IEEE IoT & Initiatives Smart Cities

IoT Enabling Smart Cities

Bruce Kraemer

IEEE-SA Workshop

Vienna, 23 March 2015

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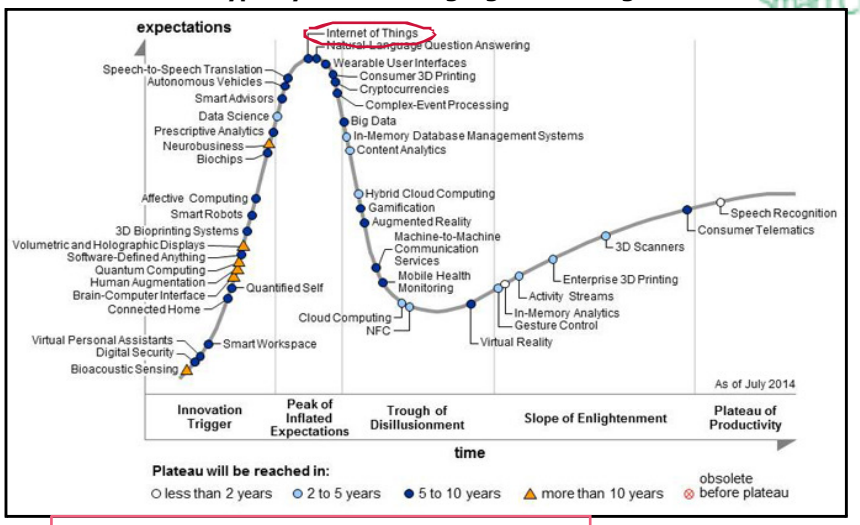
Internet of Things (IoT)

&

IEEE Initiatives

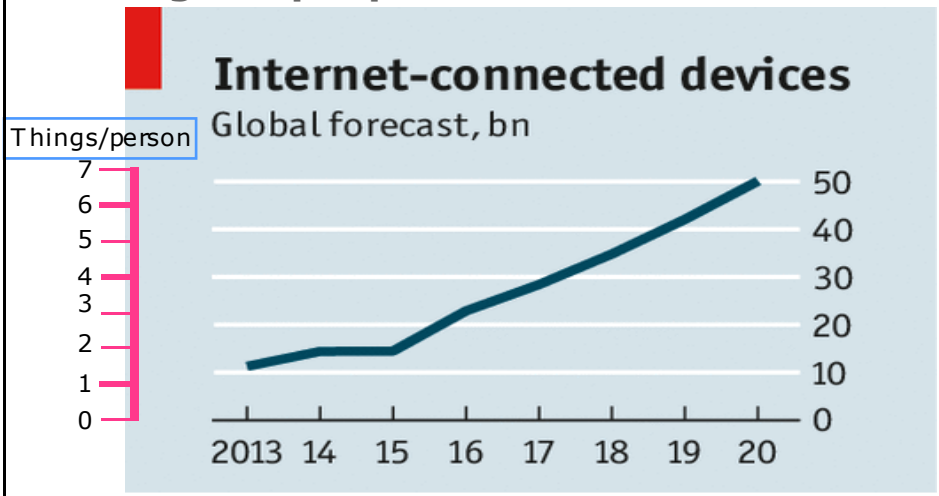
IoT: Today's Hot Topic

Gartner's 2014 Hype Cycle for Emerging Technologies



http://www.gartner.com/newsroom/id/2819918

Things vs people



http://www.economist.com/news/leaders/21606829-hooking-up-gadgets-web-promises-huge-benefits-security-must-not-be

Growth in Data

1 Exabyte/month=10^{18} Bytes = 1 billion GB/month

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5

What is IOT (Internet of Things)

ITU-T Recommendation ITU-TY.2060 defines IOT as a global infrastructure for the information society, enabling advanced services by interconnecting (physical and virtual) things based on existing and evolving interoperable information and communication technologies.

IEEE-SA INTERNET OF THINGS ECOSYSTEM STUDY
The Internet of Things (IoT) is a system consisting of networks of sensors, actuators, and smart objects whose purpose is to interconnect "all" things, including everyday and industrial objects, in such a way as to make them intelligent, programmable, and more capable of interacting with humans and each other.

Smart = interconnected components sharing useful information for taking actions

IOT Value

The IoT's true value lies in the data the interconnected items share.

IoT might, for example, lead to improved highways, more efficiently run hospitals, and changes in how things are shipped.

IoT has to overcome several obstacles:

- It needs more intelligent sensors that can talk to each other, as well as better and faster analysis tools to deal with the deluge of data, to say nothing of common standards.
- There are also societal concerns such as how to keep personal information private.

http://theinstitute.ieee.org/static/special-report-the-internet-of-things

Great Expectations

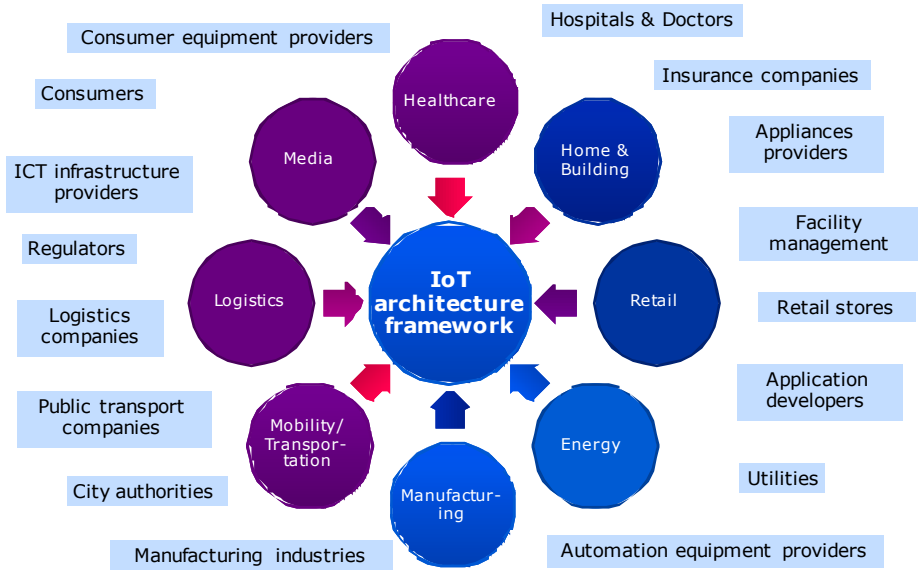
Smart systems may well be humankind's best hope for dealing with its pressing environmental problems, notably global warming.

Today power grids, transport systems and water-distribution systems are essentially networks of dumb pipes.

If the power grid in America alone were just 5% more efficient, it would save greenhouse emissions equivalent to 53m cars, calculates IBM.

Congested roads cost the US 4.2 billion working hours and 10.6 billion litres of wasted petrol in 2007 , according to the Texas Transportation Institute.

IoT Application Domains & Stakeholders*



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*due to the diversity of IoT application areas only selected domains and stakeholders are shown

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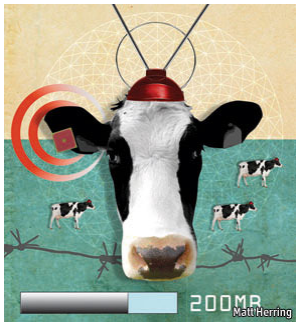
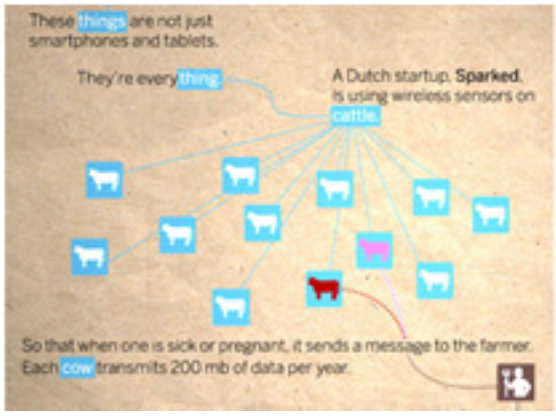
11

Cows are Things too

Nederlands, Sparked





http://www.economist.com/node/17388392

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12

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Internet of Things (IoT)

IEEE Multi- Technology Approach

IEEE Standards on Smart Systems

eHealth

IEEE Smart Cities

ISO/IEEE 11073 series Health Informatics - Medical / Health Device Communication Standards

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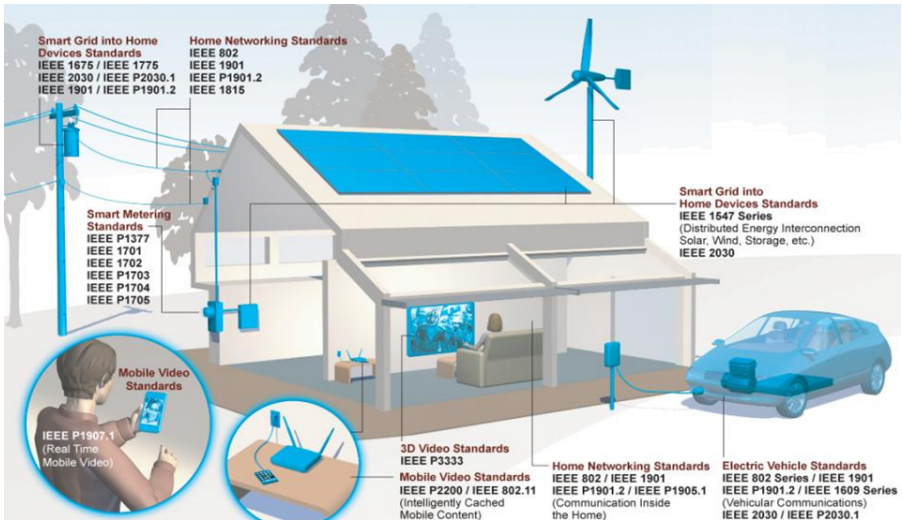
14

IEEE Standards on Smart Systems

Smart Home



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15

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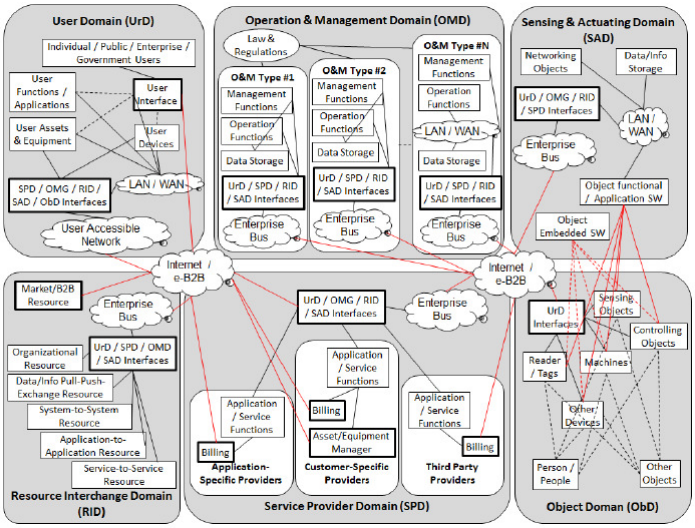
Internet of Things (IoT)

IEEE Engineering And Communiyty

IOT View – ISO 30141



What does IOT look like?

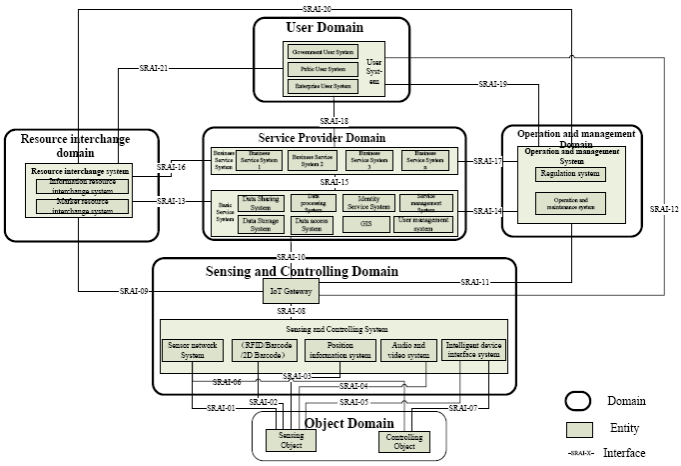


Figure 6. IoT System Reference Architecture (SRA) Diagram.

IEEE Architecture for IoT

IEEE Internet of Things

- IEEE P2413 will provide an architectural framework for the IoT and its sub-domains
  - http://grouper.ieee.org/groups/2413/
- The architectural framework for IoT will include
  - A reference model that defines relationships among various IoT verticals (e.g., transportation, healthcare, etc.) and common architecture elements
  - Architectural building blocks and their ability to be integrated into multi-tiered systems
  - A blueprint for data abstraction and the quality "quadruple" trust that includes protection, security, privacy, and safety"

IEEE View – P2413

- This standard defines an Architectural Framework for the IoT, including descriptions of various IoT domains, definitions of IoT domain abstractions, and identification of commonalities between different IoT domains.
- The Architectural Framework for IoT provides:
  - reference model that defines relationships among various IoT domains (e.g., transportation, healthcare, etc.) and common architecture elements
  - reference architecture that:
    - builds upon the reference model
    - defines basic architectural building blocks and their ability to be integrated into multi-tiered systems
    - addresses how to document and mitigate architecture divergence.
  - blueprint for data abstraction and the quality "quadruple" trust that includes protection, security, privacy, and safety.

IEEE P2413 and other bodies

IEEE Internet of Things

- A unified IoT architecture framework cannot be constructed in isolation. It must include interaction with, and input from other standardization activities. A broad range of vertical applications need to be understood to
  - Cover the various applications, their requirements and specific IoT functionalities in the IoT architecture framework
  - Ensure that the framework addresses the needs for standardization activities

P2413 will include interactions with standardization activities within IEEE

Additionally, P2413 has and will continue to establish liaisons with other standardization bodies

- for example, IEC (e.g. Industry 4.0, Smart Grid), ETSI, oneM2M, and ISO (e.g., Intelligent Transportation Systems, e-Health) on IoT matters

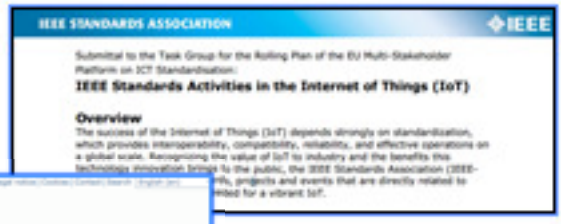
IEEE-SA Internet of Things: Activities

IEEE Internet of Things

New standards project: IEEE P2413	• IoT Architecture Framework • http://standards.ieee.org/develop/project/2413.html
Convergence of Smart Home and Building Architectures	• IEEE-SA Industry Connections program • *http://standards.ieee.org/develop/indconn/iccshba/index.html*
Engagement with IEEE IoT Initiative	• Broad-based initiative across all of IEEE focused on IoT • Covers IEEE conferences, publications, education programs and more

Contributions to European IoT Efforts

http://standards.ieee.org/develop/msp/iot.pdf



http://ec.europa.eu/enterprise/sectors/ict/standards/work-programme/index_en.htm

http://www.internet-of-things-research.eu/

IEEE IOT Special Report

TECH FOCUS

SMARTER SENSORS
Making the Internet of Things soar

THE VALUE OF PRIVACY
Safeguarding your information in the age of the Internet of Everything

OPINIONS

WILL THE IOT CRUSH IT?
Big data may force companies to merge

WHAT'S COMING NEXT: THE INTERNET OF EVERYTHING
Detecting and nurturing breakthrough technologies is critical to the success of IEEE

http://theinstitute.ieee.org/static/special-report-the-internet-of-things

IEEE IOT Special Report

BENEFITS

CONFERENCES: MARCH-OCTOBER 2014
Upcoming IEEE events cover topics related to the Internet of Things

HELP WITH BUILDING THE NEXT BIG THING
The resources you need to tackle the IoT

SETTING THE STAGE FOR THE INTERNET OF THINGS
Covering a spectrum of applications

PEOPLE

YEN-KUANG CHEN: IMPROVING LIVES
Crossing disciplines to advance the Internet of Things

http://theinstitute.ieee.org/static/special-report-the-internet-of-things

IEEE IOT Special Report

WEB EXTRAS

ASK THE EXPERT: THE INTERNET OF THINGS
Two IEEE members will answer your question on this emerging area

TECH NEWS: THE INTERNET OF THINGS
This segment focuses on IEEE's role in the IoT revolution

BOOKS OF INTEREST: MARCH 2014
On technologies that make the Internet of Things possible

SETTING STANDARDS FOR THE IOT
Video highlights IEEE's involvement in the interconnected future

http://theinstitute.ieee.org/static/special-report-the-internet-of-things

IEEE IOT Special Report

THE EXPLOSION OF THE IOT FOR BUSINESS
How the Internet of Things with spur buyouts

THE POWER OF THE INTERNET OF THINGS
Video from IBM illustrates the acceleration of the IoT

THE FATHERS OF THE INTERNET
Four IEEE Life Fellows helped create the revolutionary network

VINTON CERF DISCUSSES THE INVENTION OF THE INTERNET
Indian television network NDTV interviews the father of the Web

http://theinstitute.ieee.org/static/special-report-the-internet-of-things

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27

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Internet of Things (IoT)
New Business Models

Selling Hot Air

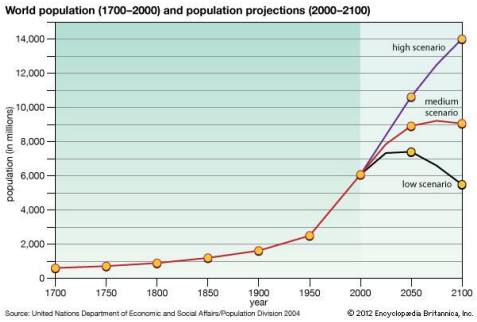
- **Smart systems can support new business models.**
  - Aircraft engines are packed with sensors
  - 80% of Rolls-Royce engines are not sold but rented
  - Rolls-Royce charges for the time they run.
  - Most Rolls-Royce engines send telemetry data to four centers, the biggest one in Derby, Great Britain
- **Smart systems support as an alternative to owning physical goods or dedicated businesses, running services and sharing resources**
- For example: Uber, Airbnb, TaskRabbit…
- **How many taxis, garages, drivers an mechanics does the $40 B (market value) UBER employ?**

Trend Toward Urbanization

- Half of the world population is living in cities in 2013
- The world population today is half what it will be in 2100
- Population in cities is expected to grow from 3.6 Billion to 6.3 Billion by 2050

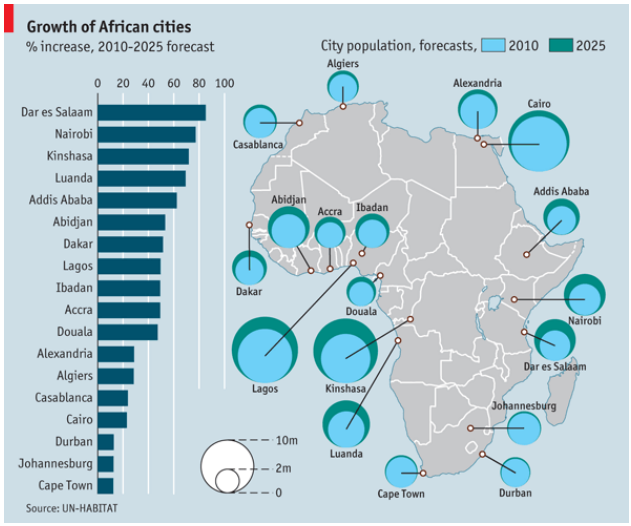
❑ By 2030, the populations of all developing countries, most notably in Asia and Africa, will be more urban than rural.

❑ The world slum population will reach 889 million by 2020.



http://unhabitat.org/making-slums-history-a-global-challenge-for-2020-international-conference-rabat-morocco-26-29-november-2012/

African cities Example



Urban challenges
at least some of them…

Early Smart City Examples

Walt Disney World – began 50 years ago,1964

27000 acres –the size of San Francisco

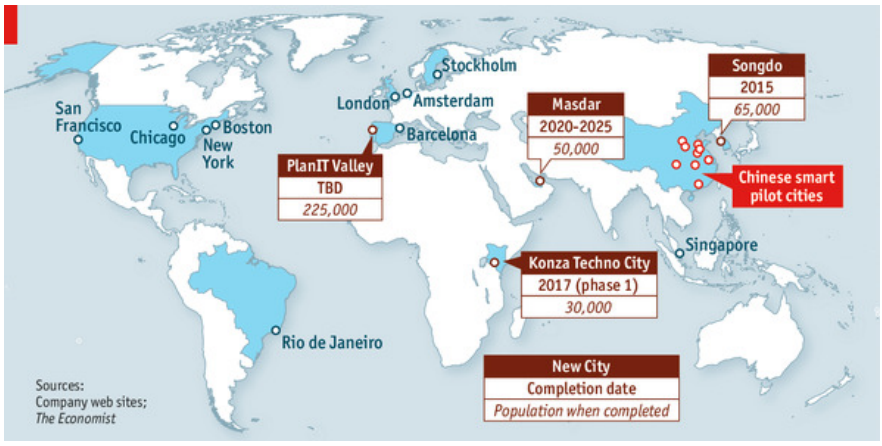
Employs 62000 people

140,000 visitors per day

Infrastructure built first at ground level

Park built on top

Smart City Initiatives



http://www.economist.com/news/briefing/21585003-building-city-future-costly-and-hard-starting-scratch

Initiative Objectives

- The IEEE Smart Cities Initiative is a global, multi-disciplinary effort to:
  - Create a **vibrant and world wide network of cities**, providing education, insights and expertise
  - Collaborate to share knowledge, experience and good practices
- Involve local **governance**, **universities**, **industries** and local **IEEE volunteers**
  - Assist municipalities in **managing the transition** to urbanization
  - **Raise awareness** of the benefits and downsides of technology and help guide the appropriate uses of technology
  - Build collaboration with organizations such as **IEC**

IEEE Smart Cities

- IEEE Conducted an urbanization Challenge and selected three cities to be supported by the initiative
- 2014 – Guadalajara (Mexico)
- 2015 – Trento (Italy), Wuxi (China)

Information Services

- Where am I?
- Where are my friends?
- Are there coffee shops near by?
- How do I get to the store I'm looking for?
- Is his a fair price to pay for this item?
- Before I buy this Do you like this style and color?

Common Themes

- Location services
- Communication services
- Sensors

Smart City – Information Value

- Engineers dream of a digital nervous system that captures data from every nook and cranny: from sewers, parking spaces, school thermostats, cameras designed to show how many windows have lights turned on behind them, and so on.
- Powerful computers then crunch the data, optimise operations and tell the authorities about incipient problems.
- It is a notion of control happily abetted by technology companies that want to sell components and services: "Unlocking a one trillion dollar opportunity" was the tagline of a smart-city workshop in Singapore earlier this year.

http://www.economist.com/news/briefing/21585002-enthusiasts-think-data-services-can-change-cities-century-much-electricity

Smart City – Information Value

- Proponents claim that the right tools, properly hooked up, would allow a new level of integrated response.
- A fire alarm would not simply call out fire engines: it could determine their best route, redirect traffic away from it, warn downwind schools to close their windows and make sure that there was adequate water.

http://www.economist.com/news/briefing/21585002-enthusiasts-think-data-services-can-change-cities-century-much-electricity

Static data is also valuable…..
New York OpenData currently offers 1337 databases to the public
Such as: Subway entrance maps, construction projects, after school programs, hiking trails, recycling bin locations, street tree inventory

https://nycopendata.socrata.com/data

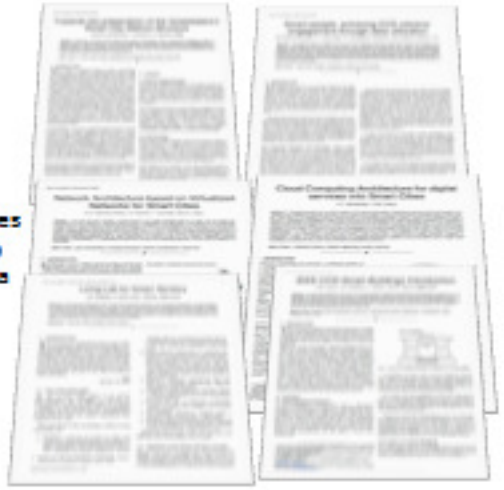
Initiative Deliverables

- As a framework for the initiative
  - Web Portal
  - Knowledge Database : Whitepapers, applications, metrics, use cases, etc.
  - On-Line Technical Community
  - Dissemination through press releases, newsletter, conferences, social media…
- For each of the selected cities
  - Completion of **workshops** in cities planning or building a smart city
  - **Working groups** and **whitepapers**
  - **Metrics** to measure effectiveness of Smart Cities
  - Published **theses** and doctoral **dissertations** from university students
  - **MOOC Courses** developed by the universities on agreed topics
  - Follow-on **conferences**
  - **Standards**

Whitepapers: Guadalajara Project

- Six papers published on Portal
  - Cloud Computing Architecture for Digital Services into Smart Cities
  - IEEE-GDL CCD Smart Buildings Introduction
  - Living Lab for Smart Territory
  - Network Architecture based on Virtualized Networks for Smart Cities
  - Smart people: Enhancing GDL CCD Citizens' Engagement Through Data Utilization
  - Towards the Preparation of the Guadalajara's SmartCity Metrics Structure

http://smartcities.ieee.org/



First Course - Smart Cities Metrics

- Course Title: Introduction to Metrics for Smart Cities
- Abstract:
  - Develop a basic understanding of the elements of a Smart City and learn the impact of using metrics to measure its performance.
- Course Details:
  - **Start Date: 23rd March 2015**
  - Duration: 4 weeks
- Further Information: https://www.edx.org/course/introduction-metrics-smart-cities-ieeex-scmtx-1x#.VQKE5eHxiFV

IEEE Smart Cities Standards

- Invention is good; re-invention is a waste
- Standards are an integral part of Smart Cities
- IEEE is engaged in a very broad portfolio of standards development
  - Seamless Connectivity: Communication Standards
  - Intelligent Transportation
  - Smart Grid & Energy Management/Smart Homes
  - eHealth
  - Green Communities
- The underlying technologies are being driven by the new paradigm of 'Internet of Things'

IEEE Standards on Smart Cities

Seamless Connectivity - New 802 Initiative:
High Efficiency WLAN (HEW)

Point-of-Sight in Stadium

Location Services

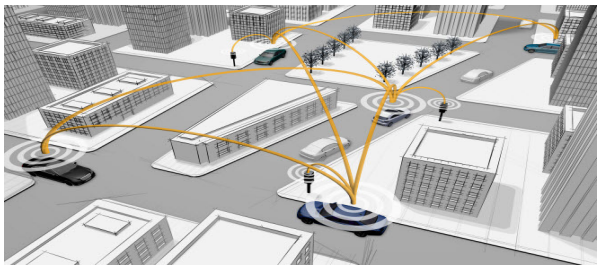
Enhanced Video

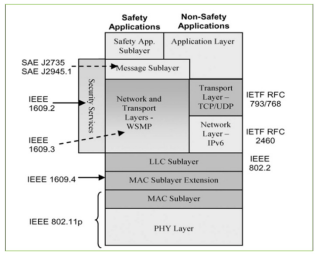
Consumer Wearable

IEEE Standards on Smart Cities

Intelligent Transportation

- **IEEE 802.11p** supports communication between vehicles and the roadside and between vehicles while operating at speeds up to a minimum of 200 km/h for communication ranges up to 1000 meter in the 5 GHz bands; specifically 5.850-5.925 GHz band within North America with the aim to enhance the mobility and safety of all forms of surface transportation, including rail and marine.





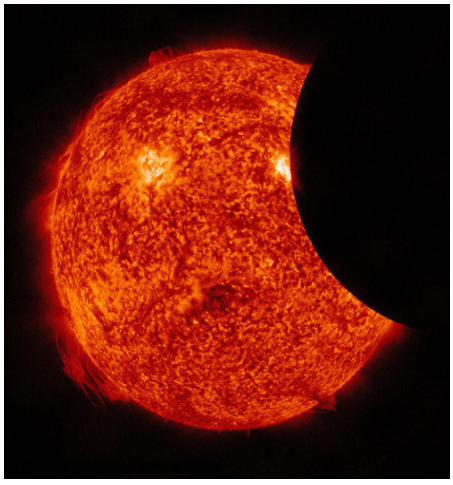
- **IEEE 1609 Family of Standards for Wireless Access in Vehicular Environments (WAVE)** define an architecture and a complementary, standardized set of services and interfaces that collectively enable secure vehicle-to-vehicle (V2V) and vehicle-to-infrastructure (V2I) wireless communications.

More information available at https://standards.ieee.org/develop/wg/1609_WG.html

Smart City Promises

- Connected
- Informative
- Scalable
- Safe
- Renewable
- Sustainable
- Less Pollution
- More energy efficient
- What could go wrong?

Clean Energy - Smart Grid –The Dark Side



March 19, 2015

Europe is Using So Much Solar Power that the sudden decrease and subsequent surge of power from Today's Eclipse Could Test its Grid

Questions?

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Thank You