

Presentation to Montreal Chapter

December 16, 2015

**“The Future of Collaborative
Internet of Things”**

By

Fawzi Behmann, President TelNet Management

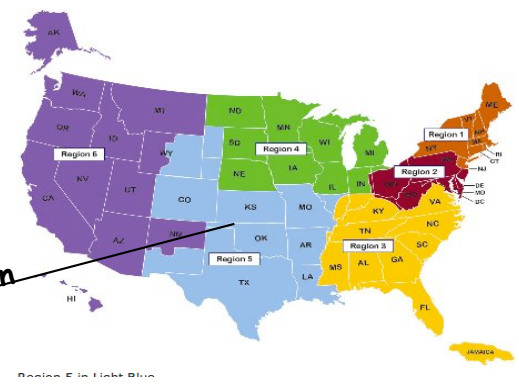
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Greetings from



R5/CTS/Austin



IEEE Communications Society Chapter Awards Program 2015



212 Chapters

ComSoc Chapter-of-the-Year Award

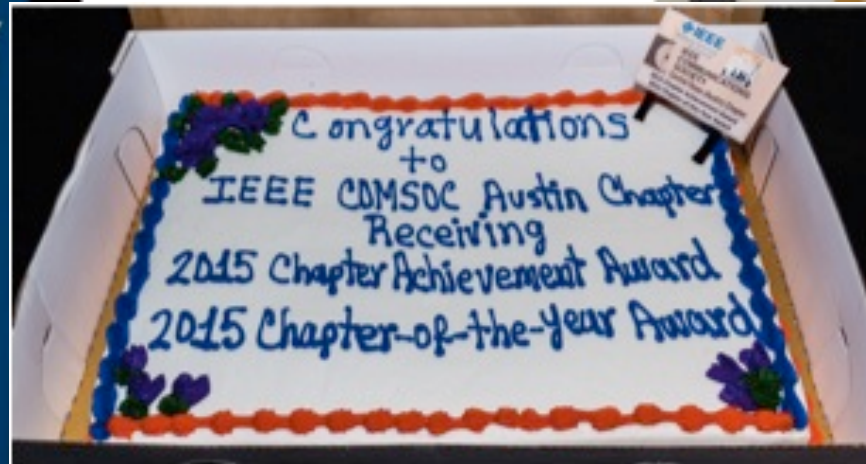
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“The Future of Collaborative Internet of Things”

Q1: What is Collaborative IoT?

Q2: What are some of the key drivers influencing the advancement of Collaborative IoT?

Q3: What are some of the key examples and benefits?

Q4: Is it too early to talk about IoT KPI (Key Performance Indicators)?

While IoT is still largely unknown amongst the general public, it is expected to make a big impact in 2015 and beyond. Estimates indicate that the number of connected devices will reach 4.9 billion this year, and various sources point out to 50-200 billion devices connected by 2020.

This presentation will provide a quick overview on the evolution of IoT, explore future opportunities that calls for innovative approach supported by industry initiatives and standards activities. The presentation will explore the need for platform to launch and accelerate collaborative IoT applications, and present a few examples addressing smart health & fitness, smart home, smart energy, smart car, smart parking, smart public safety and smart cities.

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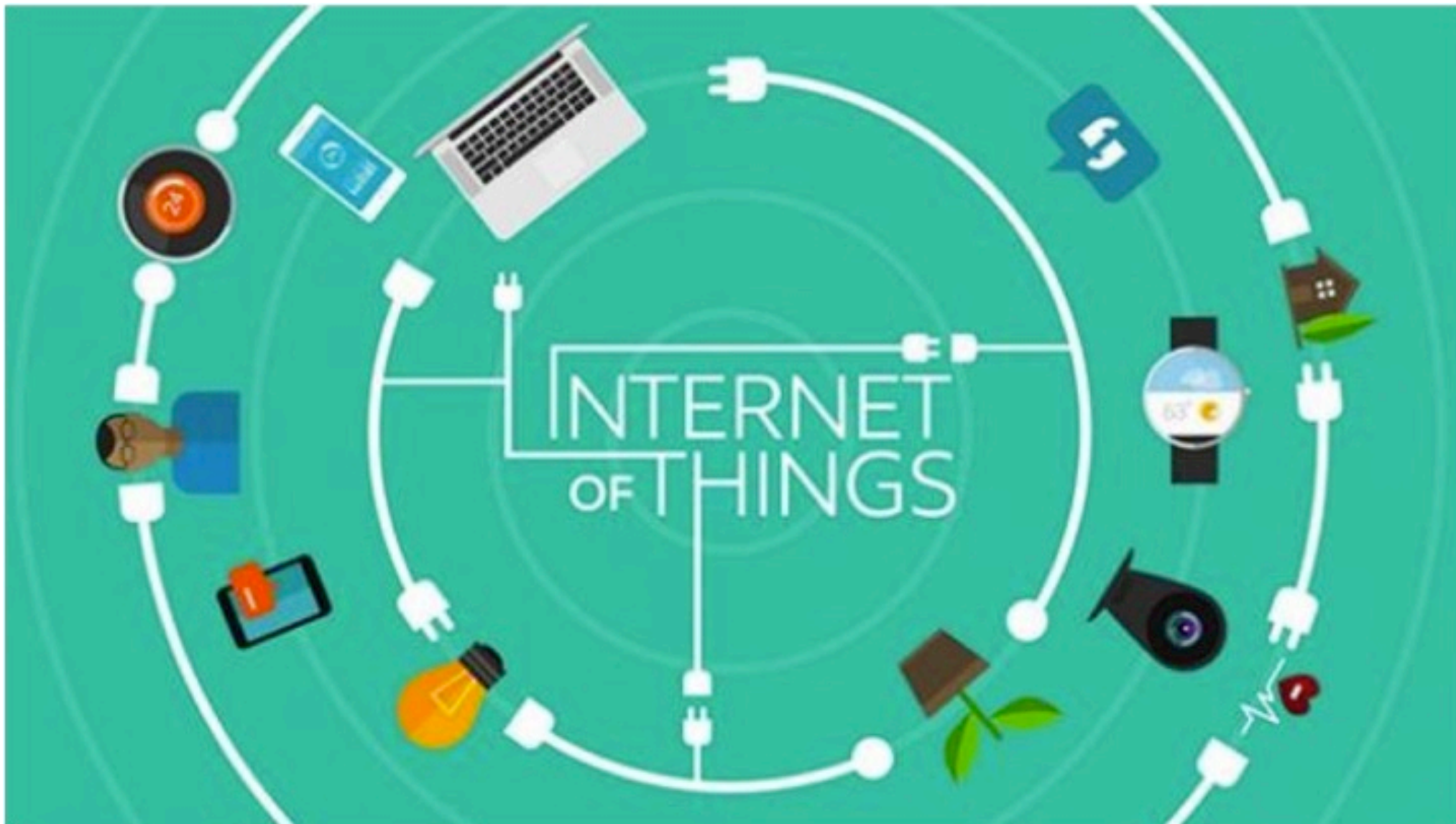


“The Future of Collaborative Internet of Things”

Outline

- Is the concept of IoT new?
 - Introduction to IoT
 - IoT Visibility in 2014/15
 - IoT Market Trends
- What are some of the key Drivers & Enablers?
 - Market
 - Technology & Standards
- IoT Examples & Benefits
 - Health & Fitness
 - Smart Home
 - Smart Connected Car, Smart Parking, Streetlight
 - Public Safety
 - Smart Cities
 - IoT Cybersecurity
- KPI for IoT
 - Summary - IoT – Disruptive Rebranding Initiative

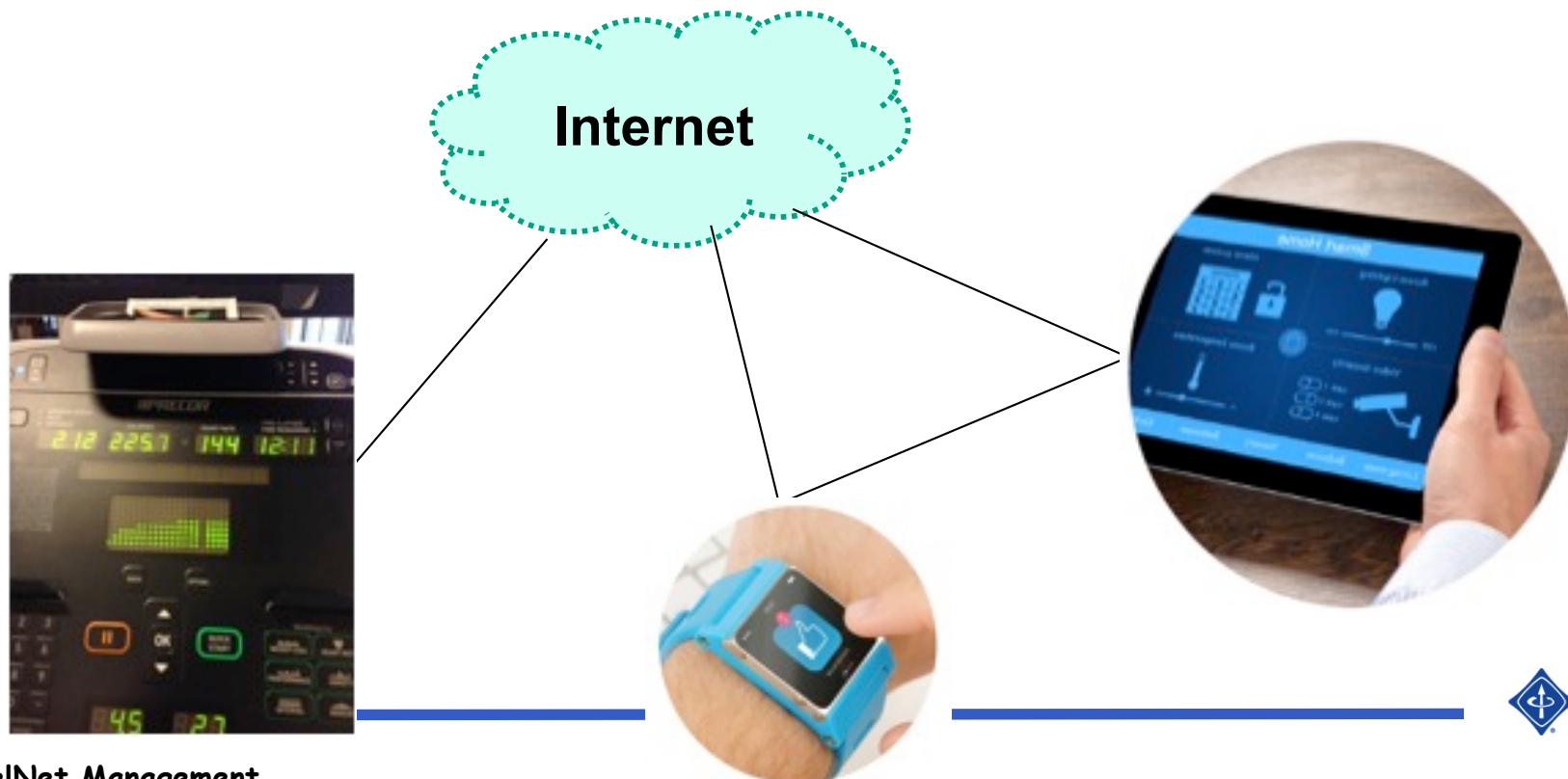
What is IoT?



What is IoT?

Definition: The Internet of Things (IoT) describes the phenomenon of everyday devices connecting to the Internet through tiny embedded sensors and computing power.

Devices are enabled to sense and transmit information online, offering consumers greater information and influence over their environment. Previously unconnected objects can now be accessed digitally and controlled from anywhere on a variety of devices, including mobile, desktop and tablets.



IoT Adoption

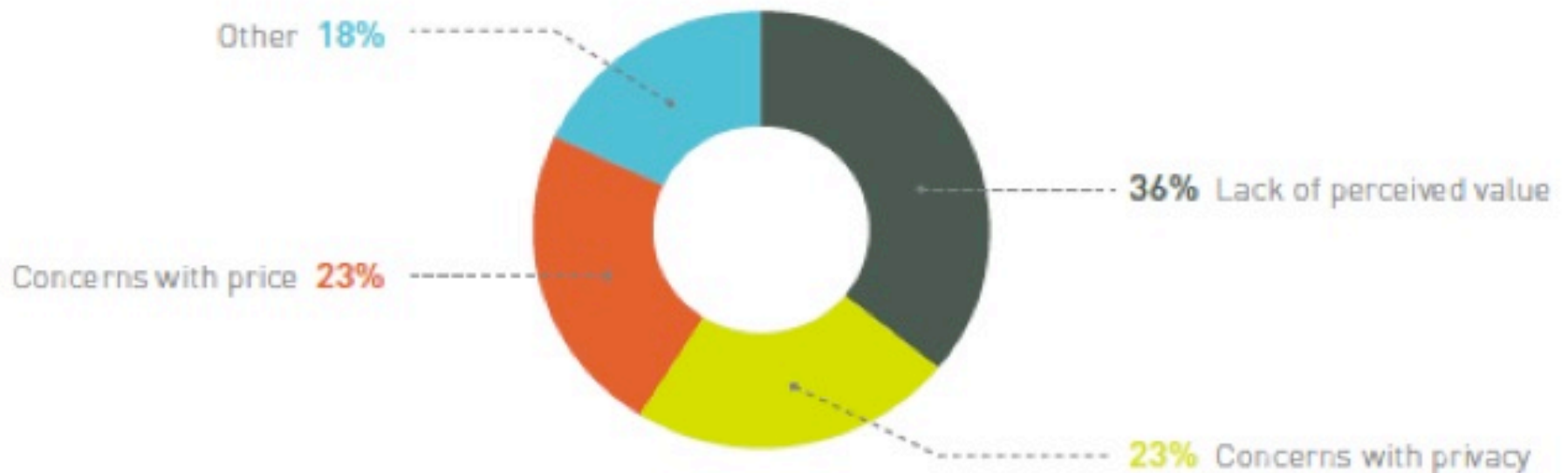
What are some of the barrier of adopting IoT?

- 1. Lack of perceived value**
- 2. Concern with price**
- 3. Concern with privacy**
- 4. Others**

IoT Adoption

Majority of Consumers Unfamiliar with “Internet of Things” and Other Barriers to Adoption

Lack of awareness is not the only barrier to adoption for in-home IoT devices. Consumers aware these devices are available for purchase said their number one reason why they haven't purchased in-home smart technology was:



IoT Visibility in 2014/2015

2014 – Many companies created division for IoT:
Cisco, Intel, Freescale, TI, Ericson, others

Great strategic Alliance to offer IoT Services:

- IBM & Apple
- IBM & AT&T
- Apple & Cisco



Microsoft Azure Service Fabric
Enables Autonomic PaaS and
IaaS Delivery for IoT?

TRENDS

amazon analytics AWS azure big data
bigdata bluemix cisco cloud
converged infrastructure coreos dell
docker emc hp hybrid cloud hyper-
converged infrastructure IaaS IBM
Internet of Things IoT Microsoft
mobile nimboxx nutanix oracle paas
private cloud rackspace SaaS sap servers
simplivity softlayer storage supermicro
vblock VCE vCloud vcloud air
virtualization virtustream VMware
vspex

IBM INVESTS \$3B TO ACCELERATE INTERNET OF THINGS (IOT) - JOINS OTHER IT AND CLOUD PROVIDERS

[April 8, 2015](#) | [VCloudNews](#) | [Leave a comment](#)

There are other IT players moving into IoT – **Oracle** has an IoT group, middleware, applications and PaaS offerings. **SAP** has been positioning **SAP HANA** as a driver for IoT.



ORACLE



Cisco has arguably been the most prominent promoter of IoT over the last several years with focus on networking products for IoT and has

also organized numerous IoT events.

IoT Definition - High Level Architecture

Service Layer

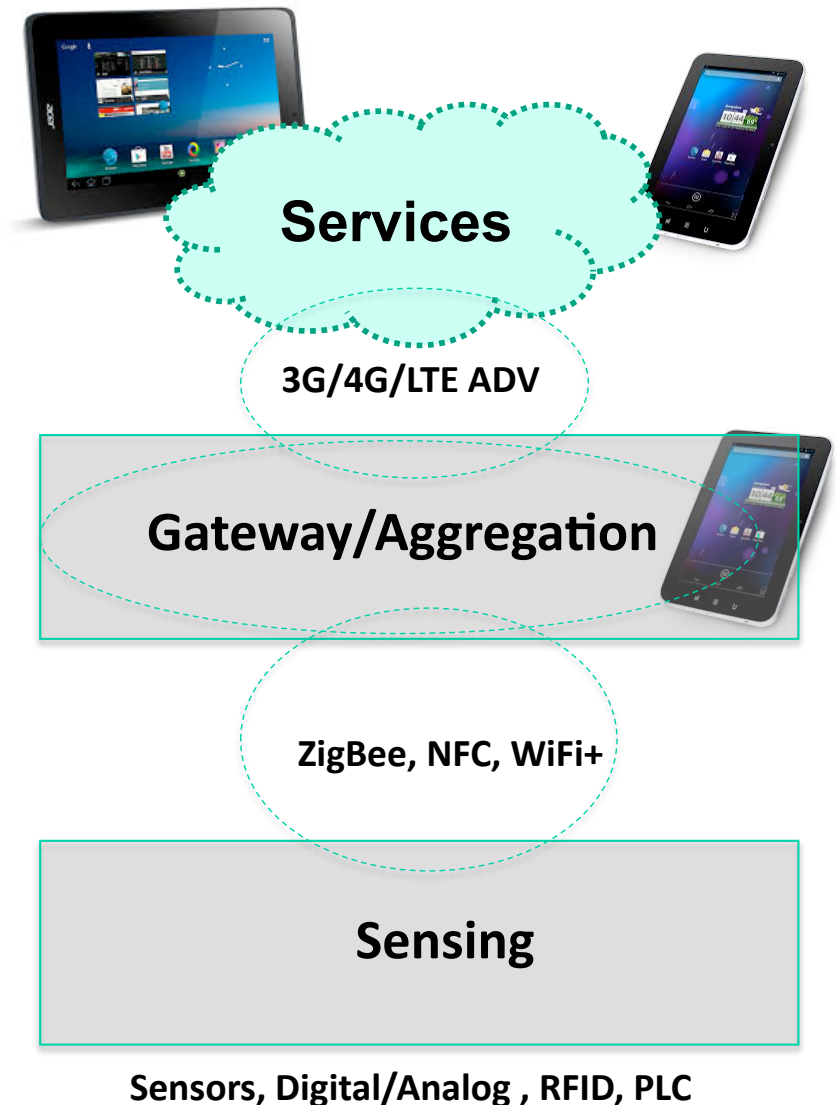
This layer provides insight to the data collected from all layers and offers the information as a service to individuals, industries or infrastructures.

Gateway/Aggregation Layer

This layer enables the stream of data to move from one level to the next for additional processing. For example, this can be for moving from a Body Area Network , Personal Area Network to Home Area Network or from a Home Area Network to Local Area Network or from Local Area Network to Wide Area Network.

Sensing Layer

This layer enables interface to objects that are currently passive, where tapping into these objects will generate a stream of pertinent data and information.

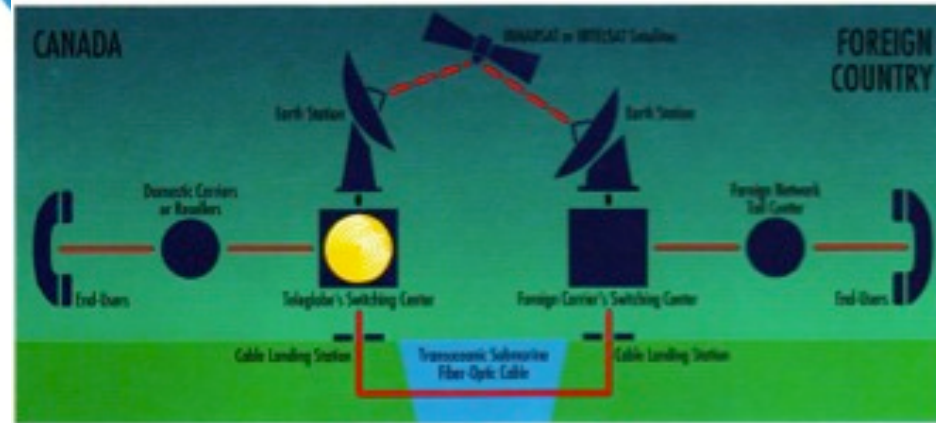


Emerging IoT in the 2010' s



Pre IoT

Telecom Space



Routing an international phone call

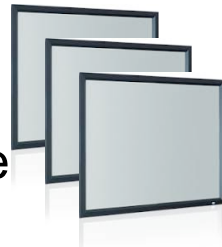


Pre IoT

Development of Network Management Systems for Teleglobe – International Carrier (1991)

Projection Screens

- Graphical views
- Service Performance



Work Stations

- TMN Functions (Multiple views)
- ACK/Control



Terminals

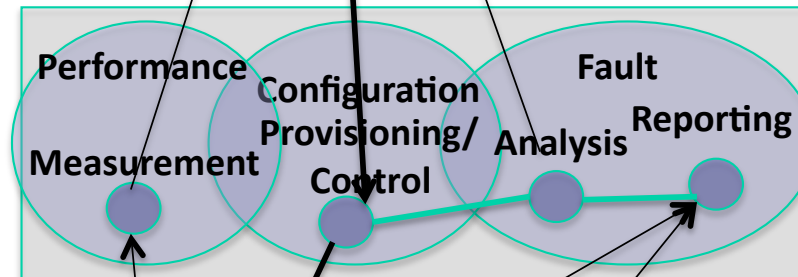
- Elements of TMN
- Sensing (analog, digital)

Supervisory



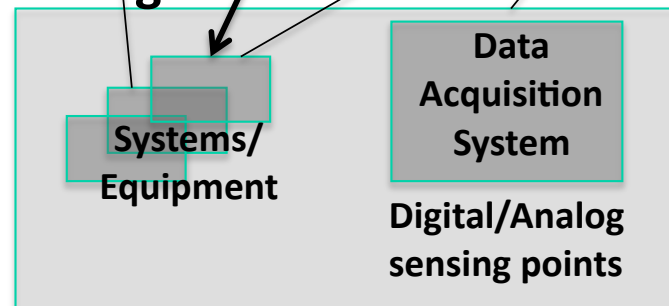
Network Control/
Analysis Center

Control



Int'l Gateways
Switching &
Transmission

Monitoring



Stations
Cable Stations
Satellite Base Stations



Pre IoT

Teleglobe Network Management Systems Data Network

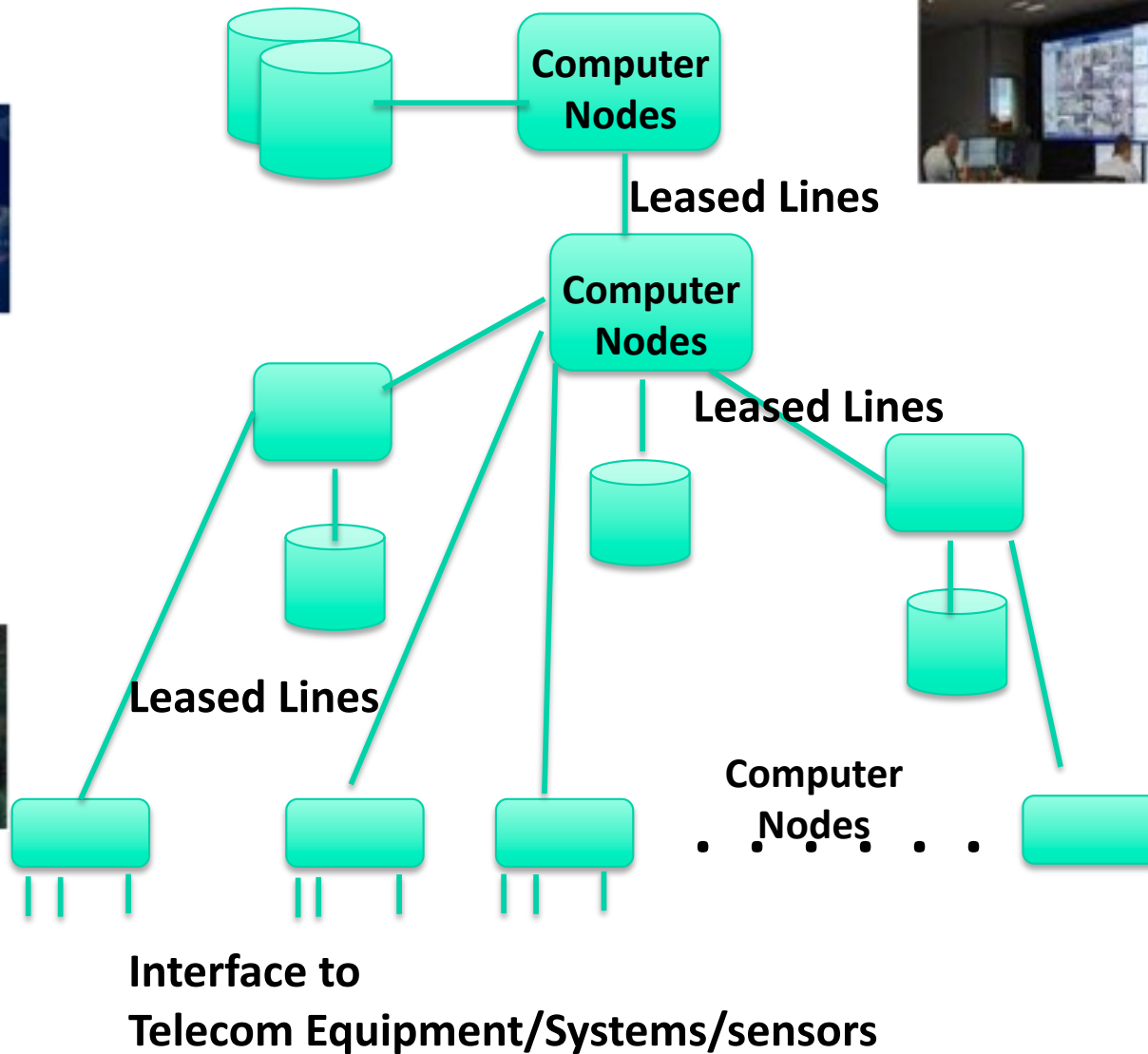
Network Control/
Analysis Center



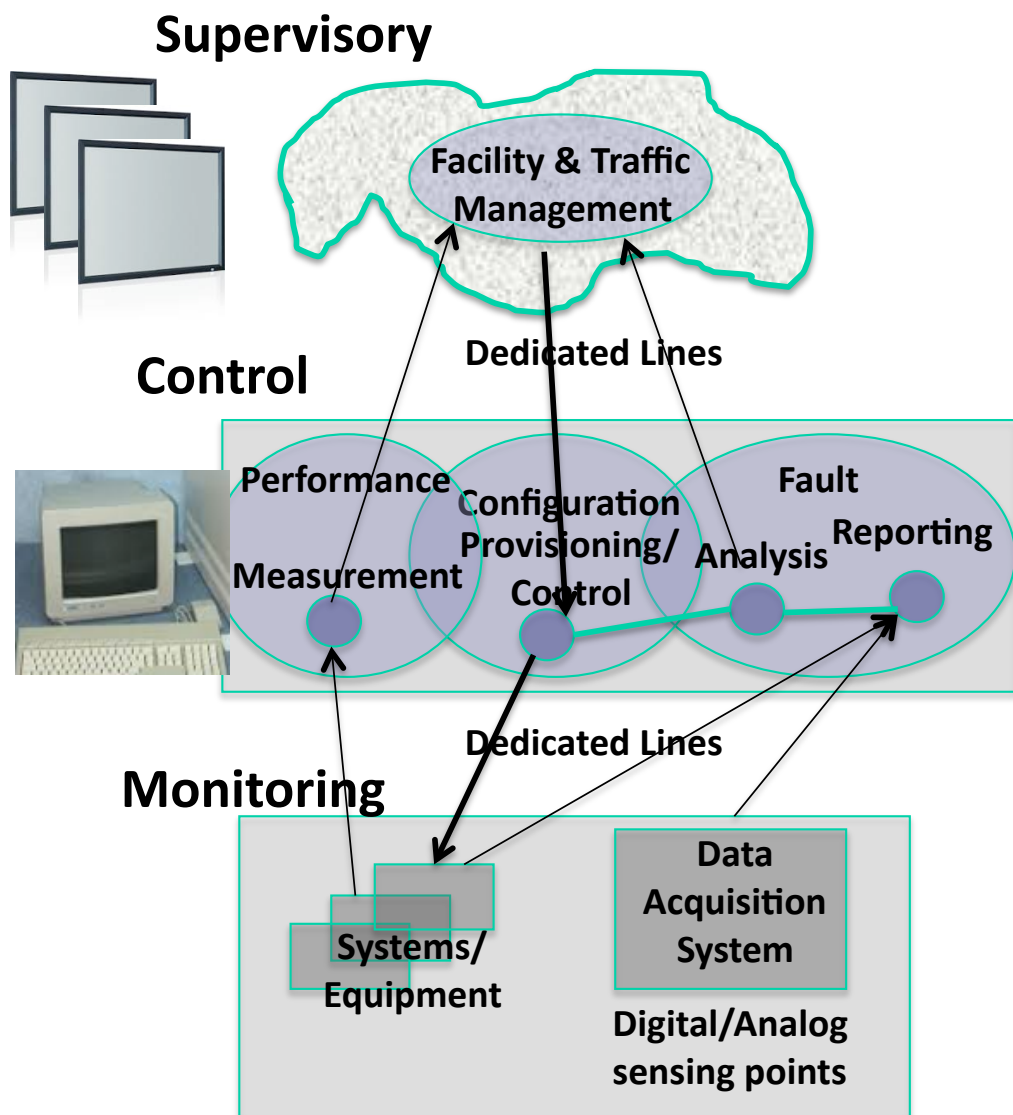
Int'l Gateways
Switching &
Transmission



Stations
Cable Stations
Satellite Base Stations



Contrast Pre IoT and Emerging IoT (Rebranding)



Example of IoT in the early 90's



Sensors, Digital/Analog , RFID, PLC
Emerging IoT in the 2010's



IoT Key Drivers – Market Growth

The most conservative independent estimates place

- 50-200 Billion connected devices by 2020.
- Spending on the IoT worldwide at \$500 billion by 2020.
- More optimistic forecasts \$15 trillion of global GDP by 2030.

Industrial Internet of Things (IIoT) Market Growth at 26.56% CAGR Forecast to 2019 in New Global Research Reports

IoT Security Market to Grow to Almost 30 Billion Dollars by 2020

By Special Guest
Dhaval Kate, Assistant Manager, ICT, MarketsandMarkets

/ August 25, 2015

http://economictimes.indiatimes.com/articleshow/48744560.cms?utm_source=contentofinterest&utm_medium=text&utm_campaign=cpps

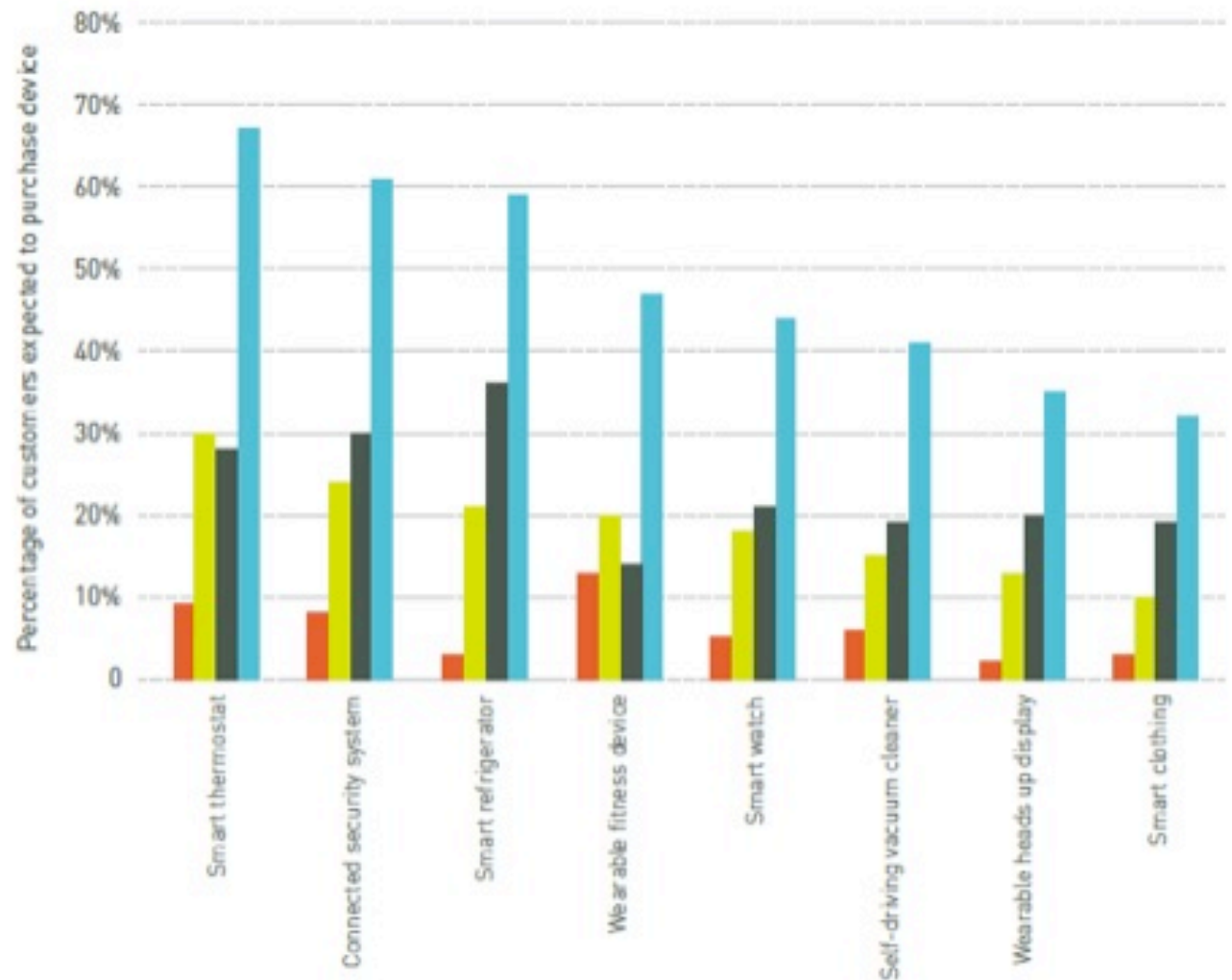
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IoT Key Drivers – Market Growth - Adoption

- In the next year
- Five years from now
- More than five years from now
- Total expected adoption

PROJECTED NEW ADOPTION OF CONNECTED TECHNOLOGY BY CONSUMERS



Wearables – Market Trends

Wearable Computing Device Shipments by Category (Millions)

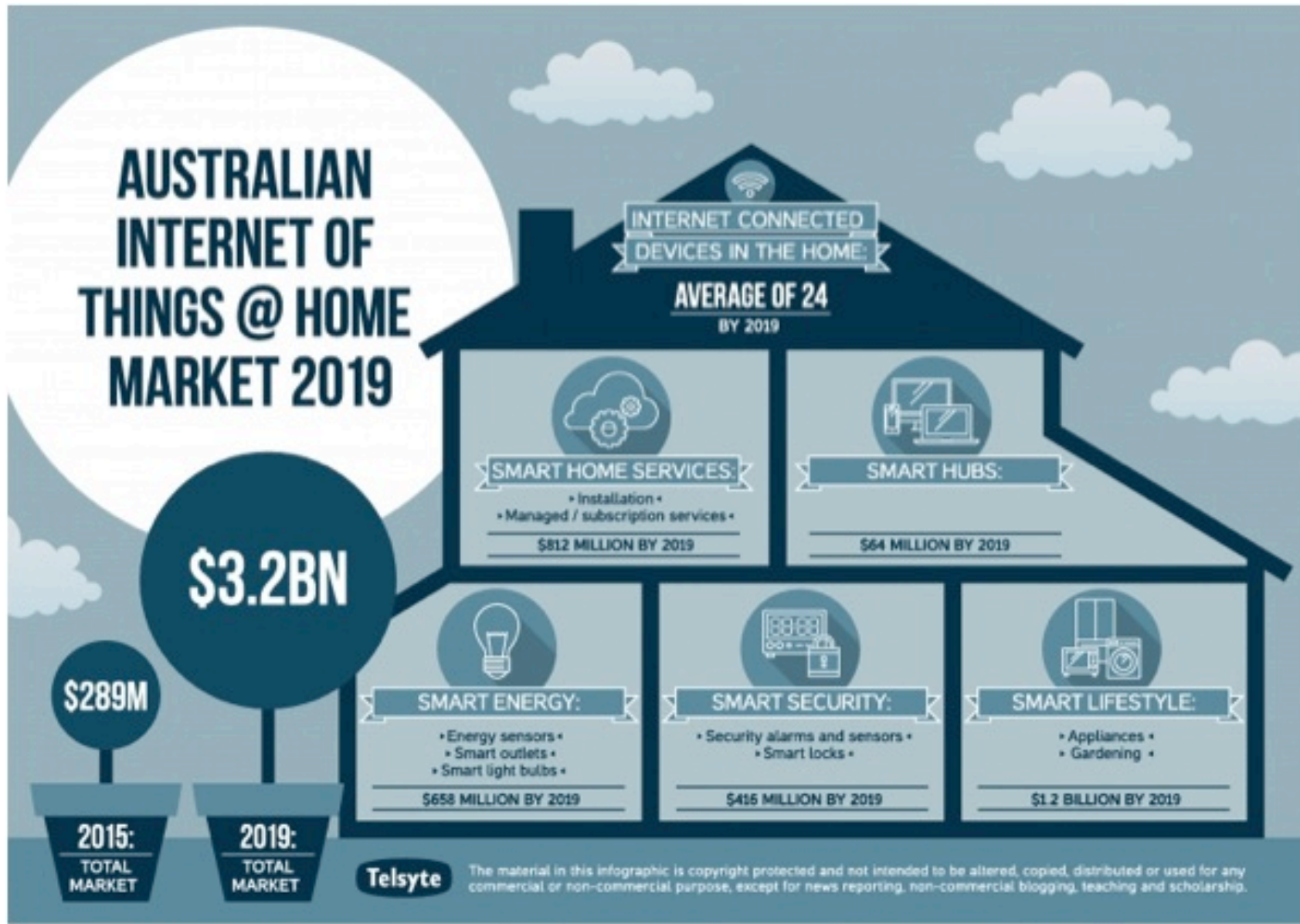
	2013	2014	2015
Wearable Cameras	6.64	13.61	15.81
Smart Glasses	0.01	2.13	10.57
Smart Watches	1.23	7.44	24.92
Healthcare	13.45	22.59	34.25
Sports/Activity Trackers	32.46	42.64	57.42
Wearable 3D Motion Trackers	N/A	0.87	2.00
Smart Clothing	0.03	0.72	1.24
Totals:	53.90	90.00	164.20

Source: Data from ABI Research World Market Forecast: 2013 to 2019

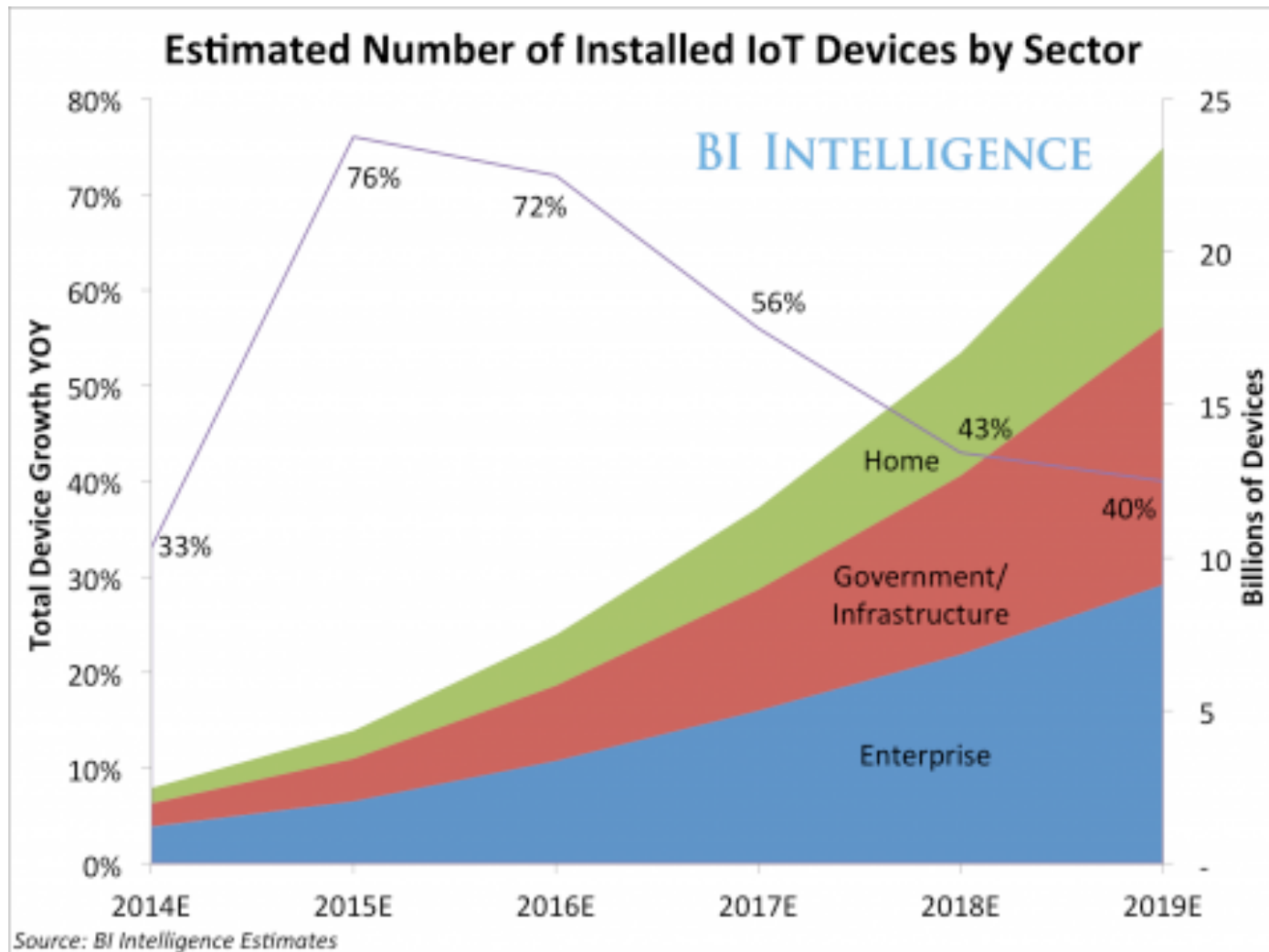


Health and fitness wearable computing devices will be a main driver of the 164 million wearable devices that are expected to ship in 2015

IoT Key Drivers – Market Growth - Country



IoT Key Drivers – Market Growth by Segment

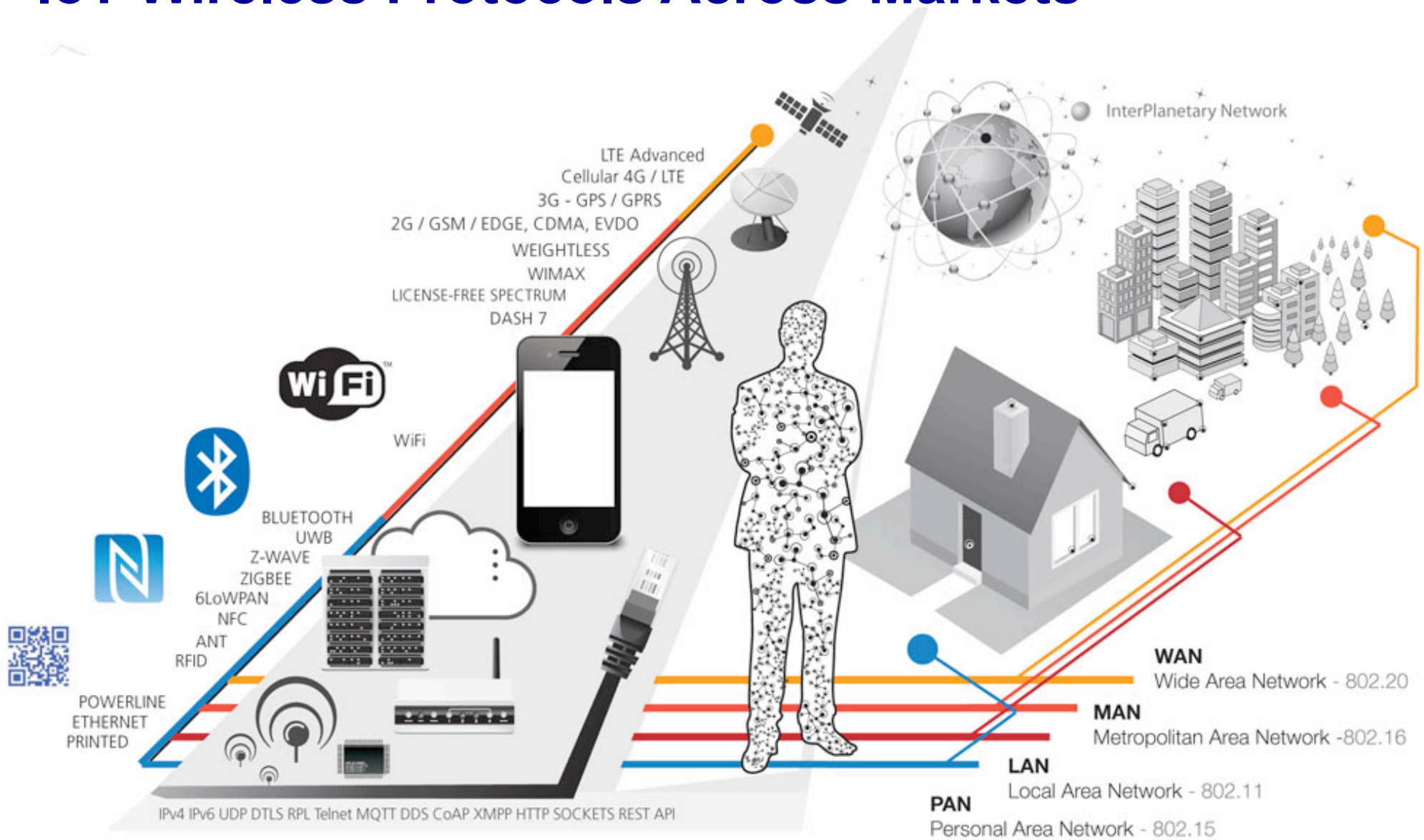


IoT Key Enablers - Standards

- **Hal Varian, Chief Economist at Google**
“Believes that Moore’s Law has something to do with the newfound interest in IoT: “The price of sensors, processors, and networking has come away down. WiFi is widely deployed, it is easy to add new networked devices. ”
- **Janus Bryzek, known as the father of sensors, VP at Fairchild Semiconductor**
“Multiple factors accelerating the surge:
 - IPv6 – enabling unlimited number of devices connected to networks
 - Cisco, IBM, GE and Amazon support IoT and add Fog layer.”
- **Bob Metcalfe, Inventor of the Ethernet**
“Technologies, standards, products and markets emerge slowly, but then suddenly the media latches on and BOOM! 2014 is the year of IoT.”
- **Wireless/Cellular advancement in WiFi and LTE**
- **Convergence of Platforms**
- **Embedded security**



IoT Wireless Protocols Across Markets



IoT Related Wireless Standards (PAN, LAN, WAN)

Wireless class	Example technologies	Range	Example uses/applicability
Wireless wide area network (WWAN)	3G, 2G, GPRS, CDMA, Ev-DO	10 km +	Used for high mobility applications that do not require large bandwidth, such as mobile telephone internet services.
Wireless metropolitan area network (WMAN)	WiMAX, Mobile Broadband Wireless Access	1 km to 10 km	Offers high data speeds and significant range. WMAN technologies are utilised primarily as wireless broadband links, such as for inter-building connections.
Wireless local area network (WLAN)	WiFi, HiperLAN	Up to 1 km	Used for applications that require high bandwidth connections at low range, such as wireless access for laptops to a corporate network from within the company's offices, or to access Internet 'hot spots' at airports, cafes, and other locations.
Wireless personal area network (WPAN)	Bluetooth, Infrared, ZigBee, UWB	Up to 100 m	Used for small devices that only require low bandwidth and little range, such as Bluetooth headsets for mobile phones.

(Fig-2 : Categories of Wireless Networks)

Wi-Fi Roadmap

802.11N	802.11AC	Advanced 802.11AC	802.11AX
2009	2012	2015	2017
450 Mbps	1.75 Gbps	3.5 Gbps	High efficiency MAC
20/40 MHz	80 MHz	Mu-MIMO	
		3x deployment density	High density and efficiency Wi-Fi

Higher Wi-Fi Deployment Density using Wider transmission bandwidths
Increases channel Congestion – Mandates LTE-U/LAA



Unlicensed & Licensed Future Considerations

**Wi-Fi AC/AD/AX
802.11-Based Technology
Unlicensed Spectrum**

**LTE Unlicensed
LTE-Based Technologies
Unlicensed Spectrum
LTE-U LAA MuLTEfire**

**LTE Advanced
Licensed Spectrum
Foundation augmented with
Unlicensed Spectrum
Solutions**

**Evolved for enhanced
performance and
expanding to new usage
models**

**Broadens LTE ecosystem to
enhanced and new
deployment opportunities**

**Mobile broadband services
for best performance and
quality-of-service**

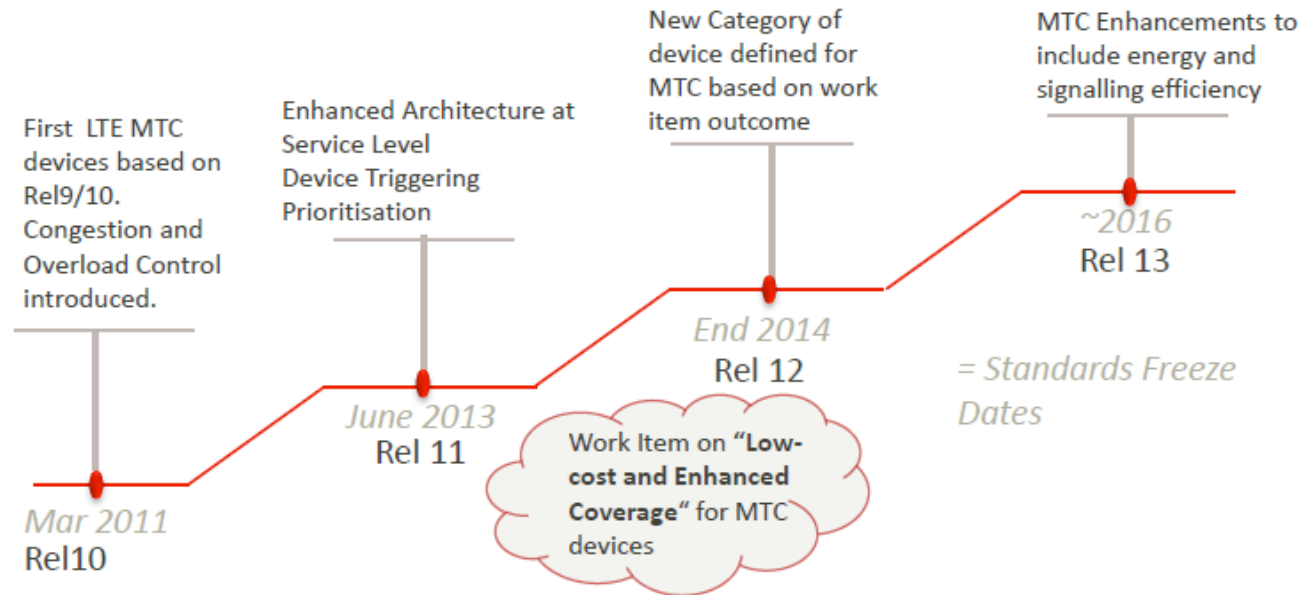
LTE is currently being adapted to work in the 5GHz bands for small cell deployments

- **Broadly called LTE-U**
- **License Assisted Access (LAA) is currently main effort in 3GPP (for release 13)**



IoT Related LTE Standards Roadmap

LTE Machine Type Communications (MTC)



Study Item for low-cost, enhanced coverage, for MTC recommends:

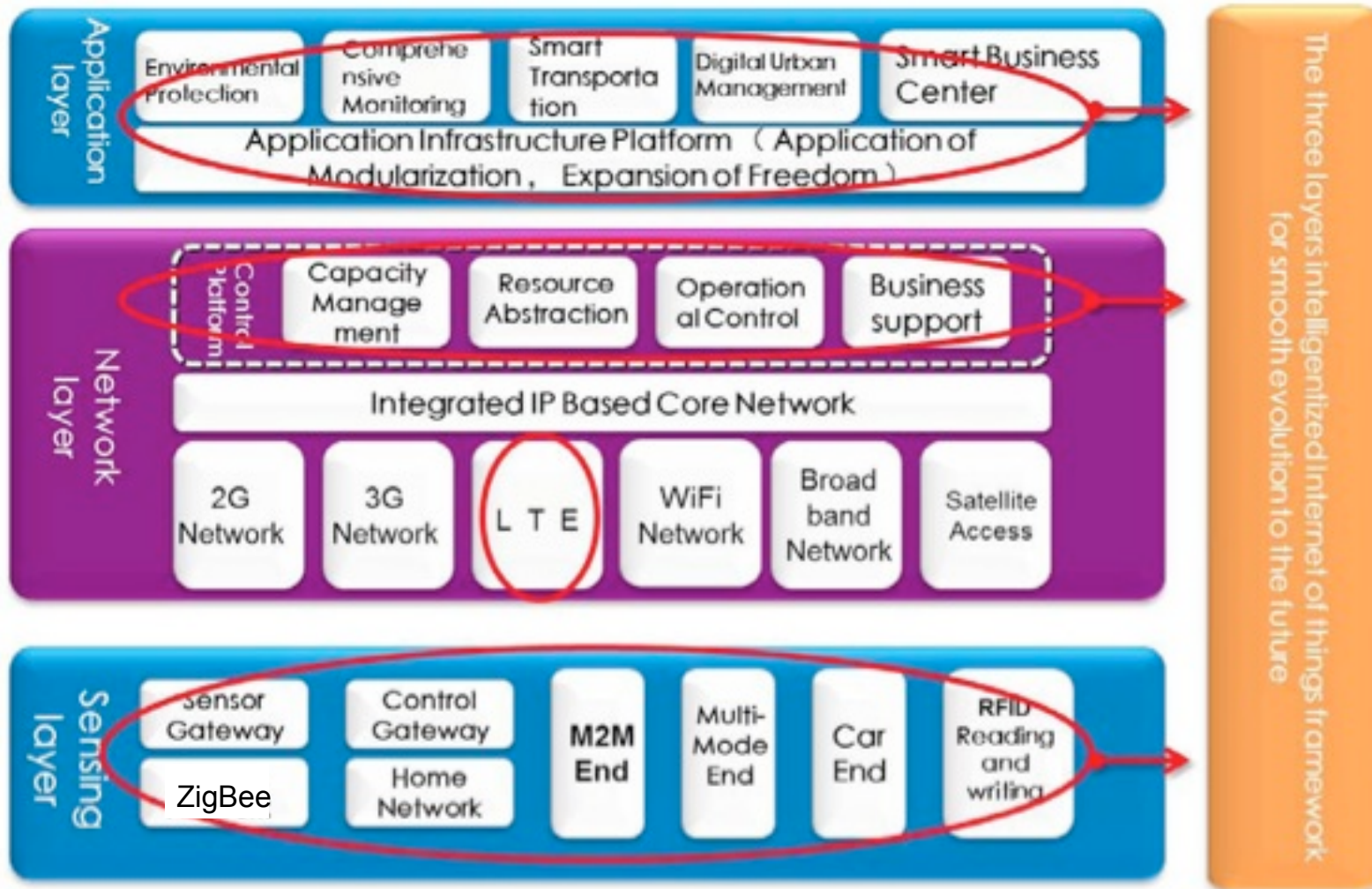
- Single receive antenna for MTC devices
- Reduced peak data rate of 1Mbps
- Reduced bandwidth with baseband data channel of 1.4MHz
- Coverage Enhancement of 15dB
- Further cost-reduction available with half-duplex

New Technology – Enabler for the New Service

- New technology which help to reduce the OPEX/CAPEX, also gives the possibility for introduction of the new services
- Recent Technology developments:
 - NFV (Control plane/User plane): Network is changed from entities to functions. The scope of the NFV is beyond the entity virtualization and ties to network and services.
 - SDN (User Plane): Complex routing logic can be centralized and updated based on the service requirement. Provides possibility for having one common switching layer for all services.
 - Distributed DB (Data plane): An autonomous and distributed data service layer, which can be deployed, scaled and evolved independently from the rest of the system, provides necessary data availability, reliability and recovery.



Evolved IoT Platform



IEEE IoT Thought Leadership:

Newsletter & Publications

➤ IEEE IoT Newsletter

- Bi-monthly, technically focused electronic publication highlighting important IoT-related technology developments, innovations, and trends from the world's top subject matter experts, researchers, and practitioners

➤ The Institute Special Report: The Internet of Things, March 2014

➤ Internet of Things Journal

- Four issues; 33 papers

➤ IEEE Xplore Digital Library

- ~125,000 Internet-related documents



Creating an Ecosystem Through Standards: IEEE P2413

- P2413 intends to consider a very broad range of verticals and stakeholder groups
- The architectural framework defined in this standard will promote cross-domain interaction, aid system interoperability and functional compatibility, and further fuel the growth of the IoT market
- Establish liaisons with other standardization bodies
 - for example IEC (e.g. Smart Manufacturing, Smart Grid), ETSI oneM2M and ISO (e.g., Intelligent Transportation Systems, e-Health) on IoT matters



IoT Examples - Health & Fitness

- Capture the data
- Store the data
- Graph the data
- Analyze the data



Given:

- Speed
- Elevation
- Time

Basic Indicators:

- Distance
- Calories
- Heart Rate

Treadmill

Muscle Built ?

Fat Burning ?

Sudden increase in HR trigger a medical alert ?

Vital Signs:

- Temperature
- Systolic Blood pressure
- Diastolic Blood Pressure
- Respiratory rate
- ECG

Stress ?

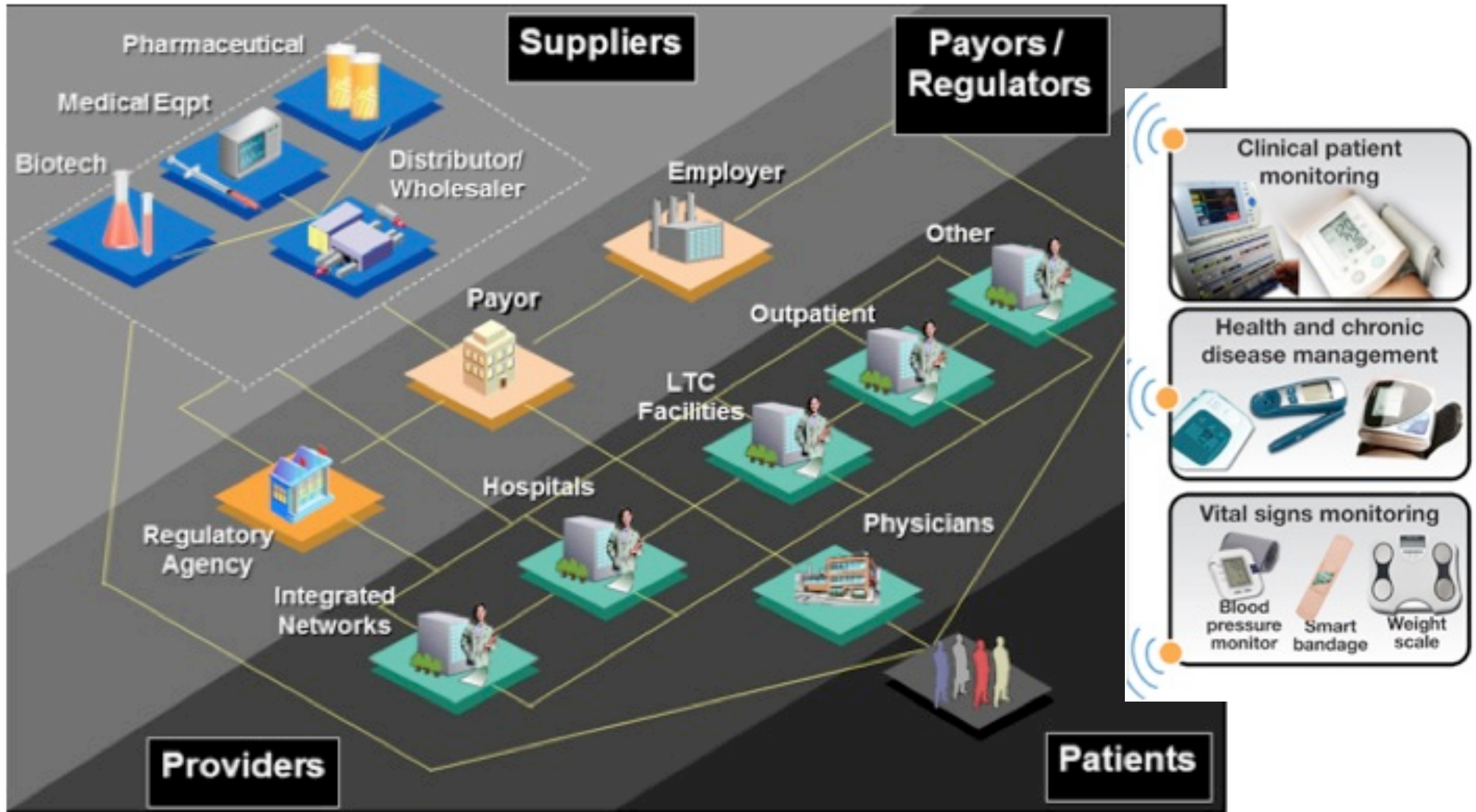
Hypertension?

Arrhythmia (irregular heartbeat) ?

Some of the technology is currently available for medical clinics and hospitals.



IoT and Healthcare Value Chain Benefits - Improve Process and Services



IoT Health & Fitness Benefits



Wellness, engagement, and organizational environment

- General health education
- Preventive screenings
- Health risk appraisals
- Immunizations
- Participation incentives
- Team games and challenges
- Health fairs
- Value-based benefit design
- Firm environment, e.g., healthy eating choices, walking paths, company gym
- Workplace policies

No risk to low-risk



Risk reduction

- Targeted education and communications
- Biometric screenings
- Disease-specific risk assessments
- Health coaching, risk avoidance
- Self-care tools and education
- Telephonic and online information and care coordination
- Lifestyle management
- Participation incentives

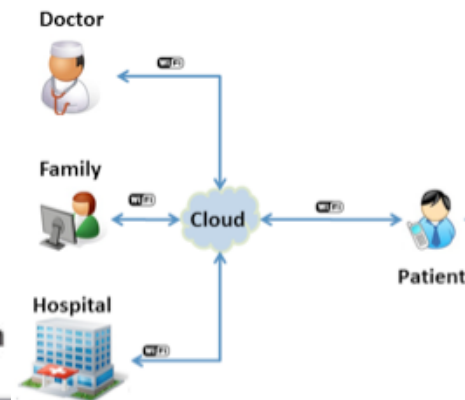
At-risk to medium-risk



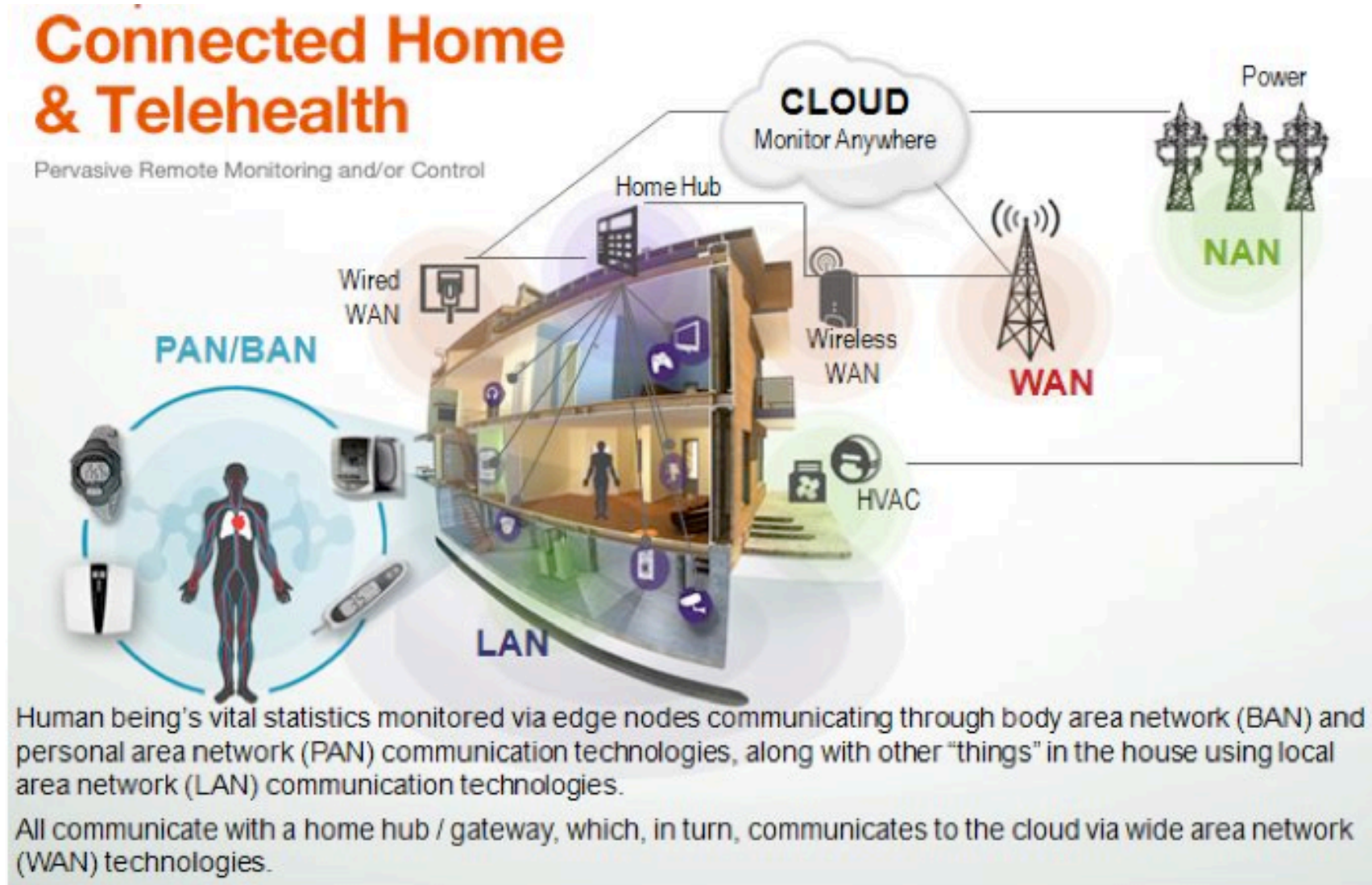
Health condition management

- Disease management programs
- Lifestyle management
- Evidence-based treatment and supports
- Case management/ coordinated medical decision making
- Outcomes-based incentives for adherence and achievement
- Employee assistance programs
- Worksite changes, e.g., ergonomic evaluations

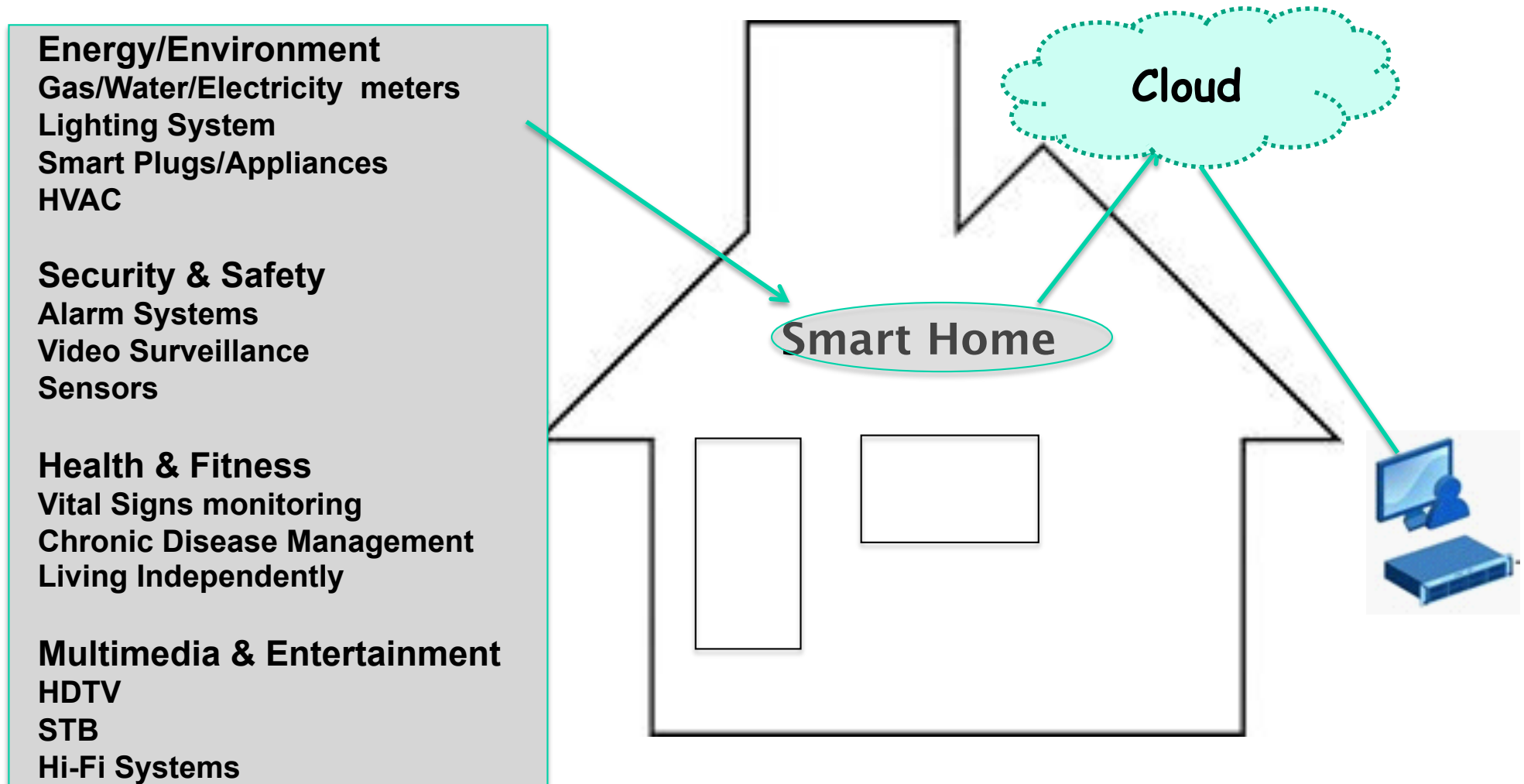
High-risk



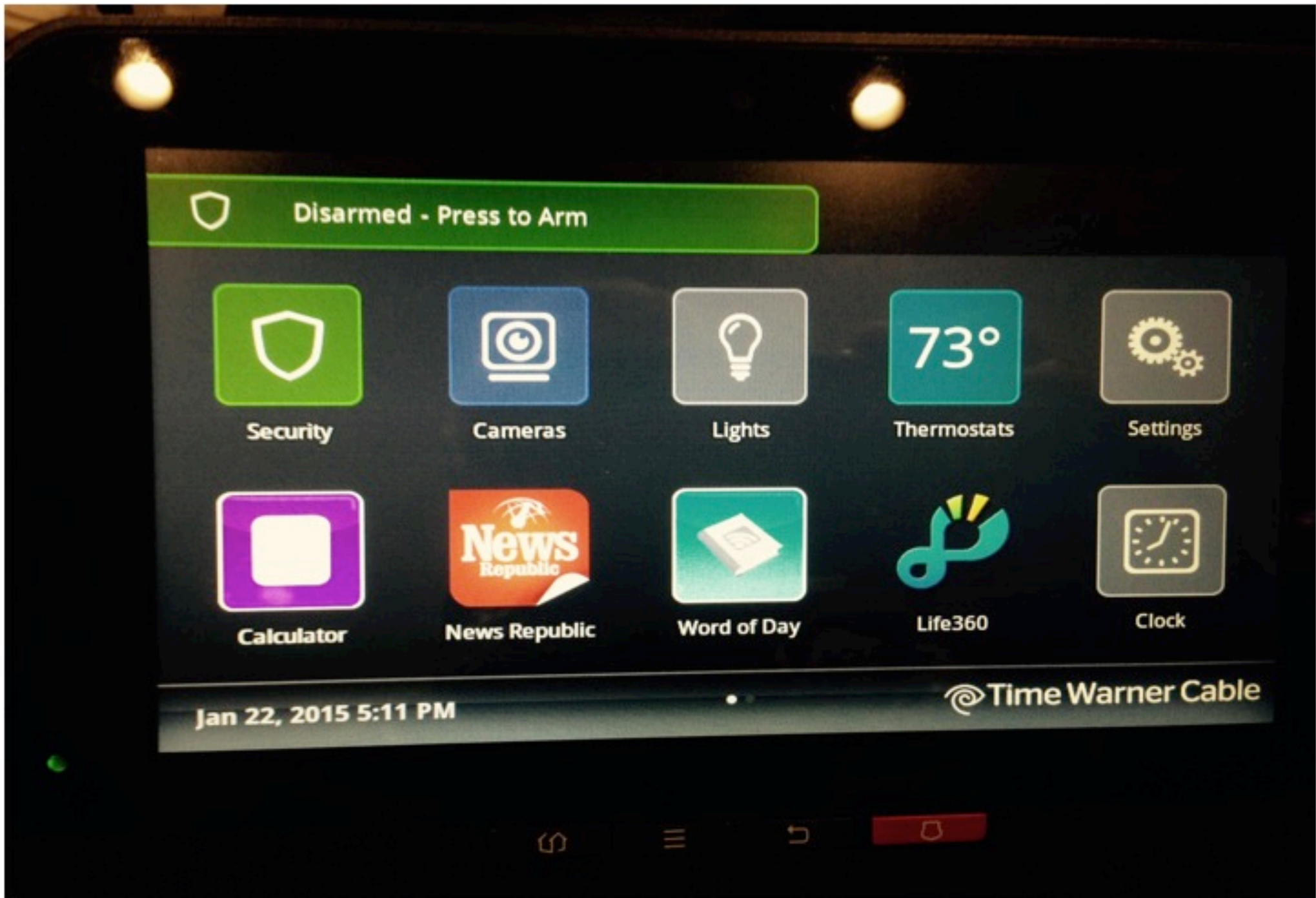
IoT Examples - Smart Home Health & Fitness



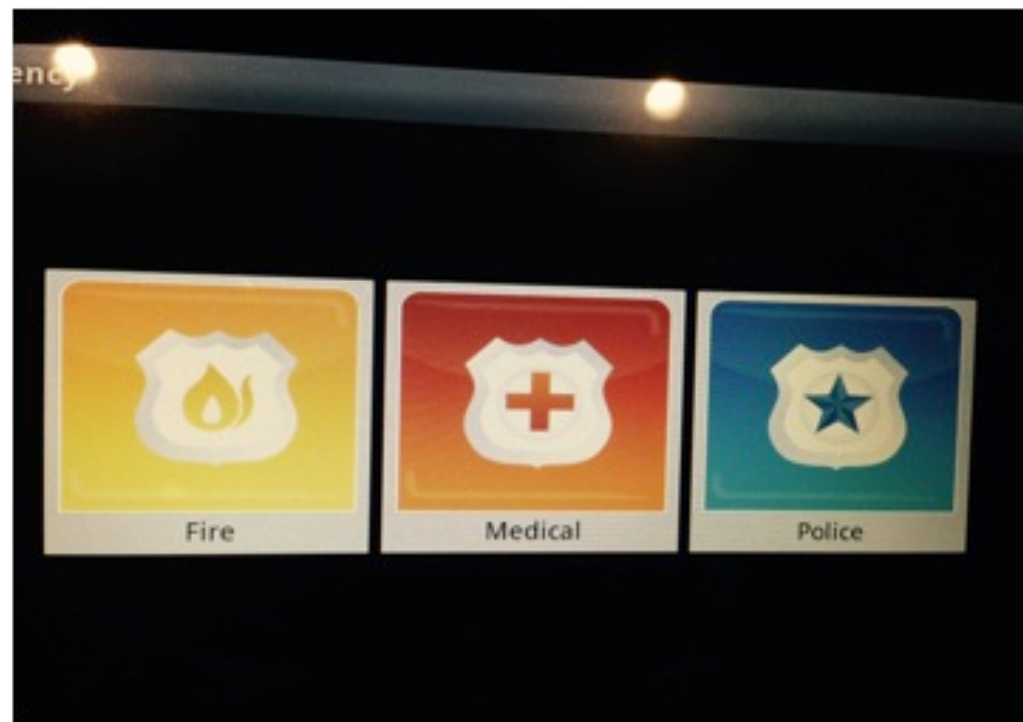
IoT application - Smart Connected Home



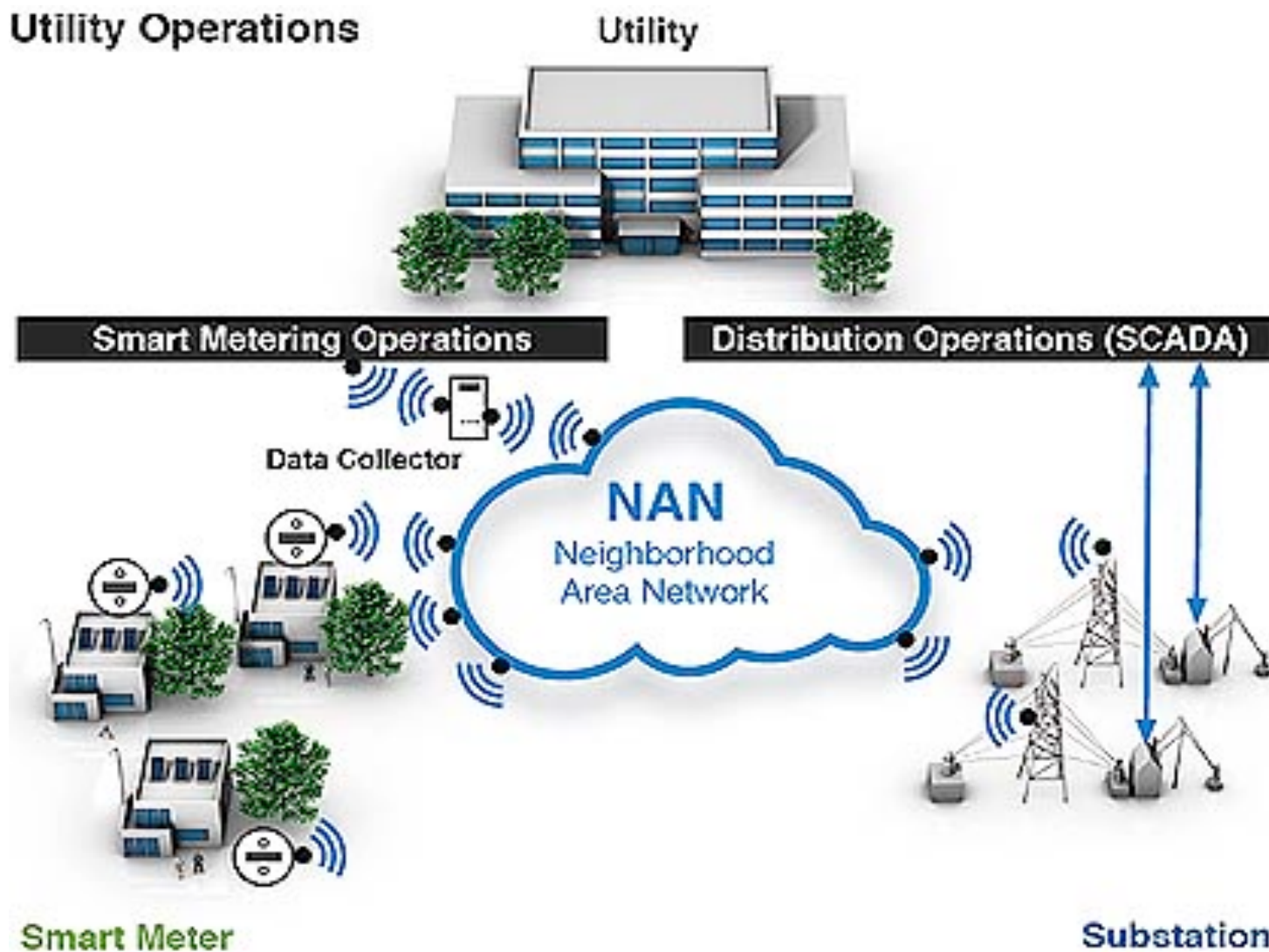
IoT Examples - Smart Connected Home Services



IoT Examples - Smart Connected Home Services

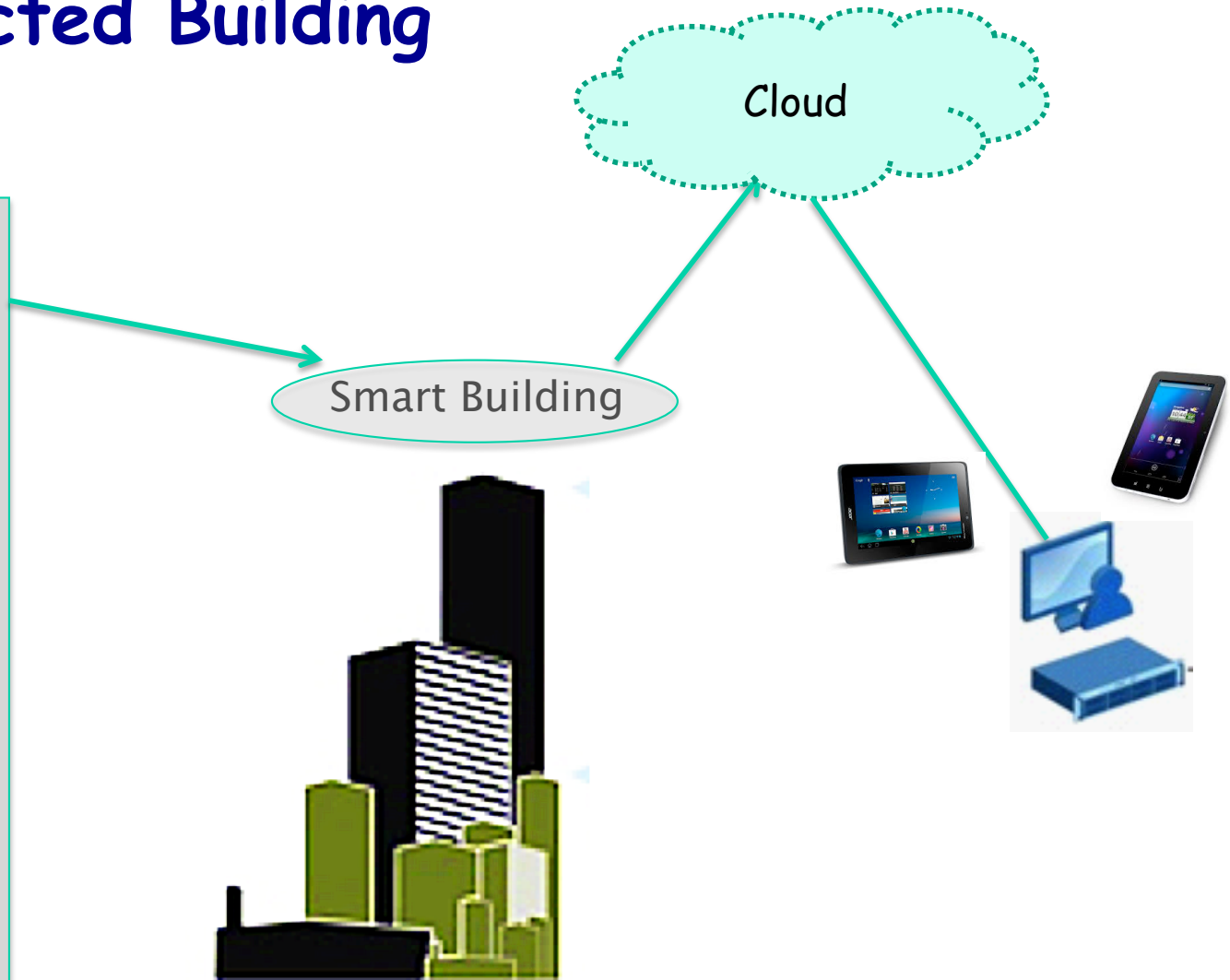


IoT Smart connected Homes - Smart Energy



IoT application requirements and Solutions - Smart Connected Building

- HVAC Control: heating (electric, gas), ventilation, air conditioning,
- Lighting control,
- Smoke detector & Sprinkler System,
- Access Control,
- Data Network, VOIP,
- A/V System,
- Wireless Systems,
- Facilities.



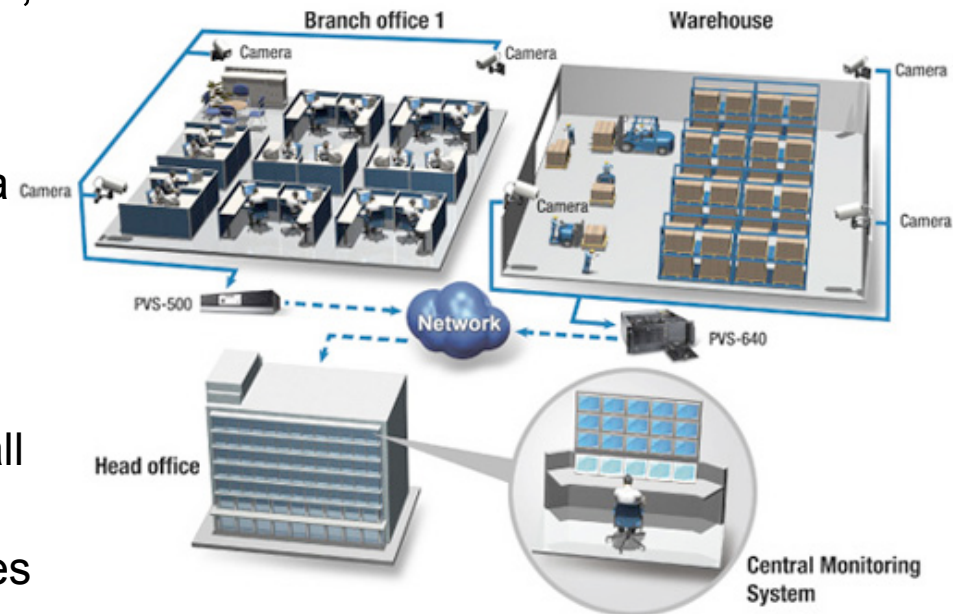
IoT application requirements and Solutions – Smart Building

System Requirements

- Resilient backbone supporting multiple head-ends for data recording, network management, disaster recovery
- Bandwidth
 - Higher resolution images mean higher data rates.

Video Surveillance Across Key Markets

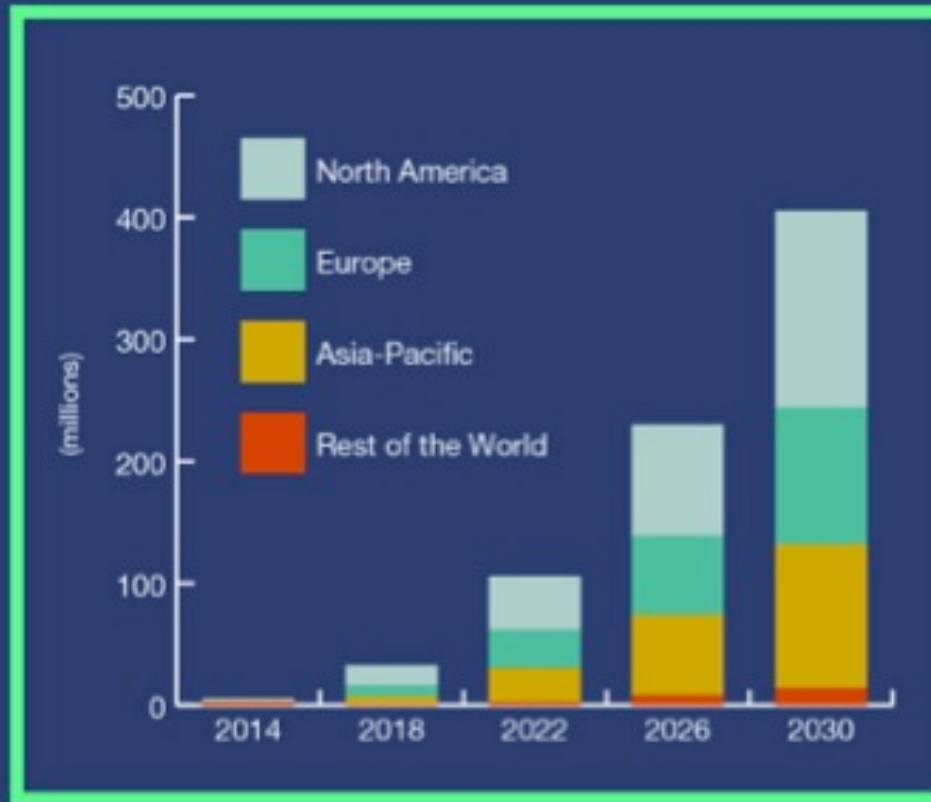
- Security
 - Configure high-security authentication on all camera-connected ports
 - Configure switches to send alarm messages if cameras are ever unplugged
- Video Analytics
 - Create custom criteria based alerts
 - Send Alerts to you mobile device
 - Technology advancement to smart camera for facial recognition, license plate recognition, compare images,..



IoT Adoption – Smart connected Vehicles

Registered Vehicles with IoT Application by Region

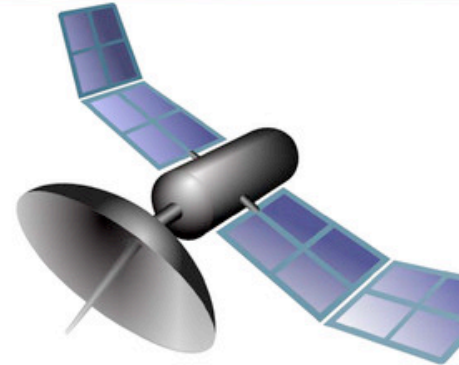
World Market, Forecast: 2013 - 2030



Source: ABI Research

IoT Smart Connected Cars

Future Opportunities: The Connected Car



Communication
Telematics
Information
Location
Social networking
eCommerce



41

IoT Smart Connected Cars

DSRC Technology

Dedicated Short-Range Communication

- Ad hoc networking technology that allows vehicles to communicate with each other, roadside devices, pedestrians, bicycles, trains,
- IEEE portions also called WAVE (Wireless Access in Vehicular Environments)

V2X Communications

- Long range sensing
- Non line-of-sight capability
- Collaborated driving

V2I

- Red Light Violation Warning
- Curve Speed Warning
- Stop Signal Gap Assist
- Reduced Speed/Work Zone Warning
- Pedestrian in Signalized crosswalk

Warning

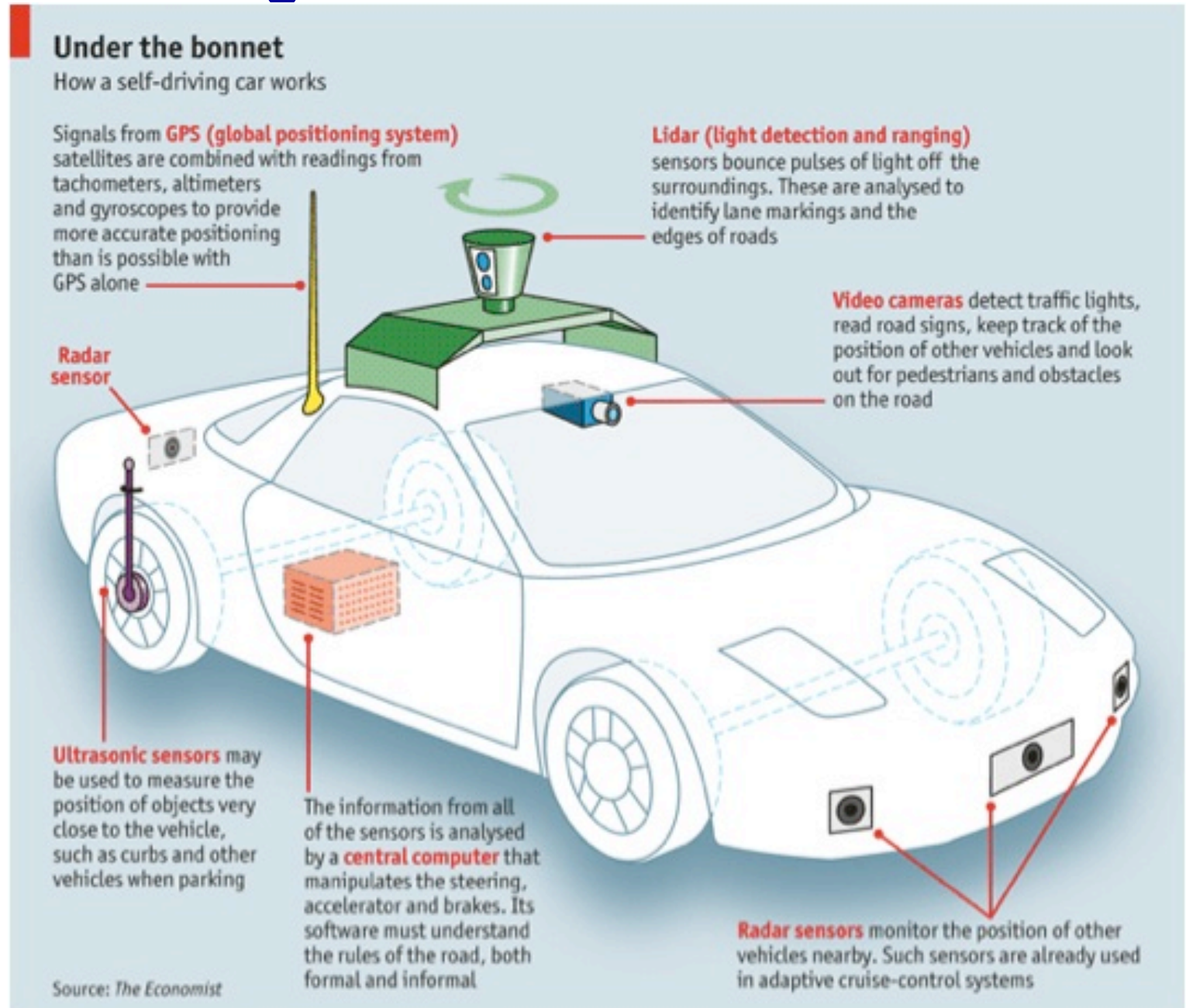
V2V

- Emergency Electronic Brake Lights
- Forward Collision Warning
- Intersection Management Assist
- Left Turn Assist
- Blind Spot/lane change warning
- Do not pass warning



IoT and Self-Driving Cars

Capable of sensing the environment and navigate without human input.



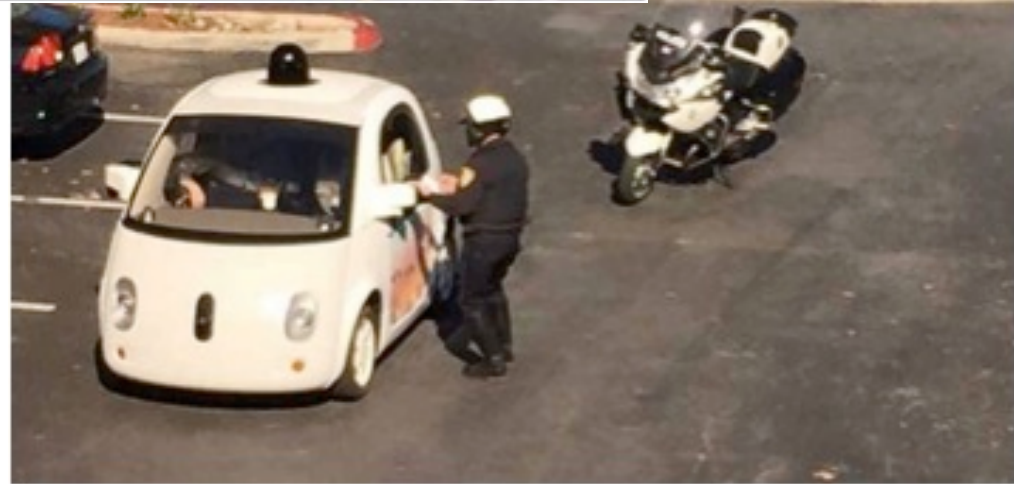
Self-Driving Cars even in difficult situations



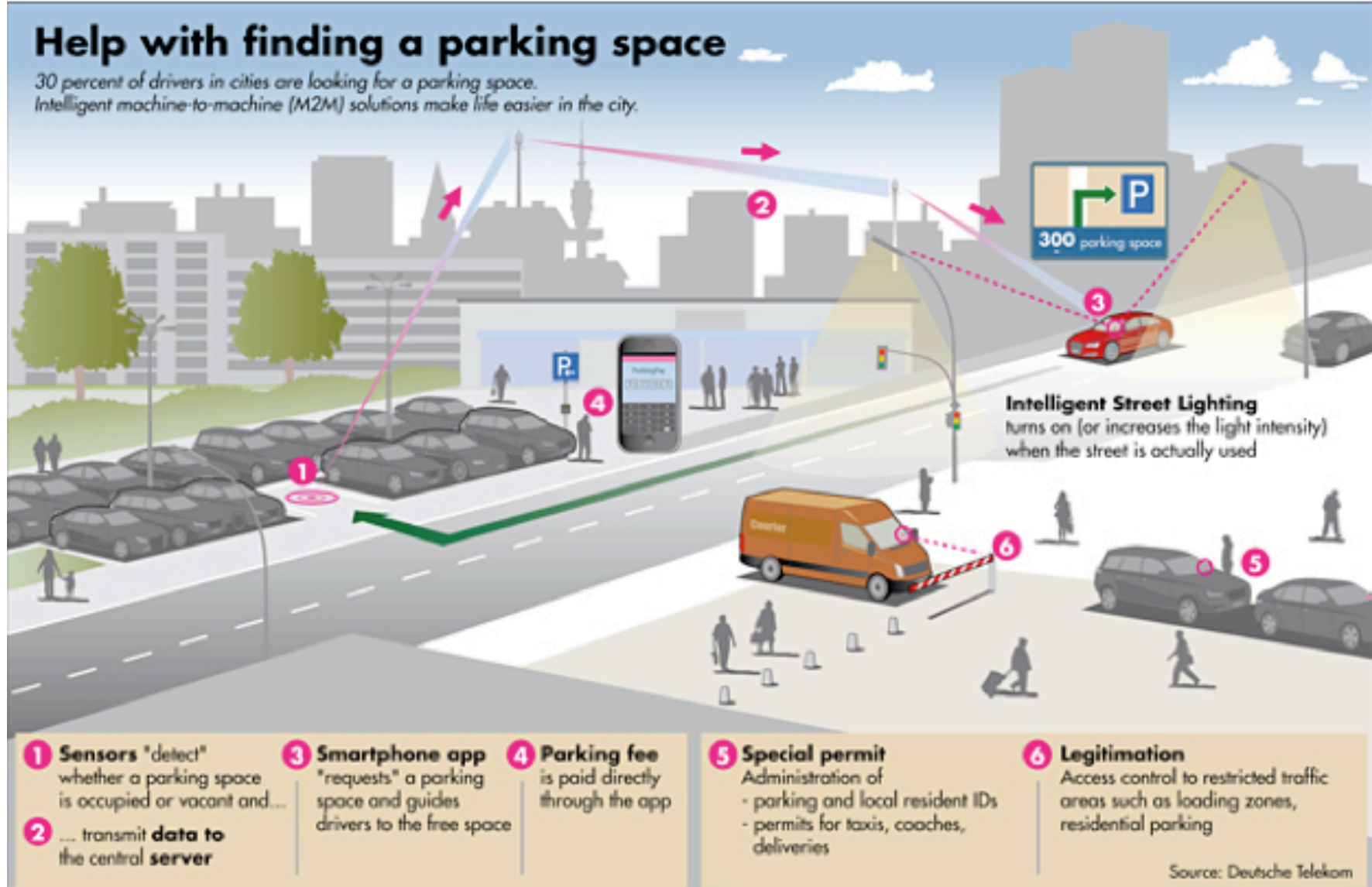
Self-Driving Cars even in difficult situations



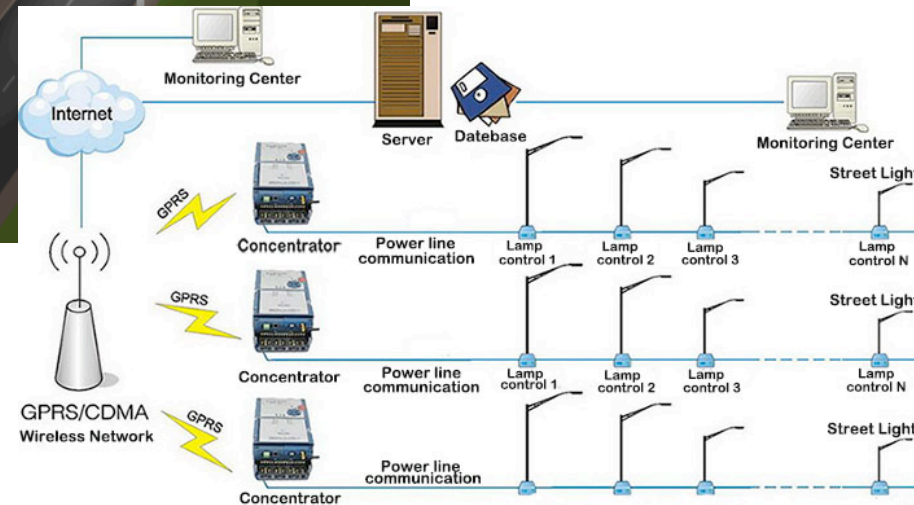
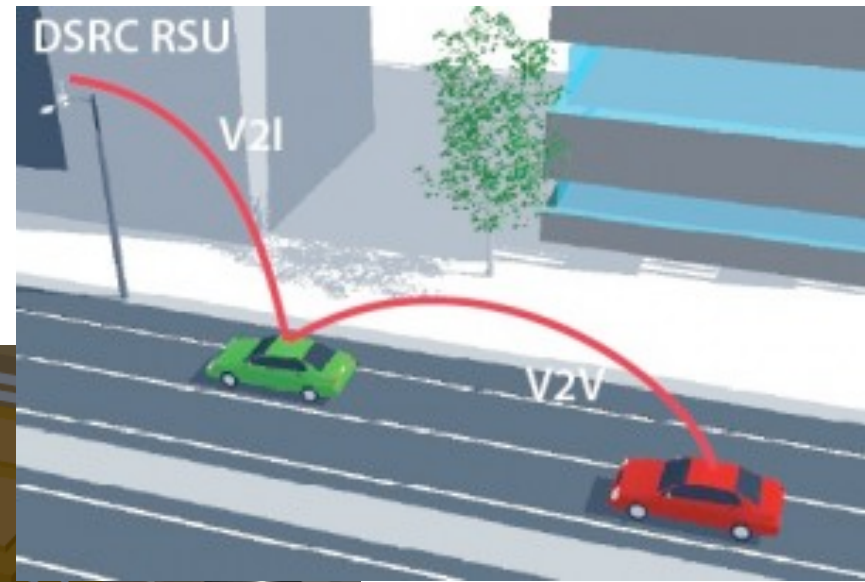
OOPS



IoT and Smart Parking



IoT Intelligent Public Safety



IoT and Smart City

The Internet of Things

Smart City – A Combination of Vertical Solutions

- Smart Transportation & Public Transport
 - Smart Ticketing
 - Signage
 - Geo-Services
 - Communication Gateways
 - ...
- Public Safety & Security
 - Surveillance & Security
 - Emergency Services
 - Public Infrastructure
 - ...
- Smart Well-being
 - Healthcare
 - Elderly living
- Smart Energy / Smart Grid
- Smart Building
- Smart Water Management
- Smart Retail
- ...



IoT Security Features

- Secure boot
 - Ensure that firmware has not been altered
- Secure code updates
 - Ensure that malicious code cannot be introduced into the system
- Data Security
 - Prevent unauthorized access, encrypt data storage and encrypt communication
- Authentication
 - Use strong password
- Secure communications
 - Use encrypted communications (e.g. SSL)
- Protection against cyber attacks
 - Embedded firewalls
- Intrusion detection and security monitoring
 - Monitor and detect invalid login
- Embedded security management
 - Security policies update to mitigate against known threats
- Device tampering detection
 - Device tampering detection capabilities

Source: Design World 2015



IoT Adoption/Value Model

Fitness & Health

- Sports Games
- Gyms
- Medical Clinics
- Homes - Alerts

Smart Industry (smarter products & services)

- Smart homes/buildings
- Smart cars
- Smart factories
- Energy Source: Solar, Electricity, Wind,..

Smart Infrastructure – Smart City

- Smart Transportation
- Public Safety
- Smart Energy (smart grid end-to-end)
- Smart Environment

Value Proposition

Quality of life

Smart Business Operations
Process efficiency
Smarter decisions
(supply chain)

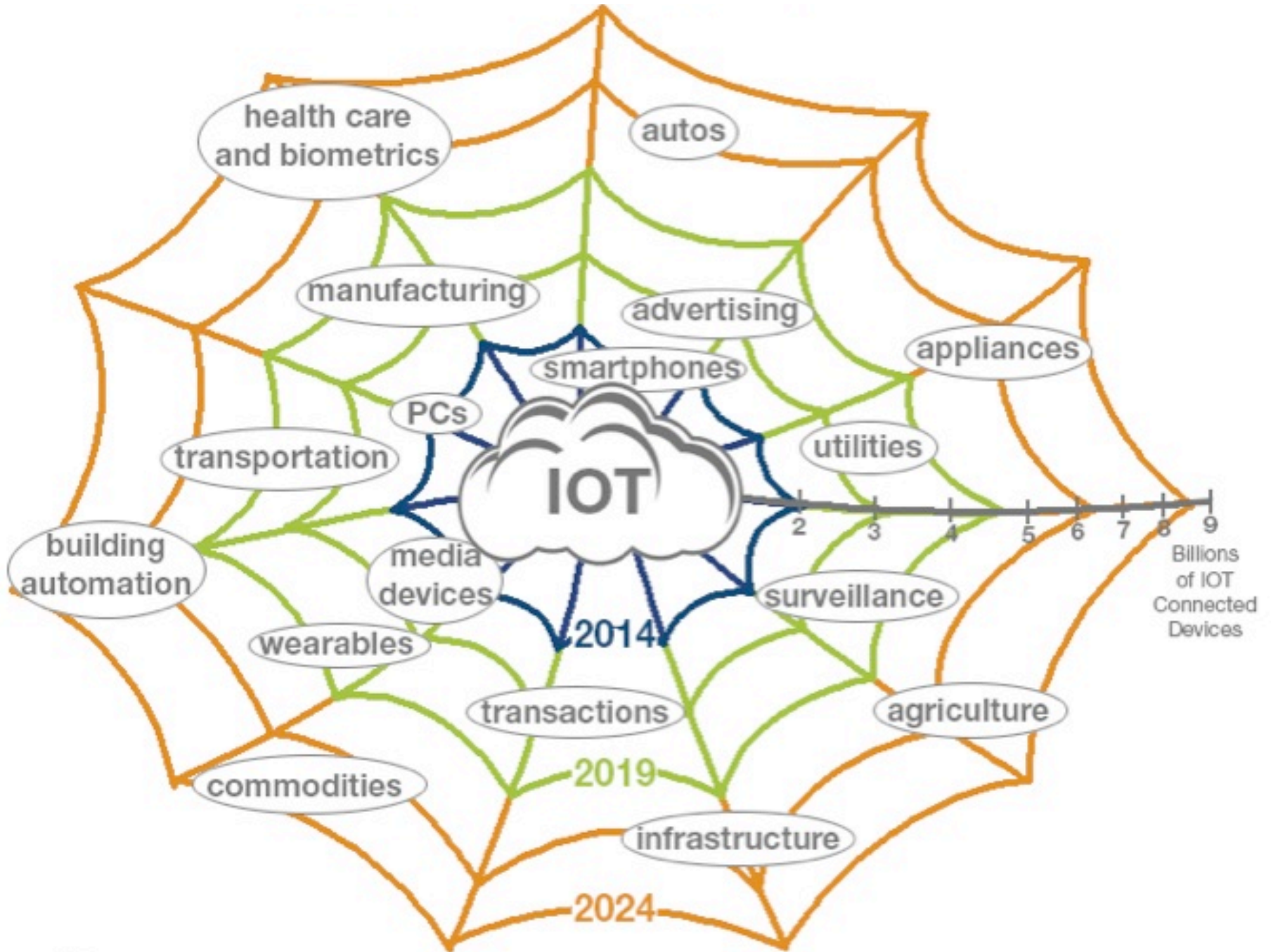
Pre-emptive care
Oper efficiency

Overall Value Proposition

- Operational efficiency across homes, enterprise and government
- Quality of lives of citizens
- IoT may lead to breakdown barriers among vertical markets → change in business model



IoT Device Connectivity web roadmap



IoT KPI

What does this mean?

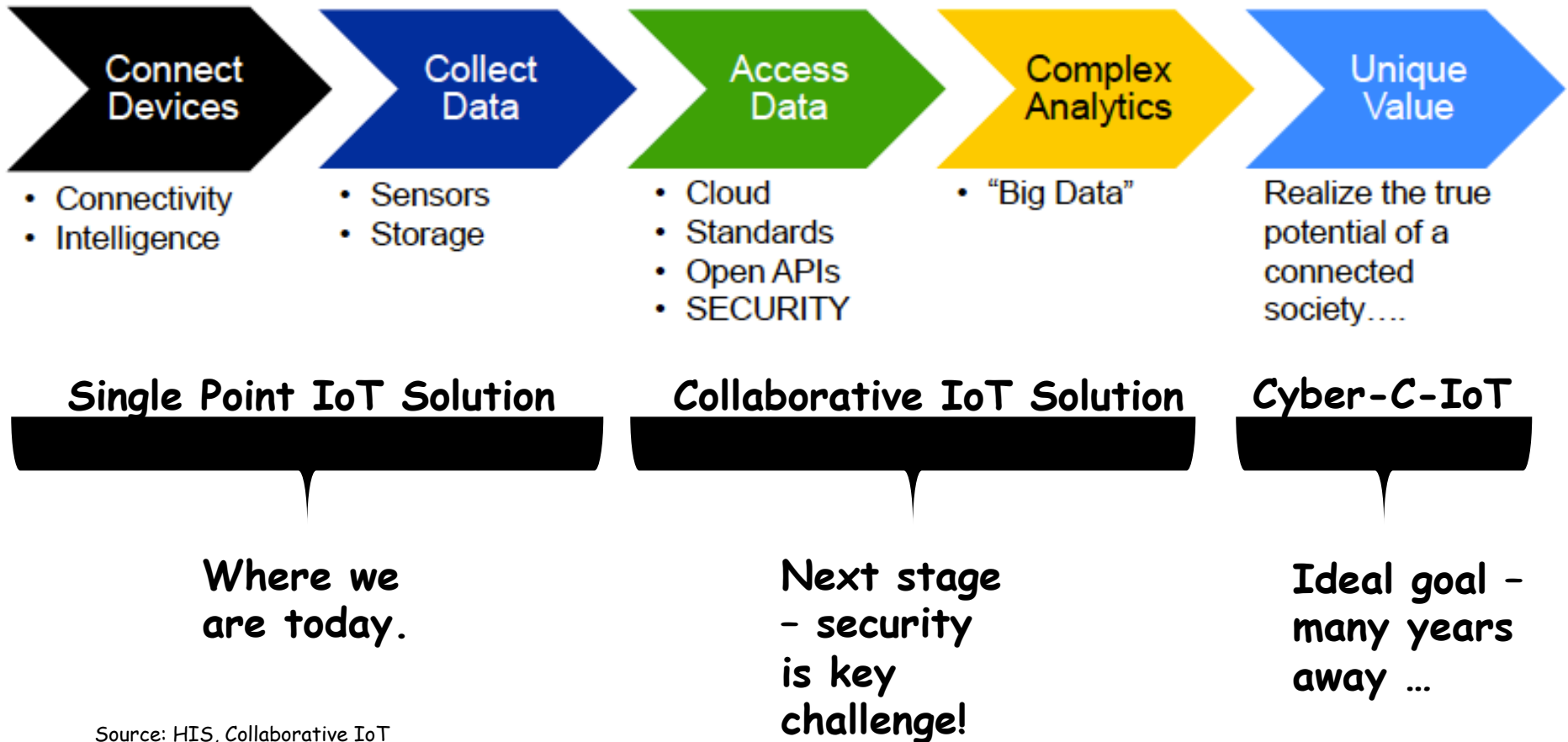
- Advancing IoT to mainstream (collectively) endorsed and adopted by Government, Industry and consumers
 - Smart sensing (providing alerts that matter)
 - (Real time) Monitoring & Control
 - Cloud based analytics for decision making
- Balanced interception of technology & standards for best case uses
 - Common software platform for developers
 - Interoperable (collaborative) solutions across markets
- Scalable and multi-layer end-to-end secure solutions
 - Security across sensing, aggregation and services

Moving from Standalone to Collaborative to Secure IoT



Summary - IoT Evolution

“The Future of Collaborative Internet of Things”



Source: HIS, Collaborative IoT

Reference book *“Are you prepared to think about the world as an Internet of Things?”*
By Fawzi Behmann & Kwok Wu

**Opportunities for 2020's
and 2030's**

Requirements & Solutions

- Health & Fitness
- Smart Home
- Smart Car
- Smart Energy
- Smart Factory
- Smart City

**For Individual, Industry and
Infrastructure**

Covering

- Sensing
- Gateway
- Services

**Market & Technological
trends**

Standards Initiatives

Collaborative Internet of Things (C-IoT)
for Future Smart Connected Life and Business
Fawzi Behmann and Kwok Wu

The Internet of Things refers to uniquely identifiable objects and their virtual representations in an Internet-like structure and has many definitions, one being a global network infrastructure, linking physical and virtual objects through the exploitation of data capture and communication capabilities. This infrastructure includes existing and evolving Internet and network developments. It will offer specific object-identification, sensor and connection capability as the basis for the development of independent cooperative services and applications. These will be characterized by a high degree of autonomous data capture, event transfer, network connectivity and interoperability.

Collaborative Internet of Things (C-IoT) for Future Smart Connected Life and Business provides the reader with an overview of the evolution of Internet of Things and its impact on Smart Connected Digital Life and emerging Cloud Services comparing trials in the 1990s with current solutions offering future trends. The underlying drivers of innovative change are the scalability of Internet, advancement of

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