innovate achieve lead

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Pilani | Dubai | Goa | Hyderabad

Internet of Things : Introduction

Let’s begin with smart Things….

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Put a Sensor in it…

Some Game Changers(1): Wii Remote - 2005

PUT A SENSOR IN IT

Input

- Accelerometer
- Gyroscope (Wii Remote Plus only)
- Infrared sensor

Connectivity

- Bluetooth
- Accessory connector port (400 kHz I²C)

Some Game Changers(2): Nike + iPod - 2006

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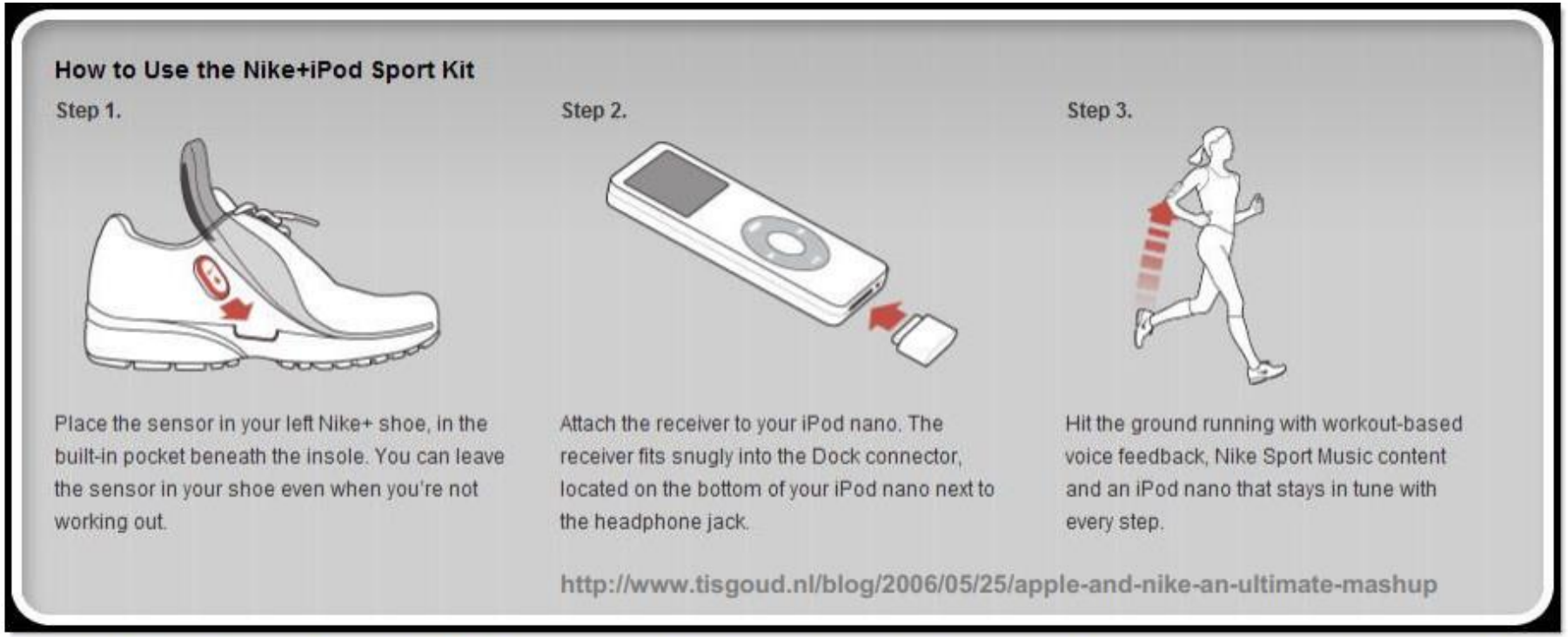
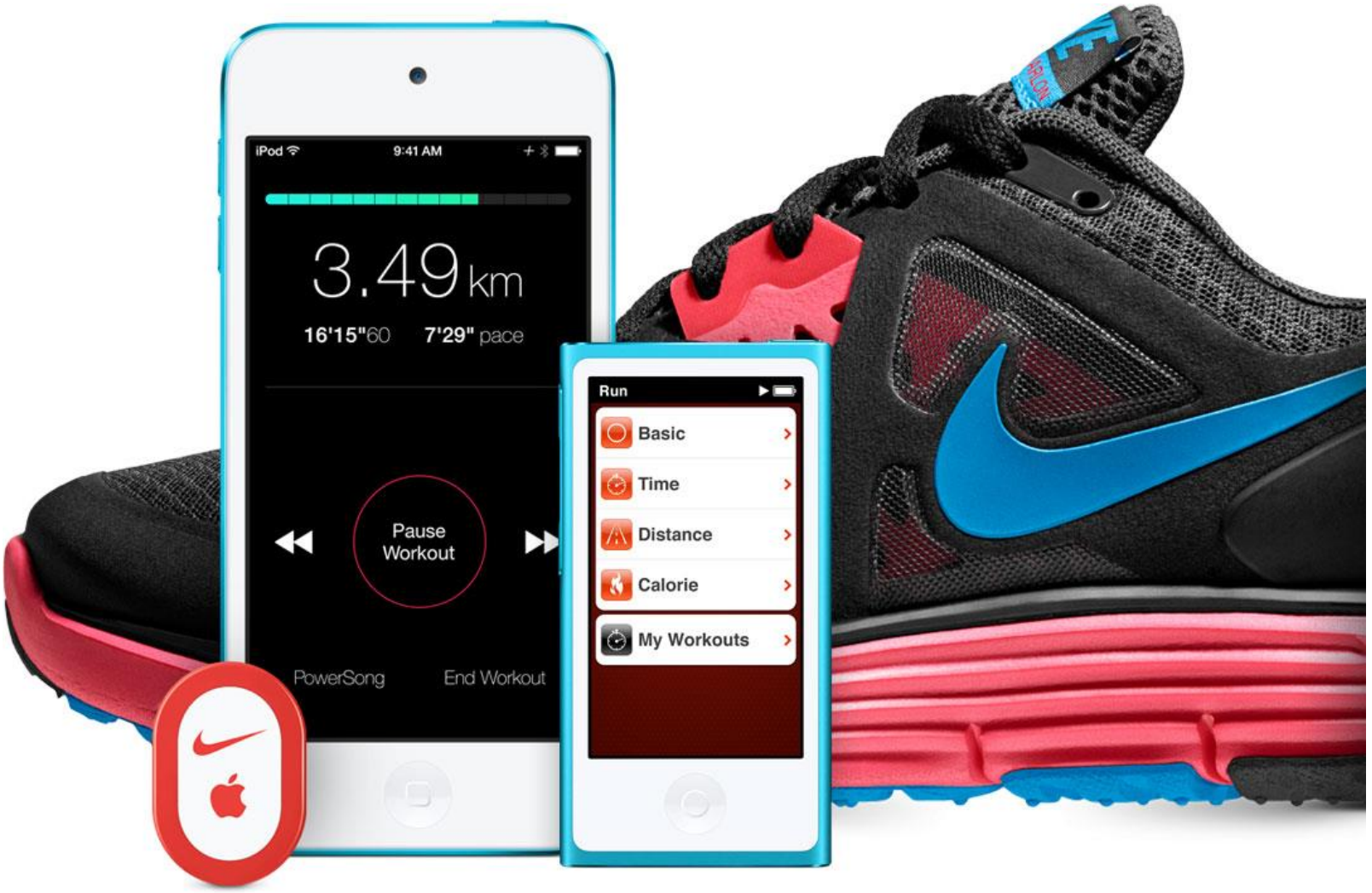
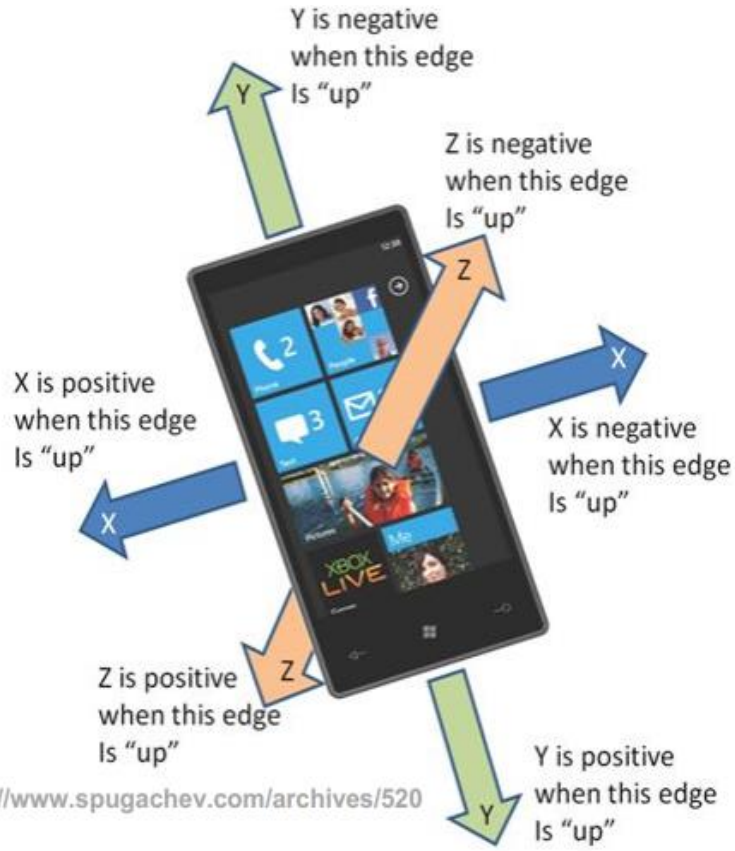


The Nike+iPod Sports Kit is an activity tracker device which measures and records the distance and pace of a walk or run. The Nike+iPod consists of a small transmitter device attached to or embedded in a shoe, which communicates with either the Nike+ Sportband, a receiver plugged into an iPod (Source: wikipedia)


iPod
9:41 AM
3.49 km
16'15"60
7'29" pace
Pause Workout
PowerSong
End Workout
Run
Basic
Time
Distance
Calorie
My Workouts

Some Game Changers(3): iPhone - 2007

http://www.pcmag.com/article2/0,2817,2418360,00.asp



http://www.spugachev.com/archives/520

PUT A SENSOR IN IT

- Proximity sensor
- Ambient light sensor
- 3-axis accelerometer
- Magnetometer
- Gyroscopic sensor

An IoT Definition

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- The Internet of Things (IoT) envisions a self-configuring and adaptive complex system made out of networks of sensors and smart objects whose purpose is to interconnect "all" things, including every day and industrial objects in such a way to make them intelligent, programmable and more capable of interacting with humans by providing useful services.

- Smart Objects and Sensors
- Networks of Things
- Self-organizing systems

- Intelligence at the edge
- Massive Data
- New communication paradigms

What are the Things of <<Internet of Things>>

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A Measure

An Identity

An action

What are the Things of Internet of Things?

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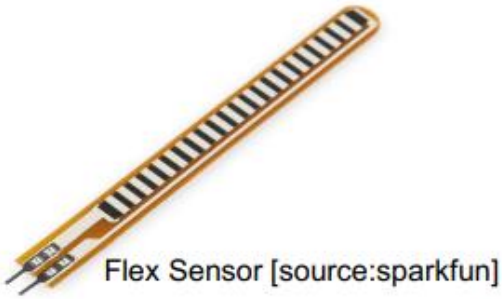
A Measure



Flex Sensor [source:sparkfun]

A Sensor

A **sensor** is an object whose purpose is to detect events or changes in its environment, and then provide a corresponding output [Wikipedia]

Properties

- it is sensitive to the measured property,
- it is insensitive to any other property likely to be encountered in its application, and
- it does not influence the measured property.

An Identity

A Tag

Radio-frequency identification (**RFID**) is the wireless use of electromagnetic fields to transfer data, for the purposes of automatically identifying and tracking tags attached to objects.

A radio-frequency identification system uses tags, or labels attached to the objects to be identified. Two-way radio transmitter-receivers called interrogators or readers send a signal to the tag and read its response.

What are the Things of Internet of Things?

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An action

An Actuator

A device capable of executing an action

An actuator is the mechanism by which a control system acts upon an environment. The control system can be simple (a fixed mechanical or electronic system), software-based (e.g. a printer driver, robot control system), a human, or any other input.

What are the Things of Internet of Things?

Smart Objects: A combination of measuring and acting

A hw and sw system capable of making measures, execute rules, and subparts capable to execute tasks

Are we there yet?

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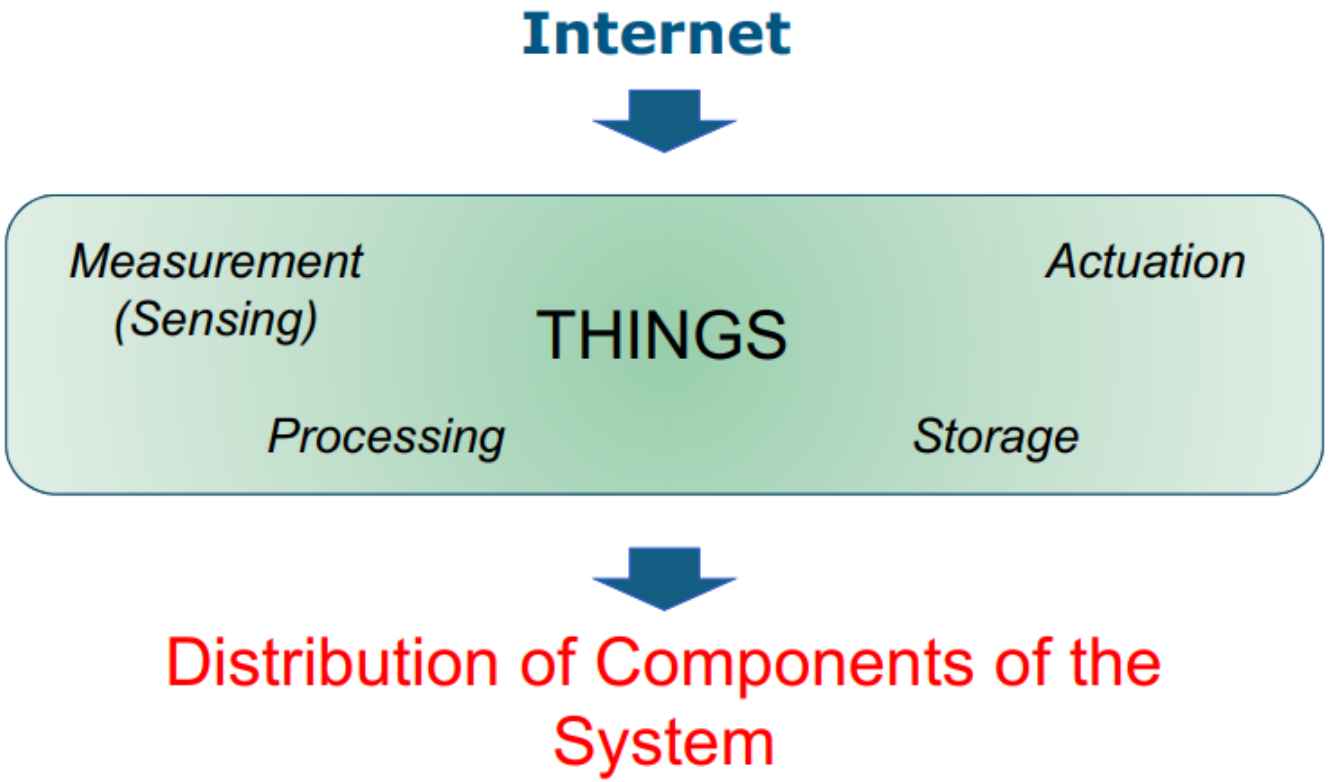
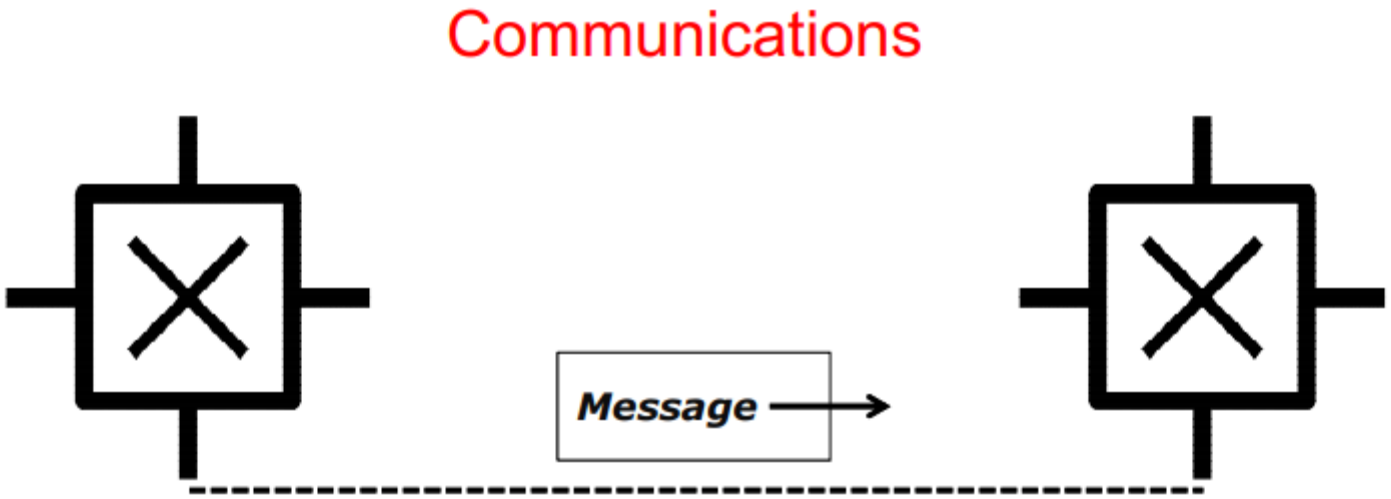
We have sensors, actuators, processing and possibly storage.

Is this Internet of Things?

What is Missing for IoT?

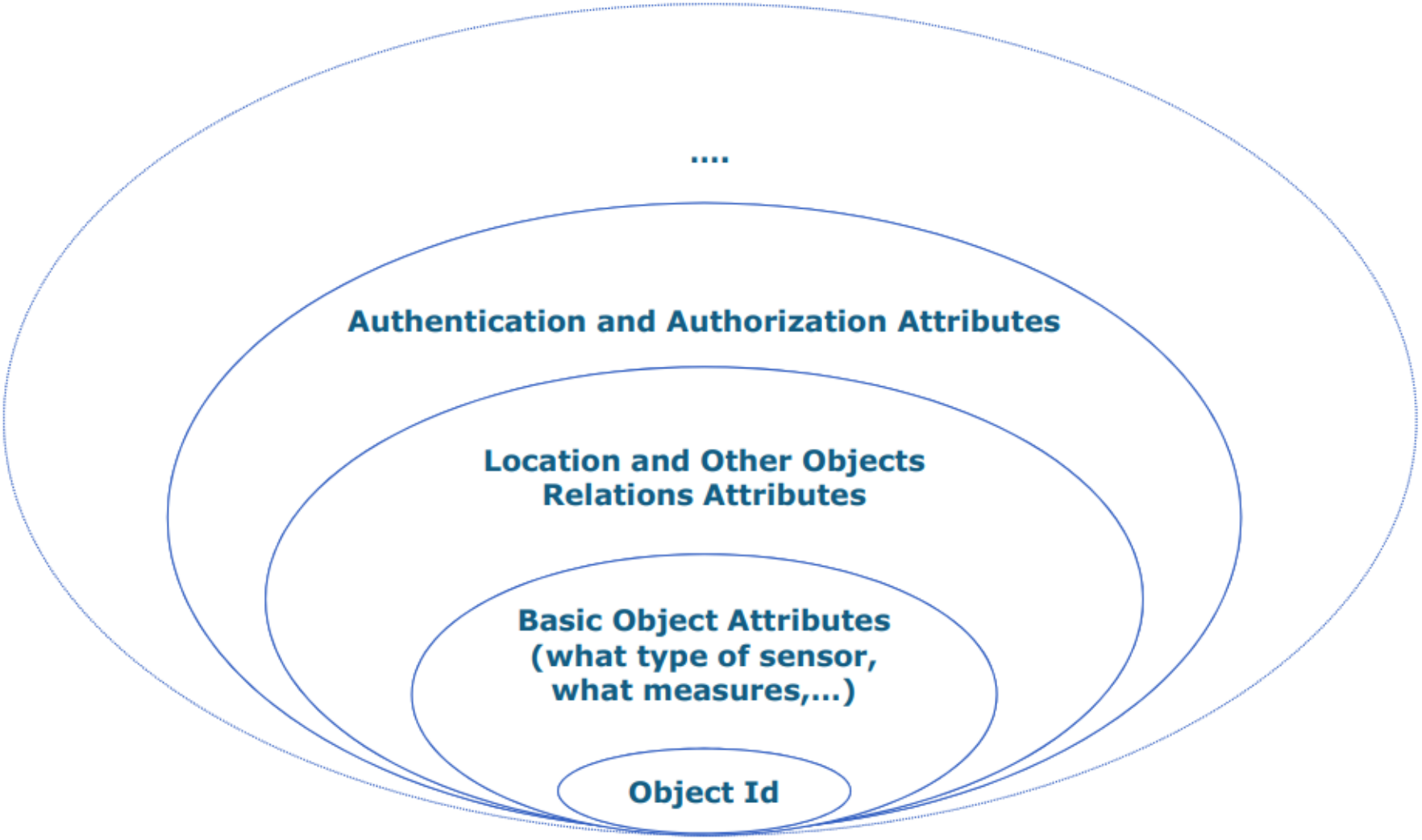


What Comes with Distribution?



What networks and nodes ?
What protocols ?
What formats?
What communication paradigm?

What comes with Distribution?



Identity is a primary constituent of Things

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An Identity

A Tag

Essentially a pointer to an object description

What are “Things”?

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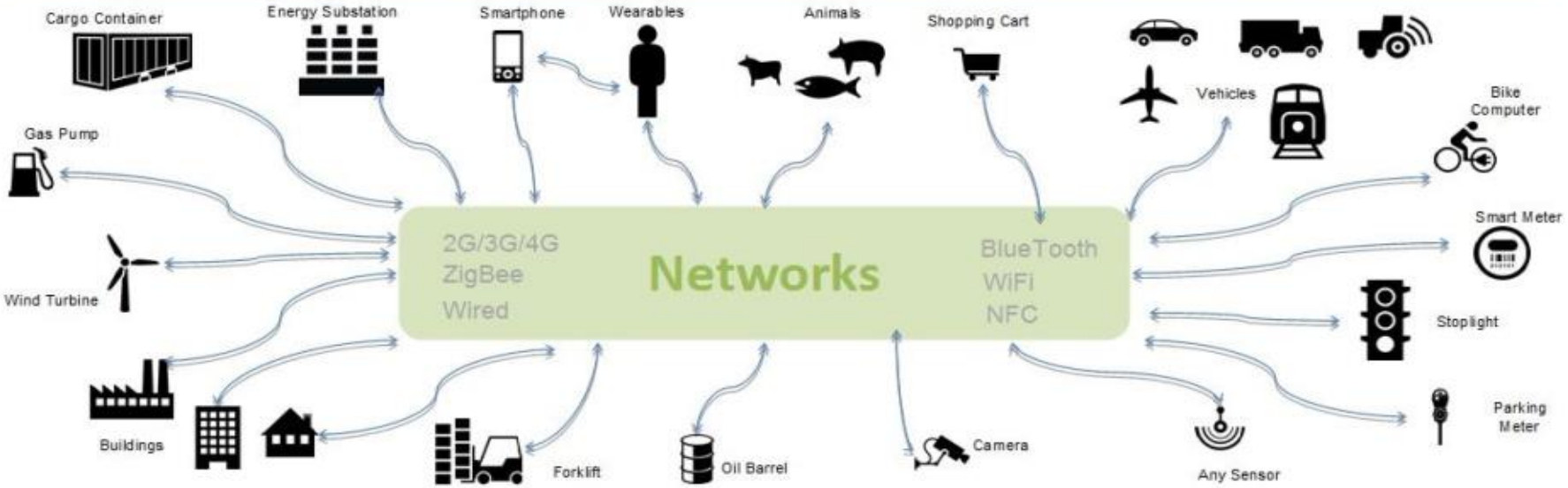
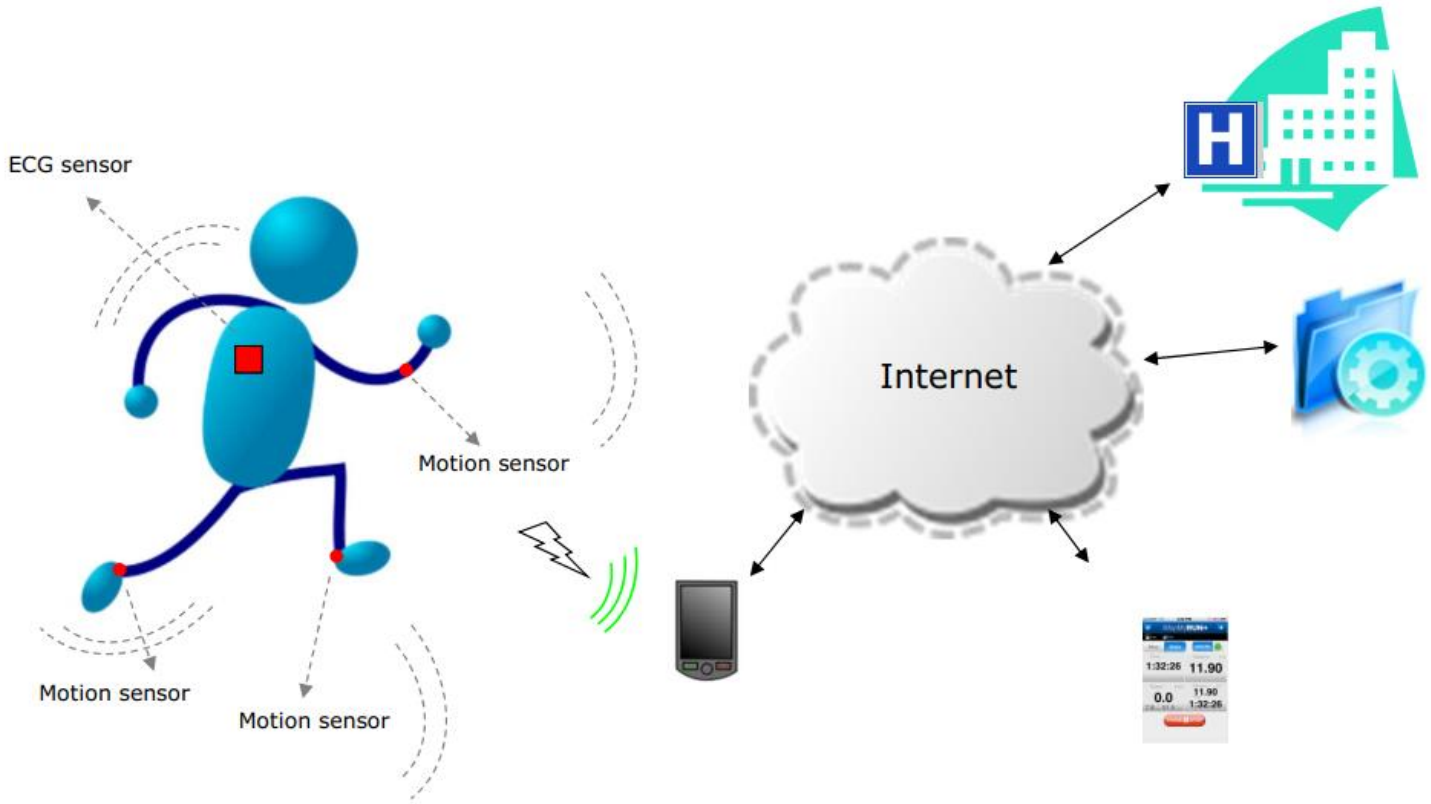
“Things” refer to any physical object with a device that has its **own IP address** and can **connect & send/receive** data via a **network**



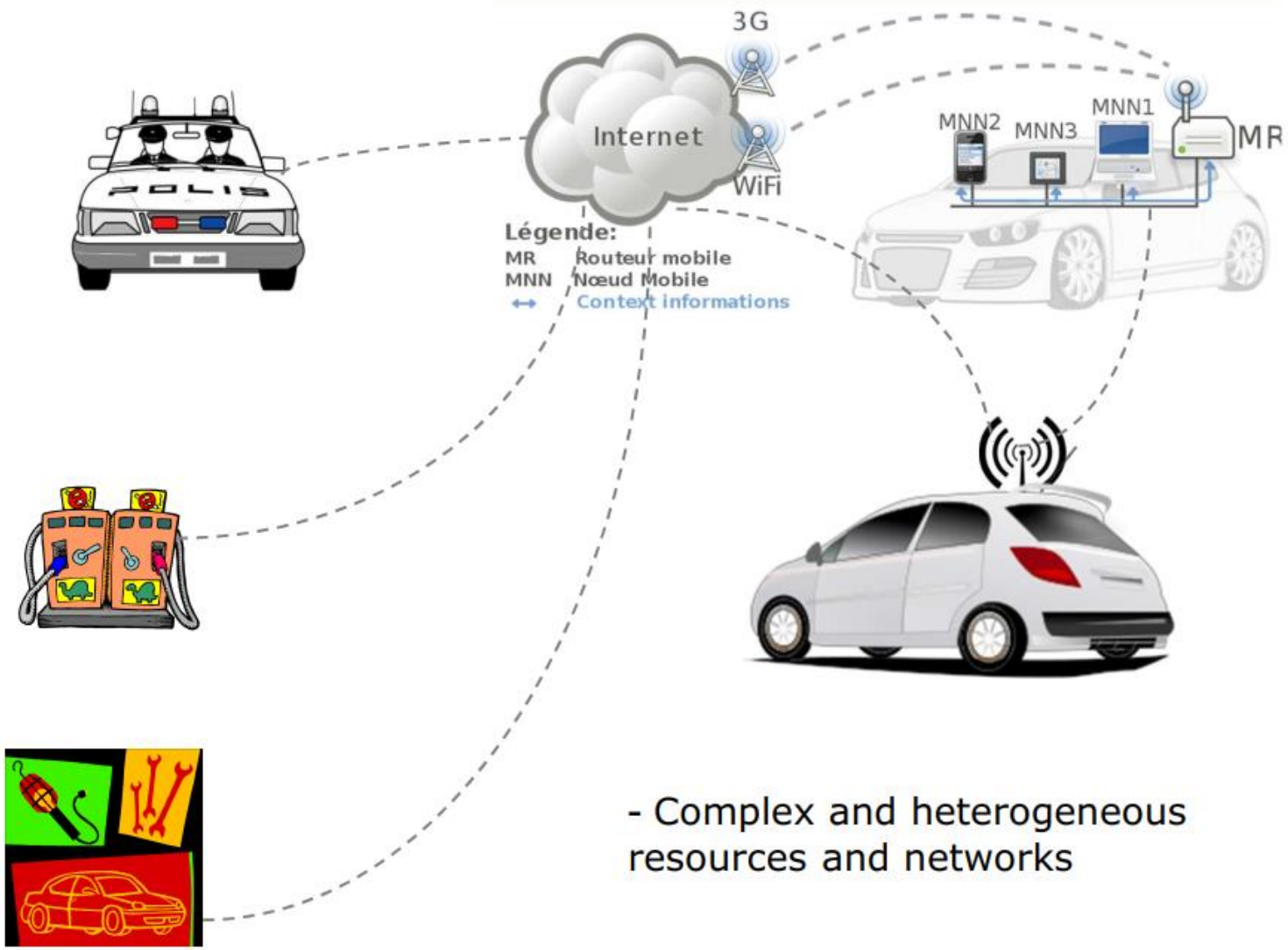
https://ibmcai.files.wordpress.com/2014/06/iot-network.jpg

Smartness refers to the ability of the object to provide some forms of Sensing/Actuation together with processing, storage and communications

IOT: People Connecting with Things



IOT: Things Connecting with Things



IOT Application Areas

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Consumer
- Smart home control (lighting, security, comfort)
- Optimized energy use
- Maintenance

Retail
- Product tracking
- Inventory control
- Focused marketing

Medical
- Wearable devices
- Implanted devices
- Telehealth services

Military
- Resource allocation
- Threat analysis
- Troop monitoring

Industrial
- SmartMeters
- Wear-out sensing
- Manufacturing control
- Climate control

Automotive
- Parking
- Traffic flow
- Anti-theft location

Environmental
- Species tracking
- Weather prediction
- Resource management

Agriculture
- Crop management
- Soil analysis

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DNA. The Danish company claims that their robots can operate for about 2.5 hours and disinfect about nine or ten rooms on a single charge [142].

According to a leading robotics expert from the Carnegie Mellon University (CMU), in addition to the tasks mentioned above, robots with the potential to execute tasks like obtaining nasal samples for testing, and rendering support to isolated patients, may also be developed soon [143].

B. AUTONOMOUS VEHICLES

Amid the global health crisis that is the COVID-19 pandemic, AVs could help ease the stress on existing delivery mechanisms while mitigating the risk of virus transmission [144]. China has led the charge in the use of autonomous vehicles (AVs) against the pandemic. In fact, at the time of writing, it is believed to be the only country in the world to deploy AVs for COVID-19 impact management. Beijing-headquartered White Rhino Auto company, in alliance with UNIDO's Investment and Technology Promotion Office (ITPO), dispatched two autonomous delivery vehicles from Beijing to the Guanggu Field Hospital in the Hubei province of China. These vehicles have proved to be highly useful for a variety of tasks, such as delivering medical supplies and meals. The use of AVs not only lessened the workload on the overburdened hospital staff, but it also helped in limiting the risk of cross-infection [145].

XIII. WEARABLES

Wearables are communication enhancing devices worn on the body that are connected to an internet source. Wearables range from smartwatches like Apple Watch, fitness trackers like Fitbit, smart headbands like Dreem, to personal sensors & patches. The ability to monitor people's physical health, along with their stress levels, has made wearables an ideal technology for adoption in the healthcare sector. In the midst

using 24/7 physiological data, gathered via the wrist-mounted WHOOP Strap 3.0, from hundreds of WHOOP members who have identified themselves as having the COVID-19 and volunteered to be a part of the study [146]. By discerning any deviation in respiratory rates of an individual from their established baseline, the strap can notify that individual of any issues that they might experience. This study will also collect data from the WHOOP Journal, a recently launched online interface accessible from the members' smartphones that enables them to monitor their daily behavior and make healthier lifestyle choices.

Although a few watches from Garmin and Fitbit also have the functionality to measure respiratory rates [146], WHOOP claims to be the only wearable to have its accuracy of measuring cardiorespiratory variables validated by a third-party study [147].

B. ESTIMOTE WORKPLACE LEVEL CONTACT TRACING WEARABLE

Estimote, a start-up known for its Bluetooth location beacons, has recently developed a set of wearable devices to enable contact tracing at the workplace, in an attempt to provide employees with a safer workplace environment. This wearable device allows organization leaders to monitor the health status of their employees remotely and to keep a record of any case of COVID-19 transmission amongst them. It empowers an organization's leaders to curb the disease spread before it spreads rampantly within the organization or even outside it [148]. When this device is turned on, it scans for other wearable devices and records any close interactions with them. The devices' hardware includes a passive GPS location-tracker in addition to Bluetooth powered proximity sensors, ultra-wideband connectivity, built-in LTE, and a rechargeable battery [149]. Furthermore, every device has LED indicators and buttons, just like a smartwatch. The purpose of these buttons is to allow the employees to log

Pg 19, https://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=9086010

A. SMART THERMOMETERS

Eight years ago, a US health technology company named Kinsa had launched internet-connected thermometers to screen people for high fevers. Although these thermometers were initially developed to track the common flu, they are, nevertheless, proving to be highly useful in identifying the potential COVID-19 clusters throughout the USA. Following the COVID-19 outbreak, Kinsa Health has deployed more than a million smart thermometers to households in various cities of the USA. These thermometers are linked to a mobile application, which allows them to transmit their readings to the company immediately. Once received, this data is assimilated by Kinsa to generate daily maps showing which of the US regions are witnessing an increase in high fevers, thereby allowing the US authorities to identify potential hotspots. In the past few years, Kinsa's interactive maps have proven to be highly accurate in the timely prediction of the spread of flu around the US, outdoing even the CDC's official app in terms of the promptness of prediction [112].

IOT Architecture

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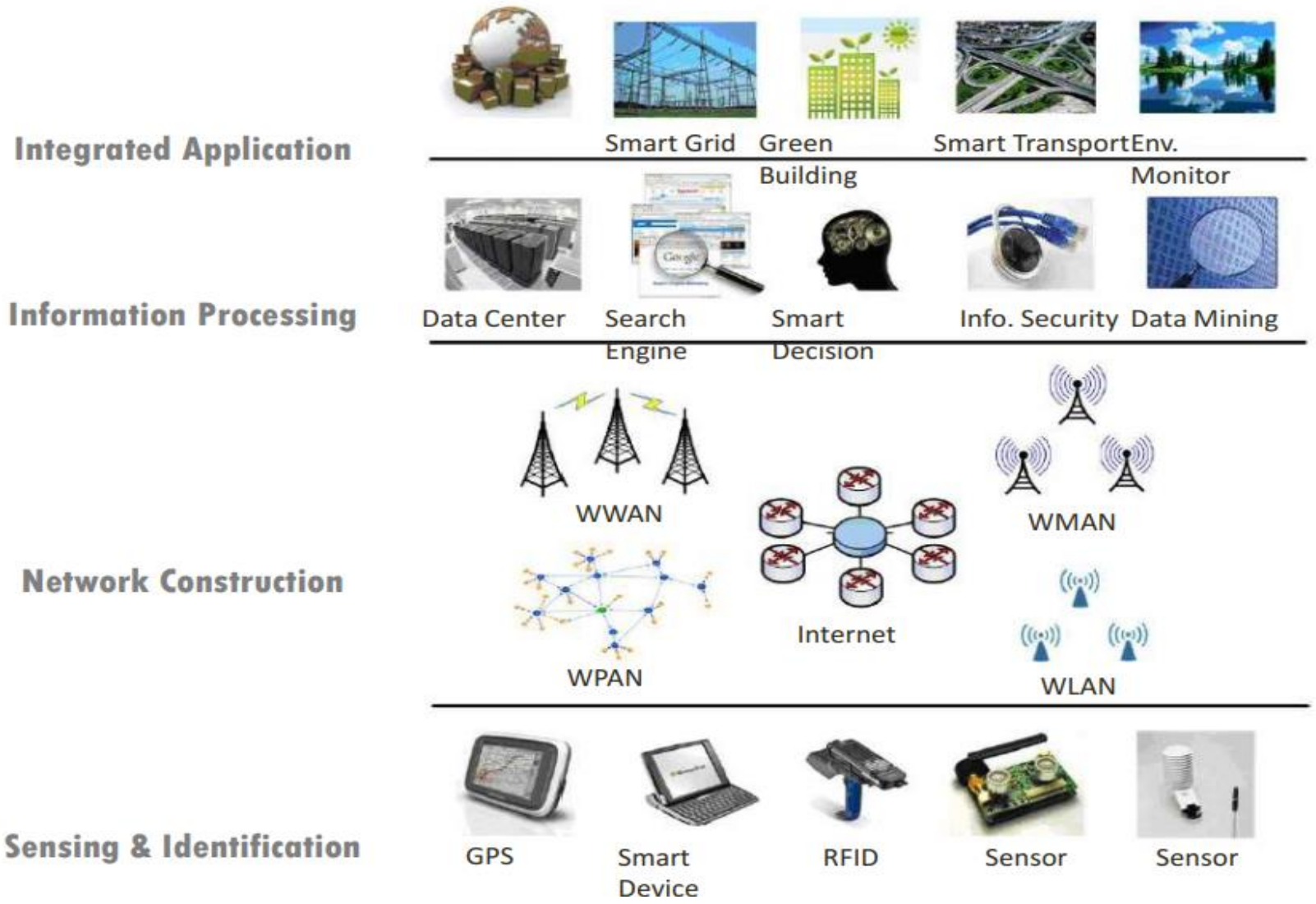

IOT Layered Architecture

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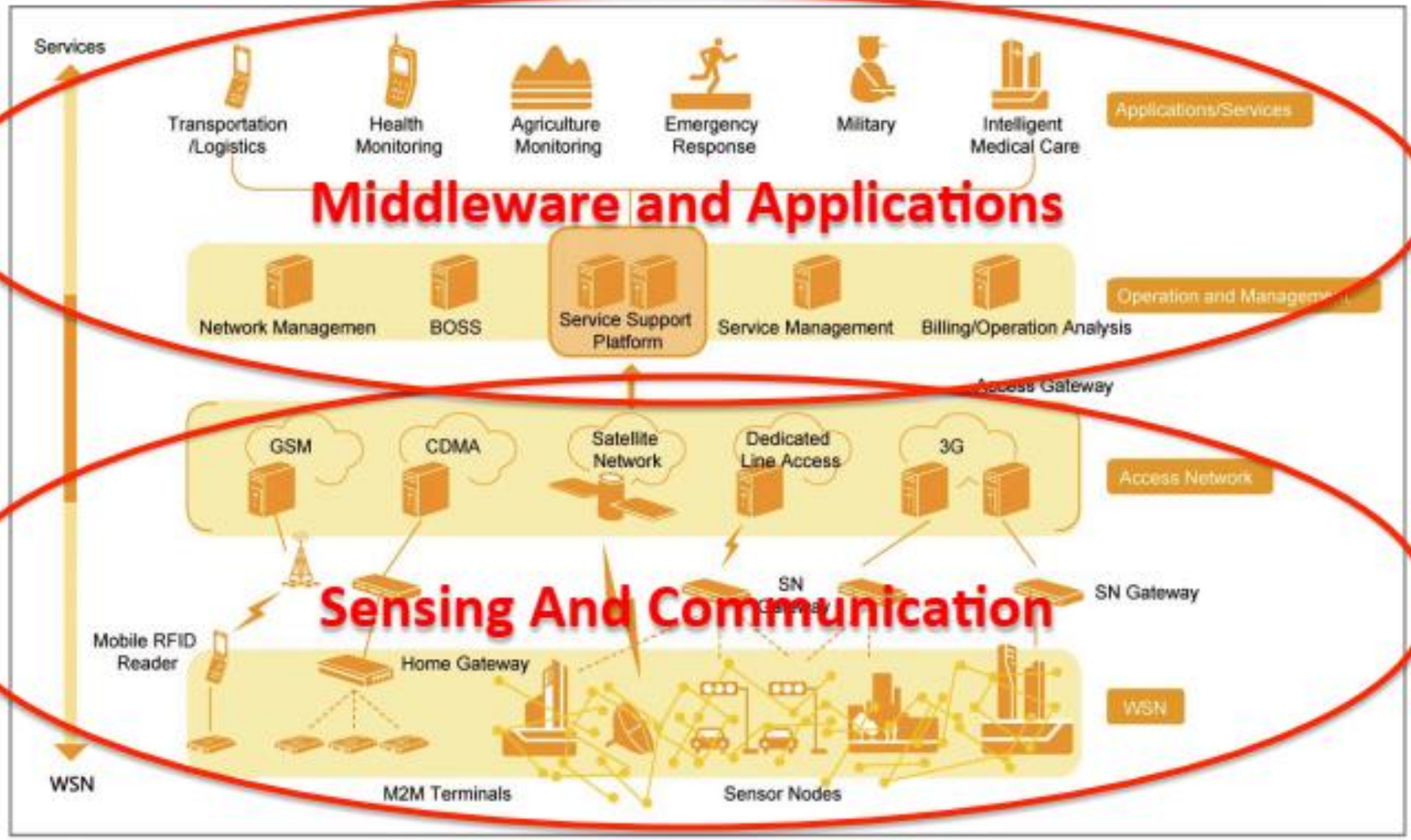

Networking & Communication

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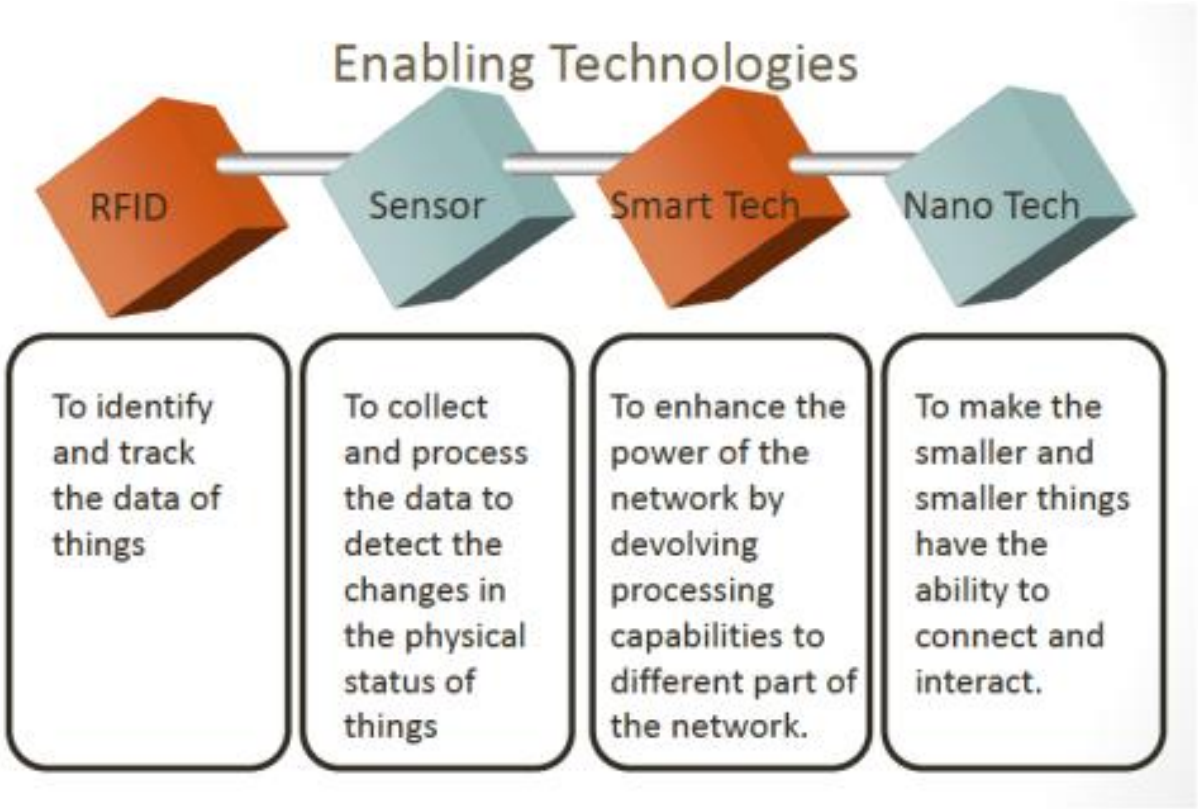

RFID to smallest enabling technologies, such as chips, etc.

IOT Sensors & Actuators