Internet of Things: Applications and Services

Regional Workshop for Africa on

"Developing the ICT ecosystem to harness Internet-of-Things (IoT)"

Sami Tabbane

28-30 June 2017

Mauritius

ICTs is multi-sectoral and so are IoT applications

Emergency

Education

Health

Agriculture

Governance

Investment

Applications

Policy & Regulation

Capacity Building

Transport

IoT, Sensor Networks

Universal Broadband

Green ICT & E-Waste

Measurements

Electricity

Privacy & Security

Infrastructure Security

Water

SMART SOCIETY

Digital Inclusion

Spectrum Management

Standards, Conformity & Interoperability

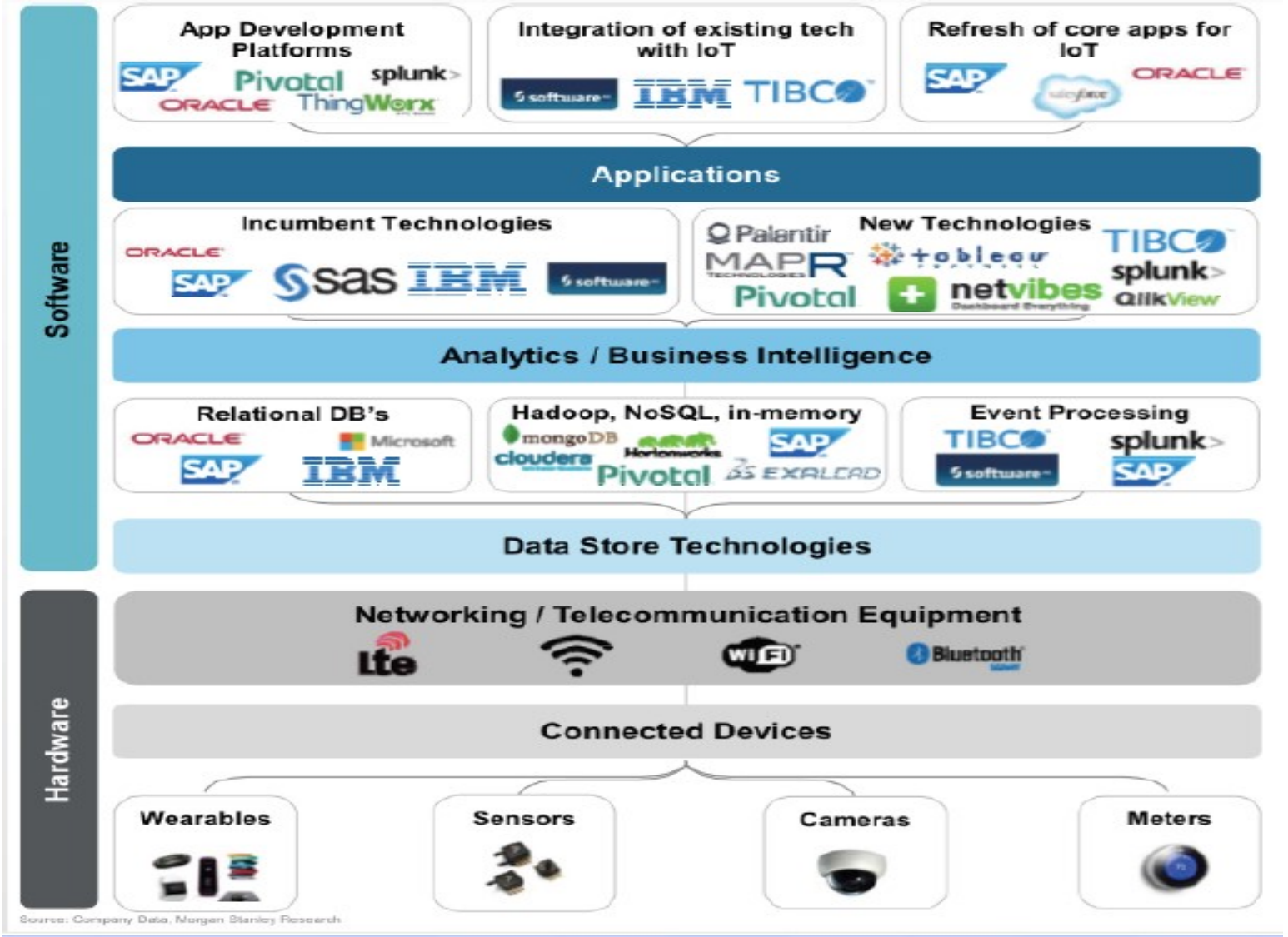
Teleworking

- **Enablers**: design IoT technologies (beacons, tags, NFC, QR code, etc.)
- **Engagers**: imagine, create, integrate and provide the services to the users (platforms for smart cities, sharing or renting between people, for carriers, etc.)
- **Enhancers**: elaborate their own high value added services, in addition to the products and services provided by the enablers and engagers, and specific to IoT.
- **Traditional enterprises**: use the technologies to improve the efficiency and optimize their activities.

IoT Ecosystem (ISO/IEC NP 19654)

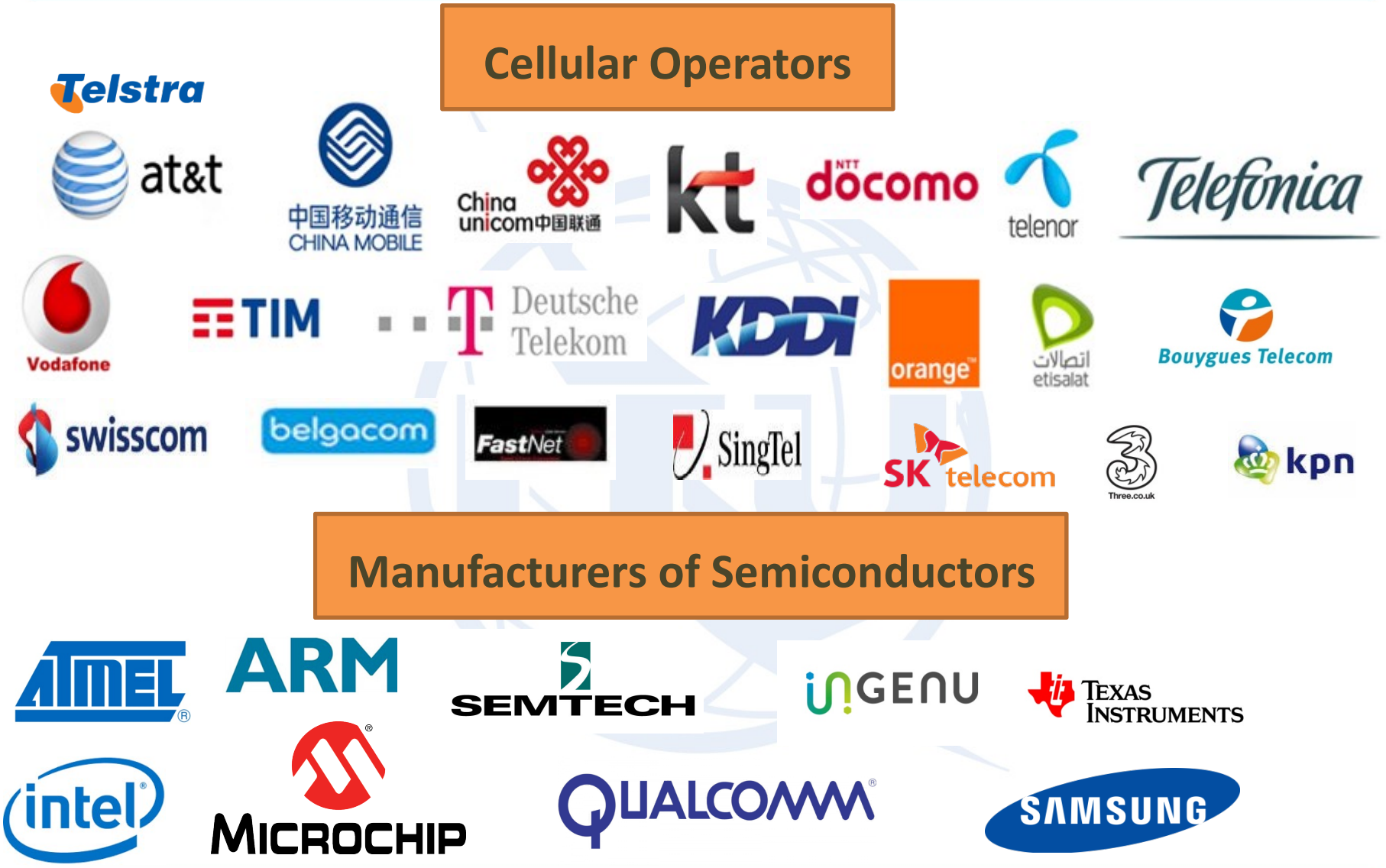
1) *IoT System: System developed,* implemented and operated. Includes descriptions of **target applications and services** including health care, grid, home, etc.
2) *Sensing Devices: Domain representing all* **physical entities** such as sensors, tag readers, etc.
3) *Things/Objects: Physical (things) and virtual* (objects) domain that includes **entities part of the IoT system domain without sensors** including displays, alarms, smartphones, etc.
4) *Control/Operations: Domain representing* **organizations that manage the system** activities of an IoT system.
5) *Service Providers: Domain representing* **organizations providing IoT services**.
6) *Customers: Domain representing the* **end user of goods** (both tangible and intangible) and services provided by the organizations in the *service providers domain or by the IoT* system in IoT *systems of interest.*
7) *Markets: Domain representing* **operators and participants** in the IoT system and service provider markets.

Overview of the IoT Ecosystem



Source: CIMdata

a. Stakeholders

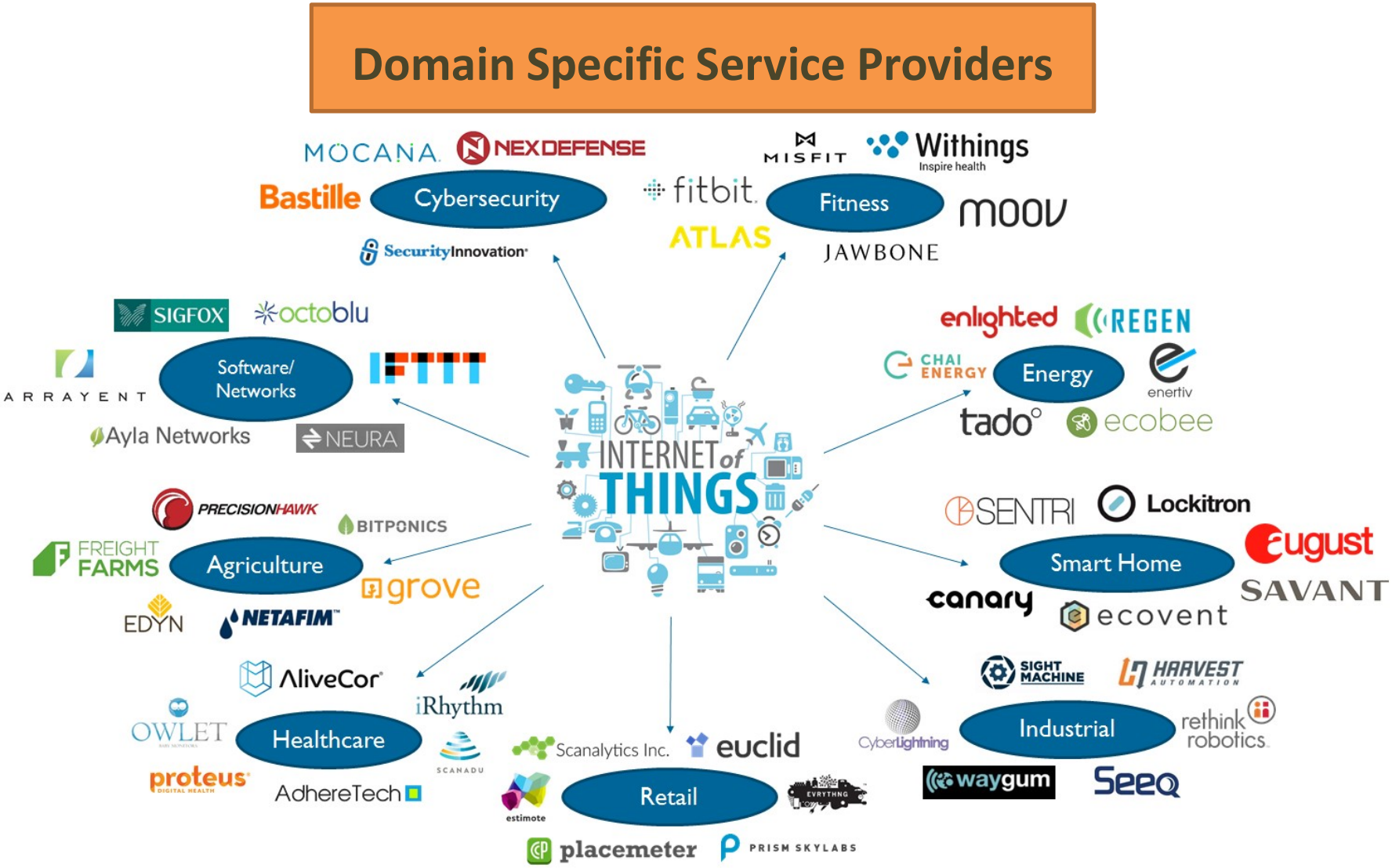


a. Stakeholders

- **ISPs**
- **Startup Companies**
- **Infrastructure Owners (PMR, Broadcasters, …)**
- **Utilities and Cities**

- New entrants have more opportunities to enter this new market
- Lower barriers (lower network cost)

a. Stakeholders



C. Customers

CITIES

FARMERS

TRANSPORTERS

GOVERNMENTS

INDUSTRIES

INDIVIDUALS

- All domains and economical sectors can be concerned
- Each country has its specificities and development goals

d. Existing and IoT Potential Services

Definition

An IoT Service is a transaction between 2 parties, the service consumer. It causes a prescribed function enabling the interaction with the physical world by measuring the state of entities or by initiating actions which will cause a change to the entities.

Low level service	Makes the capabilities of the devices or the resources accessible to entity services or integrated services
Resource service	Provides the observations that the resource is capable to make or provide the actions a resource is capable to execute
Entity service	Heart of the IoT systems. Provided by the entities and composition of low level services
Integrated service	Work with entities and compose entity services with non IoT services

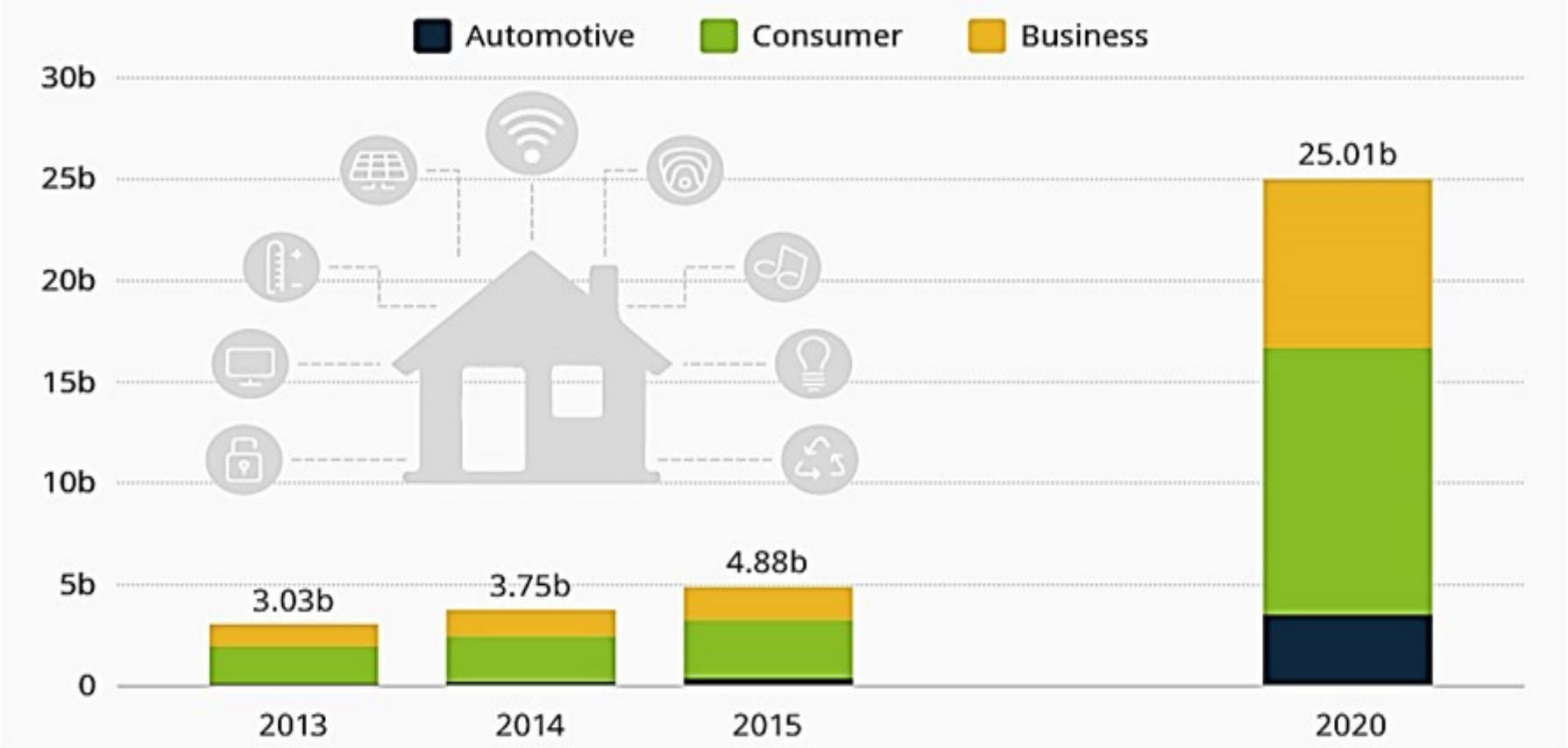
Deployable	Not yet in the field. Service description exists in a service repository but an appropriate runtime environment is not assigned.
Deployed	Already in the field but not yet ready to use as further steps (technical or economical) are necessary to make it operational.
Operational	Already deployed (if applicable) and ready to use. Associated to an entity and the association is known to a resolution infrastructure.

Matthias Thoma et al. In *On IoT-services: Survey, Classification and Enterprise Integration* in 2012 IEEE International Conference on Green Computing and Communications, Conference on Internet of Things, and Conference on Cyber, Physical and Social Computing.

d. Existing and IoT Potential Services

The internet of Things to Hit the Mainstream by 2020

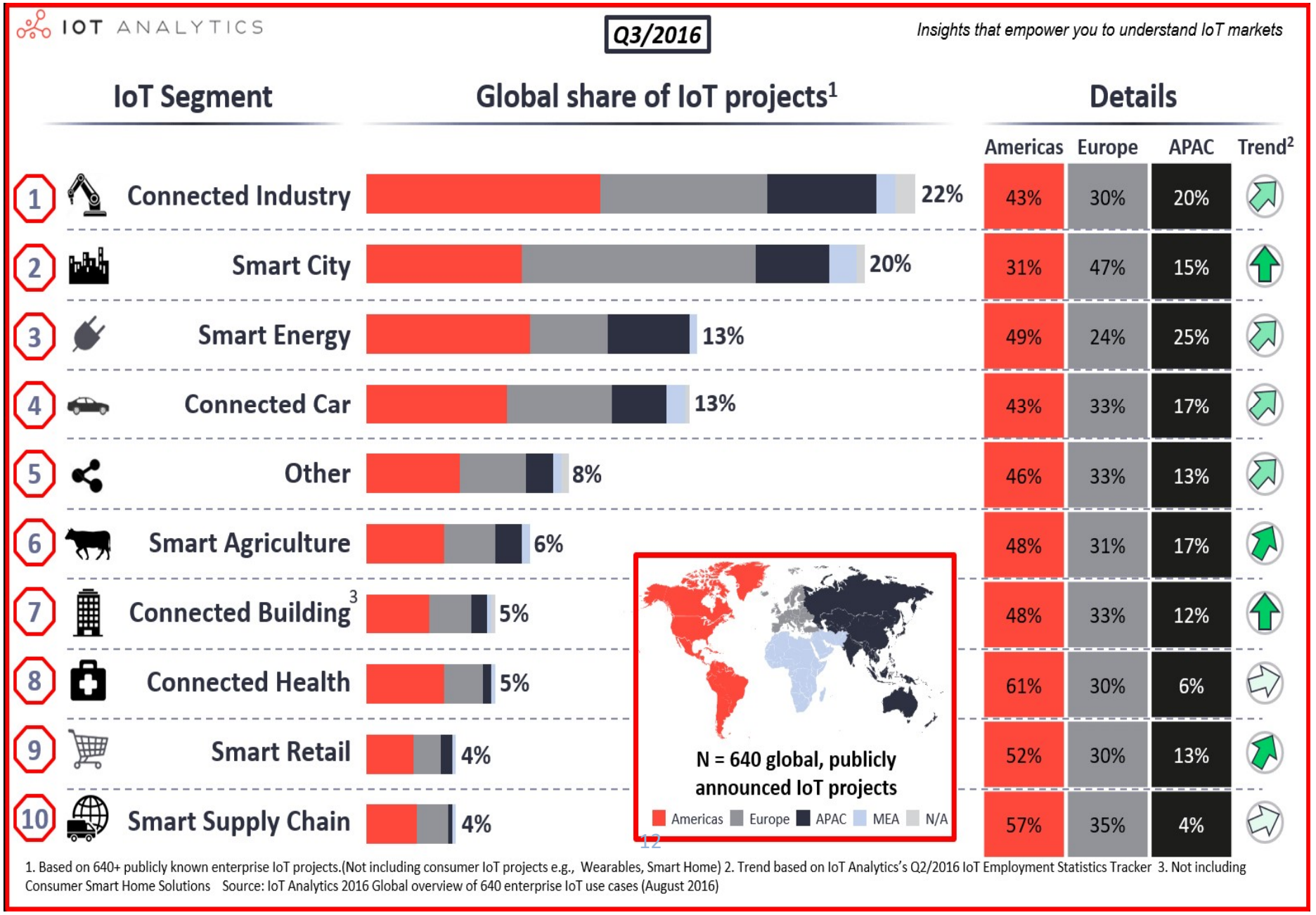
Estimated number of smart connected things in use worldwide, by category



x5 evolution of connectable things

Source: Gartner

d. Existing and IoT Potential Services

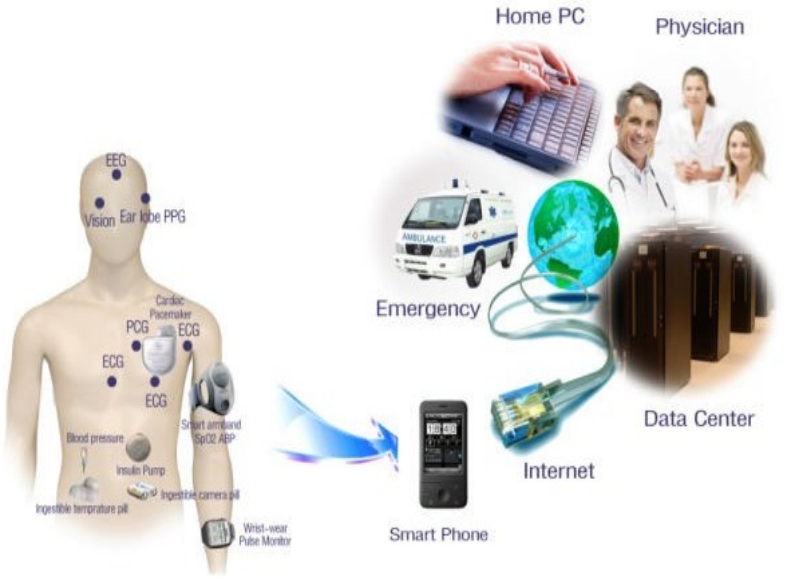


c. Existing and IoT Potential Services

Examples of services

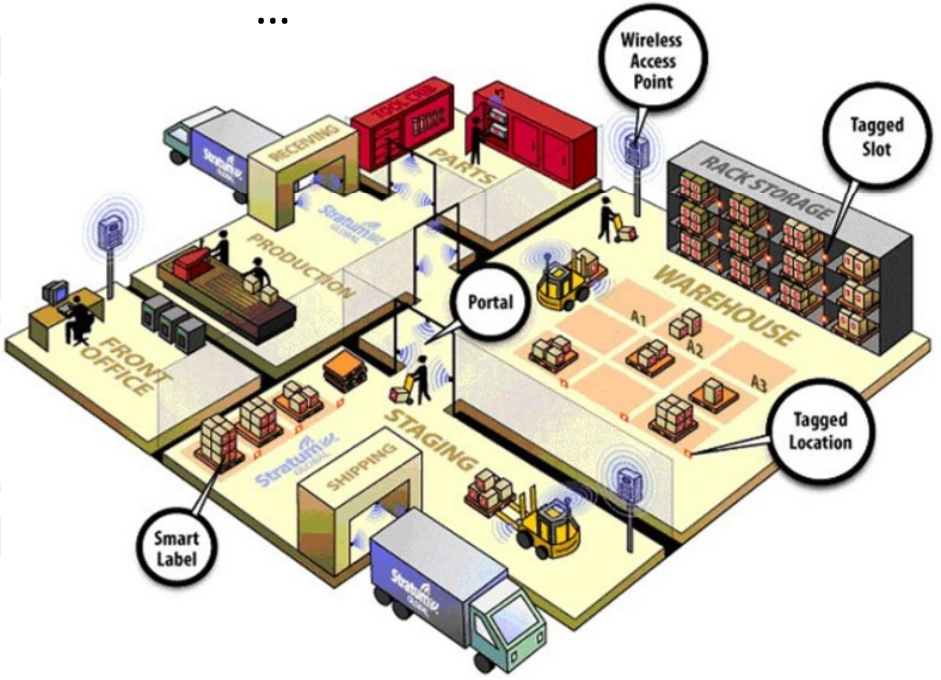
Health Care

Patients physical state analysis (heart rhythm, sleep, activity, sweating ...)



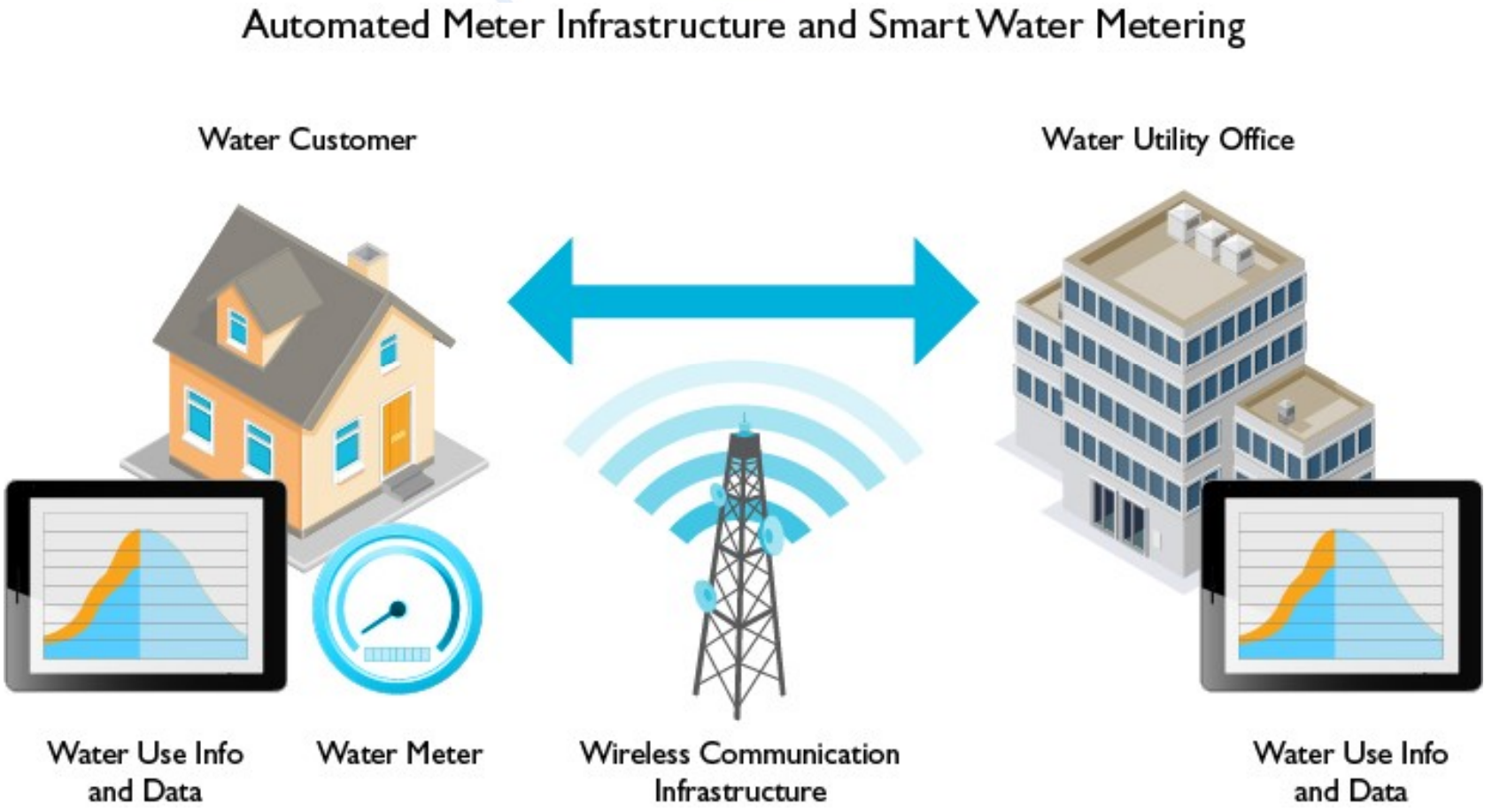
Supply Chain

Tracking, Organization, Control, …



Examples of services

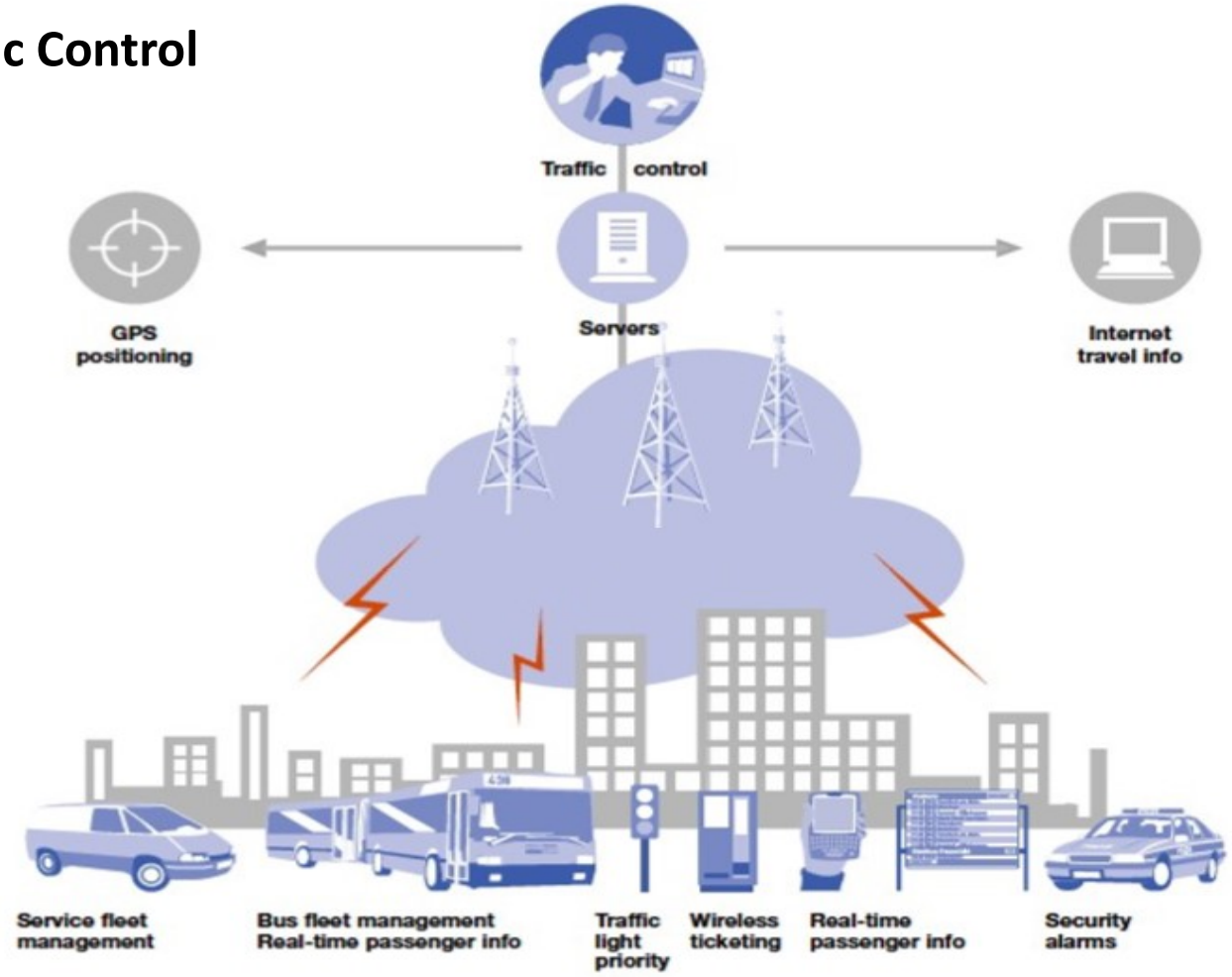
Smart Metering



c. Existing and IoT Potential Services

Examples of services

Traffic Control



Examples of services per Category

Smart Utilities

- Intelligent Utility Network
- Smart Metering
- Energy Optimization
- Smart Production
- Demand Planning
- Advanced Distribution Management
- Operations Control
- River Basin and Smart Water Management
- Wastewater Treatment

Smart Health

- Smart Care Management
- Connected Health
- Smart Medicine Supply
- Mobile Health
- Remote Healthcare Management

Smart Education

- Smart Classroom
- Performance Man.
- Asset Management

Smart Public Services

- Smart Citizen Services
- Smart Tax Administration
- Smart Customs, Immigration, Border Management
- Smart Crime Prevention
- Smart Emergency Response
- Smart Financial Management

Smart Building

- Energy Optimization
- Asset Management
- Facility Management
- Video Surveillance
- Recycling and Power Generation
- Automatic Fault Detection Diagnosis
- Supervisory Control
- Audio / Video Distribution Management

Smart Transportation

- Intelligent Transportation
- Smart Public Transportation
- Integrated Fare Management
- Fleet Optimization
- Tolling Solutions
- Real-time Adaptive Traffic Management
- Smart Parking
- Traveler Information Systems

All sectors, All types of Things, All Environments taken into account for network design (**capacity requirements**, **coverage areas**)

Kilimo Salama (Safe Farming)

Solution: A connected weather station that:

- Monitors *agricultural events*
- Facilitates links with *insurance companies*.

Several types of micro-meteorological stations capture a range of data such as **air** and **soil temperature**, air and soil **moisture**, **solar radiation**, **wind direction**, **wind speed**, **atmospheric pressure**, the **amount of rain**, the **electrical conductivity** of the ground and the **visual appearance**.

The solution is deployed for **51,000** farmers in Kenya and **14,000** farmers in Rwanda

Rwanda

Currently Sorwathe produces about **3 million Kg** of tea a year and accounts for about **14%** of Rwandan production.

- It employs about 2,500 workers.

Nano Ganesh

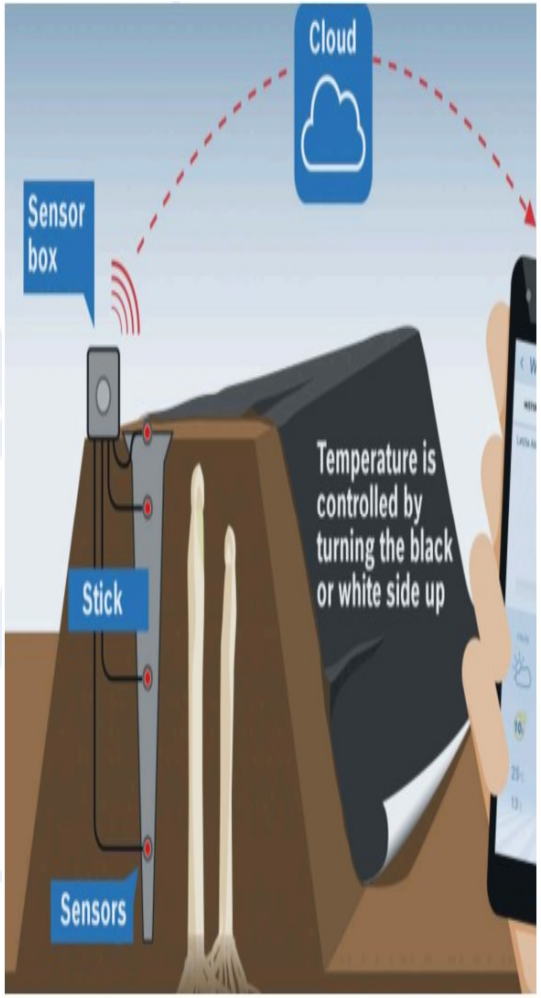
Solution: Nano Ganesh-GSM is the M2M application whereby a remote *water pump* can be *controlled* and *monitored* by a mobile phone.

The farmer can:

- *Turn on the water pump* from any location,
- Check the *availability of power* at the end of the water pump,
- Understand the on-off condition of the water pump (pump ON, pump off),
- Be alerted by a call or SMS if someone opens the doors of the boot panel (open panel),
- Be aware of the condition of the food. (Power On, Power Off, Faulty Power),

Asparagus

Asparagus grows particularly well between 18 and 22 degrees Celsius. **Bosch** has developed a sensor that measures temperature in beds where vegetables are grown and passes it to the farmer's smartphone **(monitoring changes in crop temperatures in detail and optimizing growing conditions)**



Wine

- TracoVino measures: *air humidity*, *air temperature*, *soil moisture*, *soil temperature* and *solar intensity*.
- Additional sensors to measure *soil PH* values and *nutrient levels*.
- Helps to define the *optimal time* for actions such as fertilization and pesticide.
- Helps to plan precisely and in advance the working resources and necessary actions.

Examples of existing services

Arable

Measures rainfall, crop water demand, water stress, microclimate, cover biomass and chlorophyll.

Smart Sprinklers & Irrigation service

Level 1 (basic) service: triggers the irrigation according to the level of moisture in the soil. Manual (alarm based) or automatic.

Level 2 (information based) service: triggering based on information about:

- The type of plants, soil, grass, weather forecast etc.
- History (training based on past actions and obtained results)
- Electricity rates on a daily basis

Level 3 (big data and analytics based) service: triggering is based on data collection and analytics such as:

- Data from other areas and countries
- Consumers preferences and transportation conditions
- Published experiences and obtained performance
- …

Geolocation services

Abeeway

Hidnseek

zTrack

ZTE Welink

Equipment examples

Gateway and sensors

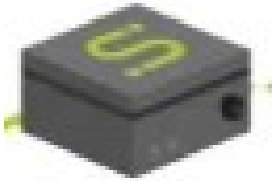
Lora Chipsets

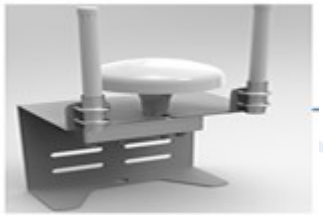
Kerlink LORA Gateway

Sigfox Gateway

Sensors

Smart water sensor





Ingenium Access point

ZTE LORA Gateway

Lora Chipsets

Thank You