Internet of Things
overview

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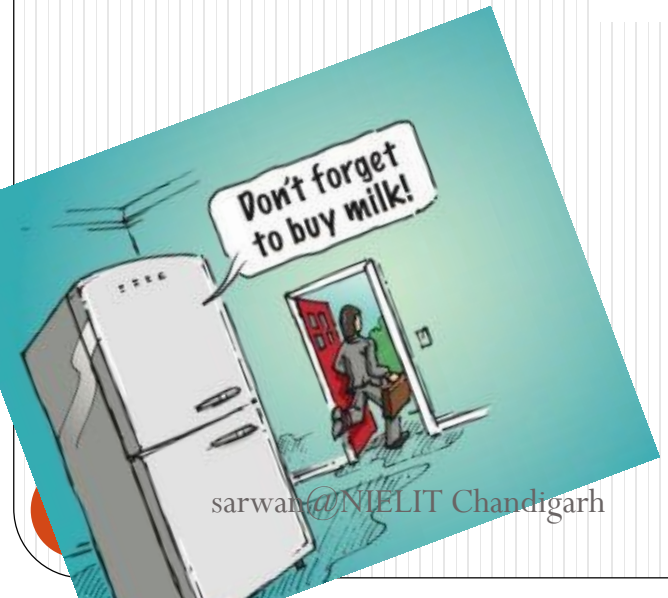
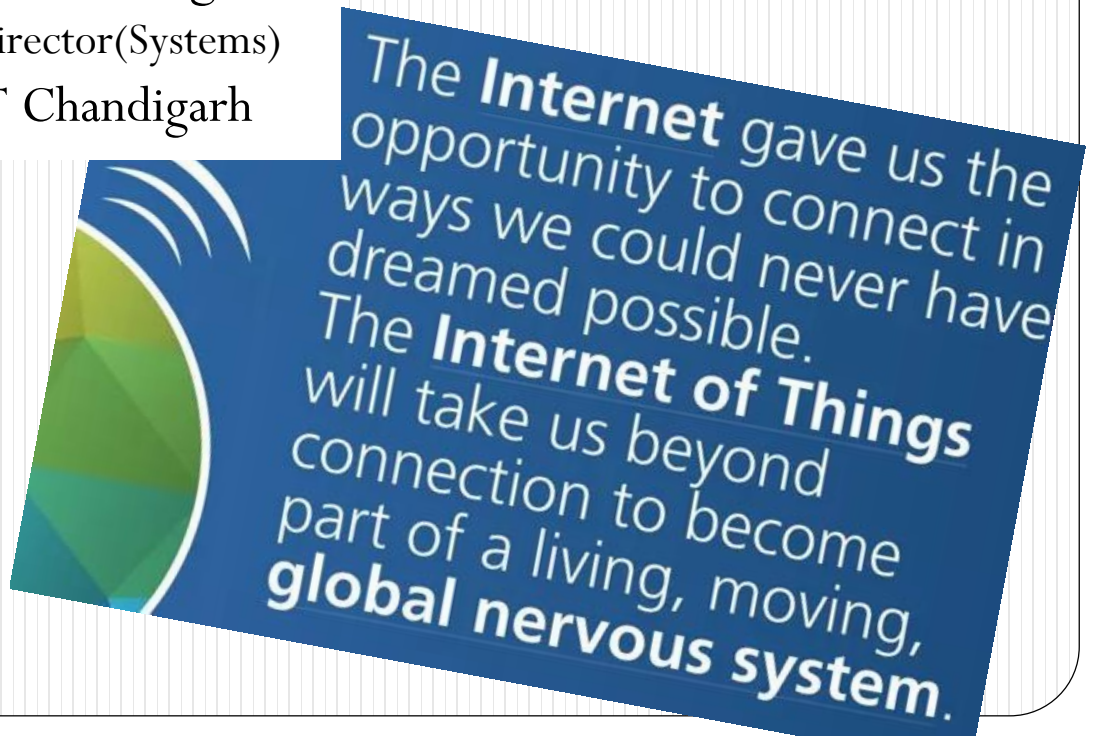
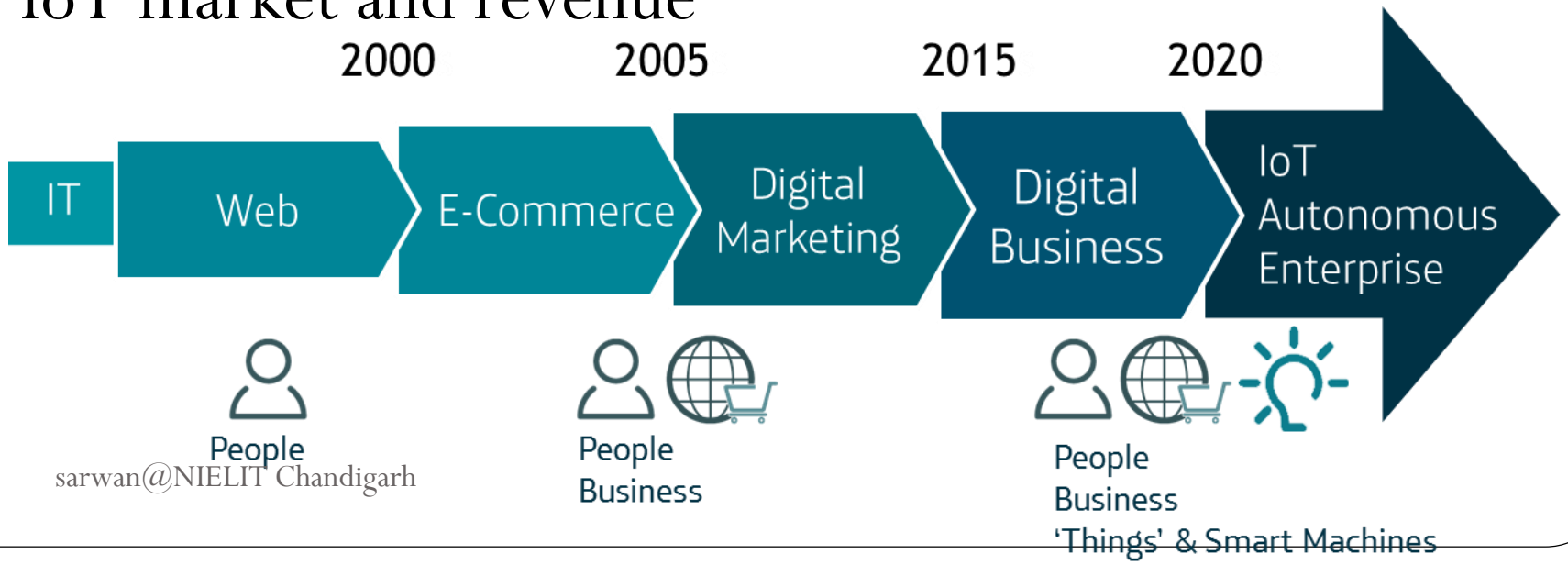




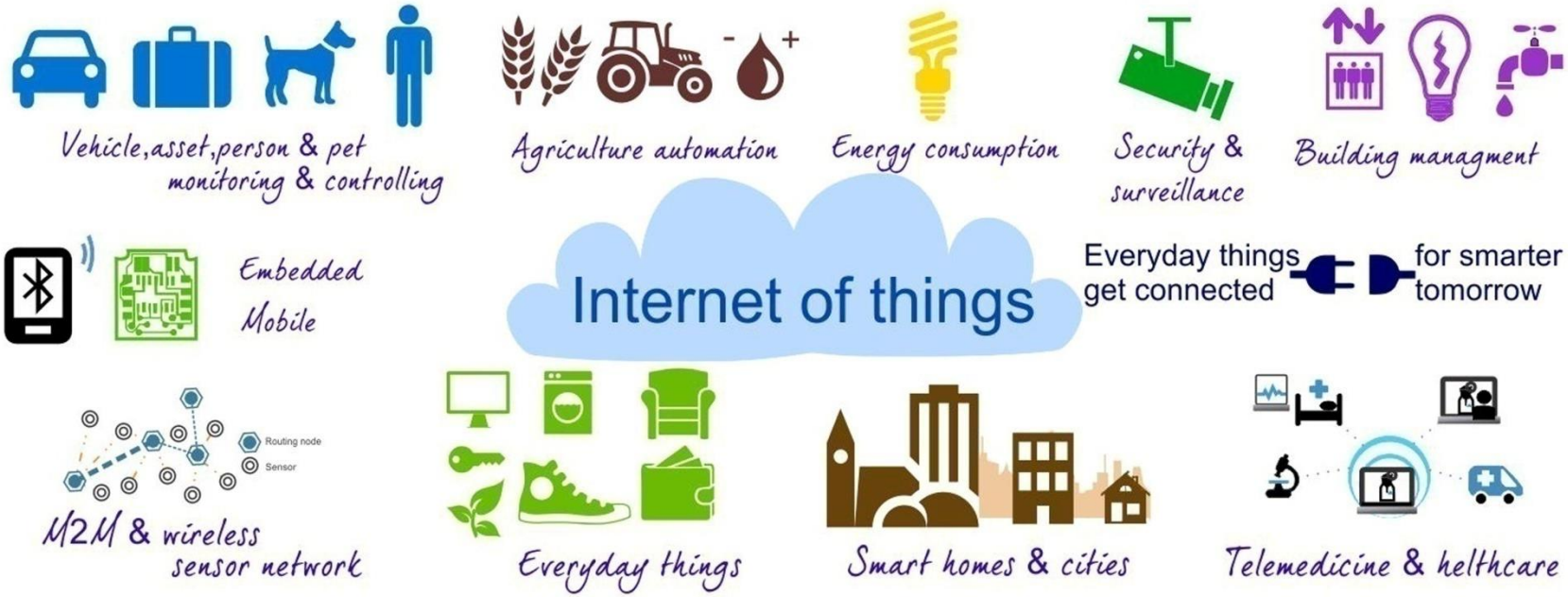
Agenda

- About IoT
- What is IoT
- Sensors
- IoT applications in different domains
- IoT market and revenue



IoT - *Definition*

"The Internet of Things is the network of physical objects that contain embedded technology to communicate and sense or interact with their internal states or the external environment." - Gartner




What Happens in an Internet Minute?
639,800 GB of global IP data transferred
20
New victims of identity theft
204 million
47,000
App downloads
$83,000
61,141
20 million
Photo views
3,000
Photo uploads
320+
New Twitter accounts
100,000
135
1,300
New mobile users
100+
New LinkedIn accounts
6
New Wikipedia articles published
277,000
Logins
6 million
Facebook views
2+ million
Search queries
30
Hours of video uploaded
1.3 million
Video views
And Future Growth is Staggering
Today, the number of networked devices
the global population
By 2015, the number of networked devices
2x
the global population
In 2015, it would take you 5 years
IP
to view all video crossing IP networks each second

IoT is Everywhere


8.6B
Connected
"Things"
$508B
Market
Opportunity
2019: IoT in Asia
@CRASingapore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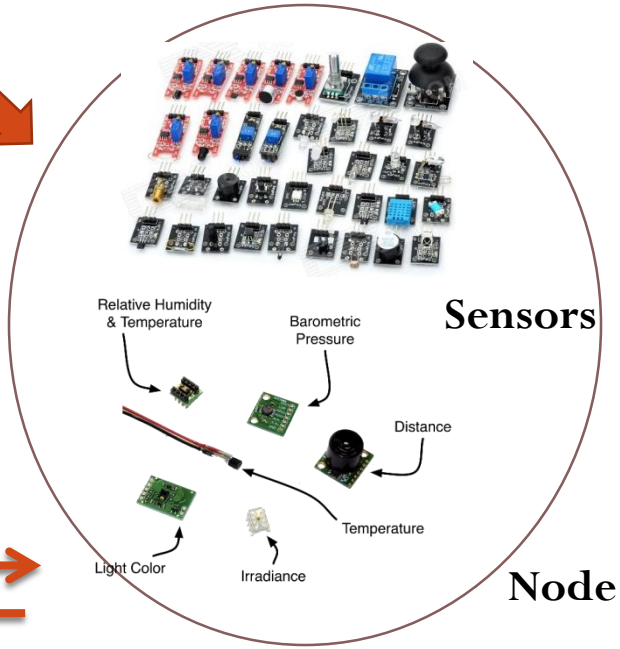
IoT Market Maturity in 2019
IoT Units/Capita
0.6
1.2
1.3
1.5
1.7
2.2
2.3
3.5
3.8
5.1
5.6
8.2
8.5
IN
PH
VT
ID
HK
TH
MY
PRC
TW
SG
NZ
SK
AU

How is IoT works



Cloud based ERP of Things, Device Mgmt platform

Smart systems and IoT are driven by combination of three things

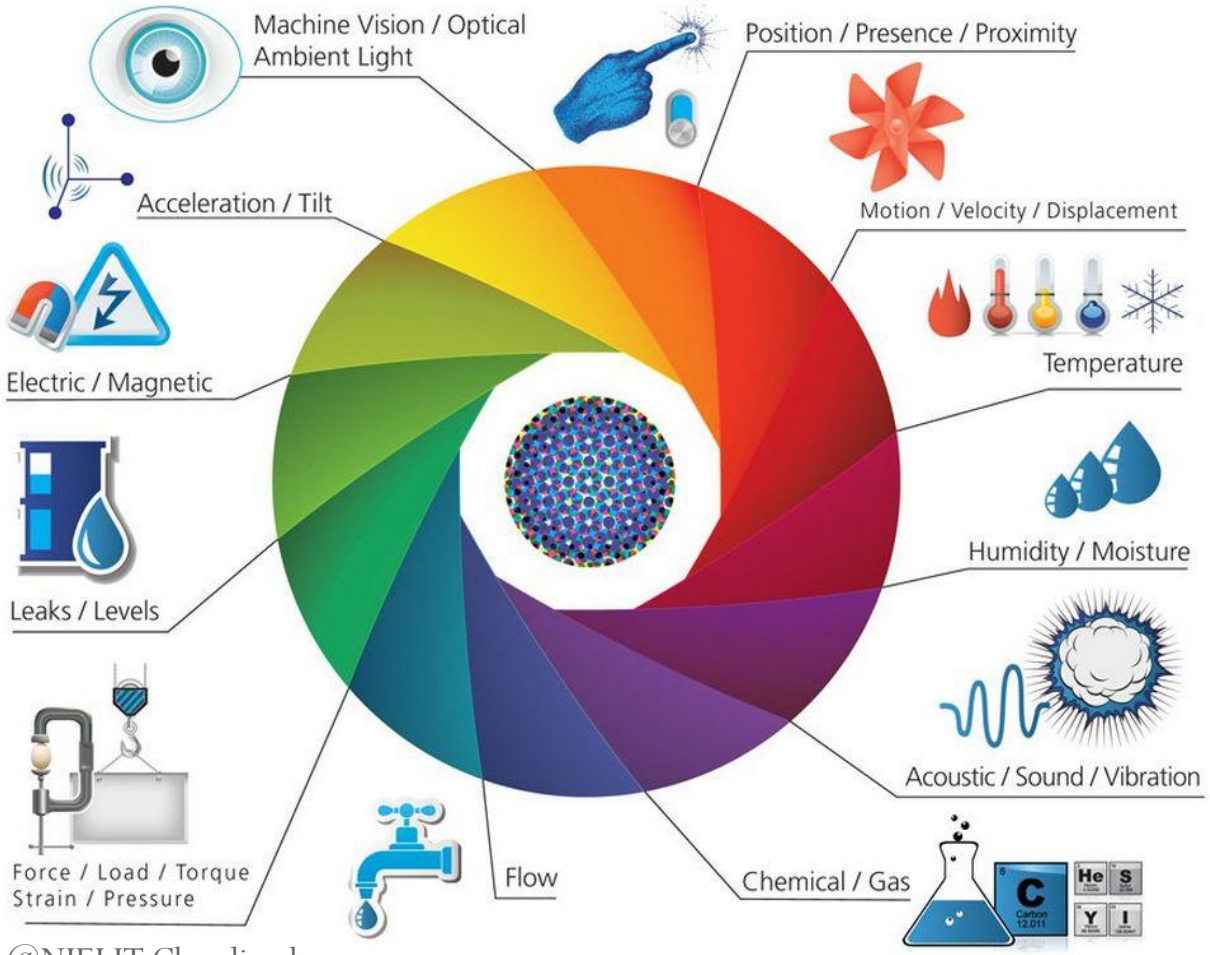
Sensors & Actuators

Connectivity

People & Processes

Sensors & Actuators

- We are giving our world 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.



Sensors & Actuators

The embedded systems can be connected to different sensors such as below for collecting the information:

- Humidity sensor
- Level/tilt sensor
- Pressure sensor
- Temperature sensor
- Motion Sensors
- Proximity Sensors
- Optical Sensors
- Acceleration sensors
- Load sensors
- Vibration sensors
- Chemical sensors
- Flow sensors

They can also be connected to actuators to translate the collected or received information into actions, below are some of the actuators:

- Light emitting Diodes [LED]
- Relays
- Motors
- Linear actuators
- Lasers
- Solenoids
- Speakers
- LCD or Plasma displays

Connectivity

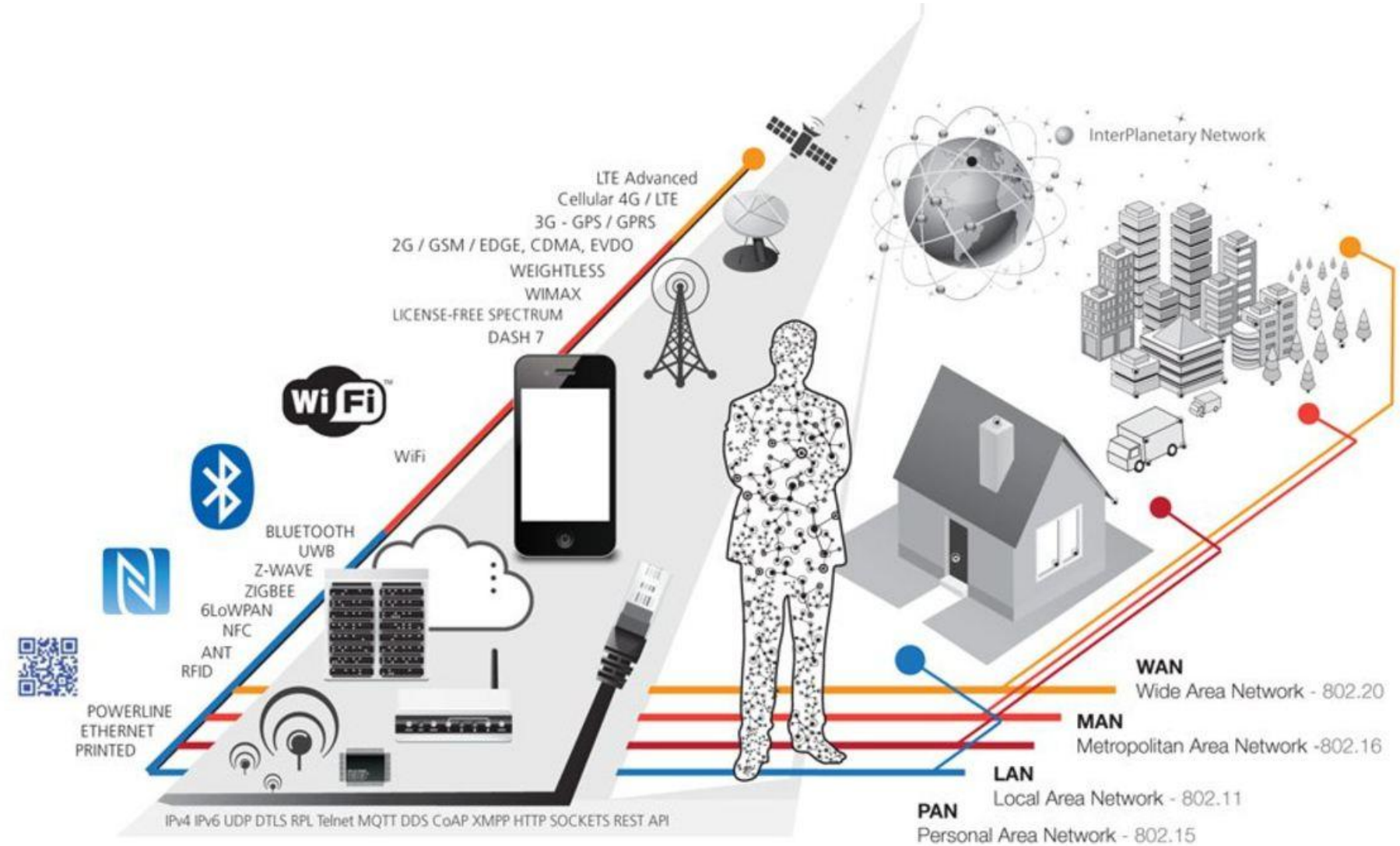
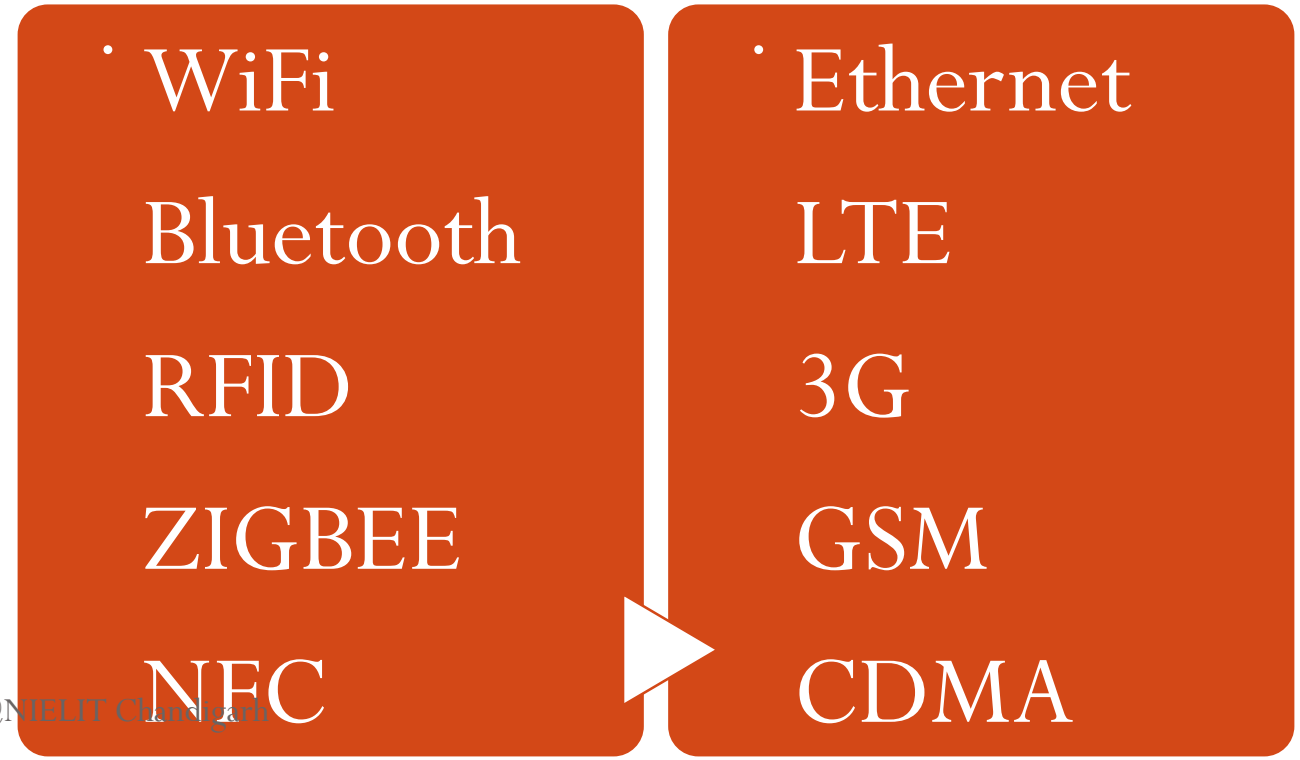


Image Source: Postscapes

Connectivity

The embedded systems can use a range of connectivity to connect with other devices or the internet.

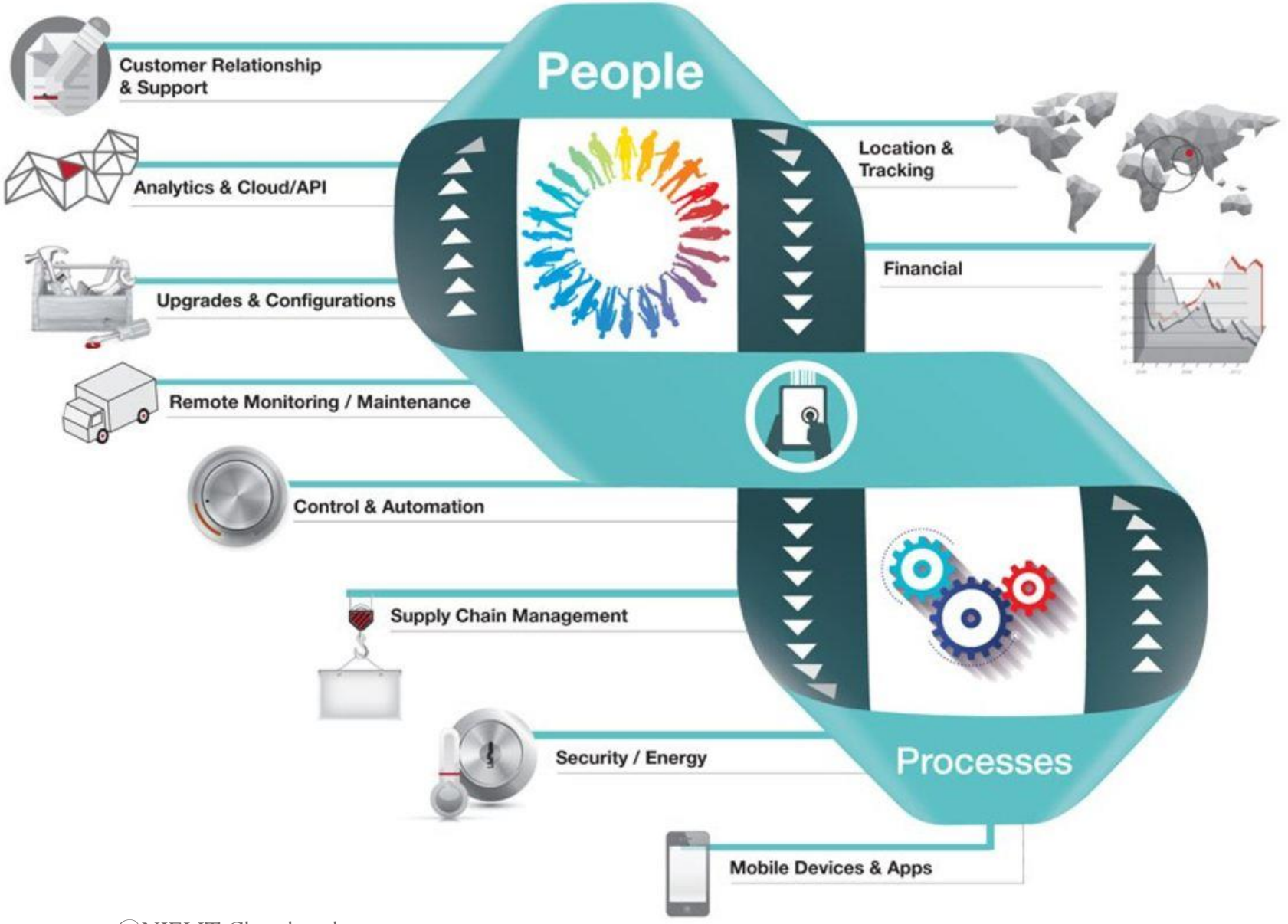
- Some examples are as below:



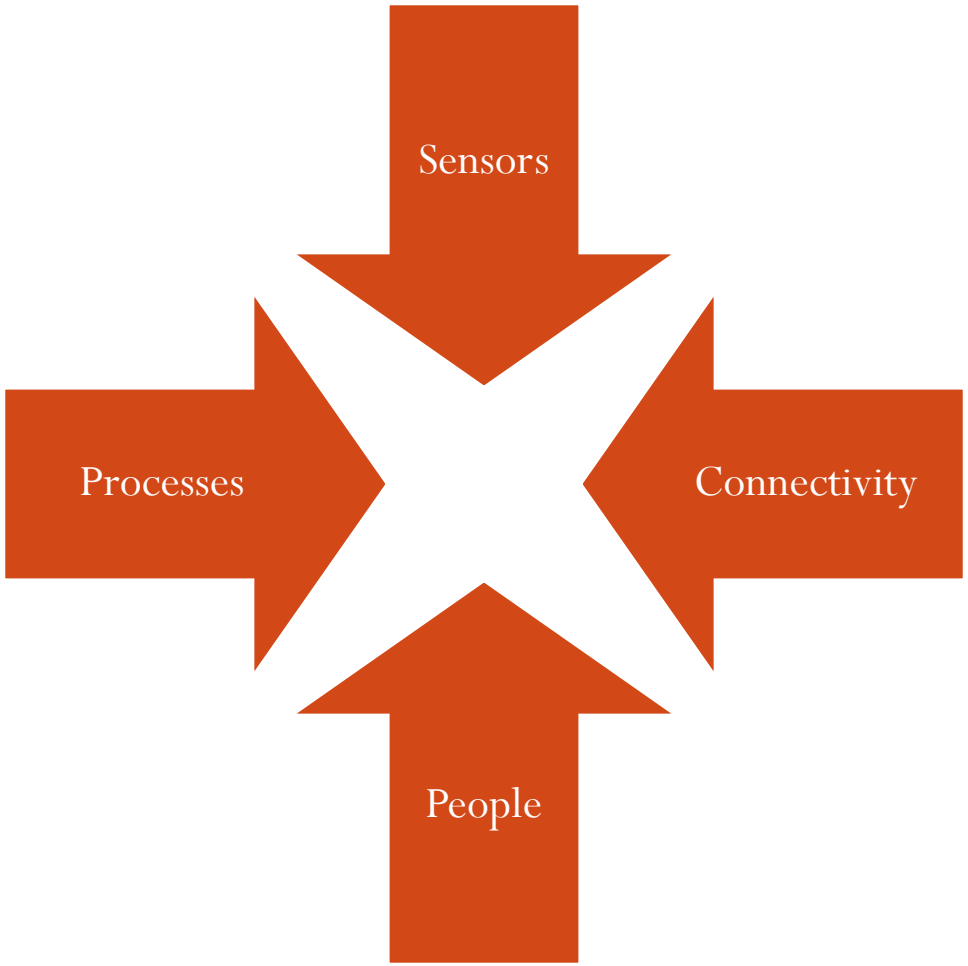
People and Process

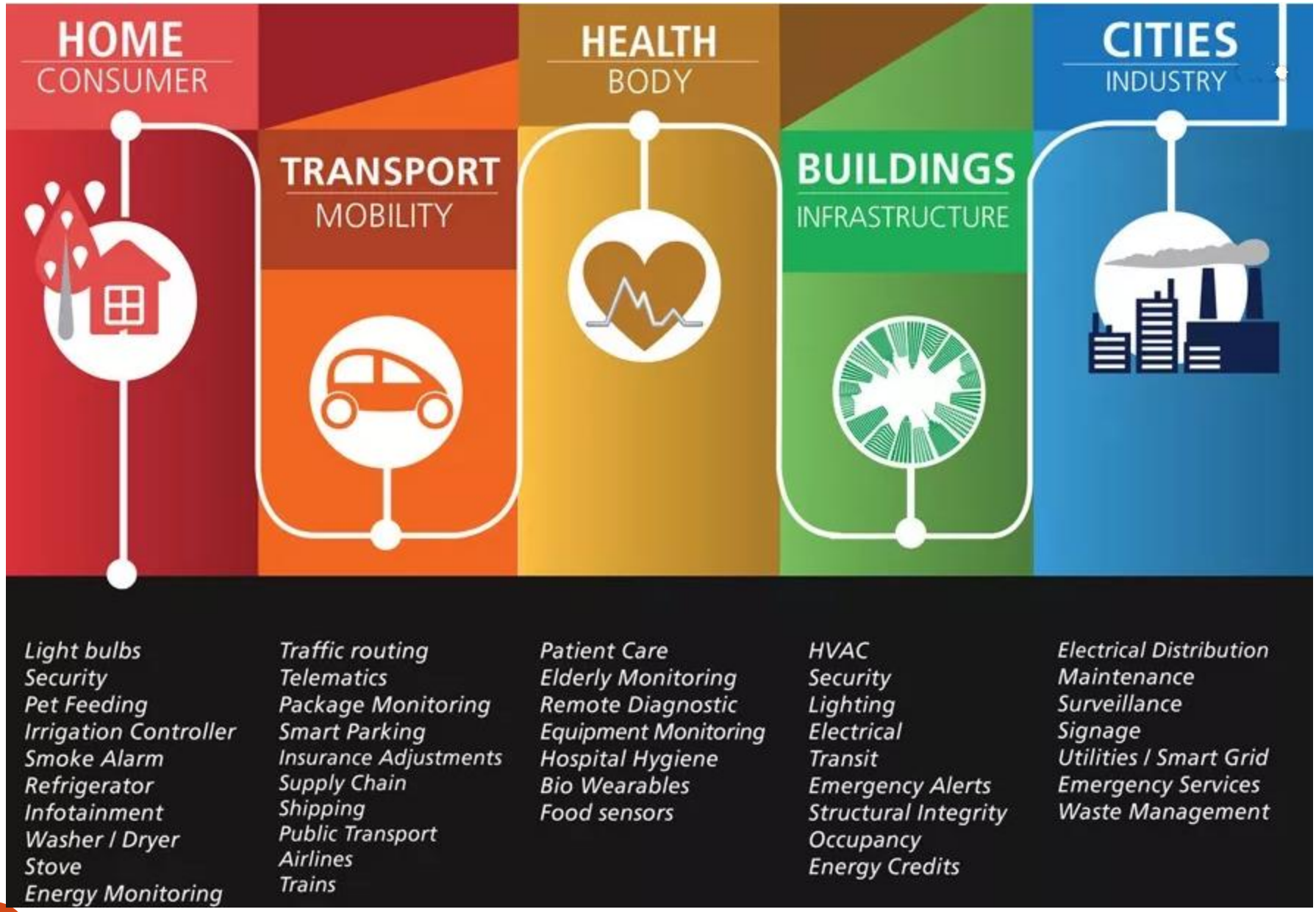
The information transmitted via the chose connectivity can be used by people and processes to take action or re-transmit the info to a different embedded system to be used to perform an action using actuators, below are some examples:

- A gas leak/ smoke is detected by a chemical sensor and the info is transmitted to a monitoring center. Help is dispatched immediately and the affected are informed
- A home security system detects intrusion, a call is placed to the authorities and owners alerted. Help dispatched
- Load sensor can initiate a communication to the supplier to send more stock enabling the supply chain management automation
- Car can send the diagnostics to the service center and the service center schedules a repair.
- Your IoT thermostat sends the information to the cloud which can then be analysed by to manage your energy expenditure.

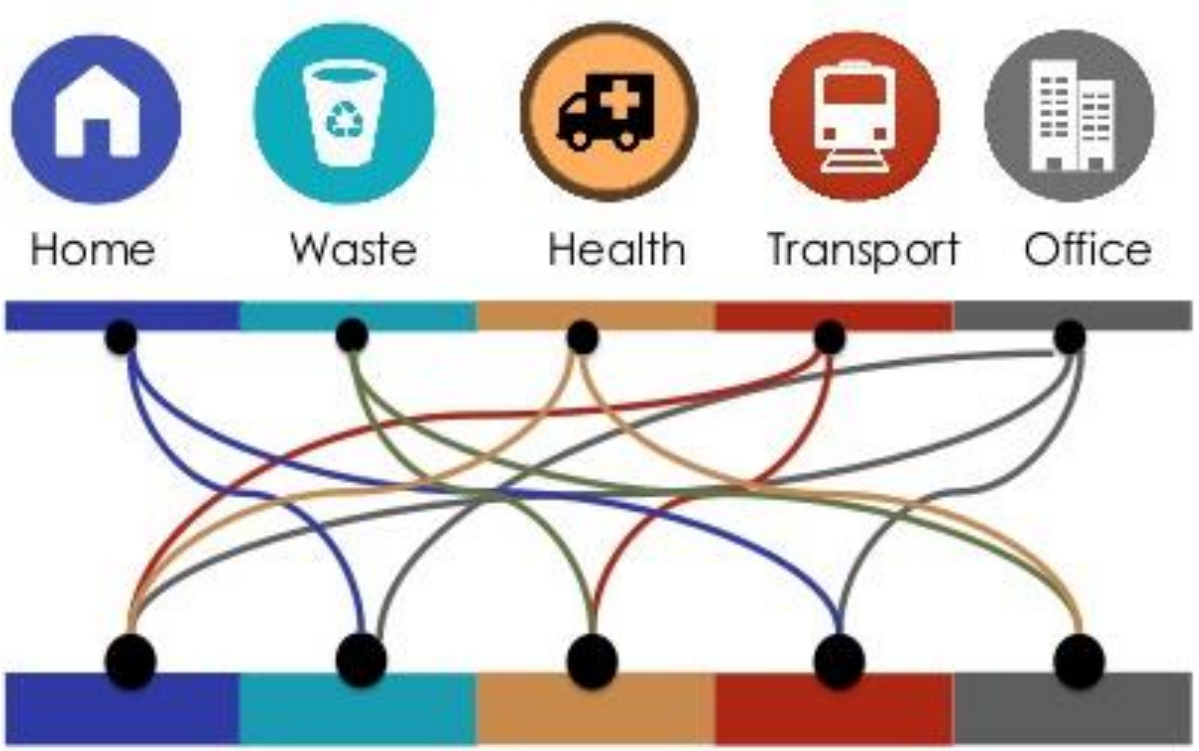

People
Customer Relationship & Support
Analytics & Cloud/API
Upgrades & Configurations
Remote Monitoring / Maintenance
Control & Automation
Supply Chain Management
Security / Energy
Mobile Devices & Apps
Location & Tracking
Financial
Processes

Interaction between these entities are creating new types of smart applications and services



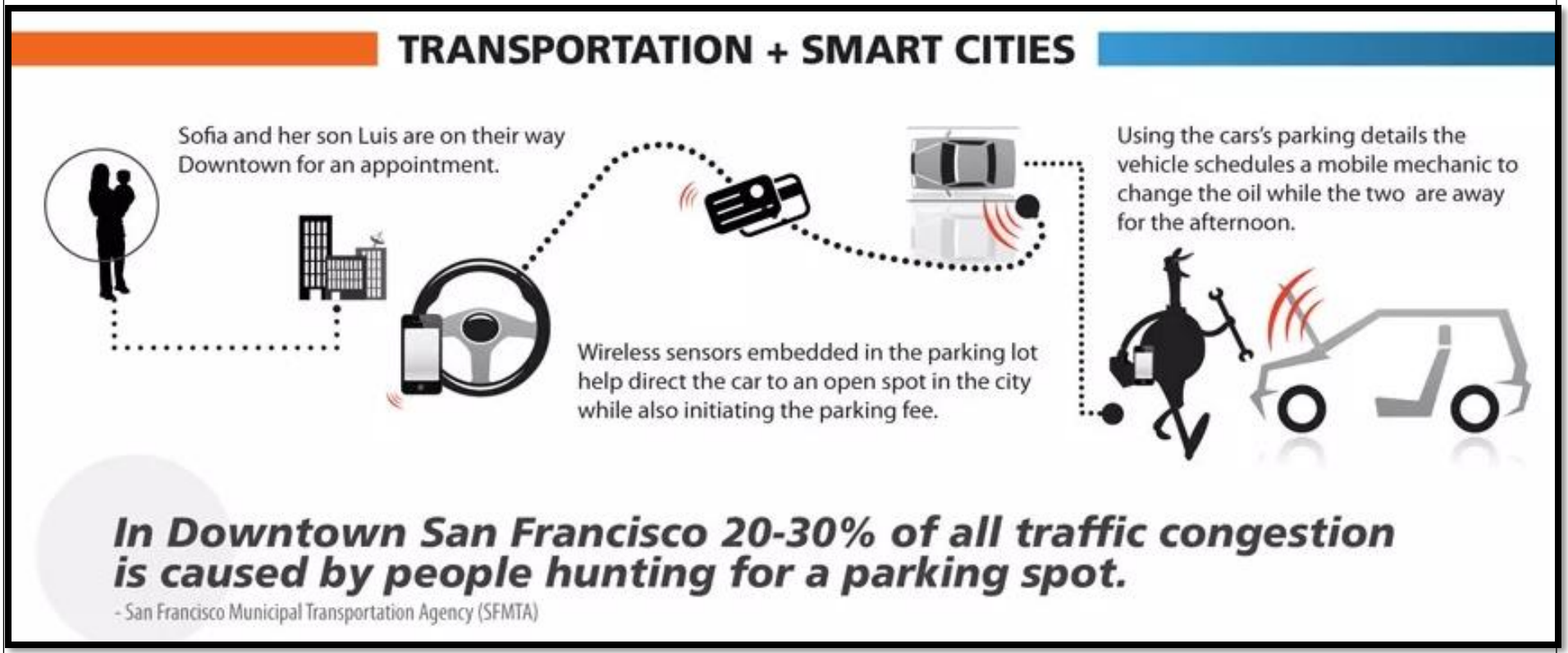

HOME
CONSUMER
TRANSPORT
MOBILITY
HEALTH
BODY
BUILDINGS
INFRASTRUCTURE
CITIES
INDUSTRY
Light bulbs
Security
Pet Feeding
Irrigation Controller
Smoke Alarm
Refrigerator
Infotainment
Washer / Dryer
Stove
Energy Monitoring
Traffic routing
Telematics
Package Monitoring
Smart Parking
Insurance Adjustments
Supply Chain
Shipping
Public Transport
Airlines
Trains
Patient Care
Elderly Monitoring
Remote Diagnostic
Equipment Monitoring
Hospital Hygiene
Bio Wearables
Food sensors
HVAC
Security
Lighting
Electrical
Transit
Emergency Alerts
Structural Integrity
Occupancy
Energy Credits
Electrical Distribution
Maintenance
Surveillance
Signage
Utilities / Smart Grid
Emergency Services
Waste Management

- Things get interesting when these connected devices and services start creating **COMPOUND APPLICATIONS** with in their own verticals and across industries.



Creating New Compound Applications

Compound Applications Example



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)

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

REAL-TIME SERVICE NETWORKS

- Appliance Monitoring
- Predictive Maintenance
- Service Technician / CRM
- Waste Management / Recycling

R Hotel Denver,
Industrial Washer #GHS40-2608

Location: ID: *FC-RM #00243*
Manufacturer: *Appliance Park Louisville, KY ID: #45205343*
Materials: *FC / SUS*
Sensor: *Vibration*
Connectivity: *Wireless LAN*

Connor, the Lead Maintenance Manager at the R Hotel in Denver, receives a sensor notification that the pump body O-ring #6 on washing machine #230243 is starting to fail in the housekeeping laundry room.

On his mobile, Connor prompts the machine to order a new part. This action triggers a bidding opportunity for local service technicians within the product's authorized maintenance network.

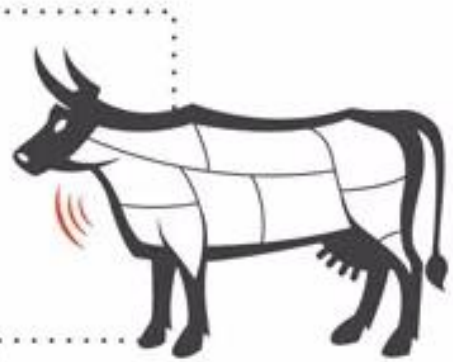
The request lays out:
- *Pricing parameters*
- *Timing requirements*
- *Machine history*
- *Part specs*
- *Predictive sensor measurements & alerts*

Tom from IA Appliances bids on the service request and receives a notification a few moments later that his bid was accepted.

Within 1.5 hours, a service technician from IA Appliances is on site (Using a temporary facility access code for the wireless door lock) to replace the water pump. Connor sends a brief note on the service quality and IA Appliances releases a bid request for the part's raw materials to local recycling centers.

DIGITAL FARM TO TABLE

- Farm & Livestock ID & Sensors
- Food packaging sensors
- Retail Supply Chain Monitoring
- Health Services



Cattle
AIN: 840 003 123 456 789

Location: ID: Braymeadow Farm *FR #00285453543*
Slaughterhouse ID: *#45205343*
Sensor: *Temperature, Accelerometer*
Connectivity: *RFID, NFC, WAN*

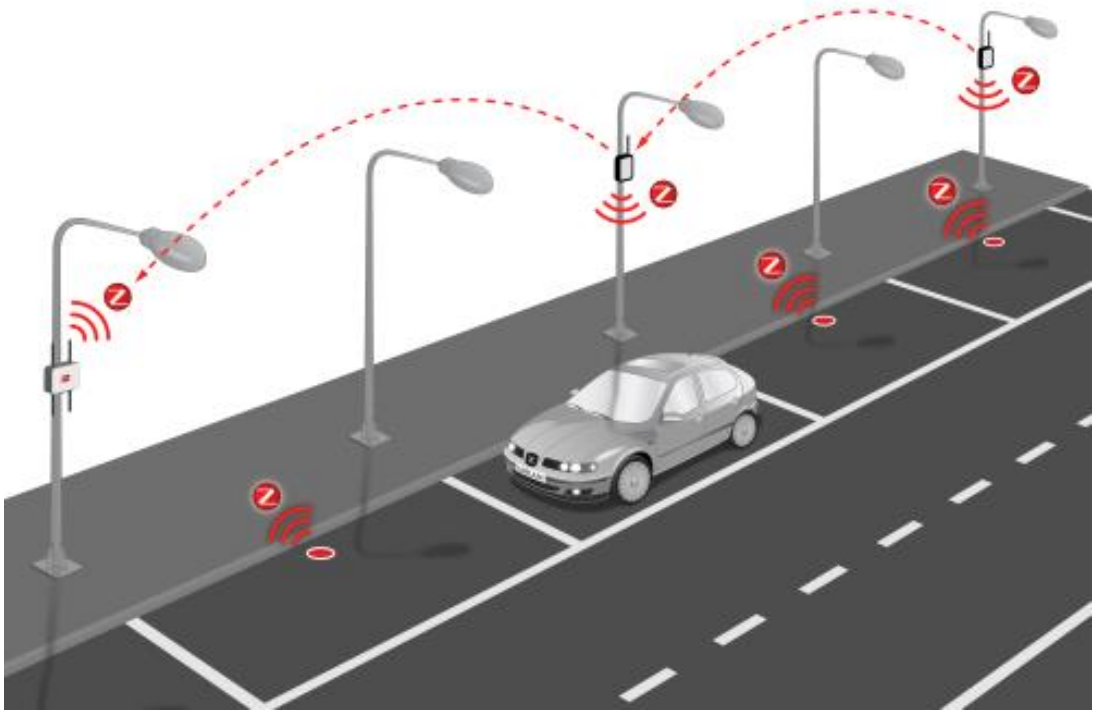
Maria and her daughter are picking up groceries for the week. Using packaging with printed sensors, the two can make sure the ground beef they are purchasing has never reached unsafe temperature levels while on the shelf or being transported.

The packaging also contains a QR code which they can use to query the cow's RFID tag and bring up its history:

- *Where it was raised*
- *What it was fed*
- *Where it was slaughtered*
- *How it was transported*
- *Where it was packaged*
- *The last time it was inspected.*

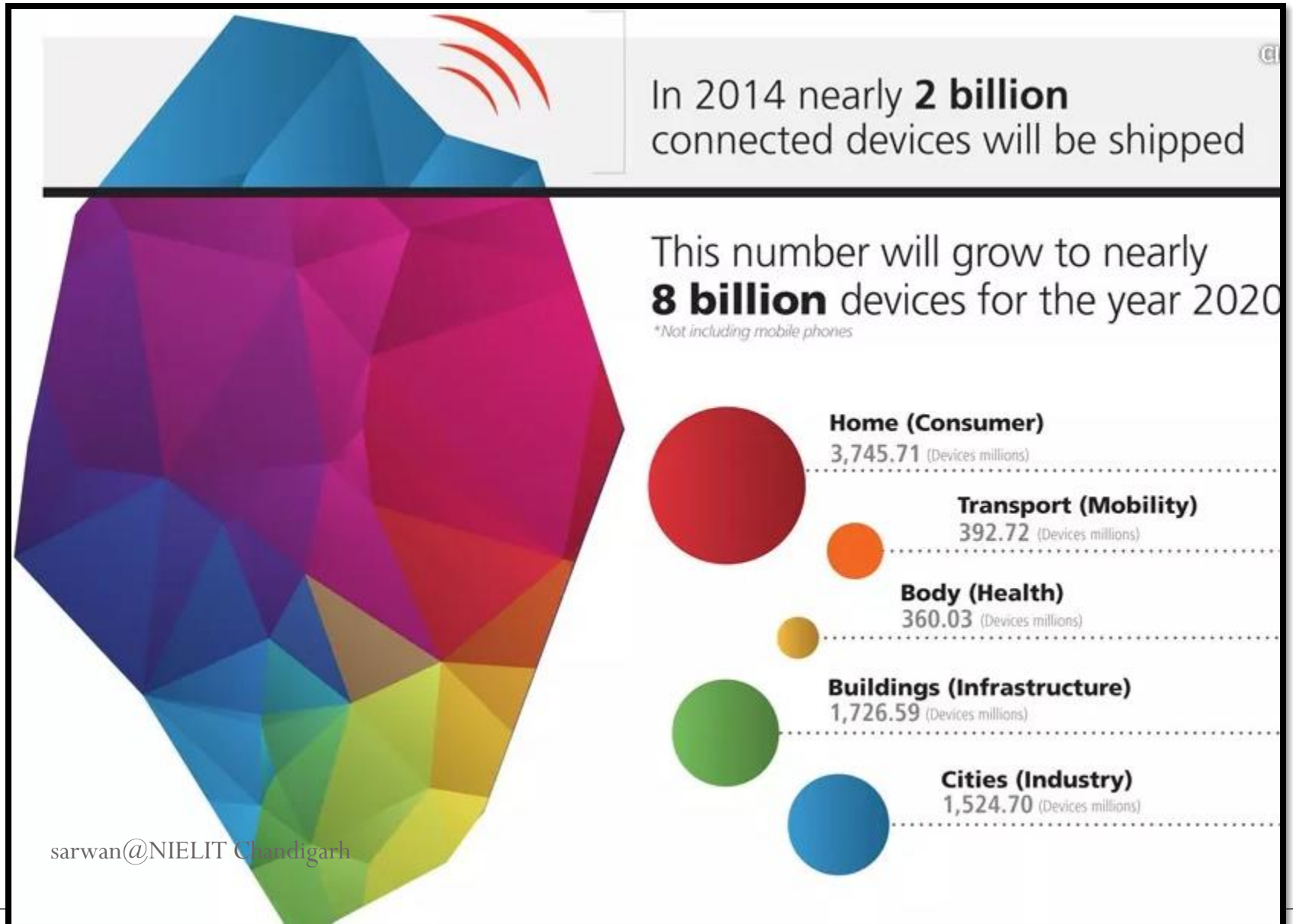
A week later the U.S. Department of Agriculture's Food Safety Service determines ground beef from originating from a regional packing company and sold at a neighboring store is contaminated with E. coli O157:H7. All packages from this distributer change their alert color and notification messages are sent to those shoppers that may have been impacted.

Connect with things



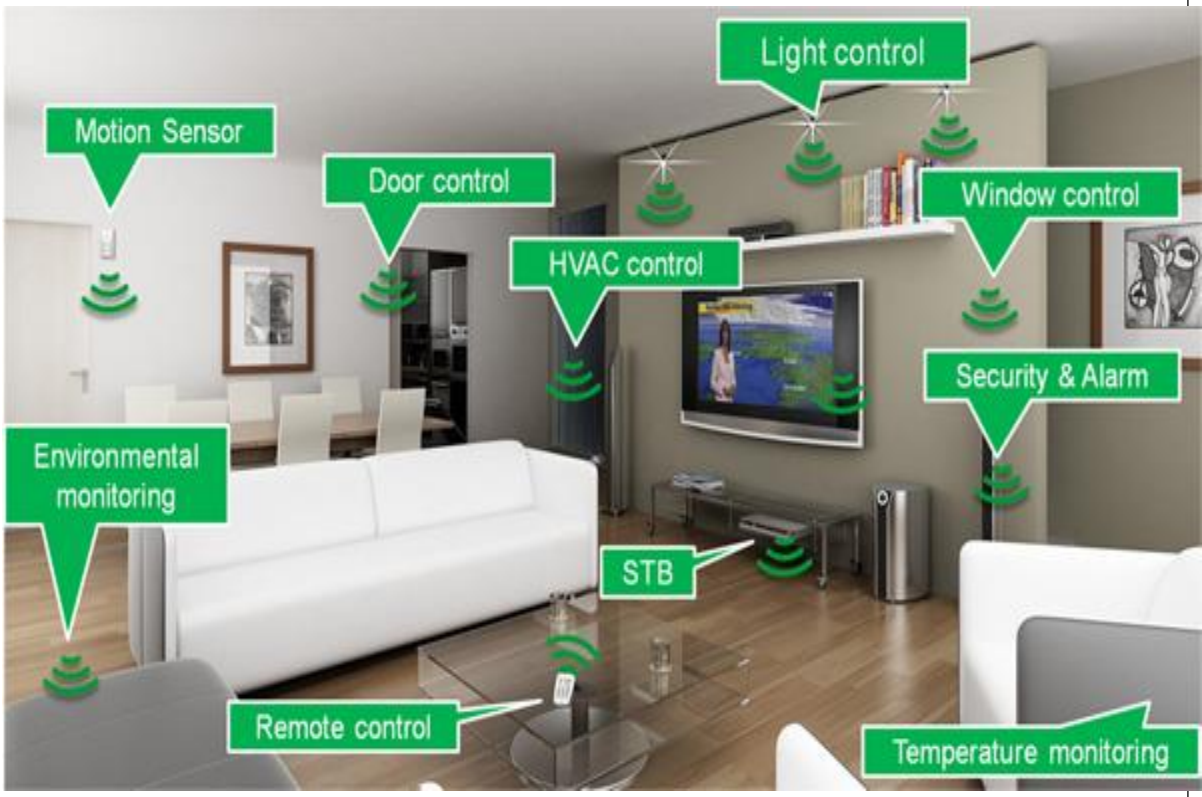
- Connect with things
- *Search for things*
- *Manage Things (manage facilities)*

How large is IoT market – connected devices

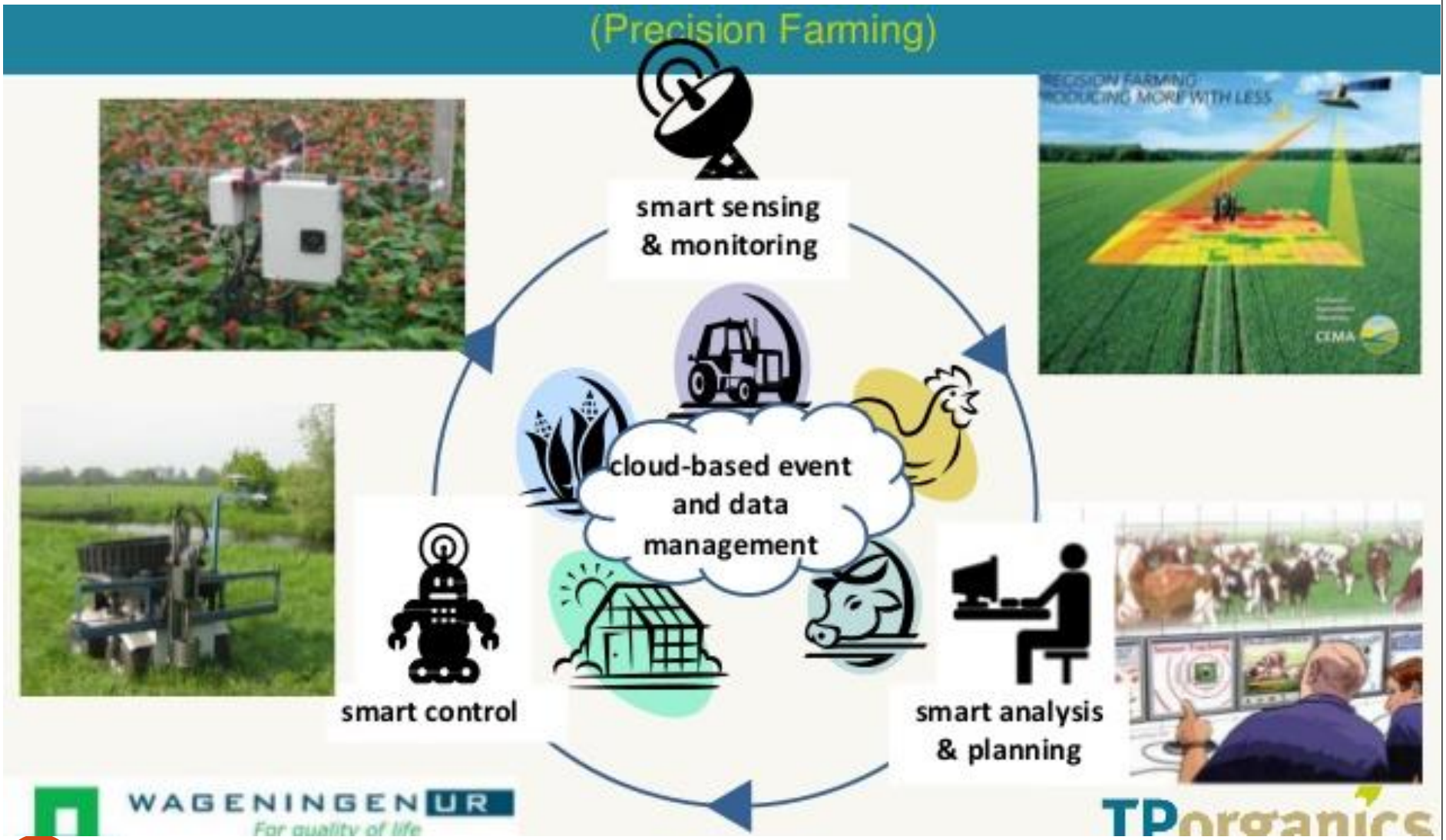


Home automation

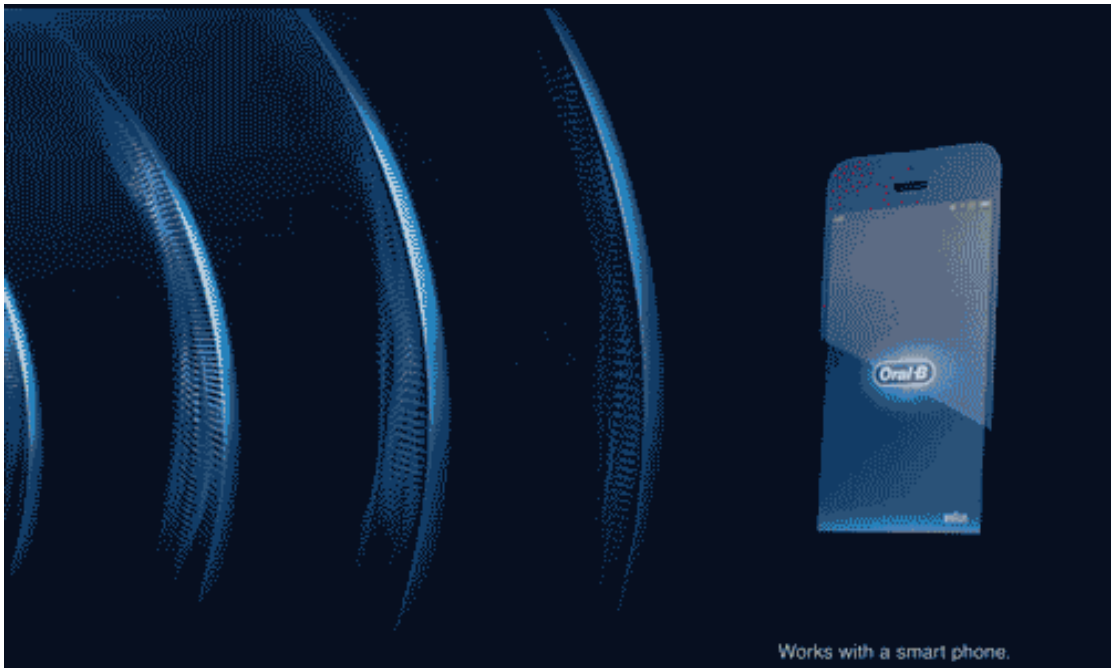
- Home & family
- Door & locks
- Light & Switches
- Damage & Danger
- Motions & cameras
- comfort



Smart Agriculture

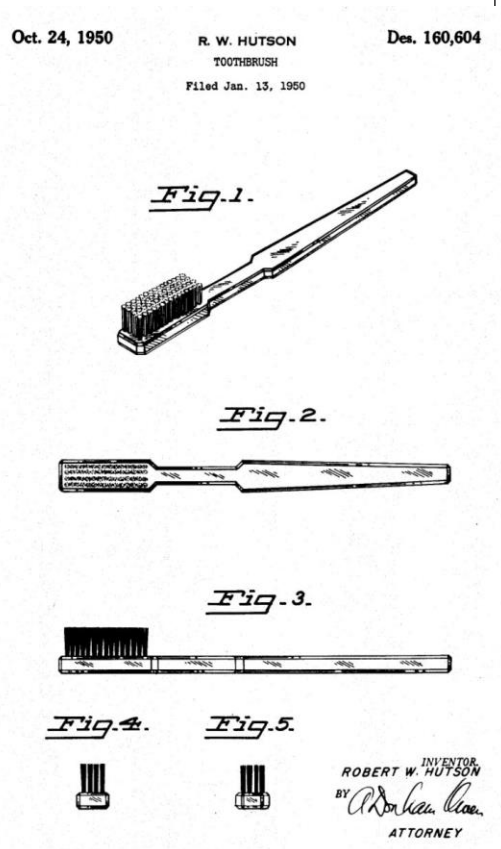


Smart Agriculture


Oral-B
Works with a smart phone.

Oral B

- Oral-B began back in late 1930's in California, America.
- In 1938 Henry Sargol invented a soft nylon bristled toothbrush with the name Oral-B
- founder of Oral-B, periodontist, Dr. Robert W. Hutson filed US Patent for designs for the "Huston Toothbrush" in January 13th 1950



- Within 10 years of of creating that first patented brush, it is believed that the company were selling over 5 million brushes a year thanks to great design
- in 1969 Oral-B brushes made their way on board the Apollo 11 mission to the moon
- In 1984 the Gillette group acquired Oral-B
- Since 2005 Oral-B has been part of the Procter and Gamble company after Gillette merged with them

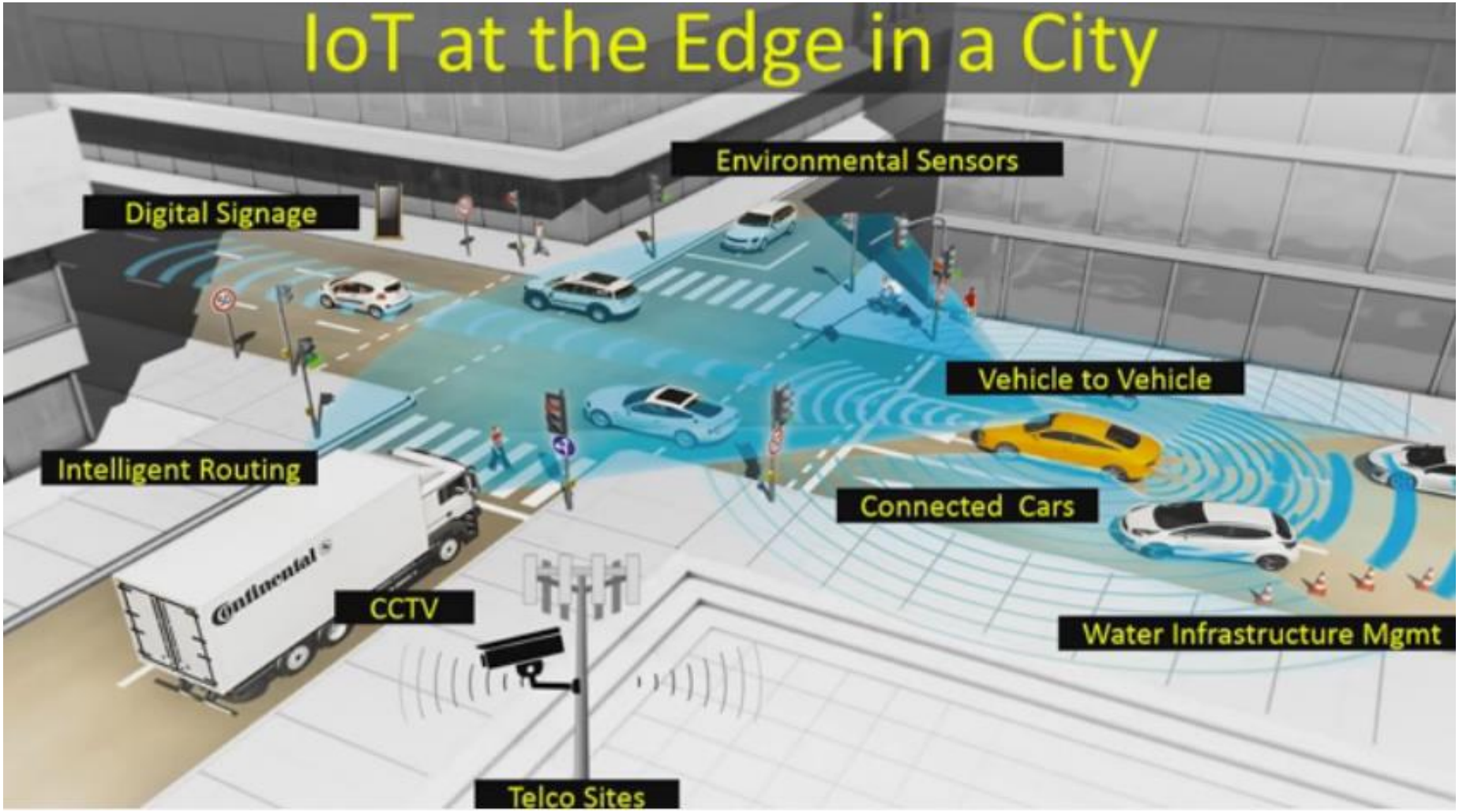
TAAS – Things as a Service

Things when **you** need it, as long as you need it

Cost when **you** use it, as long as you use it

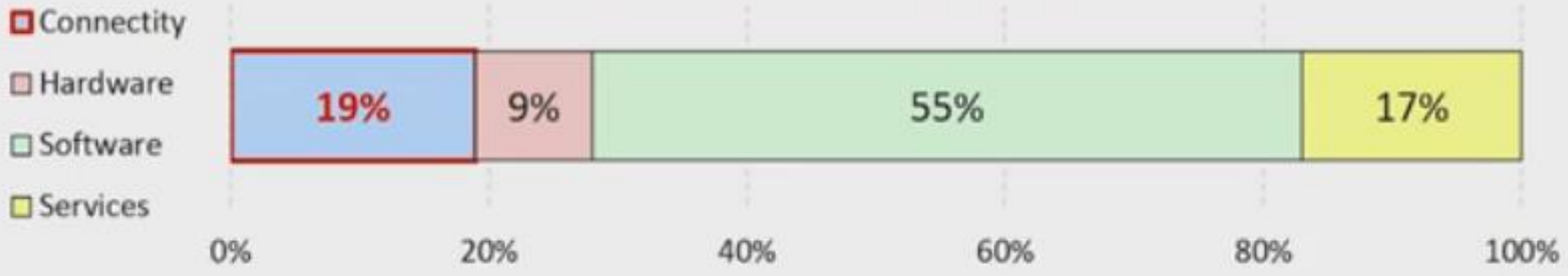
Maintenance is always **ours**

Things as a Service - TaaS


IoT at the Edge in a City
Environmental Sensors
Digital Signage
Vehicle to Vehicle
Intelligent Routing
Connected Cars
CCTV
Water Infrastructure Mgmt
Telco Sites

The Improved Business Case

Smart Meter Costs – SIM-based Solution



2015
SIM-based solutions

$12 - $60
per year

Future
Low Power WAN solutions

$1 - $12 per year*

+ potential to reduce hardware, software & services costs

* Anticipated pricing levels

@CRASingapore


For IoT
to take-off,
we need to
change our
perspective
@CRASingapore

SUMMARY

#1 Below the Surface Innovation

#2 Bridging the IT/OT Divide

#1 More Devices, Less Value

#2 Conventional Thinking

#1 IoT at the Edge

#2 Low Power, Wide Area Networks

Source: IDC Asia/Pacific Internet of Things Practice