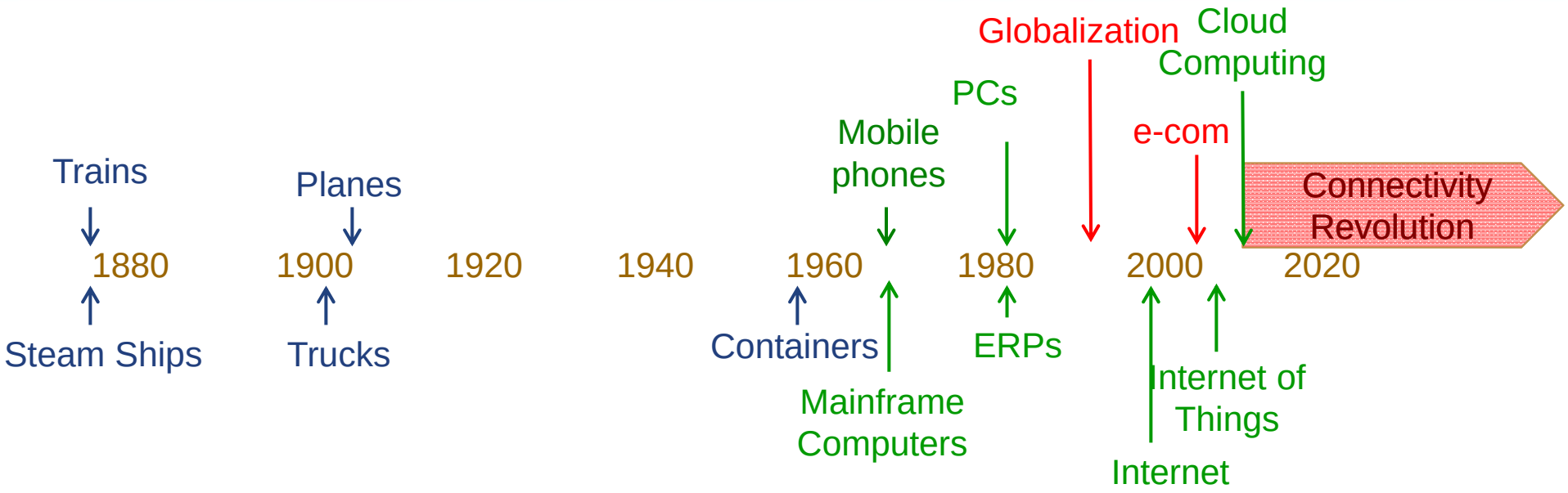
Digital Connectivity and the Future of Supply Chains & Logistics

Dr. Don Ratliff
don.ratliff@gatech.edu

GEORGIA TECH
Logistics Innovation & Research Center
Panama City, Panama
A Unit of the Supply Chain & Logistics Institute

Evolution of Supply Chain Thinking



- **Digital connectivity creates a totally new playing field for logistics**
- **We must fundamentally change the way we think**
- **Big companies have more capability to adapt but much more complexity**
- **Countries are having great difficulty adapting**
- **Only those that successfully adapt can compete**

2

"Big 3" Technology Enablers

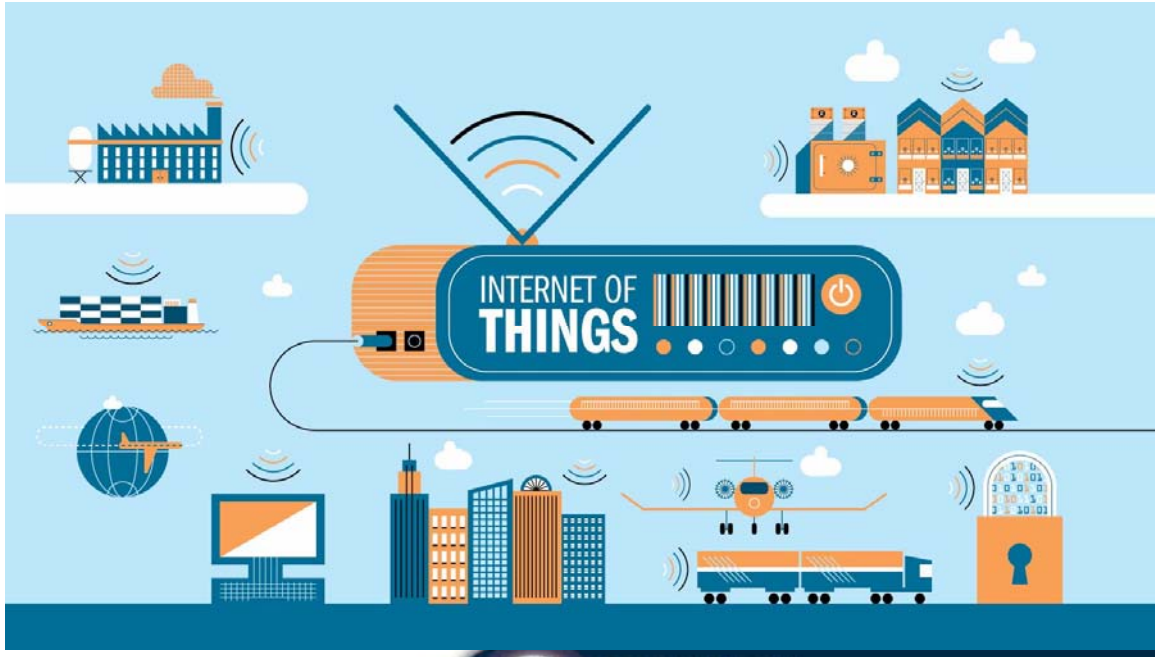
- **The internet**
  - Enables global movement of data and information almost everywhere
- **The internet of things (i.e., devices and sensors connected to the internet)**
  - Enables data capture from and provide information to various entities of supply chains
- **Cloud computing**
  - Enables almost unlimited data storage and computing power

Internet

- **16 million users in 1995**
- **More than 3 billion users currently**
  - About 2 billion smart phones currently
  - About 7 billion people in the world currently
- **Internet access is increasingly available anywhere, particularly to businesses**

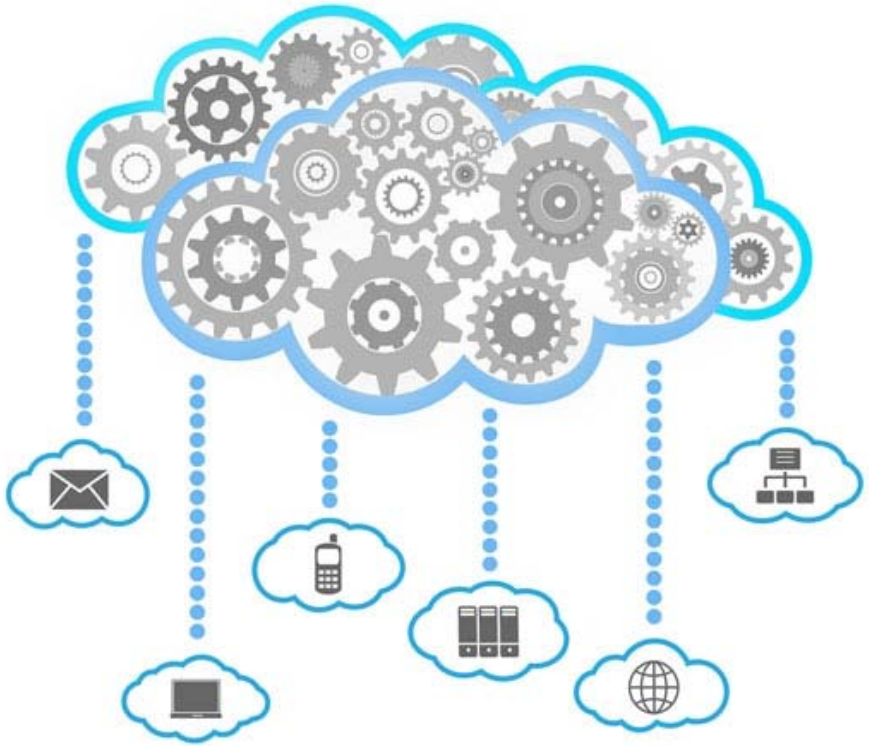
Internet of Things (IoT)

- Currently 15 billion devices connected to the internet
- By 2020 and estimated 50 billion devices will be connected to the internet
- More than 1.5 trillion devices could benefit from being connected to the internet



Cloud Computing

- **Global communication networks**
- **Cloud computing services**
  - "Infrastructure as a service" (IaaS)
    - Servers and operating systems
  - "Platform as a service" (PaaS)
    - Databases and runtime engines
  - "Software as a service" (SaaS)
    - Application software
- **Distinguishing features**
  - Remote networked servers
  - Virtualization
  - Shared resources
  - Public or private
- **By 2018 Cisco predicts that 78% of workloads will be processed by cloud data centers**



Industrial Internet of Things January 2015

- http://www3.weforum.org/docs/WEFUSA_IndustrialInternet_Report2015.pdf
- **Survey results – 88% of respondents say that they do not fully understand the underlying business models and long-term implications to their industries.**
- **Global Council on Future of Supply Chains and Logistics**
  - Don Ratliff council chair
  - 2 year project
  - Develop a set of use cases
  - Develop a framework for analyzing the value of implementation
  - Joint effort of Georgia Tech Panama Center and Hull Logistics Institute

WORLD ECONOMIC FORUM

WEF White Paper: Framework for analyzing Internet of Things Innovation in the Supply Chain

Cases

- 1. Non-traditional delivery
- 2. Centralized and automated planning
- 3. Global supply chain monitoring
- 4. Shipment monitoring
- 5. Operator monitoring
- 6. Connecting businesses (facilitating collaboration)
- 7. Facilitating international trade
- 8. Transportation asset optimization and control
- 9. Measuring performance
- 10. Centralized supply chain services

Values

- **Monitoring**
  - Shipments, assets, employees, requirements, risks
- **Measuring**
  - Performance, resource utilization
- **Planning**
  - Integrated across entities
- **Controlling**
  - Routing, scheduling
- **Automating**
  - Transactions, regulatory compliance
- **Optimizing**
  - Transportation and inventory plans, forecasts
- **Learning**
  - Opportunities for improvement

Barriers

- Massive amounts of data
- Uncertainty regarding what data exists
- Lack of standards
- Uncertain value
- Lack of technical expertise
- Lack of analytics
- Privacy & data security concerns
- Requirement for collaboration

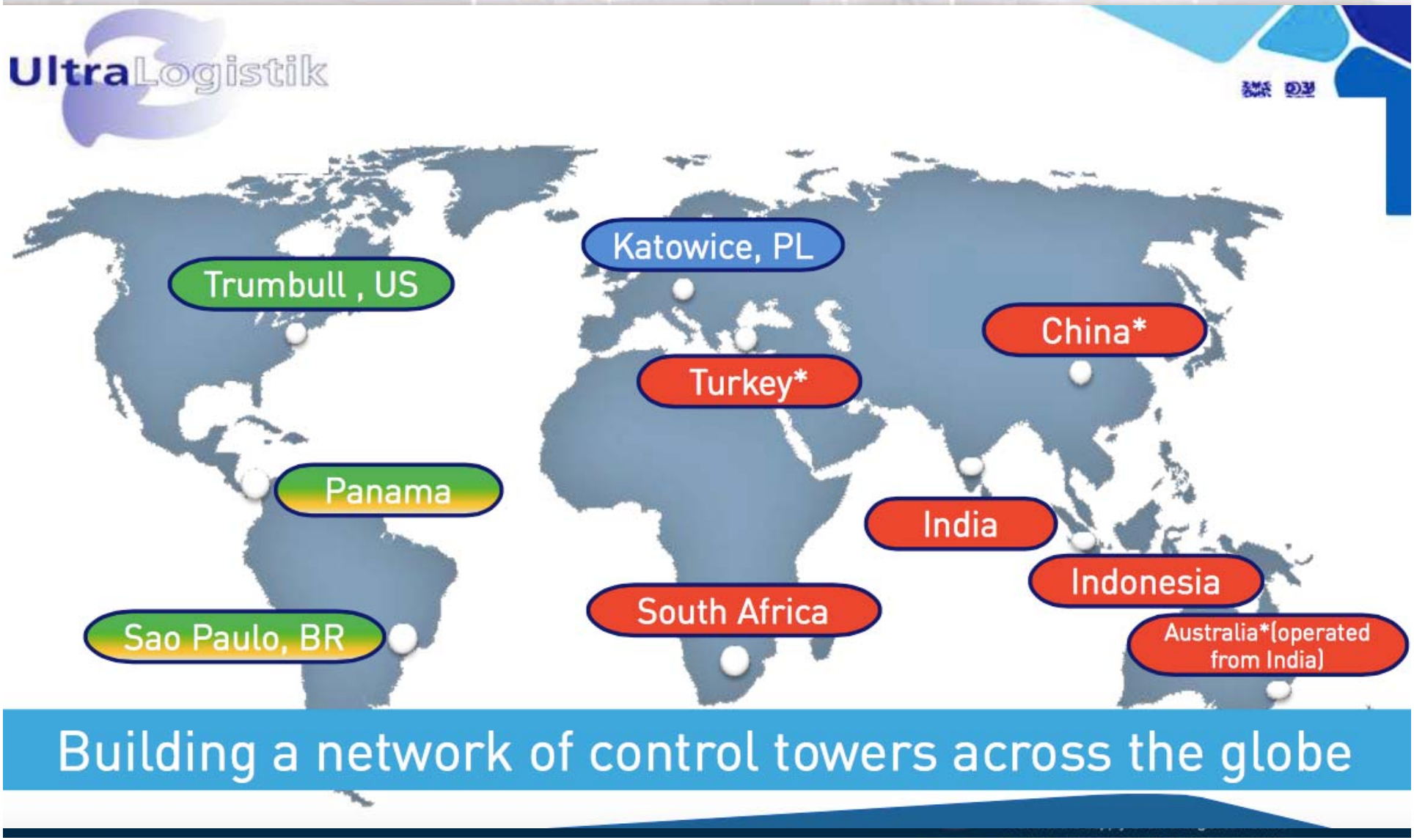
Control Tower Concept

- Centralized “master” facilitative control tower
- Multiple “satellite” control towers
- Data repository at master tower
- Common analytics developed at master tower
- Monitoring of end-to-end system at master tower
- Monitoring of component systems at satellite towers
- Plan overlays provided from master tower

Supply Chain Companies with Global Control Towers

- Flextronics
- Unilever
- Procter & Gamble
- Samsung Electronics
- Cisco
- Colgate-Palmolive
- Coca-Cola
- Walmart
- Lenovo Group
- Kimberly-Clark
- Caterpiller
- Philips
- Scania

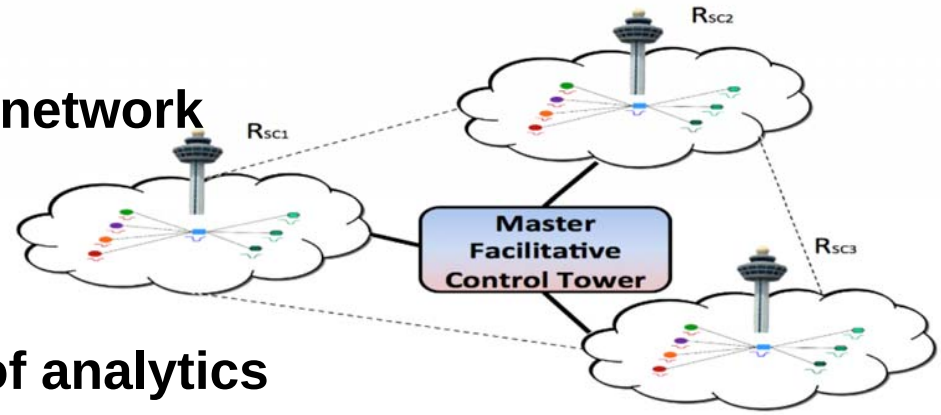
Unilever


UltraLogistik
Katowice, PL
Trumbull , US
China*
Turkey*
Panama
India
Indonesia
South Africa
Sao Paulo, BR
Australia*(operated from India)
Building a network of control towers across the globe

Flextronics

Exploring a Control Tower Network for Panama

- **Step 1: Cataloging existing data**
  - Public sector
  - Private sector
- **Step 2: Acquiring and rationalizing data streams**
  - Harmonization
  - Cleaning
- **Step 3: Develop a control tower network**
  - Master control tower
  - Satellite control towers
  - Control system
- **Step 4: Develop a common set of analytics**
  - Common mapping framework
  - Common business intelligence framework
  - Common modeling framework
- **Step 5: Develop visualization facilities**



New Digital Connectivity Companies

- **More than 1000 supply chain and logistic start-ups leveraging digital connectivity**
  - https://angel.co/supply-chain-management
  - https://angel.co/logistics
- **Marketplace – biggest group**
- **Centralized monitoring & planning – biggest impact**
- **Performance measurement – biggest opportunity**
  - GPS technology

Conclusions

- Just at beginning of digital transformation
- Massive data will create problems and opportunities
- Customer expectations are being raised
- Huge number of new applications (more than a million iPhone apps)
- Transformation is critical to survival
- Even large companies will struggle with transformation
- Huge opportunities for countries to leverage digital connectivity
- Digital connectivity is fundamentally transforming supply chains and logistics!!

Questions?

Comments?

IPIC 2016 - 3rd International Physical Internet Conference
June 29-July 1, 2016 | Atlanta, GA, USA

The Internet of Things:
A Central Axis of the Physical Internet – Promises and Hurdles

Alain Louchez
Managing Director
GT Center for the Development and Application of IoT Technologies (CDAIT)

Georgia Tech | Center for the Development and Application of Internet of Things Technologies

www.cdait.gatech.edu

The Internet of Things?

Jean Broc (1771–1850), The Fortune Teller

The Internet of Things

- The Interconnection of Intelligent Things -

The Internet of Things (IoT) is about the immersion of almost anything and everything (previously "out of scope") into the communications space thanks to the timely convergence of scientific, technological, and societal advances and trends.

Nothing will be forever fixed.

Inert will become active; delayed, instantaneous; offline, online; and static, dynamic.

IoT will give rise to a pulsating world (*).

(*) Emerging from things sending and receiving data

What's so special about the Internet of Things?

PRODUCTION OF "SMART GOODS" IS WEAVING THE IoT FABRIC

"The emergence of smart goods represents a seismic shift in the way IT will be designed, produced, distributed and marketed…the IoT revolution of the next 50 years will be enabled in part by the development of manufacturing platforms capable of delivering higher performance at lower cost" (*).

(*) Brian K. Paul, Rahul Panat, Christina Mastrangelo, Dave Kim and David Johnson, *NSF Workshop on Advanced Manufacturing for Smart Goods*, held in Portland, Oregon on May 14 and 15, 2015, *available at* https://labs.wsu.edu/advancedmanufacturing/wp-content/uploads/sites/238/2014/10/NSF-workshop-Adv-Mfg4Smart-Goods-090415.pdf

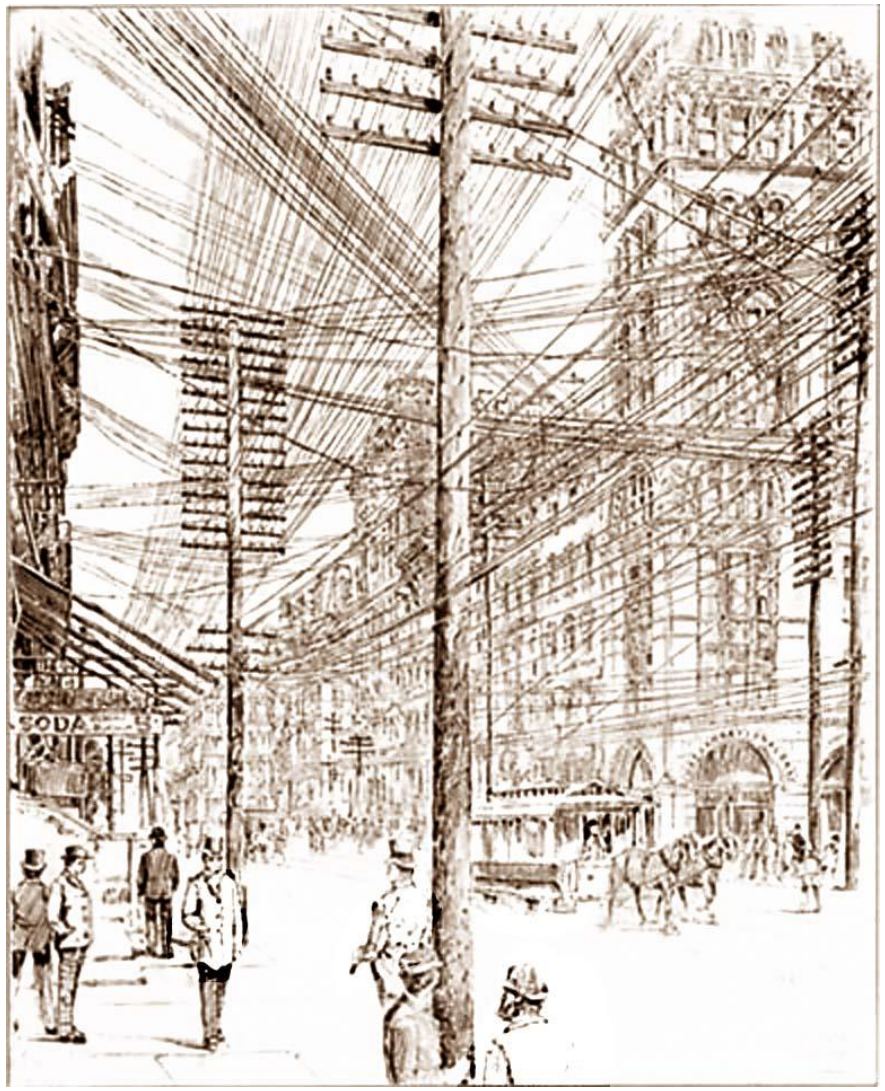
"The pervasive availability of embedded intelligence will allow the birth and growth of new ecosystems and services to maintain, upgrade and leverage the related capabilities." (**)

(**) Filing at NTIA following *Request for Comment (RFC) on the Benefits, Challenges, and Potential Roles for the Government in Fostering the Advancement of the Internet of Things - Docket Number: 160331306-6306-01,* June 1, 2016, *available at* http://www.ntia.doc.gov/files/ntia/publications/iot_rfc_june_2016_georgia_tech_cdait_alain_louchez.pdf

Intelligence will no longer be an "add-on", it will be "baked in"

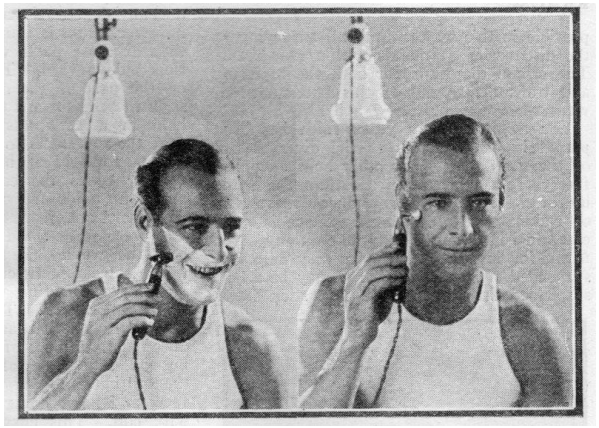
Picture source: http://www.burningphone.com/

IoT to follow the power path?



New York City streets in 1890. Besides telegraph lines, multiple electric lines were required for each class of device requiring different voltages.

http://stopthecap.com/2010/03/17/broadband-the-21st-century-equivalent-of-electricity-part-1-the-early-years/



Electric razor in 1926

http://paleofuture.gizmodo.com/tag/electricity-history

IMPORTANT

Rural Electrification Meeting

To Be Held At

Grange Hall - LEMPSTER, N. H.

MONDAY, NOV. 27, 1939 7:30 P. M.

IF YOU ARE A TENANT, INVITE YOUR LANDLORD

A. M. BLAKENEY, Jr., Washington, D. C.

Asst. Chief of Wiring Section of REA, Will Be Here To Explain

What Is Necessary For You To Do

NOW

To Get Electric Service Quickly

Construction has been started and immediate action is necessary.

ALSO

1—What has been done to lower the cost of wiring.
2—That you cannot obtain your wiring at these low costs, unless you sign a wiring contract before construction is completed.
3—That the electric lines will ultimately belong to you.
4—How to get long term financial assistance for wiring, lighting fixtures and plumbing.

IMPORTANT MESSAGE TO FARM WIVES

Bring your husband if you can, but if you can't, bring your neighbor's wife.

New Hampshire Electric Cooperative, Inc.

Phenix Hotel Phone 1338 Concord, N. H.

Est. U.S. residential sector electricity consumption (end use, 2014)

End use	Share
Space cooling	13%
Lighting	11%
Water heating	9%
Space heating	9%
Refrigeration	8%
Televisions and related equipment	6%
Clothes dryers	4%
Furnace fans and boiler circulation pumps	3%
Computers and related equipment	2%
Cooking	2%
Dishwashers	2%
Freezers	2%
Clothes washers	1%
Other uses	28%
TOTAL	100%

https://www.eia.gov/tools/faqs/faq.cfm?id=96&t=3

1930s: 44% of US pop. in rural areas, only 10% with electricity

http://extension.unh.edu/articles/Rural-Electrification-Broadband-Use

INCREASING ATTENTION ON IoT IN U.S. GOVERNMENT CIRCLES

WHITE HOUSE: *See* U.S. President's National Security Telecommunications Advisory Committee (NSTAC), *NSTAC Report to the President on the* ***Internet of Things***, November 19, 2014, p. ES-1, *available at:* https://www.dhs.gov/sites/default/files/publications/NSTAC%20Report%20to%20the%20President%20on%20the%20Internet%20of%20Things%20Nov%202014%20%28updat%20%20%20.pdf

U.S. SENATE: *See* S. 2607 Bill introduced in Senate, *Developing Innovation and Growing the* ***Internet of Things*** *Act or the DIGIT Act*, March 1, 2016, available at: http://www.commerce.senate.gov/public/_cache/files/52aad6c5-837c-47b8-ab60-490263ccb5a6/73AE8EEFC07D2B3C154B48BF3C6146D8.bills-114s2607is.pdf (*)

U.S. HOUSE OF REPRESENTATIVES: *See Latta and Welch Launch Bipartisan* ***Internet of Things*** *Working Group,* May 24, 2016, available at: https://energycommerce.house.gov/news-center/press-releases/latta-and-welch-launch-bipartisan-internet-things-working-group

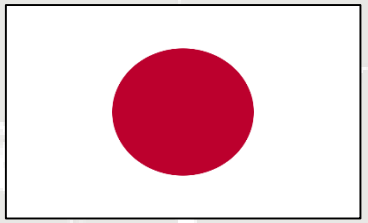
U.S. DEPARTMENT OF COMMERCE (NTIA): *See Notice and Request for Comments on the Benefits, Challenges, and Potential Roles for the Government in Fostering the Advancement of the* ***Internet of Things****,* April 5, 2016 (deadline June 2, 2016), *available at*: https://www.federalregister.gov/articles/2016/04/06/2016-07892/the-benefits-challenges-and-potential-roles-for-the-government-in-fostering-the-advancement-of-the?et_cid=449892&et_rid=49295945

(*) In particular, see Hearing of U.S. Senate Subcommittee on Surface Transportation and Merchant Marine Infrastructure, Safety, and Security titled *"How the* ***Internet of Things (IoT)*** *Can Bring U.S. Transportation and Infrastructure into the 21st Century,"* Tuesday, June 28, 2016, *available at:* http://www.c-span.org/video/?411886-1/hearing-focuses-internet-things-selfdriving-vehicles

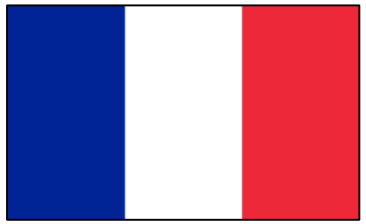
INCREASING ATTENTION ON IoT AROUND THE WORLD

Fourth Industrial Revolution

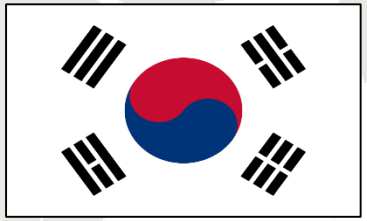
“Made in China 2025”, “Digital Silk Road” & “Global Internet of Things Innovation Union Advocacy” [“One Belt One Road”]



“Robot Revolution Initiative Council” & “Industrial Value Chain Initiative”



“La Nouvelle France Industrielle (NFI)”



“Manufacturing Innovation 3.0”

“Industry 4.0” & “Digital Strategy 2025”

“High Value Manufacturing (HVM) Catapult”

“La Fabbrica del Futuro”

“National Network for Manufacturing Innovation” & “Smart Manufacturing Leadership Coalition”

FROM ONE REVOLUTION TO ANOTHER…

Internet of Things: a pivot on which the Physical Internet (π) rotates

Physical Internet: Transforming the way physical objects are :

Moved

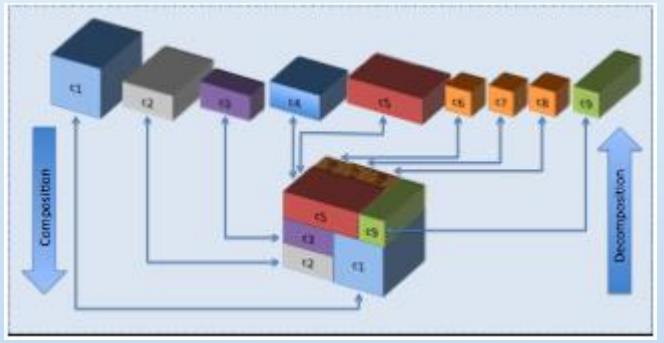
Stored

Realized

Supplied

Used

Who, What, How, Where and When



Internet of Things Technologies

in a manner that is **economically**, **environmentally** and **socially** **Efficient** and **Sustainable**

TECHNOLOGICAL HURDLES TO IoT DEVELOPMENT

- Scale and scalability (modeling & simulation, etc.)
- Energy (reduced power [LPWA], enhanced battery life, energy harvesting, etc.)
- Standards (interoperability, ontology, etc.)
- New architectures (memory and system levels, computing at the edge and/or in the cloud, etc.)
- Impact on data centers (storage, UPS, etc.)
- Miniaturization and cost-effectiveness of sensors & actuators
- Digital printing
- Design tools to support the development of intelligent things
- Antenna technologies
- Frequency availability (licensed vs. unlicensed spectrum)
- Integration (complex value chain, data-driven decision making)
- Link between the past and the future (re. legacy systems)
- System trustworthiness (cybersecurity, privacy, safety, reliability and resilience)

NON-TECHNOLOGICAL HURDLES TO IoT DEVELOPMENT

- Ethics («we can but should we?»)
- Education (future workforce) & training (current workforce, i.e., « re-skilling ») – broad range of expertise
- Enterprise management (e.g., business models; marketing; etc.)
- Enterprise organization (e.g., merger of IT and OT)
- Advocacy (what is IoT, its potential, its benefits; how to overcome inertia? etc.)
- Technical trade-off management (value judgment), e.g., security vs. speed; power consumption vs. features, etc. – Who makes the choice/decision?
- Access to financing, favorable tax environment
- Policy (e.g., digital development), laws (e.g., liability and IP) and regulations (e.g., bandwidth allocation) – Role of government (too much or not enough?, regulatory silos?)
- Expectations («Amara's law», long-term transformation vs. short-term demands)
- International cooperation (e.g., standards, cross-border traffic) and competition
- Social acceptability (e.g., net job destruction? vs. solution to demographic challenges?; « surveillance society », etc.)
- Existence of « domestic/global digital divide » (pertaining to age, disability, gender, income, ethnicity and location)

IoT and PI: A TIGHT RELATIONSHIP

*"A global hyperconnected logistics system, the **Physical Internet** is a leading example of a vast **Cyber-Physical System** integrating 'computation, communication, sensing, and actuation with physical systems to fulfill time-sensitive functions with varying degrees of interaction with the environment, including human interaction' (*). The Internet of Things and the Physical Internet's symbiotic relationship is unquestionably bound to grow and tighten sooner rather than later" (**).*

(*) See U.S. NIST CPS Public Working Group – DRAFT - Framework for Cyber-Physical Systems – Release 08 – September 18, 2015, p. 7.

(**) See Benoit Montreuil and Alain Louchez, *The Physical Internet Will Rest On The Internet Of Things*, Manufacturing.net, November 5, 2015, available at http://www.mbtmag.com/article/2015/11/physical-internet-will-rest-internet-things

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Thank You!

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