IoT Technology and Service for Smart World

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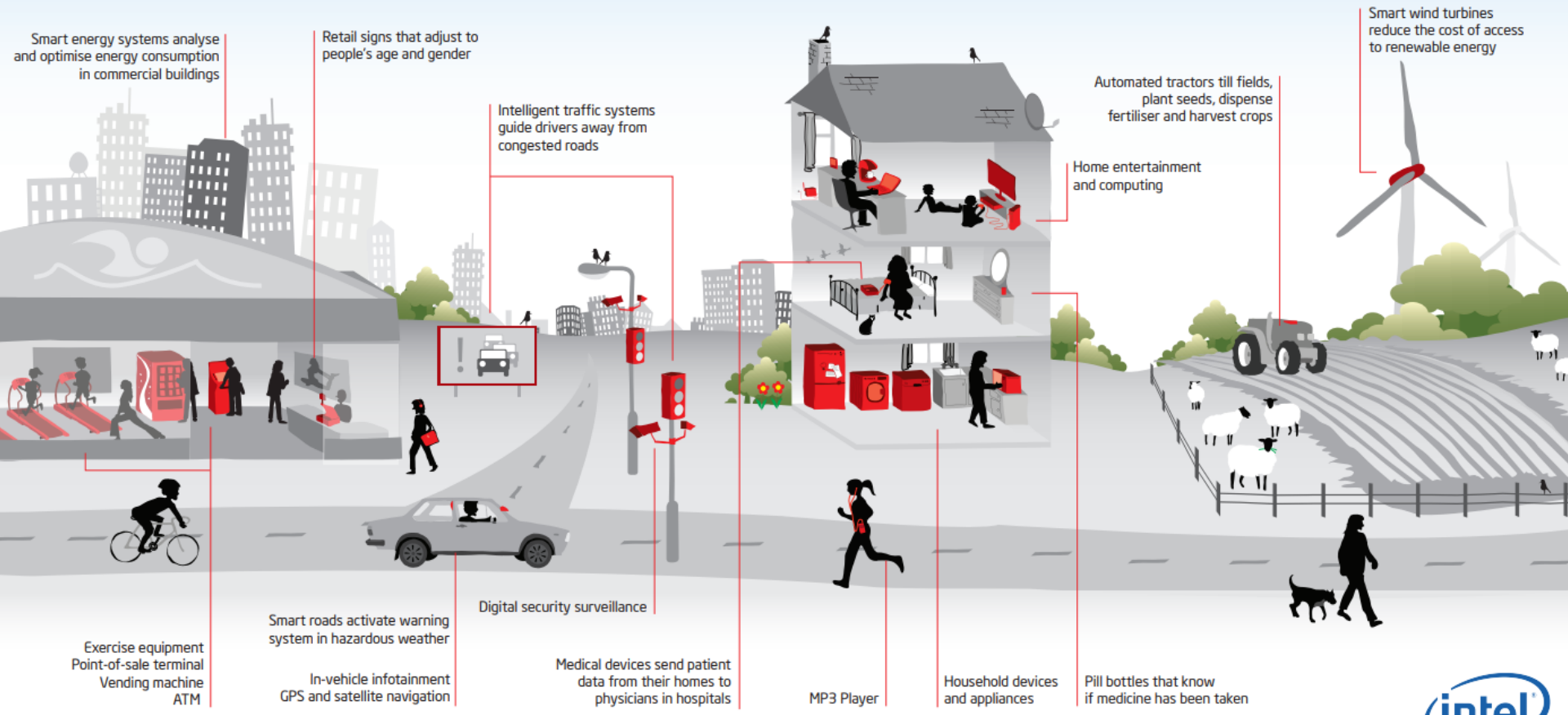
It's a Smart World

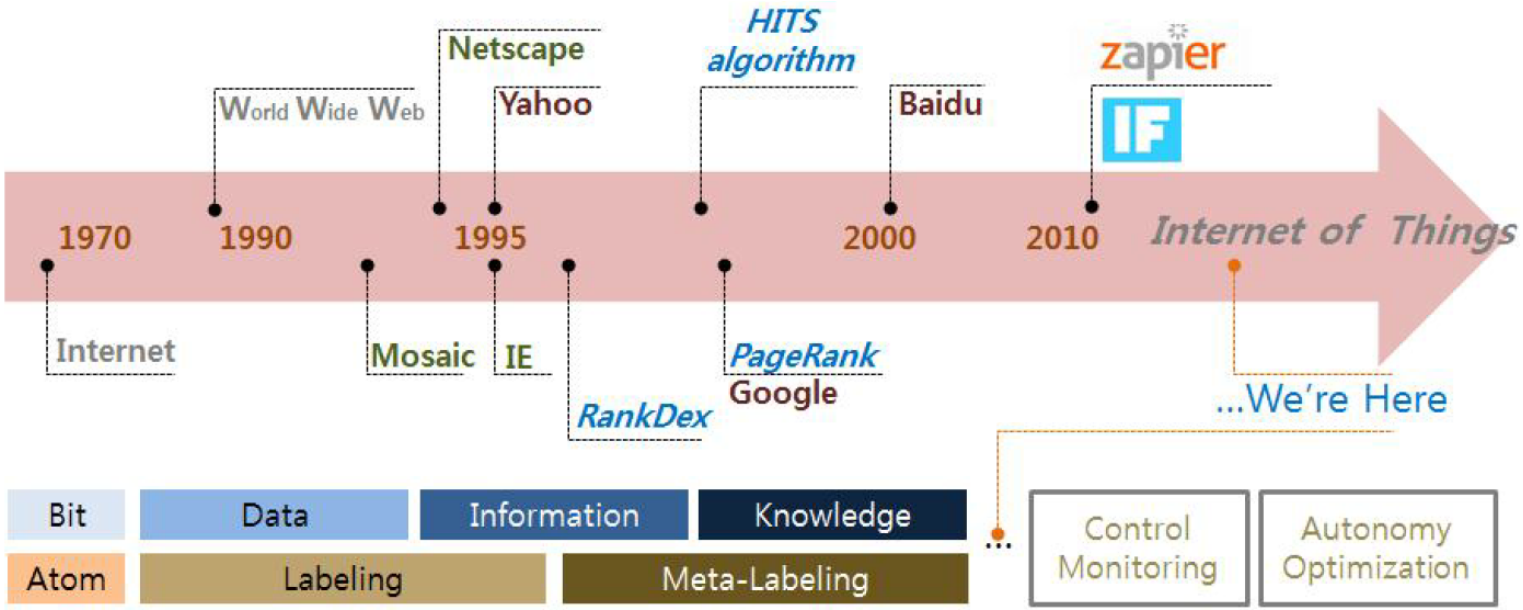
Invisible yet ubiquitous, small but mighty, unnoticed but life changing. Forty years ago the microprocessor was born, beginning the quiet but profound process which has radically reshaped our lives. Today, thanks to the microprocessor, we live in a smart world, can do smart things and make smart choices. We don't see them, but these tiny embedded computers shape our world to a remarkable degree. From the cars we drive and tractors that till the fields, to the fresh food delivered to our shops, billboards that advertise and machines that help us stay fit – they're the invisible brains that power our daily being. Long live the smart life.



https://www.dailyinfographic.com/microprocessors-in-our-smart-world-infographic

Internet and IoT

- Internet : Data, Information, Knowledge
- IoT : Monitoring, Control, Optimization, Autonomy



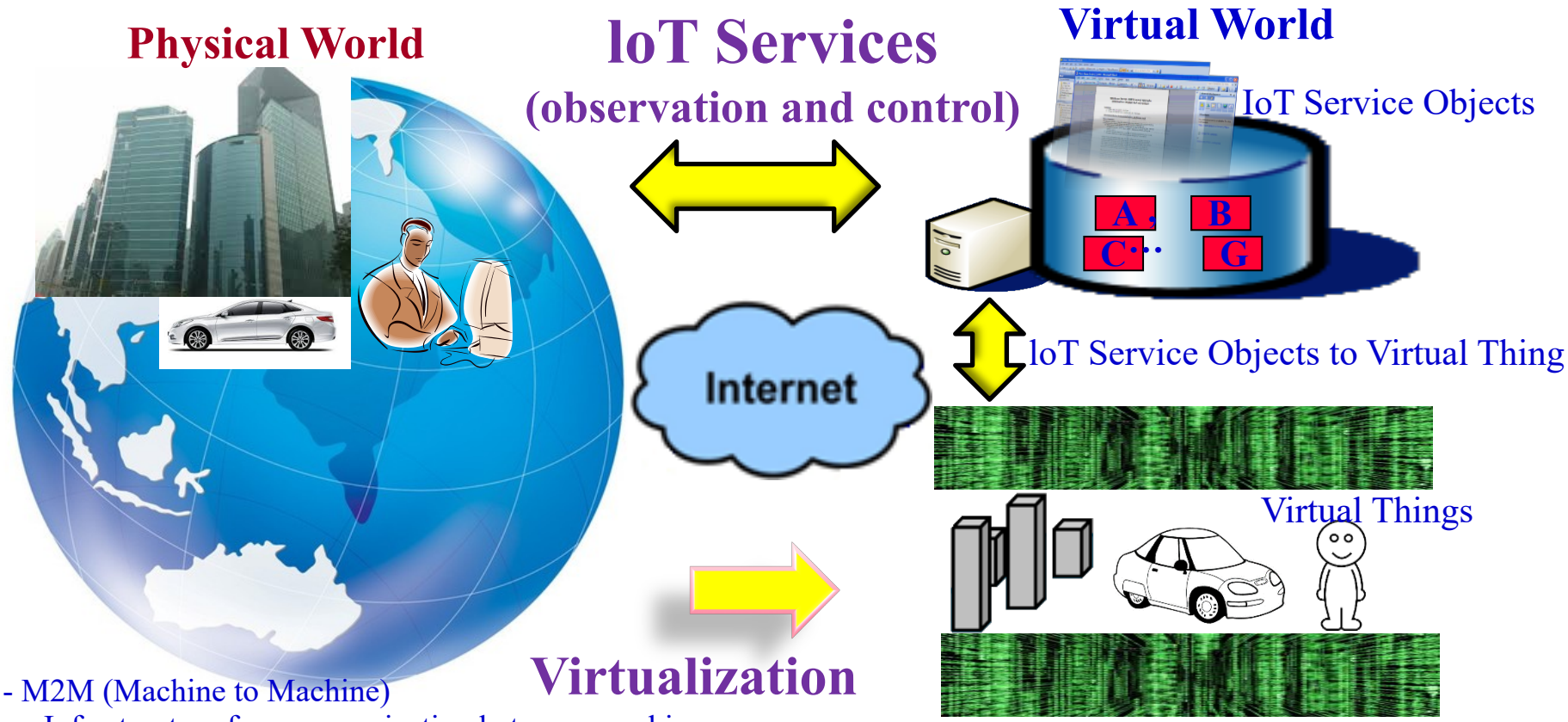
"ECOsight 3.0", ETRI Insight Report 201501, 2015. 6

Contents

- IoT Architecture
- IoT Connectivity and Platform
- IoT Service Model
- Intelligent IoT Concept and Technology
- Intelligent IoT Service

IoT (Internet of Things)

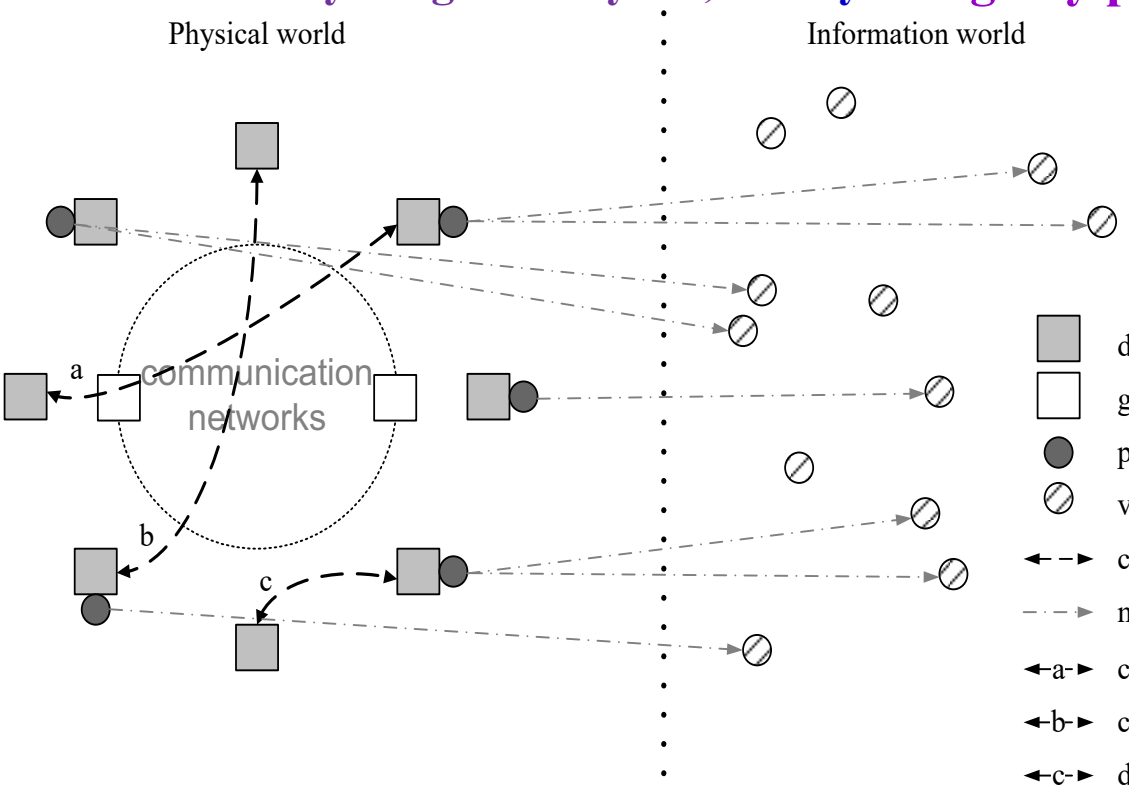
- A global network infrastructure, linking physical and virtual objects through the exploitation of data capture and communication capabilities.



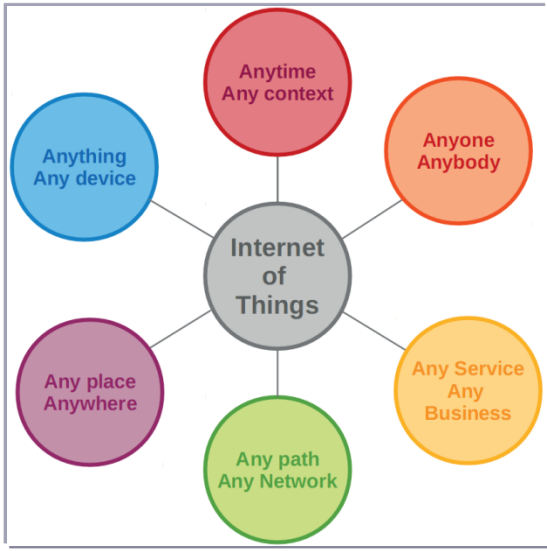
- M2M (Machine to Machine)
  : Infrastructure for communication between machines
- IoT (Internet of Things) : Connection between physical things on Internet for sensing and controlling things.

What is IoT (Internet of Things)?

- IoT Conceptual Model(ITU-T)
- The networks and services that enable communication among these objects (EU policy Outlook RFID, 2007)
- The Internet of Things allows people and things to be connected anytime, anyplace, with anything and anyone, ideally using any path/network and any service.



device
gateway
physical thing
virtual thing
communication
mapping
-a- communication via gateway
-b- communication without gateway
-c- direct communication

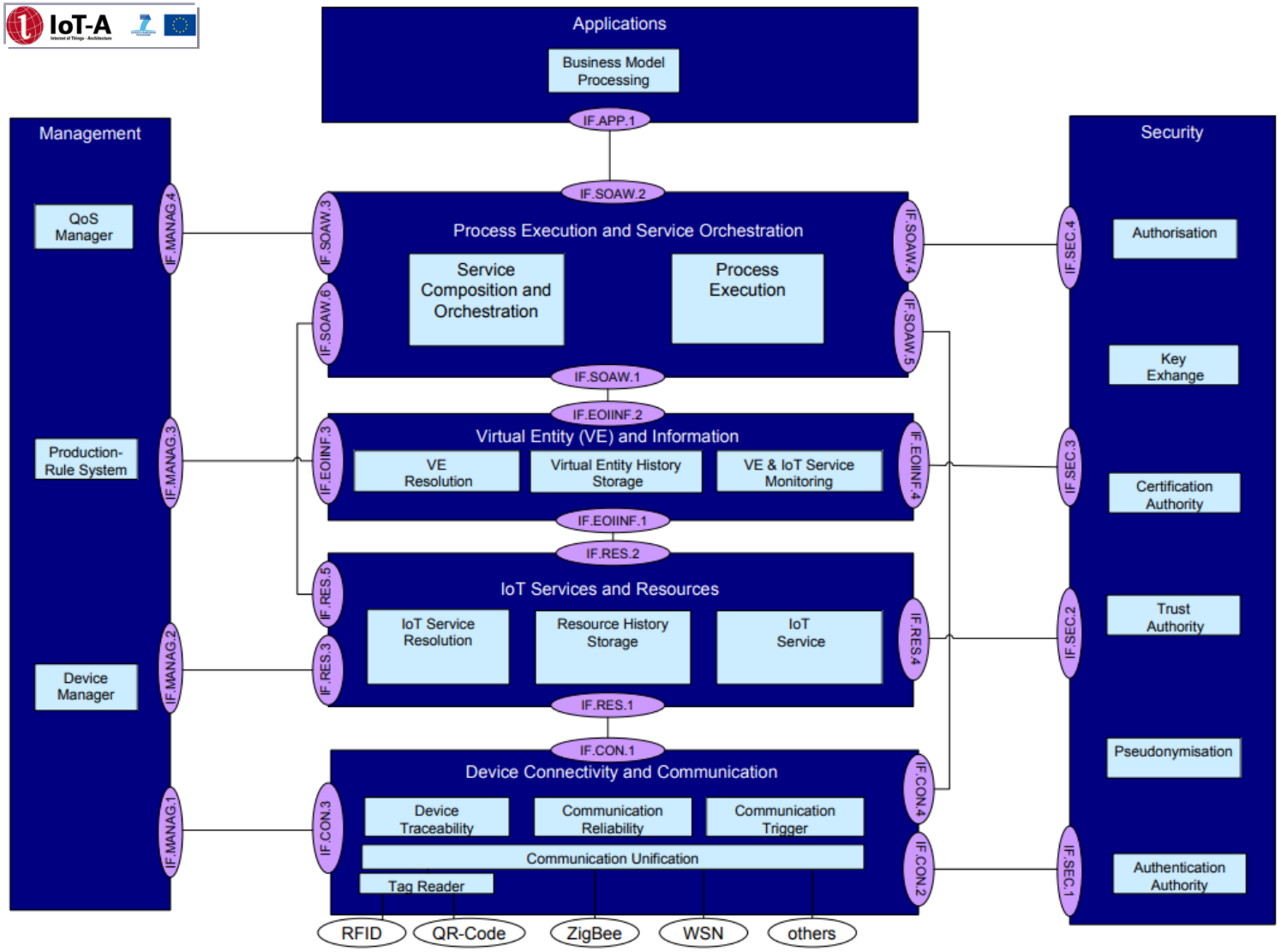


"ITU-T Y.2060," http://www.itu.int/ITU-T/

IoT Reference Architecture

- Diagram depicting the functional view of the IoT reference architecture

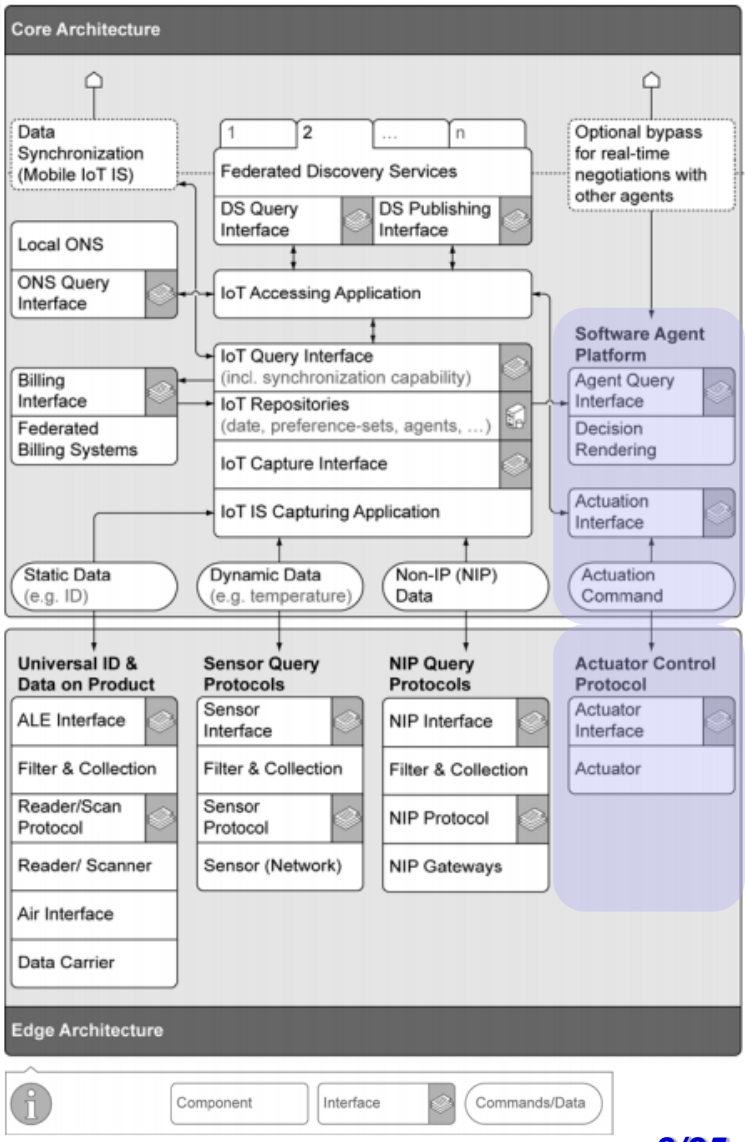
Joachim W. Walewski,"Project Deliverable D1.2 – Initial Architectural Reference Model for IoT," IoT-A, 3611



EPCglobal IoT Architecture

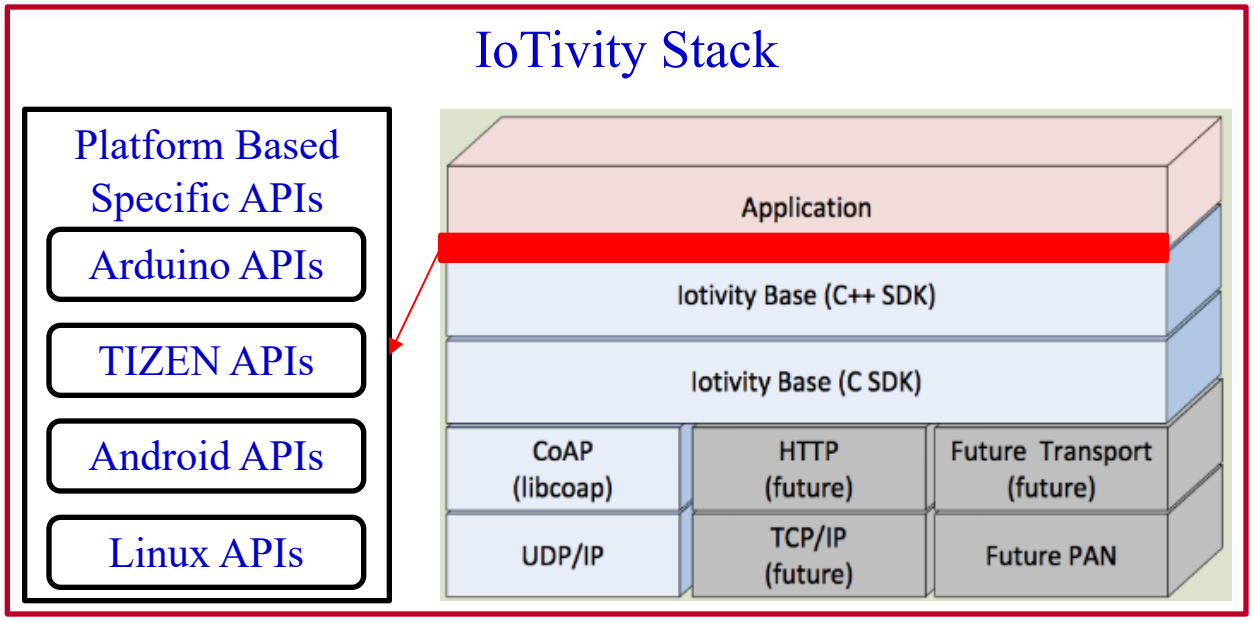
- **An Extended EPCglobal Architecture Towards a Future Internet of Things**
  - **Integration of sensors, actuators and software agents connected to the Internet of Things Information Service is presented.**
  - **Mobile and disconnected, requiring means for synchronisation of data and logic.**
  - **Accessibility of information will be enabled through federated discovery services.**
  - **These search and discovery services will rely upon mechanisms for universal authentication and access control, at the desired level of granularity.**

Dieter Uckelmann, Mark Harrison, Florian Michahelles,
"An Architectural Approach Towards the Future Internet of Things"



IoT Standard

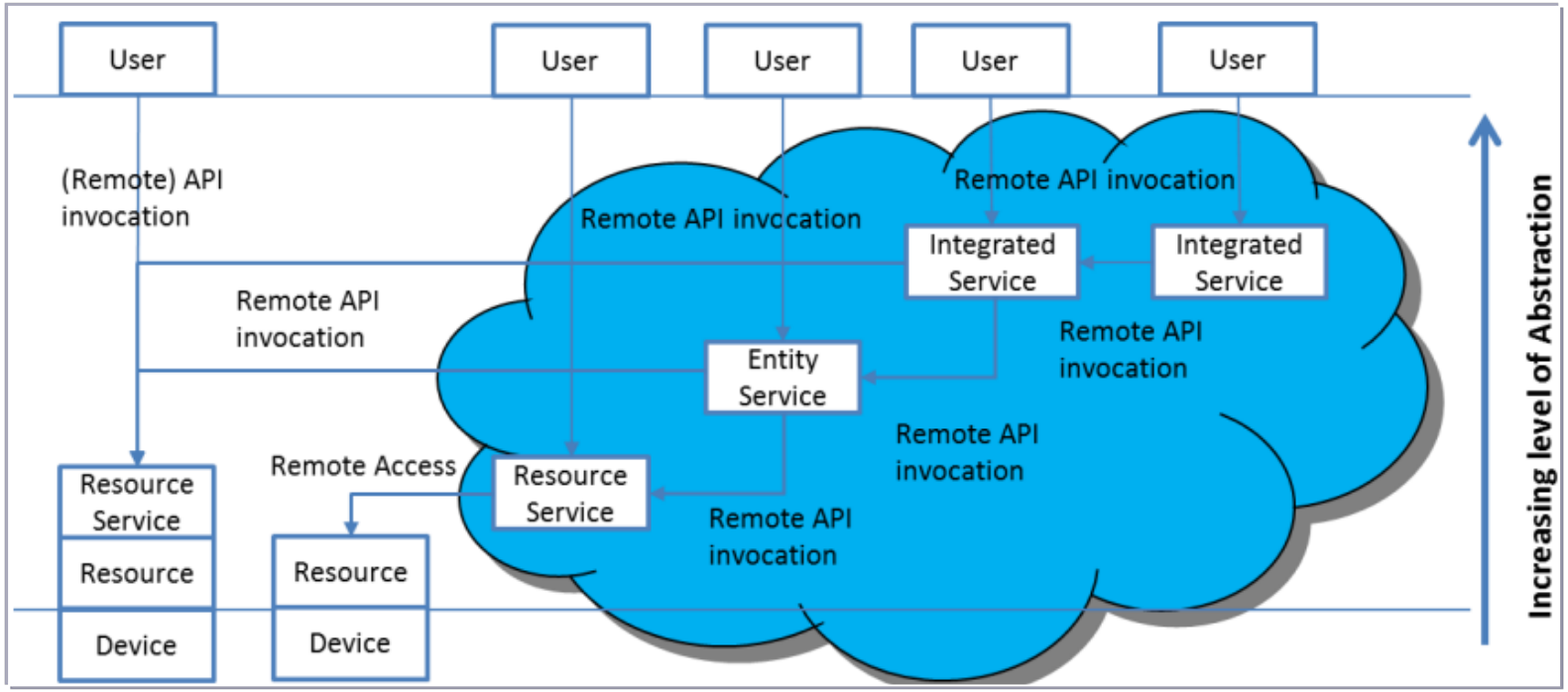
- Open Connectivity Foundation (OCF)
- OCF IoTivity Stack
  - CoAP Protocl.
  - Base SDK (C/C++).
  - Open APIs.
- IoTivity Specification



Standardization	Open Connectivity Foundation (OCF)
Current Version	IoTivity 2.0
License	Apache License Version 2.0
Supported Platform	TIZEN, Linux (Ubuntu, Yocto), Android, Arduino (ARM, AVR)

IoT Service Model

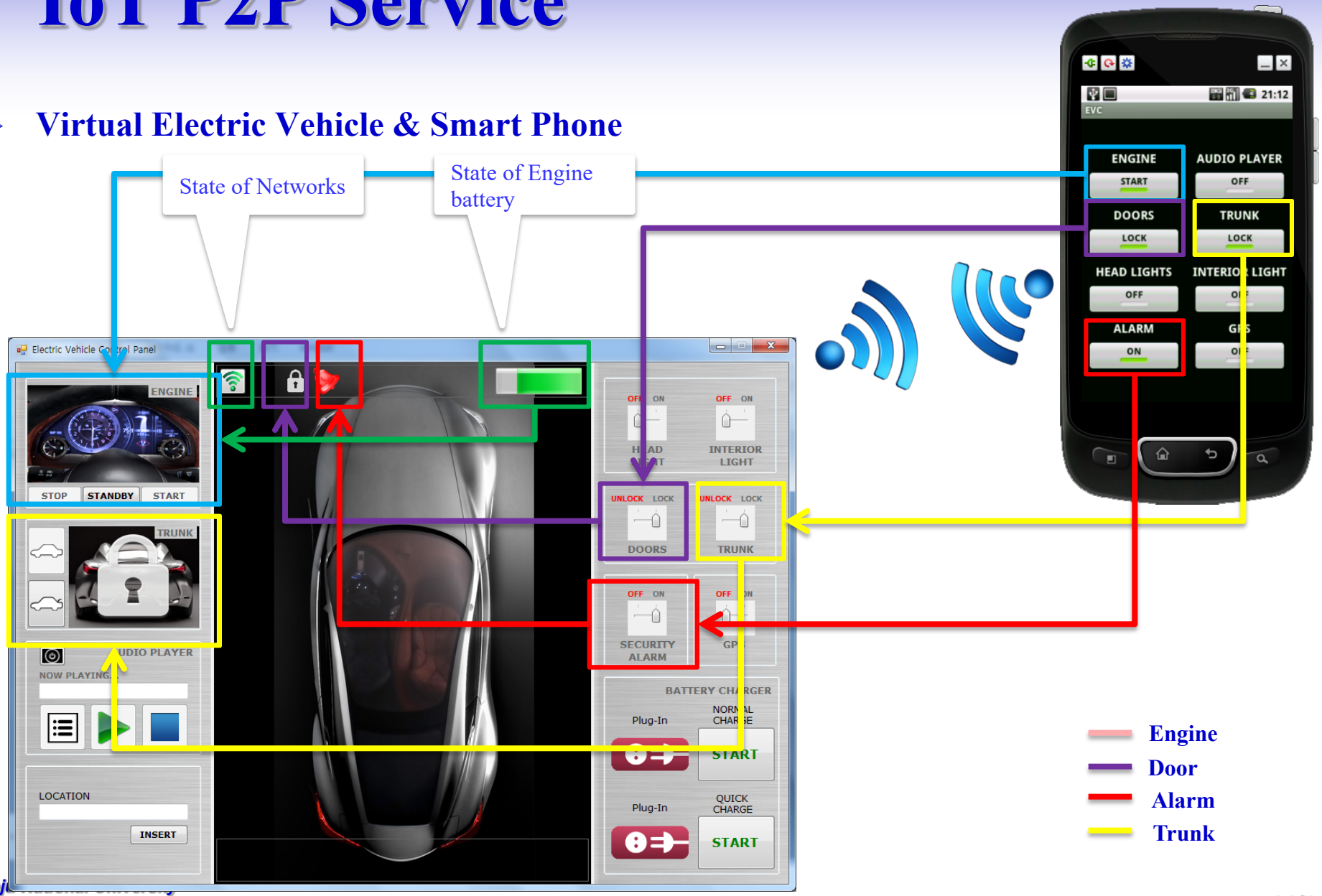
- **Relationship between devices, resources and services.**
- **IoT P2P service, IoT service based on Gateway**
- **IoT service based on server (local, national, global)**



Joachim W. Walewski,"Project Deliverable D1.2 – Initial Architectural Reference Model for IoT," IoT-A, 3611

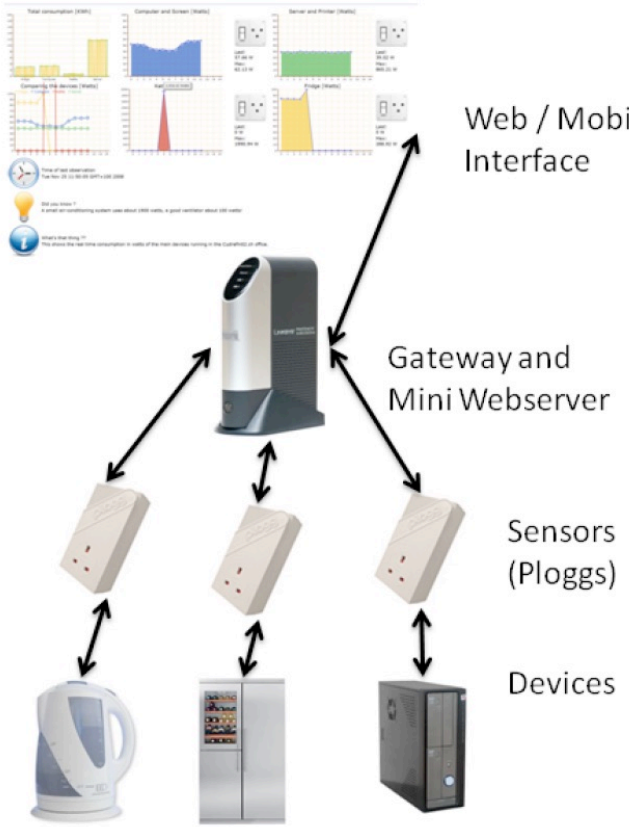
IoT P2P Service

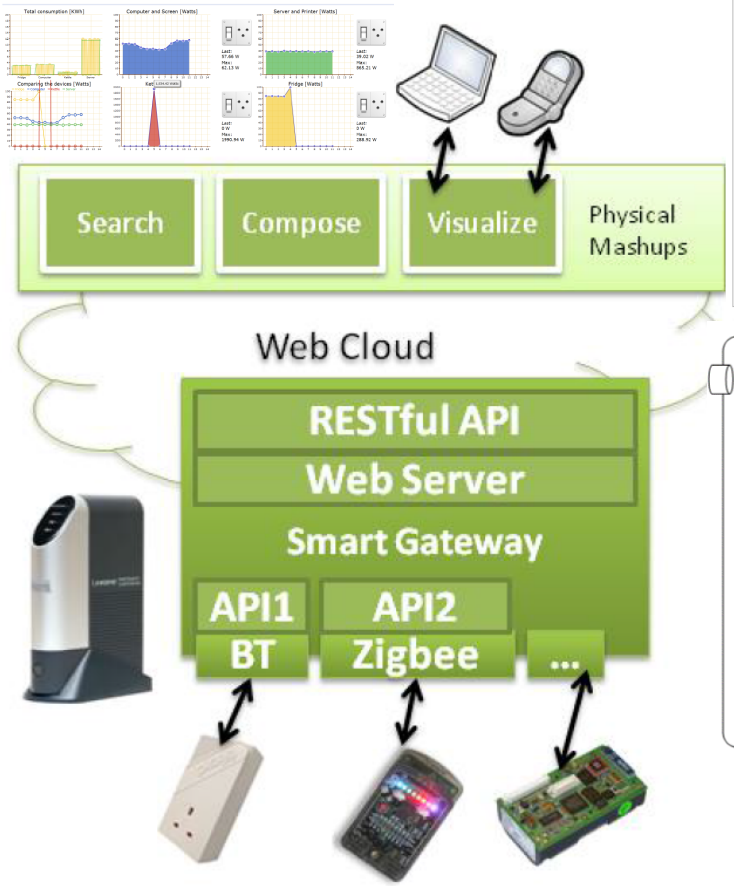
- **Virtual Electric Vehicle & Smart Phone**

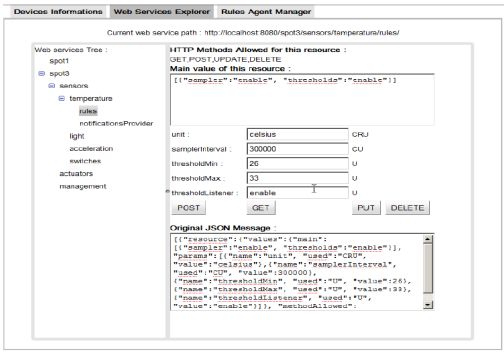


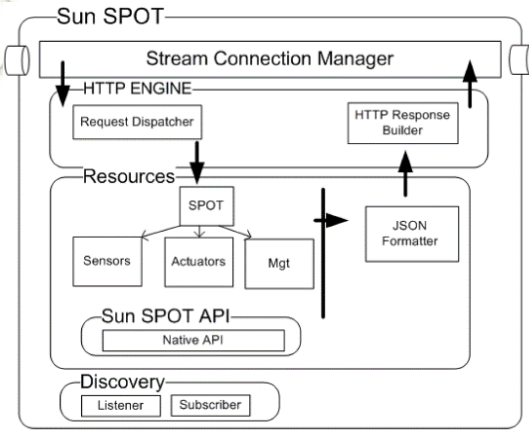
IoT Service Based on Gateway

- **AJAX**



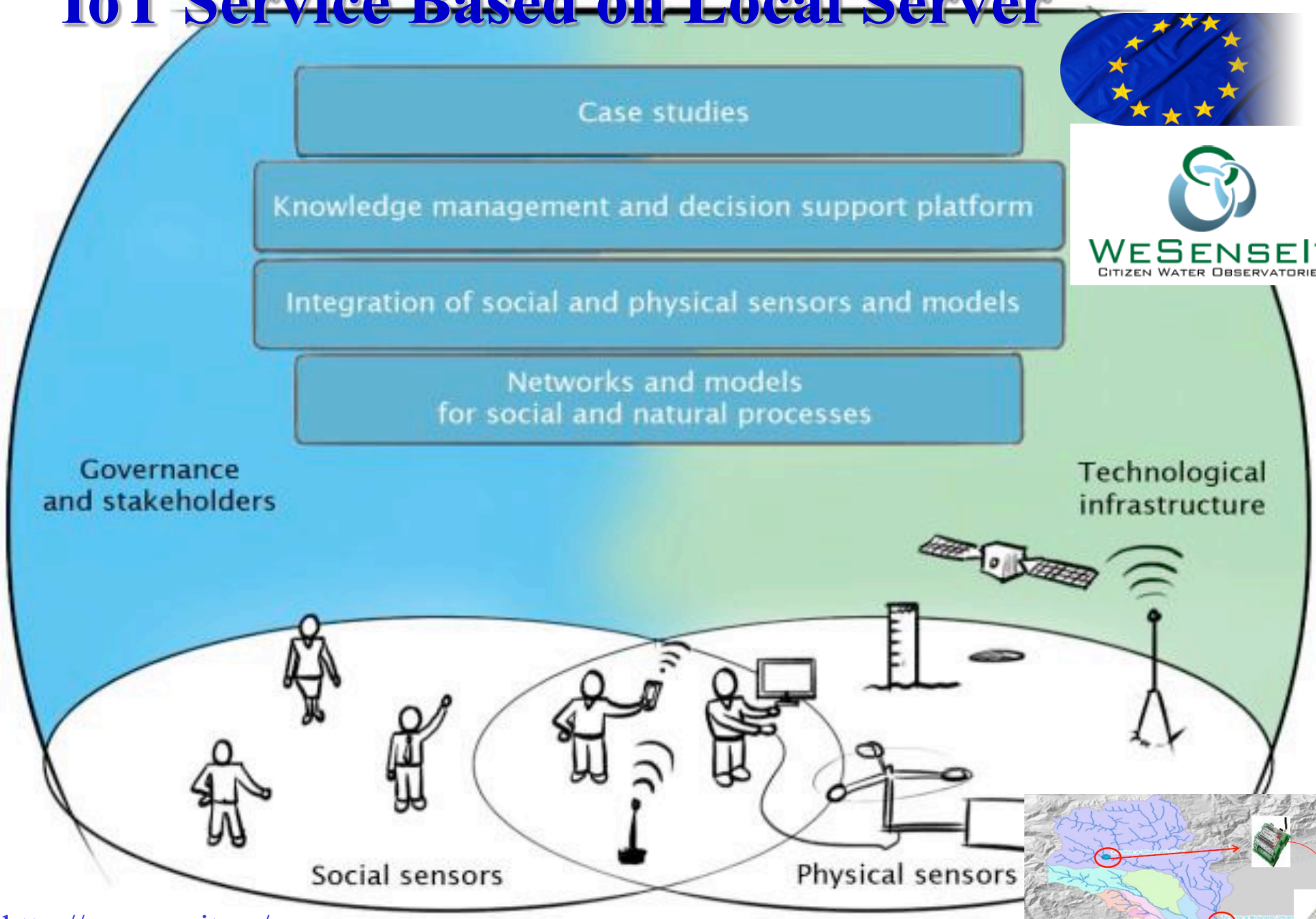






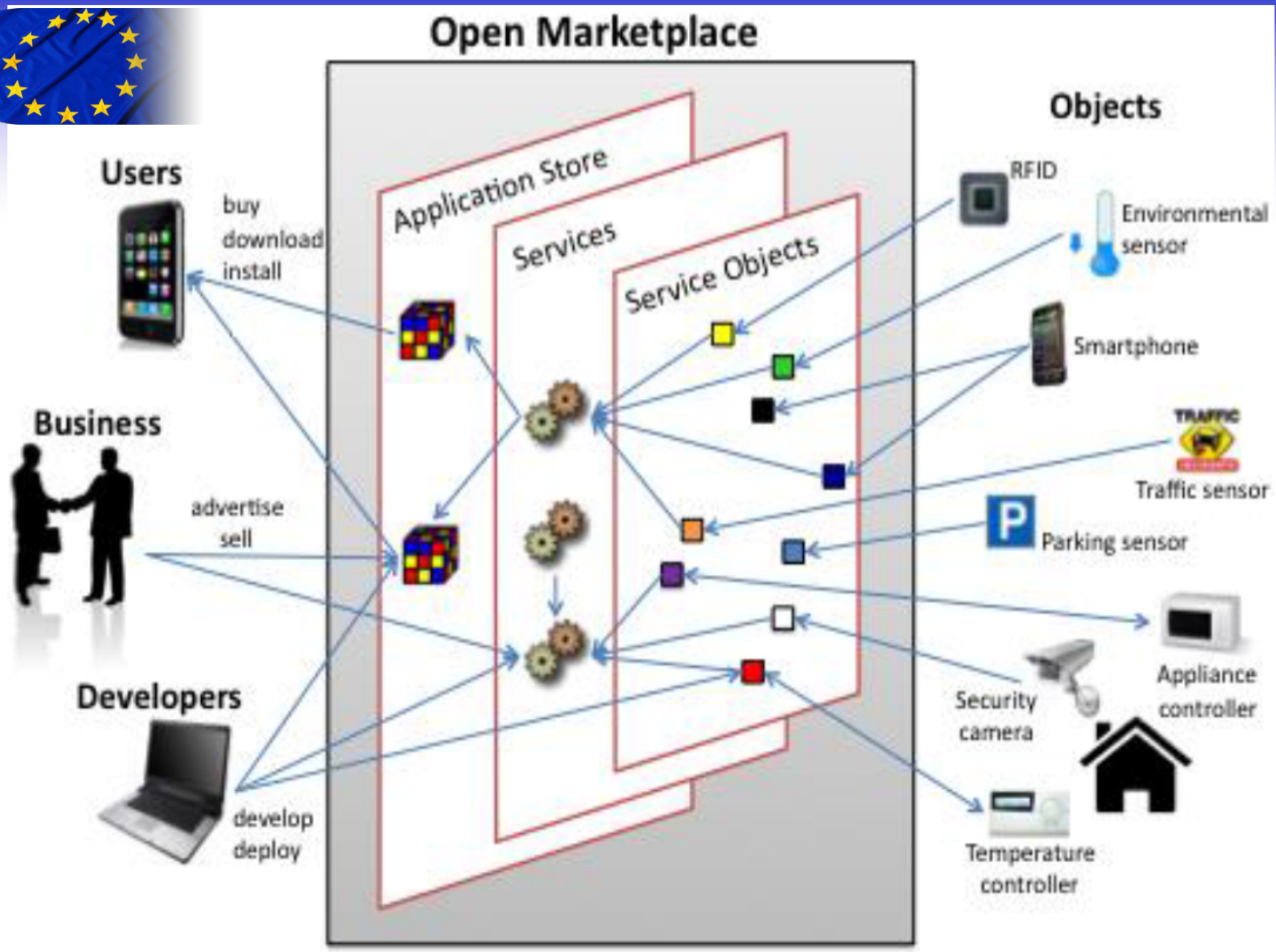
D. Guinard and V Trifa," Towards the web of things: Web mashups for embedded devices", 2009

IoT Service Based on Local Server



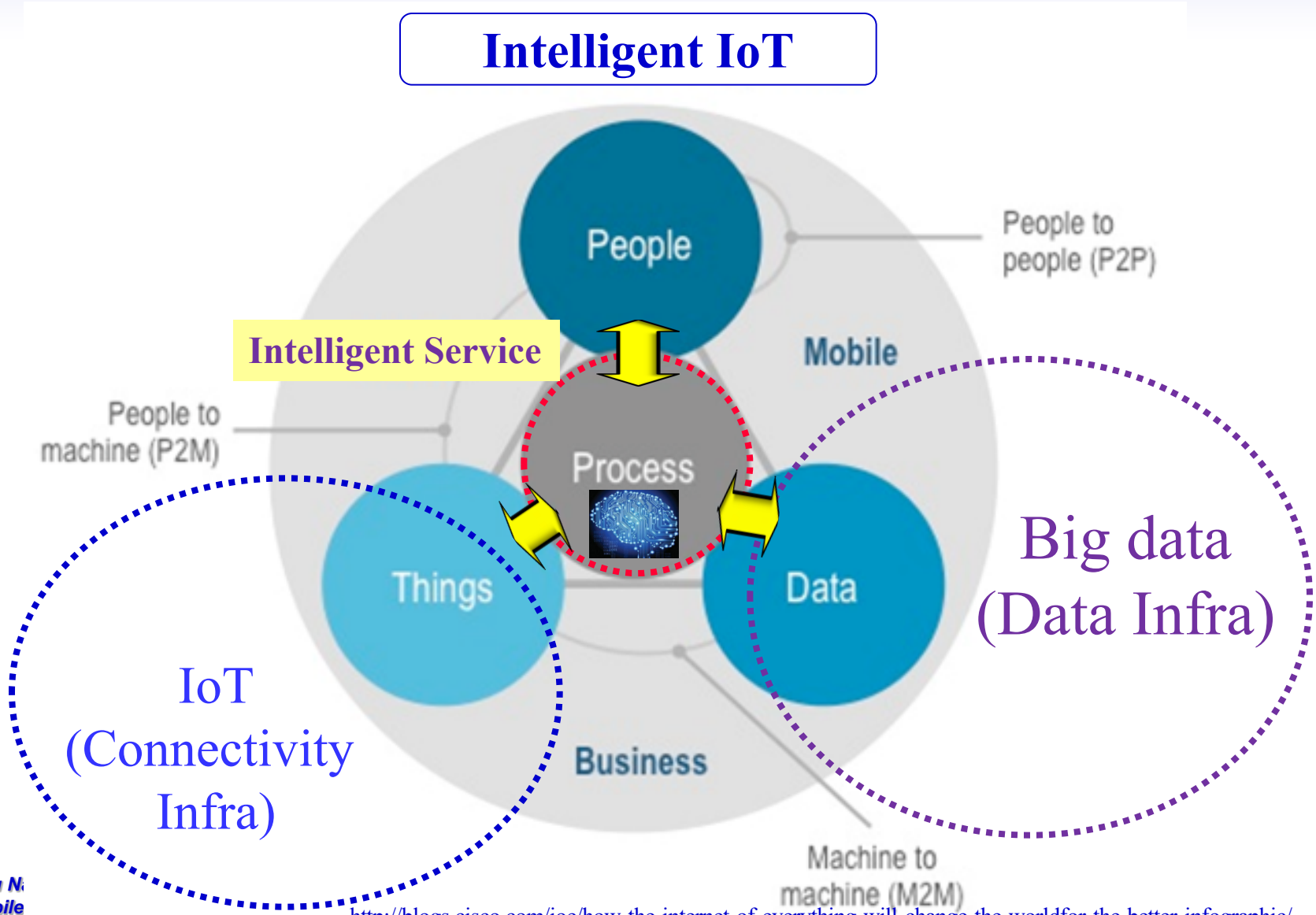
WeSenseIt
Citizen Water Observatories

http://wesenseit.eu/



Charalampos Doukas1, Dave Raggett,"Collaborative Open Market to Place Objects at your Service,"3613

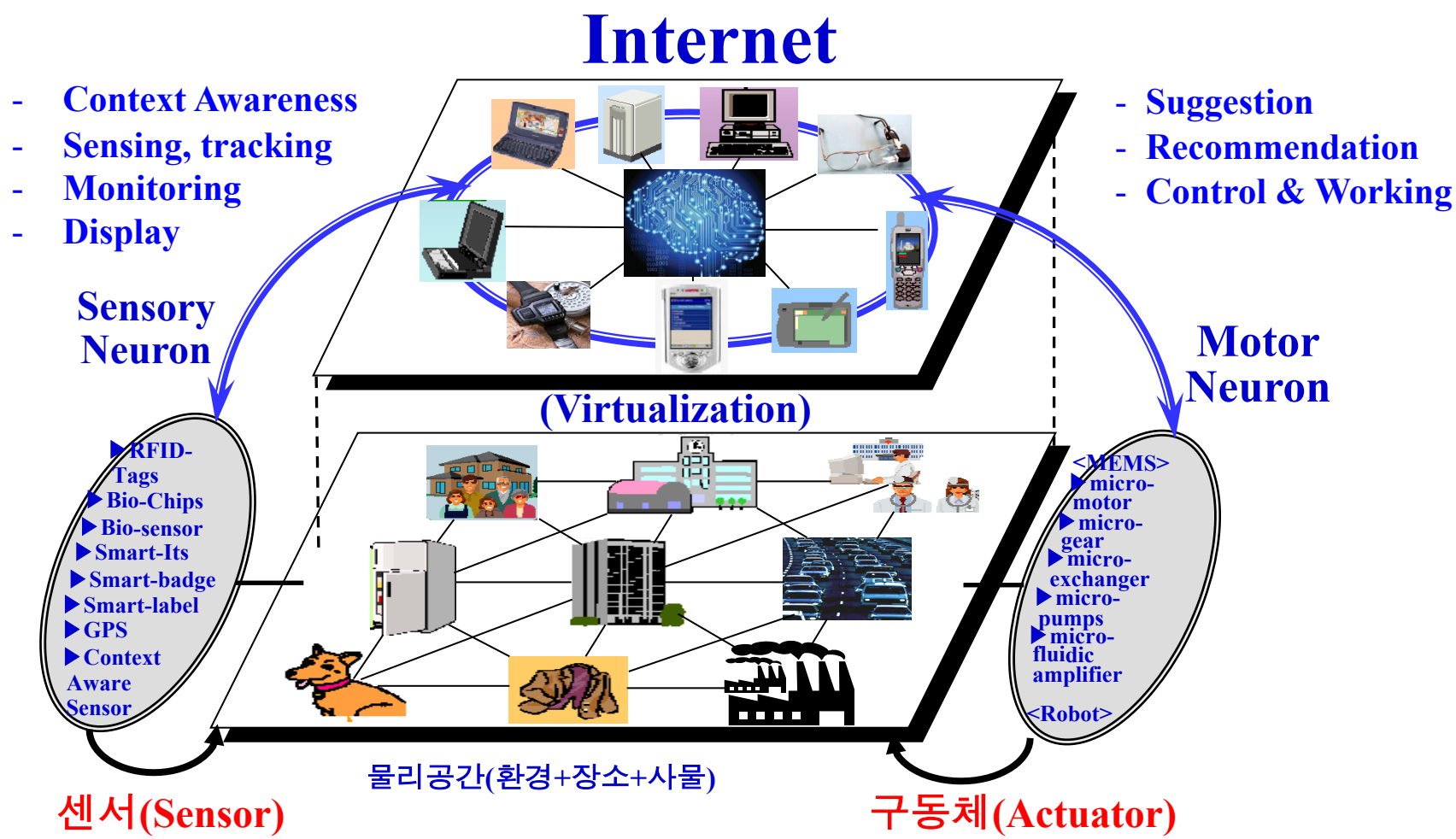
Intelligent IoT Concept



http://blogs.cisco.com/ioe/how-the-internet-of-everything-will-change-the-worldfor-the-better-infographic/

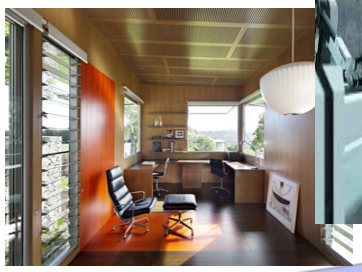
Intelligent IoT Concept

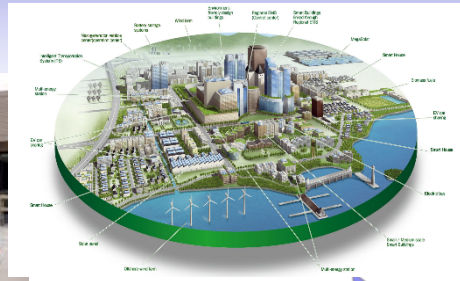
- Connectivity of Space-Things-Computer-Human



Intelligent IoT Technology

- ✓ Monitoring
- ✓ Control
- ✓ Optimization
- ✓ Autonomy



Monitoring

1. Sensors and external data sources enable the comprehensive monitoring of:
   - the product's condition
   - the external environment
   - the product's operation and usage

   Monitoring also enables alerts and notifications of changes

Control

2. Software embedded in the product or in the product cloud enables:
   - Control of product functions
   - Personalization of the user experience

Optimization

3. Monitoring and control capabilities enable algorithms that optimize product operation and use in order to:
   - Enhance product performance
   - Allow predictive diagnostics, service, and repair

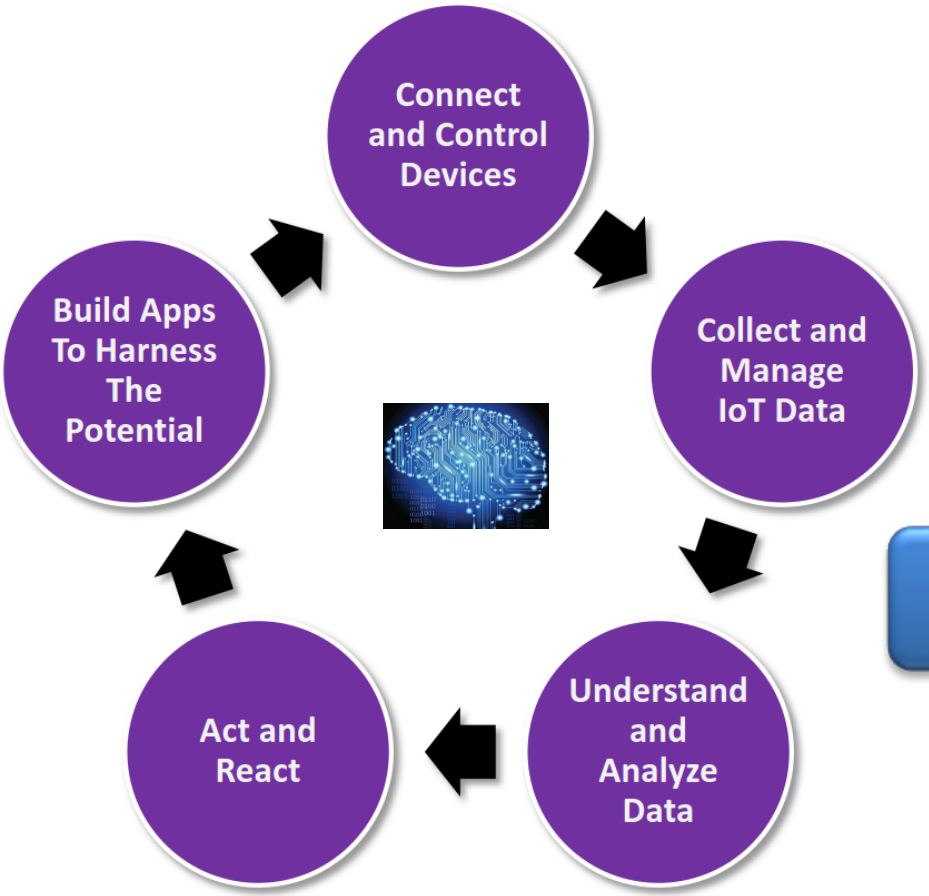
Autonomy

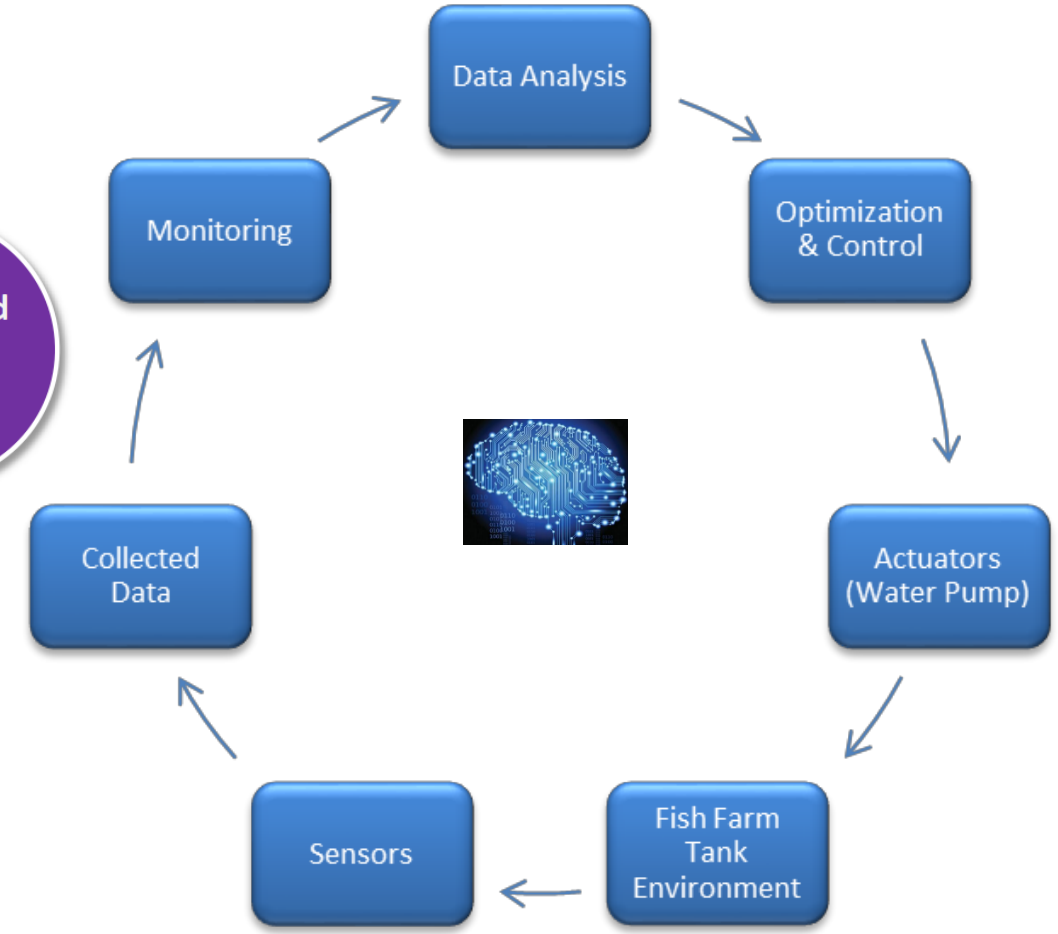
4. Combining monitoring, control and optimization allows:
   - Autonomous product operation
   - Self-coordination of operation with other products and systems
   - Autonomous product enhancement and personalization
   - Self-diagnosis and service

M.E. Porter & J.E. Hepplemann (2014) " How Smart, Connected Products are Transforming Competition?, HBR, Nov, 2014

Intelligent IoT Technology

- **Five keys to tapping into IoT value**





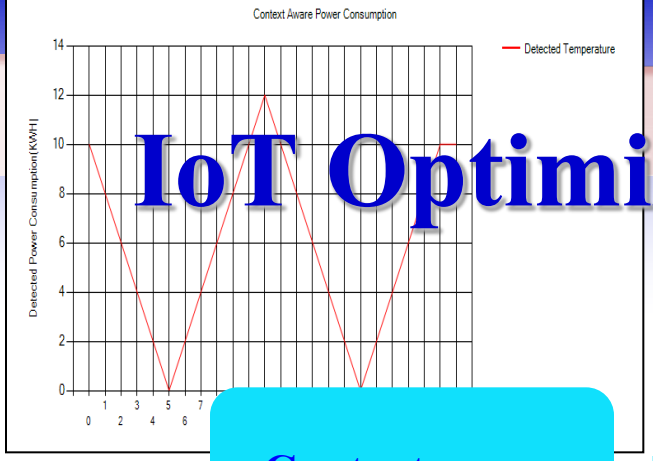
IoT Monitoring Service

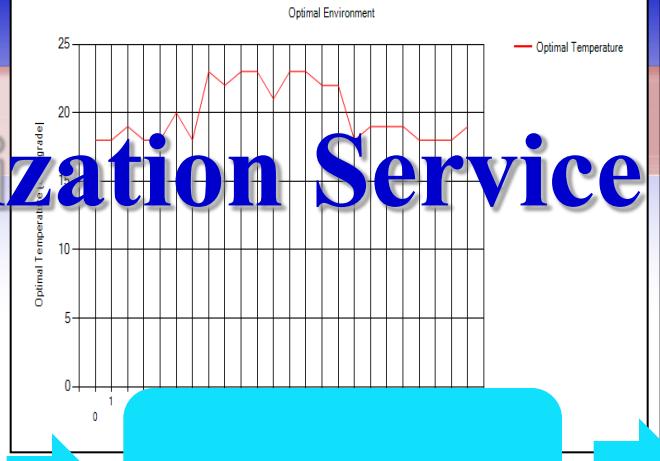
http://www.siliconrepublic.com/innovation/item/23983-deri-researchers-create-fre

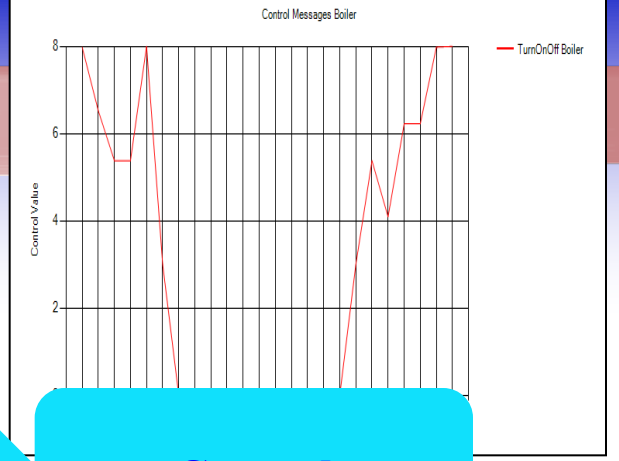
IoT Control Service

https://smart.kookmin.ac.kr/index.php?document_srl=1836&mid=news

IoT Optimization Service







Context aware

Optimization

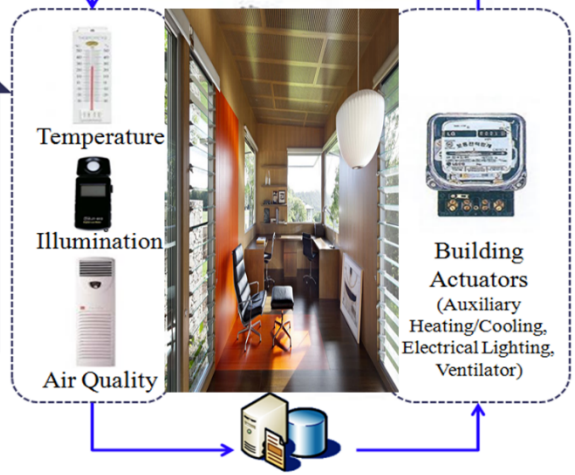
Control

Sensor

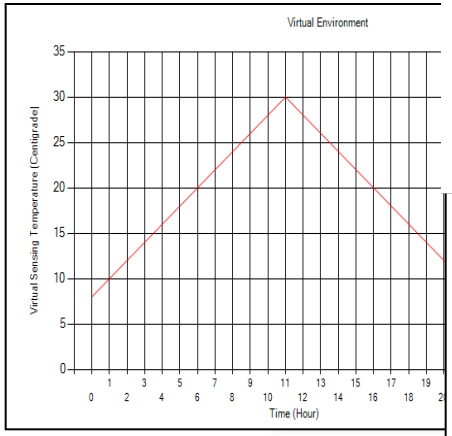
Actuator nodes

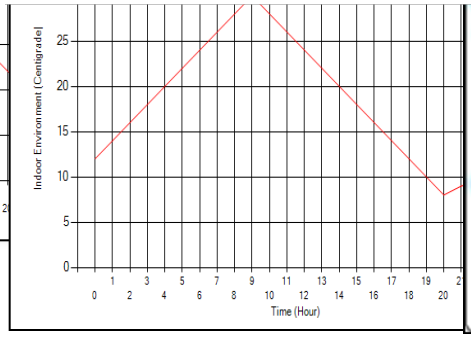
Comfortable Index

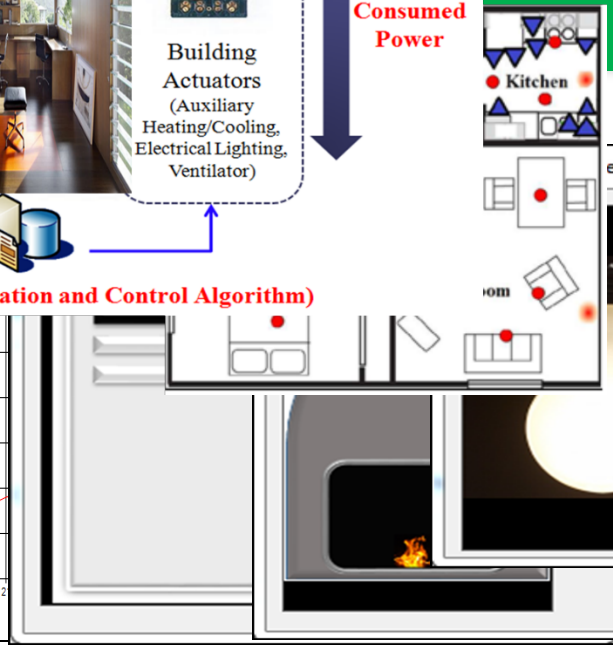
Consumed Power

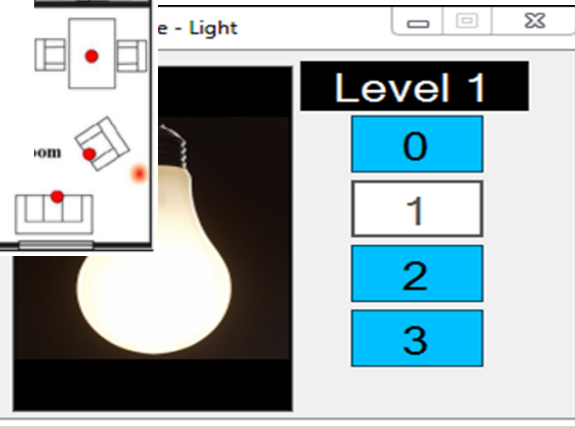


Agent (Optimization and Control Algorithm)









IoT Autonomy Service

- Collaborative farm work
- Self driving car
- Unmanned autonomous tractor

Publications (1/2)

- [1] (Electronics, SCIE IF 2.110) Wenquan Jin, Dohyeun Kim. "Resource Management Based on OCF for Device Self-Registration and Status Detection in IoT Networks", 2019.03.
- [2] (Sustainability, SCIE IF 2.075) Wenquan Jin, Israr Ullah, Shabir Ahmad, Dohyeun Kim. "Occupant Comfort Management Based on Energy Optimization Using an Environment Prediction Model in Smart Homes", 2019.02.
- [3] (Sustainability, SCIE IF 2.075) Wenquan Jin, Dohyeun Kim. "Consistent Registration and Discovery Scheme for Devices and Web Service Providers Based on RAML Using Embedded RD in OCF IoT Network", 2018.12.
- [4] (Sensors, SCIE IF 2.475) Wenquan Jin, DoHyeun Kim. "Development of virtual resource based IoT proxy for bridging heterogeneous web services in IoT networks", 2018.05.
- [5] (Sensors, SCIE IF 2.475) Wenquan Jin, Do Hyeun Kim. "Design and implementation of e-health system based on semantic sensor network using IETF YANG", 2018.02.

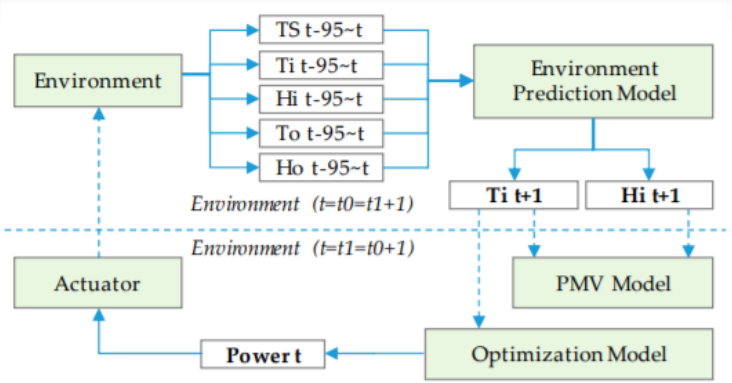


Fig. Architecture of the proposed occupant comfort management based on the prediction model [2].

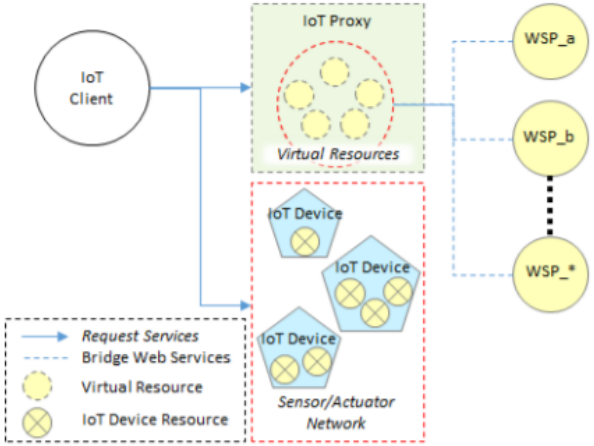


Fig. Proxy-based IoT architecture for providing services from sensor/actuator network and WSP [4].

Publications (2/2)

- [6] (Electronics, SCIE IF 2.110), Azimbek Khudoyberdiev, Wenquan Jin, DoHyeun Kim. "A Novel Approach towards Resource Auto-Registration and Discovery of Embedded Systems Based on DNS", 2019.04.
- [7] (Processes, SCIE IF 1.279) Lei Hang, Sang-Hun Kang, Wenquan Jin, Do-Hyeun Kim. "Design and Implementation of an Optimal Travel Route Recommender System on Big Data for Tourists in Jeju", 2018.08.
- [8] (Electronics, SCIE IF 2.110), Lei Hang, Wenquan Jin, HyeonSik Yoon, Yong Geun Hong, Do Hyeun Kim. "Design and Implementation of a Sensor-Cloud Platform for Physical Sensor Management on CoT Environments", 2018.08.

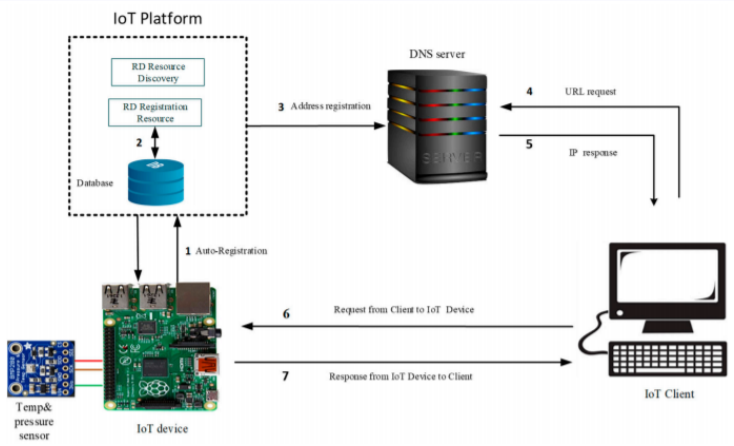


Fig. Proposed system architecture for auto-registration and resource discovery [6].

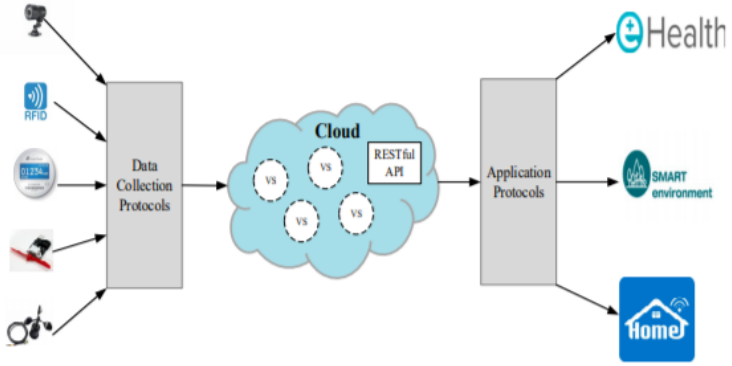


Fig. Basic architecture of Cloud-based platform [8].


Q&A