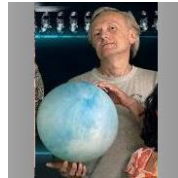


Humankind 2.0: The Technologies of the Future

4. Internet of Things

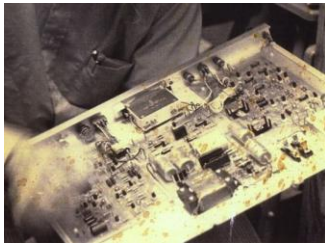
Piero Scaruffi, 2016



See <http://www.scaruffi.com/singular/biotech.html>
for the full text of this discussion

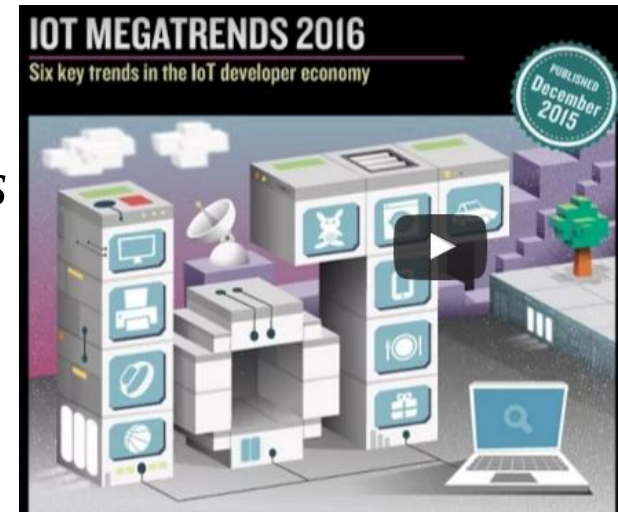
A World of Smart Objects

- 1980s: We connected computers
- 1990s: We connected pages of knowledge
- 2000s: We connected people
- 2010s: Connecting objects



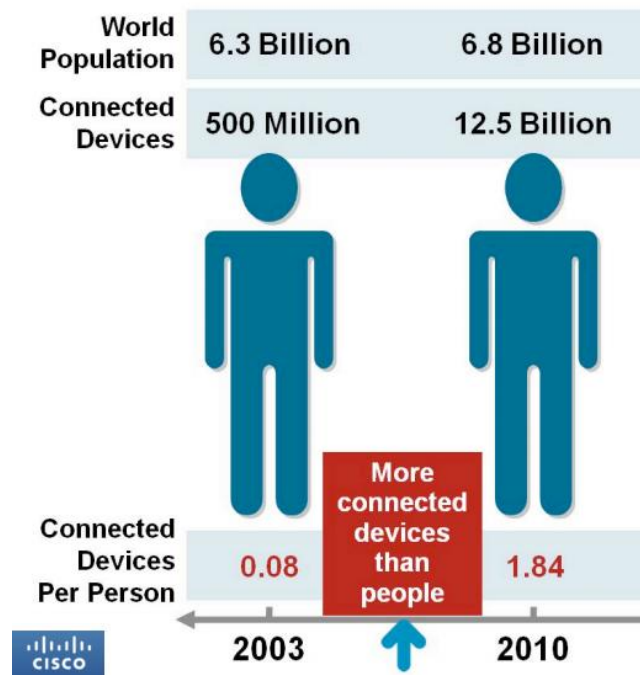
A World of Smart Objects

- IMS (2015): *By 2020 there will be more than 22 billion web-connected devices, generating 2.5 quintillion bytes of new data each day*
- Cisco (2015): *By 2025 there will be 100 billion interconnected devices, each equipped with dozens of sensors, for a gran total of more than a trillion sensors, that will generate a \$19 trillion economy*
- VisionMobile (2015): *4.5 million developers are working on IoT applications*

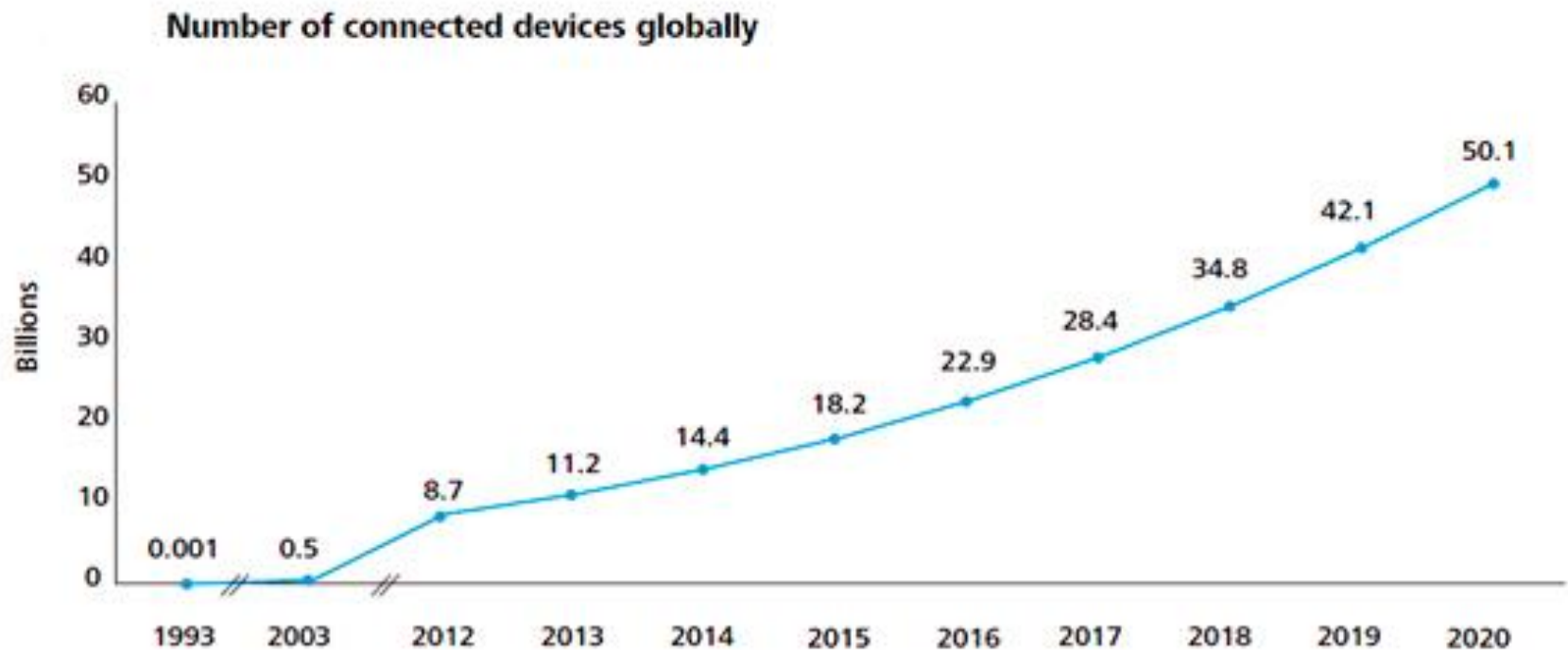


A World of Smart Objects

- *During 2008 the number of connected things exceeded the number of connected people*



A World of Smart Objects



Source: National Cable & Telecommunications Association, "Broadband by the numbers," <https://www.ncta.com/broadband-by-the-numbers>, accessed April 22, 2015.

It's already here...

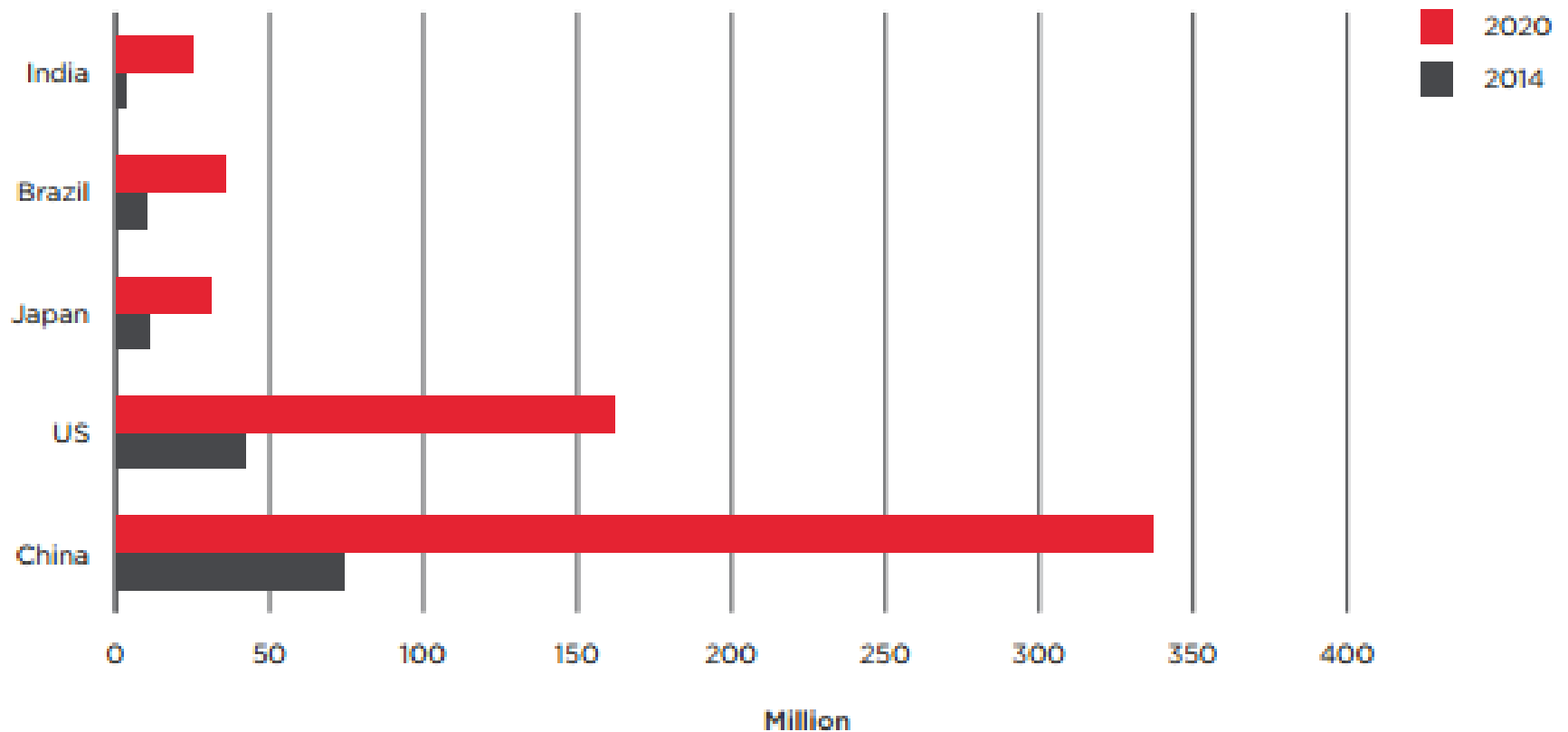
- Number of high tech sensors in the oceans in 2015: 750,000, carrying out 1.5 billion measurements every second

A banner for Marinexplore.org with a dark background and a satellite map of the ocean. At the top center is a colorful logo consisting of two interlocking geometric shapes. Below the logo, the text "Open Data Community for Ocean Professionals" is displayed. Underneath this is a button that says "Sign Up For A Free Account". Below the button are four social media icons: LinkedIn, Facebook, Google+, and Email, each with its respective label. At the bottom, a statement reads "Marinexplore.org is the easiest way to explore, discover, and share public ocean data." Below this statement is a table with four columns of statistics.

5,323	1,491,887,087	35,395	41
Professionals	Point Measurements	In-Situ Platforms	Gridded Data Sources

The Market

- China is the largest IoT market



The first generation

- Nike



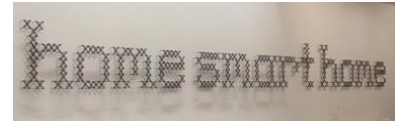
WAREABLE ...

[RUNNING FEATURE](#)

The rise and fall of the smart shoe – and why they could be on the way back

Kieran Alger

The first generation



- Nest
- Ring
- Tile
- August



The first generation

- Replacing the button



Microbot 2015

Switchmate Lets You Control Your Light Switches From Your Phone, No Rewiring Required

Posted Jan 7, 2015 by [Greg Kumparak \(@grg\)](#)



Switchmate 2015

The first generation

- Smart home



SOURCE: CISCO.

Internet of Things Store Opens in Silicon Valley

Palo Alto, Calif., is now home to the first 'Internet of Things' brick and mortar store, b8ta.

BY JASON GREEN, PALO ALTO DAILY NEWS, CALIF. / DECEMBER 11, 2015



b8ta will be a store dedicated to showcasing IoT products.

The first generation

- The Internet of Useless Things
- The Internet of Insecure Things
- Internet of Crappy Things
- A solution looking for a problem

www.internetofuselessthings.io

A +rehabstudio Hackweek Project ▶



The Internet of Useless Things

How can something so smart, be so dumb?



KASPERSKY  DAILY

Internet of Crappy Things

📅 February 19, 2015 👤 Alex Drozhzhin 📁 Featured Post, News, Security



The New York Times

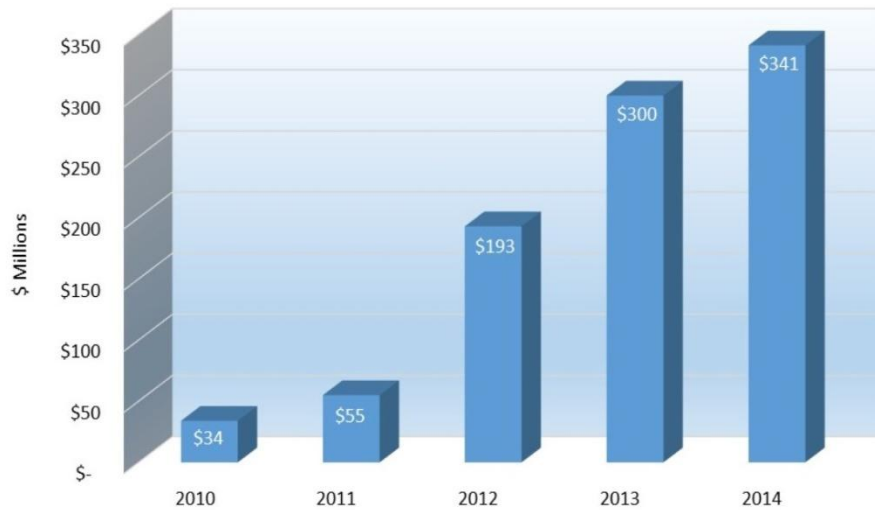
Nest Thermostat Glitch Leaves Users in the Cold

Disruptions

By NICK BILTON JAN. 13, 2016

The first generation

VC Investment in Internet of Things (IoT) Startups

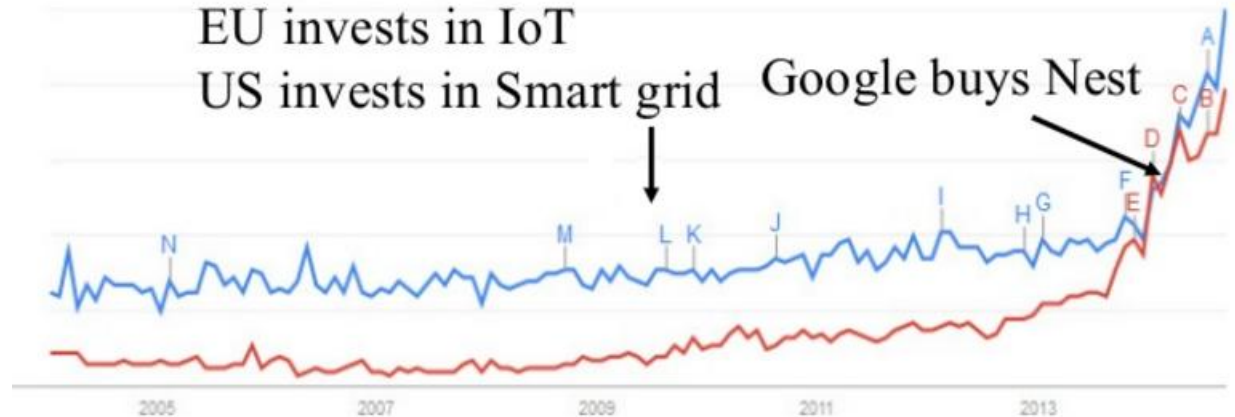


Source: CrunchBase, TechCrunch | ©2015 Edmond Banayan

EU invests in IoT

US invests in Smart grid

Google buys Nest



The Most Active IoT Investors

VCs Ranked by Unique IoT Investments, 2010 - 2015 YTD (11/24/15)

Investor	Rank	Companies																			
Intel Capital	1	AeroScout	Aiaware	Apia	Arrayent	Avegant	BASIS Science	Bocom Int. Network	Body Labs	Braigo Labs	Enlighted	EyeSmart	FreedomPop	GainSpan Corporation	Grid Net	Guangdong Appcom	iControl Networks	Impinj	Inrix	JouleX	
		Mark One	NewAer	OrCam	Peloton Technology	Performance Lab	Prim Skylabs	Razer	Recon Instruments	SanJet	Sano Intelligence	Skully Helmets	SnowCookie	Sotera	Stratoscale	Thalmic Labs	Yunec				
Qualcomm Ventures	2	3D Robotics	Airstrip Technologies	AliveCor	August	Avaak	Concert	Fitbit	Ineda Systems	LIFX	LiveScribe	Olo Wearables	Panoramic Power	Placemeter	Skycatch	Sotera	Streetline	Telcare	Waze	Whistle Labs	
		3DR	AS	AliveCor	August	AAAK	Concert	Fitbit	ineda systems	LIFX	LiveScribe	ollo	Panoramic Power	Placemeter	SKYATCH	Sotera	Streetline	TEL CARE	Waze	Whistle Labs	
Foundry Group	3	3D Robotics	Cuseum	Dragon Innovation	Fitbit	ivee	littleBits	Loop Labs	MakerBot	OnTheGo Platforms	Orbitix	Pie Digital	Rachio	Revolv	Revolv	Sileo	SnowShoe Food	U Grik It			
		3DR	Cuseum	Dragon Innovation	Fitbit	ivee	littleBits	Loop Labs	MakerBot	OnTheGo Platforms	Orbitix	Pie Digital	Rachio	Revolv	Revolv	Sileo	SnowShoe Food	U Grik It			
Kleiner Perkins Caufield & Byers	3	Aiaware	Dropcam	Enlighted	iControl Networks	Inrix	Jawbone	Kinsa	mCube	MODE	Motiv	Nest Labs	Quirky	Relayr	Telogs	Verdium	Waze	Wearable Intelligence			
		Aiaware	Dropcam	Enlighted	iControl Networks	Inrix	Jawbone	Kinsa	mCube	MODE	Motiv	Nest Labs	Quirky	Relayr	Telogs	Verdium	Waze	Wearable Intelligence			
Andreessen Horowitz	5	Aiaware	Anki	Automatic Labs	goTenna	Halo Neuroscience	IFTTT	Jawbone	Leap Motion	Locktron	Osito	Prim Skylabs	Quirky	Ringly	Shapeways	Thync	Wearable Intelligence				
		Aiaware	Anki	Automatic Labs	goTenna	Halo Neuroscience	IFTTT	Jawbone	Leap Motion	Locktron	Osito	Prim Skylabs	Quirky	Ringly	Shapeways	Thync	Wearable Intelligence				
Khosla Ventures	5	AliveCor	Canary	CellScope	Ginger.io	Helium Systems	Jawbone	littleBits	Mist	Momentum Machines	Narrative	ParStream	Quanttus	Theatro	Thync	Tile	View				
		AliveCor	Canary	CellScope	Ginger.io	Helium Systems	Jawbone	littleBits	Mist	Momentum Machines	Narrative	ParStream	Quanttus	Theatro	Thync	Tile	View				
True Ventures	5	3D Robotics	Athos Works	Fitbit	Ginger.io	littleBits	MakerBot	Narrative	OpenROV	Ring	Sano Intelligence	Sileo	SoundHawk	Streetline	Technical Machine	Valencell	Veniam				
		3DR	Athos Works	Fitbit	Ginger.io	littleBits	MakerBot	Narrative	OpenROV	Ring	Sano Intelligence	Sileo	SoundHawk	Streetline	Technical Machine	Valencell	Veniam				
Cisco Investments	8	AeroScout	Ayla Networks	Bit Slew Systems	Cohda Wireless	Control4	EVERYTHING	Grid Net	iControl Networks	Ineda Systems	Phonware	Relayr	Sensory Systems	smart-FOA	Stratoscale	Worldensing					
		AeroScout	Ayla Networks	Bit Slew Systems	Cohda Wireless	Control4	EVERYTHING	Grid Net	iControl Networks	Ineda Systems	Phonware	Relayr	Sensory Systems	smart-FOA	Stratoscale	Worldensing					
New Enterprise Associates	9	APK Labs	Cuff	Glacier Bay	IFTTT	Kaazing	Little Labs	MetroMile	Olio Devices	Orange Chef	Placemeter	Senseonics	SmartDrive Systems	Topera Medical							
		APK Labs	Cuff	Glacier Bay	IFTTT	Kaazing	Little Labs	MetroMile	Olio Devices	Orange Chef	Placemeter	Senseonics	SmartDrive Systems	Topera Medical							
Sequoia Capital	10	Airstrip Technologies	DJI Innovations	eMeter	Jasper Technologies	Jawbone	LIFX	Nod Labs	Romotive	SimpliSafe	Strava	SynapseSense	Telcare								
		AS	DJI	eMeter	Jasper Technologies	Jawbone	LIFX	Nod Labs	Romotive	SimpliSafe	Strava	SynapseSense	Telcare								
First Round Capital	11	Aiaware	Electric Objects	MetroMile	Nomi	Ring	Ringly	SmartThings	Sprouting	Stickybits	Thalmic Labs	Wearable Intelligence									
		Aiaware	Electric Objects	MetroMile	Nomi	Ring	Ringly	SmartThings	Sprouting	Stickybits	Thalmic Labs	Wearable Intelligence									
SV Angel	11	Electric Objects	Helium Systems	IFTTT	LIFX	Lily	MetroMile	Nervana Systems	Nomi	Prim Skylabs	Romotive	SmartThings									
		Electric Objects	Helium Systems	IFTTT	LIFX	Lily	MetroMile	Nervana Systems	Nomi	Prim Skylabs	Romotive	SmartThings									
CrunchFund	13	Avegant	IFTTT	Sotera	Lark	Olio Devices	ParStream	Prim Skylabs	Romotive	SmartThings	Weaved										
		Avegant	IFTTT	Sotera	Lark	Olio Devices	ParStream	Prim Skylabs	Romotive	SmartThings	Weaved										
Felicitas Ventures	13	Aiaware	CyFly Works	Dropcam	Fitbit	InteraXon	Mark One	MetroMile	PlotWatt	Romotive	Sano Intelligence										
		Aiaware	CyFly Works	Dropcam	Fitbit	InteraXon	Mark One	MetroMile	PlotWatt	Romotive	Sano Intelligence										

Silicon Valley's IoT

Intel has invested in Arrayant,
WebAction/Striim and Ossia.

Cisco has invested in: Ayla, Jasper,
ParStream, Evrythng, iControl,
Worldsensing and Sensity Systems.

PLUGANDPLAY

Internet of Things Angel Investors

Person	Investments
 Christine Tsai Founding Partner at @500 Startu... Palo Alto · South Korea	152
 Peter Kellner Investor in early stage technology... New York City · Hardware + Software	114
 Garry Tan Partner at @Y Combinator. Cofou... Mountain View · Photo Sharing	99
 Ullas Naik Seed investor- 20 years; Founder... Palo Alto · Wearables	98
 Gil Penchina @ Flight.vc Syndicated: @Altschool @Beepe... San Francisco · Small and Medium Businesses	87

ABOUT PLUG AND PLAY IOT



Plug and Play IoT is a 12-week startup acceleration program based in Silicon Valley. Plug and Play, along with a round-table of corporations and industry experts, will jointly select the startups that will be accepted into the program and invited to Silicon Valley.

Dec 1, 2015

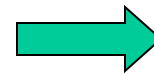
VENTURE CAPITAL

Autodesk Creates \$100 Million Fund for Internet-of-Things Startups

angel.co Feb 2016

Connecting things...

- A shower smart enough to know that you don't turn on cold water when it's very cold outside.
- A hotel whose elevators can read my key card and take me automatically to my floor and direct me to my room; a door that opens automatically when it sense my key card



Connecting things...

- Cash register-less payment
 - Faster transactions
 - More space to display products
 - More money to pay concierges
 - Radio frequency identification (RFID) only transmits information to an RFID reader
 - Near field communication (NFC) is capable of two way communication
 - Contact-less mobile payments require the store to have a compatible card reader



Connecting things...

- Cash register-less payment
 - Made.com: customers can scan items on show and purchase them online
 - Casino supermarket: customers scan the items they want to buy and use their phone to check out
 - Why can't we just walk out of the store with the items we want to buy?



Smart Products

- Products will be able to report back to the manufacturer about the user
 - Refining the product: how the user uses the product
 - Upgrading the product: what else the user uses
- The retailer used to know the customer best, because the retailer would get the feedback from the customer; now it will be the manufacturer who will get feedback directly from the product

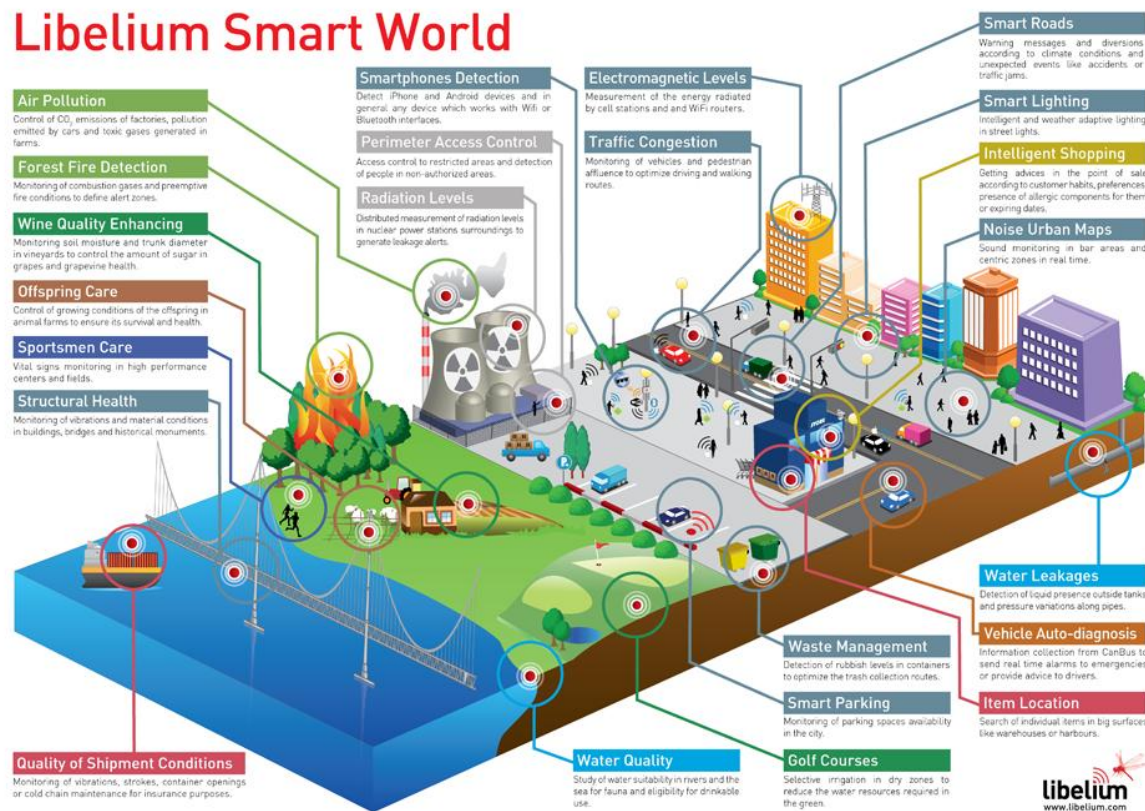
The social life of objects

- The Internet of Things will connect people, their personal devices, home appliances, buildings, cars, roads, etc.
- We will live in a "smart" world where objects are "smart" and provide "smart" services.
- That world will be hyper-saturated with data.
- The future of social networking: not the social life of people but the social life of objects



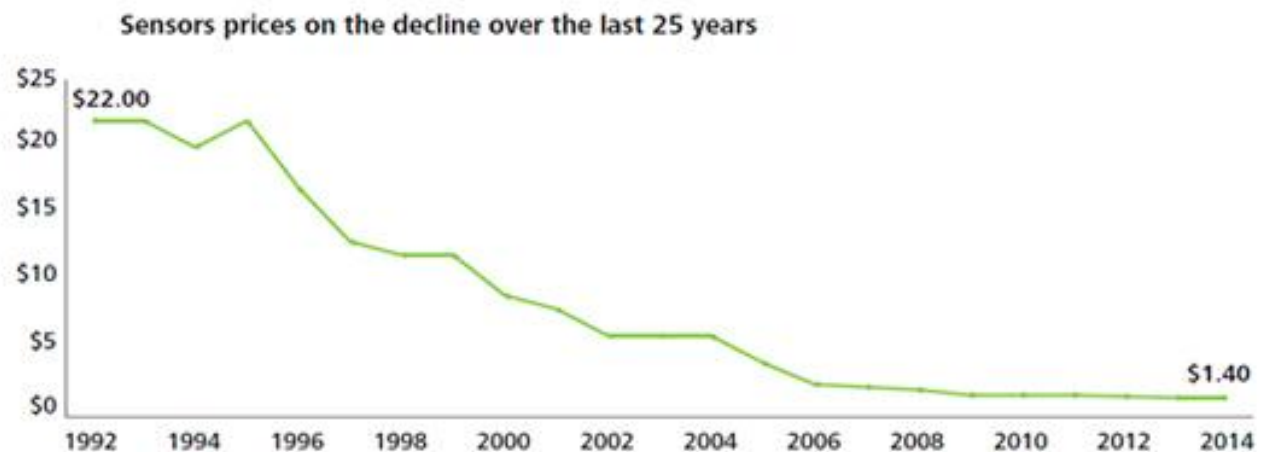
The programmable city

- Cities are constellations of computers
- Cities are run by software instructions



Enabling technologies

- Sensors
 - Power consumption
 - Security
 - Interoperability



Source: Rob Lineback, IC Insights Inc. "The market for next-generation microsystems: More than MEMS," http://itac.ca/uploads/events/execforum2010/rob_lineback_10-6-10-2.ppt, June 10, 2010, accessed January 28, 2015; Lee Simpson and Robert Lamb, *IoT: Looking at sensors*, Jeffries Equity Research, February 20, 2014, p. 4.

Note: Prices shown above are average selling prices for image sensors and accelerometers.

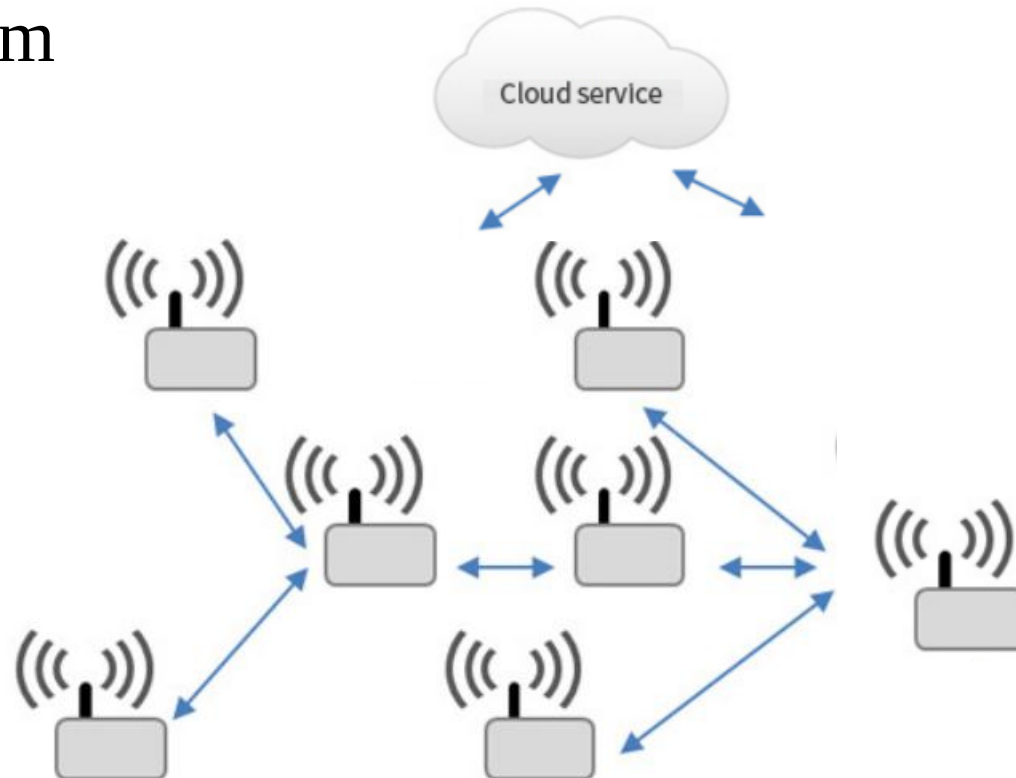
Enabling technologies

- The difference between being a rock and a living being is the sensors: living beings "sense" the environment and react to it
- The sensor revolution of the 2000s: cheap, light, small and powerful sensors
- Not the "next big thing" but the "next small thing"
- We can now put sensors into every object
- When we put sensors into objects, we inject life into them



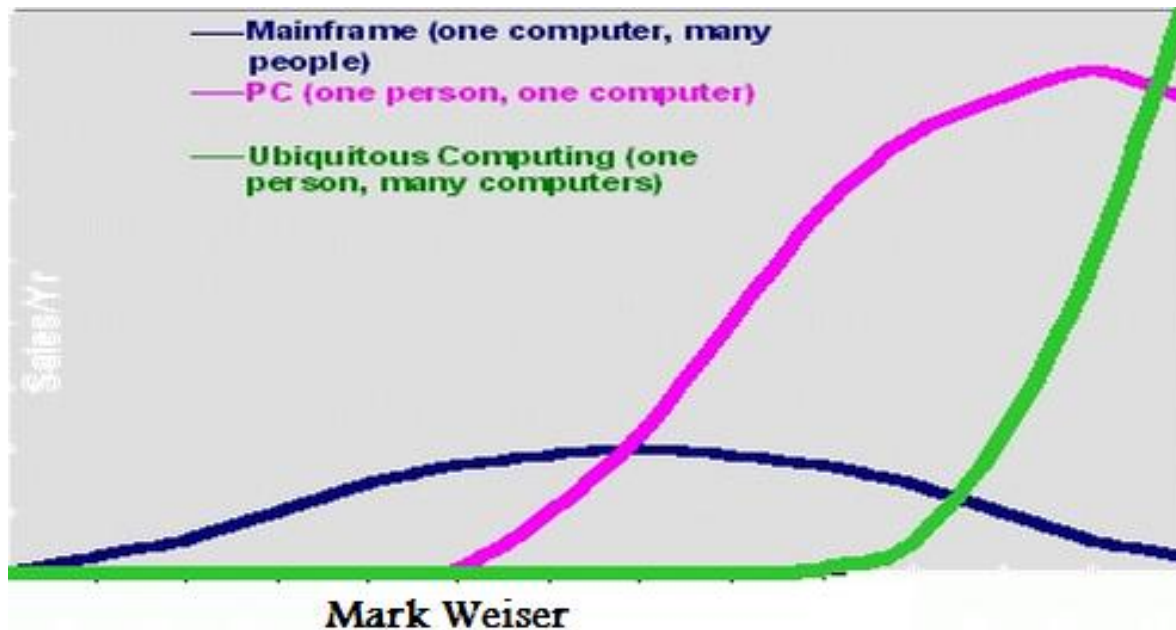
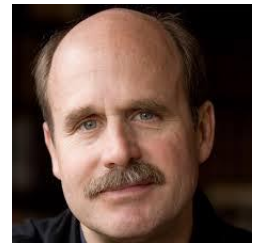
Enabling technologies

- The "cloud" allows them to communicate
- The cloud organizes smart objects into an ecosystem



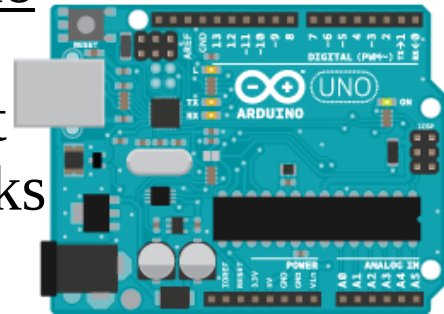
Enabling technologies

- A brief history of the Internet of Things
 - 1991: Mark Weiser's article "*The Computer of the 21st century*"
 - 1997: Paul Saffo's article "*Sensors - The Next Wave of Infotech Innovation*"



Enabling technologies

- A brief history of the Internet of Things
 - 2003: Adam Dunkels' open-source operating system Contiki
 - 2005: Open-source hardware platform Arduino for the community of makers, facilitating the transition to a world of interactive objects that can sense and control the physical world thanks to microcontroller-based kits
 - 2006: The IPv6 protocol provides 340,282,366,920,938,463,463,374,607,431,768,211,456 possible Internet addresses, or 100 for every atom on the face of the Earth



Platforms

- Platforms
 - Software for monitoring sensors and processing their measurements in real time, and to broadcast the data over the cloud
 - Infrastructure providing a public cloud service for M2M (machine to machine) communication
 - Development kits for makers and hobbyists to build smart devices + cloud to make them communicate



Platforms

- Platforms
 - “Machine cloud” pioneers:
 - Cisco/ Jasper Technologies (Silicon Valley, 2004)
 - Autodesk/ SeeControl (San Francisco, 2004)
 - Libelium (Spain, 2006)
 - PTC/Parametric/Axeda (Boston)
 - Xively/ Pachube (London, 2007)
 - Particle/Spark (Minneapolis, 2008)



Platforms

- Platforms
 - Seebo (Israel, 2012)
 - Konekt (Chicago, 2013)
 - Temboo (New York, 2013)

seebo 

 KONEKT

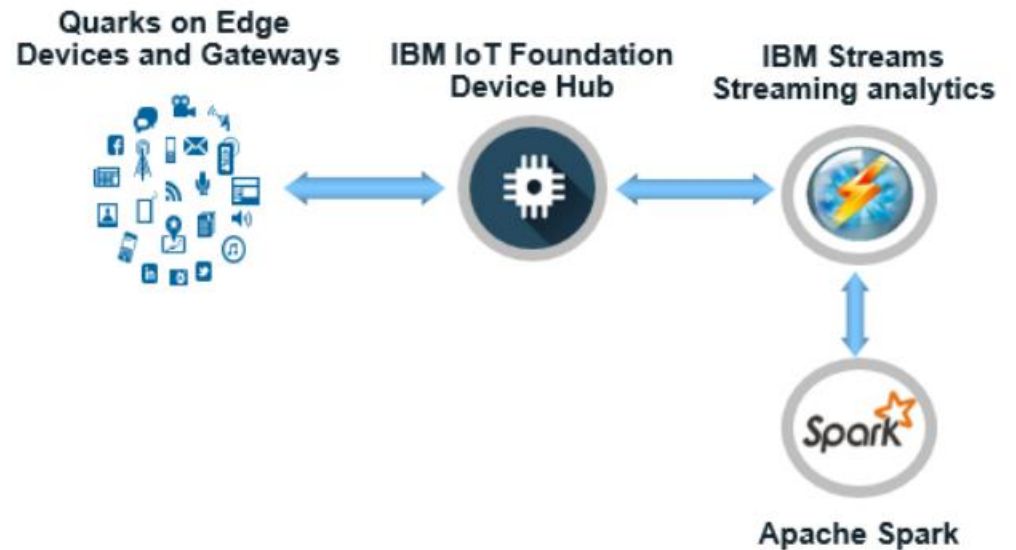
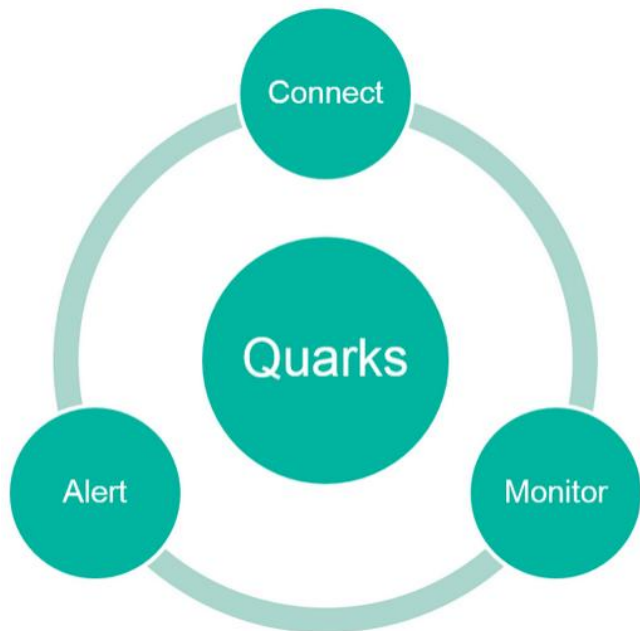
TEMBOO 

Platforms

- Platforms (adapted cloud solutions)
 - Amazon
 - SalesForce
 - IBM
 - Oracle
 - Google
 - Microsoft
 - ...

Platforms

- Platforms
 - Free software
 - IBM's Quarks (2016)



Obstacles

- Battery life
- Security
- Too many IoT standards

Internet of Things Alliances and Consortia



EnFilm™: the Energy of Things
Thin-film rechargeable battery



Batteries

- Chips that are connected all the time consume batteries very quickly, even if their power consumption is low.
- The Internet of Things needs batteries that are light, cheap, that charge in seconds, and that last months.
- Lithium-ion batteries were introduced in 1991
- Since then, their performance has improved between 5 and 10% per year.
- Unfortunately, our needs have improved a lot faster.
- Our devices consume more and more electricity, so they need bigger and bigger battery packs

Batteries

- Host + Positive element (M^+) + Electrons
- Why lithium?

How do We Store Electrons?

$$e^- + M^+ \longleftrightarrow M$$

$$e^- + M^+ + Host \longleftrightarrow MHost$$

M atomic weight	M maximum voltage	M cost (\$/kg)
Pb ^{2+/4+} (207)	Li ⁺ (<4.5V) <i>best</i>	Li (40)* <i>ouch!</i>
Zn ²⁺ (65)	Na ⁺ (~4.2V)	Na (1)
Al ³⁺ (27)	Mg ²⁺ (<~3.8V)	Mg (2)
Mg ²⁺ (25)	Al ³⁺ (<~3.1V)	Al (2)
Na ⁺ (23)	Zn ²⁺ (<~2.2V)	Zn (2)
Li ⁺ (7) <i>best but flies away</i>	Pb ^{2+/4+} (<2.1V)	Pb (2)
H ⁺ (1)	H ⁺ (<~1.5V)	H (nearly free)

Most of the cost of a battery is actually the host, so paying a lot for lithium is ok

Batteries

Global reserve of lithium: 40 million ton 

**Nissan Leaf, 24 kWh, 84 miles
4 kg Lithium**

10 Billion Leaf



**Tesla S model, 85 kWh, 265 miles
14 kg Lithium**

3 Billion Tesla



Batteries

- For 20 years mobile phones have been getting smaller and smaller.
- Now smartphones are getting bigger: the battery is twice the size of a few years ago



Batteries

- Looking for solutions:
 - 2012: the US government's program "Joint Center for Energy Storage Research" (JCESR)
 - Nanotech (e.g., Israel-based StoreDot's "super-capacitors")
 - 24M (Boston): cheaper and better lithium-ion batteries



Wireless Power

- Nikola Tesla's 62-meter high Wardenclyffe Tower (New York, 1902)



Wireless Power

- Magnetic Resonance
- Inductive Power Transfer
- Radio-frequency waves
- Ultrasounds

Wireless Power

- Magnetic Resonance

Marin Soljačić

(Pronunciation: *Maa-ren Soul-ya-cheech*)

MacArthur Fellow

Professor of Physics at MIT



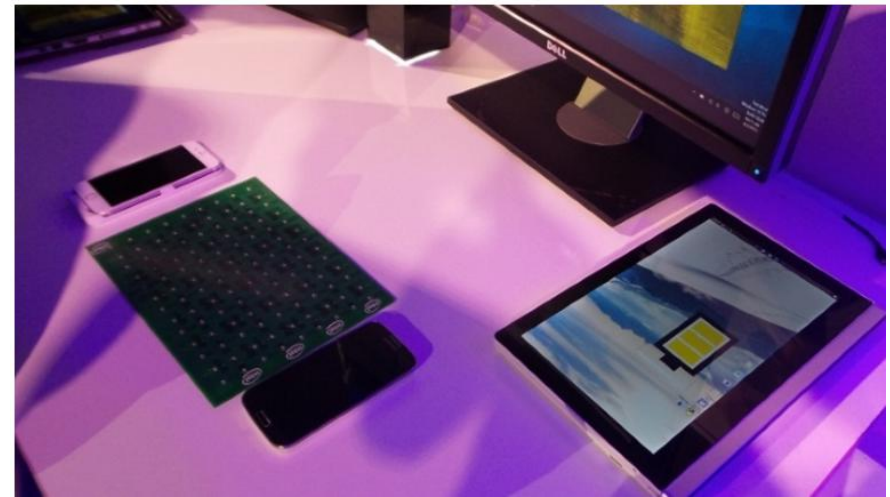
2015

First Look at Intel's Laptop Wireless Charging

BY SASCHA SEGAN SEPTEMBER 3, 2015 08:15AM EST 3 COMMENTS

Intel's wireless charging can handle laptops as well as phones that are slid across the table.

201 SHARES    



Wireless Power

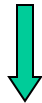
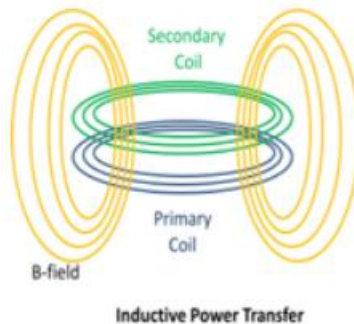
- Inductive Power Transfer



John Talbot Boys



1991



2009



2014



November 18, 2014 Company

Starbucks Begins National Roll-Out of Powermat Wireless Charging in San Francisco



Wireless Power

- Radio-frequency waves

 energous

OSSiQ



Wireless Power

- Ultrasounds



Wireless Power

- Jeeva Wireless (Seattle, 2014): harvest electrical power from the "air" (TV broadcasts, Wi-Fi radiations and Bluetooth radiations)



Power from the Air

Internet devices powered by Wi-Fi and other telecommunications signals will make small computers and sensors more pervasive.

Security

- How can i guarantee that nobody else will be able to command my house's door or my car?
- How can we guarantee that the communication between my car and my garage will not be "hijacked" by a "pirate" device?

Security

- Afero (Silicon Valley, 2014)



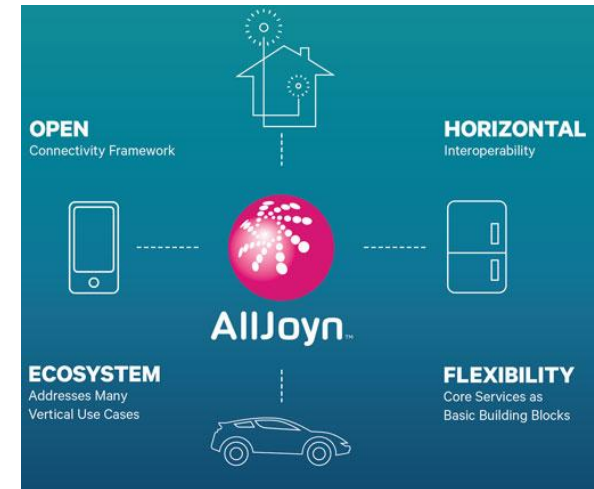
Standards

- Alliances for Internet of Things
 - Wireless Power Consortium, which is behind the standard Qi (supported by Nokia, Samsung, LG, Sony, BlackBerry, and HTC)
 - Power Matters Alliance (Powermat, Duracell, AT&T, Google and WiTricity)
 - Alliance for Wireless Power
 - 2015: Power Matters Alliance + Alliance for Wireless Power = AirFuel Alliance (200 members)



Standards

- Communication standards for IoT
 - AllJoyn (Qualcomm): objects can broadcast what they can do to all other objects nearby (WiFi or Bluetooth)
 - There are 120 million smart home devices shipped with Qualcomm chips; and 20 million cars equipped with its chips; and Qualcomm silicon is used in 20 types of wearable devices.



Standards

- Communication standards
 - Apple's HomeKit (2014): smart home appliances connected via Bluetooth and WiFi to the iPhone
 - Wi-Fi Alliance (2015), included Apple, Microsoft and Intel: Wi-Fi Aware, a technology that allows Aware-enabled devices to discover and communicate with other Aware objects
 - Industrial Internet Consortium (AT&T, Cisco, IBM, GE, Intel)
 - Open InterConnect Consortium (Broadcom, Samsung, Dell)



Opportunities

- Opportunities
 - Selling boards that contain all the sensors and chips needed to wireless connect objects
 - Building an alternative cellular network that is low cost, low battery-demand for connected objects
 - E.g., Samsung's open platform ARTIK (2014)
 - E.g.: Intel's Curie module (2015): a sensor hub + a Quark processor + a Bluetooth connection



Networked cars (V2V)

- Networked Cars (V2V)

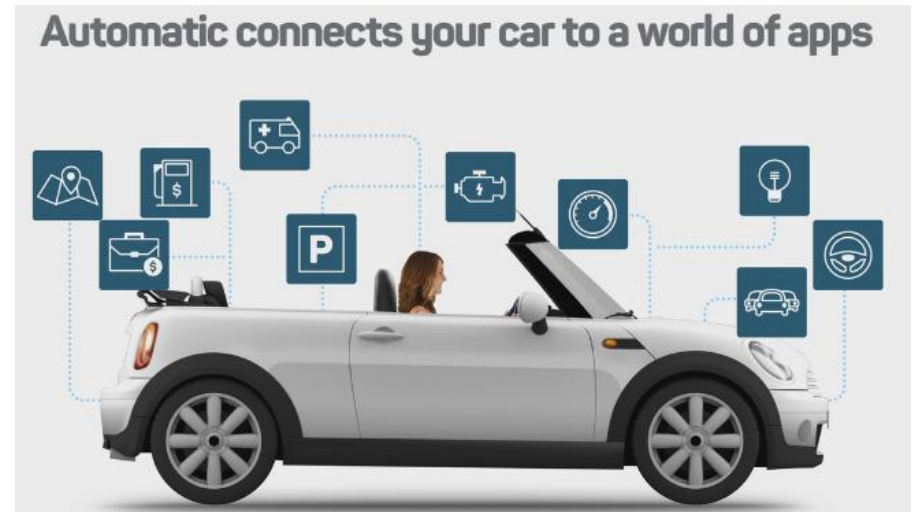


Networked cars (V2V)

- Networked Cars (V2V)
 - 2014: 8% of cars have some kind of networking capability
 - April 2014: all new BMW models will embed a SIM card
 - 2020: 90% of new cars will have a SIM card

Networked cars (V2V)

- Networked Cars (V2V)
 - Connected-car platforms (collecting data from onboard computer + smartphone apps):
 - Automatic (San Francisco, 2011)
 - Dash Labs (New York, 2012)
 - Zubie (South Carolina, 2012)



Networked cars (V2V)

- Networked Cars (V2V)
 - Apple's CarPlay (2014)
 - Google's Android Auto (2015)
 - Ford's SmartDeviceLink (2015)



Apple CarPlay
The ultimate copilot.

Android Auto

The right information for the road ahead



smart
device link

Networked cars (V2V)

- Apps for the networked car:
 - Search for parking space
 - Communicate road hazards and accidents
 - Exchange information about traffic
 - Monitor driver's behavior (eg, your son)
 - Ride-sharing
 - Broadcast a car's position, speed, etc so that nearby vehicles can avoid a collision

Networked cars (V2V)

- Networked car
 - Nvidia's “supercomputer” for cars: Drive CX (2014) and Drive PX 2 (2015) that can process data from 12 video cameras and other sensors in real time (8 teraflops of calculation power, 24 deep learning tera operations per second)
 - HERE (Audi + BMW + Mercedes): cloud-based maps for automated driving (2016)



Networked cars (V2V)

- Utopia of the 1970s: the virtual movement of information replacing the physical movement of people
- Dystopia of the 21st century: the car is becoming a second home, a second center of personal life, equipped with communications, entertainment and, soon, ecommerce.

Rinspeed (Switzerland, 2014):
the "Xchange Concept"



Robot Home

- Brain of Things (Redwood City, 2015): a home fitted with 100s of sensors and smart objects and run by A.I.



Smart cities

- The telecommunications companies that arose during the cellular era typically think in terms of "broadband": they want to provide an infrastructure that can carry large amounts of data (your pictures and videos). Therefore they have invested in 3G, 4G, and now 5G and tomorrow 6G.
- These are precisely the technologies that don't work well for connecting home and city objects.
- The smart city needs a networking technology for very-low-power operation, but also capable of long range transmission.
- IoT needs narrow-band low-power long-range radio networks

Smart cities

- European "ultra-narrow band" (UNB) technology with power levels that are thousands of times lower than in cellular communications:
 - Telensa (Britain, 2005)
 - Sigfox (France, 2009)
 - Actility (France, 2010), the brain behind the LoRa Alliance, established in 2015 with Cisco, IBM, Eolane, Kerlink, IMST, MultiTech, Sagemcom, Semtech, Microchip Technology, etc.



Smart cities

- LTE (Long-Term Evolution), originally introduced in Scandinavia in 2009 by TeliaSonera, uses the existing 4G wireless network
 - Altair Semiconductor (Israel, acquired by Sony in 2016)
 - Sequans (France)



Smart cities

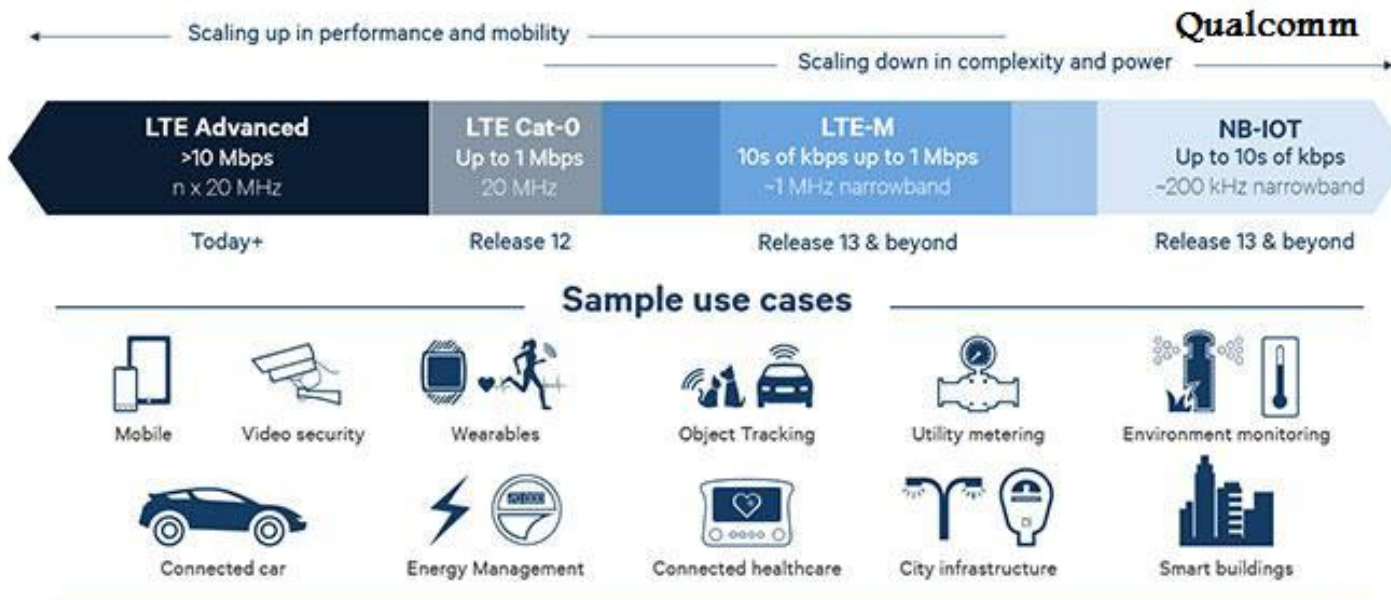
- 2015:
 - Narrow Band-LTE (NB-LTE) from Intel, Ericsson and Nokia
 - Narrow-Band Cellular IoT (NB-CIoT) from Huawei and Vodafone



NOKIA



ERICSSON



Smart cities

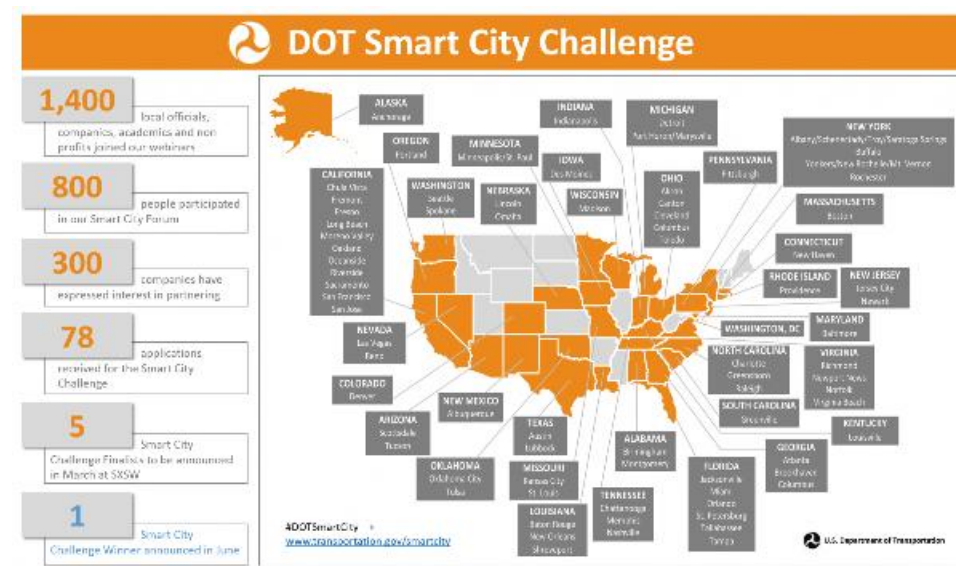


- South Korea's Songdo International Business District: a 6 square km "smart city" developed jointly with Cisco, LG CNS and ADT Caps.



Smart cities

- 1950s: the USA built cities around cars. The suburbs came to symbolize the great economic boom of the USA during the 1950s and 1960s.
- 2015: The US government's "Smart City Challenge"



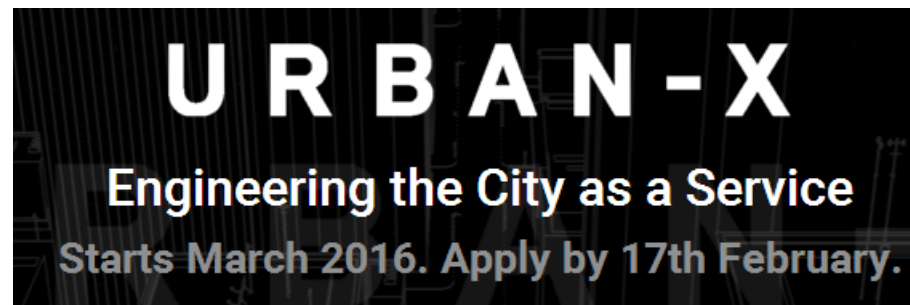
Smart cities

- 2014: Cisco's blueprint for the future of smart cities in India

<i>Cisco's Blueprint for Smart & Connected Communities</i>				
Connected & Sustainable Work	Connected & Sustainable Mobility	Connected & Sustainable Buildings	Connected & Sustainable Energy	Sustainable Socio – Economics
Smart Work Centers	Smart Transportation Pricing	Homes	Renewables & Co-Generation	Active Community & Eco Maps
Digital Swarming & Hub Pavilions	Personal Travel Assistant	Office Buildings	Urban Monitoring & Measurement	Innovative Green Business Models and Sustainability Clusters
Connected Workplaces	Connected Public Transit	Public Spaces	Citizens Energy Efficiency	
Connected Workforce		Public Transit Hubs		
		Hospitals & Schools		

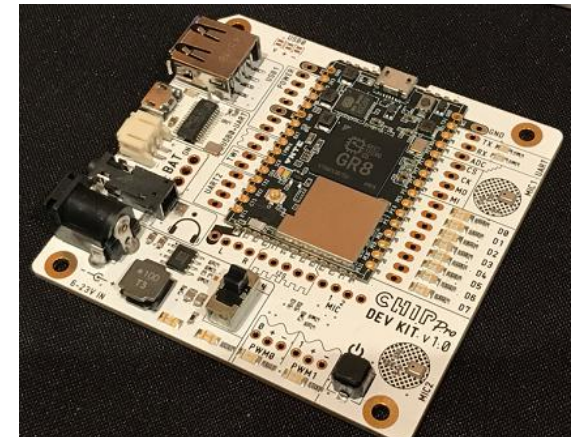
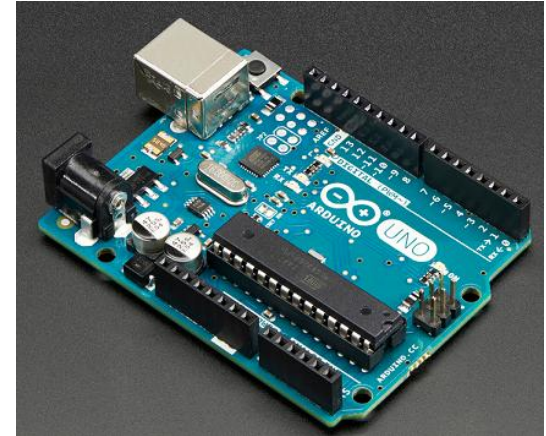
Smart cities

- 2016: Urban-X, a New York incubator founded by BMW's Mini division and Cyril Ebersweller's incubator HAX (based in Shenzhen and San Francisco) dedicated to startups working on the city of the future



Open-source IoT

- Hardware
 - Arduino Uno (Italy, 2005)
 - Raspberry Pi (Britain, 2012)
 - Pine64 (Fremont, 2015)
 - Chip Pro (Oakland, 2016)



Open-source IoT

- Software
 - OpenHAB (2010)
 - Robot Operating System (2005)



ROS



Privacy vs Security

- Your “smart objects” spy on you
- Your smart objects protect you
- No more privacy but...
- ... no more crime



“99% of the crimes committed in Mexico go unpunished”
(Economist, 2016)

Privacy vs Security

- "Internet of Other People's Things": the "smart" things that you install in your house are made by others, and they obey the manufacturer, not you
- Raj Talluri of Qualcomm: the #1 breakthrough of 2013 - 2015 was the arrival of "always-on sensors"

Qualcomm announces
Snapdragon 820's new
Hexagon DSP for always-on
sensors, image processing

2015

TE

CRUNCH NETWORK

The Internet Of Someone Else's Things

Posted Oct 11, 2014 by [Jon Evans \(@rezend\)](#), Columnist



Privacy vs Security

- 2016: Evrythng + Avery Dennison plan to create "smart" clothes and shoes that can communicate with the "cloud" and therefore with smartphones



teenVOGUE

Soon, You'll Be Able to Find That
Favorite Top That Went Missing
Through an App

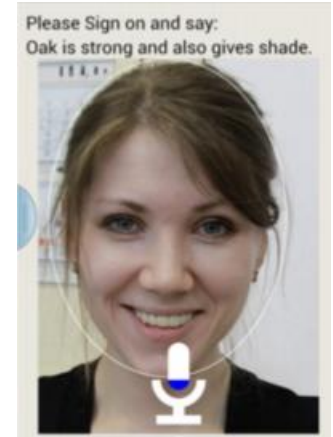
APR 22, 2016 4:53PM EDT



**Over 10 billion shirts and shoes will soon
talk back to you via your phone**

Privacy vs Security

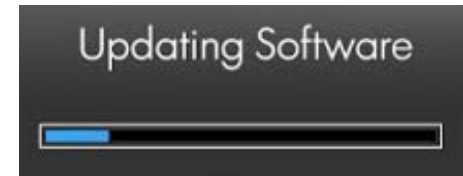
- The voice recognition and face recognition software must be always on, always working
- The old world of "touch" was passive: my old tv set turns on when i touch a button on a remote control
- The new tv sets will need to track everything that i say and every movement that i make
- The new tv sets will listen to everything that i say and watch every movement that i make because one of those words or gestures could be a command



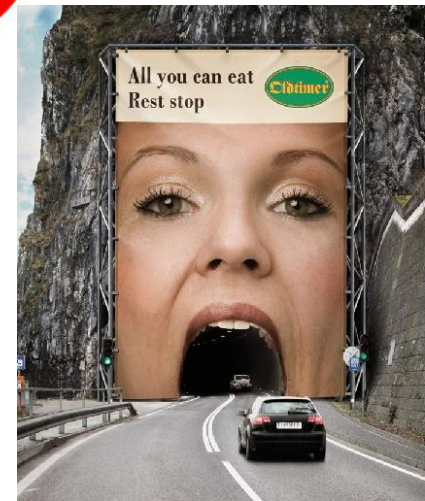
Screenshot by CNET

Dangers

- Problem #1 in the integration of machines and humans: machines are simple while humans are complicated
- Software and hardware updates
- Smart appliances and furniture may have software "bugs"
- Hardware and software engineers have a passion for making devices beep
- Smartphones and computers have become vehicles for advertising

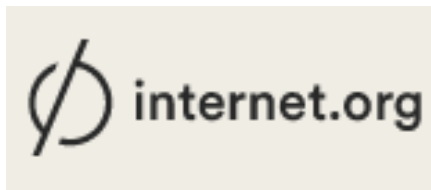


FATAL RUN-TIME ERROR



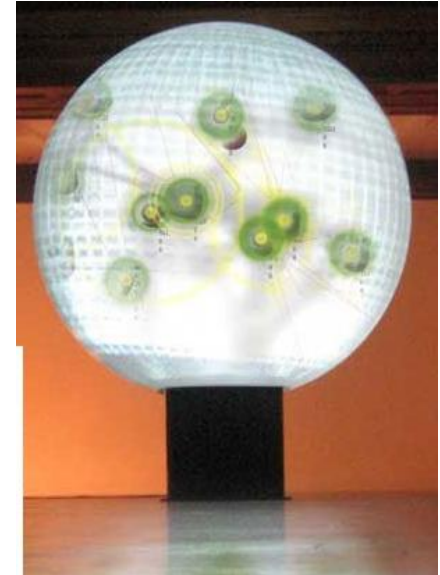
Next...

- The Internet of Everything: Facebook (Internet.org), SpaceX, Google (Project Loon), Qualcomm and Virgin (OneWeb) are planning to provide global Internet connectivity to every person on the planet...

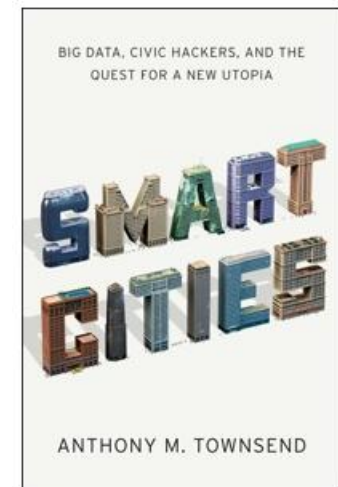
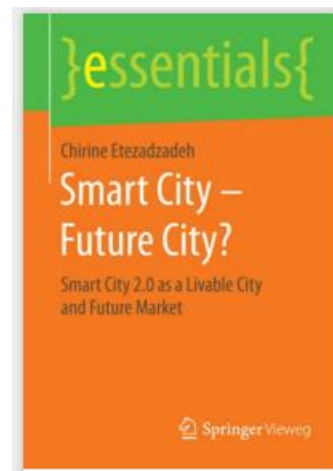
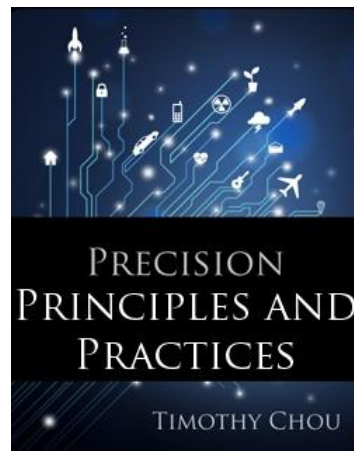
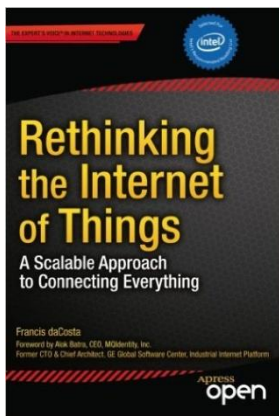
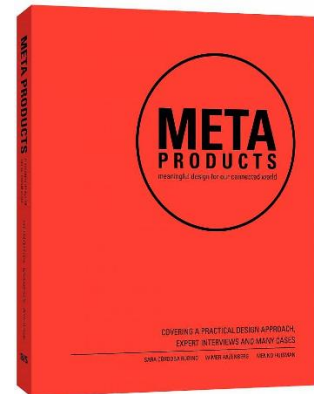
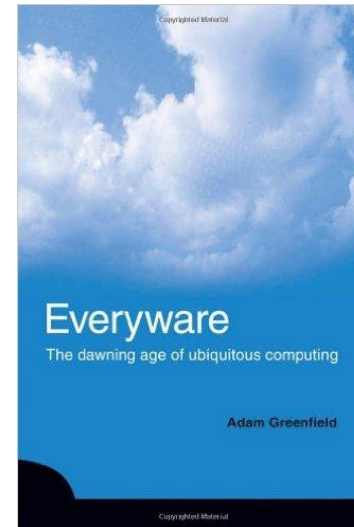
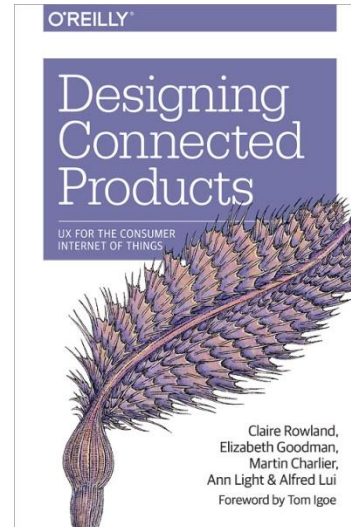
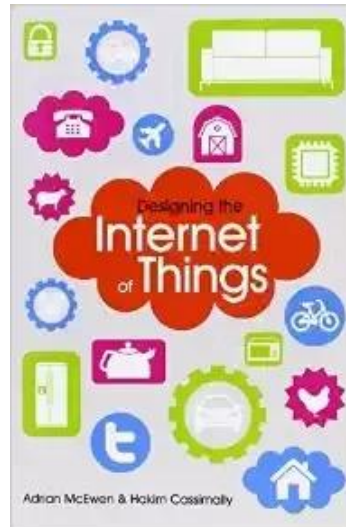
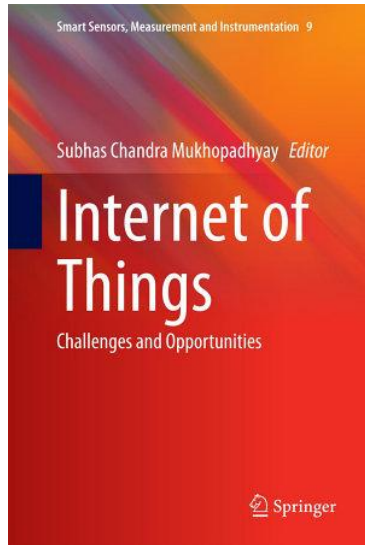


Networked Art

- Future Cities Lab
- Tom Keene and Kypros Kyprianou
- Stanza
- Timo Arnall



Bibliography



Events



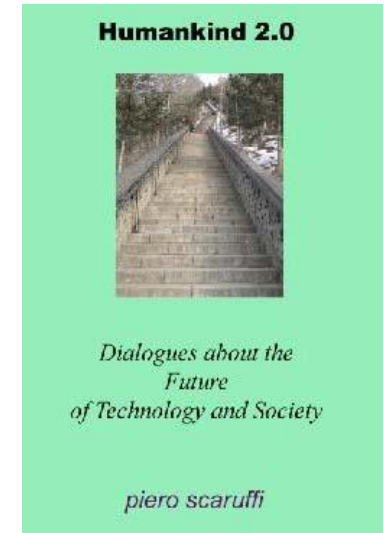
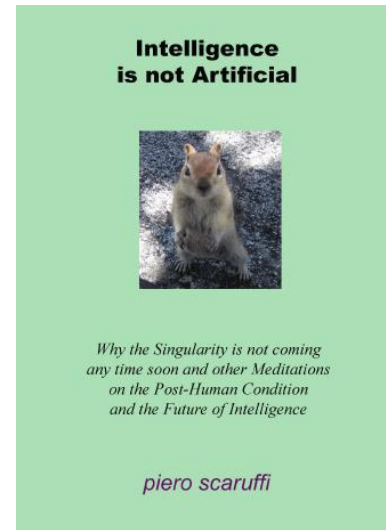
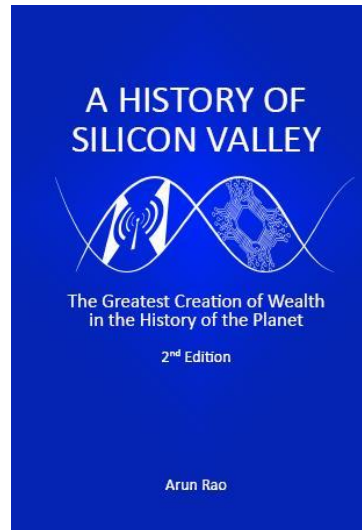
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- www.scaruffi.com



See <http://www.scaruffi.com/singular/biotech.html>
for the full text of this discussion