Internet of Thing (IoT) and Big Data

Reza Jafari, PhD, PE
NCDOT – Planning Branch

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What is IoT?

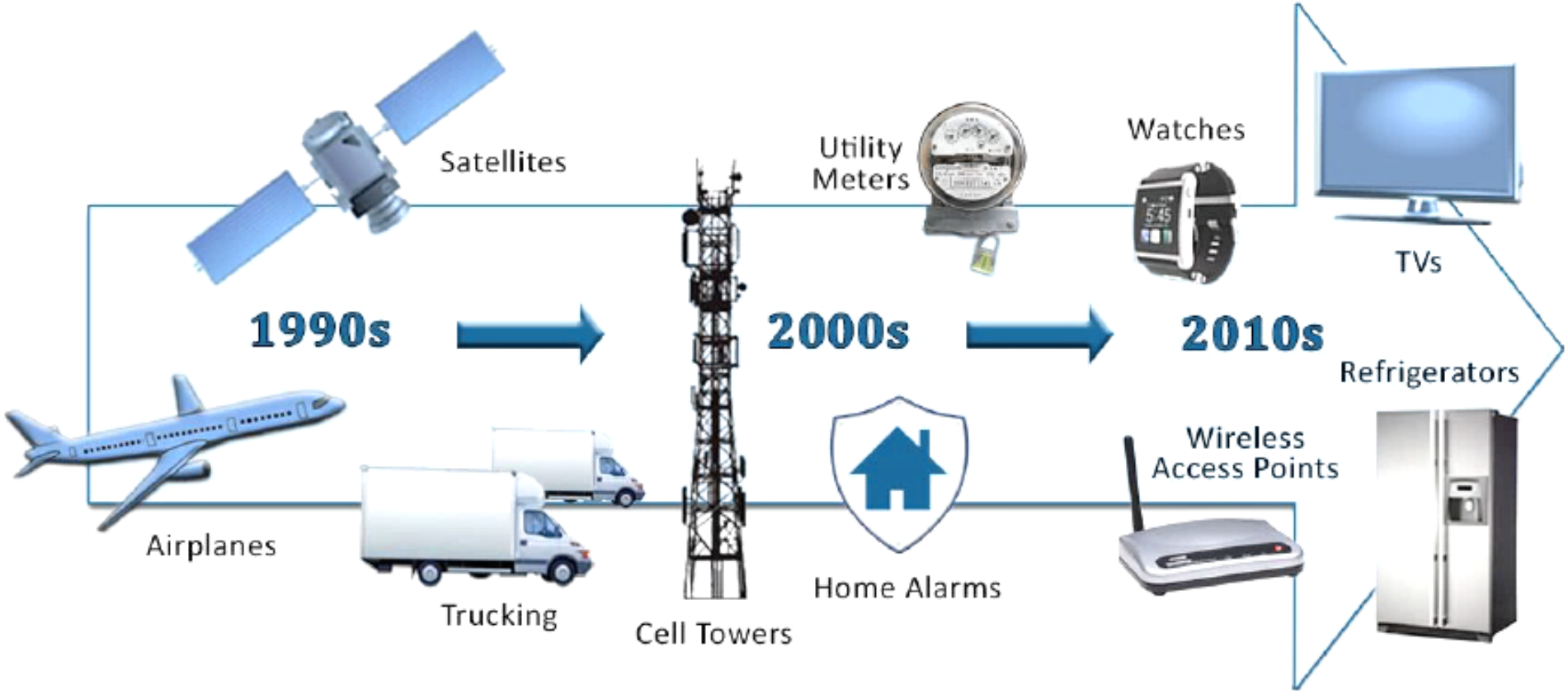
- In the past 25 years internet was used to connect people (internet of people)
- New concept of Internet of Things (IoT) connects objects to human and other objects
- Embedded electronics within everyday items to exchange information with a user or other devices so they function more efficiently
- Wireless network between objects

IoT Connects Everything

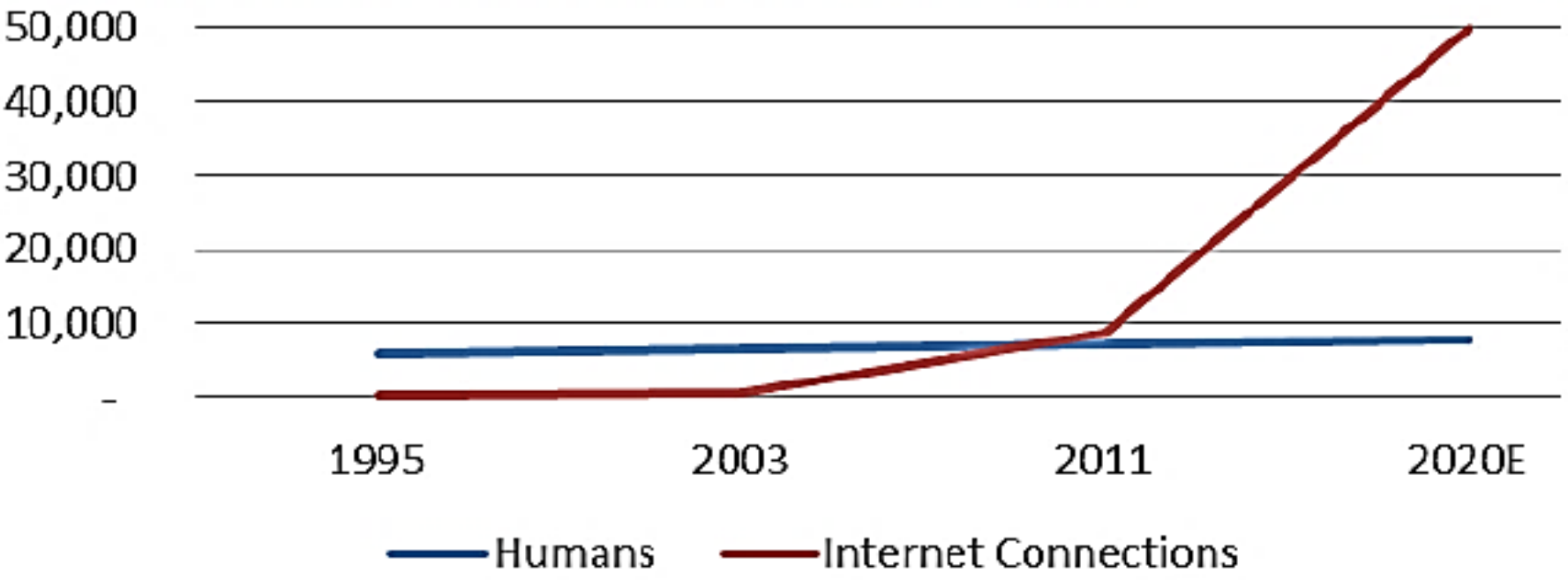
Electronics, machine tools, industrial equipment, cars, appliances, and a number of devices likely not yet invented.

In US	**2011, $2 billion market (14 million devices sold)**
	2016, it will be $6 billion (171 million devices sold)
Globally	**2013, $2 Trillion**
	2020, over $7 Trillion

… Slowly

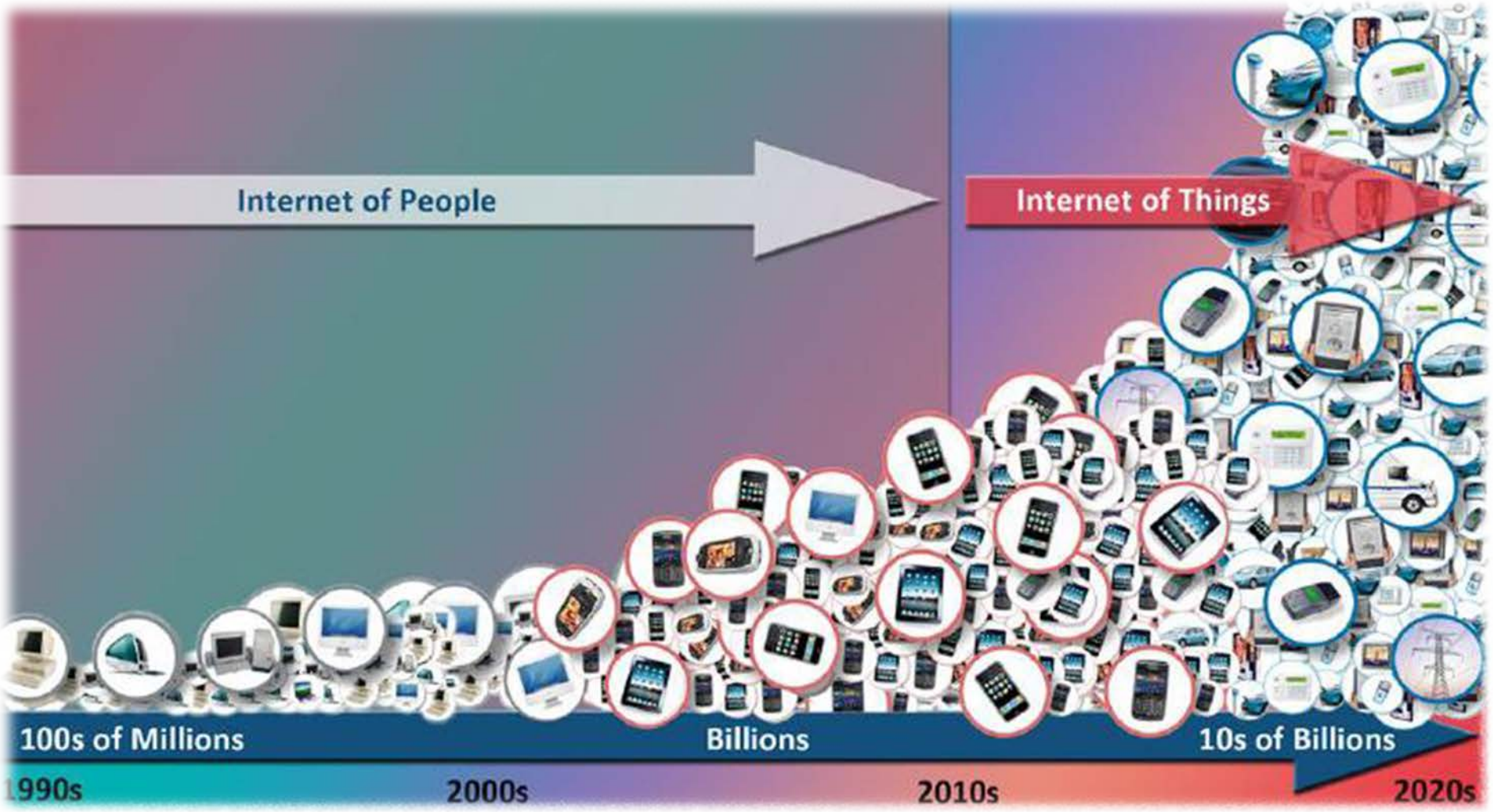

Satellites
Utility Meters
Watches
TVs
1990s
2000s
2010s
Refrigerators
Airplanes
Trucking
Cell Towers
Home Alarms
Wireless Access Points

History



Internet-connected devices:
In 2008, 8 Billion
By 2020, 50 Billion

History

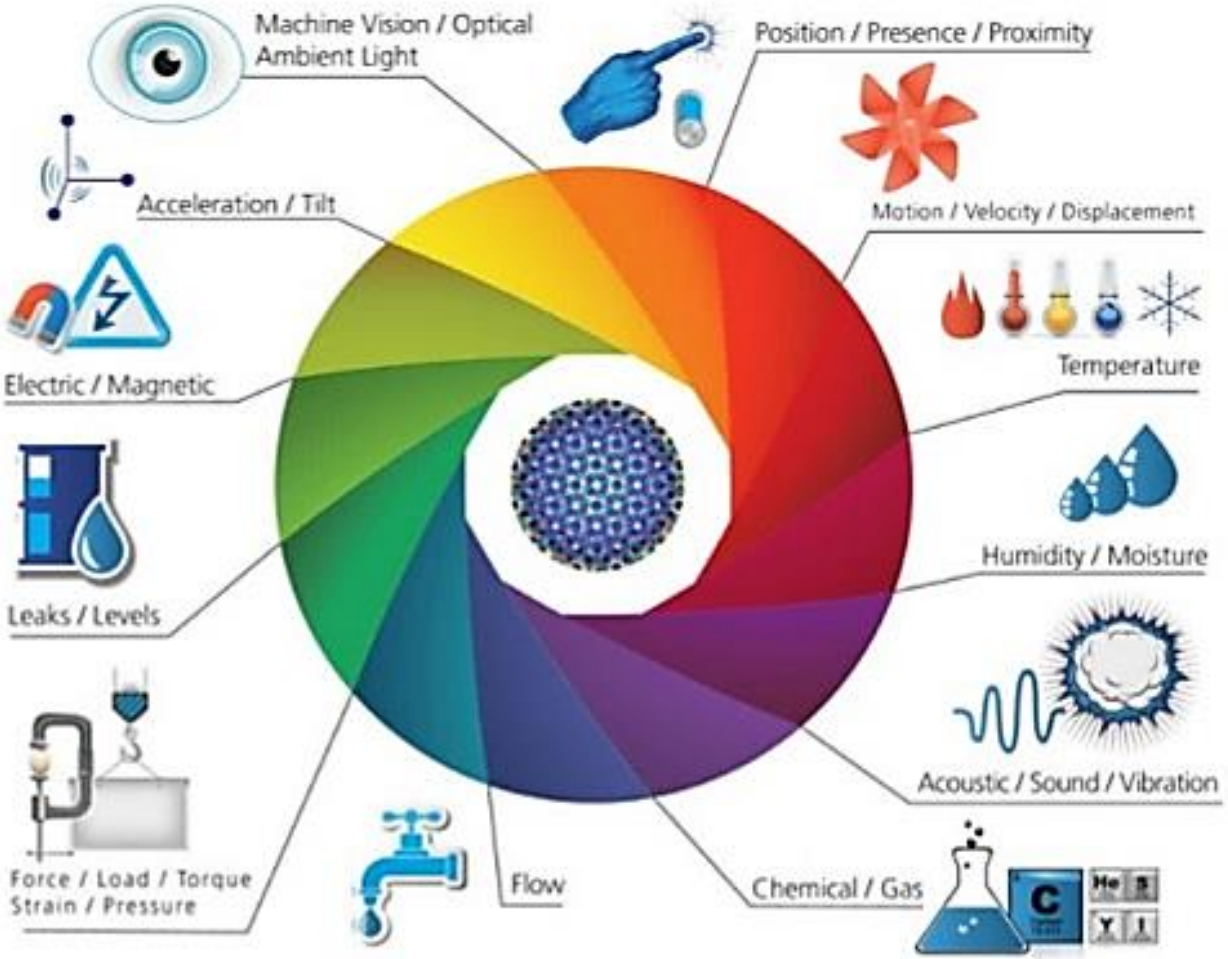

Internet of People
Internet of Things
100s of Millions
Billions
10s of Billions
1990s
2000s
2010s
2020s

IoT is a Combination of…

- Sensors
- Connectivity
- People & Process

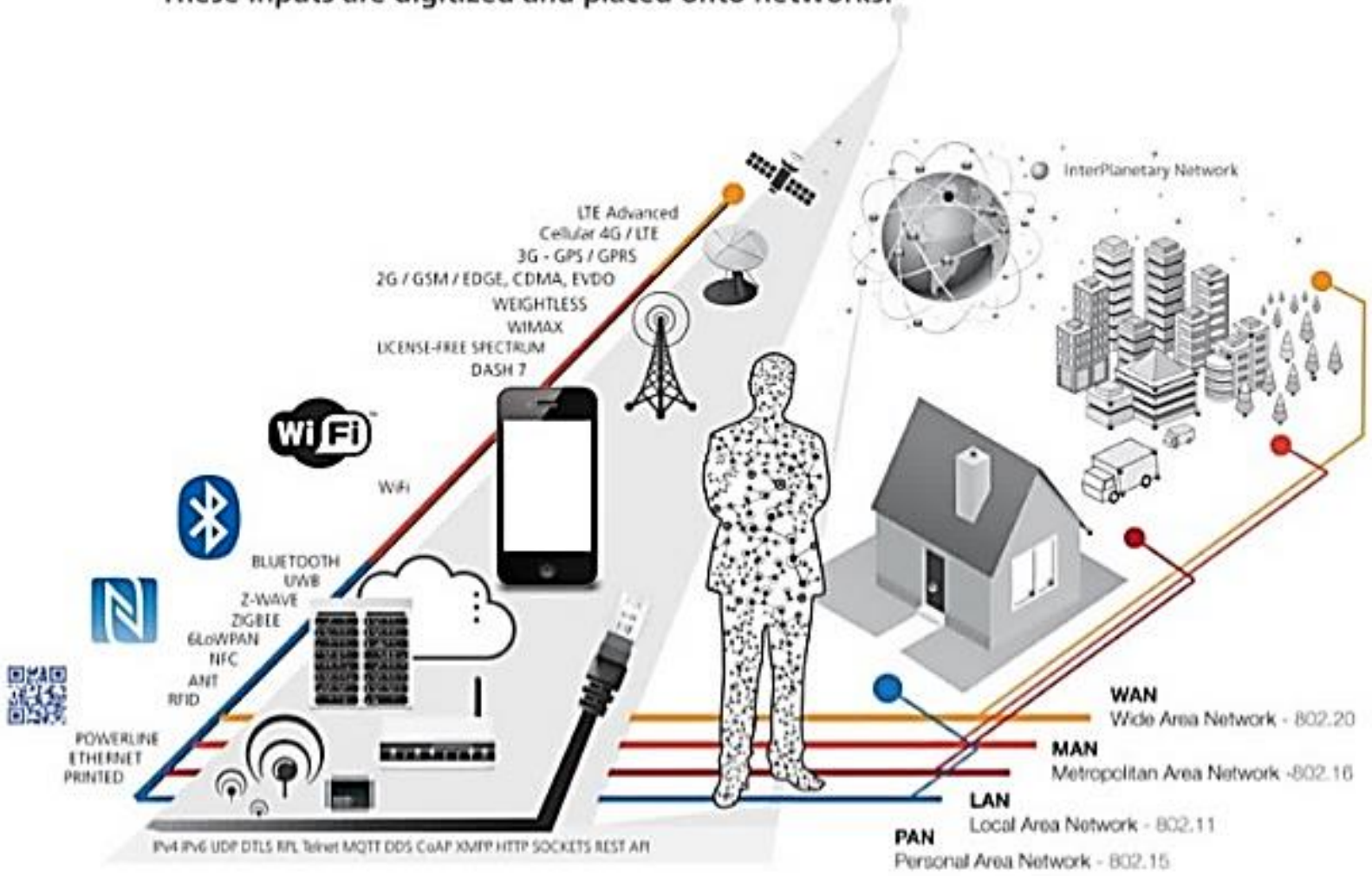
1 SENSORS *& ACTUATORS*

We are giving our world a digital nervous system. Location data using GPS sensors. Eyes and ears using cameras and microphones, along with sensory organs that can measure everything from temperature to pressure changes.



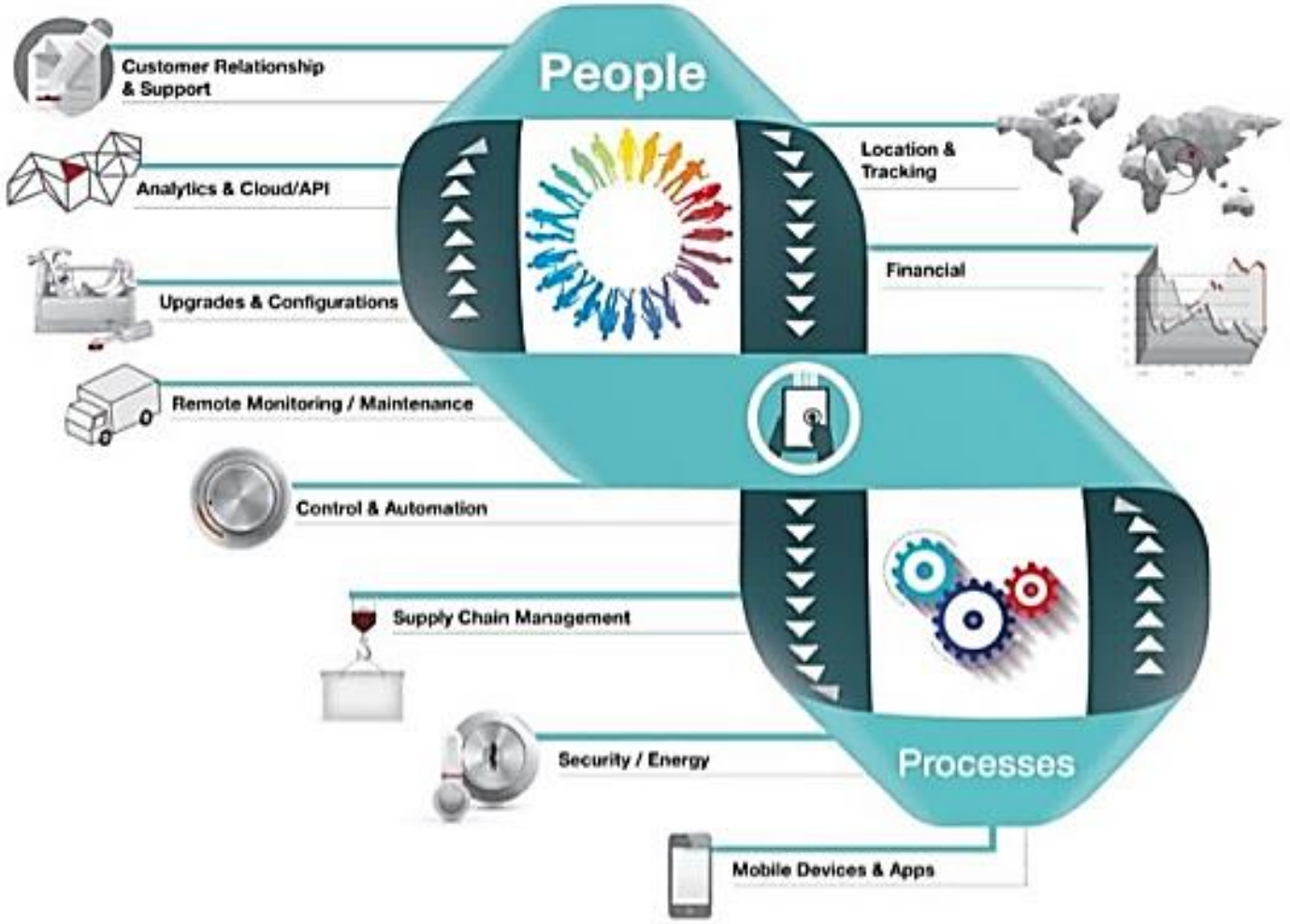
2 CONNECTIVITY

These inputs are digitized and placed onto networks.



3 PEOPLE & *PROCESSES*

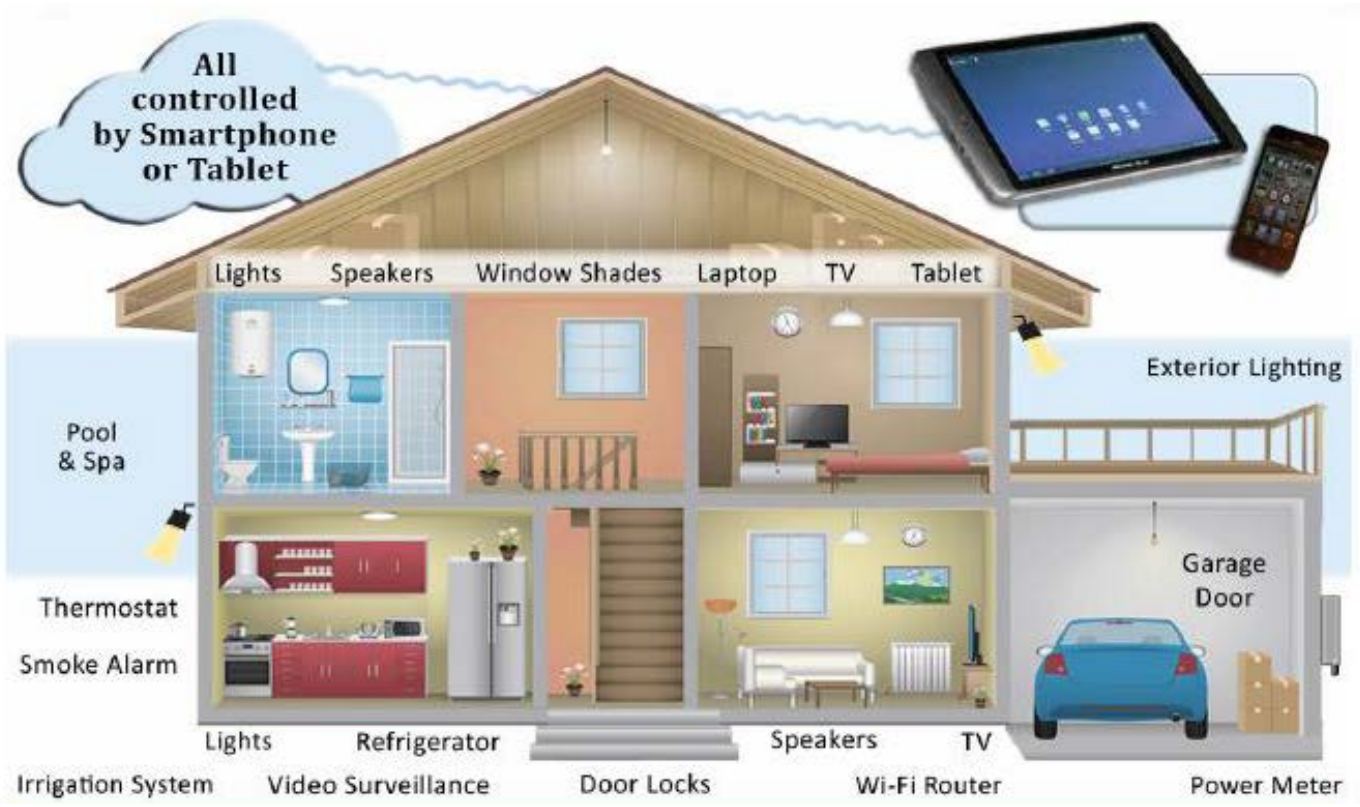
These networked inputs can then be combined into bi-directional systems that integrate data, people, processes and systems for better decision making.



Why IoT?

- Dynamic control of industry and daily life
- Improve the resource utilization ratio
- Better relationship between human and nature
- Forming an intellectual entity by integrating human society and physical systems
- Universal transport & internetworking
- Accessibility & Usability?
- Acts as technologies integrator

IoT Application: Building



Smart Homes: smart meter, light, fridge,…

- Your fridge will tell grocery store what you need

- Your thermostat will be set up based on room size, number of people,…

2008, 4% - 2012, 18% - 2020: Over half the homes!

IoT Application: Building

IoT Application: Shopping

- When entering, scanners will identify the tags
- When shopping, goods will introduce themselves
- Moving goods, the reader put a new one
- Paying, credit card communicates with checkout reader

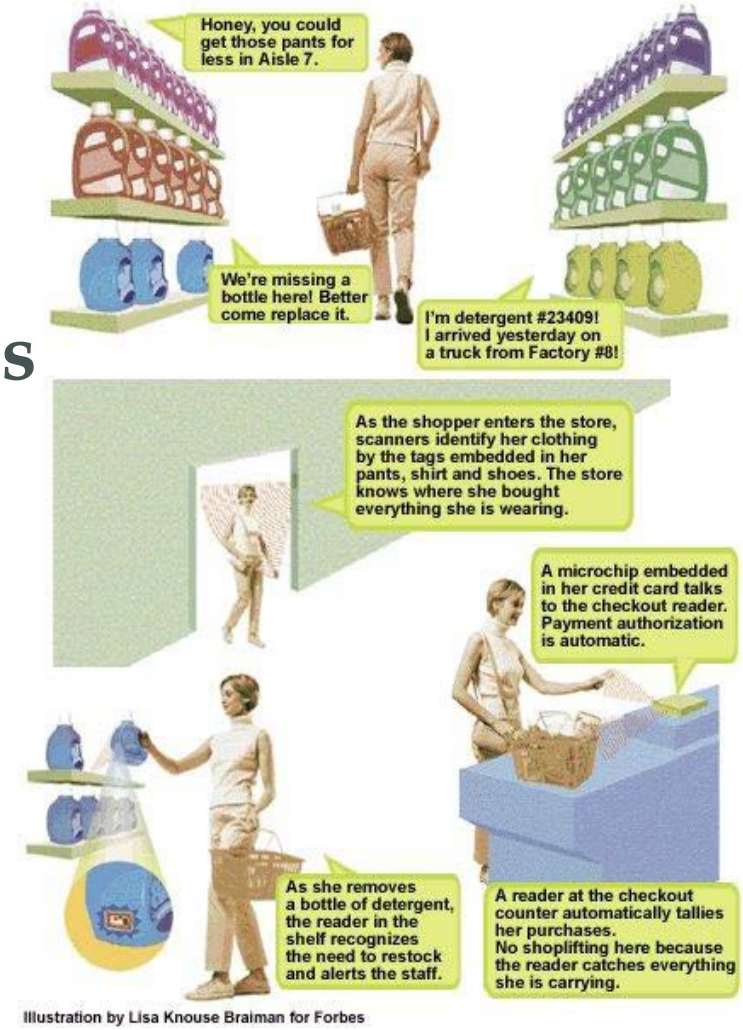
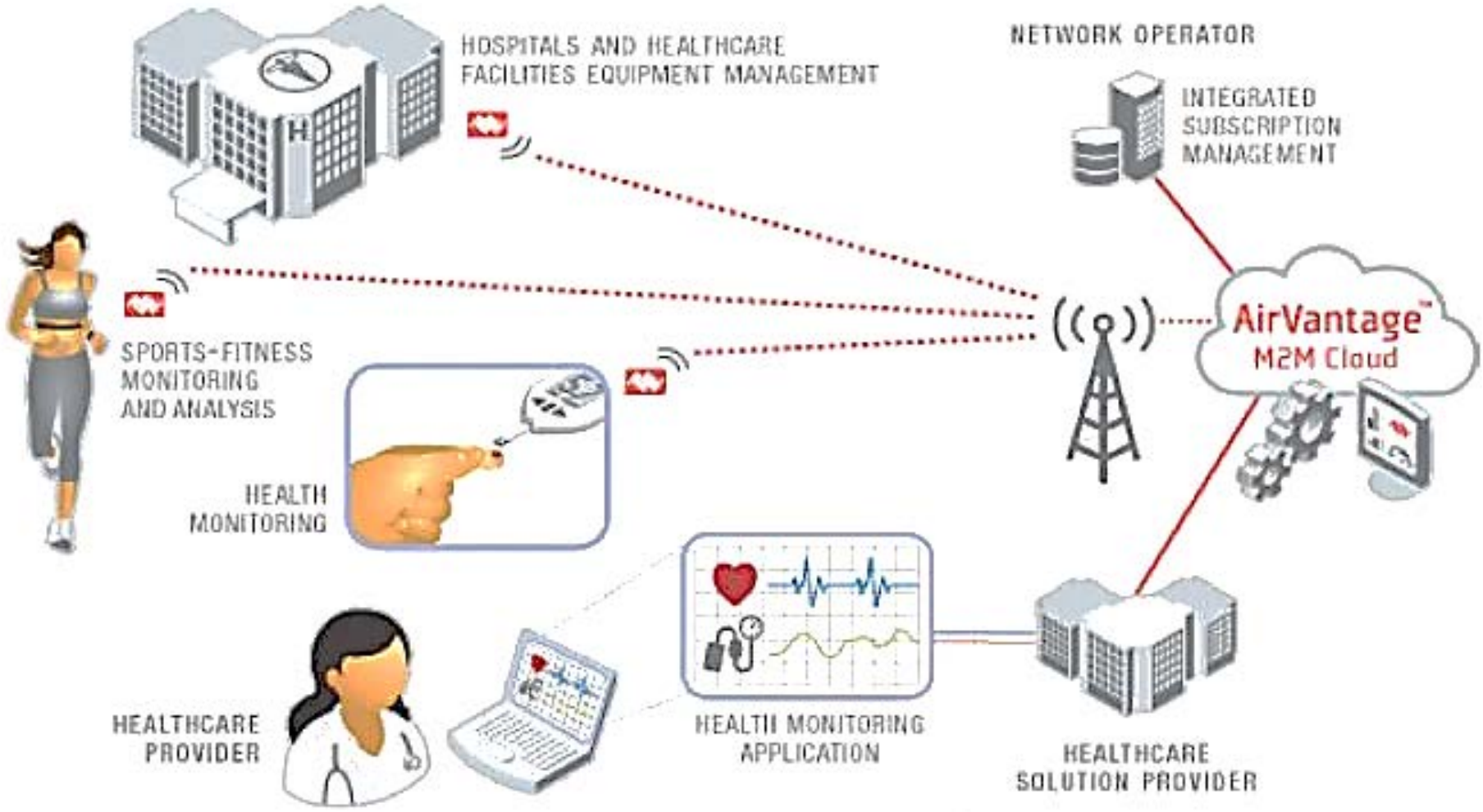
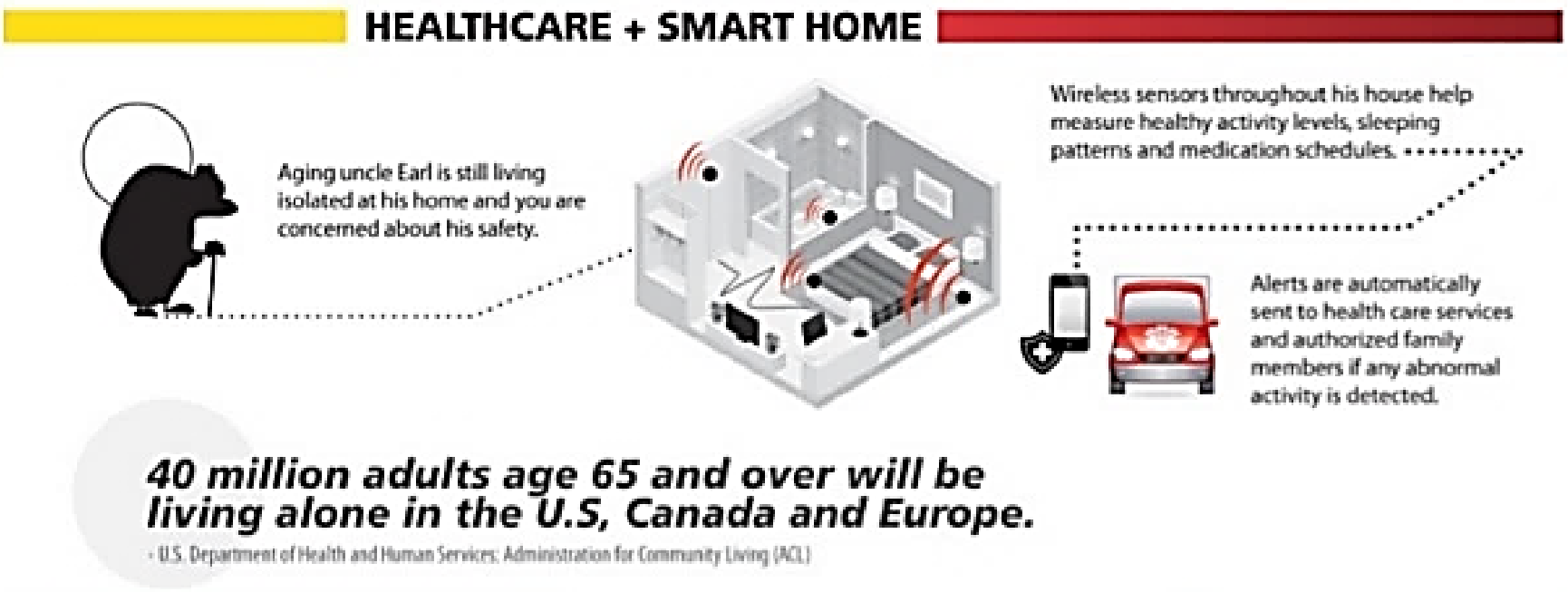


Illustration by Lisa Knouse Braiman for Forbes

IoT Application: Healthcare



IoT Application: Healthcare



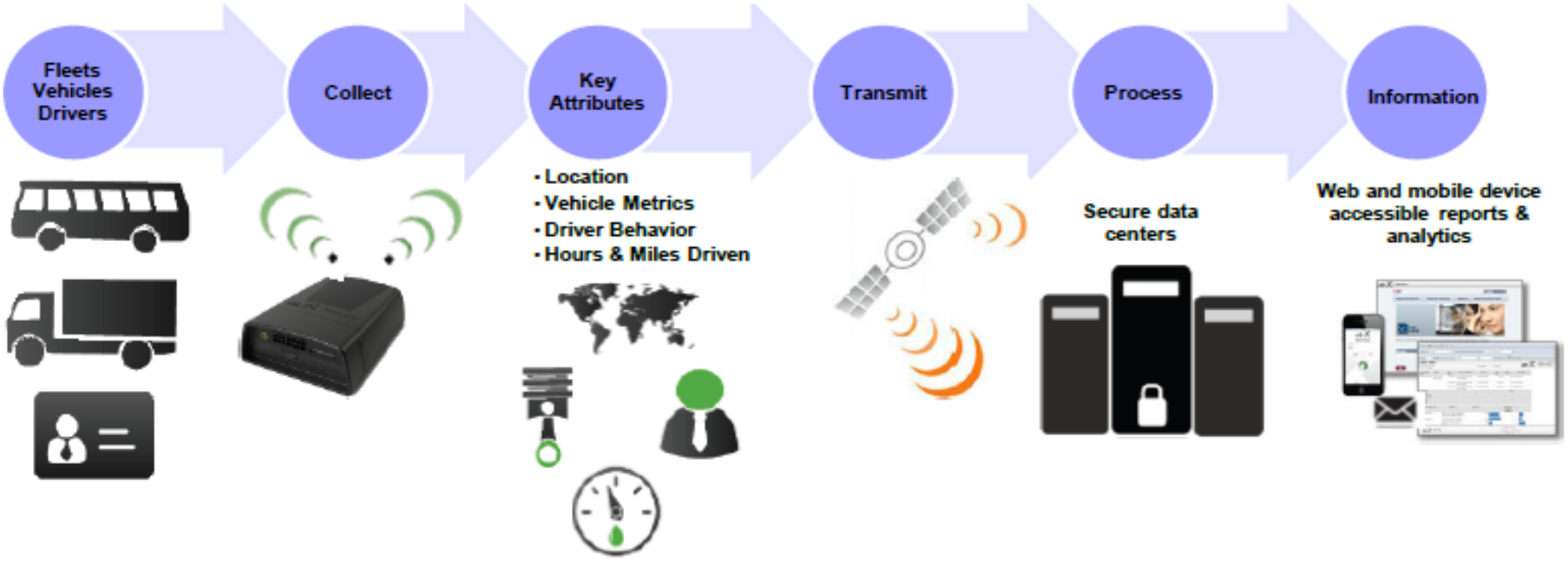
IoT Application: Smart Cities

- Parking: online parking search and payment
- Street light: energy efficient, monitor air quality, provide wifi hotspot
- Bus stops: display real time, charging sockets
- Garbage bins: monitor trash levels, optimize routes for garbage collection

IoT Application: Transportation

- **Fleet management**
- **Safer cars and routes**
- **Passenger security**
- **Delivery time**
- **Etc.**

IoT Application: Transportation

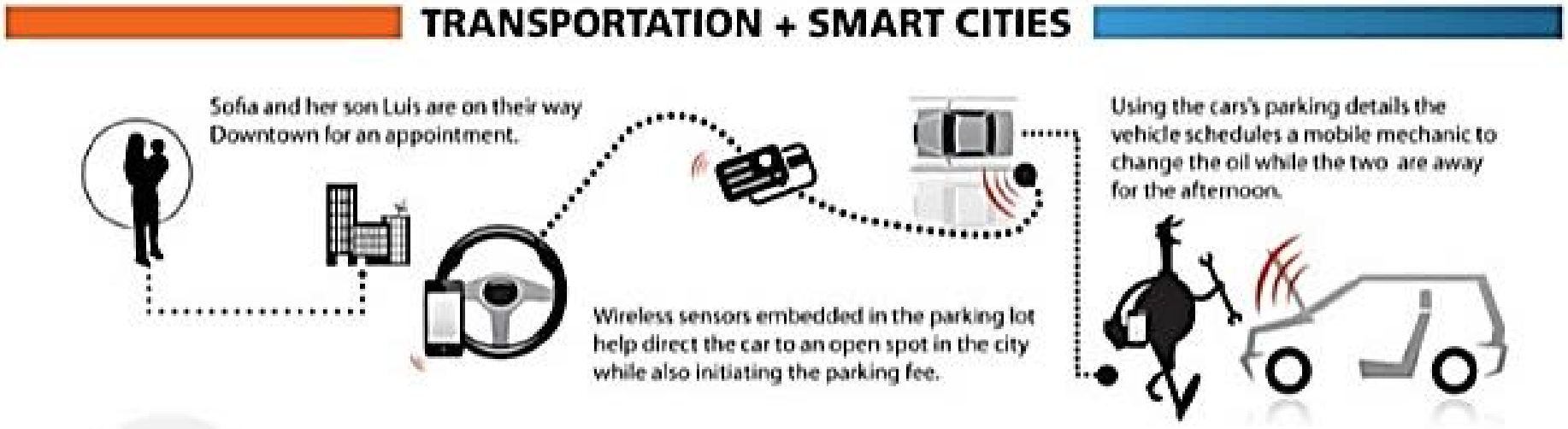


Transportation is one of the first business sectors interested in IoT

Sensors per car: 2014: 60-100, 2020: over 200, there are over 22 billion sensors in automotive industry

Cars connected: 2012: only 10%, by 2020: 90%

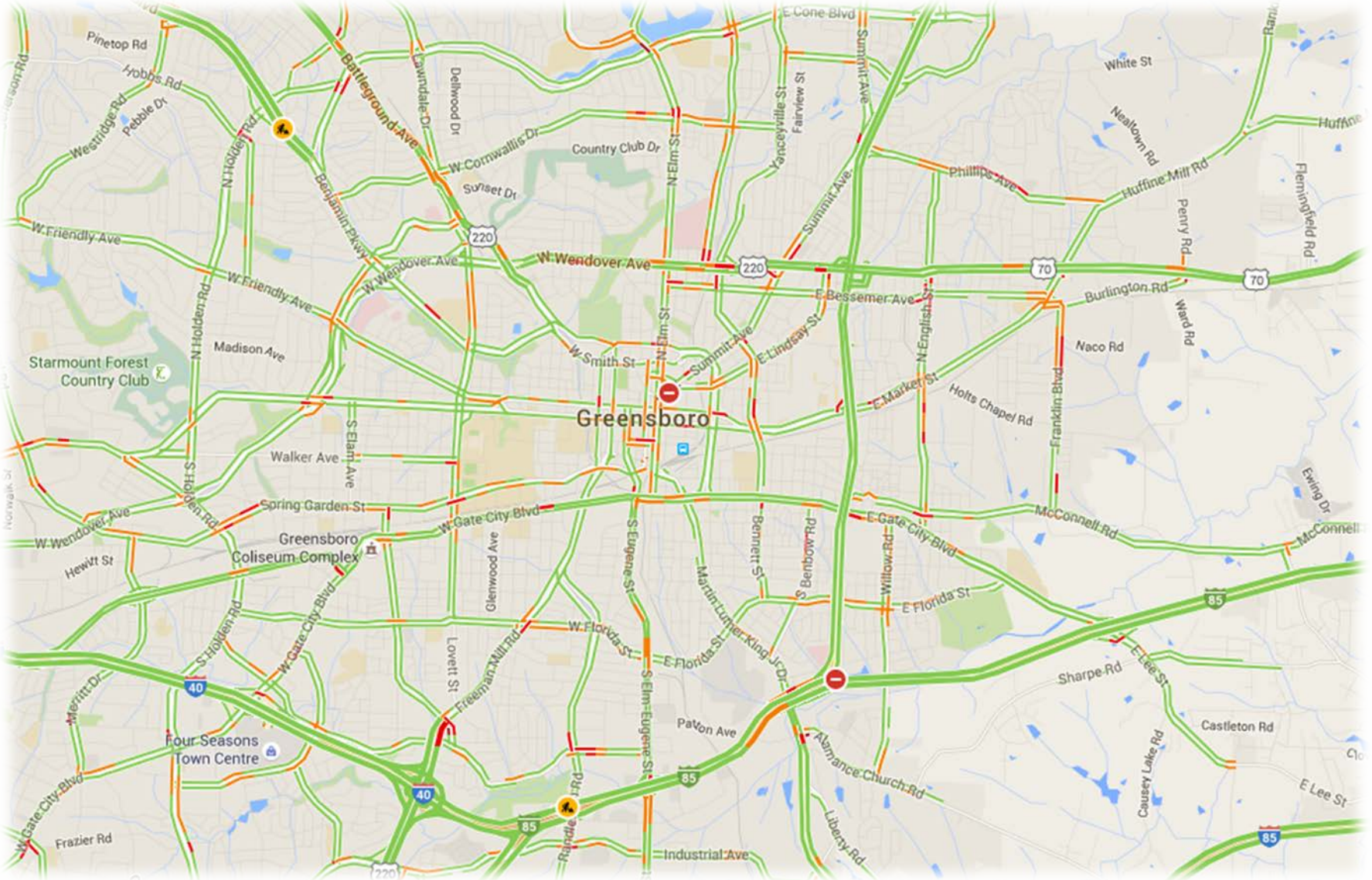
IoT Application: Transportation



In Downtown San Francisco 20-30% of all traffic congestion is caused by people hunting for a parking spot.

- San Francisco Municipal Transportation Agency (SFMTA)

IoT Application: Traffic



Big Data

Every minute we …

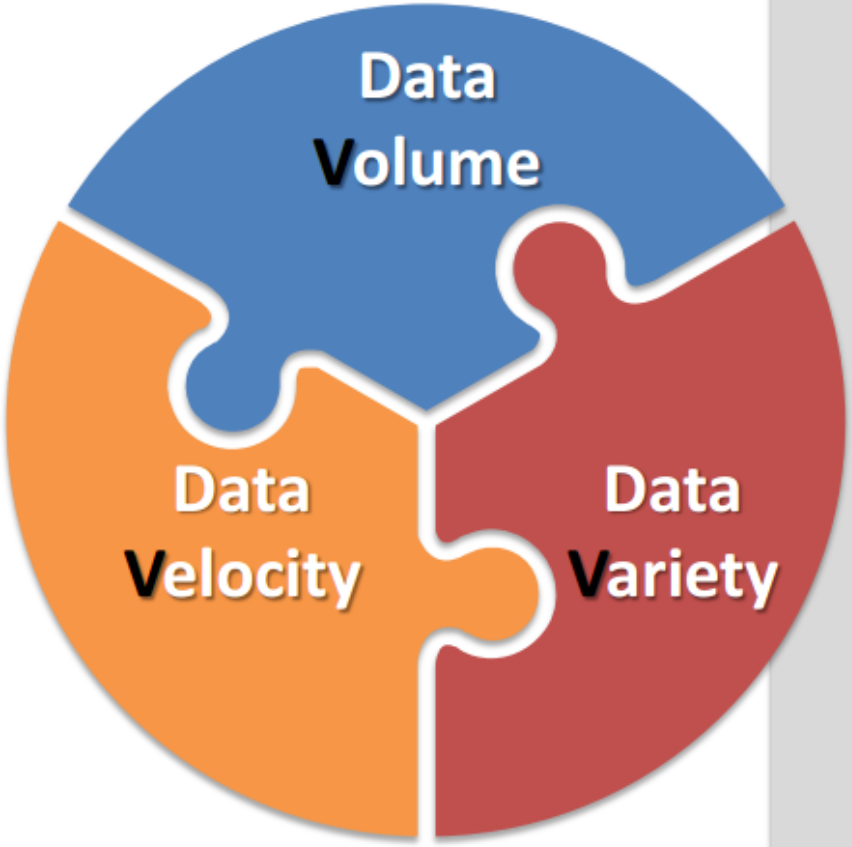
- **Send 204 million emails**
- **Generate 1.8 million Facebook likes**
- **Send 278 thousand tweets**
- **Upload 200 thousand photos to Facebook**

… This is big data!

… Data still in motion, need to extract info

… Big data is not always well understood

Big Data



Volume

Large data size (TBs to PBs)

Velocity

High speed of data flow (CEP), data change (OLTP) and data processing (OLAP, analytics)

Variety

Diverse data (structured/ unstructured), diverse data models and query languages, diverse data sources

3Vs…

- Big data is characterized by having a particular challenge in one or more of the 3Vs
- IoT applications challenge in all of them: both Velocity & Volume and sometimes also Variety

IoT Big Data Requirements

- Connected things' real-time monitoring: Conditions, issues, load, configuration, etc.
- Predictive maintenance: fix before breaking
- Optimization: configuration, interaction with humans, energy efficiency, etc.
- Analytics to design next versions of "things"

IoT and Big Data

- **IoT is *real-time* data and information communication thru sensors**
- **In most applications challenge is *large scale* data communication**
- **Sensors are categorized due to variety of data sources & how data to be stored & processed**
- **By observing thing's behavior, gain insight and optimize process**

Challenges and Limitations

- Privacy and security
- Absence of governance
- Vulnerability to internet attack
- Technological standardization is missing
- Managing rapid innovation: a challenge for governments
- No principles to reduce risks of collecting and using data
- Scalability
- Streamline manageability
- Correlate streams of data with stored data
- Update operational databases with streams of data

Future of IoT

- Daily life
- Traffic issue
- Production
- Trucking
- Logistics
- Retailing
- Resource & power control
- Much more…

Other Applications

- Customized Insurance
- Retail business
- Air pollution & water qualities
- Flood management
- Smart agriculture
- Emergency response (fire safety)
- Mining workers safety
- Supply chain management
- Manufacturing
- Much more…

Resources

- Tamara Dull, SAS Best Practices
- Mazlan Abbas, CEO of REDtone IoT
- www.jabil.com
- Raymond James Report Research
- Cisco Systems
- Ricardo Jimenez-Peris, University of Madrid

Questions?

Reza Jafari, PhD, PE
NCDOT – Planning Branch
rrjafari@ncdot.gov
919-604-0808