



Internet of Things

By: Eng. Javier E. Hernandez

About me

- Javier Hernandez
- BS Computer Engineer, UPRM
- Developer
 - Data Collection
 - Mobile solutions



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Agenda

- What is?
- Is this new?
- Why it is important?
- Industries
- Infrastructure
- Challenges
- Future

What is the Internet of Things?

Let's ask

Google

According to Google

About 123,000,000 results (0.38 seconds)

Inter·net of things

noun

noun: Internet of things

a proposed development of the Internet in which everyday objects have network connectivity, allowing 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"

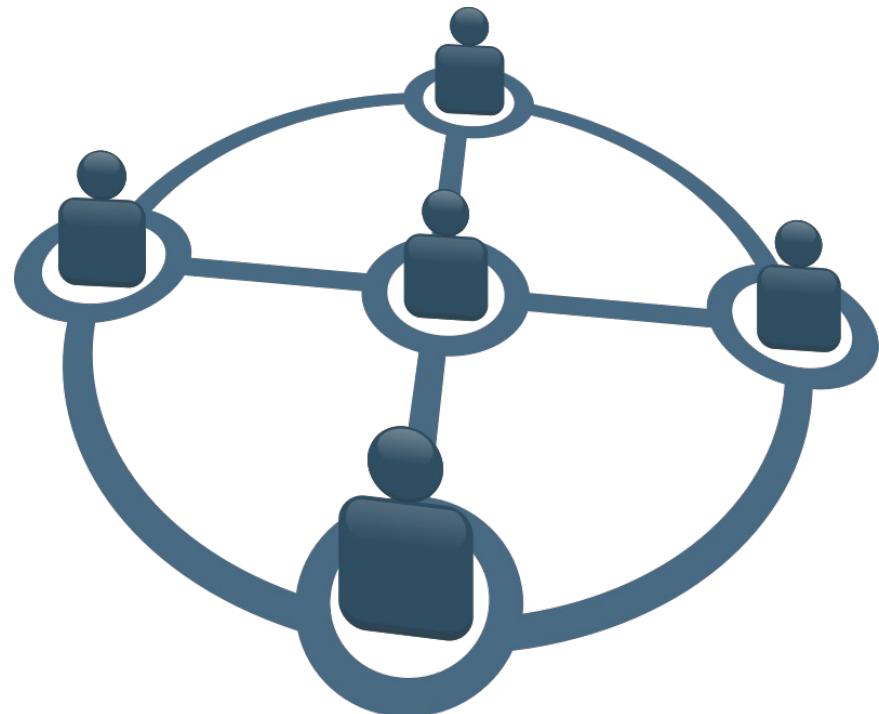
“Every object”

- What is an object?
 - Mobile: phones, tablets, laptops, “phablets”
 - Transportation: Car, Bus, Bikes
 - Home appliances: Fridge, TV
 - Traffic lights
 - Doors
 - Clothes
 - Furniture
 - Anything and everything

Every object has network connectivity

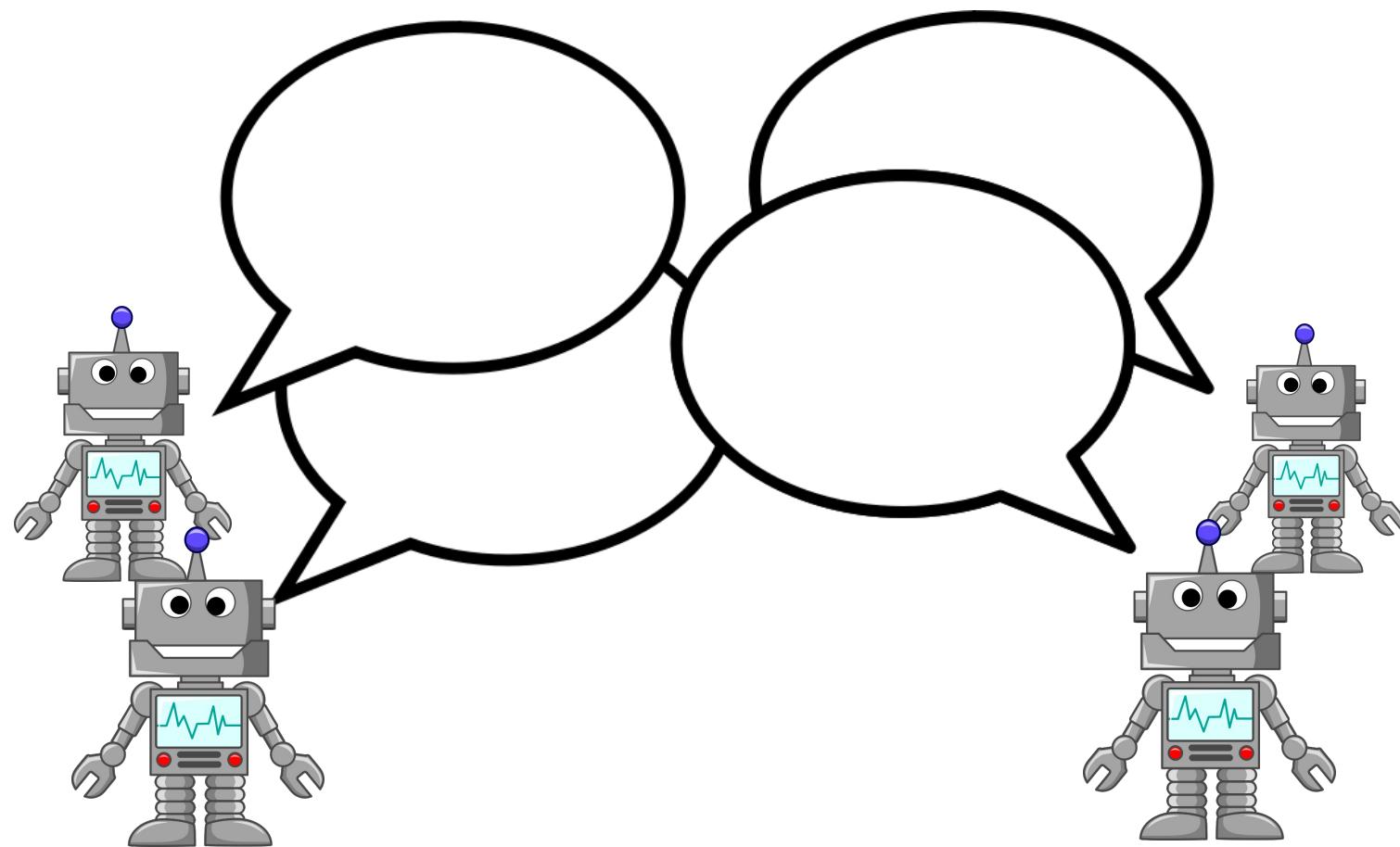
- **Some** examples may be:

- Wireless
 - Bluetooth
 - Wifi
 - RF
 - IRDA
- Wired
 - Ethernet
 - RS232/RS485
 - USB



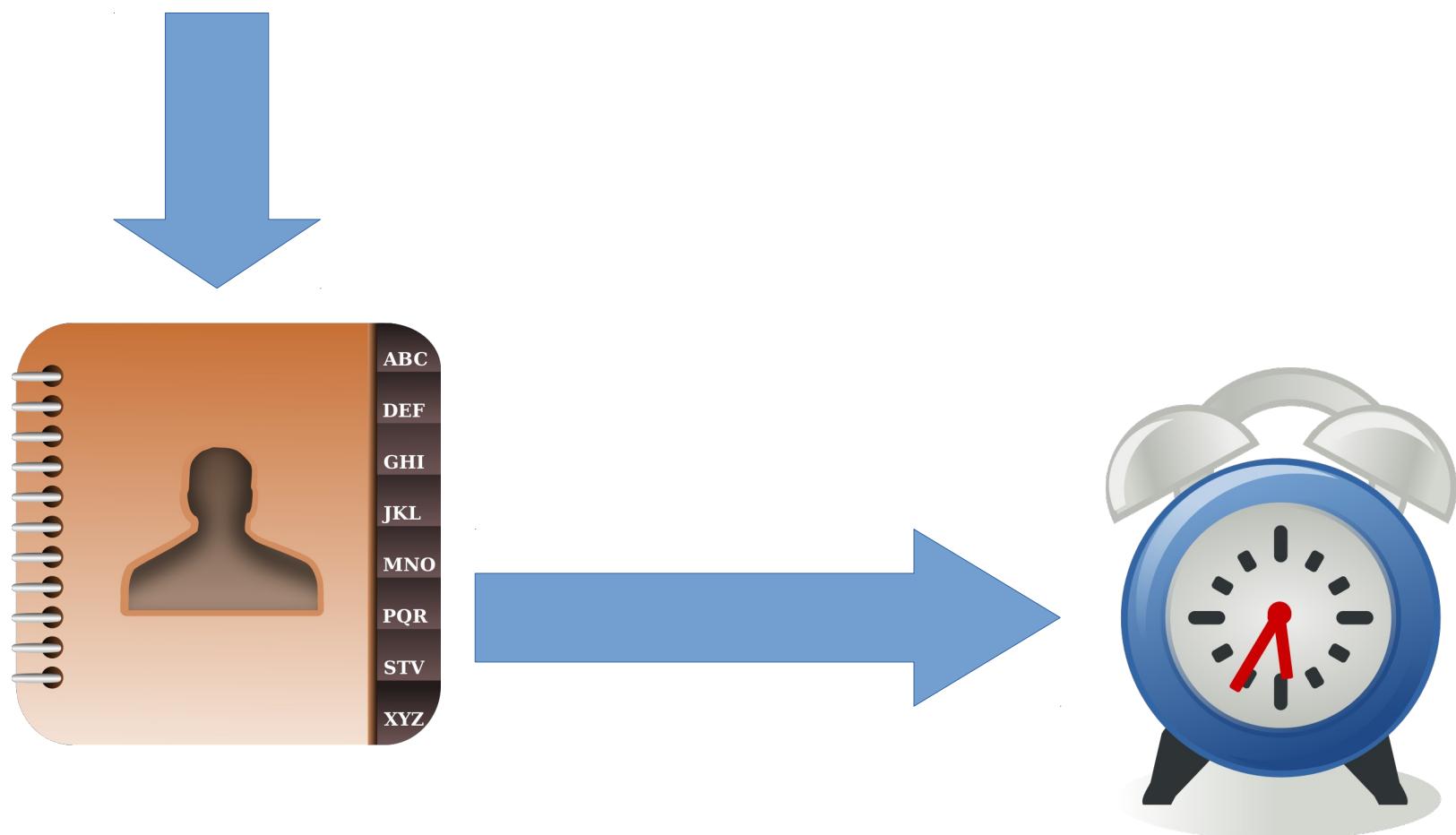
Send and Receive Data

- The devices can talk!



Example

- Monday 8AM meeting @Office



Monday

- Morning
 - Wake up on time
 - Automatically make coffee



Make Coffee



Coffe, tea?

by Manolo Rei

Monday

- Traffic report
 - Estimated morning commute delay 30min



Monday

- Traffic report
 - Estimated morning commute delay 30min



Adjust alarm -30min



Make Coffee



Coffe, tea?

by Manolo Rei

Is this new?

- The concept of a network of smart devices was discussed as early as **1982**, with a modified Coke machine at Carnegie Mellon University becoming the first internet-connected appliance, [9] able to report its inventory and whether newly loaded drinks were cold.

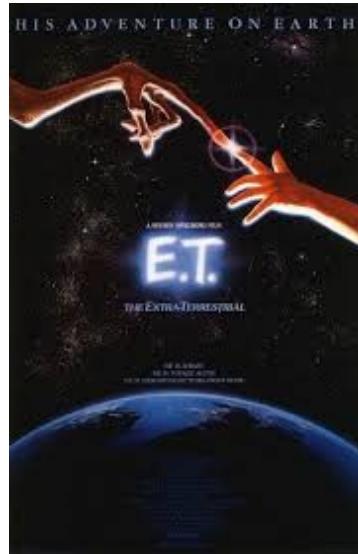


Source: Wikipedia

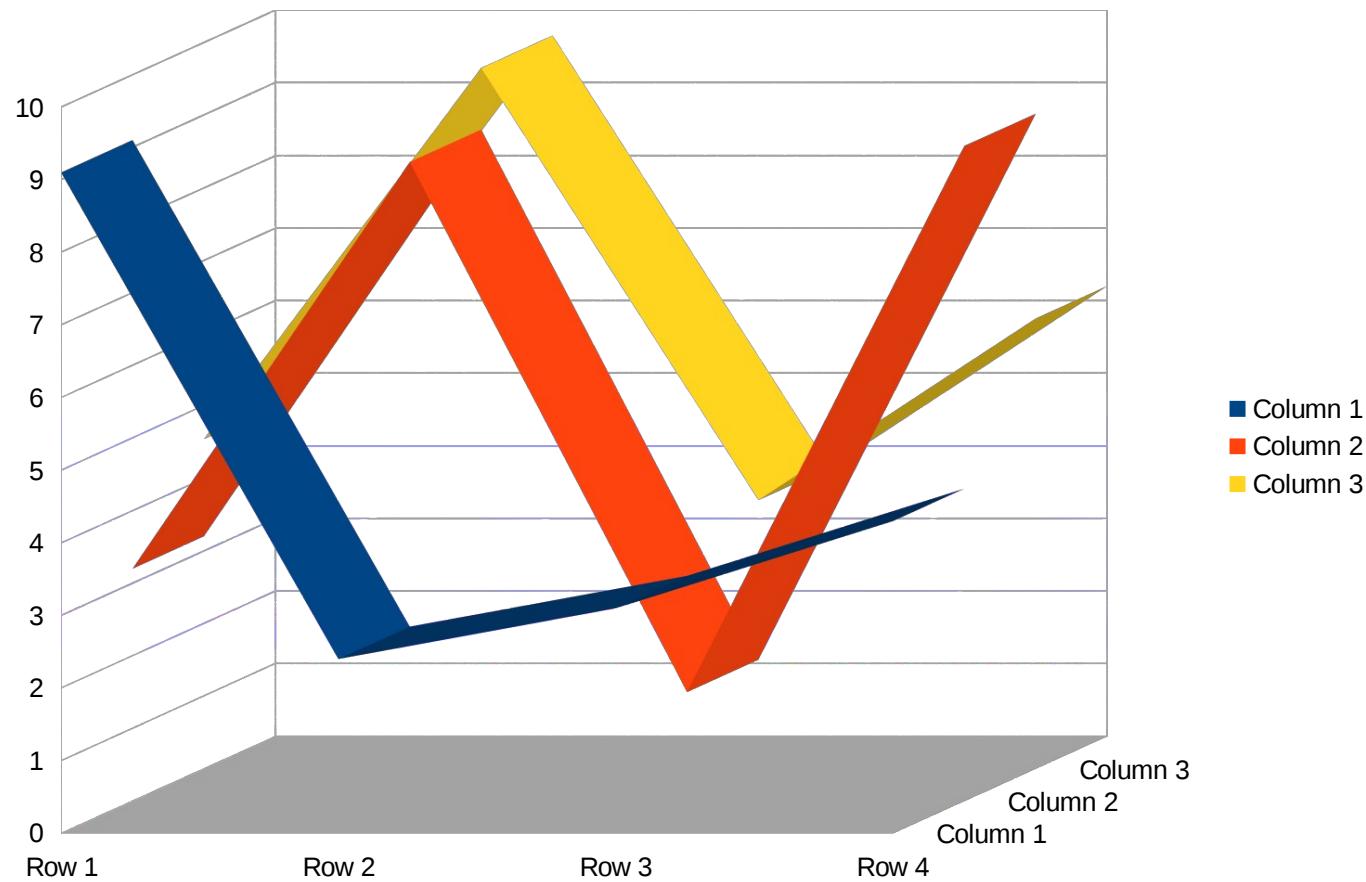
http://en.wikipedia.org/wiki/Internet_of_Things

1982?

Also in 1982



Statistics and Projections



UN (medium variant – 2012 revision) and US Census Bureau (June 2012) estimates

Year	UN est. (millions)	Difference	USCB est. (millions)	Difference
2005	6514	-	6474	-
2010	6916	402	6864	390
2015	7324	408	7250	386
2020	7717	393	7628	378
2025	8083	366	7984	356
2030	8425	342	8315	331
2035	8743	318	8619	304
2040	9039	296	8899	280
2045	9308	269	9154	255
2050	9551	243	9383	229

Source: http://en.wikipedia.org/wiki/World_population

Gartner: 26 Billions devices

Gartner Says the Internet of Things Installed Base Will Grow to 26 Billion Units By 2020

The [Internet of Things](#) (IoT), which excludes PCs, tablets and smartphones, will grow to 26 billion units installed in 2020 representing an almost 30-fold increase from 0.9 billion in 2009, according to Gartner, Inc. Gartner said that IoT product and service suppliers will generate incremental revenue exceeding \$300 billion, mostly in services, in 2020. It will result in \$1.9 trillion in global economic value-add through sales into diverse end markets.

26 billions units installed in 2020

Almost 30-fold increase from 0.9 billions in 2009

In not a distant future

- Anything and everything that can be connected will be connected. Always
- House
- Car
- Clothes
- There is no scape



Will there be enough IPs

- IPV6
 - A main advantage of IPv6 is increased address space. The 128-bit length of IPv6 addresses is a significant gain over the 32-bit length of IPv4 addresses, allowing for an almost limitless number of unique IP addresses.

Source:

<http://whatismyipaddress.com/ip-v6>

Why the buzz?

- “GE estimating that the “Industrial Internet” has the potential to add \$10 to \$15 trillion (with a “T”) to global GDP over the next 20 years”
- “Cisco increasing to \$19 trillion its forecast for the economic value created by the “Internet of Everything” in the year 2020”



Source Forbes:

<http://www.forbes.com/sites/gilpress/2014/08/22/internet-of-things-by-the-numbers-market-estimates-and-forecasts/>

GDP = Gross Domestic Product

IOT Companies



The CNET website header features a red navigation bar with the 'c|net' logo on the left. To its right are search fields labeled 'Search CNET' and 'Reviews'. The main menu includes 'News', 'Video', 'How To', 'Games', and 'Downloads'. Below the header, the URL 'CNET > Internet > Google closes \$3.2 billion purchase of Nest' is visible. The main title of the article is 'Google closes \$3.2 billion purchase of Nest' in large, bold, black font. A subtitle below it reads: 'The acquisition brings with it the Learning Thermostat and the Protect smoke and CO detector as Google looks to make its mark in the smart home.' The author is listed as 'by Lance Whitney @lancewhit' and the date is 'February 12, 2014 5:00 AM PST'. Social sharing icons for comments (26), Facebook (10), Twitter (6), Google+ (6), LinkedIn (5), and a 'more +' option are shown at the bottom.

Nest Labs, Inc. (Nest), a company whose mission is to reinvent devices in the home such as thermostats and smoke alarms

Industries

- Technology
- Manufacturing
- Health
- Agriculture
- Transportation
- Entertainment
- Security
- ...

Everyone

Health industries

- 24hr health monitor
- Link with medical support
- Prevention of illness
- Call for help



Companies & campaigns

ARM

ARM®

The screenshot shows the ARM website's IoT page. The header reads "ARM The Architecture for the Digital World". The main content area features a large image of a circuit board with the text "The Internet of Things (IoT) is the collection of smart, sensor-enabled physical objects, and the networks, servers and services that interact with them. It is a trend and not a single sector or market. However, ARM's technology designs enable the current and future IoT applications and services to become truly ubiquitous and intelligent." Below this, there is a section titled "Internet of Things (IoT)" with a detailed description of what it is and how ARM's technology fits into it. A sidebar on the left lists various product categories like "Gaming Processor", "Mobile", "Automotive", "Industrial", "Consumer", "Network", "Security", "Power", and "ARM Powered Products".

More Details

ARM

Stock Ticker: ARMH

Market Cap: 22.07B

"ARM's comprehensive product offering includes 32-bit RISC microprocessors, graphics processors, enabling software, cell libraries, embedded memories , high-speed connectivity products, peripherals and development tools."

IoT Overview: "ARM creates sensors, controllers, and other embedded intelligence in devices. The Internet of Things (IoT) is the collection of smart, sensor-enabled physical objects, and the networks, servers and services that interact with them. It is a trend and not a single sector or market. However, ARM's technology designs enable the current and future IoT applications and services to become truly ubiquitous and intelligent."

IoT Projects & Activity:

- [Internet of Things Site](#)
- [UK Technology Strategy Board project](#)
- [Aquired Sensinode](#)
- [Video - ARM CEO on the 'Internet of Things'](#)

Atmel

Atmel®



[More Details](#)

Atmel

Stock Ticker: ATML

Market Cap: 3.16B

"Worldwide leader in the design and manufacture of microcontrollers, capacitive touch solutions, advanced logic, mixed-signal, nonvolatile memory and radio frequency (RF) components."

IoT Overview: "Today, Atmel is right at the heart of The Internet of Things, a highly intelligent, connected world where Internet-enabled devices will outnumber people. Our technologies are fueling machine-to-machine (M2M) communications and the "industrial Internet."

IoT Projects & Activity:

- Purchased Ozmo a provider of low power WiFi in 2004
- Embedded Design Blog // IoT Tag

BOSCH



[More Details](#)

Bosch

Stock Ticker: Private

Size: Approximately €52.5 billion in revenue in 2012

"The Bosch Group is a leading global supplier of technology and services, active in the fields of automotive technology, energy and building technology, industrial technology, and consumer goods."

IoT Tagline: *The Internet of Things and Services*

IoT Overview: "In the near future, more and more devices and systems will be capable of sending and receiving data automatically via the internet. We're already poised on the verge of new developments that offer enormous market potential. According to our estimates, by the year 2015 more than six billion devices and systems will be connected to each other and exchanging data via the internet. The Internet of Things and Services (IoTS) isn't just a distant vision of the future, however – it's already very real and is having an impact on more than just technological developments."

IoT Projects & Activity:

- [Internet of Things Blog // RSS](#)
- [Video Introduction](#)
- [Bosch IoT Labs](#)

Cisco



[More Details](#)

Cisco

Stock Ticker: CSCO

Market Cap: 125.08B

"Cisco hardware, software, and service offerings are used to create the Internet solutions that make networks possible-providing easy access to information anywhere, at any time."

IoT Tagline: *The Internet of Everything*

IoT Overview: "Cisco defines the Internet of Everything (IoE) as bringing together people, process, data, and things to make networked connections more relevant and valuable than ever before-turning information into actions that create new capabilities, richer experiences, and unprecedented economic opportunity for businesses, individuals, and countries."

IoT Projects & Activity:

- Whitepaper
- Video Introduction
- Infographic
- \$150m IoT Fund
- IoT World Forum

GE



Introducing the Industrial Internet
The Industrial Internet is a new way of doing business. It's a way of connecting all the assets, sensors and systems in your operations to create a real-time view of what's happening in your business. This new view can help you make better decisions, reduce costs, and increase efficiency. And it's not just limited to manufacturing. The Industrial Internet can be applied to any industry, from energy to healthcare to transportation.



[More Details](#)

GE

Stock Ticker: GE

Market Cap: 248.43B

"We build appliances, lighting, power systems and other products that help millions of homes, offices, factories and retail facilities around the world work better."

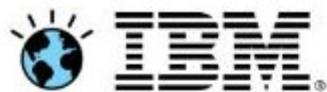
IoT Tagline: *Industrial Internet*

IoT Overview: "New GE technology merges big iron with big data to create brilliant machines. This convergence of machine and intelligent data is known as the Industrial Internet, and it's changing the way we work."

IoT Projects & Activity:

- [IndustrialInternet.com](#)
- [Minds & Machines Conference](#)
- [Whitepaper \(PDF\)](#)
- [Video: Brilliant Machines](#)

IBM



[More Details](#)

IBM

Stock Ticker: IBM

Market Cap: 203.48B

"IBM offers a wide range of technology and consulting services; a broad portfolio of middleware for collaboration, predictive analytics, software development and systems management; and the world's most advanced servers and supercomputers."

IoT Tagline: Smarter Planet

IoT Overview: "Over the past century, we have seen the emergence of a kind of global data field. The planet itself—natural systems, human systems, physical objects—have always generated an enormous amount of data, but until recent decades, we weren't able to hear it, to see it, to capture it. Now we can because all of these things have been instrumented with microchips, UPC codes and other technologies. And they're all interconnected, so now we can actually have access to the data. In effect, the planet has grown a central nervous system and is developing intelligence. It's becoming a much smarter planet."

IoT Projects & Activity:

- Video: [IoT Overview](#)
- Whitepaper: [A mandate for change is a mandate for smart](#) (PDF)
- [MQTT Support](#)
- [IBM MessageSight](#)
- [IBM MoteRunner](#)



[More Details](#)

Intel

Intel

Stock Ticker: INTC

Market Cap: 115.41B

"Intel Corporation designs, manufactures, and sells integrated digital technology platforms worldwide."

IoT Tagline: *Intelligent Systems*

IoT Overview: "The Internet of Things (IoT) is transforming our world from disconnected, isolated systems to Internet-enabled devices that can network and communicate with each other and the cloud, providing the opportunity for businesses to enhance productivity and efficiency, develop new services and improve real-time decision making. Intel is working to accelerate the development and deployment of the Internet of Things through building intelligent devices, creating systems of systems by connecting legacy devices to the cloud, and enabling end-to-end analytics."

IoT Projects & Activity:

- Video: [Collaborating for the IoT](#)
- Presentation: [The Internet of Things starts with intelligence inside \(PDF\)](#)
- Event: Company [acquires](#) Wind River in 2009
- [Intel® Atom™ Processor E3800 Product Family](#)
- [Intel Arduino Galileo](#)
- [Infographic](#)
- Backgrounder: [The Internet of Thinas Backgrounder \(PDF\)](#)

And a lot more



Microsoft

Cloud Platform

Overview Solutions Products Try/Buy

Create the Internet of Things

The Internet of Things (IoT) is here today in the devices, sensors, cloud services, and data your business uses. Begin with us and your company: the Internet of Your Things.

- Read about Microsoft's vision for IoT
- Get the facts
- Get started with IoT today

ORACLE

ORACLE

Sign In/Register Help Country ▾ C

Products Solutions Docs

Solutions > Internet of Things > Overview

Oracle Internet of Things Platform

Solutions for a Connected World

Overview

Acquire and Manage

Integrate a

Oracle Simplifies Internet of Things

Maximizing Value from Connected Devices

In this connected world, the proliferation of intelligent devices has created a market for entirely new solutions based on Internet of Things (IoT) technology. With the ever-increasing amount of data that is inherent in an IoT world, the key to gaining real business value is effective communication among all elements of the architecture.

More Details

Microsoft

Stock Ticker: MSFT

Market Cap: 373B

"Microsoft Corporation develops, licenses, markets, and supports software, computers, and related services worldwide."

IoT Overview: "The Internet of Things (IoT) is here today in the devices, sensors, cloud services, and data your business uses. Begin with us and your company: the Internet of Your Things.

IoT Project

The SAP website features a prominent red 'i' logo. The top navigation bar includes links for United States, Newsletter, Community, Free Chat Now, and Contact. The main menu has options for Internet of Things, Internet of Things Solutions, Internet of Things Technology, and Community Experts. Below the menu, a breadcrumb trail shows SAP.com > Products > Internet of Things. A large banner headline reads "Make Internet of Things Real: Monitor, Analyze, Automate." It features a photograph of a wind farm. Text below the banner explains how SAP's end-to-end offering for IoT provides everything a business needs to create a System of Things - M2M Connectivity, cloud platform, device management, big data management, event stream processing, predictive analytics, and apps-to make IoT projects real, repeatable and scalable. A "Watch: Harnessing the IoT keynote" video link is also present.

Oracle

Stock Ticker:

Market Cap:

"Oracle Cloud Infrastructure (OCI) is a broad set of cloud services that include compute, storage, databases, machine learning, and security services. Oracle also offers a range of middleware and related services."

IoT Overview: "In this connected world, the proliferation of intelligent devices has created a market for entirely new solutions based on Internet of Things (IoT) technology. With the ever-increasing amount of data that is inherent in an IoT world, the key to gaining real business value is effective communication among all elements of the architecture."

Only Oracle's Internet of Things platform delivers an integrated, secure, comprehensive platform for the entire IoT architecture across all vertical markets."

“Samsung's Artik platform aims to jump-start the Internet of Things”



Source: <http://www.engadget.com/2015/05/12/samsung-artik-iot/>

Samsung continue

- “Samsung's been dabbling with the world of connected devices for some time: Last year it bought the IoT company SmartThings for \$200 million,”
- Artik 1, a tiny 12mm device with Bluetooth and a nine-axis movement sensor; Artik 5, which runs a faster 1 gigahertz dual-core processor and on-board storage; and Artik 10, which is powered by an octa-core processor, 2GB of RAM and 16GB of storage. The latter also includes Wi-Fi and Zigbee connectivity

Source: <http://www.engadget.com/2015/05/12/samsung-artik-iot/>

Internet



Traditional Internet



Internet now



Internet of things everything



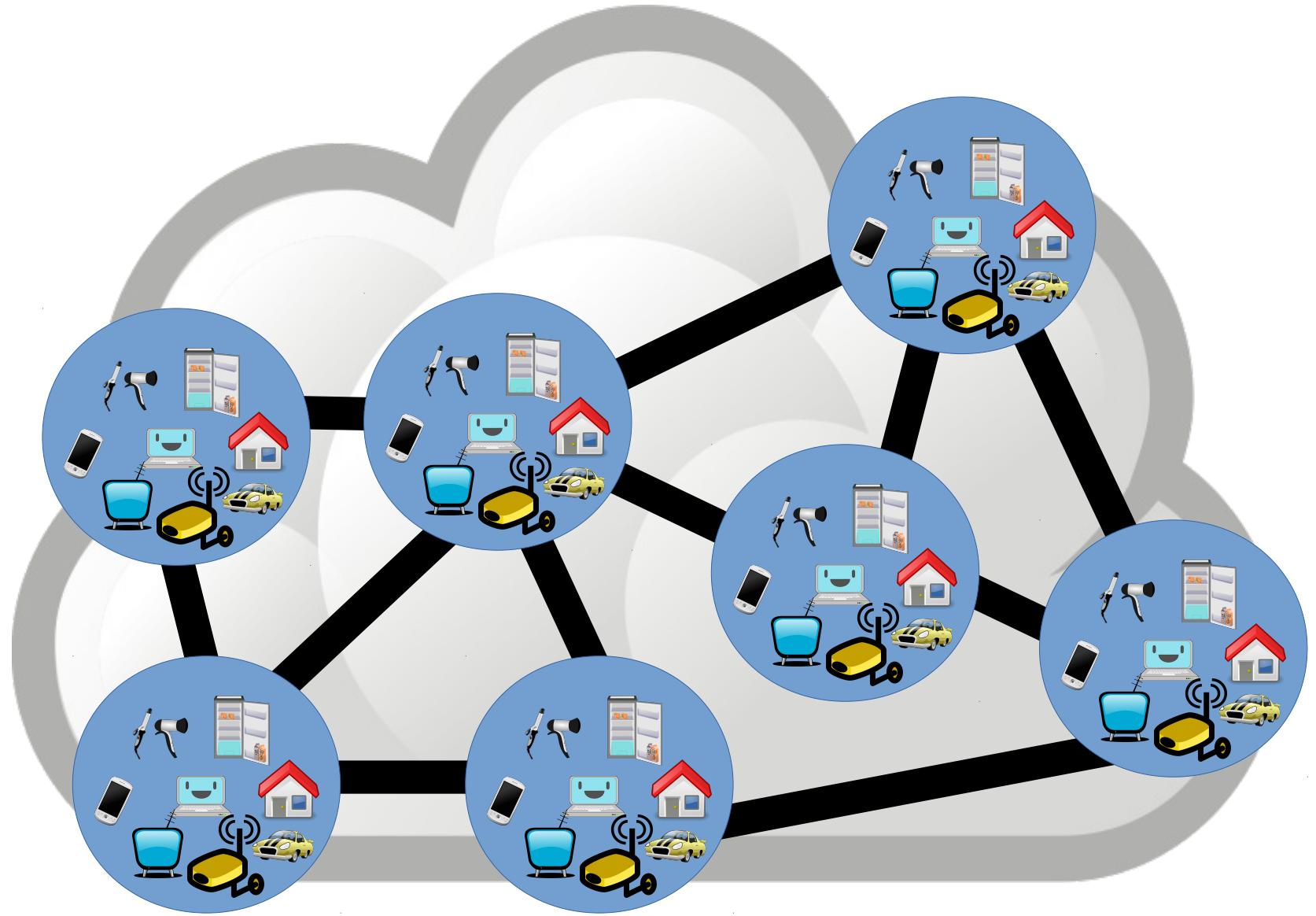
Everything is a part of a System



Small systems all over



Interconnected systems

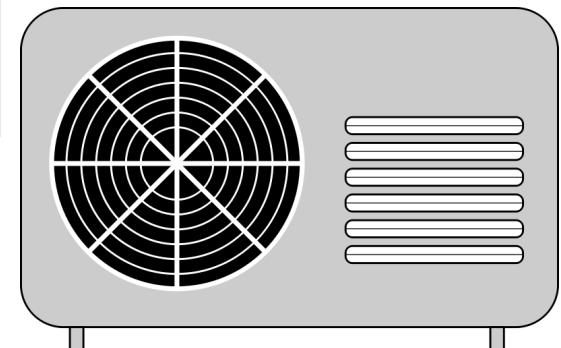
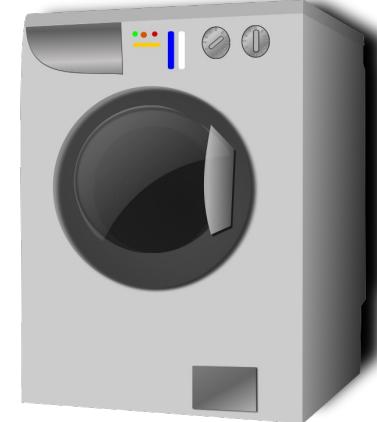


How to Connect things?



Machine to machine

- Protocols
- Data access
- Compatibility
 - Brands
 - Device type
- Security
- Open or proprietary
- Bandwidth



Eclipse

<http://iot.eclipse.org/>

Open Source for IoT

IoT needs open source to be successful.
Eclipse IoT simplifies IoT development.



Standards

Implementation of IoT standards like
MQTT, CoAP, LWM2M and OneM2M



Services & Frameworks

Building blocks to accelerate IoT
development



Getting Started

Step-by-step guide to getting
started on IoT development



All projects

Check out all our IoT open source
projects

Technology

Eclipse IoT provides open
source implementations of the
standards, services and
frameworks that enable an
Open Internet of Things.

Standards

- OMA LightweightM2M
 - LightweightM2M is principally a device management protocol, but it should be designed to be able to extend to meet the requirements of applications. LightweightM2M is not restricted to device management, it should be able to transfer service / application data.
 - OMA LightweightM2M (LWM2M) is an industry standard for device management of M2M/IoT devices. It heavily relies on CoAP and therefore is optimized for communications over sensor or cellular networks.
 - OMA LWM2M provides an extensible object model that allows to enable application data exchanges in addition to the core device management features (firmware upgrade, connectivity monitoring, ...)

Windows supports OMA-DM
DM Desktop Management

Standards

- CoAP
 - CoAP (Constrained Application Protocol) is a protocol specialized for use with constrained nodes and networks.
 - It implements the REST architectural style, it can be transparently mapped to HTTP. However, CoAP also provides features that go beyond HTTP such as native push notifications and group communication.

Standards

- Message Queuing Telemetry Transport (MQTT)
 - Protocol designed to connect the physical world devices and networks, with applications and middleware used in IT and Web development.
 - Lightweight
 - Publish/Subscribe
 - Wired/Wireless
 - Protocol used by Facebook chat!

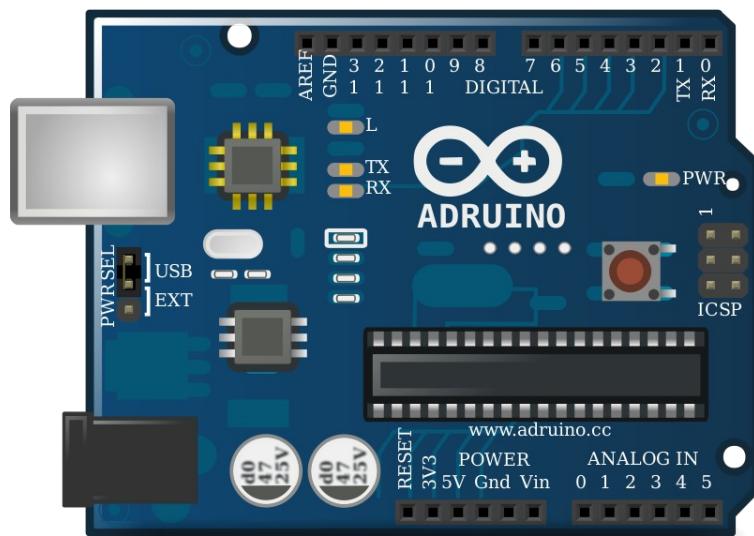
Slide from Microsoft

IoT Connectivity from the Edge: Considerations

Management 'protocol'	OMA-DM, OMA-M2M
Smart Edge Services	Local filter/aggregation, network condition detection, etc.
Data	Name/value pairs to schematized models (AllJoyn, etc.)
Serialization	JSON, BSON, Apache Avro, custom
Security	TLS-PSK; hw-based security (TLS backed by TPM)
Messaging	HTTP/s, AMQP, MQTT, CoAP, custom
Transport	TCP, UDP, non-IP [requires gateway]

Source youtube: Microsoft IoT Platform: Architecture Overview
<https://youtu.be/q6lYuUJ1mO4?list=PLfRy-jeJHMmx5RKGz5O6nxsvm8mjlevVD>

Common hardware

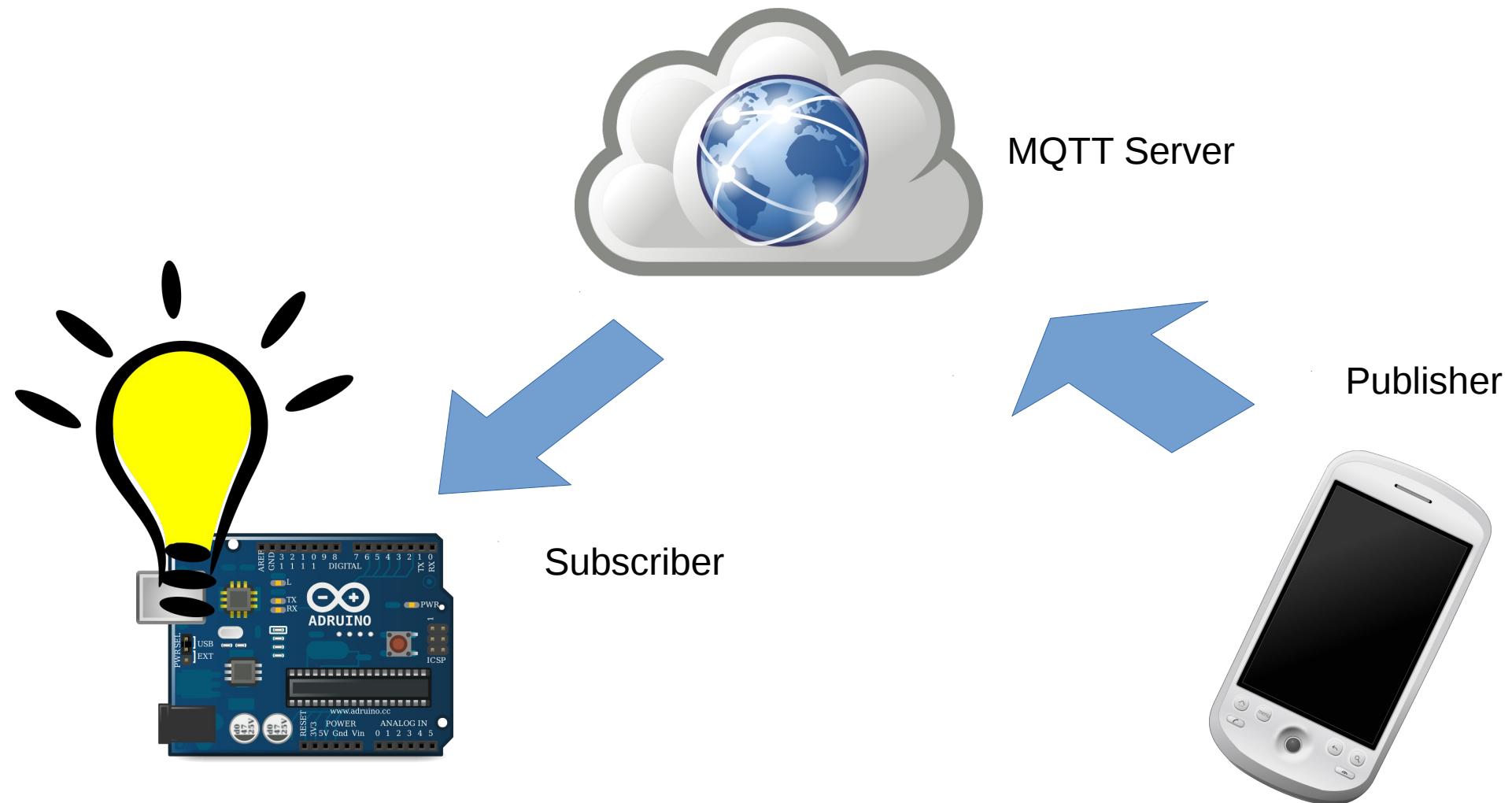


Arduino



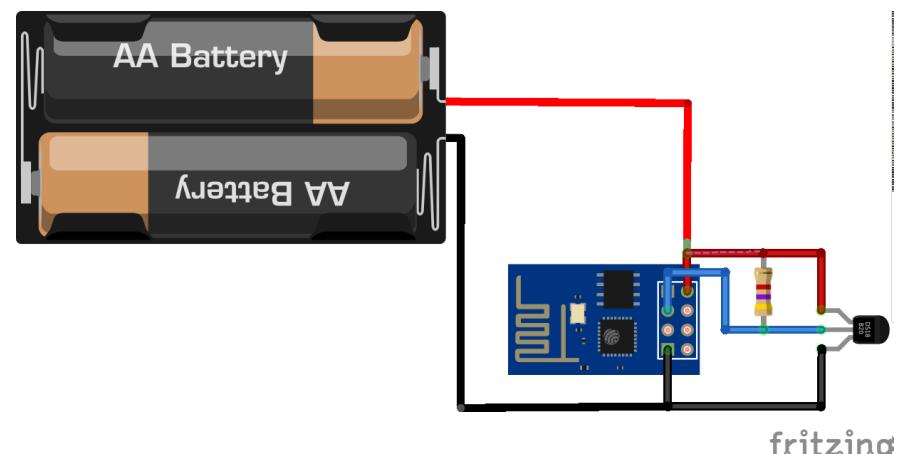
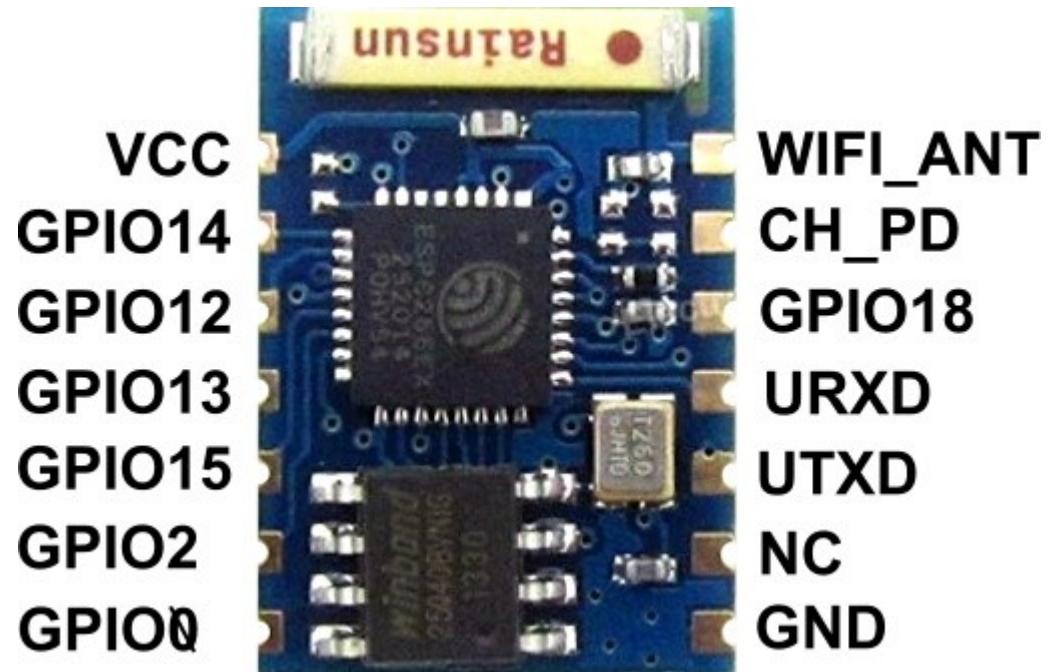
Raspberry Pi

MQTT Implementation



How to get started

- Wifi is cheap
- Multiple options
- ESP8266 < \$5



CHIP \$9 Computer kickstarter



1GHz + 512MB + 4GB

processor



ram



storage

Systems produces Data

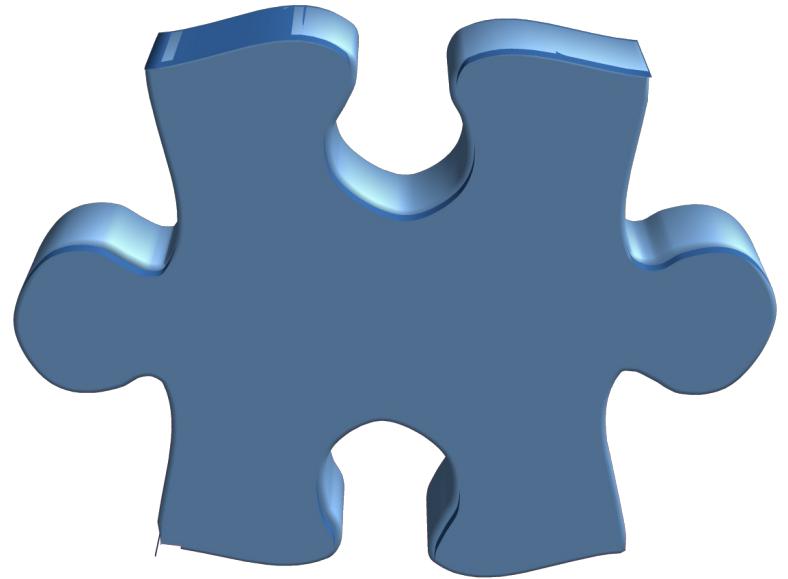
- Sensors everywhere
- Always new data
- History data
- Health data
- Weather
- Entertainment



- Analytics
- Decision making
- Storage

IOT opportunities

- Hardware electronic
- Products, data collection
 - Data Storage
- Clothes
- Analysis
 - Processing power
- Security



Some Challenges

- Connecting Existing hardware
 - Cost
- People
 - Privacy
- Interconnectivity of devices
 - Brands
 - protocols
- Connectivity
 - Around 40% of the world population has an internet connection today
 - Wikipedia says 51% of PR internet
- Security

Internet Users by Country

- In 2014, nearly 75% (2.1 billion) of all internet users in the world (2.8 billion) live in the top 20 countries.
- The remaining 25% (0.7 billion) is distributed among the other 178 countries, each representing less than 1% of total users.

E-waste

- “according to United Nations University estimates reported by ITU, 67 million metric tons of electrical and electronic equipment were put on the market in 2013. In the same year, 53 million metric tons of e-waste (waste electrical and electronic equipment) were disposed of worldwide.”



Source:

<https://itunews.itu.int/En/4850-E-waste-and-the-Internet-of-Things.note.aspx>

Existing hardware

- Legacy products
- Home appliance
- Existing elevators
- How to automate the old?

Future of Internet of Things

Depends on us



Gracias Comentarios

