Disruptive Innovation, Smart Objects and the Internet of Things

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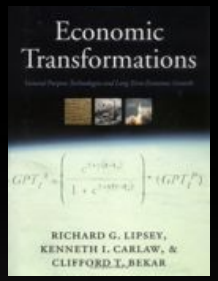
Vice President, Systems Engineering
Cisco International

Transforming the Global Socio-Economic Landscape



Long term economic growth is driven by transformative General Purpose Technologies (GPT's)…

Lipsey, Carlaw, Becker, 2006

World GDP

Time

Wheel

Writing

Sailing Ship

Printing Press

Railways

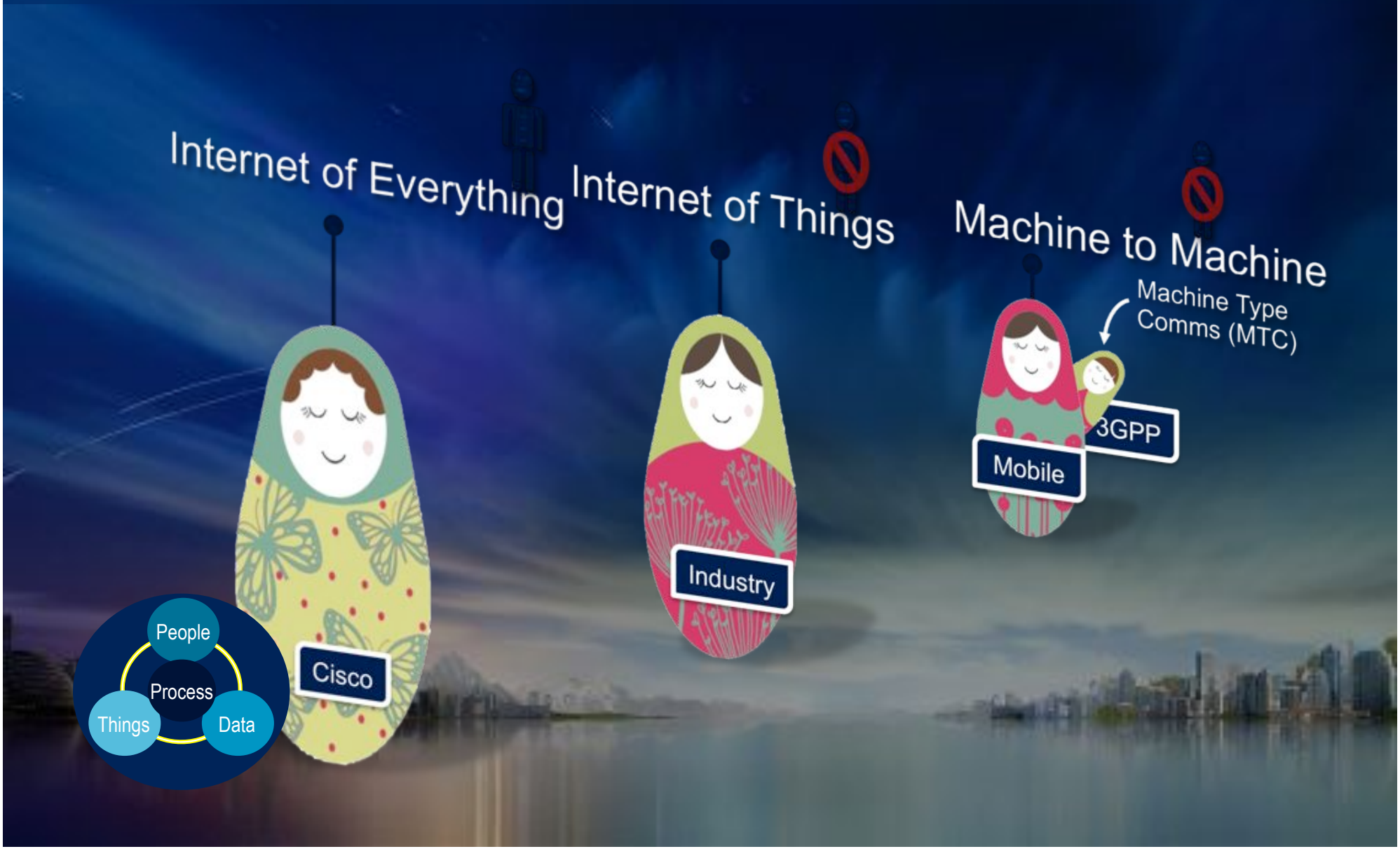
Electricity

Computer

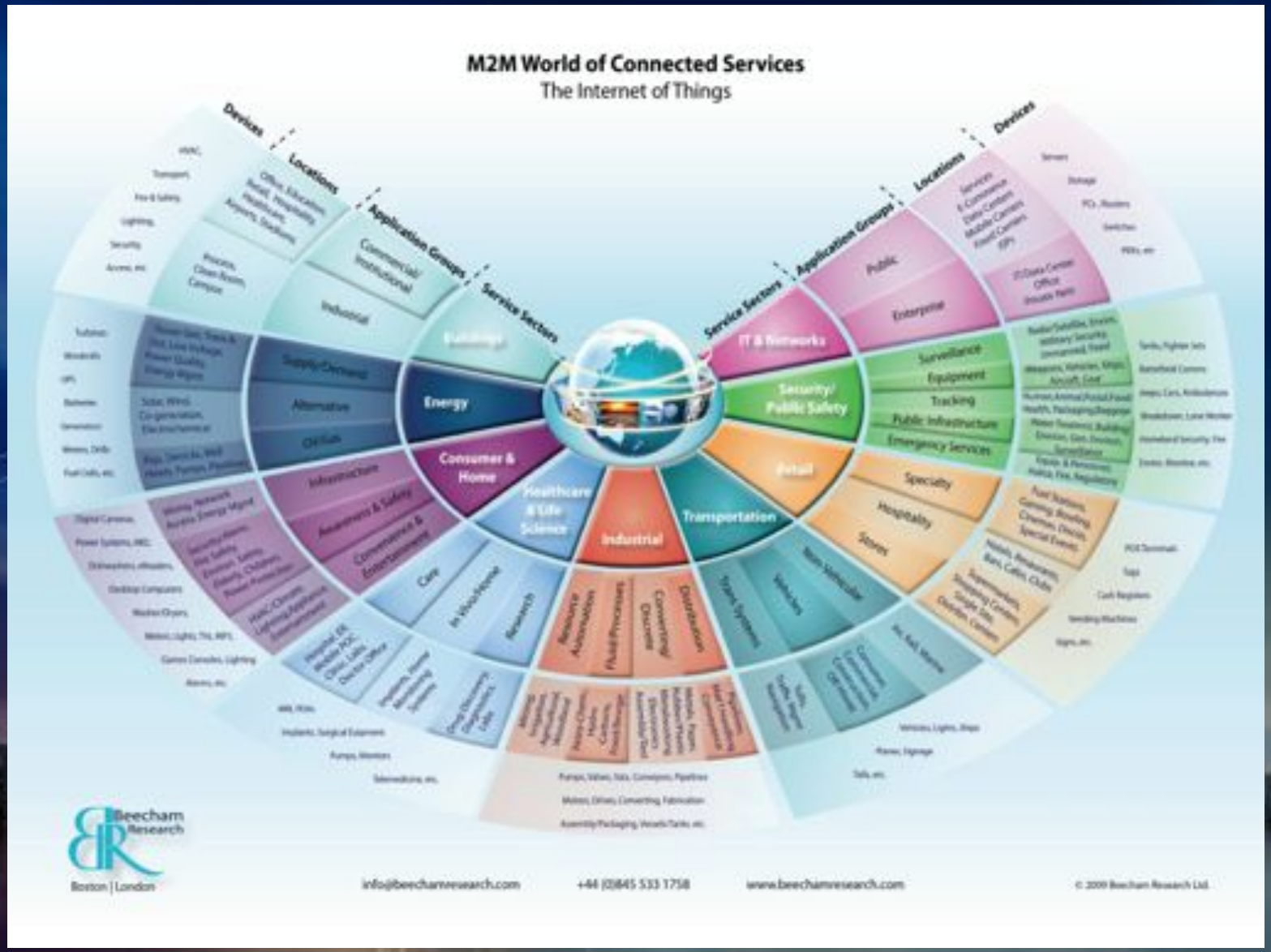
Internet

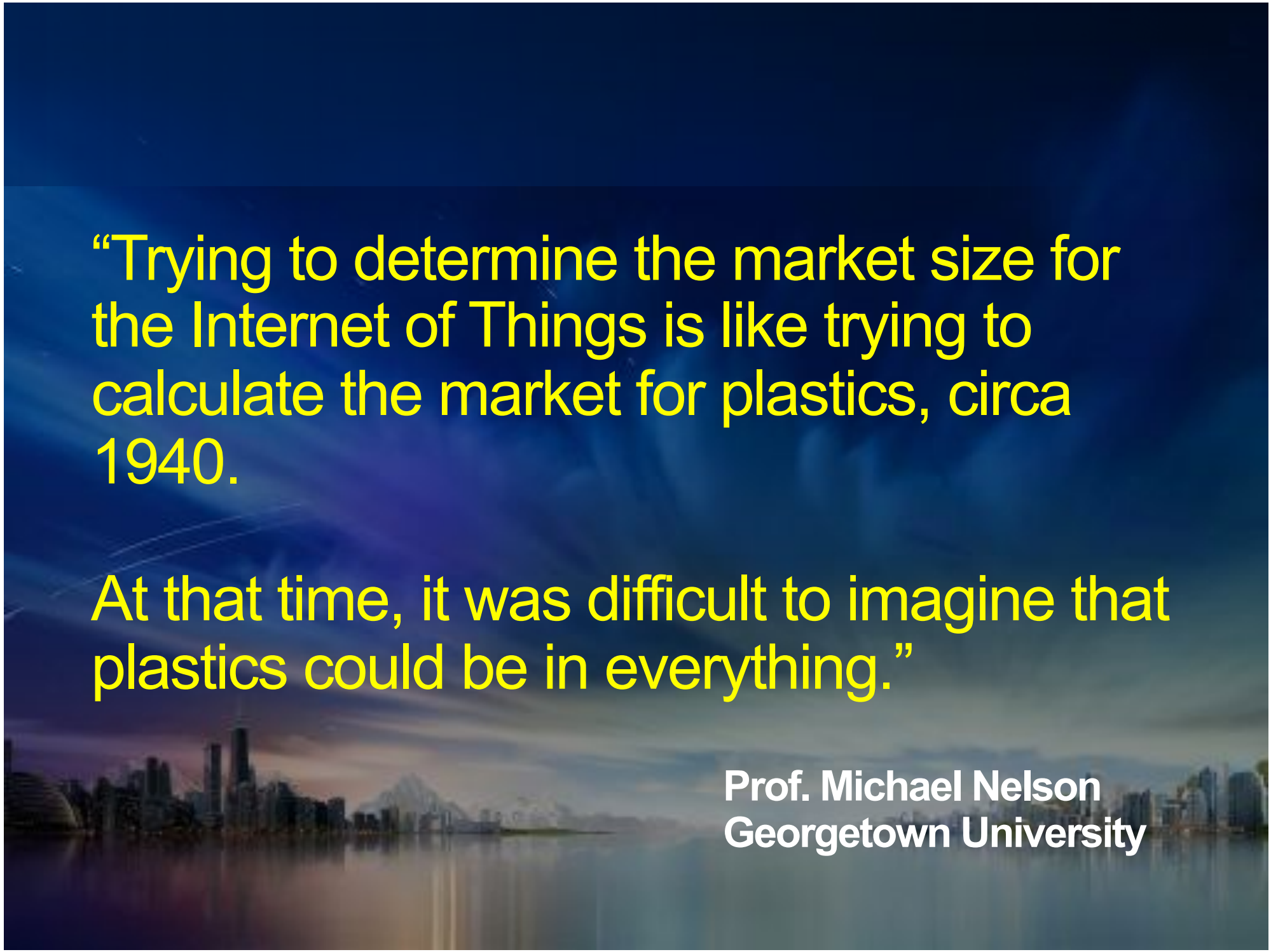
The Future
Biotech &
Nanotech

Definitions & Relationships

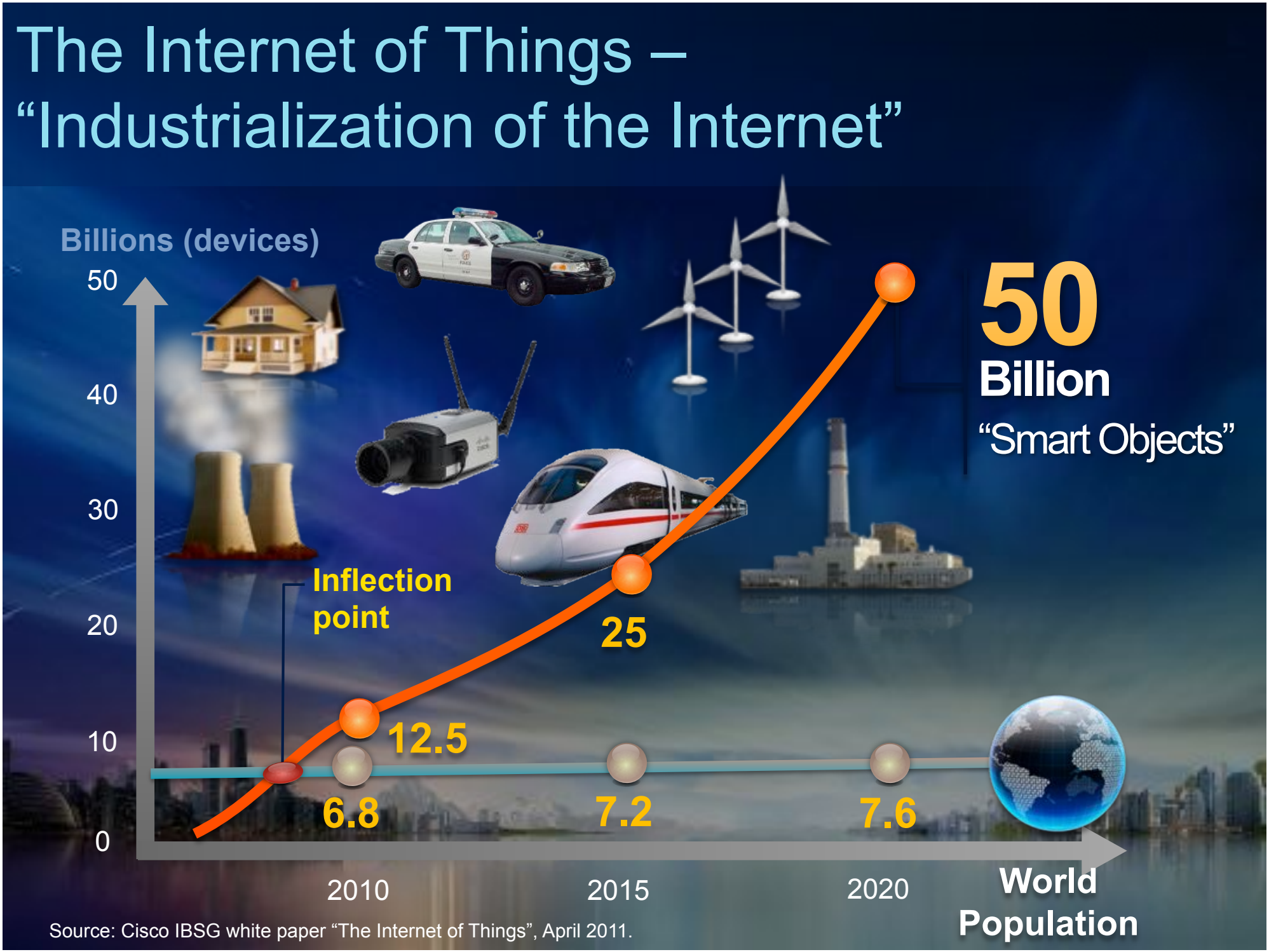


The Internet of Things –
Sectors, Applications, Locations, Devices….




“Trying to determine the market size for the Internet of Things is like trying to calculate the market for plastics, circa 1940.
At that time, it was difficult to imagine that plastics could be in everything.”
Prof. Michael Nelson
Georgetown University

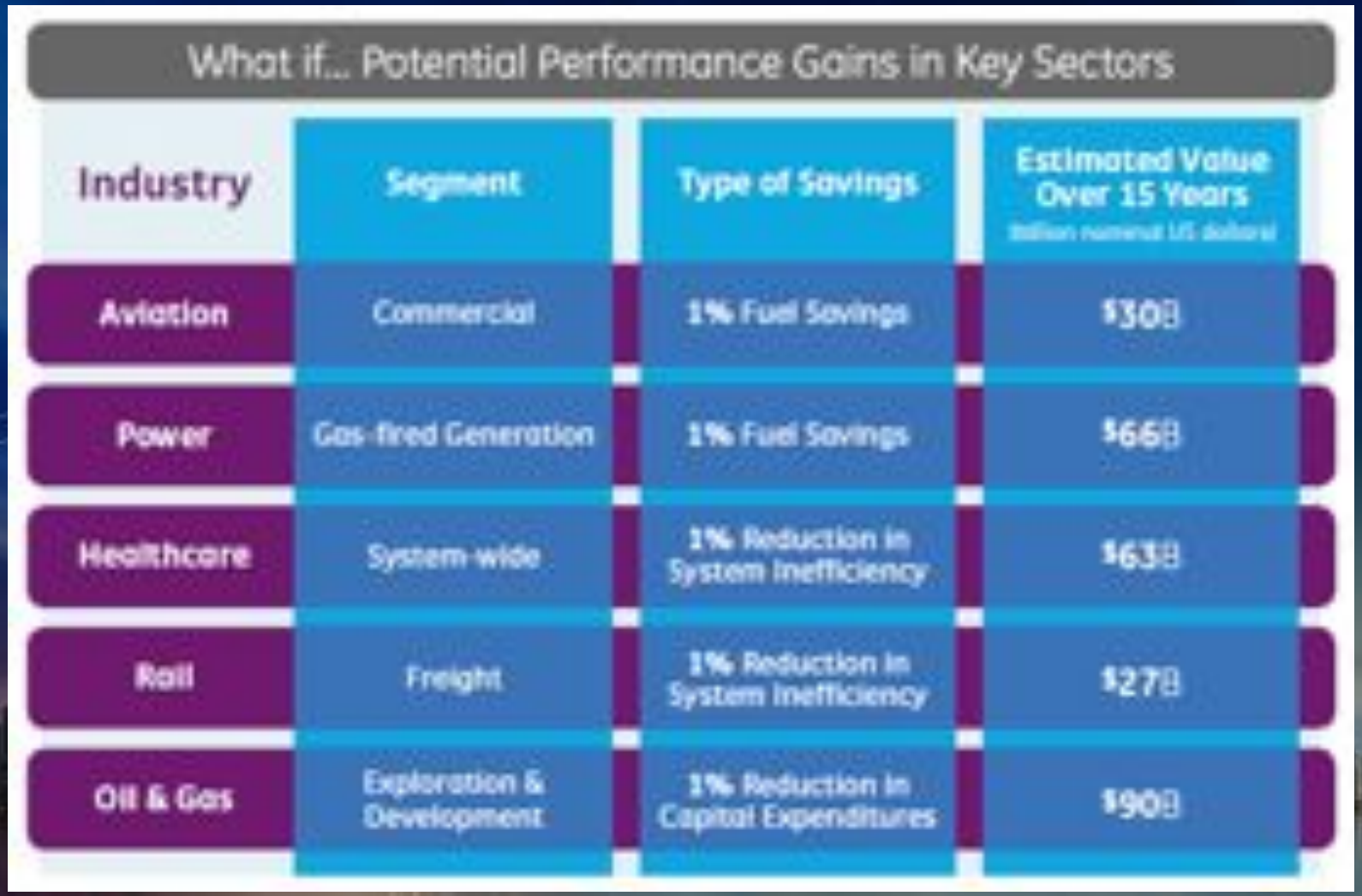
The Internet of Things – "Industrialization of the Internet"



Source: Cisco IBSG white paper "The Internet of Things", April 2011.

“The Power of One Percent”

imagination at work



What if... Potential Performance Gains in Key Sectors

Industry	Segment	Type of Savings	Estimated Value Over 15 Years (billion nominal US dollars)
Aviation	Commercial	1% Fuel Savings	$30B
Power	Gas-fired Generation	1% Fuel Savings	$66B
Healthcare	System-wide	1% Reduction in System Inefficiency	$63B
Rail	Freight	1% Reduction in System Inefficiency	$27B
Oil & Gas	Exploration & Development	1% Reduction in Capital Expenditures	$90B

Ref: Industrial Internet: Pushing the Boundaries of Minds & Machines

A Future World of Sensors – Trillions of Smart Objects

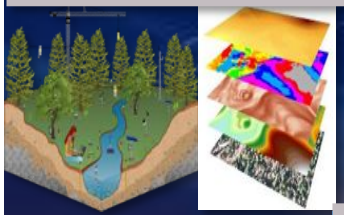
Predictive Maintenance

Energy Saving Smart Grid

High-Confidence Transport & Asset Tracking

Improve Efficiency & Productivity

Intelligent Buildings

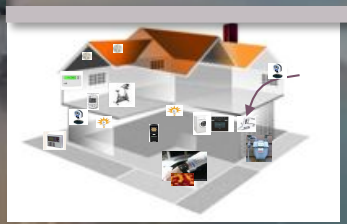


Enable New Knowledge

Enhanced Safety & Security

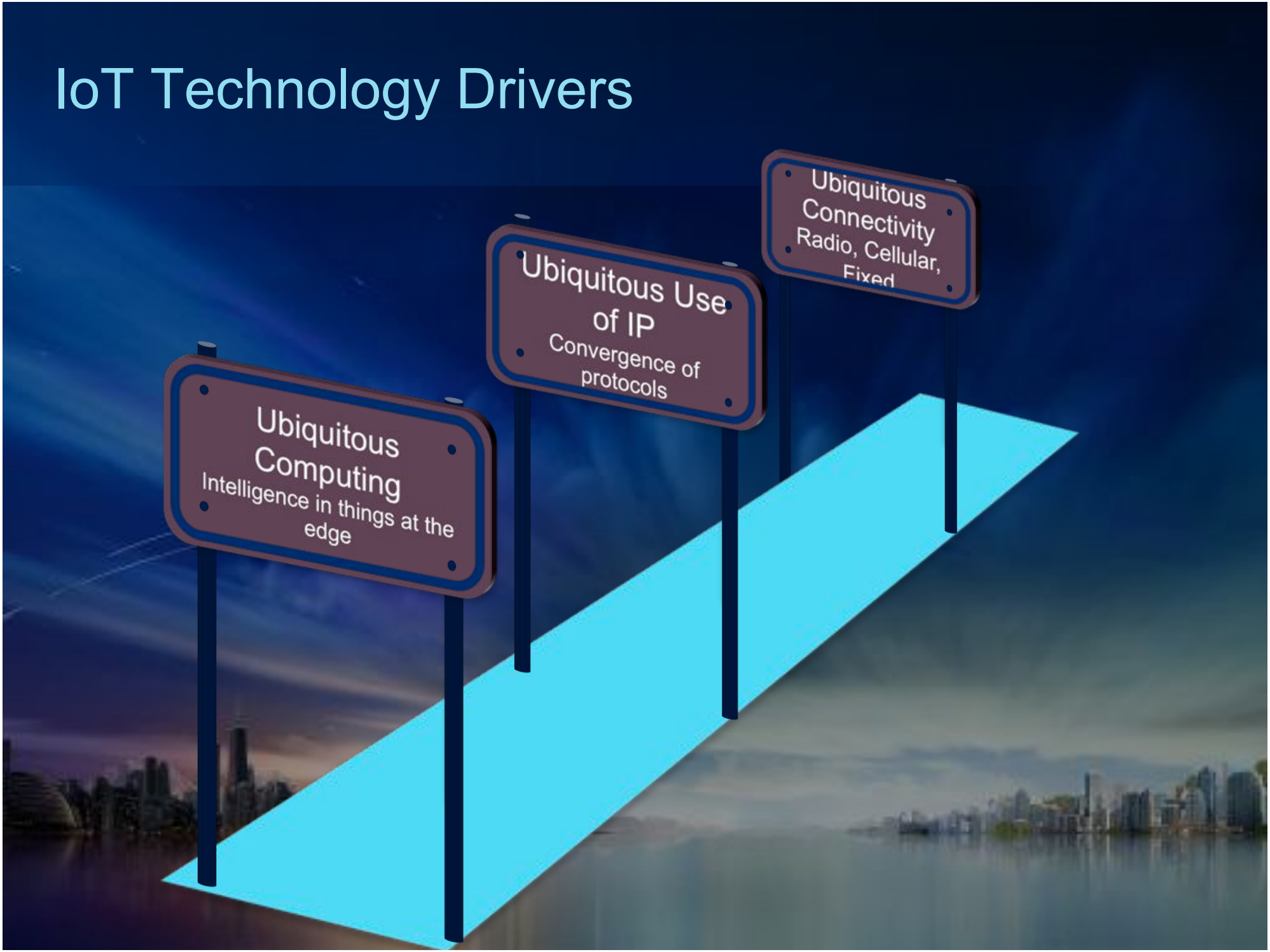
Improve Food & Water supply / quality

Healthcare E-health

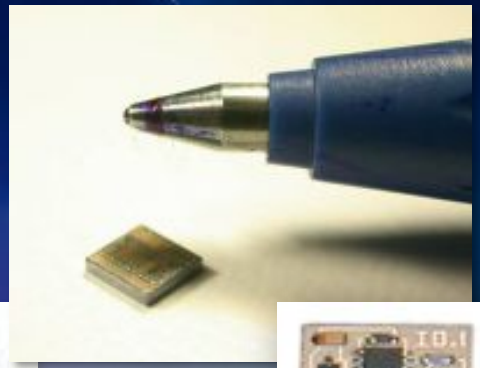


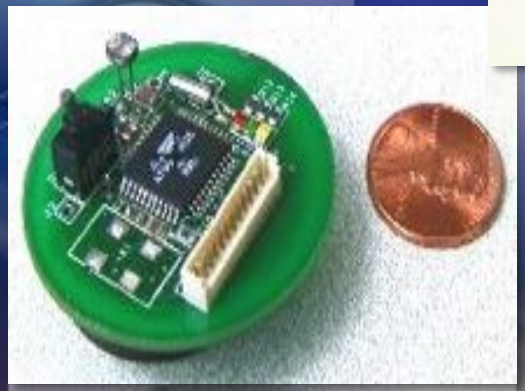
Smart City Smart Home

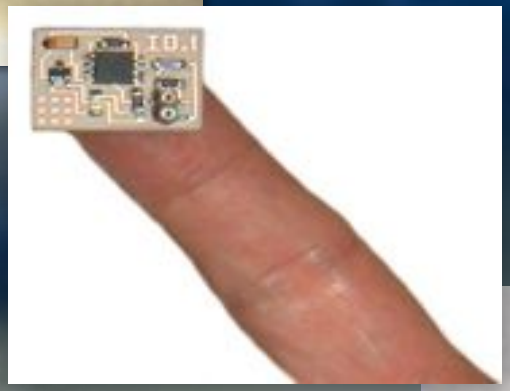
IoT Technology Drivers

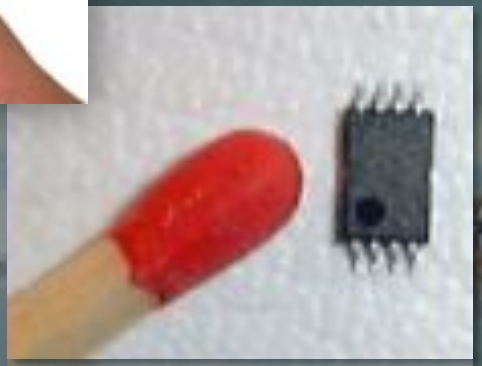


The Internet of Things & Smart Objects

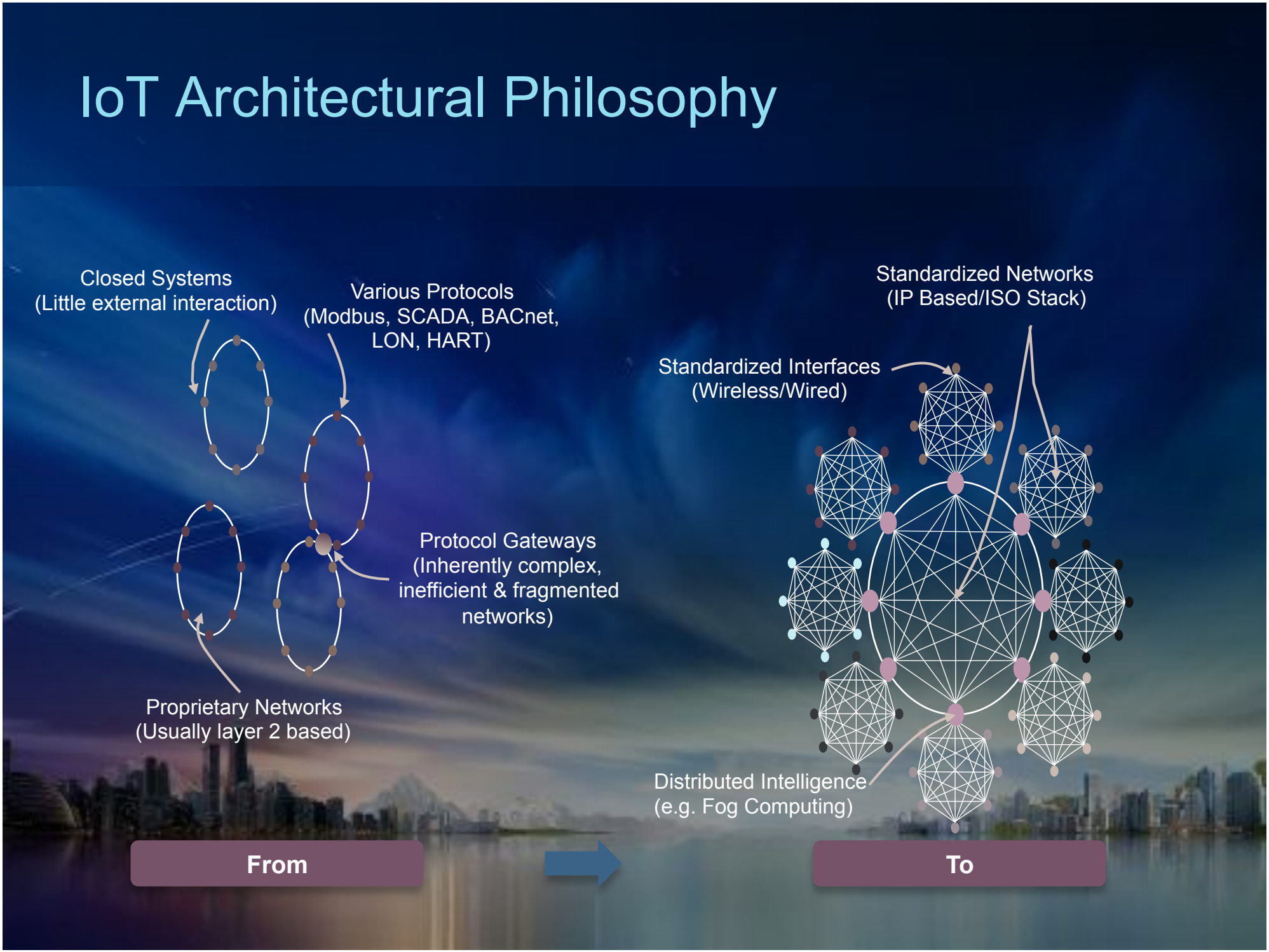








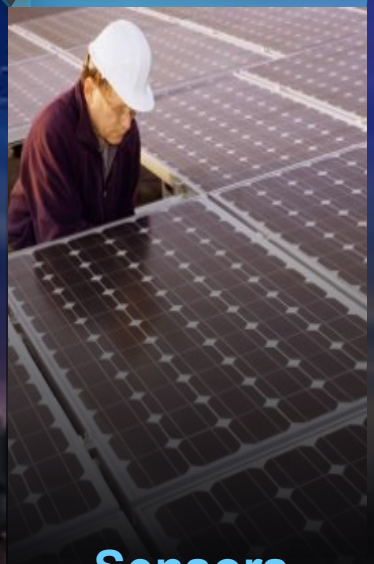
IoT Architectural Philosophy



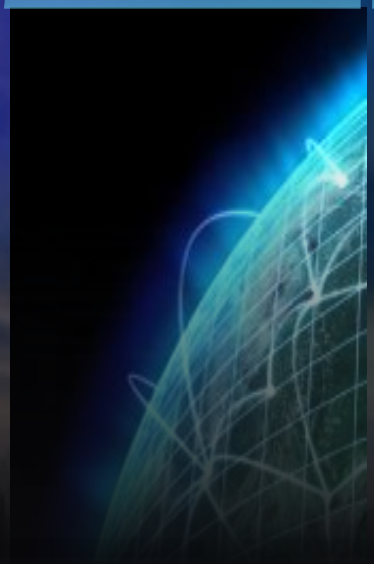
The Internet of Things: Sector-based Opportunities

Industries | Energy | B2C | Smart Cities | Connected Home | Safety and Security

Industry Innovation in Applications & Operations

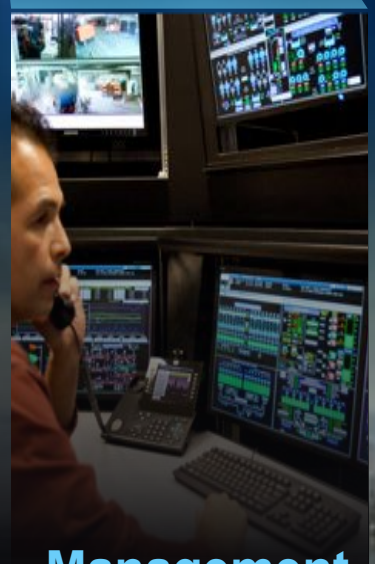


Sensors and Things



Connectivity

Data Analytics



Management and Control

IoT Platform – R&D Activity

Sensors and Devices

- Location
- Identity
- Policy
- Aggregation

Networks and Protocols

- Scale
- Lossy Networks
- Security
- Service Provider M2M

Data Analytics

- Data Aggregation
- Distributed Computing
- Video Analytics
- Data in Motion

Control Systems

- Determinism
- Safety
- Latency
- Autonomics

Data Center

Intelligent Network

Cloud

IoT Connectivity Platform

Smarter Agriculture

Moisture Meters

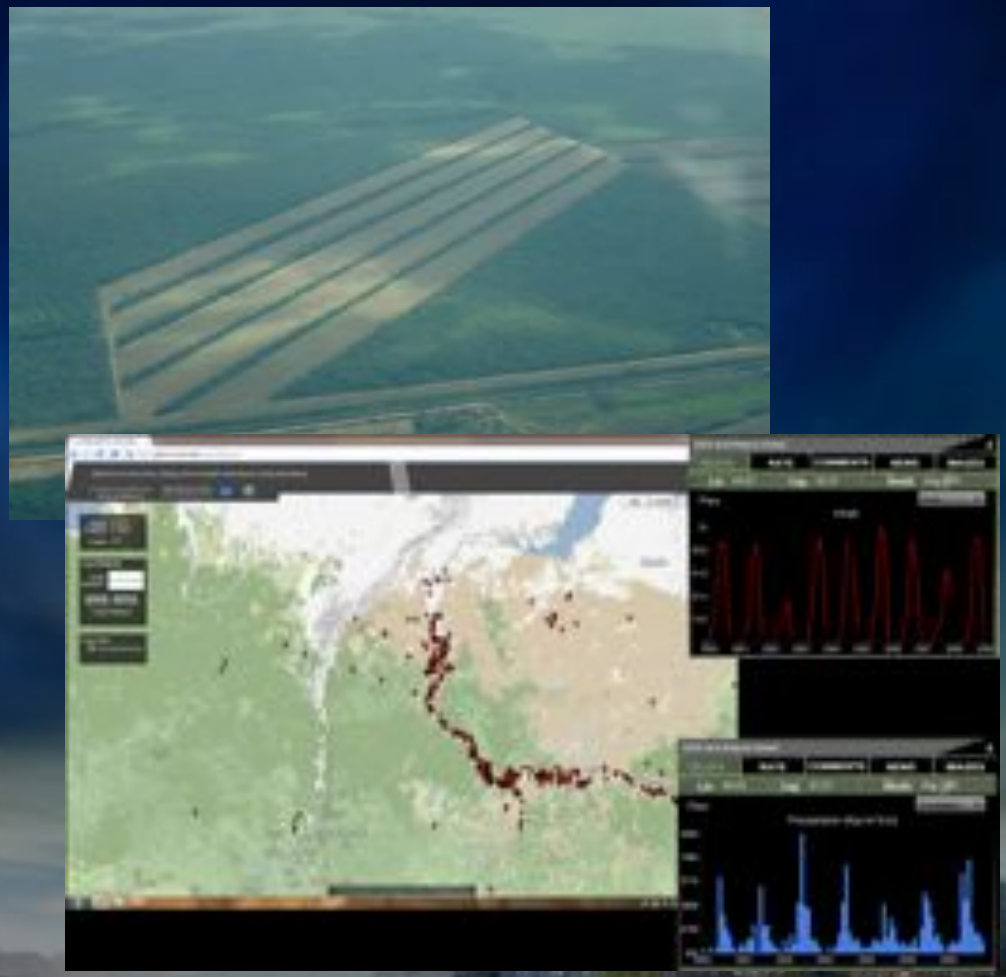
Weather sensing

Precision Farming

Connected Farm Equipment

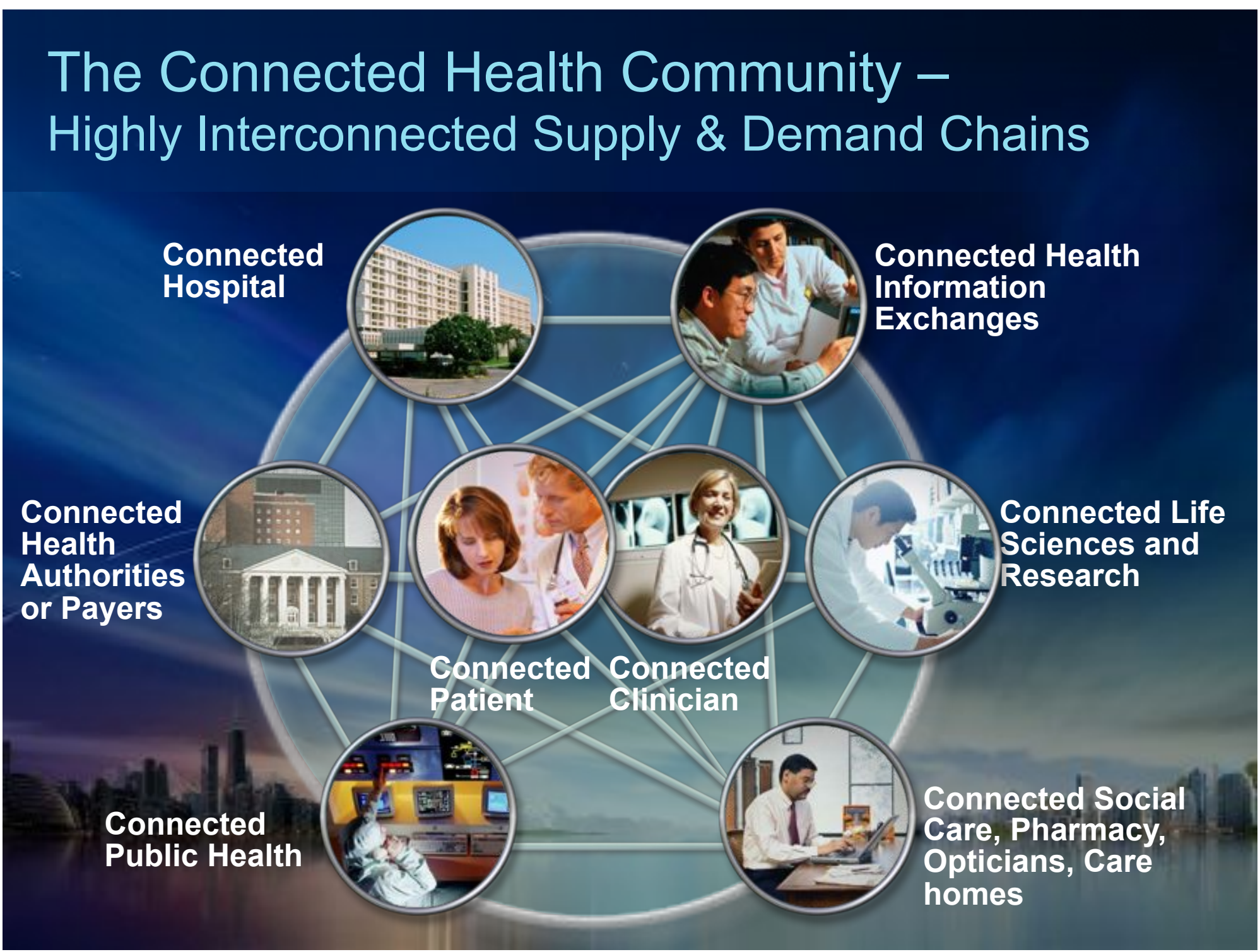
“Planetary Skin” – Sense, Predict, Act

- Integration & Visualization of complex datasets
- Aerial Imaging & Land-based Sensors
- Early Warning Systems for Natural Disasters
- Energy Resource Planning & Optimization
- Global to Local Drought Monitoring
- Global Land Change Detection



Source: Planetary Skin Institute

The Connected Health Community –
Highly Interconnected Supply & Demand Chains



The Impact of Urbanization - From 2010-2025

- GDP of City600 will rise by $30T or 65% of Global Growth
- Emerging 440Cities will contribute $23T
- 650M New Consumers in Emerging 440Cities
- Cities may need to construct floor space equivalent to 85% of todays building stock
- An 80Billion m^3 increase in municipal water demand
- ….energy, telecomms, transport, security….

Source: McKinsey Global Institute, Urban World: Cities & the Rise of the Consuming Class, June 2012

Urbanization & Smarter Cities - The need for a “The City Protocol”*

Energy Savings	Water Consumption	Crime Rates	Traffic	Carbon Emissions
30%	50%	20%	30%	25%

Education: $3/Student/Month

Healthcare: $3/Doctor Visit

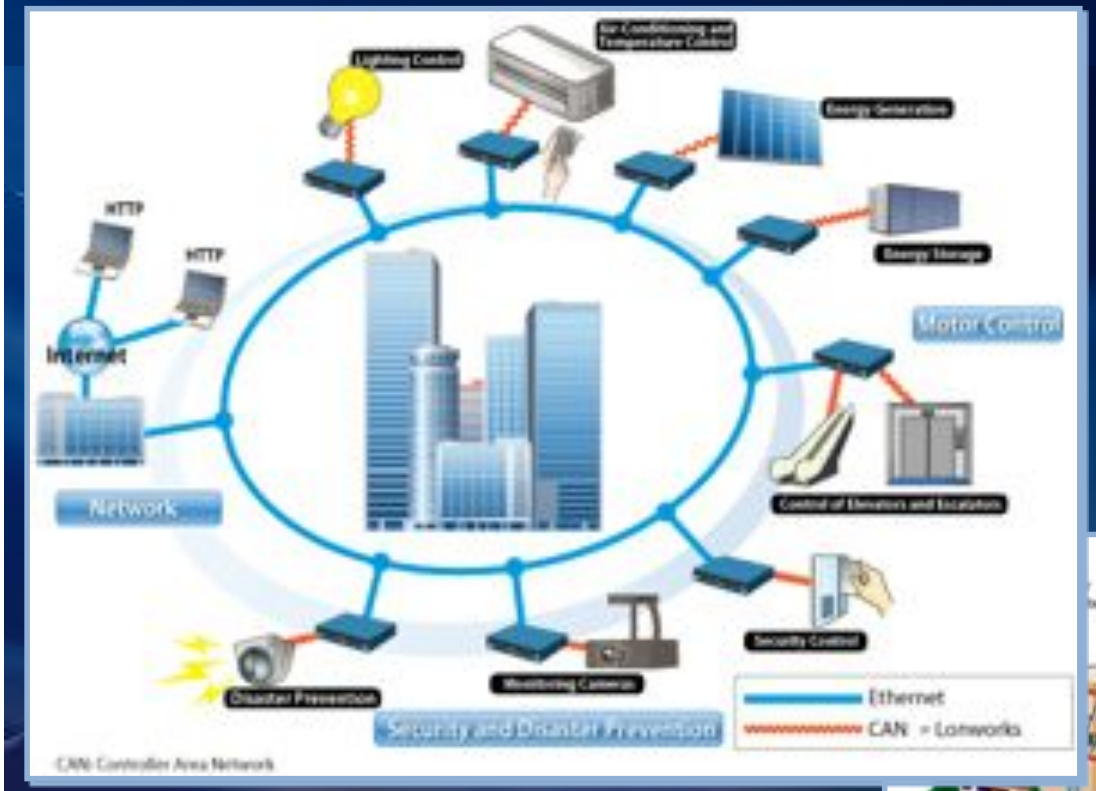
* A Certification System for Smart Cities – August 2012

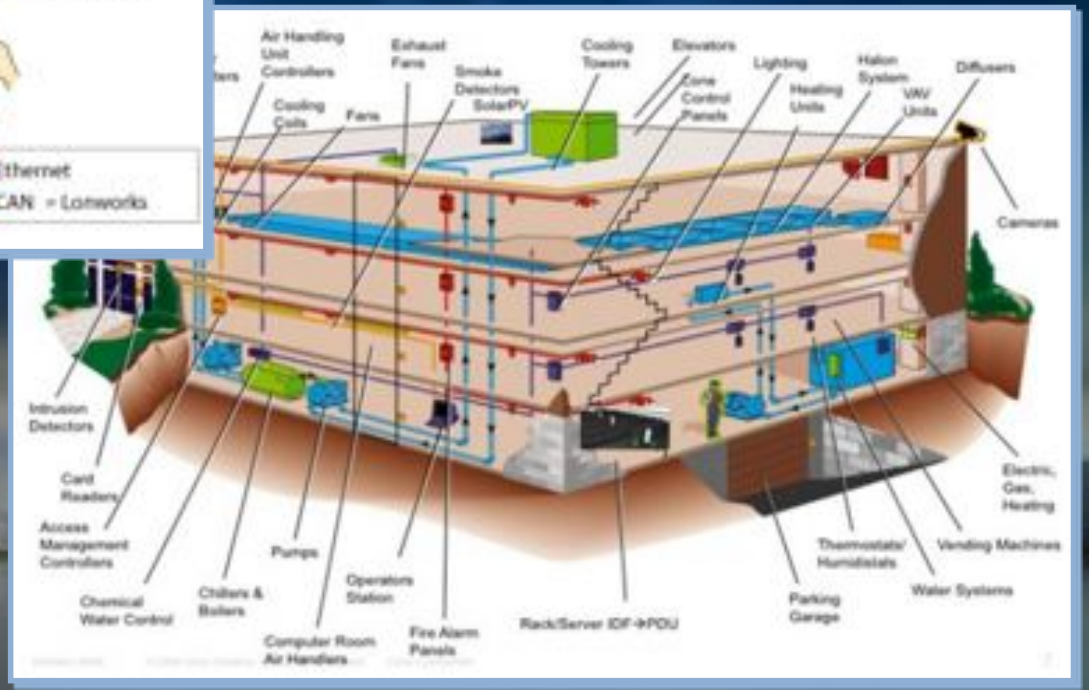
Smarter Homes – “A Machine for Living in”*

- By 2014, 70% of consumer devices are expected to be ‘capable’ of Internet connection

*Le Corbusier, Towards a New Architecture, 1923

Smarter Buildings





Ref: David Fisk (2012): Cyber security, building automation, & the intelligent building, Intelligent Buildings International, DOI:10.1080/17508975.2012.695277

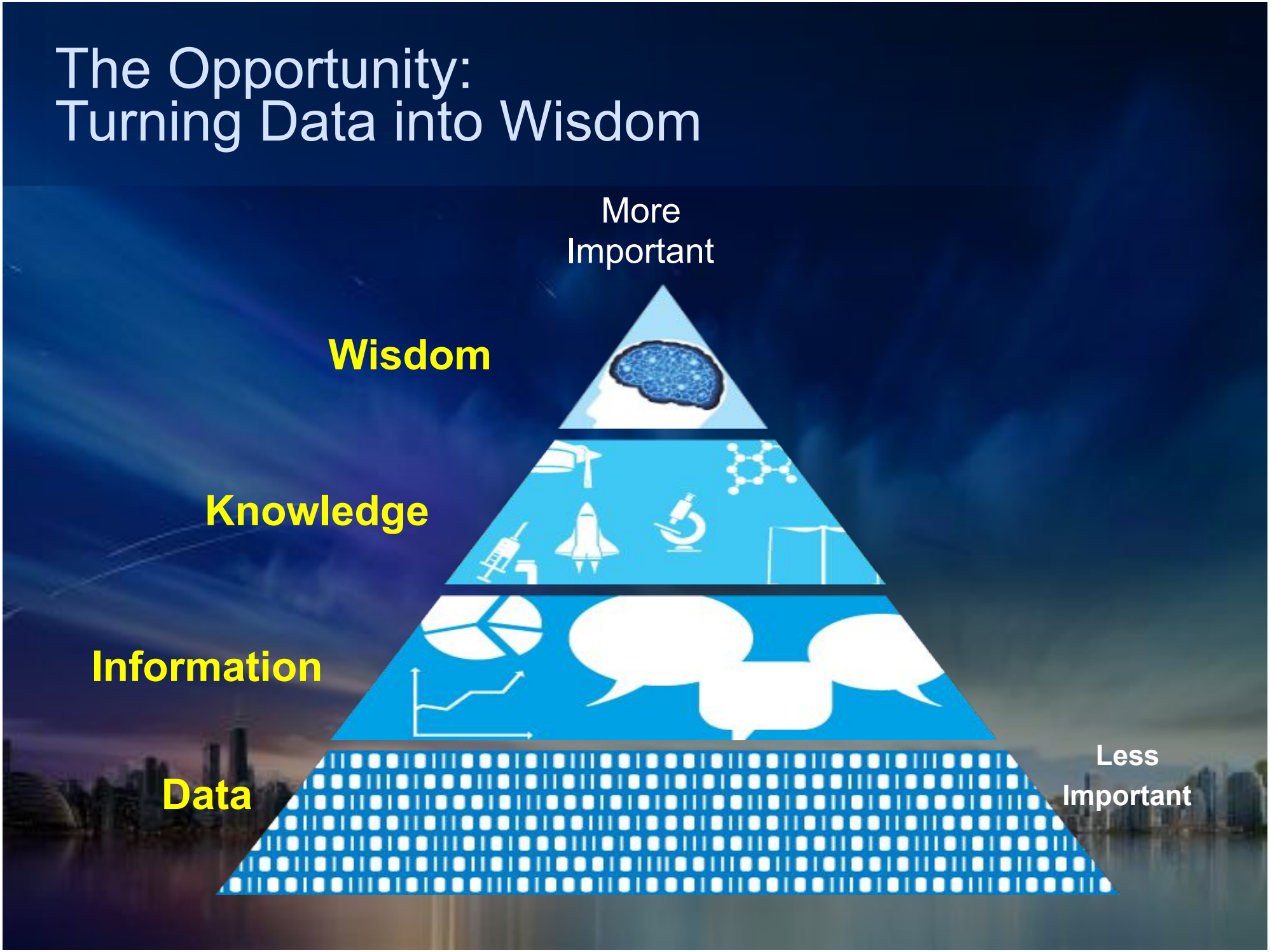
Data - Problem or Opportunity?

"What information consumes is rather obvious: it consumes the attention of its recipients.

Hence a wealth of information creates a poverty of attention and a need to allocate that attention efficiently among the overabundance of information sources…"

Herbert Simon,
Artificial Intelligence Pioneer
Nobel Prize in Economics

The Opportunity:
Turning Data into Wisdom



The IoT Architecture

Energy | Smart Cites | Connected Cars | Healthcare | …

Data Center
Hosting IoT analytics

Network Management | Applications

Core
IP/MPLS, Security, QoS, Multicast

Thousands

IP Core

FOG Computing

Sensing | Control | Correlation

Multi-Service Edge
3G/4G/LTE/WiFi

Million

Field Area Network

FOG Computing

IoT Innovation

Ruggedized Platform Hosted App. Distributed Intel.

IoT Access Network Lightweight IP + OS Zero Touch Prov.

Embedded Systems and Sensors
Low power & bandwidth, smart things

Trillion

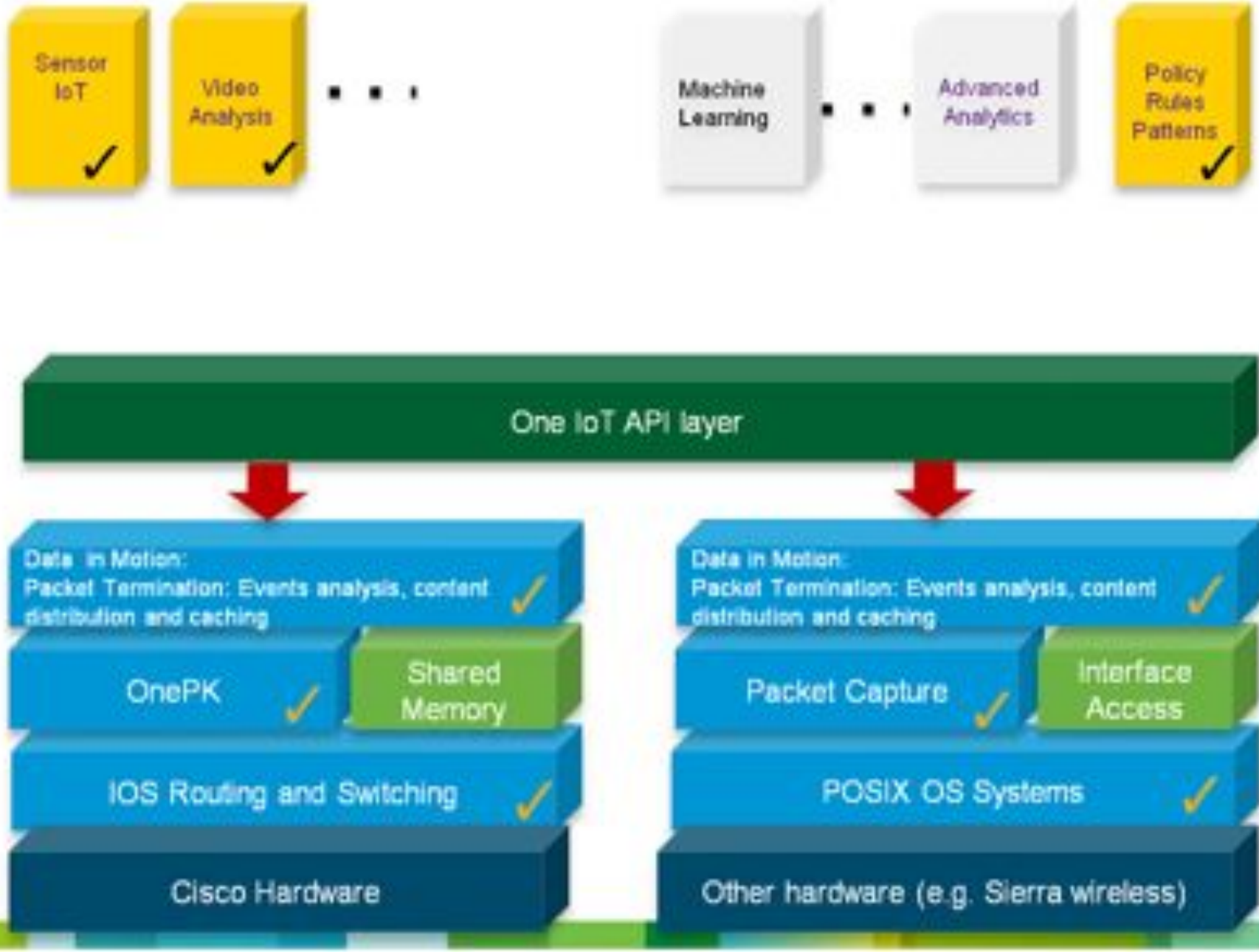
Smart Things Network

Problem Statement for OneIoT API

- To realize the potential of Internet of things (IoT), we need to program policies to listen to and detect events and then to react to them.
- To enable IoT applications, we need
  - Data Acquisition and /or analytics at the edge: In particular, we need content-centric rule application and event detection at the edge
  - A programmatic model / framework to make it easy to apply the rules and policies at scale over the sensor space.

Eclipse Proposal Krikkit: http://eclipse.org/proposals/technology.krikkit/
Registered as an Open Source project in IPCentral.

One IOT API for Data in Motion



IoT/IoE – Research Interests

Technology	What it is about in the IoT context
RFID	presence detection
Sensor networks	bridging the gap between physical and virtual worlds
Microcontrollers	computer chips that are designed to be embedded into objects
Protocols	Link Layer, ISA 100A, Wireless HART, ZigBee , lower-power radio IPv6 etc
Biometrics	Technology to recognize people and other living things
Machine vision	image-processing algorithms, distant servers can identify objects and report information about them
Actuators	detect an incoming signal and respond by changing something in the environment
Location technologies	helps people and machines find things and determines their physical whereabouts
Barcodes	optical representation of machine-readable data
Ambient technologies	electronic environments that are sensitive and responsive to the presence of people and can tailor a response based on the subject recognized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