

Internet of Thing (IoT) and Big Data

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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

The diagram illustrates the concept of the Internet of Things (IoT) with a central smartwatch. The watch screen shows the time 10:15, the day Sunday, and the date 26 Jan 2014. It also features icons for a sun, a cloud, a red alarm clock, a green phone, a blue speech bubble, and an orange envelope. Surrounding the watch are various IoT-enabled devices and icons, all connected by a dotted line. These include:

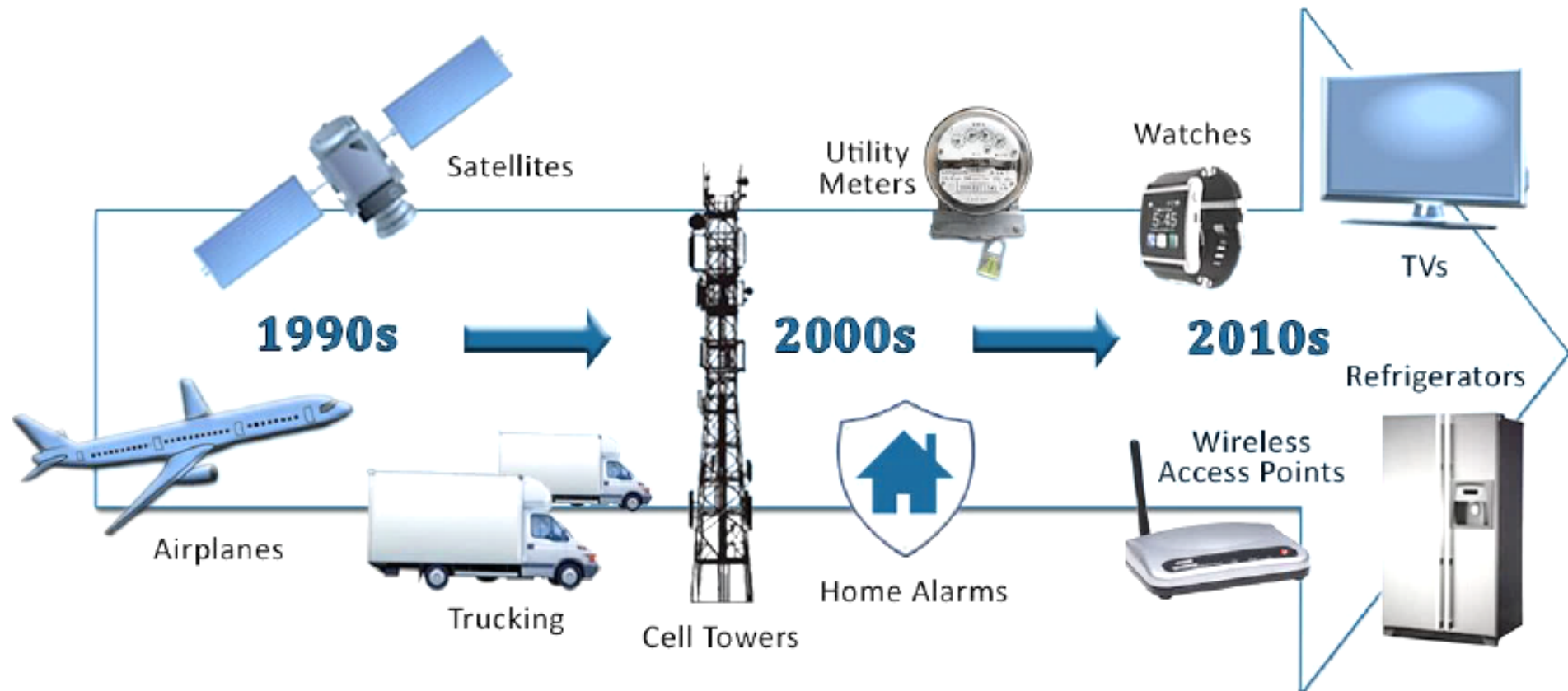
- Smart Phones:** A smartphone icon at the top left.
- Smart Cars:** A red sports car icon at the middle left.
- Smart Watches:** A black smartwatch icon at the bottom left.
- Smart Glasses:** A pair of blue smart glasses at the top right.
- Drones:** A black quadcopter drone icon at the middle right.
- Smart Textiles:** A brown polo shirt icon at the bottom right.

 Other icons scattered around the central watch include a lightbulb, a calendar showing the number 25, a speaker, a bell, a person in a green circle, a location pin, a play button, a camera, a star, a share icon, a calendar, and a speech bubble. Blue plus signs are also placed along the dotted line connecting the devices.

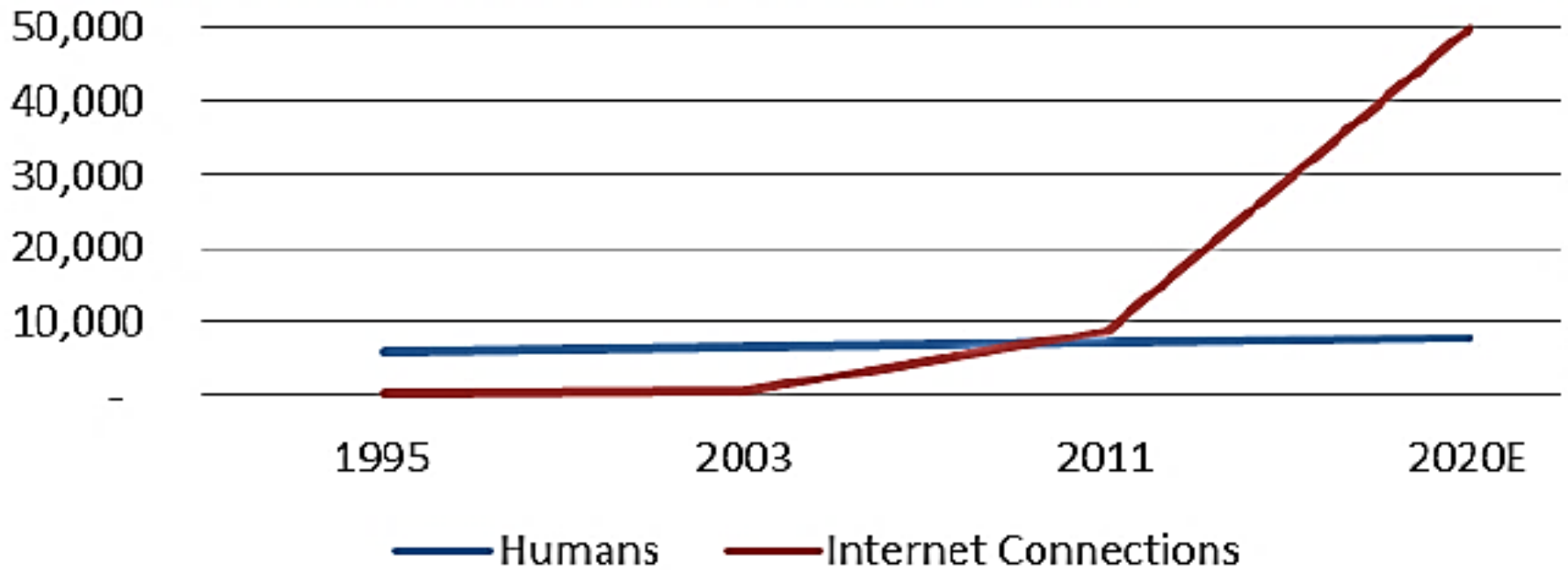
In US	2011, \$2 billion market (14 million devices sold) 2016, it will be \$6 billion (171 million devices sold)
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Globally **2013, \$2 Trillion**
2020, over \$7 Trillion

... Slowly



History

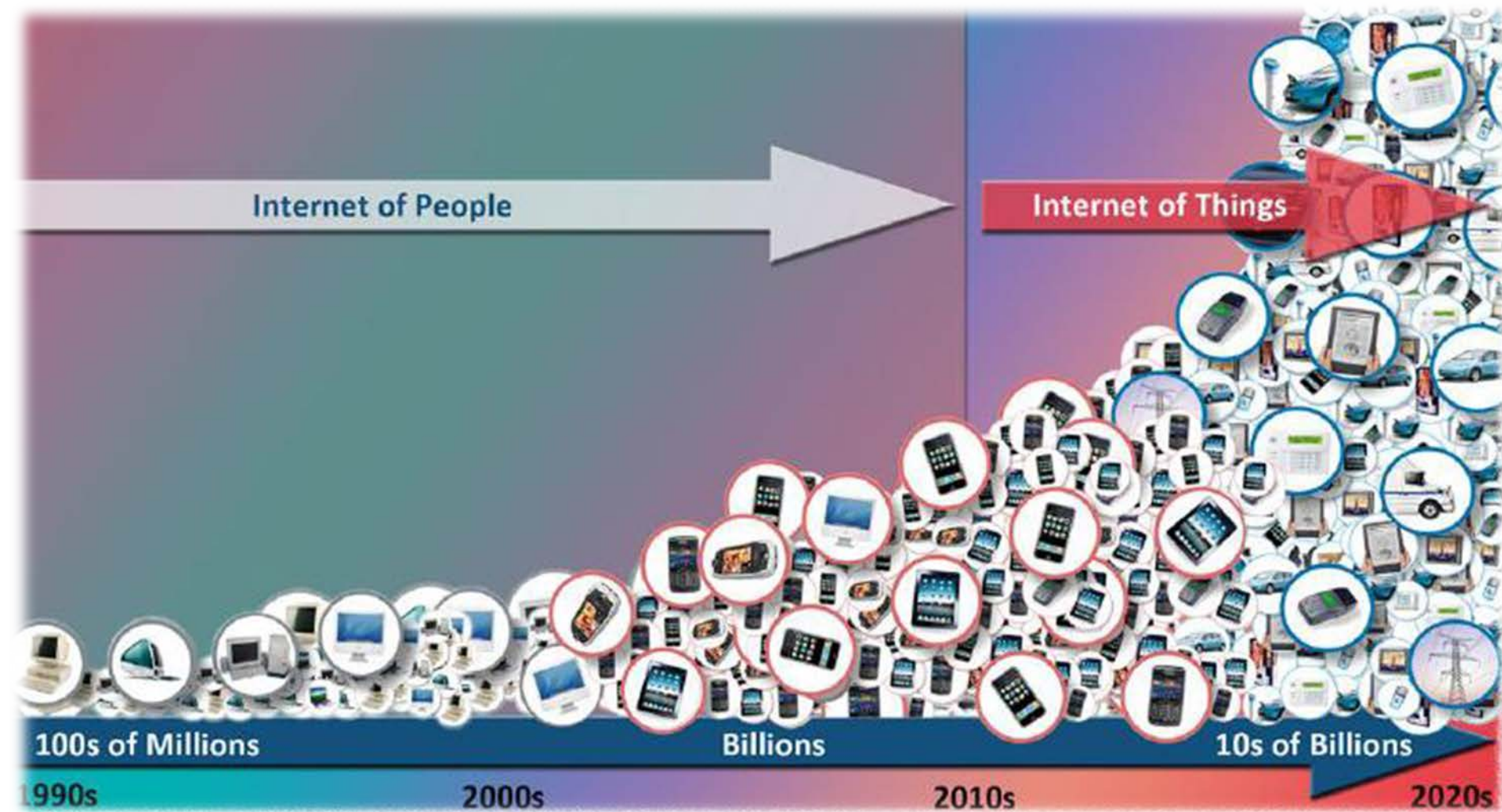


Internet-connected devices:

In 2008, 8 Billion

By 2020, 50 Billion

History

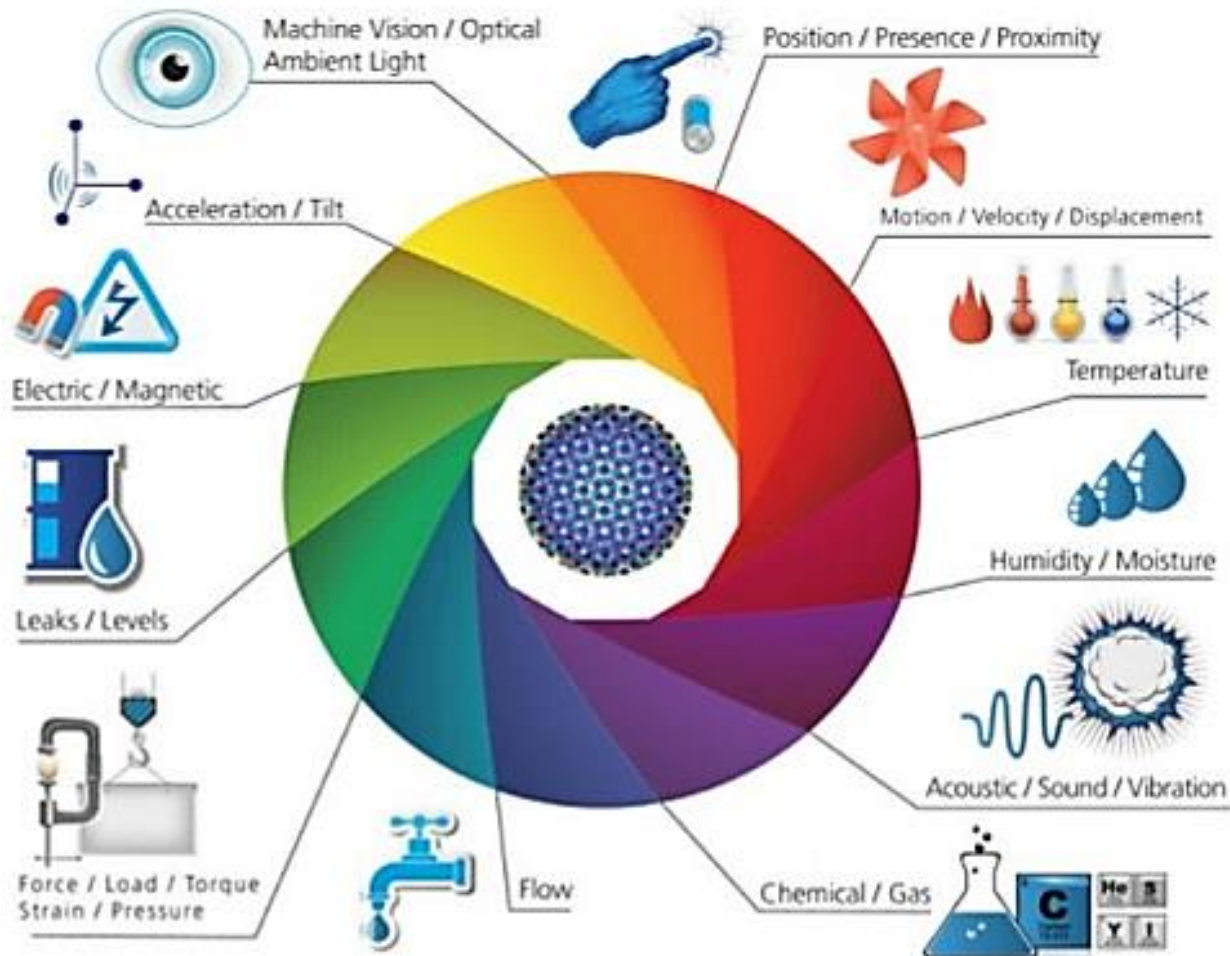


IoT is a Combination of...

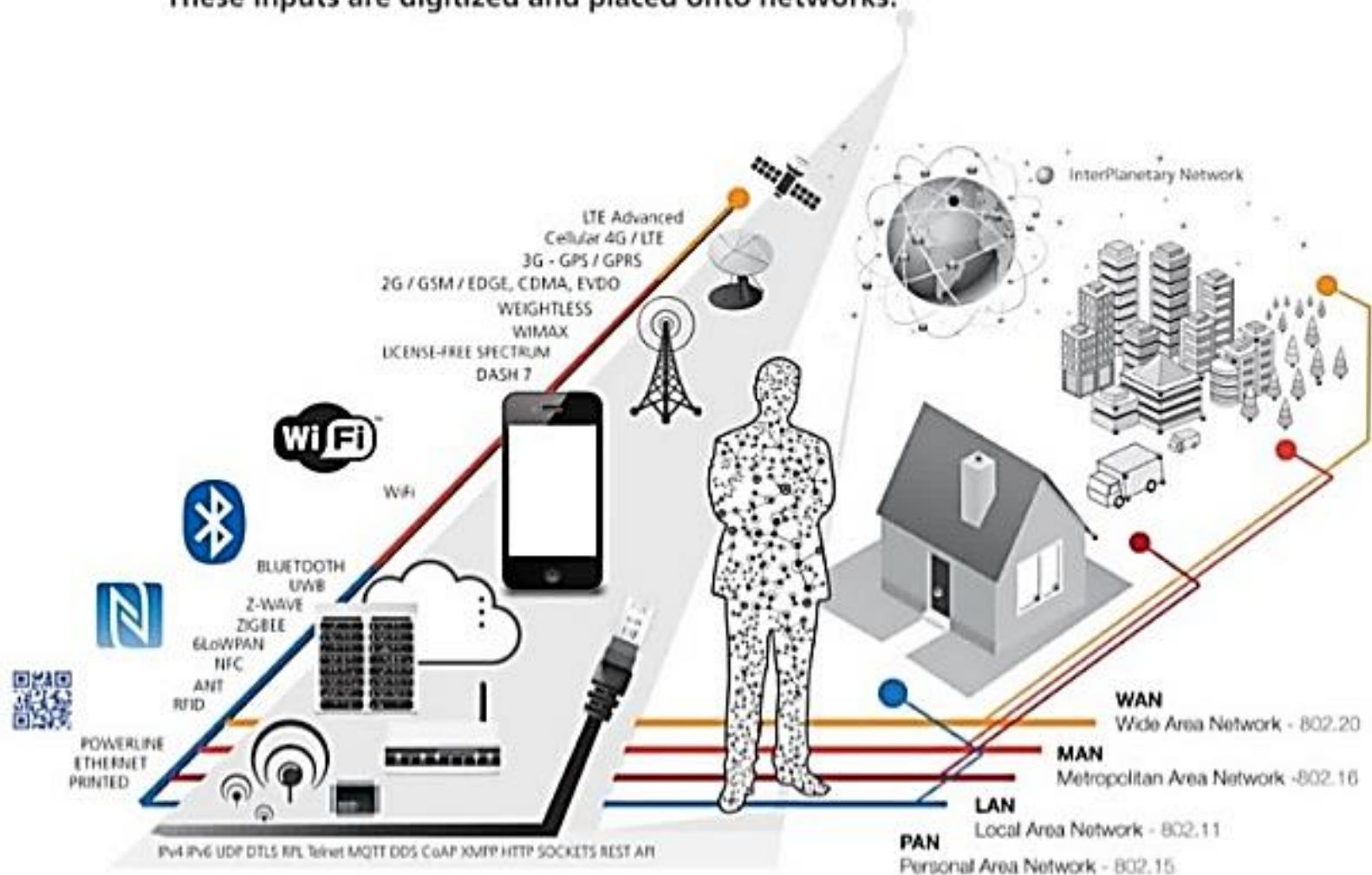
- **Sensors**
- **Connectivity**
- **People & Process**

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.

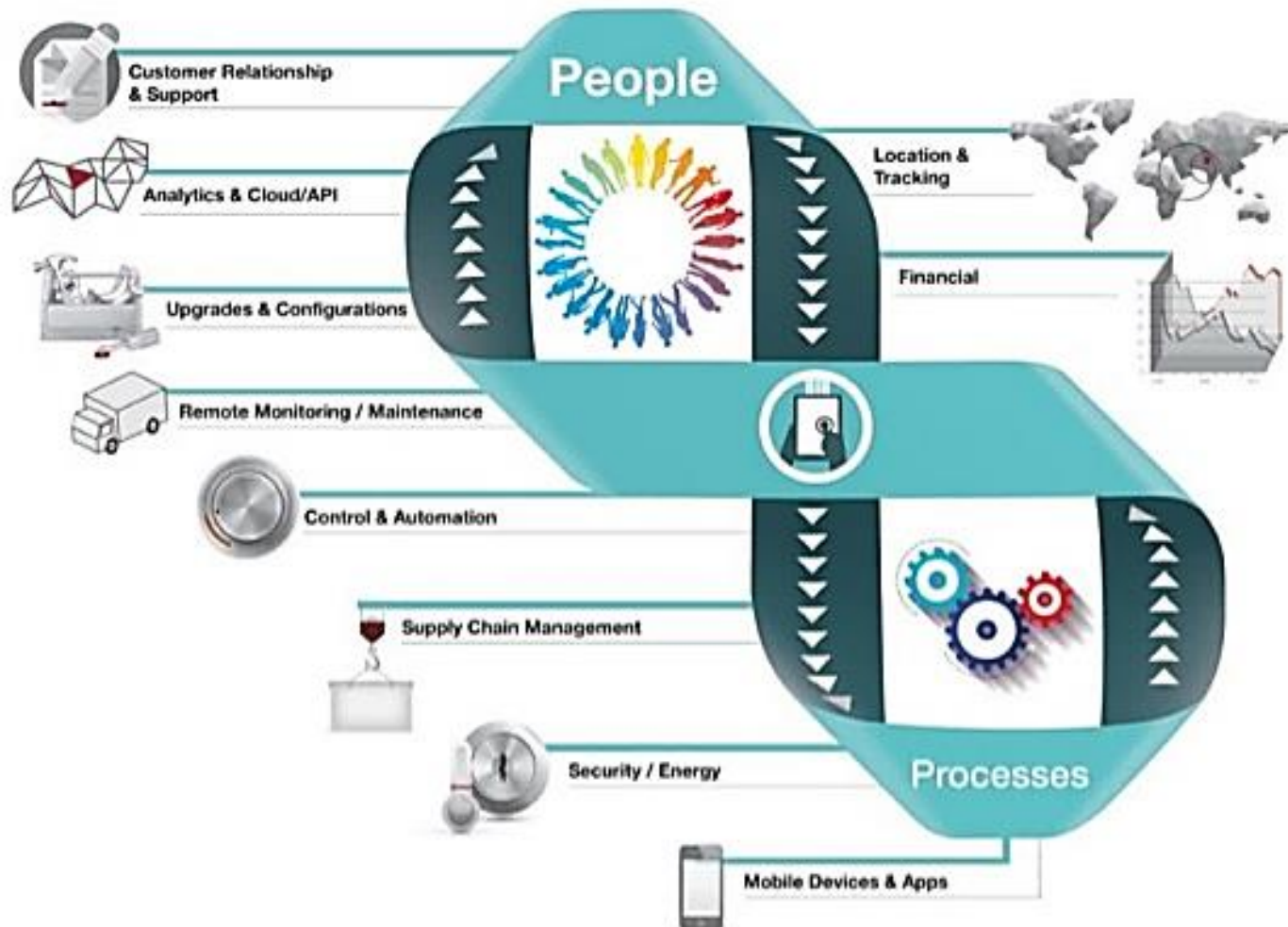


These inputs are digitized and placed onto networks.



3 PEOPLE & PROCESSES

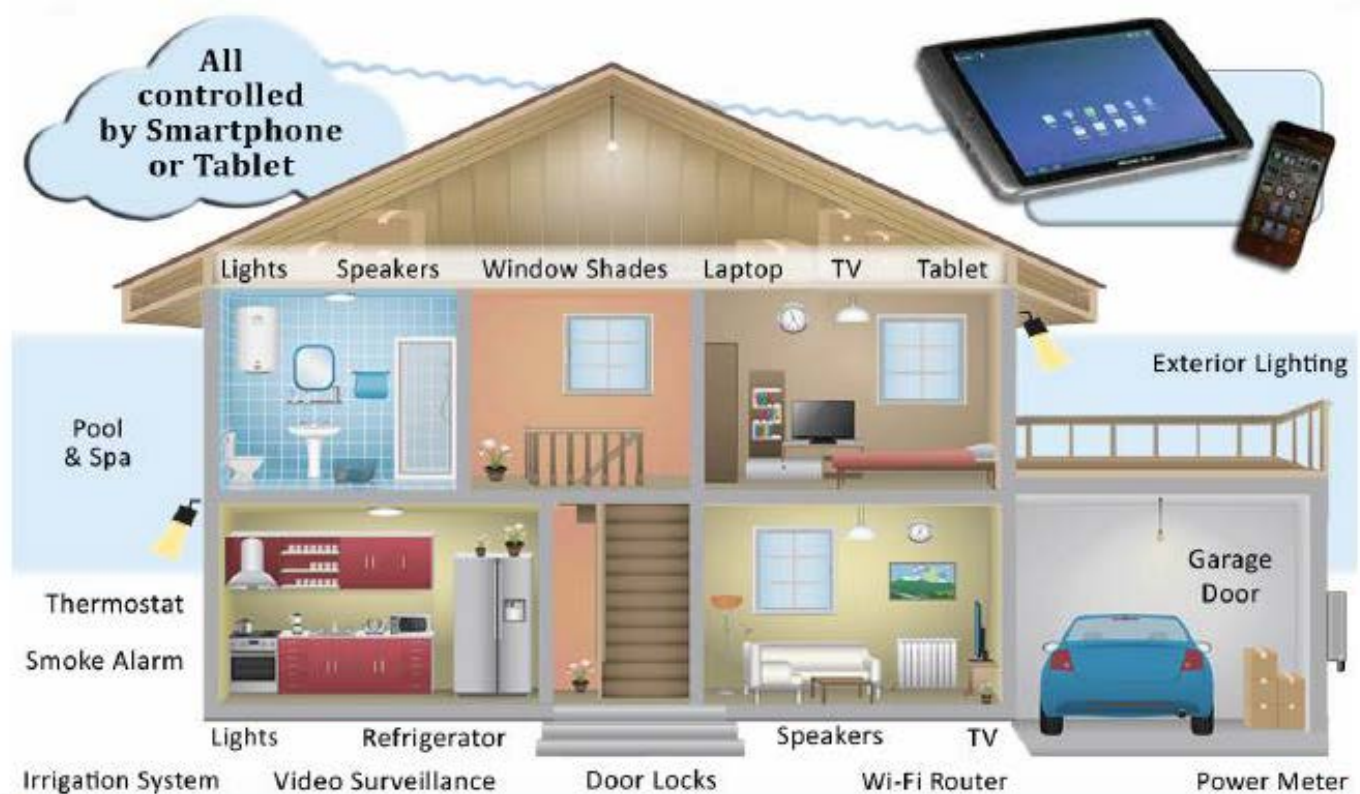
These networked inputs can then be combined into bi-directional systems that integrate data, people, processes and systems for better decision making.



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,...

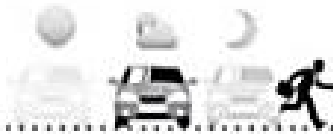
2008, 4% - 2012, 18% - 2020: Over half the homes!

IoT Application: Building

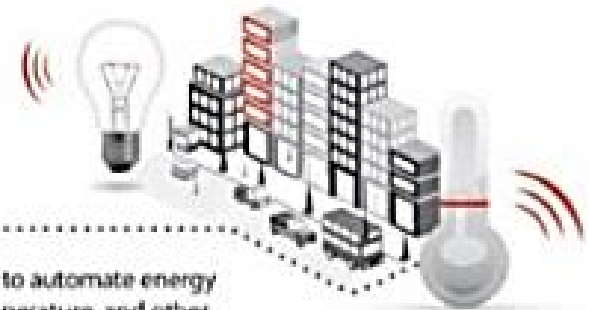
SMART BUILDINGS + MOBILITY



Anna is being pressured to reduce her company's expenses for their new corporate office.



After speaking with experts she decides to install sensors to automate energy usage according to building occupancy, people flow, temperature, and other ambient conditions – improving the building's overall efficiency.



Energy used by commercial and industrial buildings in the US creates nearly 50% of our national emissions of greenhouse gases.

- United States Environmental Protection Agency

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

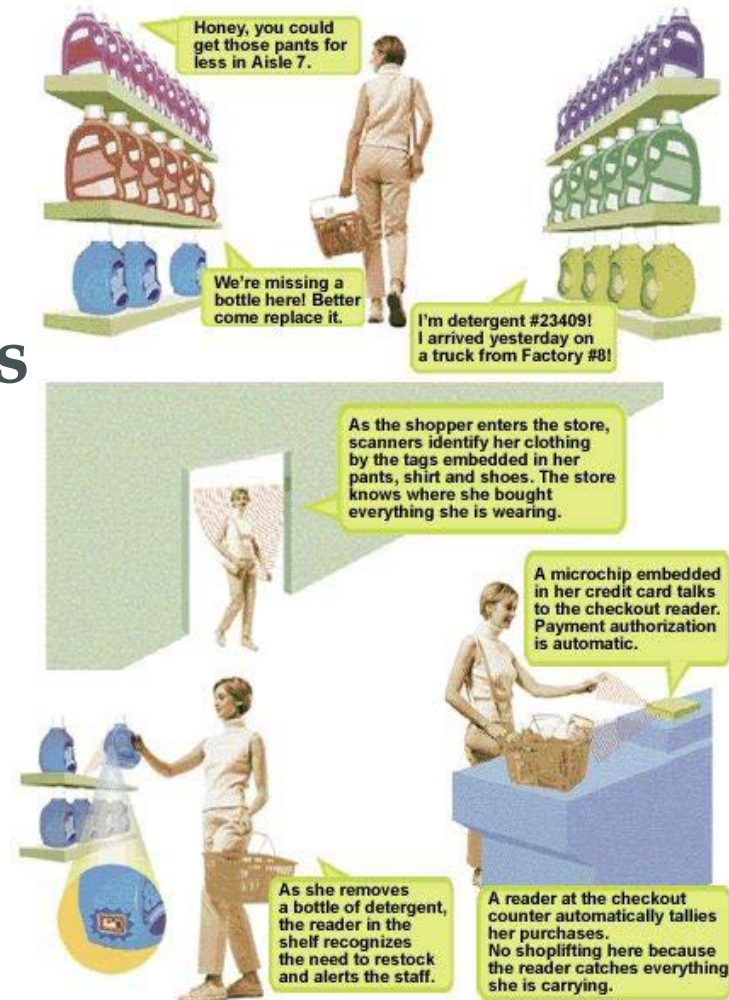
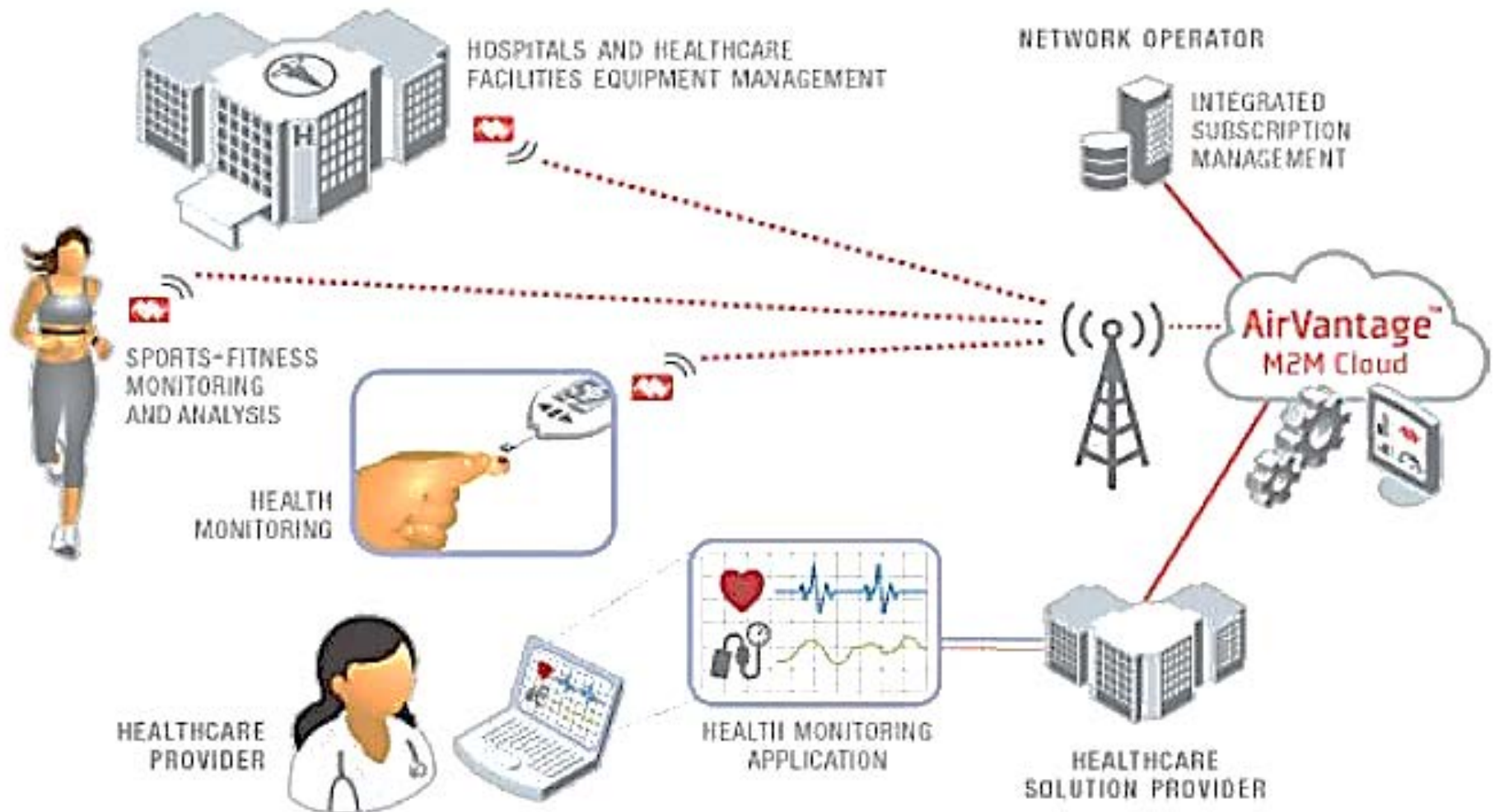


Illustration by Lisa Knouse Braiman for Forbes

IoT Application: Healthcare

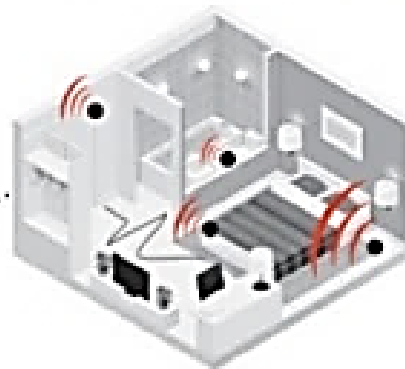


IoT Application: Healthcare

HEALTHCARE + SMART HOME



Aging uncle Earl is still living isolated at his home and you are concerned about his safety.



Wireless sensors throughout his house help measure healthy activity levels, sleeping patterns and medication schedules.



Alerts are automatically sent to health care services and authorized family members if any abnormal activity is detected.

40 million adults age 65 and over will be living alone in the U.S, Canada and Europe.

• U.S. Department of Health and Human Services; Administration for Community Living (ACL)

IoT Application: Smart Cities

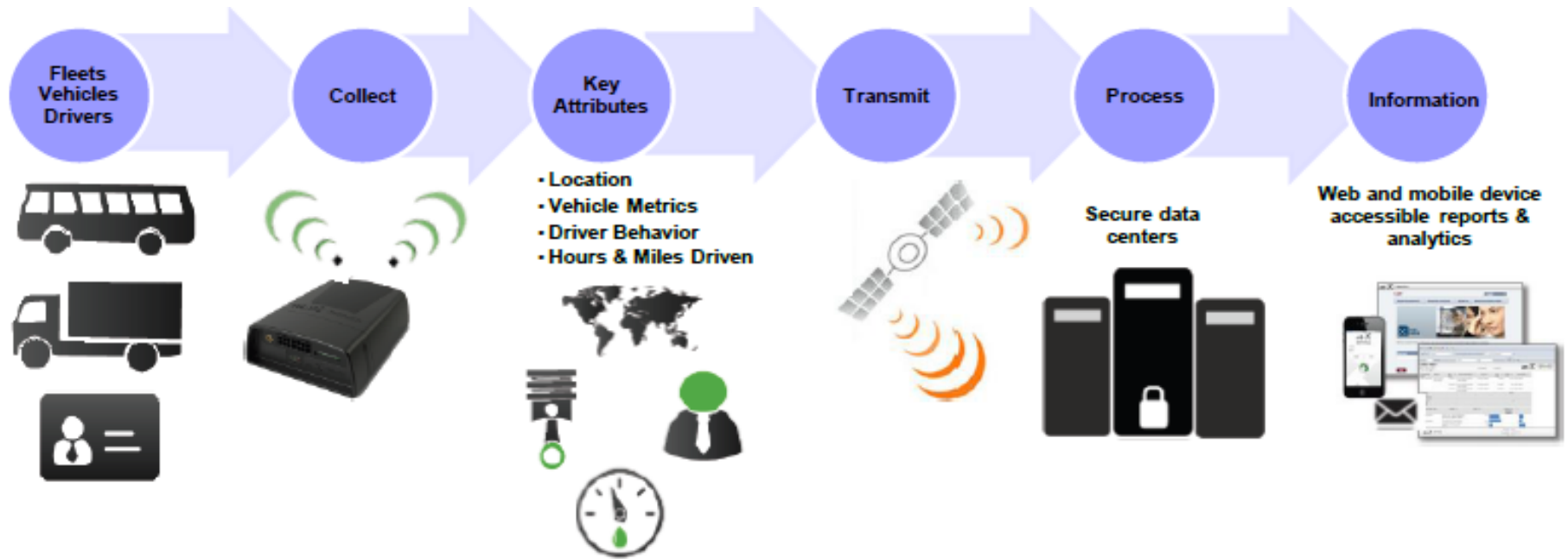
- Parking: online parking search and payment
- Street light: energy efficient, monitor air quality, provide wifi hotspot
- Bus stops: display real time, charging sockets
- Garbage bins: monitor trash levels, optimize routes for garbage collection



IoT Application: Transportation

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

IoT Application: Transportation



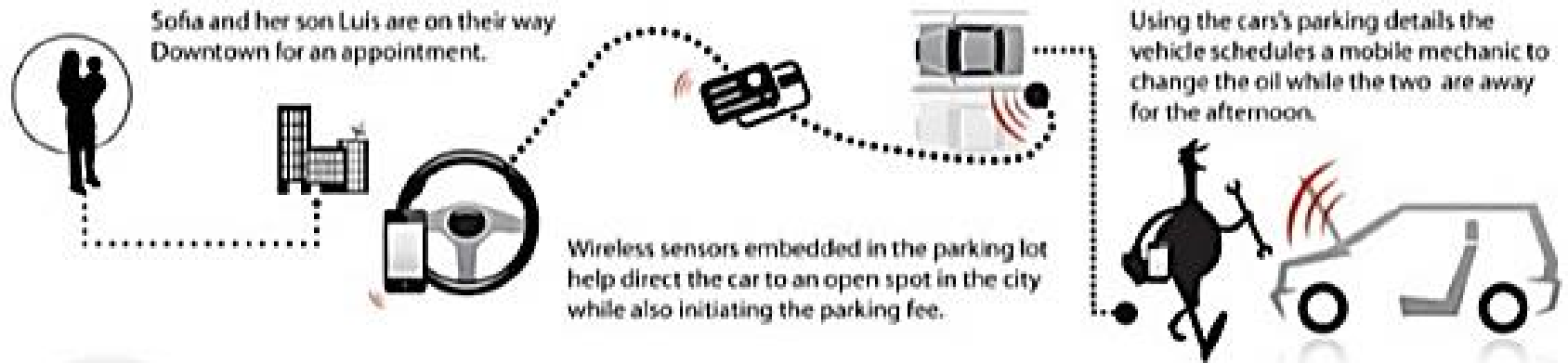
Transportation is one of the first business sectors interested in IoT

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

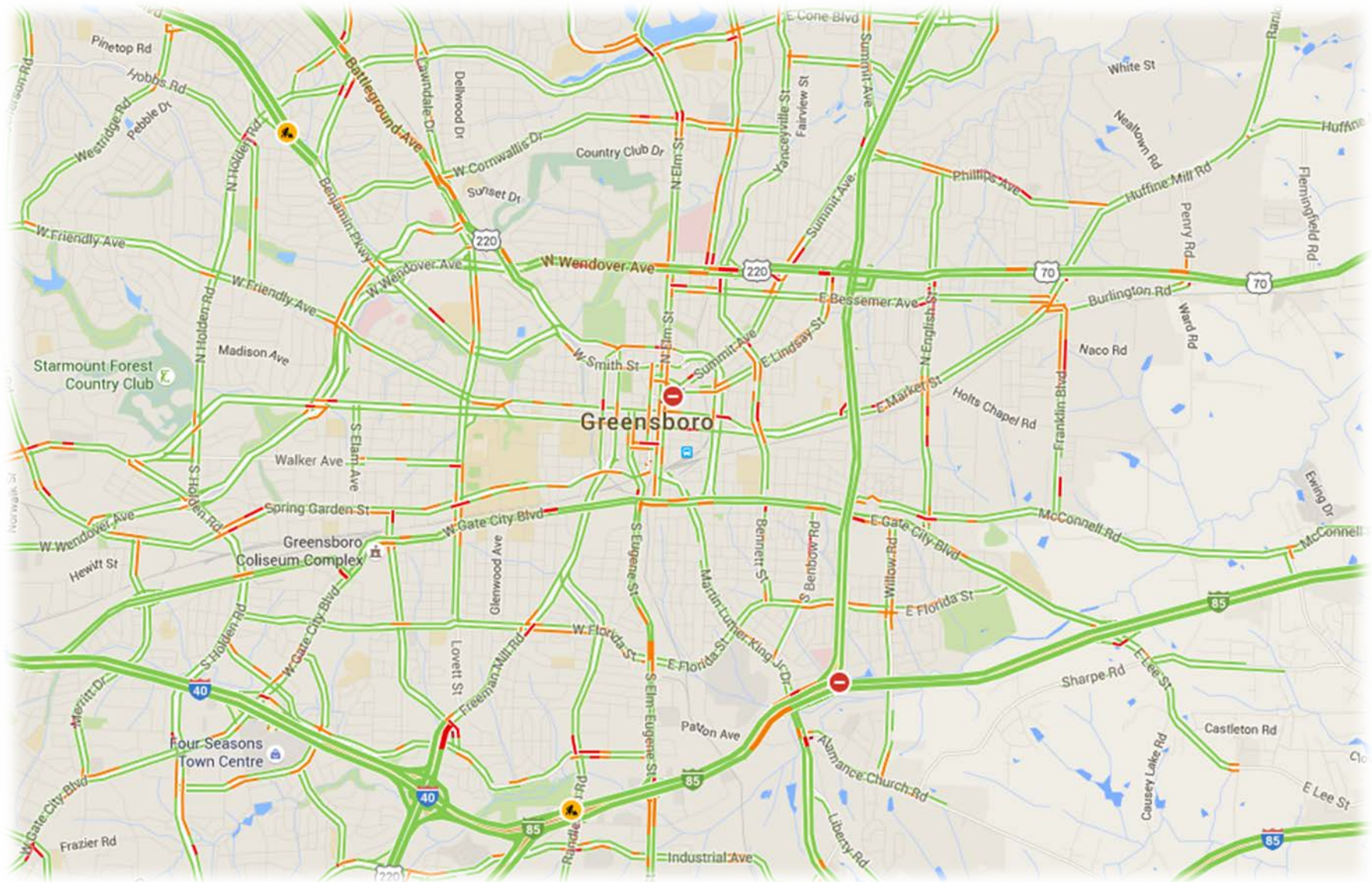
TRANSPORTATION + SMART CITIES



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 ...

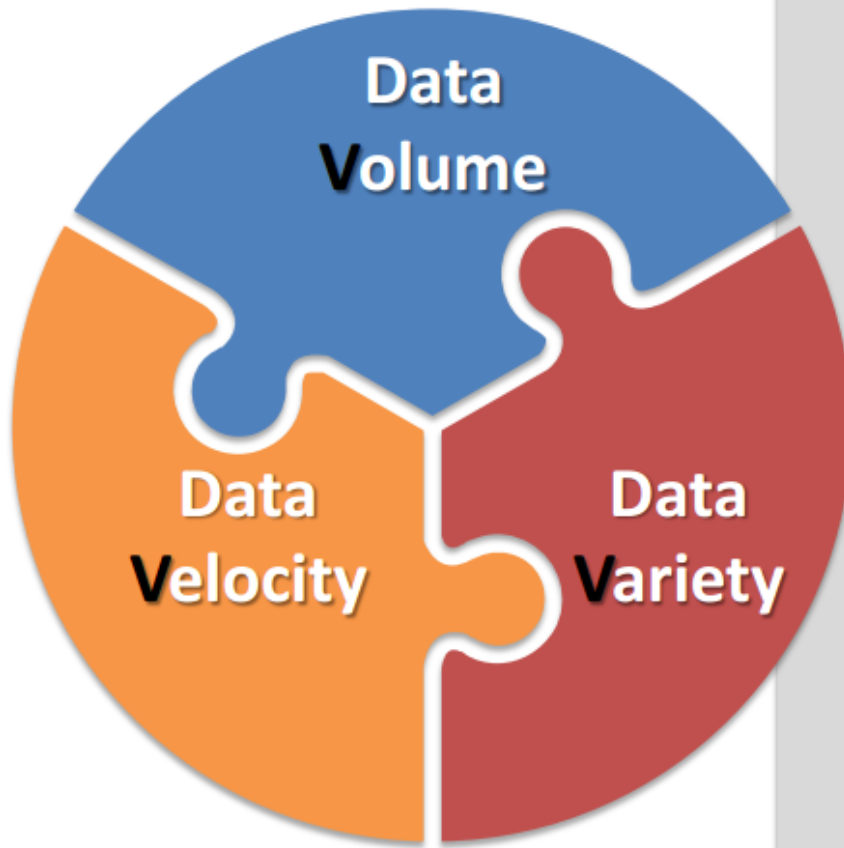
- Send 204 million emails
- Generate 1.8 million Facebook likes
- Send 278 thousand tweets
- Upload 200 thousand photos to Facebook

... 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?



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