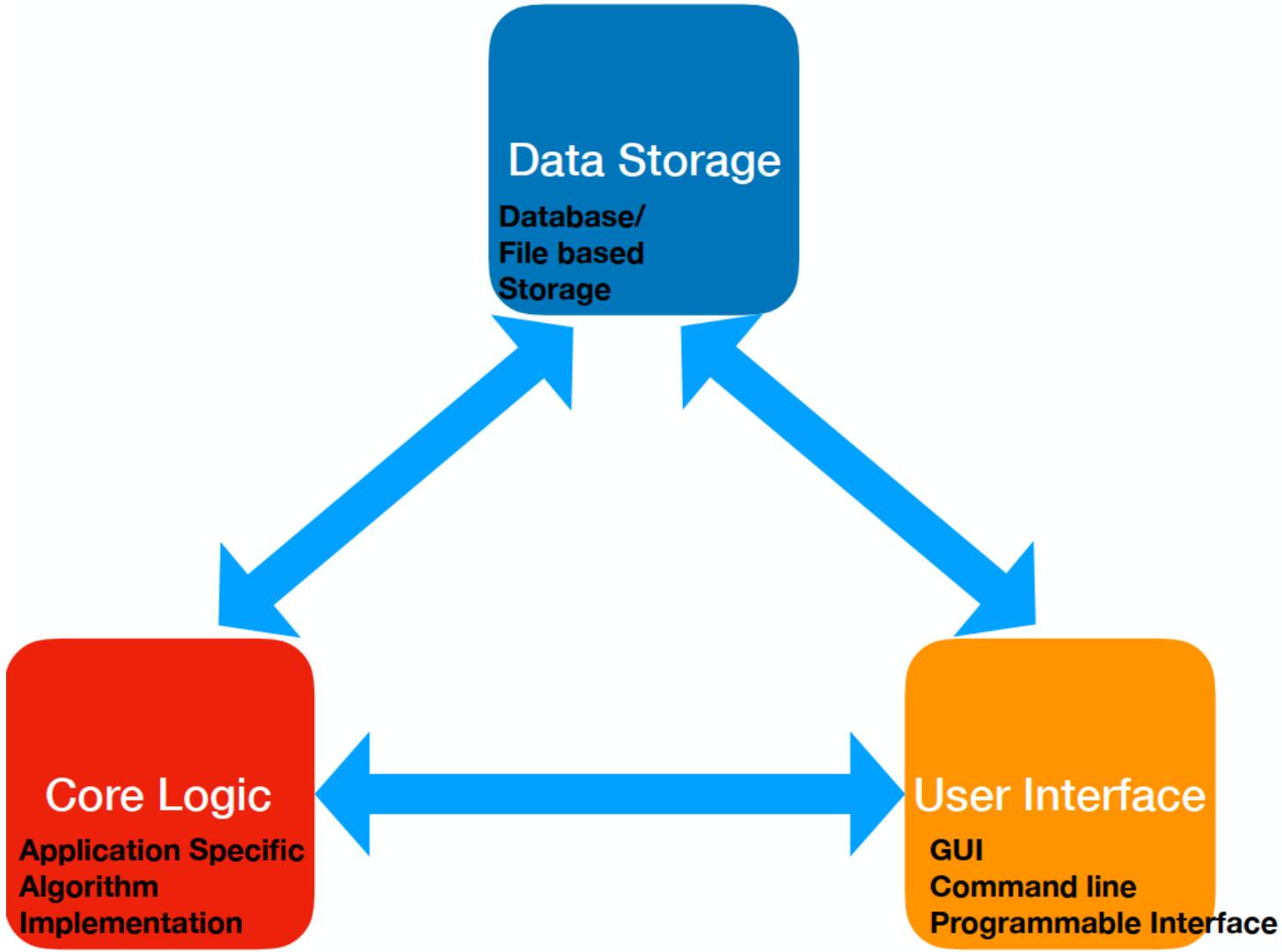
Definitions

Components of a typical software application



Traditionally the three components used to sit on the same computer

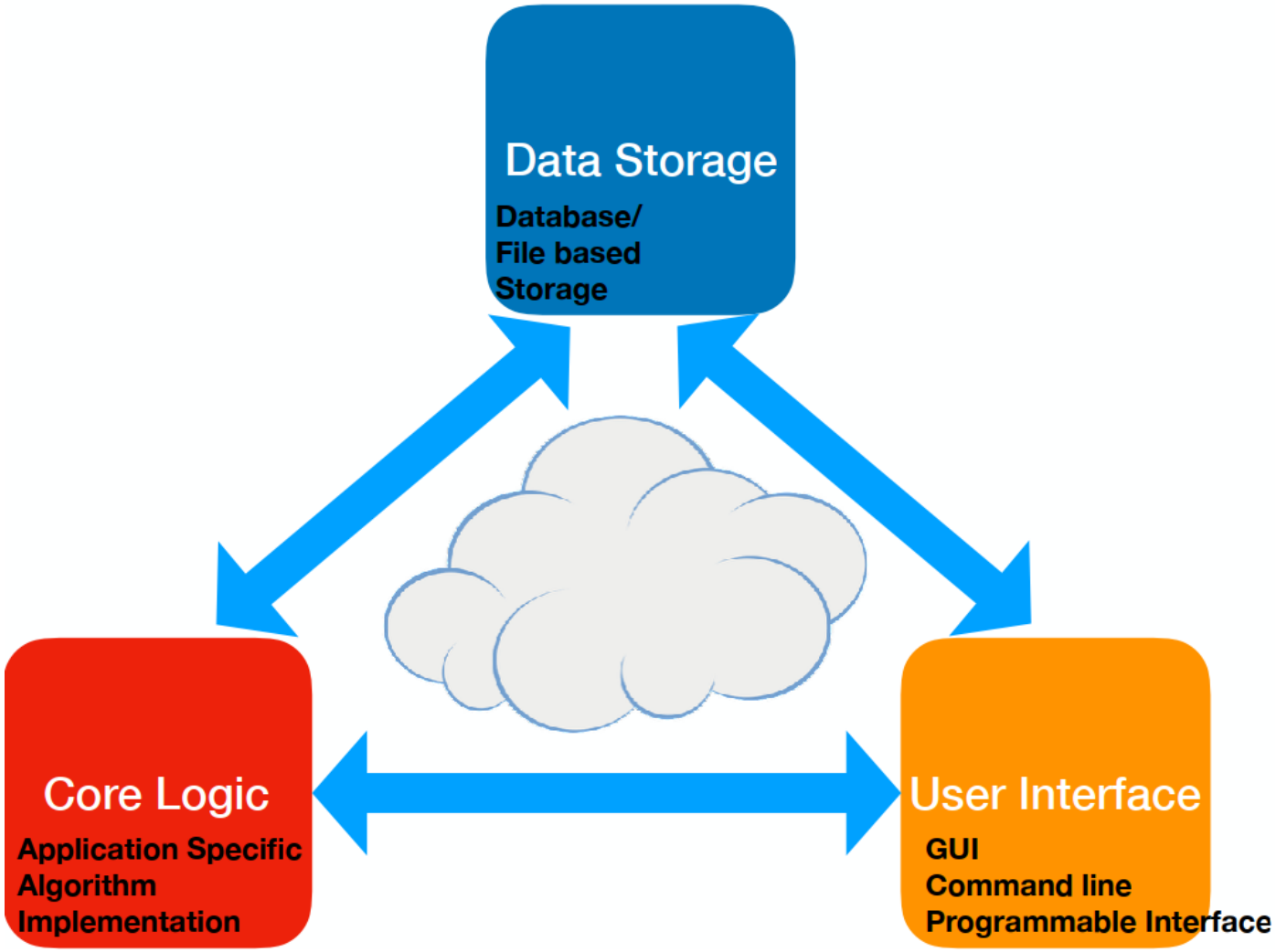
Definitions



Definitions

What's new?

Definitions



Definitions

Cloud Computing

cloud computing

noun

the practice of using a network of remote servers hosted on the Internet to store, manage, and process data, rather than a local server or a personal computer.

Definitions

What's new?

- Cloud computing reminds me of something very similar.
- Is this not same as **Distributed Computing?**
- If YES, what's the big deal?
- If NO, what is different?

Definitions

Cloud Computing

- Innovation not in the technology
- Innovation in the application of the technology
- Cloud computing consists of
  - Development of self contained components
  - Delivering these components as services
- Similar to utilities like electricity, mobile network
  - Pay-per-use, without large infrastructural cost

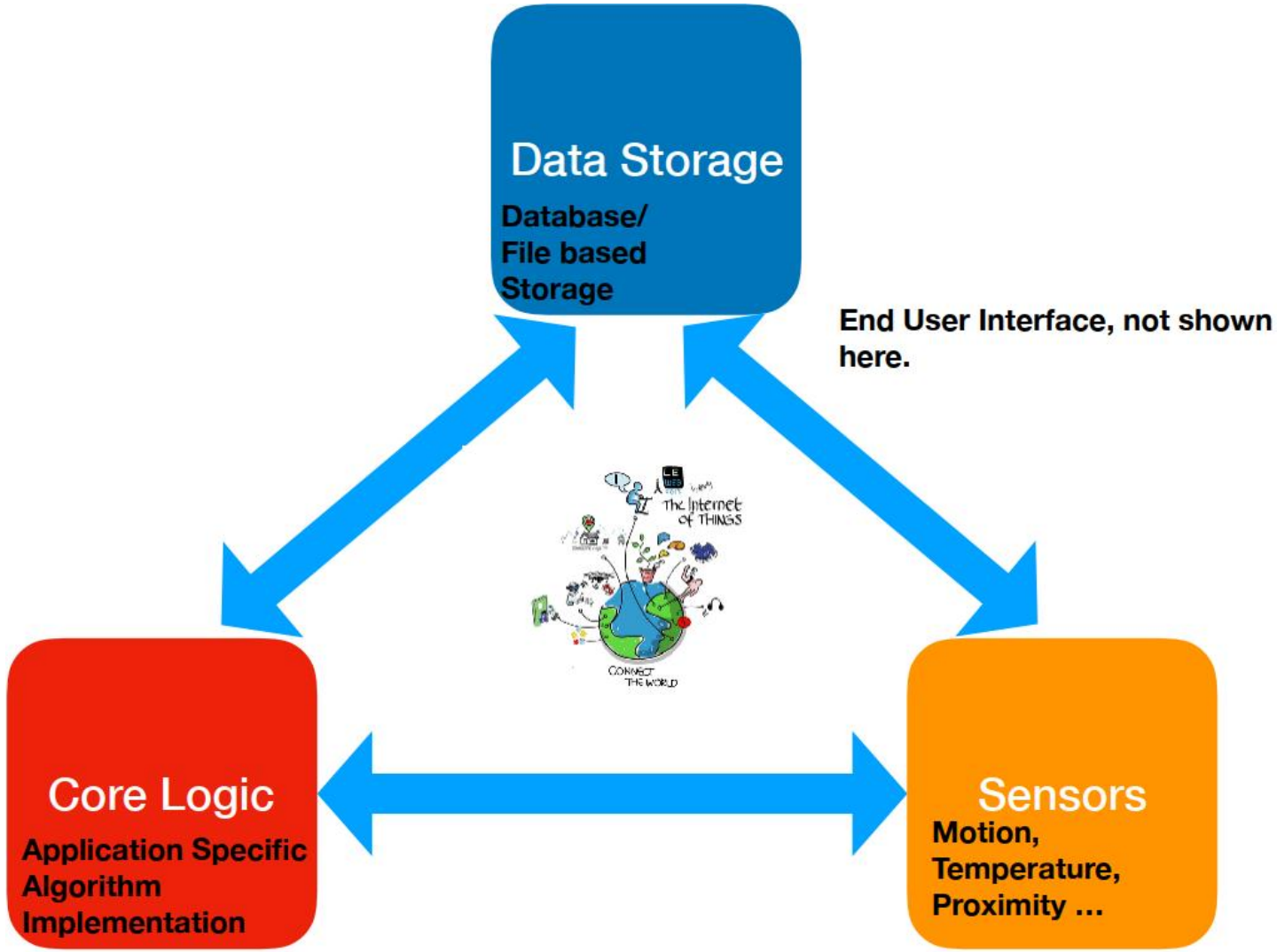
Definitions

Cloud as a Service

- Software as a Service (SaaS)
- Infrastructure as a Service (IaaS)
- Platform as a Service (Paas)

Where does IoT come into Picture?

Definitions



Internet of Things

- Sensors talk to each other.
- Only a few sensors are connected to the internet through gateway/router.
  - Why not all?
- The data generated by sensors can grow huge.
  - For example, GBs or TBs of data from video surveillance.
  - “Big Data” issues - This is where scalability of clouds come in handy.

History

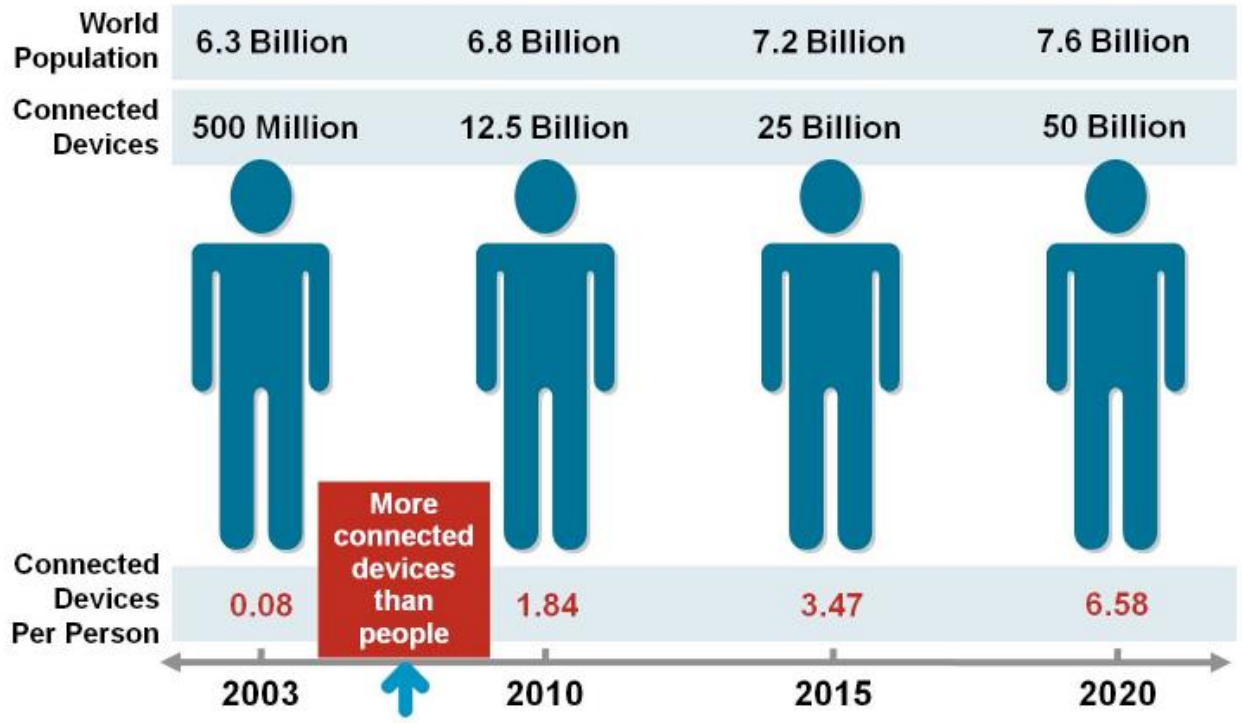
THE INTERNET OF THINGS

Connected devices (billions)

	15 billion	28 billion	CAGR 2015–2021
Cellular IoT	0.4	1.5	27%
Non-cellular IoT	4.2	14.2	22%
PC/laptop/tablet	1.7	1.8	1%
Mobile phones	7.1	8.6	3%
Fixed phones	1.3	1.4	0%
	2015	2021	

History

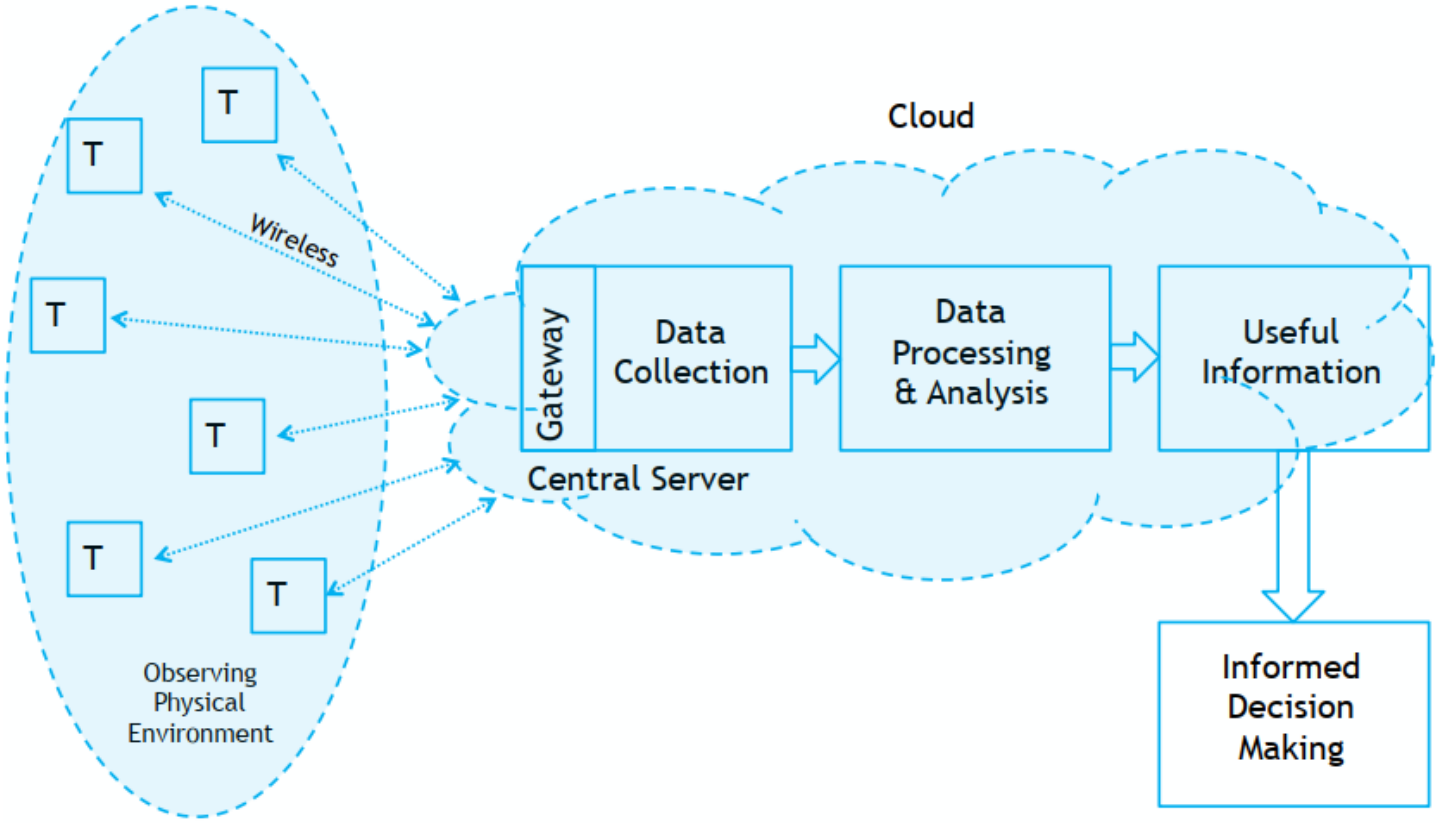
Figure 1. The Internet of Things Was "Born" Between 2008 and 2009



Source: Cisco IBSG, April 2011

Definitions

An IoT System



Machines ≡ Devices ≡ Sensors ≡ Things!

Example IoT System

Example IoT System

How Does My Fridge Do That?

- You are leaving the home (sense user)
- There's no milk in fridge (sense object)
- Use this information to make a decision (process)
- Inform user of decision (communicate)

Example IoT System

How Does My Fridge Do That?

- **You are leaving the home (sense user)**
  - What type of sensor?
  - Distinguish between parent and child
  - Identify reason for leaving home
  - Identify other contexts (e.g., store hours)
- There’s no milk in fridge (sense object)
- Use this information to make a decision (process)
- Inform user of decision (notify)

Example IoT System

How Does My Fridge Do That?

- You are leaving the home (sense user)
- **There's no milk in fridge (sense object)**
  - What type of sensor?
  - Is milk needed?
  - No milk or "little" milk? (prediction)
- Use this information to make a decision (process)
- Inform user of decision (notify)

Example IoT System

How Does My Fridge Do That?

- You are leaving the home (sense user)
- There's no milk in fridge (sense object)
- **Use this information to make a decision (process)**
  - Where is processor?
  - What are the rules?
  - Fixed rules versus dynamic rules (learning)
- Inform user of decision (notify)

Example IoT System

How Does My Fridge Do That?

- You are leaving the home (sense user)
- There's no milk in fridge (sense object)
- Use this information to make a decision (process)
- **Inform user of decision (notify)**
  - How?
  - When?
  - Privacy?
  - Subtleness?
  - Information overflow?

IoT System

Physical object (“thing”)

+

Controller (“brain”)

+

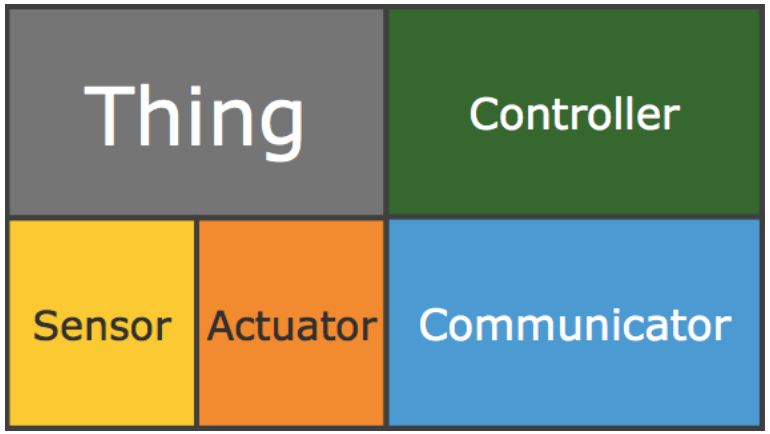
Sensors

+

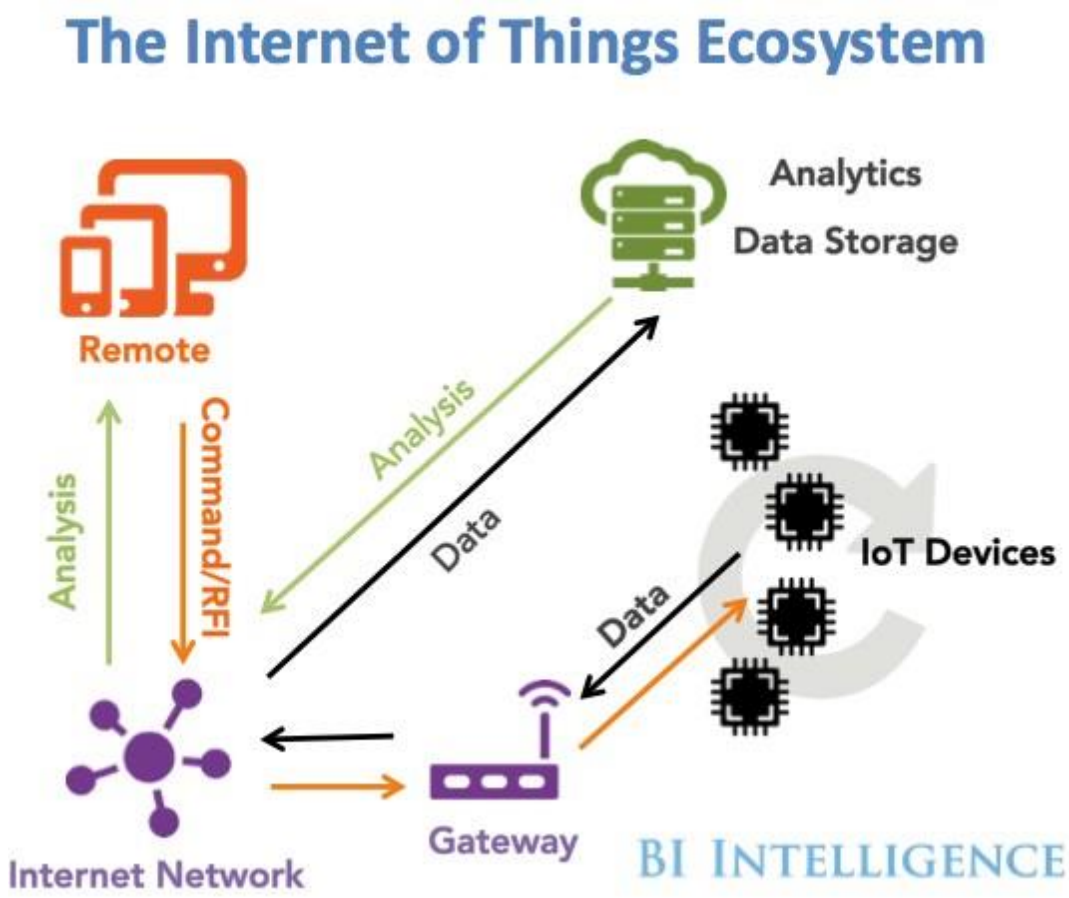
Actuators

+

Networks (Internet)



IoT System


The Internet of Things Ecosystem
Analytics
Data Storage
Remote
Analysis
Command/RFI
Analysis
Data
Data
IoT Devices
Internet Network
Gateway
BI INTELLIGENCE

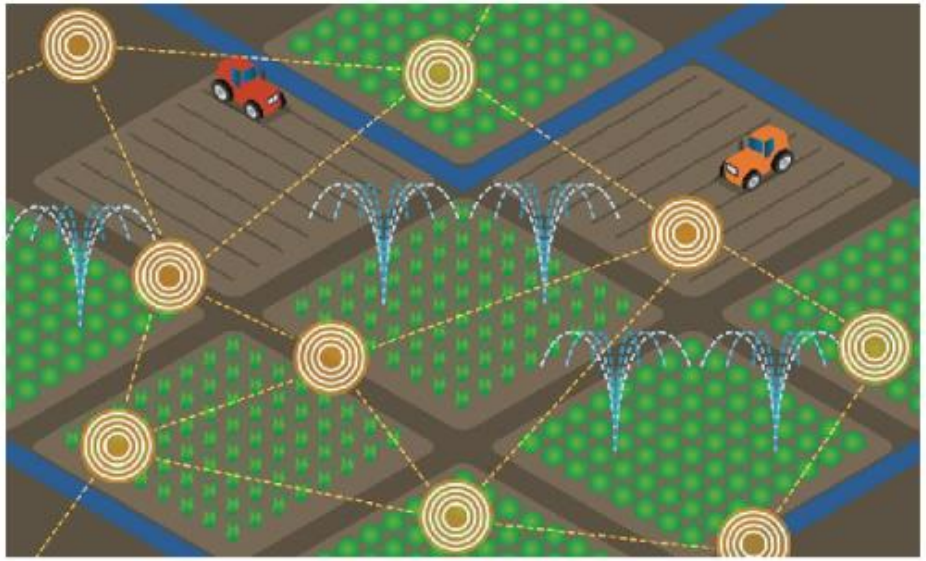
Augment Existing Things

Applications

IoT for Agriculture

What could be observed: Soil moisture, Temperature, Humidity, Gas concentration, Location

Why: Informed decision for Sowing, Irrigation, Fertilization, Soil treatment, Harvesting, Cattle management, Assessing crop quality, Pricing



Applications

IoT for Healthcare & Fitness

What could be observed : Heart rate, Temperature, General fitness, Brain pressure, Heart functioning, Blood glucose etc

Why: Making healthcare accessible, timely, remotely, improved

Applications

Vehicle – A Sensor Hub

What could be observed : Motion, Ambience light, Location, Obstacle, Fuel level, Driving behavior, Erratic functioning, Tyre pressure, Noise level , Temp &Humidity, Pollutant concn etc

Why: Safe and comfortable (S&C) driving experience!

mage source: enterpriseiotinsights.com

Applications

IoT in Transportation

What could be observed: Information on location, speed and direction of all the vehicles in a given area or fleet.

Can the traffic be better managed this way?

Image Source: iot.do

Related Areas/Terminology

- **Embedded systems**: not necessarily connected
- **Sensor networks**: collection of sensor devices connected through wireless channels
- **Cyber-physical systems**: focus on interaction between physical and cyber systems
- **Real-time systems**: focus on time constraints
- **Pervasive/ubiquitous computing**: focus on anytime/anywhere computing
- **Artificial Intelligence**: Analysis and predicting behavior based on the collected data

Conclusions

- Cloud is an IoT enabler
- Huge amount of Incoming Data
- Requires Storage, Retrieval, Management
- Fast analytics for improving business, medical support, critical decisions

Class discussion

Watch either of the next videos and come back with some points or ideas regarding what you already learned in this lecture against the explanation of the videos:

https://www.youtube.com/watch?v=_AlcRoqS65E&t=74s&ab_channel=TEDxTalks

https://www.youtube.com/watch?v=xVqniTnMfQE&ab_channel=TEDxTalks

Homework #1

Investigate an IoT application in a particular domain and prepare a short presentation regarding the solved challenge, the solution, the technology used and conclusions or improvements that you could suggest.

Thank you

Questions?

Refs:

Internet-of-Things (IoT) - Summer Engineering Program 2018
University of Notre Dame