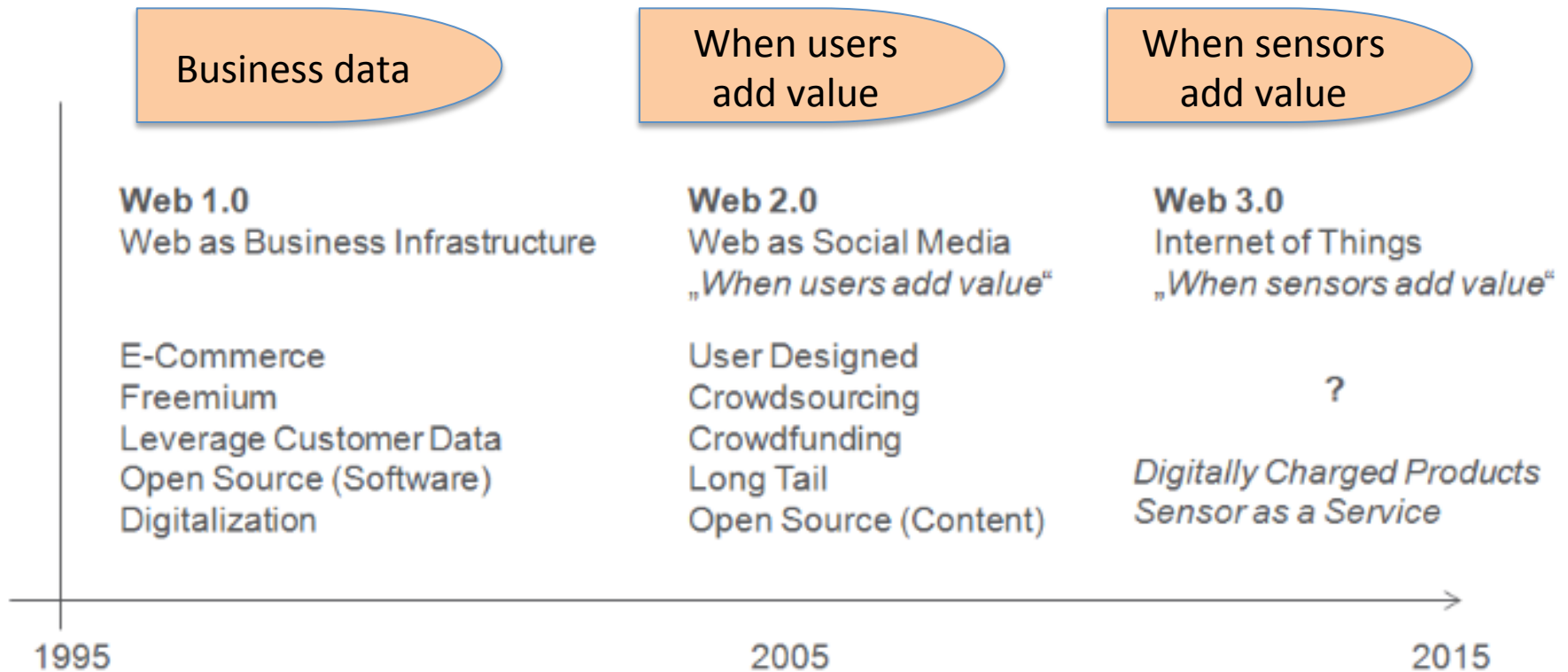


Advanced BI: IoT

Web 3.0 – when sensors add value



What is IoT

- IoT a world where “things” (devices or sensors) are connected and able to share data.
- Data coming from these devices and sensors provide business insights that were previously out of reach.
- The invaluable insights enabled by harnessing and analyzing the data from these connected devices are what the Internet of Things is all about.
- Internet of Objects = Internet of everything

Everything is a thing

- **Virtual** things are capable of being stored, processed and accessed: multimedia content, web pages, FB, Ttwitter accounts, etc.
- **Physical** things surrounding environment, like sensors, electrical equipment, etc, need **connectivity to be accessed** and **software to be processed**

Connectivity is a human need and
desire

- Roads connected “places”
- Telephone connected people
- Internet connected people and communities.

The 3As: AAA

- The basic concept of IoT is make entire world deeply and widely connected.
- Make every object:
 - Addressable
 - Accessible
 - Actionable

What matters is the third A

Consider your House

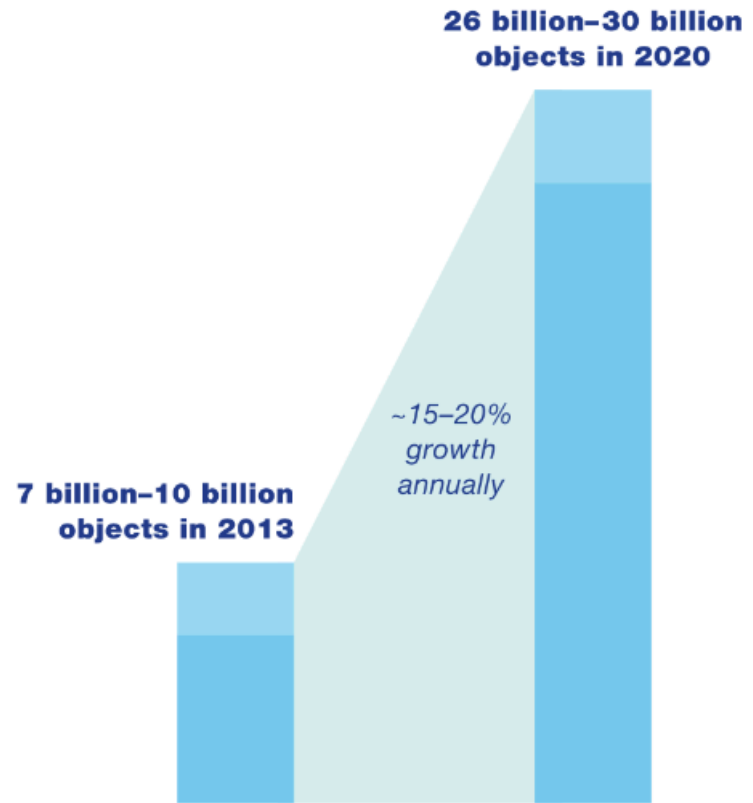
- is addressable- it has an address
- accessible - you can send a post/courier to that house
- (still mostly) **not actionable**- you can not close its door from here.

More examples

Item	Addressible	Accessible	Actionable
House	Yes	Yes	No
Mobile	Yes	Yes	Yes
Computer	Yes	Yes	Yes
TV	No	No	Yes
TV Remote	No	No	Yes

Challenge of IoT is connectivity

- The fixed internet wave connected billions people
- mobile connected several more billions
- IoT is expected to connect 28 billion “things” to the Internet by 2020 ranging from bracelets to cars
- IoT is BIG (data)



Connectivity: different network types for different devices (e.g.,
Loon project by Google's Alphabet parent company)



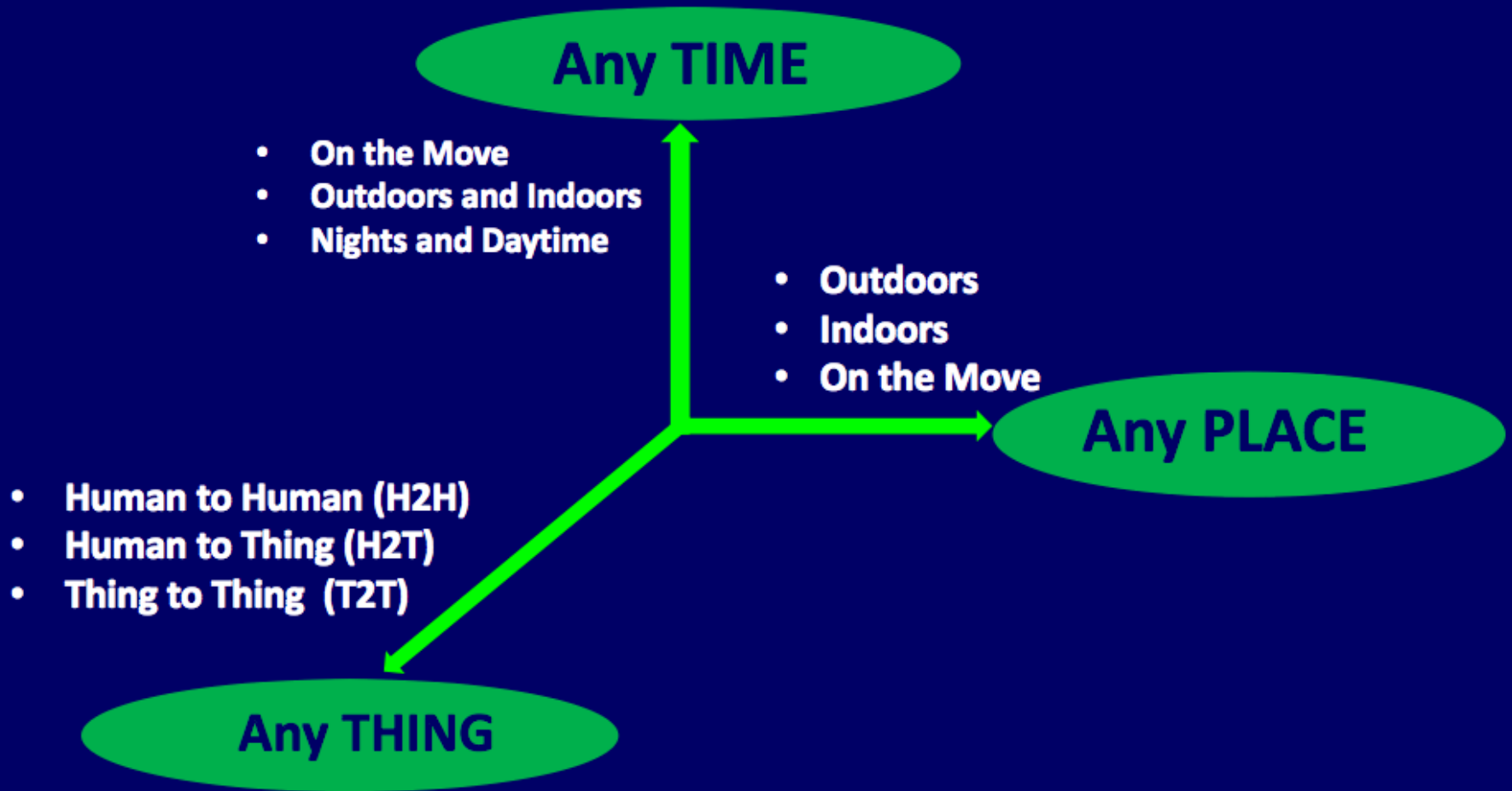
while many of us take the internet for granted, large parts of the world are

Actionable things gets connected

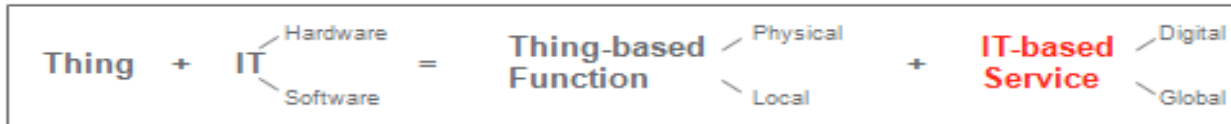
- The Internet of Things connects devices such as everyday consumer objects and industrial equipment onto the network.



What where and how? Any



Which things? many



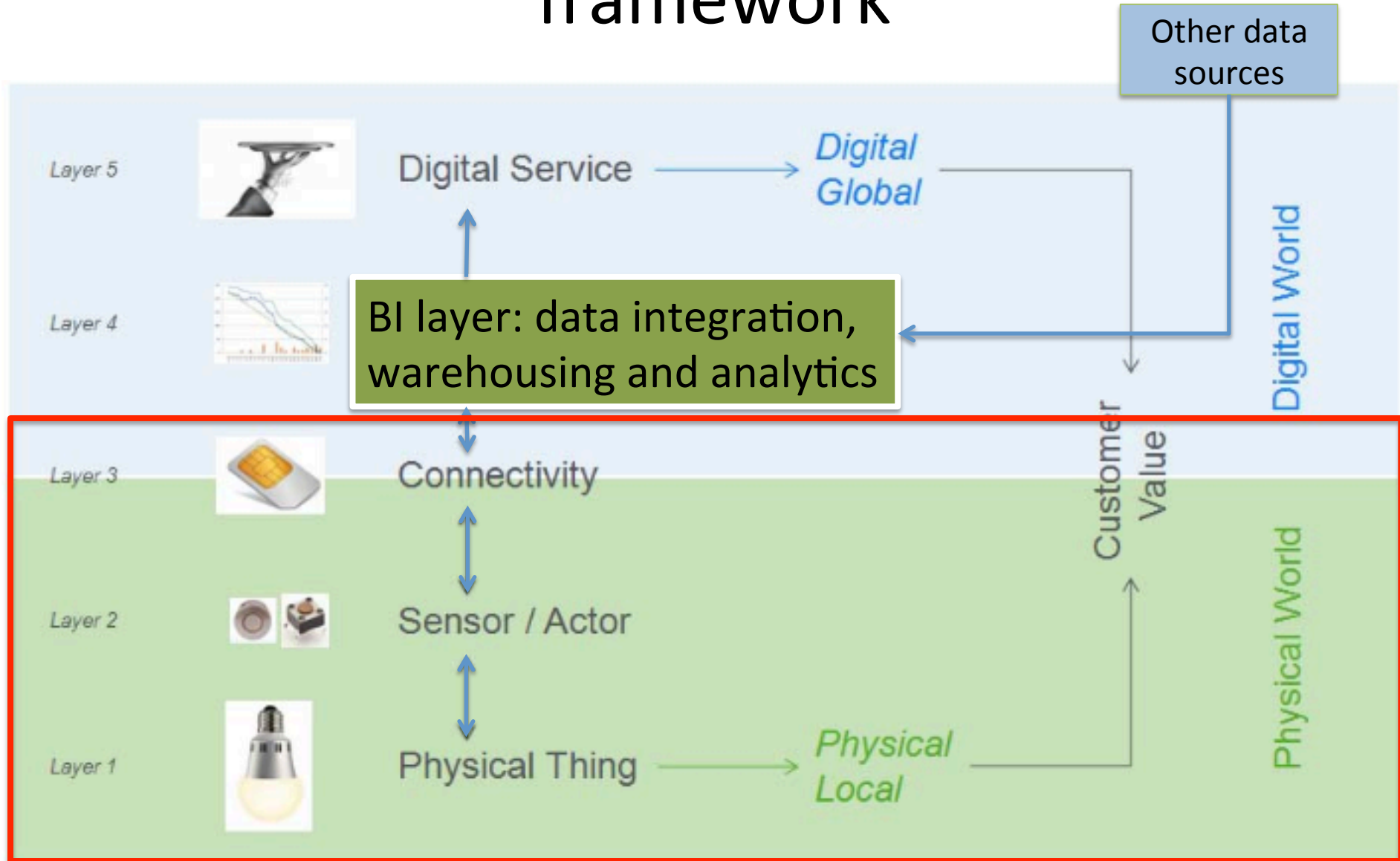
		Time	E-Call	E-call
		Stock box	Replenishment	Part replenishment
		Ride	Fleet Mgmt, Leasing etc.	Fleet managm., leasing..
		Temperature	EE Consulting Cost Savings Remote Control	Remote control, energy savings..
		Drive	Insurance, Traffic, Charging, Theft, Behavior	Insurance, traffic, thefts..
		Light	Security Heating Control Comfort	Security, Comfort, heat control
		Whatever the thing can	Installation Guide Maintenance Guide Maintenance History Active Maint. Schedule Repair Guide Repair History Replenishment Service Warranty Service Bill Insurance ...	Whatever

A more precise definition of IoT

A dynamic global network infrastructure with **self-configuring capabilities** based on **standard and interoperable communication protocols** where physical and virtual “things” have **identities, physical attributes**, and virtual personalities and use intelligent interfaces, and are **seamlessly integrated into the information network**, often communicate data associated with users and their environments|

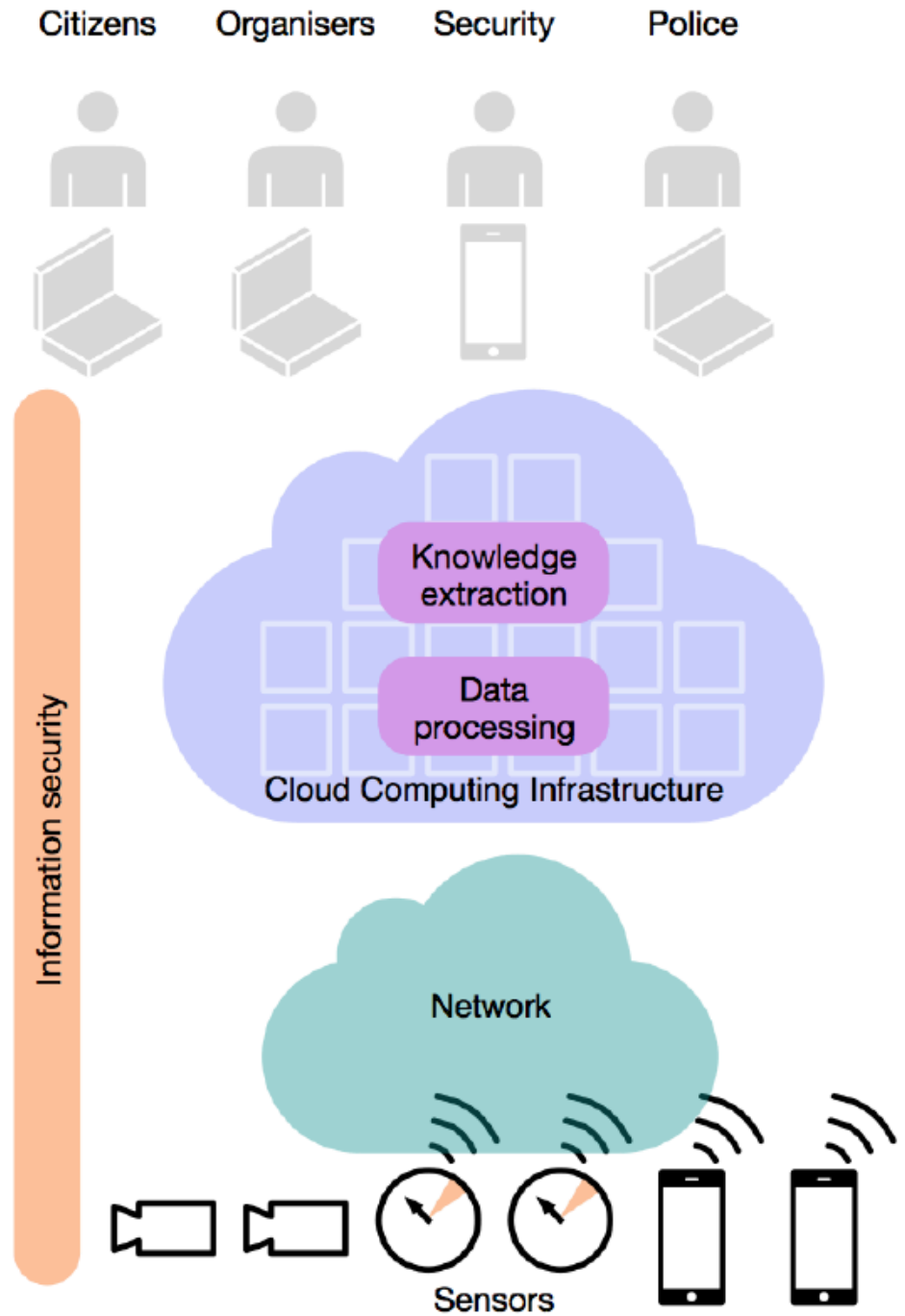
The connectivity is just an enabler but the real value of IoT is on data (business insight/data-driven economy)

Layers of IoT analytics in a BI framework



IoT reference model

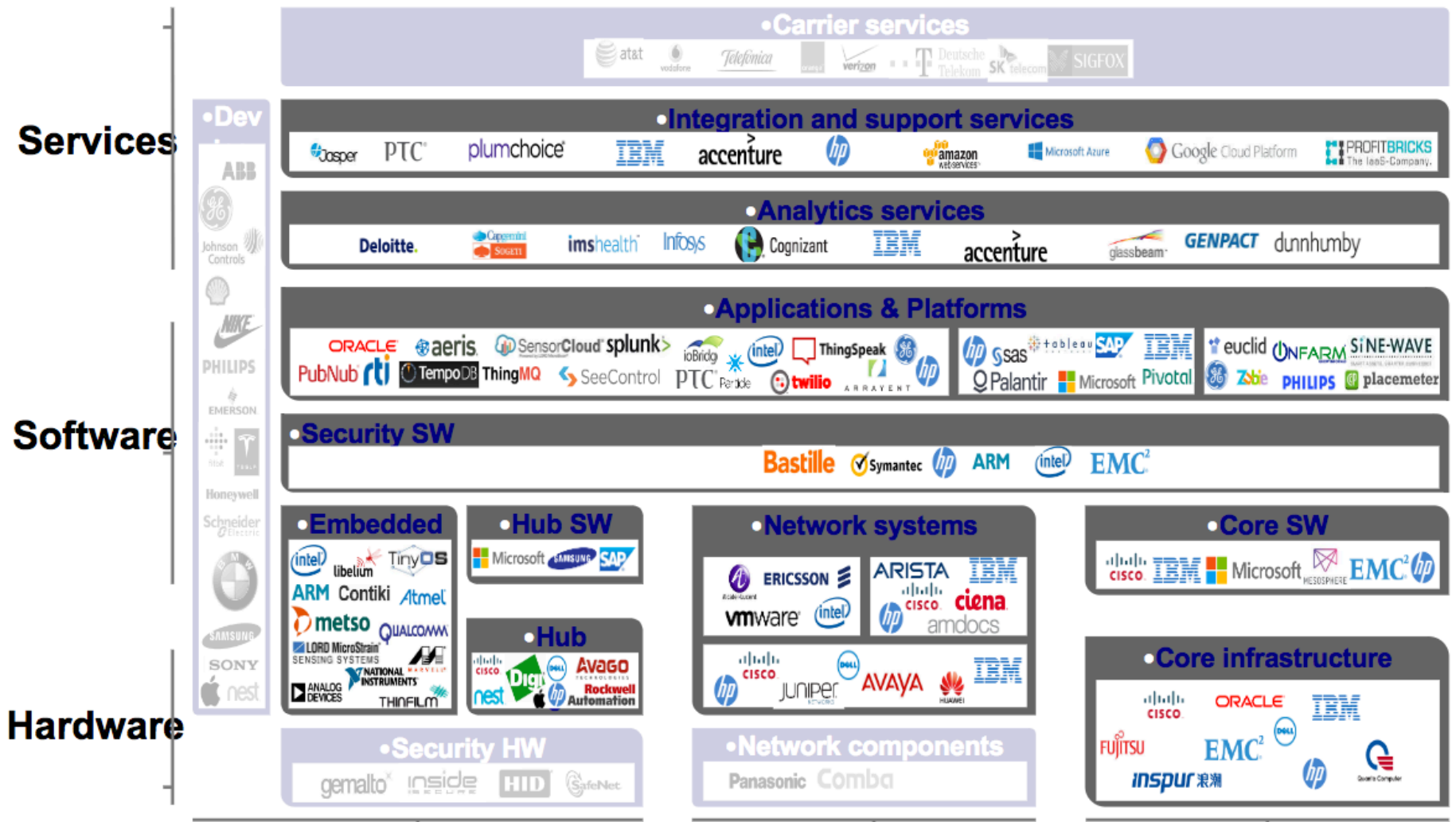
Security is crucial
(will see later)



Time is ready

- Emerging standards
 - Industrial Internet Consortium: AT&T, Cisco, GE, IBM, Intel, etc.
 - IEEE
 - ITU
- Technological advances
 - Low-energy consumption devices
 - Prices of the chip sets used in these products have declined by about 25 % per year over the past two years
- Supplier attention
 - Apple has released HealthKit and HomeKit developer tools
 - Google acquired Nest (3.2 billions \$, Feb. 2014) to catalyse the development of an Internet of Things platform and applications

More than 800 companies in the IoT business



Most of them use ecosystem of **alliances (to jointly develop standards, use-cases, technologies)**

Technology standards alliance

■ Rationale:

- Industry group for standards and reference architecture
- Address uncertainty and risk around investments at scale



Industry use-case alliance

■ Rationale:

- Industry-specific IoT solutions development
- Showcase IoT benefits in the context of industry requirements and format



Open Automotive Alliance

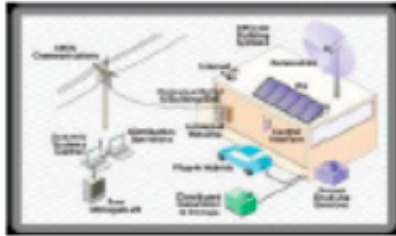
Open technology alliance

■ Rationale:

- Exploratory collaboration on specific components in the IoT stack
- Encourage developer ecosystem to test and create applications



Top application domains



Smart Grid



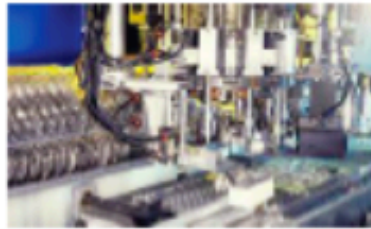
Smart Health



Smart Home



Smart Cities



Smart Industries



Smart TV



Smart Watch

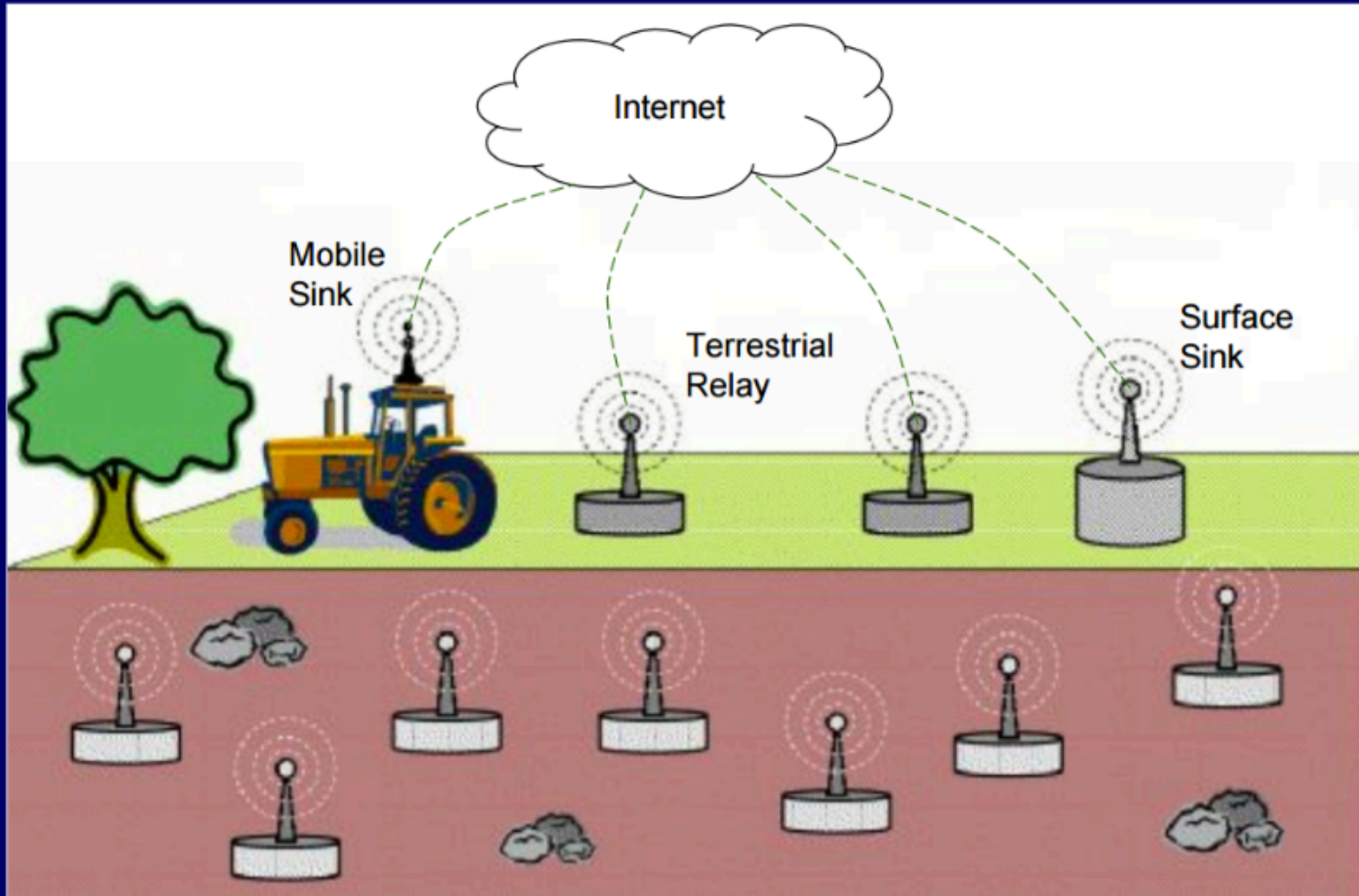


Smart Car

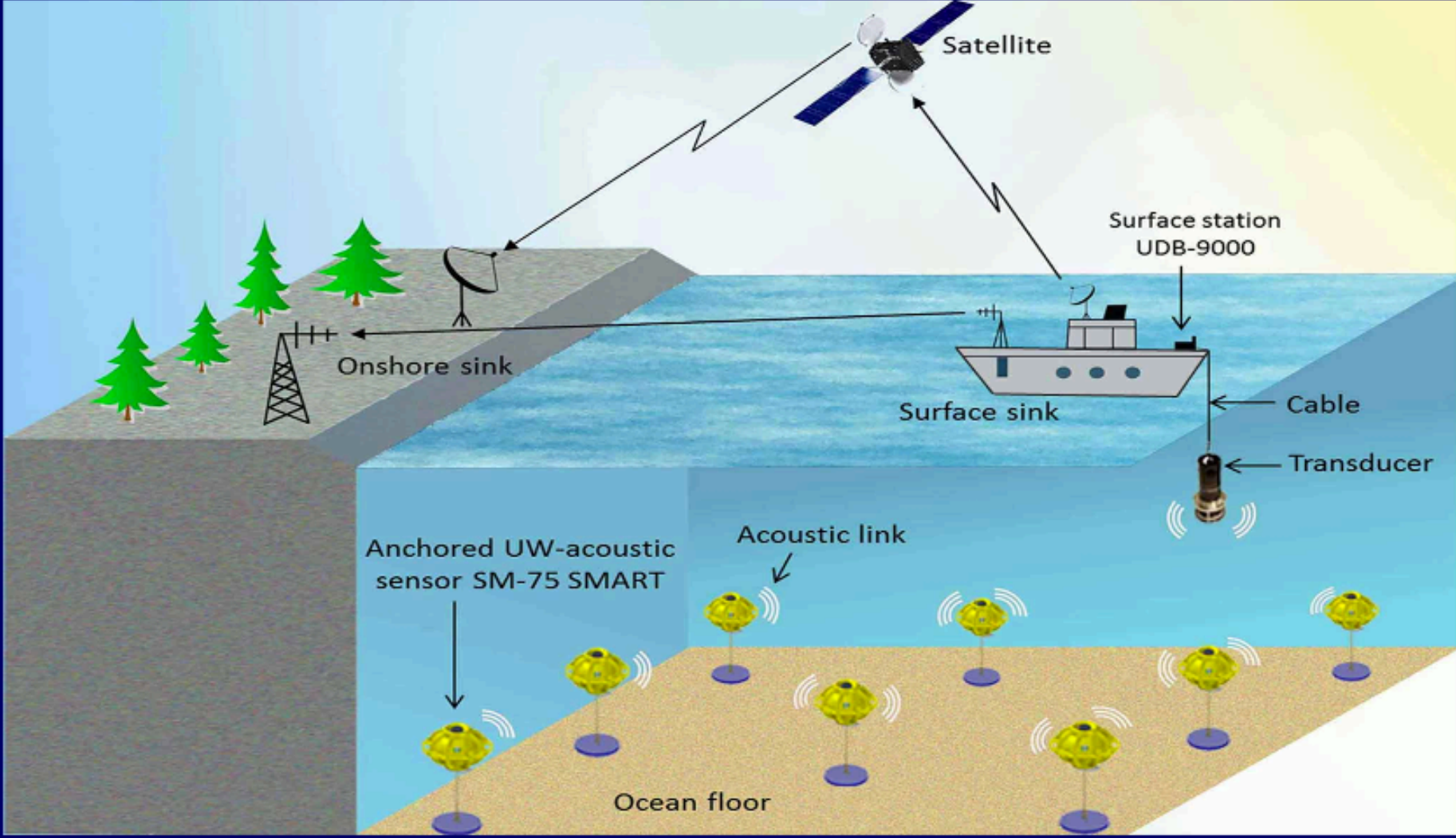


Smart Kegs

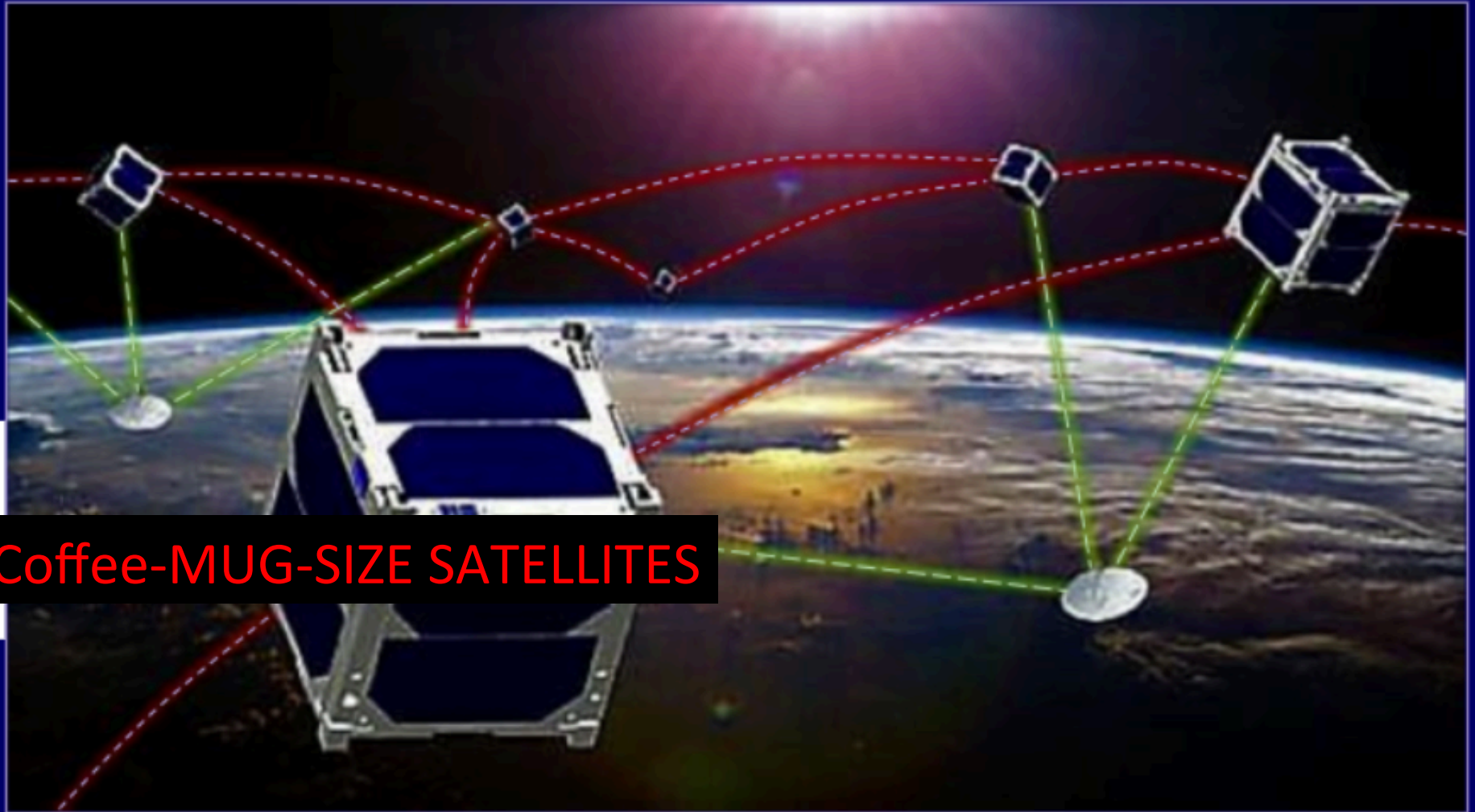
INTERNET OF UNDERGROUND THINGS



INTERNET OF UNDERWATER THINGS



INTERNET OF SPACE THINGS



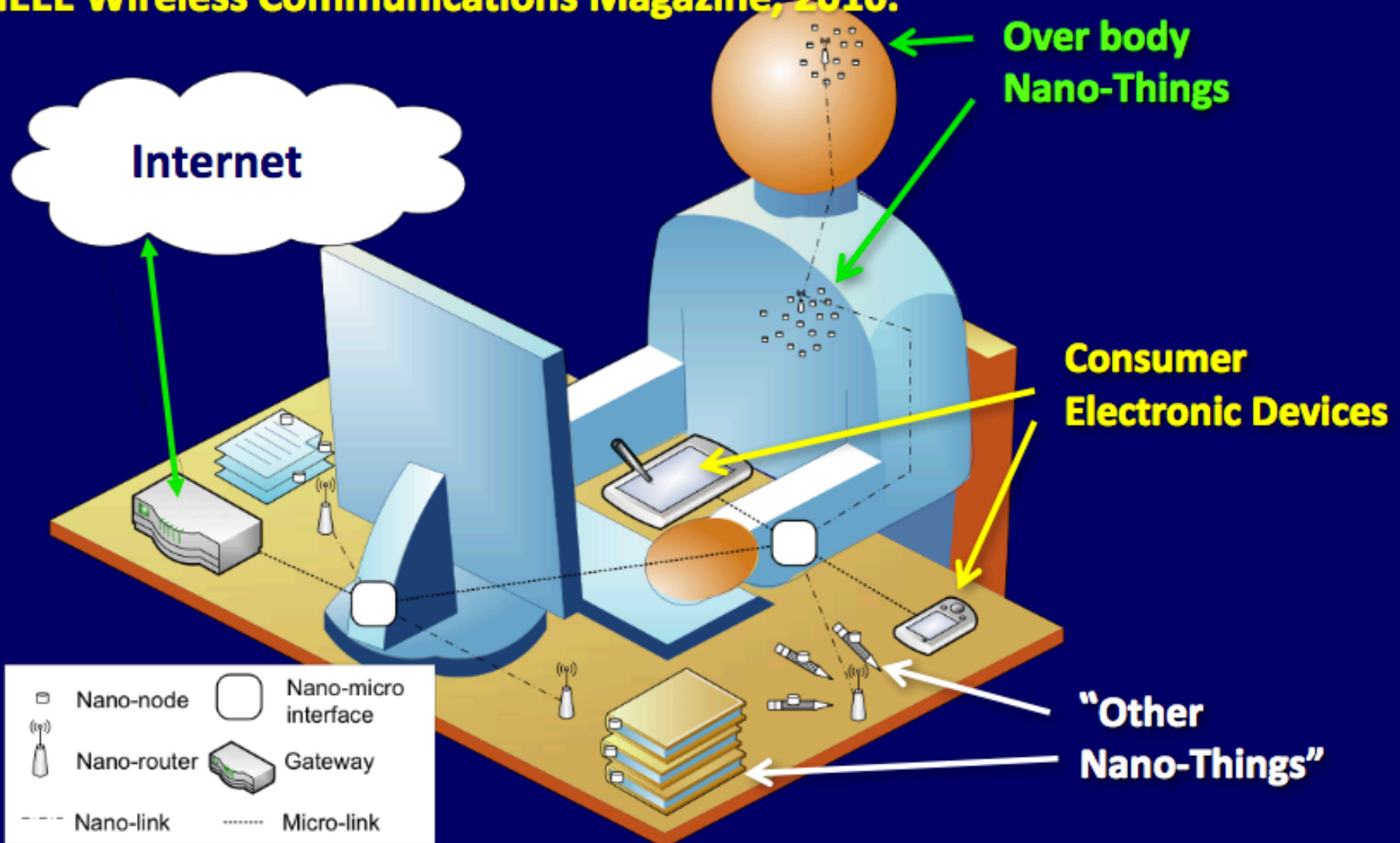
Coffee-MUG-SIZE SATELLITES

INTERNET OF NANOTHINGS

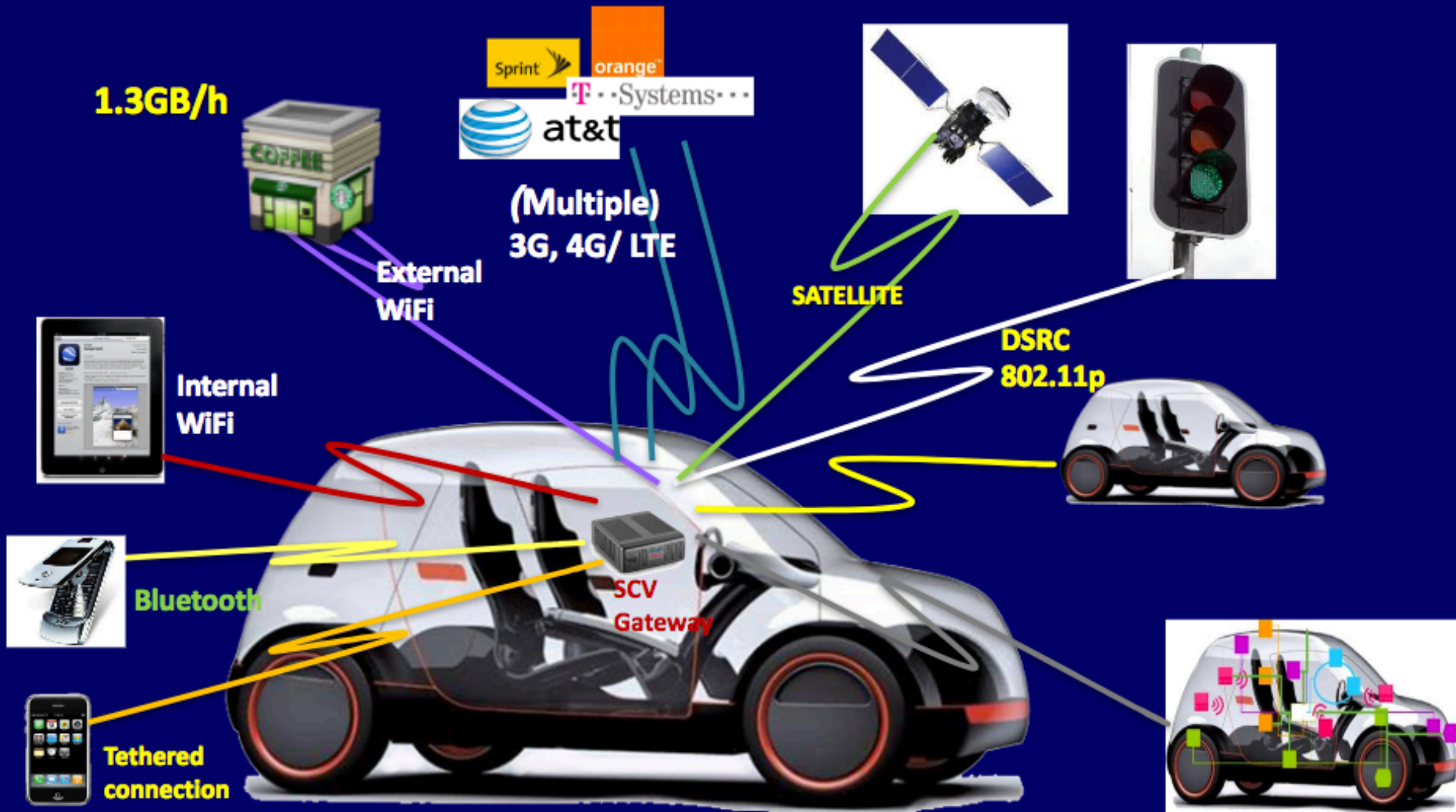
I. F. Akyildiz and J. M. Jornet,

"The Internet of Nano-Things,"

IEEE Wireless Communications Magazine, 2010.



Adoption of IoT Networks: Transportation



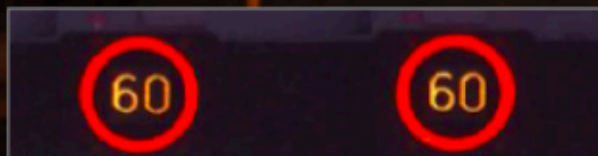


Adoption of IoT Networks: Transportation

- Save lives and property
- Reduce emissions and
- Cut commuting time and effort

SAFETY

1.3 million dead 2013
2.4 million to die 2030



ROADSIDE INSTALLATIONS

SENSORS FOR DATA COLLECTION

EFFICIENCY

EU annual congestion
cost 130 billion euro.



COMMUNICATION

SUSTAINABILITY

Road transport 20% of
EU total CO₂ emission

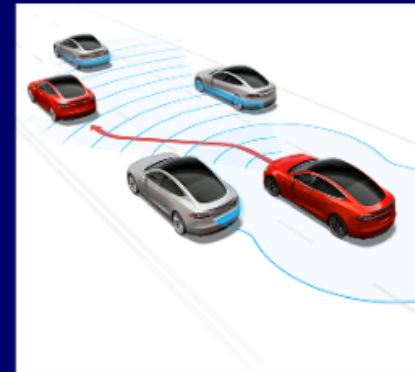


TRAFFIC MANAGEMENT



Intelligent Transportation

- Driver warning, autopilot, emergency self stop, traffic management
- Real-time vehicle tracking and fleet management
- Route planning information, high-precision estimated arrival times
- Valuable data for insurance companies



What are the additional challenges of adding “things” to data warehouses?

- Security
- Privacy
- Standards
- Regulations
- Developments

Security

- Security is a crucial issue on the Internet, and it is probably the most significant challenge for the IoT.
- When you increase the number of connected devices, the number of opportunities to exploit **vulnerabilities** through poorly designed devices can expose user's data to theft, especially when the data streams are left with inadequate protection.
- There are a number of IoT deployments that also have collections of **near identical** or identical devices. This magnifies the impact of any one security vulnerability by the number of devices that all have similar characteristics.
- Companies and end users must ultimately compare the cost against the security, which is related to the **mass scale deployment** of the Internet of Things devices.

Privacy

- The Internet of Things presents some unique challenges when it comes to privacy, and a lot of that goes far beyond the data privacy issues that exist currently. Much of this is because of the trouble integrating devices into the environments **without people using them consciously**.
- This is becoming even more prevalent when it comes to **consumer devices**, such as tracking devices for cars and phones and also smart TVs.
- Vision features and voice recognition are now being integrated into smart TVs. These features **can listen continuously** to conversations or look for activity and transmit data selectively to cloud services for processing. These cloud services may sometimes even include third parties. **The collection of all this information faces a number of regulatory and legal challenges.**
- Another critical example is e-health data

Standards

- A **lack of documented or standard best practices** has had a much larger impact on Internet of Things devices that goes well beyond simply limiting their development and potential. An absence of standards may well enable **inappropriate behavior** by IoT devices.
- Without the right standards to guide and regulate manufacturers, developers may design products that operate in any number of **disruptive ways** online without regard for their impact.
- A lot of this is caused by cost constraints as well as the need to develop products and get them to market before their competitors.
- When you add the difficulties of configuring and managing a large number of IoT devices, **the need for standardization** of methods, interfaces, configuration tools, and thoughtful design, **is essential** for the future.

Regulation

- Just like privacy, there are a number of **legal** and regulatory questions that surround the Internet of Things. This also needs some thoughtful consideration.
- Legal issues concerning Internet of Things devices aren't limited to potential **violations of civil rights** because of law-enforcement surveillance.
- Other issues that must be considered are cross-border data flow, legal liability when it comes to unintended use, privacy lapses and security breaches.
- Also, technology is advancing at a much faster pace than regulatory policies (e.g. for drones), and the agencies charged with setting and supervising IoT guidelines cannot keep up.

Development

- The broad scope of the [IoT challenges](#) is **not going to be confined to industrialized countries**.
- In fact, the IoT has a lot of promise when it comes to delivering economic and social benefits for developing and emerging economies (see the previous Loon project).
- Like the rest of the world, the less-developed regions are going to have to address the policy requirements, technical skill requirements, and market readiness to take advantage of the potential of IoT.
- This is a huge server issue and needs large-scale **server farms** to handle all the data. You will need to have a **lightweight network** that can seamlessly transfer data between servers and devices.

IoT Platforms on the market

- **GE Predix**
- **Cisco IoT Cloud**
- **IBM Watson IoT**
- **PTC ThingWorx**