Internet of Things: Introduction

By

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IoT: Current state of affairs

- We already have TV's, cars, homes, building & industrial equipment and other things connected to the internet.
- What can they do for us?
  - Automate systems for us
  - Allow us to communicate easier, and
  - Collect data for us.

So whether we've have known it or not, the Internet of Things is already here.

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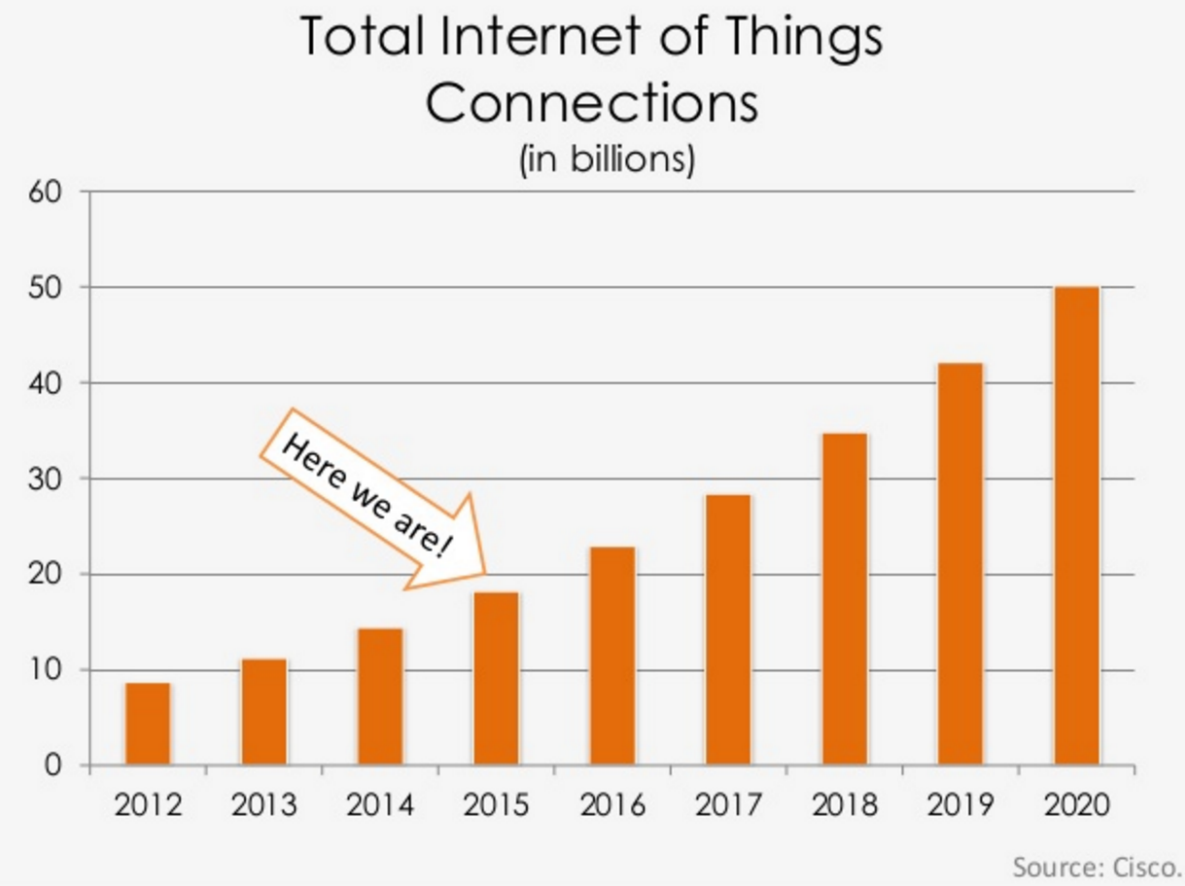
So, What is the FUSS all about?

- Amount of IoT connections about to explode.



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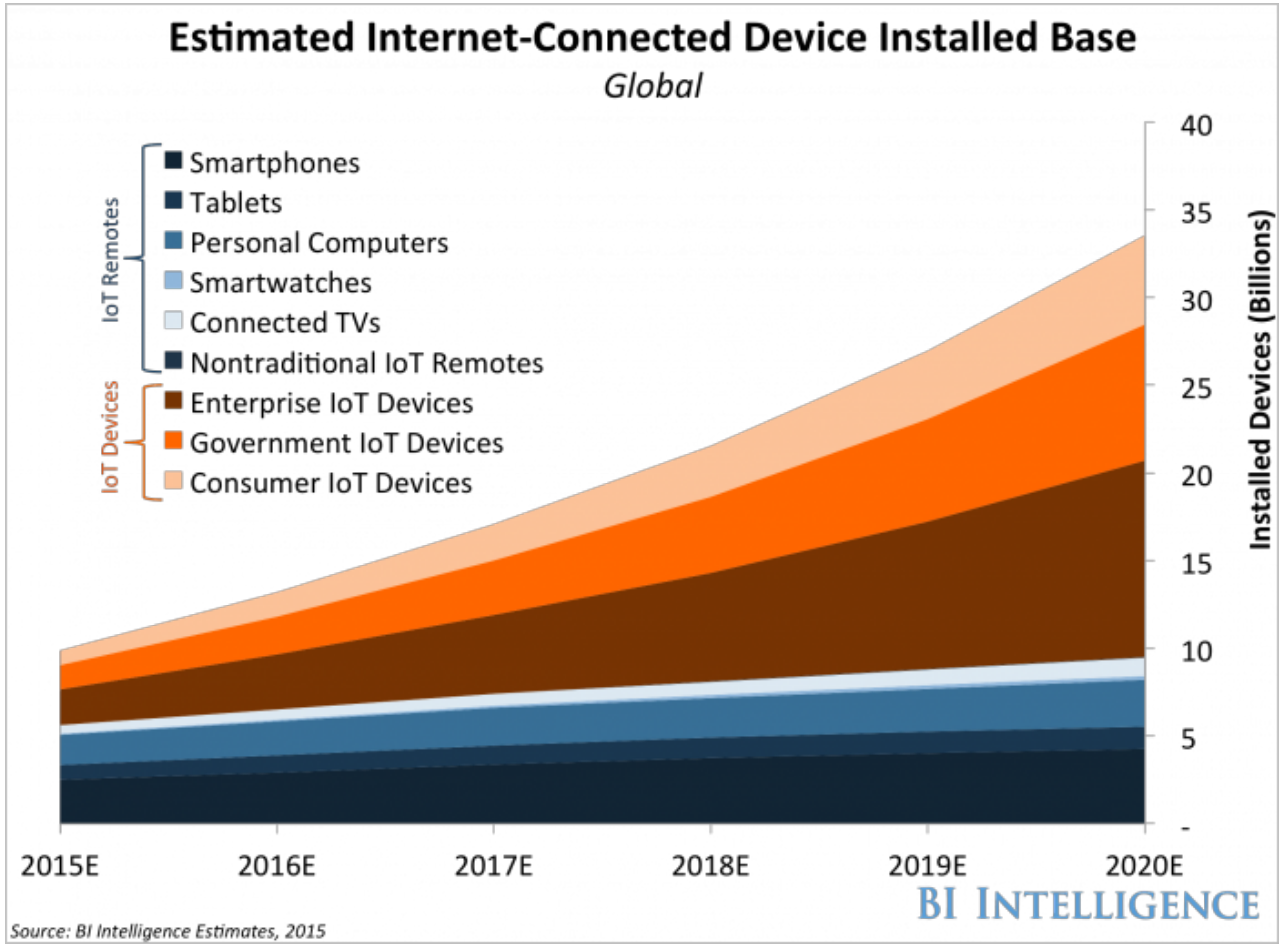

http://www.businessinsider.com/bi-intelligence-34-billion-connected-devices-2020-2015-11

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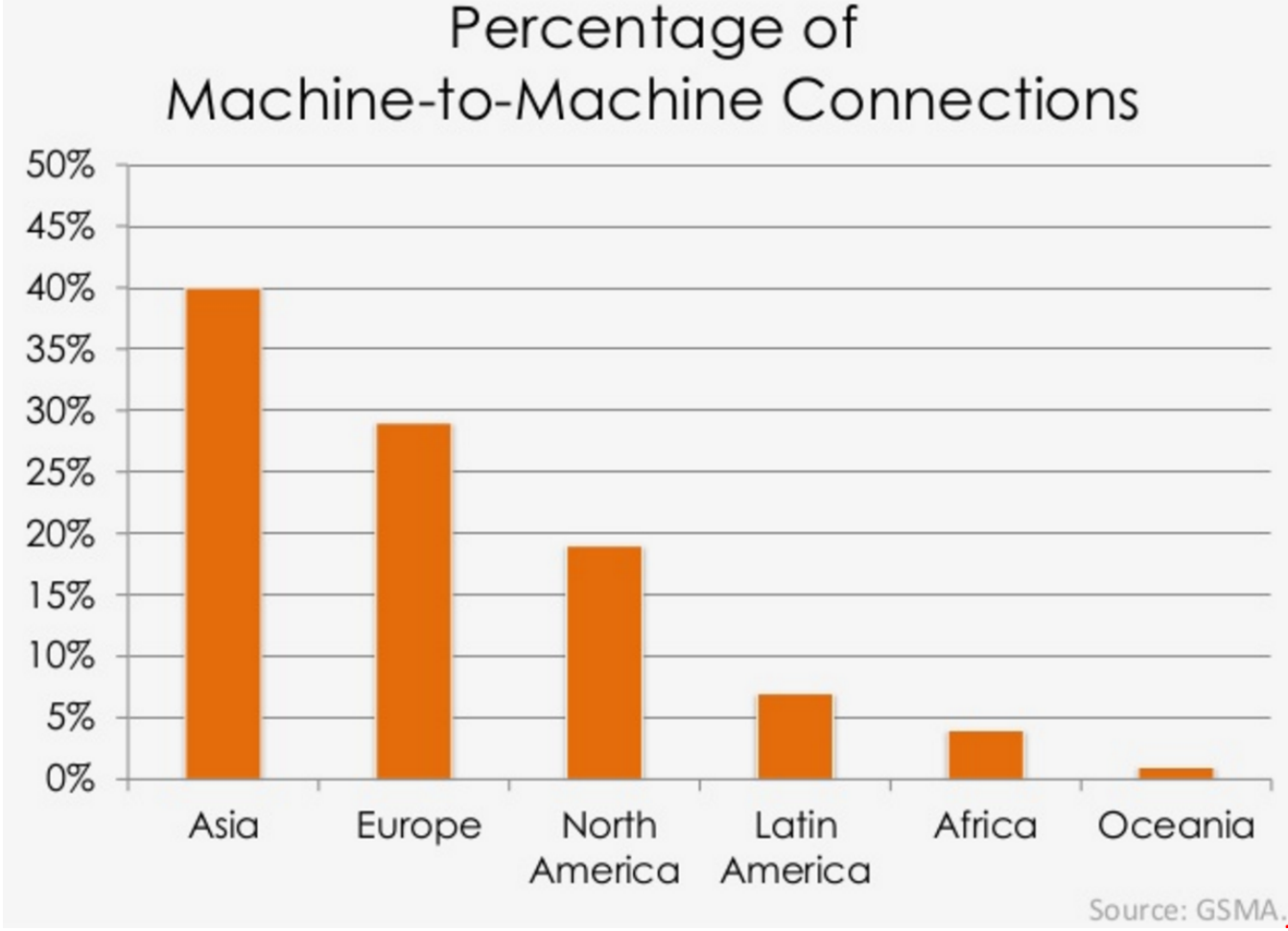
Where is all the action?

- While American technology companies are making lots of IoT progress,
- Asia currently has the most connections.



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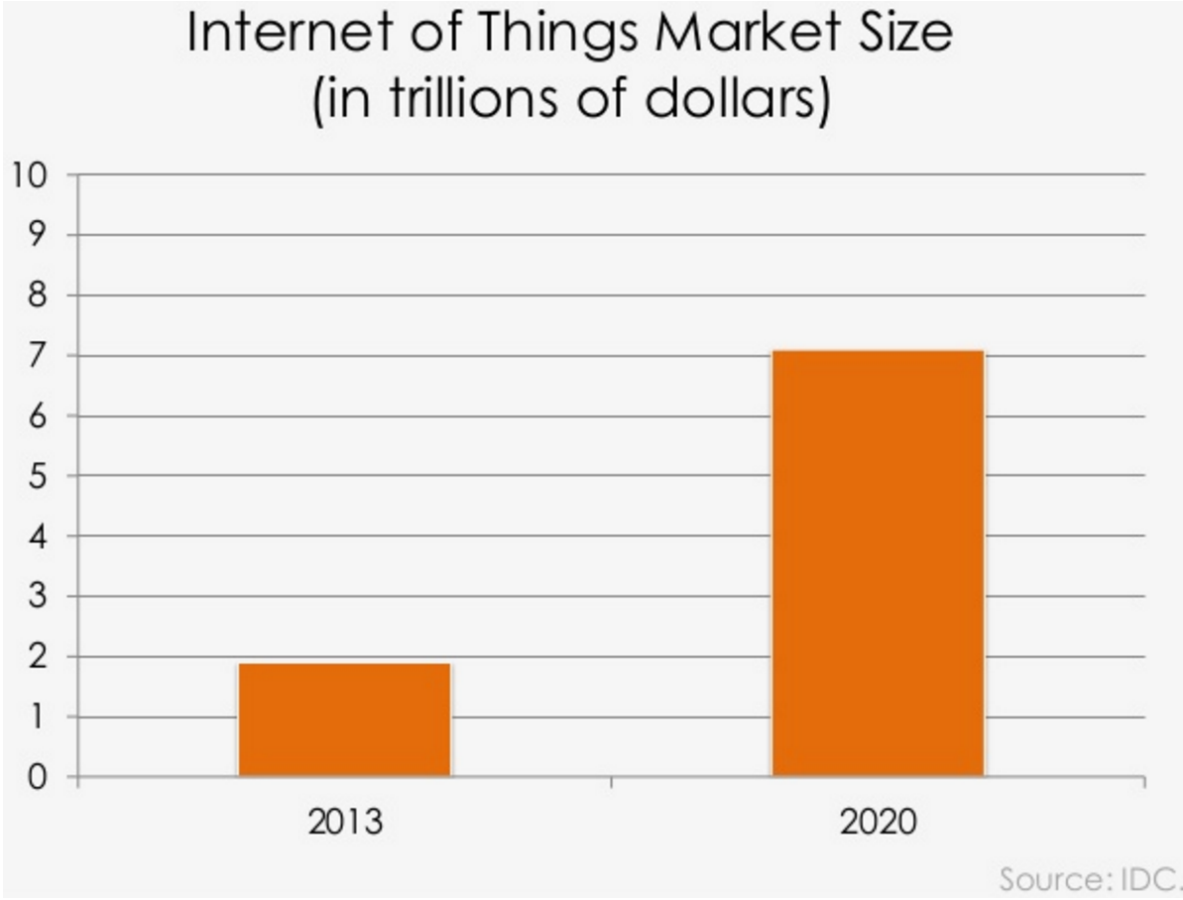
Asia – Really? – Why? What's it worth?

- China's government has committed to spend $603 billion by 2020 for M2M connections.
- What's the worth of all these connected things?
- Probably much more than you think.



Not everyone agrees.

Cisco believes the market size will be $19 trillion by 2025.

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What does it mean for Business and Me?

- The potential market size is so big because the IoT is about increasing efficiency, as well as creating new profits.
- These efficiencies will touch nearly every part of our lives: Healthcare, Transportation, Utilities, etc.
- General Electric says that a 1% increase in efficiencies from the Industrial Internet (part of the IoT) will have huge savings.

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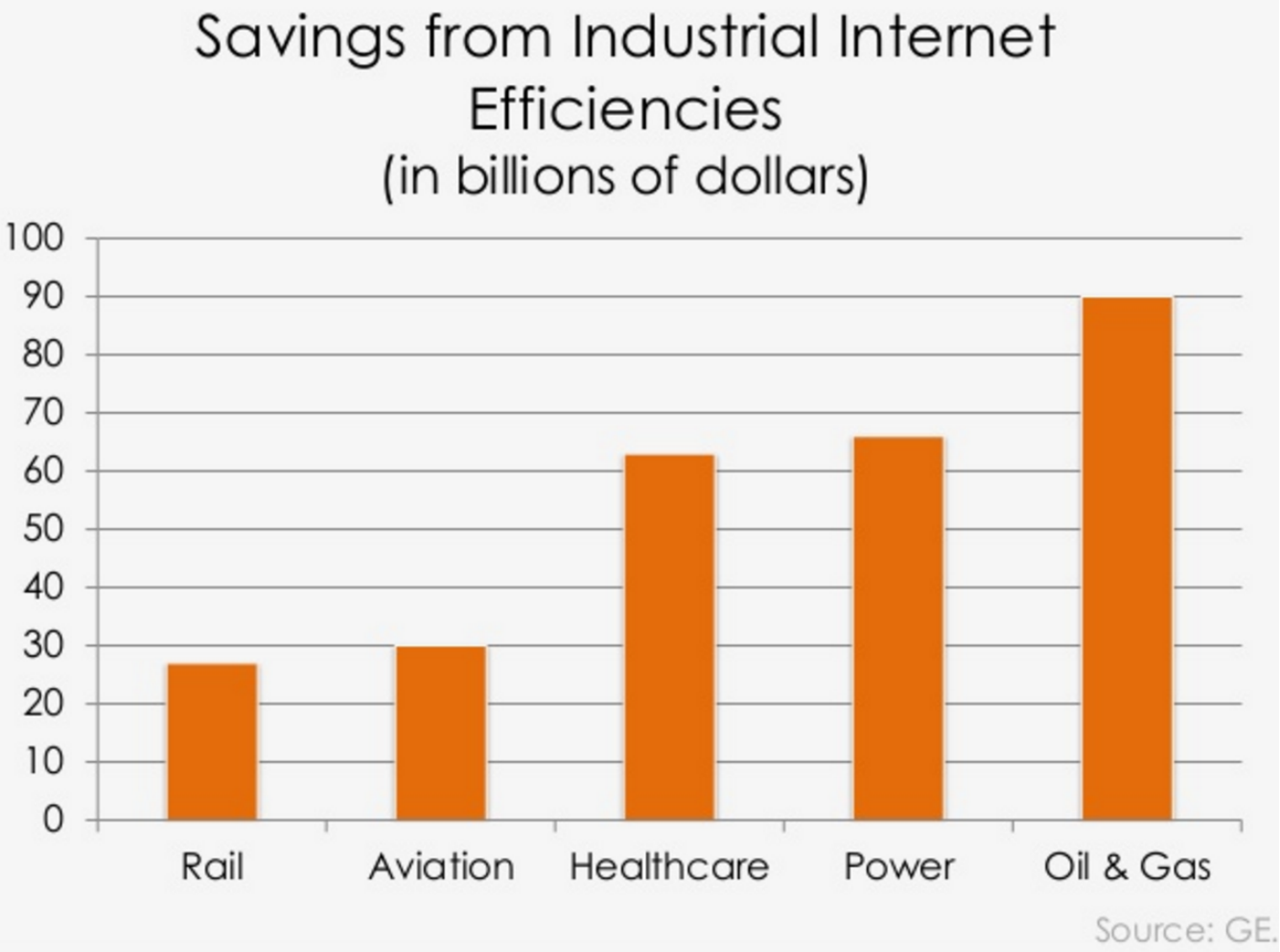
Industrial Internet efficiencies



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Some Skepticism and Optimism

- There is a lot of room for varying IoT predictions.
- But even if we look at the low estimates, IoT will still have a huge impact on our lives.
- And we've only just begun.

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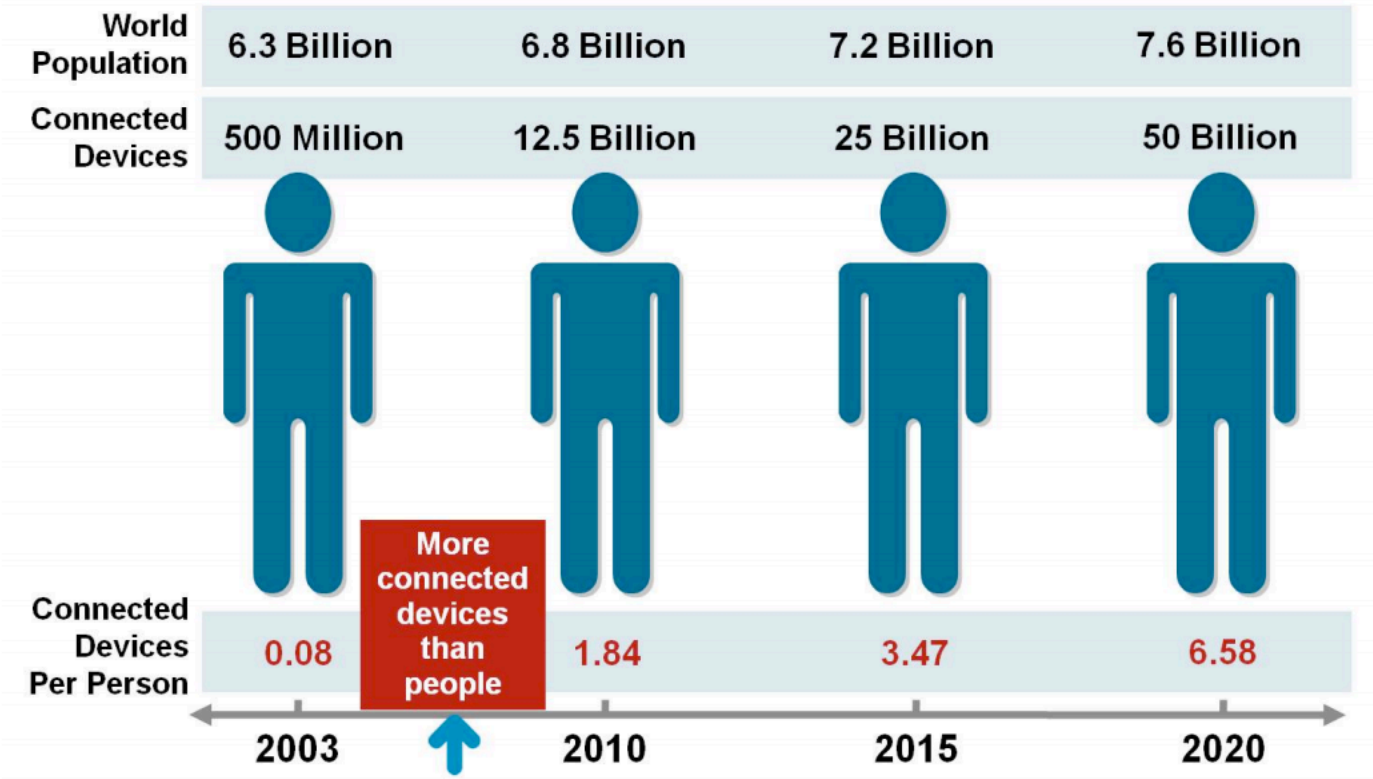
Internet Usage and Population Statistics



Source: Cisco IBSG, April 2011

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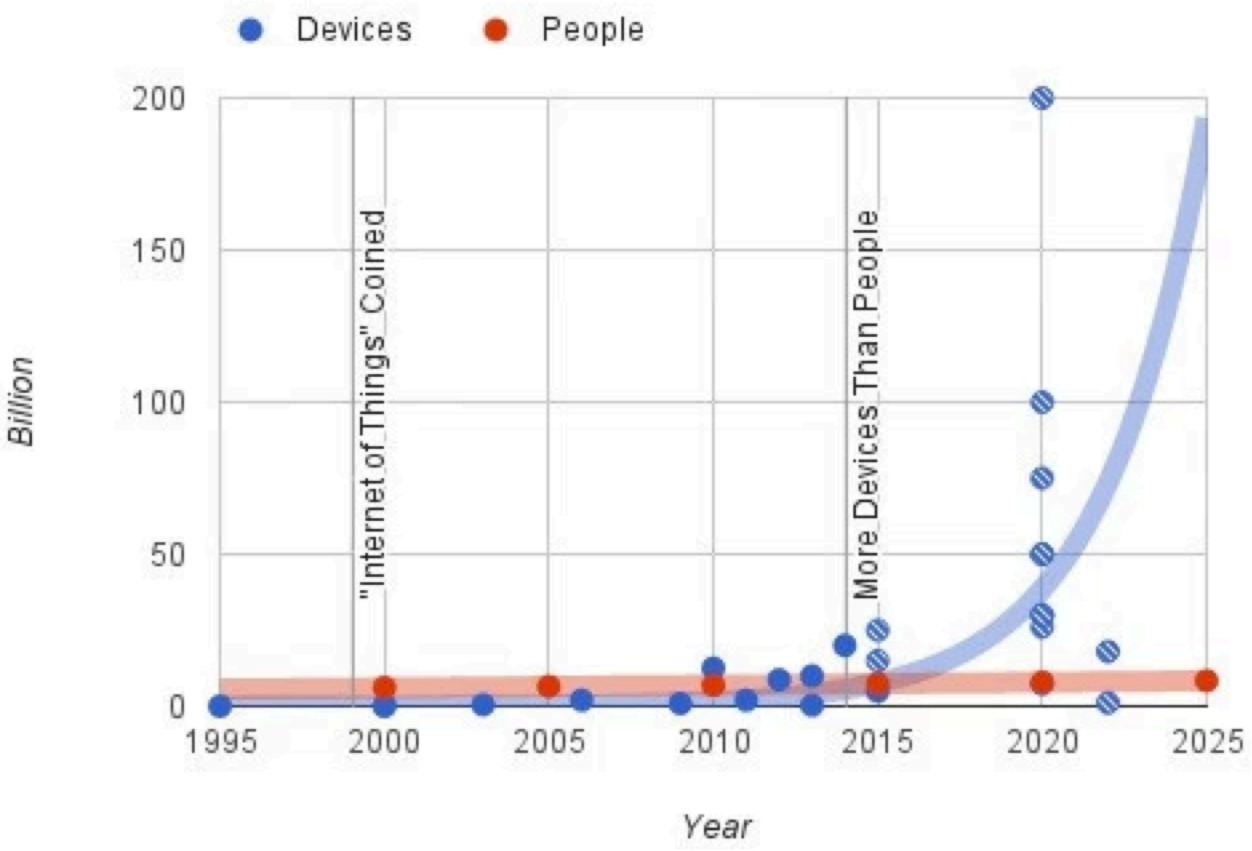
Internet Usage and Population Statistics



https://www.brookings.edu/blog/techtank/2015/06/09/sketching-out-the-internet-of-things-trendline/

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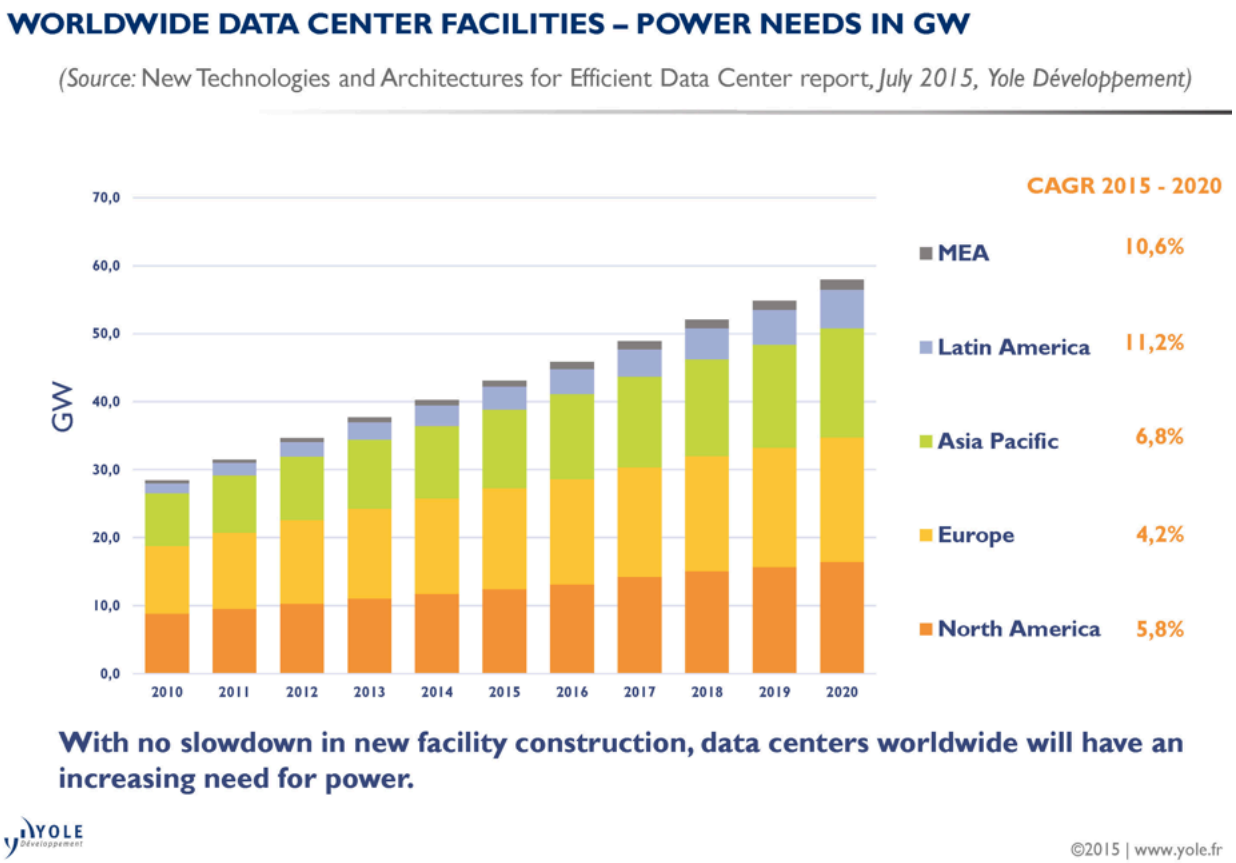
Rising Energy Requirements (Data Center + IoT)



http://www.yole.fr/Datacenter_Silicon_Photonics.aspx#.Wbxk8dN946g

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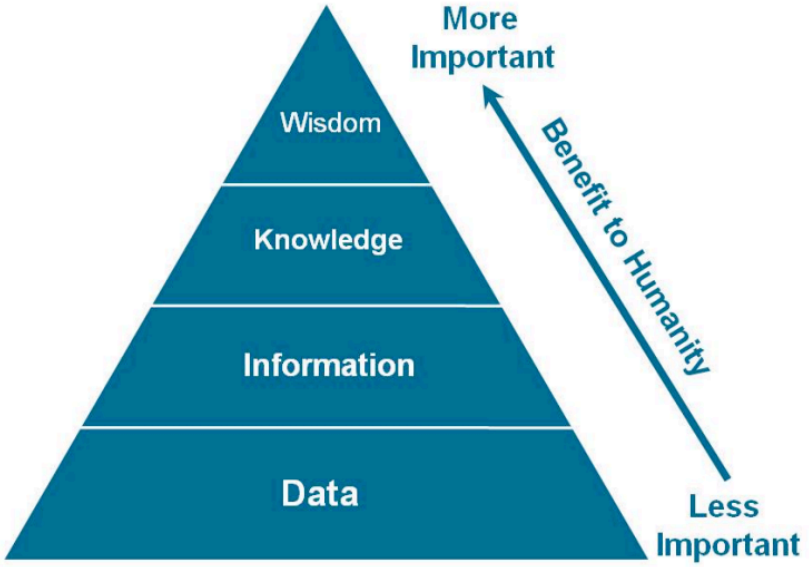
We Evolve Because We Communicate

- Humans evolve because they communicate.
  - Once fire was discovered and shared, for example, it didn't need to be rediscovered, only communicated.
  - A more modern-day example is the discovery of the helix structure of DNA, molecules that carry genetic information from one generation to another.
- Humans turn Data into Wisdom.
  - This principle of sharing information and building on discoveries can best be understood by examining how humans process data.



Source: Cisco IBSG, April 2011

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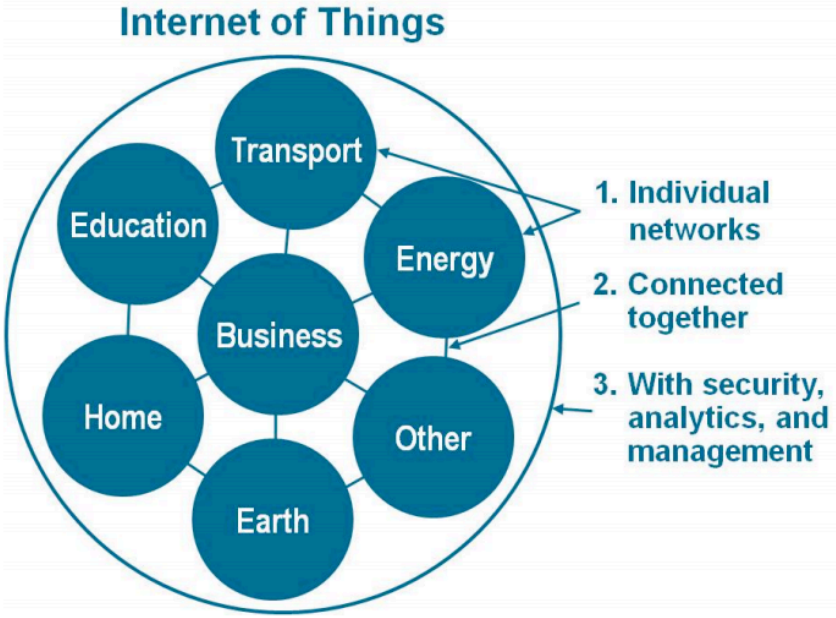
IoT as a Network of Networks

- Currently: IoT is made up of a loose collection of disparate, purpose-built networks.
  - Today's cars, for example, have multiple networks to control engine function, safety features, communications systems, and so on.
  - Commercial and residential buildings also have various control systems for heating, venting, and air conditioning (HVAC); telephone service; security; and lighting.
- In the Future: As IoT evolves,
  - These networks, and many others, will be connected with added security, analytics, and management capabilities.
  - This will allow IoT to become even more powerful in what it can help people achieve.



Source: Cisco IBSG, April 2011

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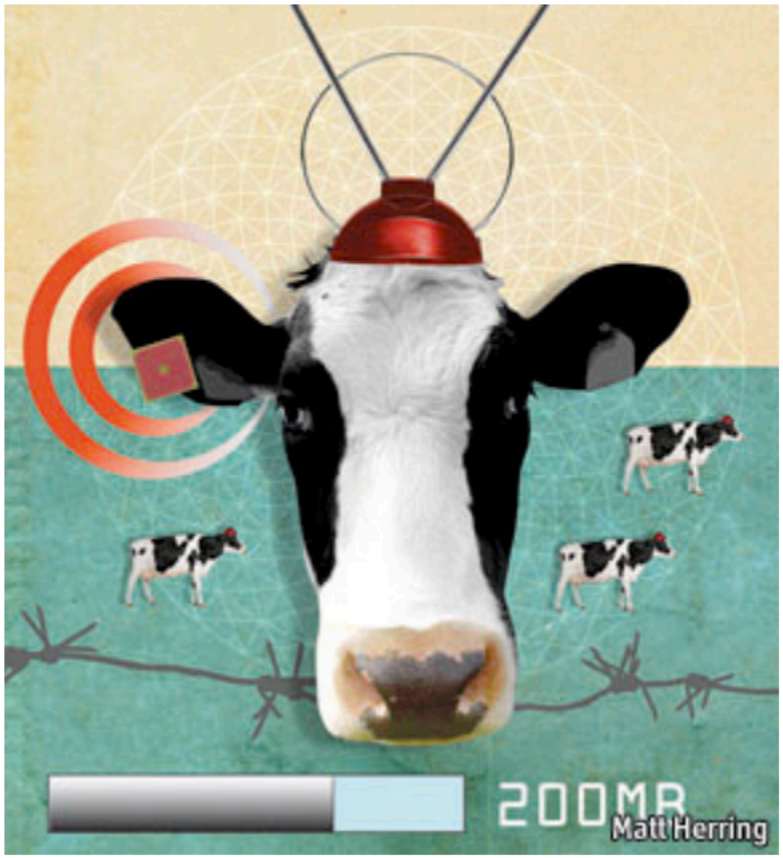
IoT: Holy Cow!

- A special report in The Economist titled "Augmented Business"
  - Described how cows will be monitored.
  - Sparked, a Dutch start-up company, implants sensors in the ears of cattle.
  - This allows farmers to monitor cows' health and track their movements, ensuring a healthier, more plentiful supply of meat for people to consume.
  - On average, each cow generates about 200 megabytes of information a year



Source: *The Economist*, 2010.

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Mumbai: A Tale of Two Cities

- One of the areas where IoT can make a significant difference is in closing the poverty gap.
  - People from Dharavi pay for municipal-grade water is $1.12 per cubic meter.
  - This compares to $0.03 for residents of Warden Road.
  - The injustice is clear: the poor people of Mumbai pay 37 times more for water (a basic human necessity).
- The main source of the disparity is the higher cost of delivering utility services to poorer neighborhoods because of infrastructure inefficiencies, problems such as leaks, and theft.
- IoT will provide authorities with more information and control in order to identify and fix these problems.

Source: *The Wall Street Journal*, 2009.

Dr. C.K. Prahalad's book, ***The Fortune at the Bottom of the Pyramid: Eradicating Poverty Through Profits***
https://www.amazon.com/Fortune-Bottom-Pyramid-Eradicating-Poverty/dp/8177587765

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Typical Views of the Internet of Things

Industrial Automation

Smart Health

Smart Home

Smart City

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The Internet of Things

"Internet of Objects" "Machine-to-Machine Era" "Internet of Everything"

(3) The term "Internet of Things" has come to describe a number of technologies and research disciplines that enable the Internet to reach out into the real world of physical objects.

------IoT 2008

(4) "Things having identities and virtual personalities operating in smart spaces using intelligent interfaces to connect and communicate within social, environmental, and user contexts".

-------IoT in 2020

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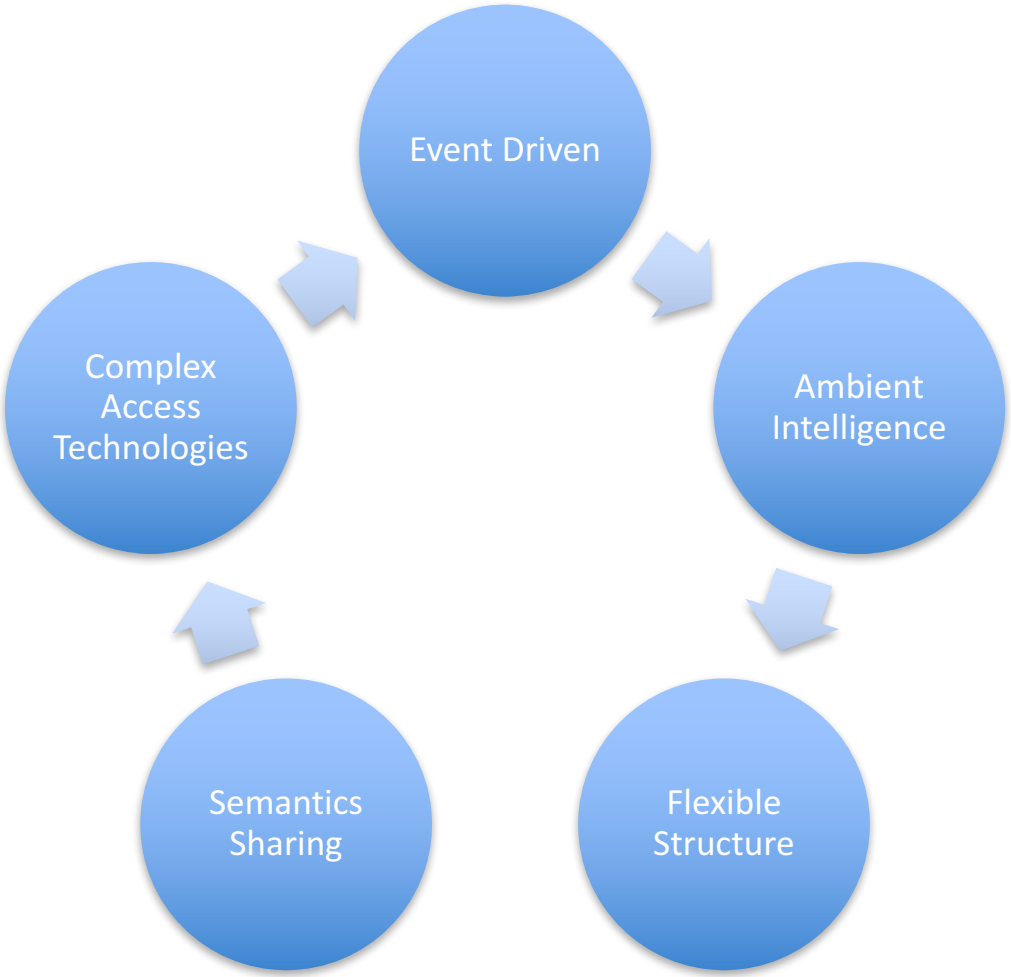
Internet of Things – Characteristics



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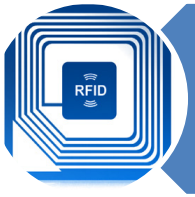
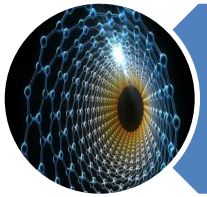
Internet of Things – Enabling Technologies



RFID: To identify and track the data of things

Sensors: To collect & process the data, to detect the changes in physical status of things

Smart Tech: To enhance the power of network by devolving processing capabilities to different parts of the network



Nano Tech: To make the smaller and smaller things have the ability to connect and interact.

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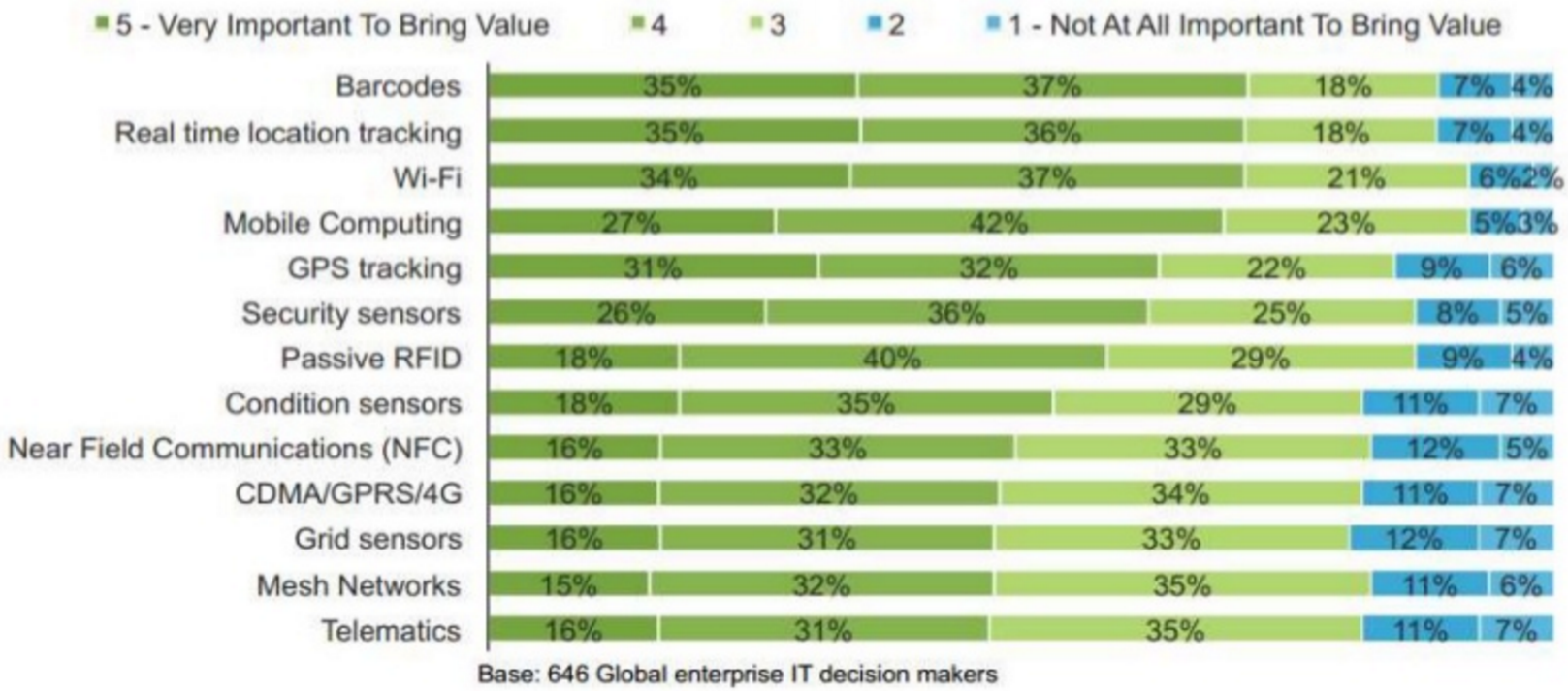
Device Types valuable to enabling of IoT

Thinking about your company, on a scale of 1 to 5, with 1 being not at all important to bring value and 5 being very important to bring value, please rate *the following technologies on how necessary each is to enable* Internet of Things solutions.



Base: 646 Global enterprise IT decision makers

Source: A commissioned study conducted by Forrester Consulting on behalf of Zebra, June, 2012

ZEBRA TECHNOLOGIES
SEE MORE. DO MORE.

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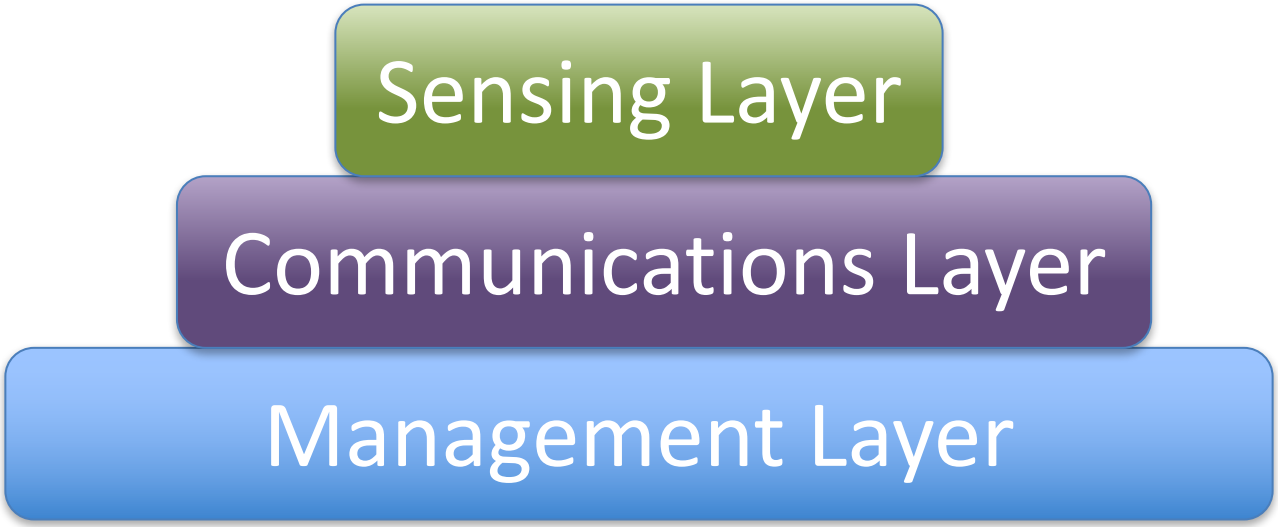
Internet of Things – A Technical Perspective



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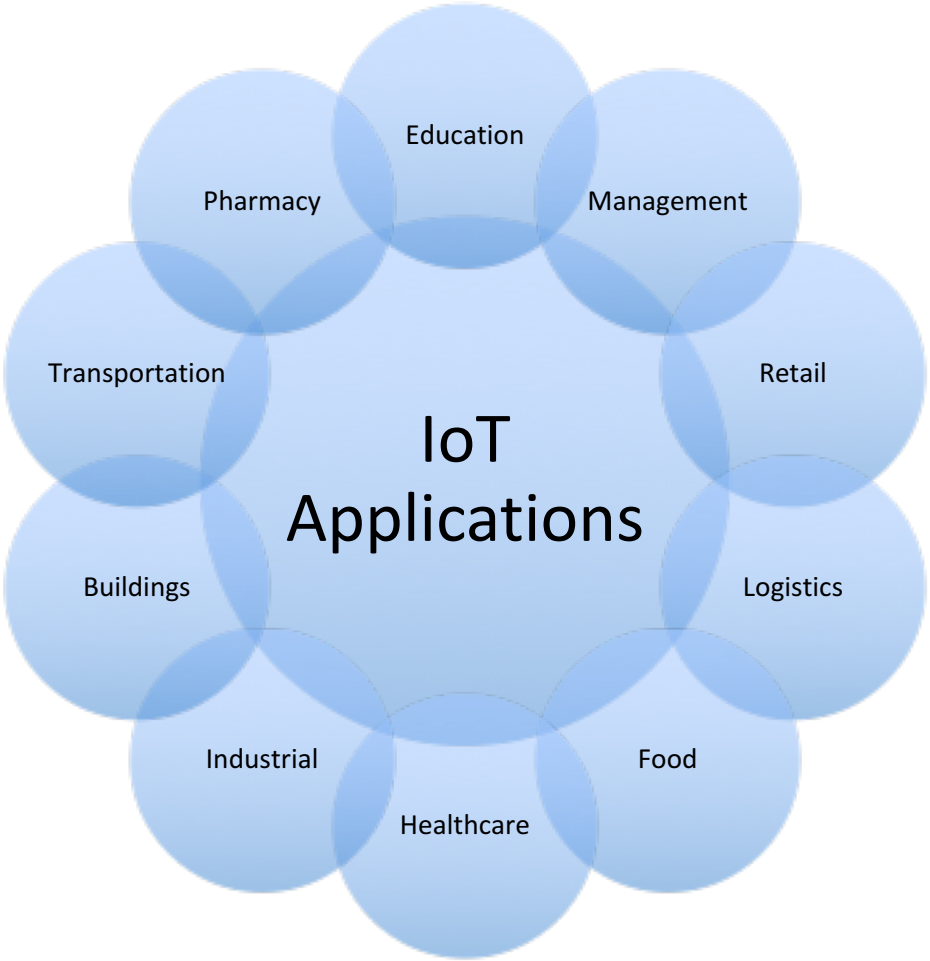
IoT Applications



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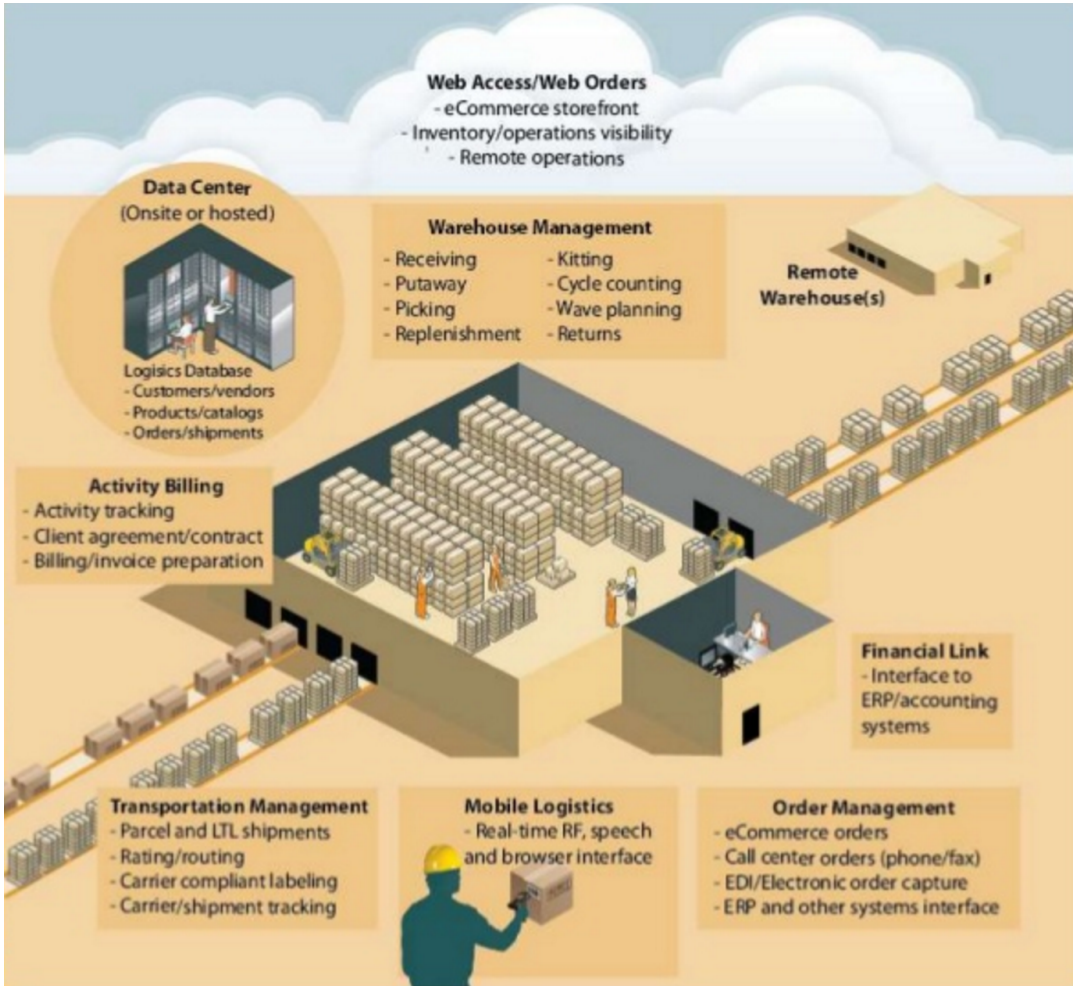
IoT Applications: Management

- Data management
- Waste management
- Urban Planning
- Production management
- Distribution management
- …



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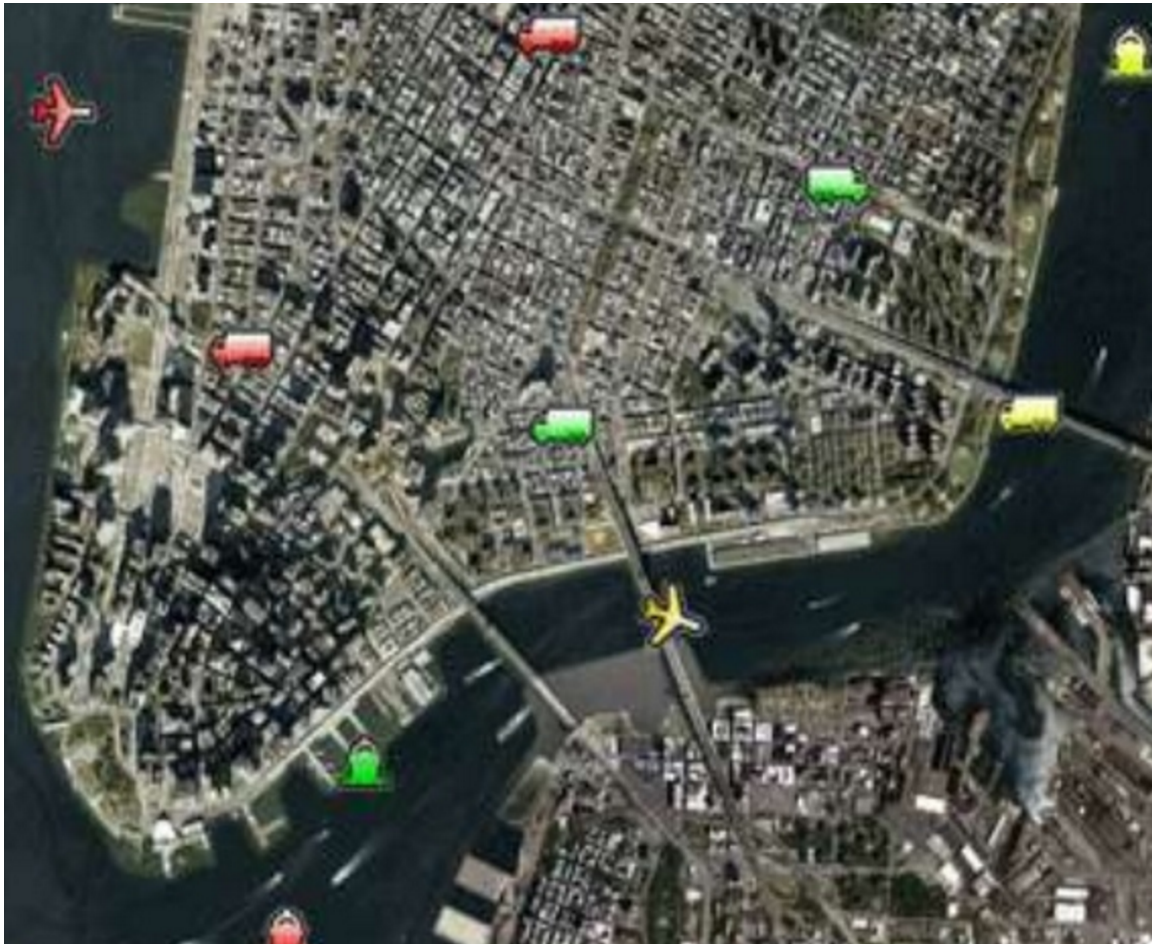
IoT Applications: Logistics

- Port management
  - Ships, Airlines, Boats containers
  - ETAs, ETDs
- Warehouse management
  - Inventory Control
  - Supply Chain management
- …



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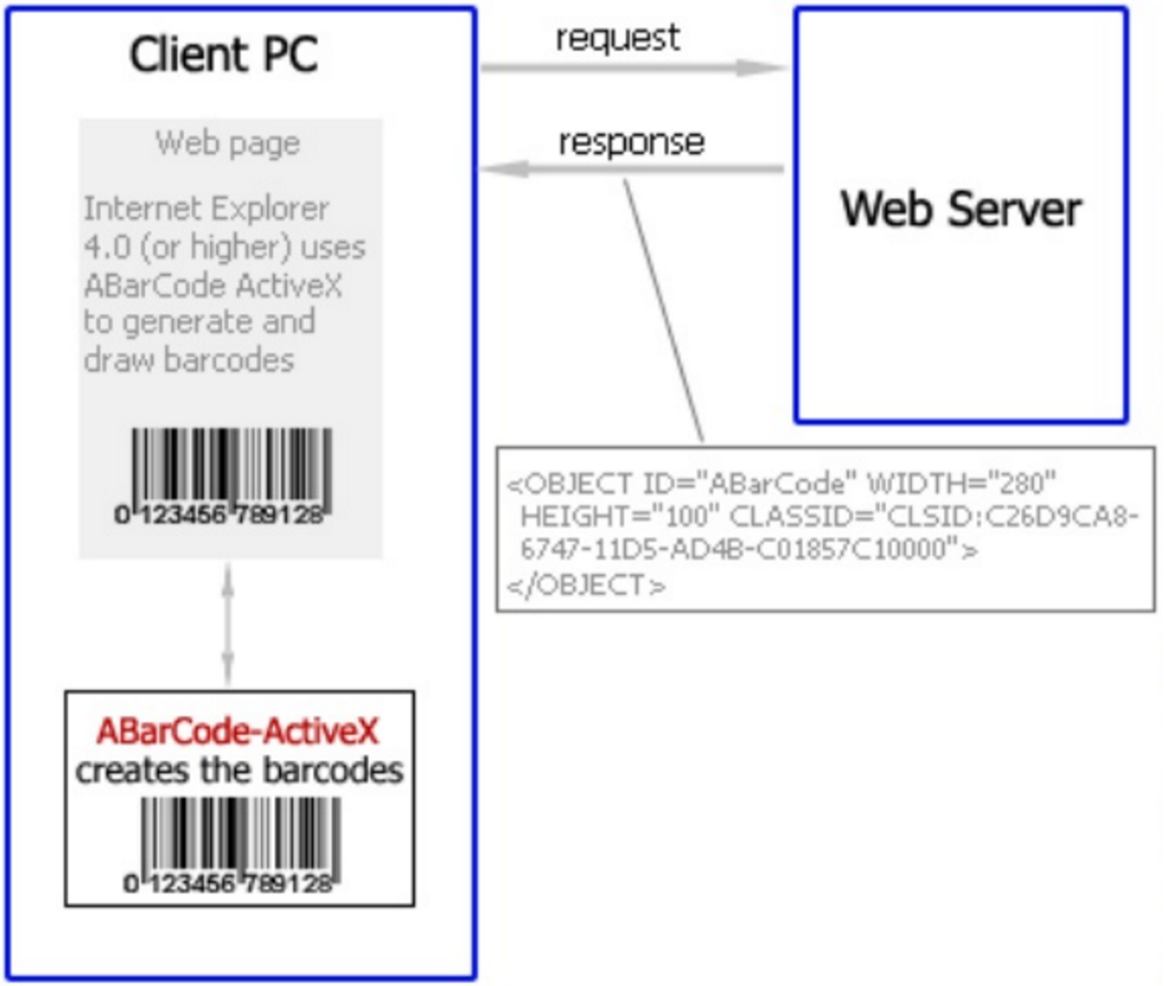
IoT Applications: Retail

- Intelligent shopping
- Bar code in retail
- Urban Planning
- Electronic tags
- …



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IoT Applications: Pharmaceuticals

- Intelligent tags for drugs
- Drug usage tracking
- Enable emergency treatment to be given faster and more accurate.
- …

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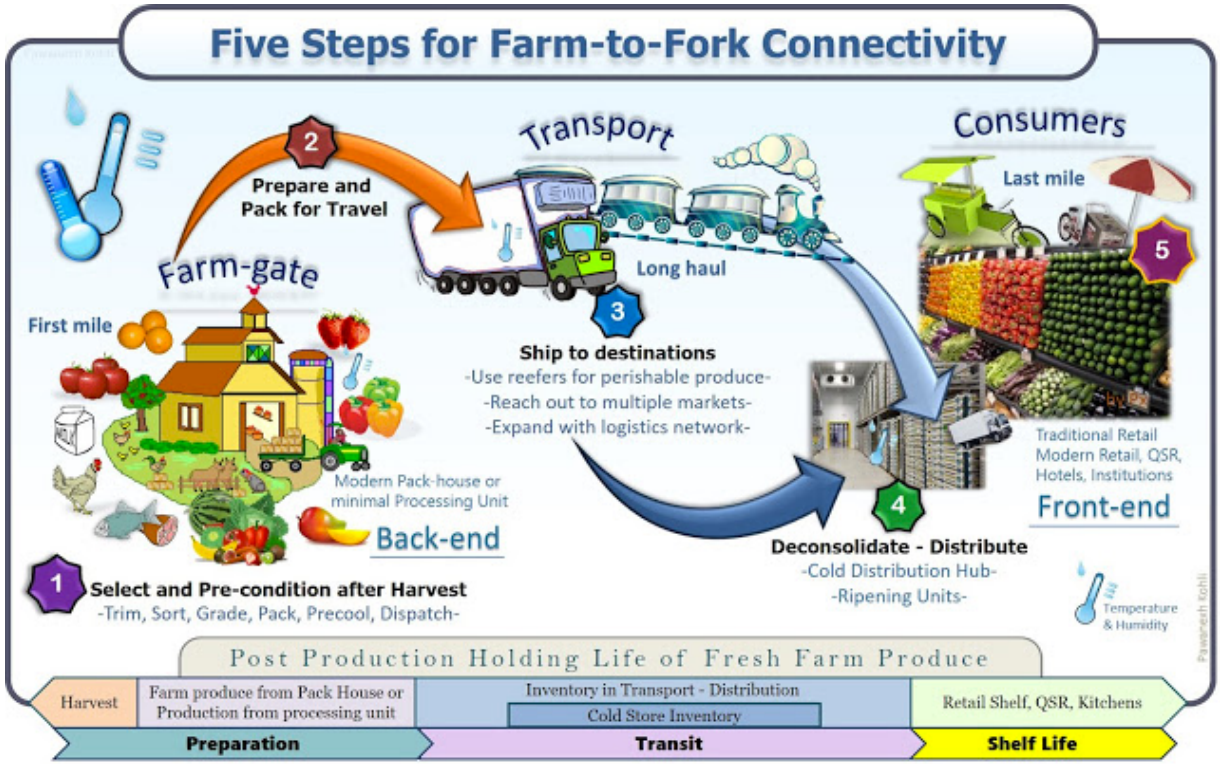
IoT Applications: Food

- Control geographical origin.
- Food production management
- Nutrition calculation
- Prevent shortages and overproduction
- Control quality, health and safety
- …



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IoT Applications: Industry

- Production traceability.
- Machine Vision, Motion I/O and Controllers
- Abnormality Diagnosis,
- Sensor Management
- Industrial Robots
- Factory Waste and Energy Management
- …

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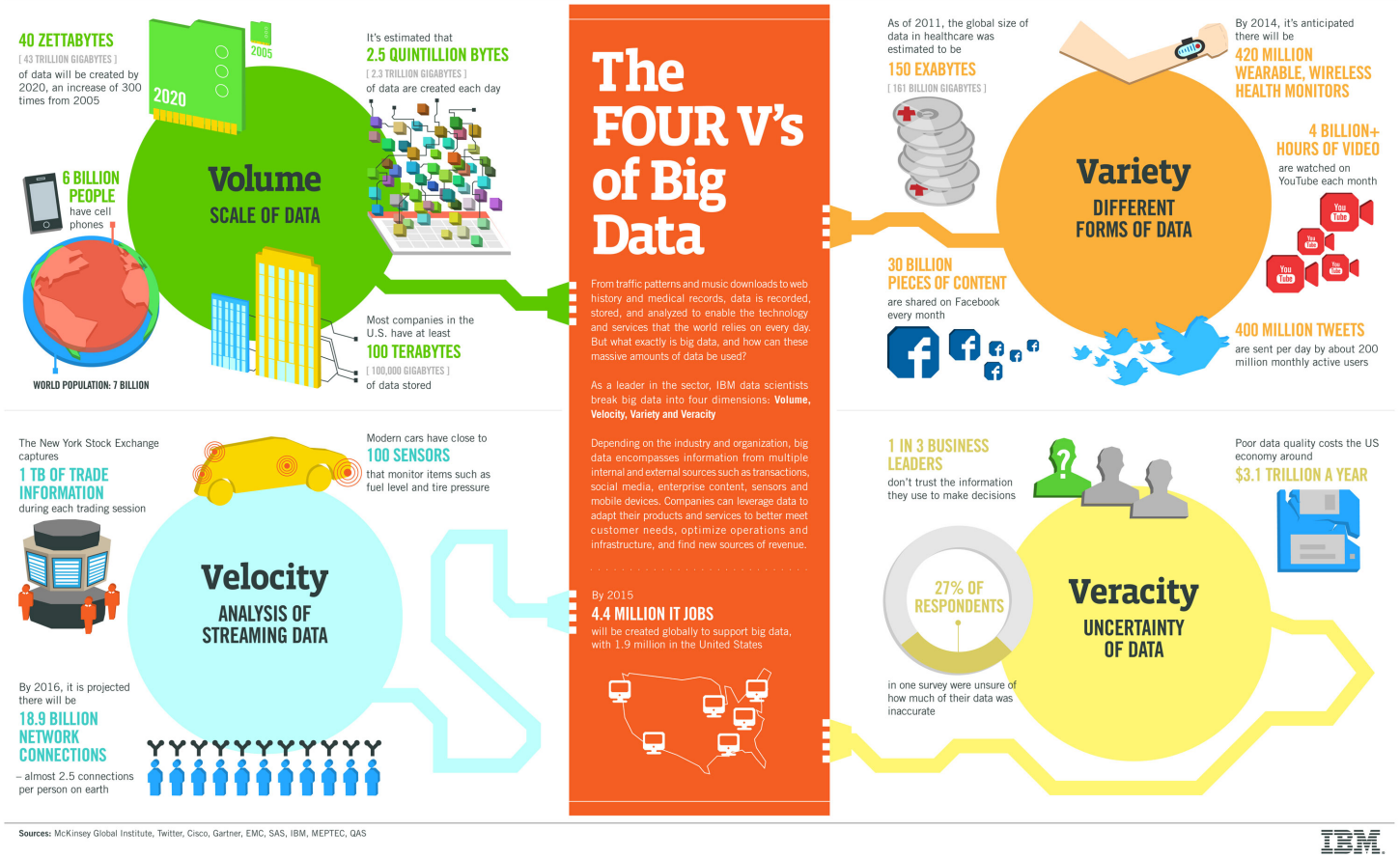
Big Data Analytics – The 4 + 1 V's



Value: It is great having access to big data but unless we can turn it into value it is useless. So you can safely argue that **'Value'** is the most important V of Big Data.

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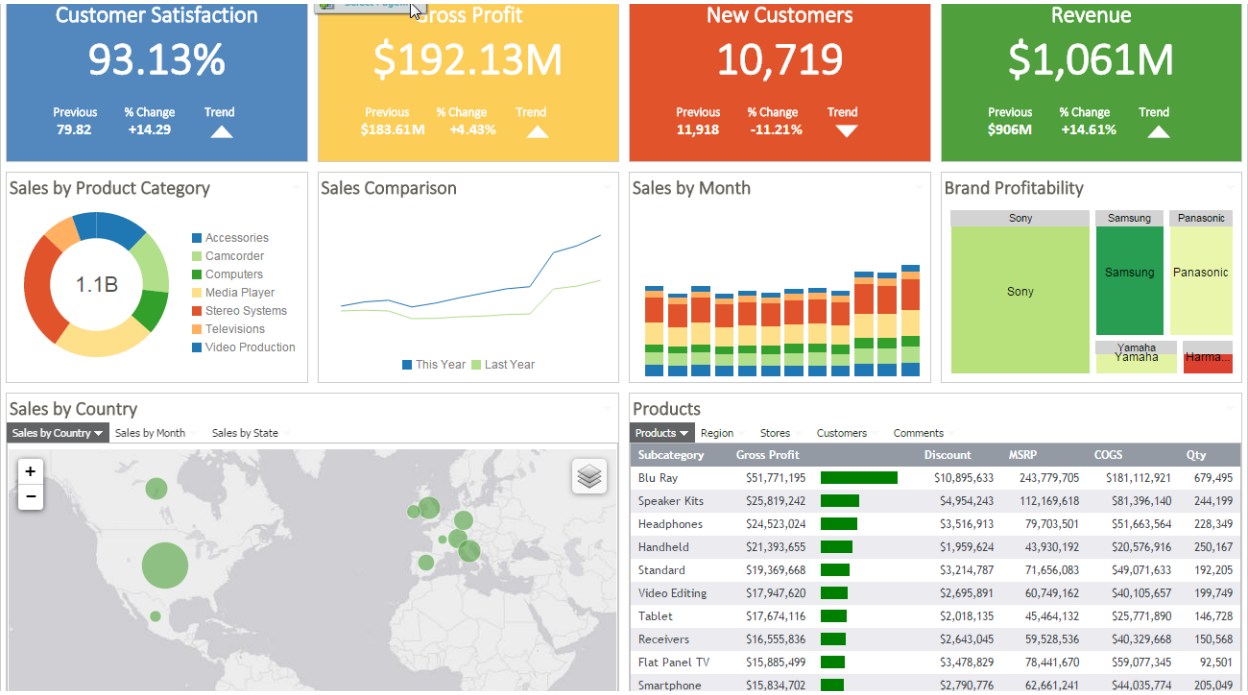
Business Intelligence

- BI technologies provide current, historical and predictive views of business operations.
- Common functions of business intelligence technologies are
  - business performance management,
  - online analytical processing,
  - predictive analytics,
  - prescriptive analytics,
  - reporting,
  - analytics,
  - data mining,
  - process mining,
  - event processing,
  - benchmarking, and
  - text mining,



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Acknowledgements

- http://www.cisco.com/c/dam/en_us/about/ac79/docs/innov/IoT_IBSG_0411FINAL.pdf
- http://www.fool.com/investing/general/2016/01/18/internet-of-things-in-2016-6-stats-everyone-should.aspx
- Hyper-Cycle for Emerging Technologies http://www.gartner.com/newsroom/id/3114217
- https://www.accenture.com/us-en/labs-insight-industrial-internet-of-things
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- http://www.progressiverailroading.com/rail_industry_trends/article/The-Internet-of-Things-A-world-of-opportunity-for-railroads--47507
- http://www.computerweekly.com/feature/How-the-Internet-of-Things-could-transform-Britains-railways
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