INTERNET OF THINGS APPLICATIONS

MIRKO FRANCESCHINIS

Workshop on Scientific Applications
for the Internet of Things (IoT)
16-27 March 2015, ICTP – Trieste

ISMB
Istituto Superiore Mario Boella

Pervasive Technologies

ABOUT ME

- 2000 – Telecommunication Engineering Master Degree at Politecnico di Torino
- 2003 – Communication Engineering PhD Degree at Politecnico di Torino
- 2004 – Research Grant on Wireless Networks at Politecnico di Torino
- [2005 - Today] – Researcher @ ISMB in the Pervasive Technologies (PerT) Area, mainly working on low-power wireless networks
- ISMB PerT Area
  - IoT Objects and Platforms
  - Pervasive Secure Networks
  - IoT Service Management

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OUTLINE

- Part I – IoT Application Domains and Scenarios: a Taxonomy
- Part II – The experience of ISMB in Projects on IoT Applications

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PART I

IOT APPLICATION DOMAINS AND SCENARIOS: A TAXONOMY

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ABOUT AN IOT TAXONOMY

- A widely accepted taxonomy of IoT applications is still elusive (and thus does not exist)
  - High diversity and heterogeneity of IoT definitions and deployments
- Referencing a common IoT application taxonomy is nonetheless very important and useful
  - A general overview for the audience of this course
  - A primary tool helping to identify and categorize the various requirements
    - Common requirements across different domains may influence general-purpose IoT features
    - Domain-specific requirements shall be considered for optional features to be supported by IoT development in specific markets

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PROPOSED TAXONOMY

- Taxonomy organization
  - A set of application domains
  - A few possible use cases for each application domain and related challenges
- Source: "*High-Level Internet of Things Applications Development Using Wireless Sensor Networks*", Book chapter published in "*Internet of Things – Challenges and Opportunities*", Springer
  - Categorization suggested in the IERC (European Research Cluster on the Internet of Things) Clusterbook
- Application domains
  - Smart Cities, Smart Environment, Smart Water, Smart Metering, Security and Emergency, Retail, Logistics, Industrial Control, Smart Agriculture, Smart Animal Farming, Domotics and Home Automation, e-Health

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SMART CITIES

- Description
  - Broad set of applications for more sustainable, safe and enjoyable cities
  - New ICT-supported models of cooperation among citizens, institutions and companies (e.g., utilities, service providers)
  - A large number of networked devices and systems deployed on city-wide scale
- Applications
  - Systems supporting urban mobility and its safety (e.g., Smart Parking, Traffic Congestion, Intelligent Transportation Systems)
  - Applications monitoring or optimizing assets and critical infrastructures in cities (Structural Health, Smart Lightning, Smart Roads)
  - Systems monitoring and protecting the citizens' quality of life (Noise Urban Maps, Waste Management)

SMART CITIES

- Structural health
  - Monitoring the status of buildings, bridges or other infrastructure by sensing their vibrations
  - Challenges
    - Large scale deployment
    - Processing and detecting events from raw data via (potentially complex) algorithms running on-board the nodes
    - Low-power constraints
    - Inter-node coordination (coherent data time-stamping)

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SMART CITIES

- Traffic congestion
  - Monitoring car and pedestrian traffic by combining data from fixed and mobile sensors
  - Challenges
    - Large scale deployment
    - Integration of data from heterogeneous devices and data sources
    - Interoperability of different vendor sensors
    - Interoperability with other systems (e.g., mobile terminals, legacy traffic monitoring platforms)
    - Distribution of intelligence (e.g., due to time constraints)

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SMART CITIES

- Participatory sensing
  - Collecting, analyzing and sharing data through participation of local communities of volunteers
  - Challenges
    - Working with heterogeneous data and sensors
    - The need for data annotation and semantic interoperability
    - Integration of crowd-sourced knowledge
    - Interoperability with community-provided devices
    - Trust and privacy

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SMART ENVIRONMENT

- Description
  - Any system monitoring or preventing critical events in wide, unpopulated areas where significant environmental risks have been identified
- Applications
  - Such areas require constant monitoring and alerting about critical events
    - Fire in forests
    - Landslides and avalanches in mountain areas
    - Earthquakes in seismic areas
    - Exceptional air or water pollution events in heavy industrial areas

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SMART ENVIRONMENT

- Forest fire detection
  - In remote forest areas to alert public authorities
  - Challenges
    - Large scale deployment without fixed communication infrastructure
    - Strict low-power constraints
    - Effective use of energy harvesting
    - Unmanned operation
    - Integration of multi-hop communication solutions (wide areas)
    - Need for efficient data processing on board constrained nodes
    - Real-time reporting of critical events

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SMART ENVIRONMENT

- Remote seismography
  - Collection of seismic data from remote areas by means of microphones or seismic-acoustic sensors
  - Challenges
    - Installations in harsh conditions
    - Synchronization and time-stamping of sensed data
- Pollution monitoring
  - Potentially dangerous gases in both urban and remote areas using fixed or mobile sensors
  - Challenges
    - Data collection from fixed and mobile installations and geotagging
    - Power supply management

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SMART WATER

- Description
  - All systems for water monitoring in both civil and natural environments
- Applications
  - Water quality monitoring (e.g., presence of chemicals) in rivers or in water distribution infrastructure
  - Water leakage detection in pipes or buffer tanks
  - Monitoring of levels of rivers, dams and reservoirs finalized to early warning of flood or drought conditions

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SMART WATER

- Water leakages detection
  - Monitoring pipes or distribution networks by means of pressure, flow or other types of sensors
  - Challenges
    - Installations and operations in harsh conditions (e.g., underground)
    - Time-correlation of spatial data
    - Data fusion from heterogeneous sensors possibly provided by different vendors
- Level-monitoring and flood detection
  - Applicable to basins, dams, rivers, lakes checks levels and detects floods
  - Challenges
    - Resilient communication and strict real-time constraints when critical events occurs
    - Continuous distributed monitoring and processing of sensed data

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SMART METERING

- Description
  - Remote monitoring and control of a large population of networked meters that provide data for accounting and consumption billing of various commodities
  - Meters deployed in storage tanks, cisterns or transportation systems (e.g., water pipes, oil pipelines)
- Applications
  - Electricity (both consumed and generated in the so-called Smart Grid)
  - Water
  - Gas and oil

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SMART METERING

- Metering in the smart electric grid
  - Monitoring/accounting electricity consumption via remote, automated meters
  - The electric power distribution market is today the most mature Smart Metering solution
  - Challenges
    - Interoperable standardized and certified solutions
    - Security and privacy, reliability and transparency
- Metering of heating systems
  - Monitoring consumption and efficiency of heating systems
  - Challenges
    - Interoperable standardized and certified solutions
    - Interoperability with legacy systems

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SECURITY AND EMERGENCY

- Description
  - Preventing people and goods from integrity risks
- Applications
  - Protection of areas sensitive to people intrusion
  - Protection of areas sensitive to environmental factors that increase the risks for people and goods
    - monitoring liquids in areas with dense electric outlets
    - detecting presence of gases and leakages in chemical factories
    - detecting radiations close to nuclear power stations

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SECURITY AND EMERGENCY

- Perimeter control and tracking
  - Detection and localization of trespassers as thieves or enemy troops, by using distributed sensors and alarms
  - Challenges
    - Resilience to interference and disruption
    - Complex data management and processing for intruder detection
- Disaster recovery solutions
  - Assistance to rescuers active after major disasters as radiation leaks or floods
  - Challenges
    - Resilience to interference and disruption (e.g., many sensors disabled or moved)
    - Real-time requirements during emergency, interoperability with mobile networks (e.g., aerial vehicles or land robots)

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RETAIL

- Description
  - Systems able to simplify, stimulate or improve the efficiency of a set of common actions in the retail sphere
- Applications
  - Stocking (Supply Chain Control)
  - Storage (Smart Product Management)
  - Marketing (Intelligent Shopping Applications)
  - Selling (NFC Payment) in shops and malls

RETAIL

- Smart shopping
  - Marketing-oriented applications in retail environments, e.g., to track customers' behavior or feed targeted advertisements in malls
  - Challenges
    - Context awareness (e.g., location-dependent behavior, time awareness)
    - Interoperability with existing business systems
- Stock control
  - Real-time monitoring of shelves and stocks by alerting for stocks that run out
  - Challenges
    - Real-time operation
    - Integration with legacy enterprise systems

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LOGISTICS

- Description
  - Systems involving storage and shipping of goods
- Applications
  - Monitoring of correct conservation of goods during the transportation by checking box opening, break of cold chain and by means of vibrations and strokes control
  - Detection of improper storage conditions, e.g. compromised by flammable materials close to heat sources
  - Location of items in storages or harbors

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LOGISTICS

- Smart transport
  - Monitoring goods in trucks or cargo ships during transport
  - Challenges
    - Monitoring system reliability and trust (e.g., anti-tampering)
    - Automatic association of sensor readings to goods
- Smart logistics
  - Detection and tracking of goods stored in warehouses
  - Challenges
    - Large scale operations
    - Standard identification schemes
    - Standard solutions for tagging

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INDUSTRIAL CONTROL

- Description
  - Systems typically deployed in manufacturing or process industries
- Applications
  - Remote machineries check
  - Diagnostic of the status and position of moving vehicles or robots
  - Monitoring of the conditions of the manufacturing environment (e.g., air quality monitoring in food processing industries)

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INDUSTRIAL CONTROL

- Manufacturing applications
  - Based on autonomous M2M interactions to optimize production lines
  - Challenges
    - Interoperability across heterogeneous system
    - Reliability in harsh industrial environments
    - Strong safety constraints
- Mobile robotics applications in industry
  - Interaction of mobile robots with fixed IoT infrastructures, e.g., to support internal logistics in manufacturing plants
  - Challenges
    - Interoperability of robots with fixed sensors
    - Support for mobile operations

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SMART AGRICULTURE

- Description
  - Embracing systems that can support the development and the efficiency of agricultural processes
- Applications
  - Monitoring the soil used for growing agricultural products, plants, greenhouses
  - Monitoring the environmental conditions (e.g., weather)

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SMART AGRICULTURE

- Crop monitoring
  - For moisture, salinity, acidity, using sets of chemical sensors, e.g., to ensure product quality
  - Challenges
    - Operations in harsh conditions
    - Self-powered operations
- Smart green houses
  - Controlled and optimized via wireless sensors and actuators
  - Challenges
    - Integration of heterogeneous sensors
    - Control logic support using distributed sensors and actuators

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SMART ANIMAL FARMING

- Description
  - Closely related to Smart Agriculture
  - Enhances the productivity of animals for meat and related products (e.g., milk, eggs)
- Applications
  - Monitoring the animal health conditions at different stages
  - Animal tracking and identification (also used for product traceability)
  - Living environment

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SMART ANIMAL FARMING

- Animal monitoring
  - Supervising animal behavior, e.g., detecting states of sickness or stress
  - Challenges
    - Operations in harsh conditions
    - Data integration from heterogeneous sensors
    - Processing of large sensor datasets
- Meat traceability
  - From farm to fork for animal-derived products, including monitoring of physical parameters during various operation phases
  - Challenges
    - Intermittent connectivity
    - Tight integration with enterprise systems

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DOMOTICS AND HOME AUTOMATION

- Description
  - Centered on homes and commercial buildings
- Applications
  - Finalized to the improvement of
    - home safety
    - ease of use and sustainability
  - By means of
    - resource consumption monitoring (energy, heating, water)
    - remote control of appliances
    - optimization of air and ventilation
    - prevention of theft and intrusion

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DOMOTICS AND HOME AUTOMATION

- Building automation
  - Monitoring and optimization of building subsystems, such as lighting or heating, ventilation and air conditioning (HVAC)
  - Challenges
    - Integration with legacy solutions
    - Need for standard protocols and interfaces
- Appliances control
  - Must be automatic and remote, e.g., for energy usage optimization in Smart Grid Environments
  - Challenges
    - Standard protocols and interfaces
    - Context-awareness features and real-time operations

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E-HEALTH

- Description
  - Systems focusing on monitoring of patients or assets needed to assist the health of people in any specific condition, e.g., disabled or elderly or under special training or dietary situation
- Applications
  - Detection of fall of elderly people living alone
  - Monitoring of stocks of medicines in hospitals

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E-HEALTH

- Patient surveillance
  - Ambient-Assisted Living (AAL) applications
  - Other systems to monitor patients inside or outside hospitals, including monitoring of living parameters and position tracking
  - Challenges
    - Privacy of patients' data, data protection and management of sensed data
    - Wearable systems
- Fall detection
  - Prevention and reaction for elderly or disabled people
  - Challenges
    - Data processing complexity for fall detection
    - Mobile and nomadic operations, location-awareness

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PART II

THE EXPERIENCE OF ISMB IN PROJECTS ON IOT APPLICATIONS

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THE EBBITS PROJECT

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ebbits

enabling business-based Internet of Things and Services

An Interoperability platform for a Real-world populated Internet of Things domain

Funding: Integrated Project in the 7th framework Programme, theme ICT-2009.1.3 Internet of Things and Enterprise environments

Project Start: August 2010

Project Duration: 54 months

Consortium: 9 partners

Programme co-funded by the EUROPEAN UNION

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EBBITS OBJECTIVES

- **Allow businesses to integrate the Internet of Things into mainstream enterprise systems**
  - Every device or subsystem can be represented by a **service** and can be integrated into an existing enterprise systems
  - Information generated by tags or sensors will feed directly and seamlessly the ERP systems
- **Support multiple domains**
  - Automotive manufacturing
  - Food traceability
- **Enable applications across stakeholder boundaries**
  - Supporting interoperable end-to-end business applications, from sensors and products to real world people.
- **Make developers' life easier**

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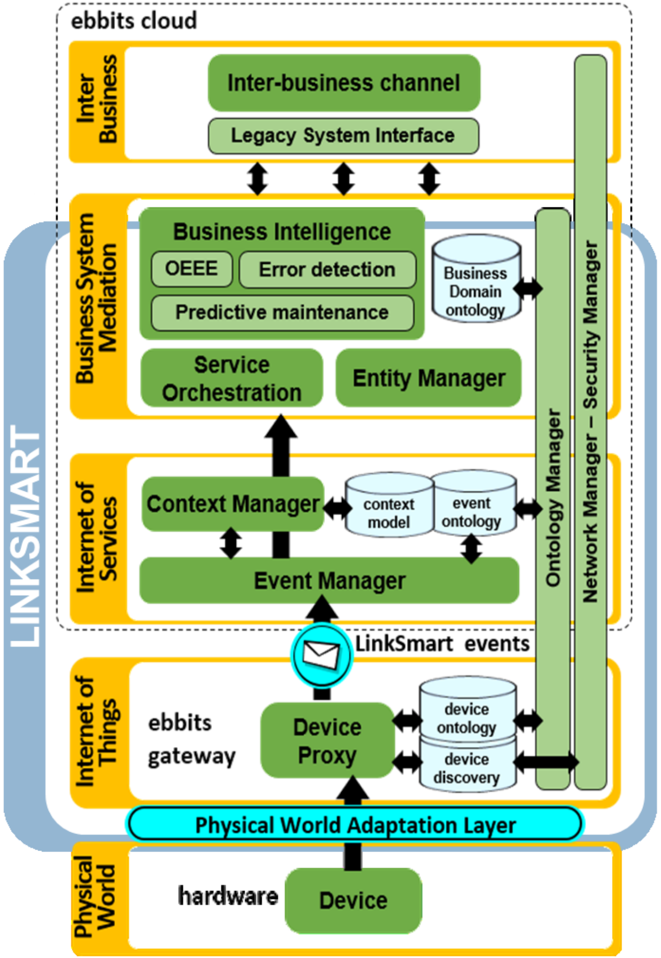
EBBITS ARCHITECTURE



- **Built on the top of the LinkSmart Middleware**

  LinkSmart it is an **open source** project, available at https://linksmart.eu/redmine

- **Physical World Sensors and Networks abstraction**

  Semantic interoperability between heterogeneous physical world technologies

- **Device discovery manager**

  Attribute-based **service descriptions**

- **Data and Event Management**

  P2P based service management using a **publish-subscribe** communication paradigm

- **Centralized and Distributed Intelligence**

  Data fusion & ontology-based context model

- **Frameworks for Business Process Life Cycle Management**

  Process **taxonomy**

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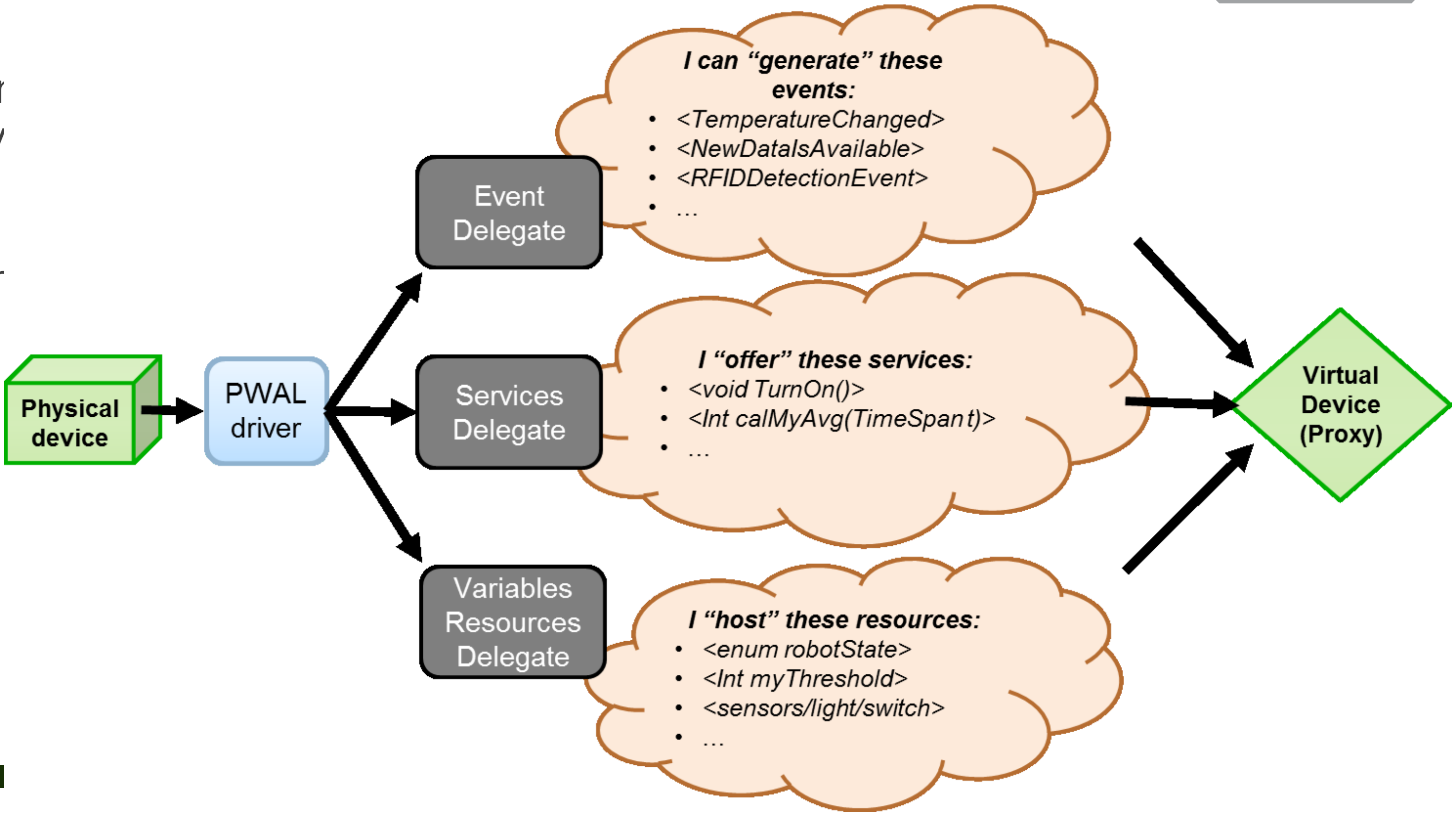
PWAL DEVICE REPRESENTATION

The PWAL is ar
that wraps dev
physical-world
actuators) and
capabilities ar



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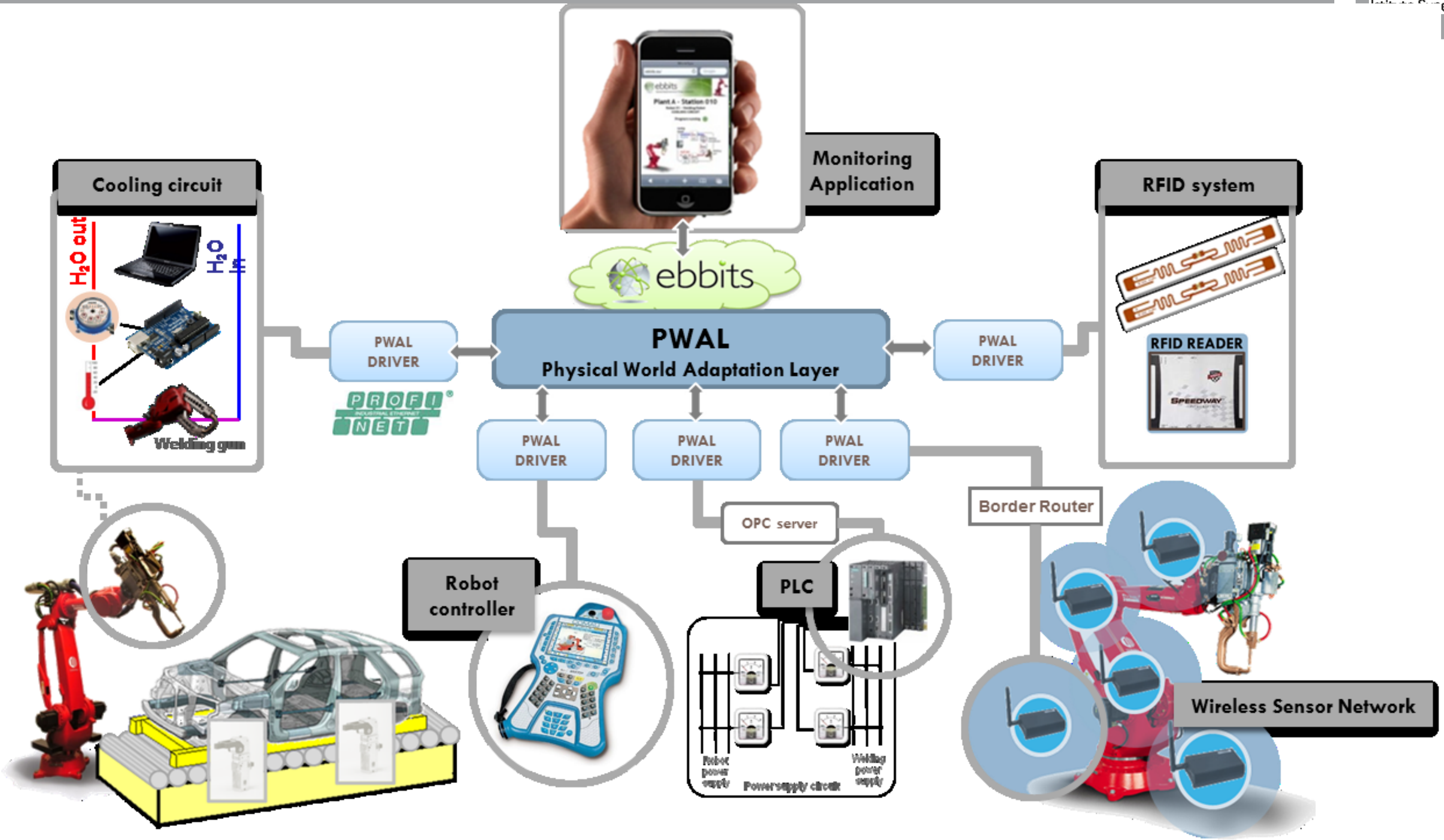
PWAL ROLE IN MANUFACTURING SCENARIO

- Remot
  on act
  shopfl



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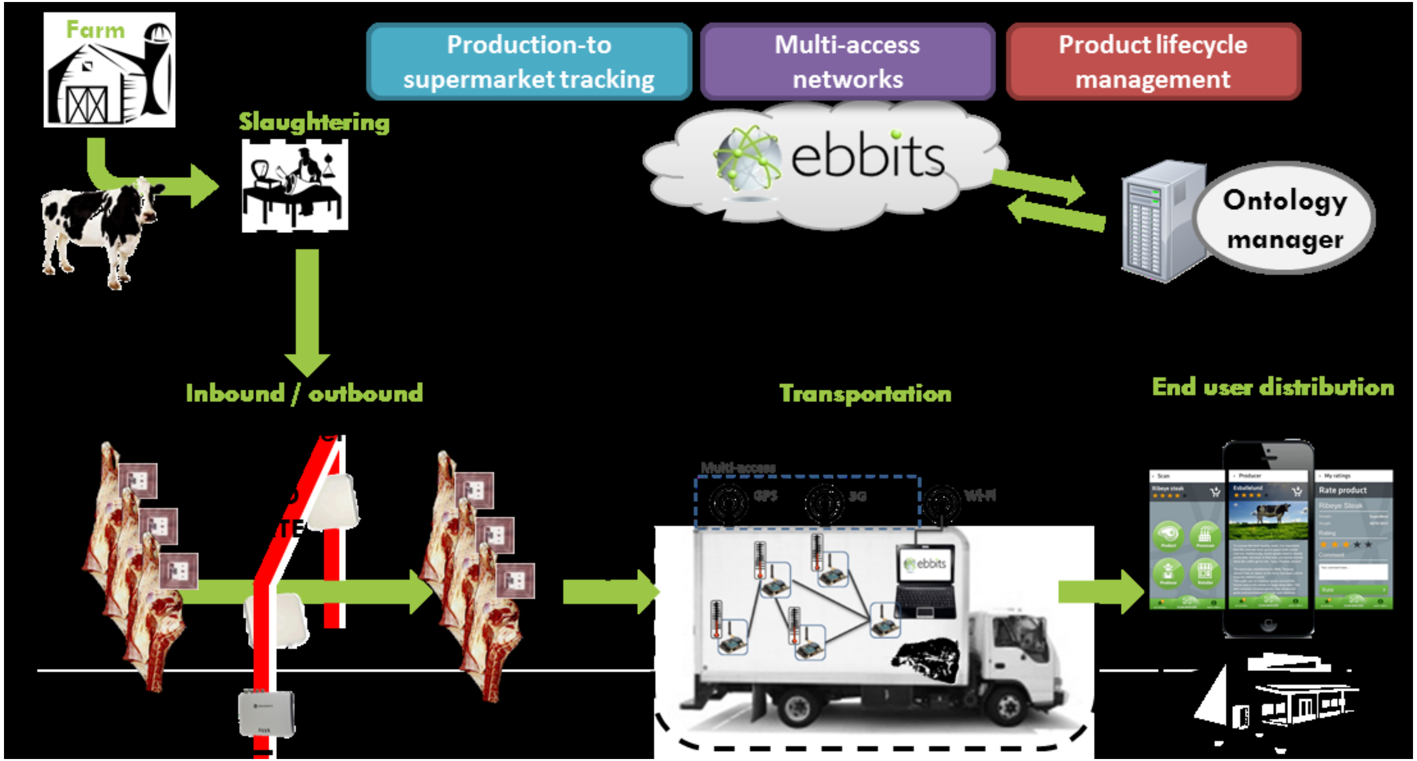
PWAL ROLE IN TRACEABILITY SCENARIO

- Dynamic food product lifecycle management through IoT devices



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THE BEMO-COFRA PROJECT

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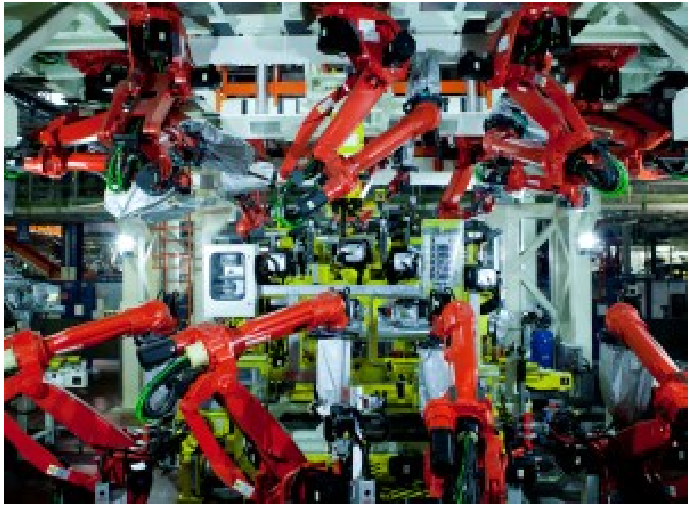
Brazil-Europe Monitoring and Control Frameworks

Funding: 7th Framework Programme in the area of EU-Brazil Research and Development cooperation

Project Start: September 2011

Project Duration: 30-months

Consortium: 9 organisations from five different countries in Europe and Brazil



Programme co-funded by the EUROPEAN UNION

CNPq Conselho Nacional de Desenvolvimento Científico e Tecnológico

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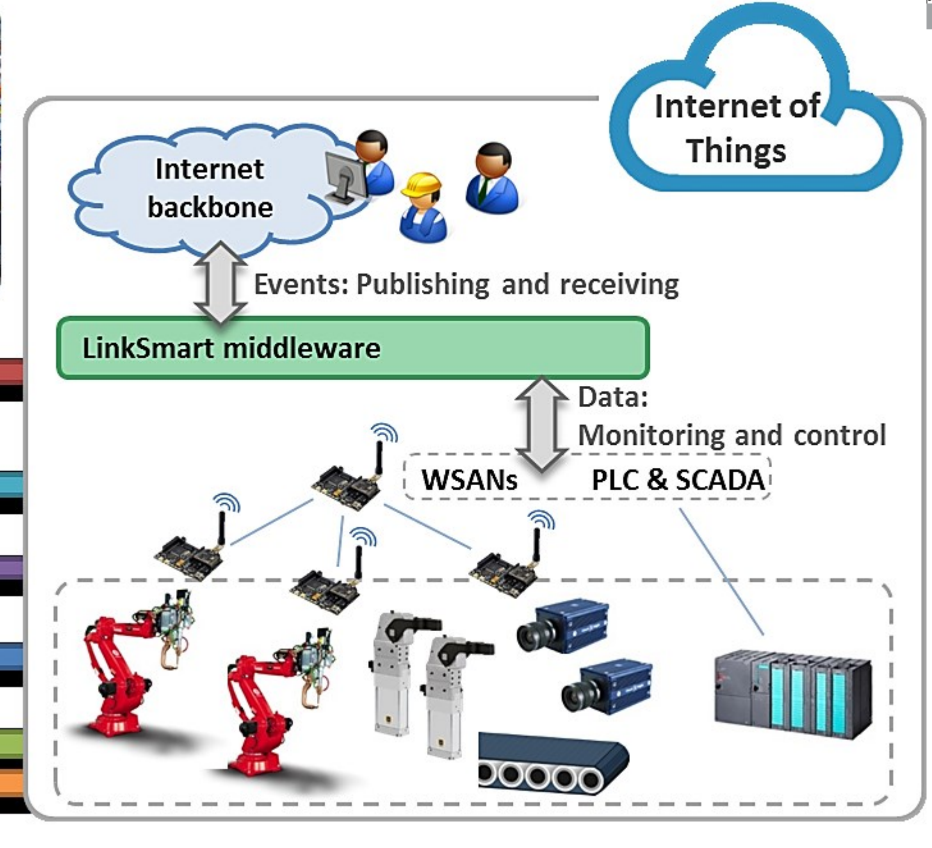
BEMO-COFRA CHALLENGES



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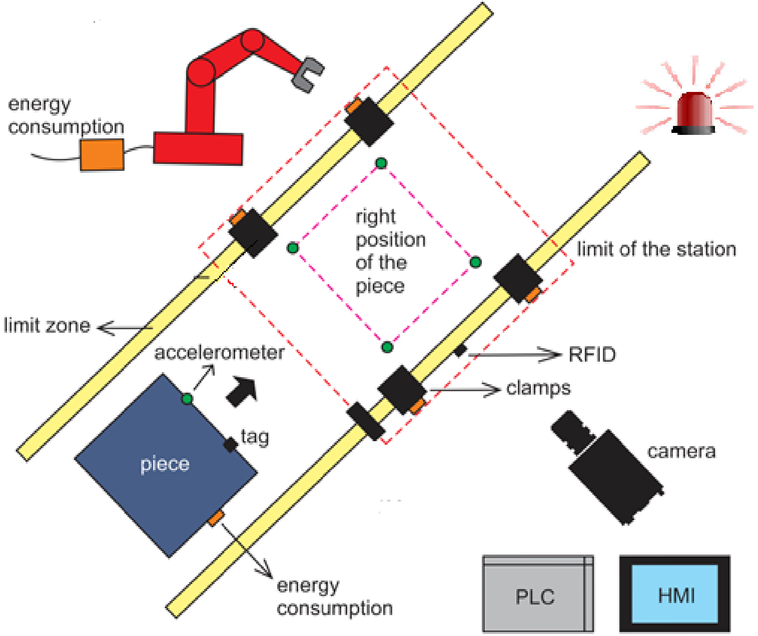
BEMO-COFRA EVALUATION



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THE SEEMPUBS PROJECT

maximum energy savings with minimum intervention for historic buildings

Funding: FP7 ICT-2010-10.2 ICT for energy-efficient buildings and spaces of public use

Project Start: 1 September 2010

Project Duration: 3 years

Consortium: 10 partners

University	Politecnico di Torino	Italy
	Katholieke Universiteit Leuven	Belgium
	Universitè Claude Bernard Lyon 1	France
Research Center	Centro Ricerche Fiat	Italy
	Fraunhofer FIT	Germany
	Istituto Superiore Mario Boella	Italy
Industry and SME	ST Microelectronics	Italy
	CNet Svenska AB	Sweden
	Sinovia SA	France
	EniServizi	Italy

Programme co-funded by the EUROPEAN UNION

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SEEMPUBS GOALS

- SEEMPubS addresses energy and CO_2 footprint reduction in existing public buildings and spaces without significant constructions works, by an intelligent ICT-based service-based monitoring and management of energy consumption.
- Develop an integrated electronic system and interoperable web-based software solution for real-time energy performance monitoring and control of lighting, HVAC services through wireless sensor networks in existing/historical buildings and public open spaces.
- Significantly raise people's awareness for energy efficiency in public spaces.

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SEEMPUBS INNOVATION IN 4 STEPS

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STEP 1 — BIM

Building Information Model

Key words:

Survey – Interoperability

STEP 2 — BEMS

Building Energy Management Systems

Key words:

HVAC and lighting control strategies – Occupancy proxy

STEP 3 — BAS

Building Automation System

Key words:

Middleware – Wireless Sensor Network – Rule Engine

Results

STEP 4 — VR and AR

VIRTUAL/AUGMENTED REALITY

Key words:

Data visualization – Awareness

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SEEMPUBS TEST BED

Modern Buildings

Politecnico di Torino

Chosen as demonstrator because of its reproducibility

Main Campus

and Cittadella Politecnica

Historical Building

Valentino Castle

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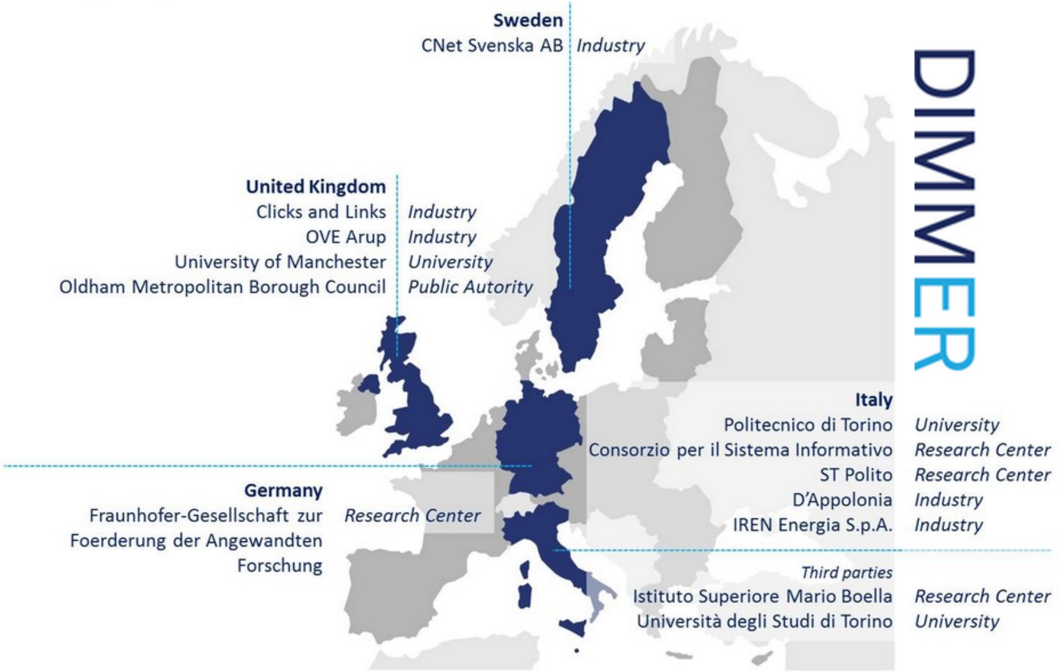
THE DIMMER PROJECT

Istituto Superiore Mario Boella

District
Information
Modelling
and Ma
for Ene
Rec

Funding: FP7-SMARTCITIES-2013 ICT
Project Start: 1 October 2013
Project Duration: 3 years
Consortium: 14 companies/4 countr

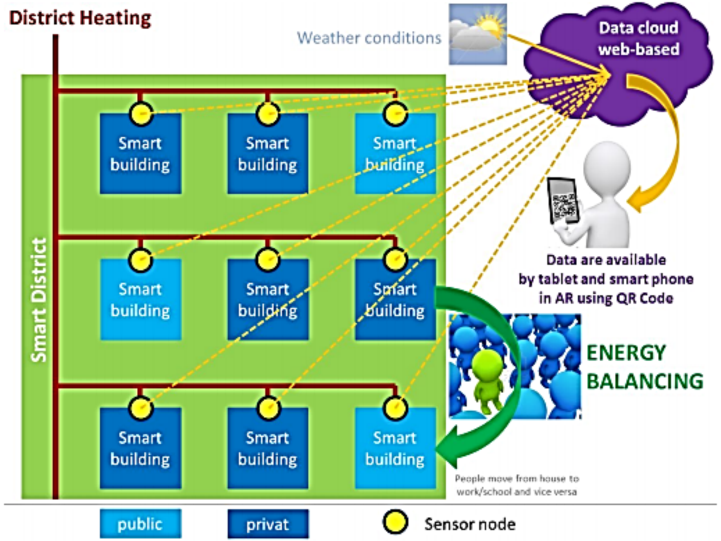


Programme co-funded by the EUROPEAN UNION

DIMMER GOALS

In the DIMMER project a **web-service oriented**, open platform with capabilities of **real-time district level data processing and visualization** will be developed. Thanks to the web-service interface, applications can be developed exploiting such an **interface to monitor and control energy consumption and production from renewable sources.**

For **public buildings** like schools or university campuses, application can be develop to visualize in real-time energy utilization leading to a considerable **educative impact**.



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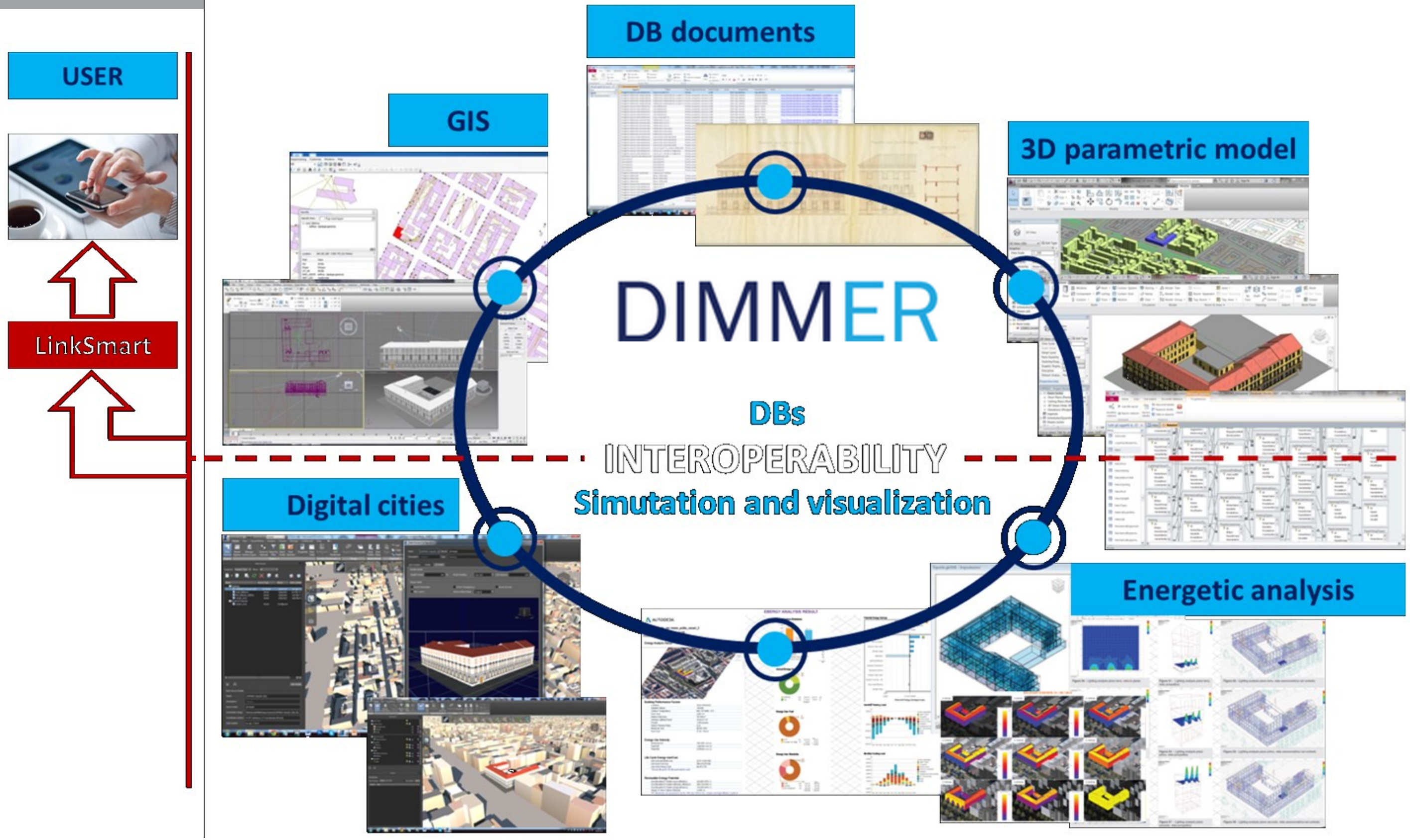
DIMMER CHALLENGES



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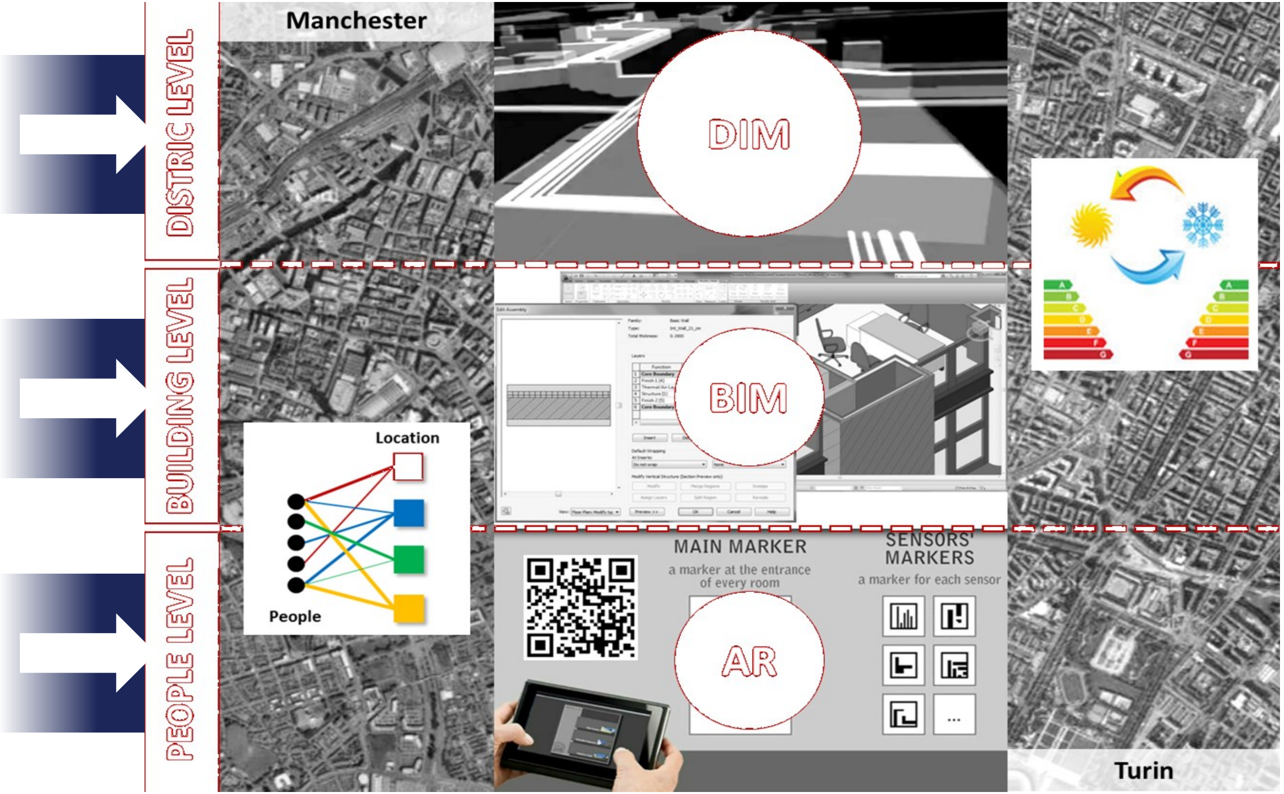
DIMMER VALIDATION PHASE



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GREENCOM – VISION

- GreenCom develops an IoT-based **S**mart **E**nergy **M**anagement **S**ystem (**SEMS**)
- **Key idea**: a small-scale distributed area (microgrid) acting as a single «virtual» entity towards the electric grid
- Mean: **IoT gateways** in homes inter-connected with **Loads**, **DS** and **DG** systems

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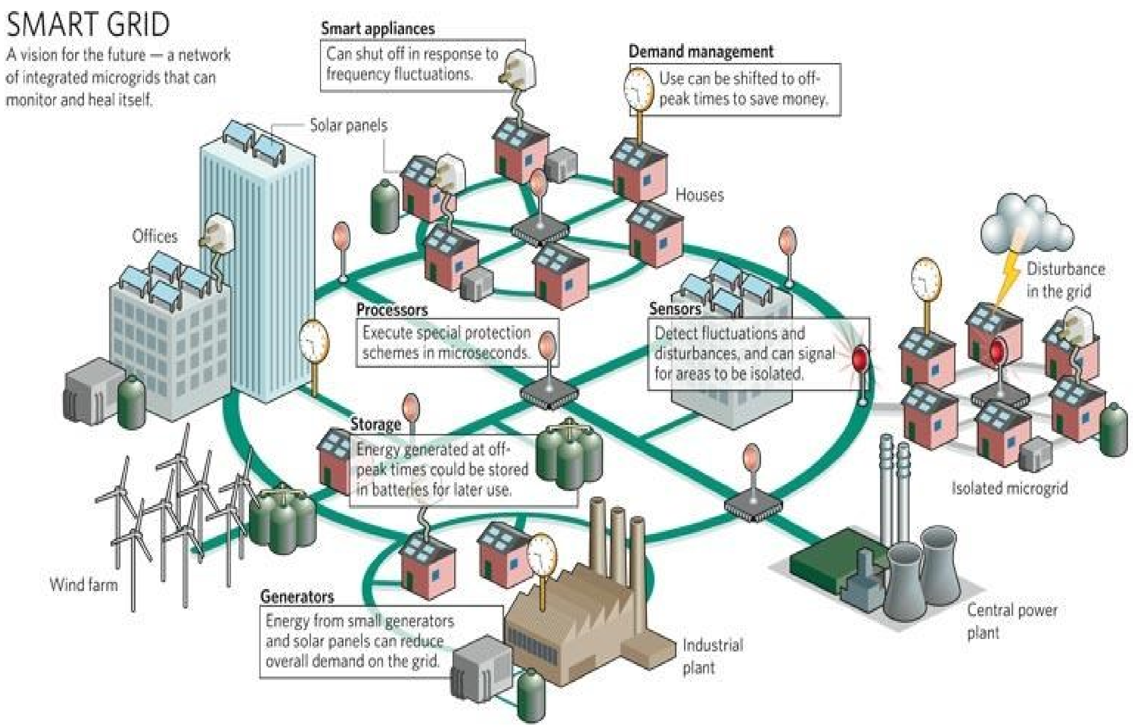
GREENCOM – APPLICATION DOMAIN

Why does it work ?

- IoT allows to exploit **demand-side flexibility** to counter the non-controllability of Renewable Energy Sources (RES)
- **Example**: shift the set-points of a set of high-consuming heat pumps in the micro-grid (thus warming more water then needed) to cope with a peak of production in wind power



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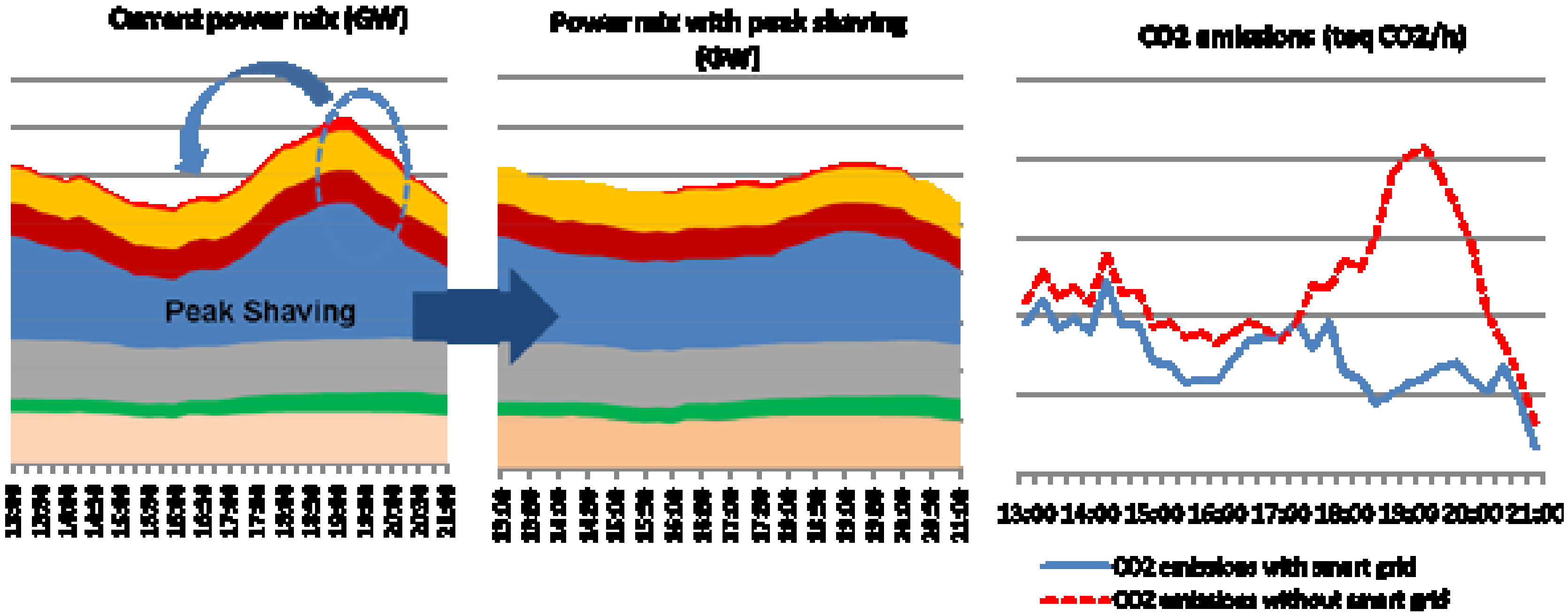
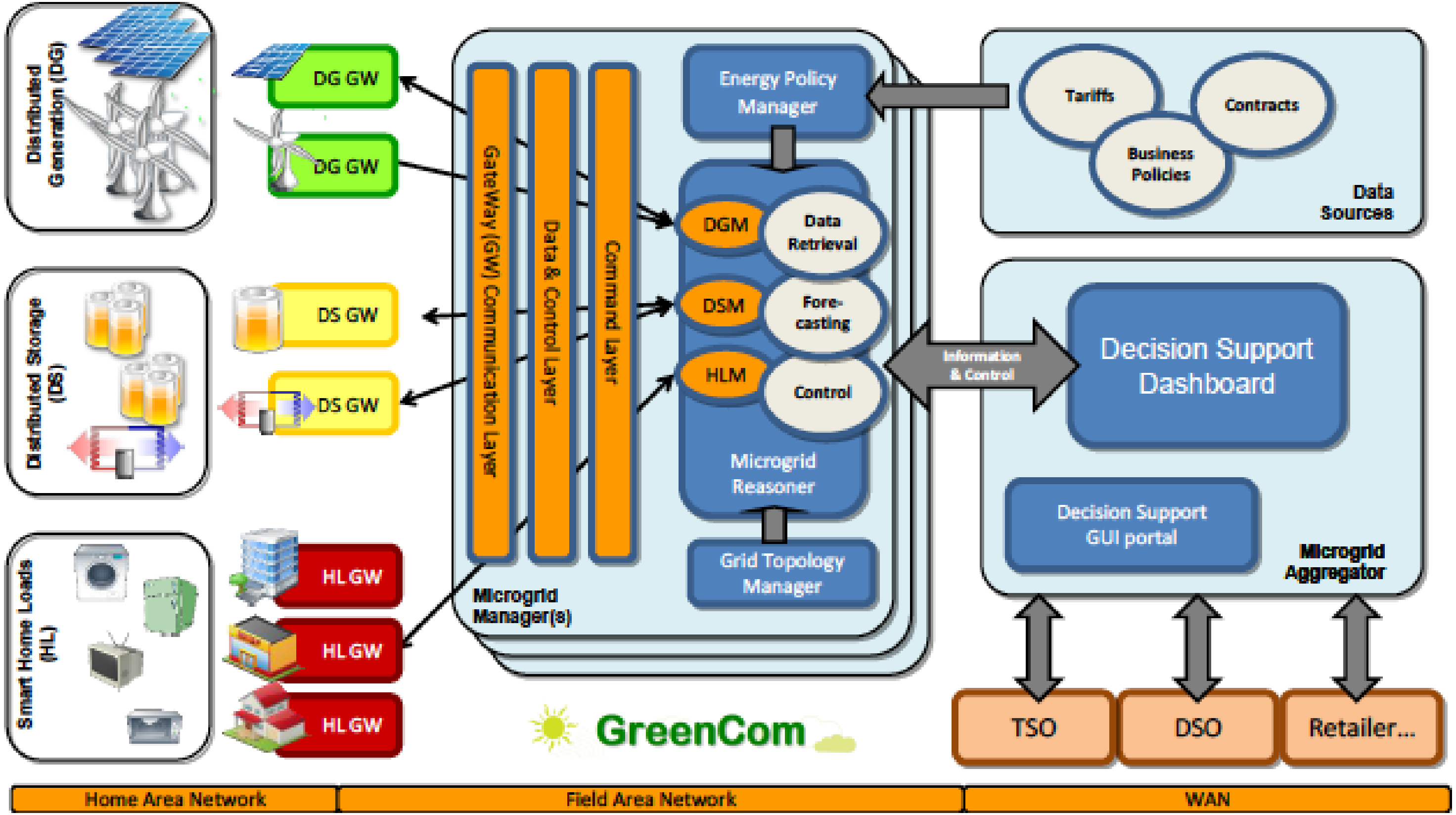
GREENCOM – EXAMPLE

- An application example – peak shaving



GREENCOM – REFERENCE ARCHITECTURE



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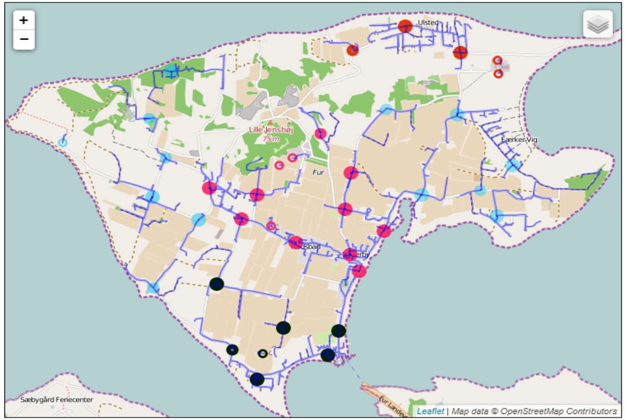
GREENCOM – PILOT

GreenCom | Home | Settings | Critical loads

The island of Fur, Denmark



This map of the island of Fur shows all transformators having access to the low voltage net on the island (Marked with the circl
connecting a set of houses to the low voltage network.
While the transformators all have names consisting of five numbers, starting all with the number 2, the names of the power line
'_T1U' and then a number between 1 and 4, numbering the power line.
An example could be the transformator '20448' with the according power lines '20448_T1U1' and '20448_T1U2'.

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UNIQUE CHALLENGE

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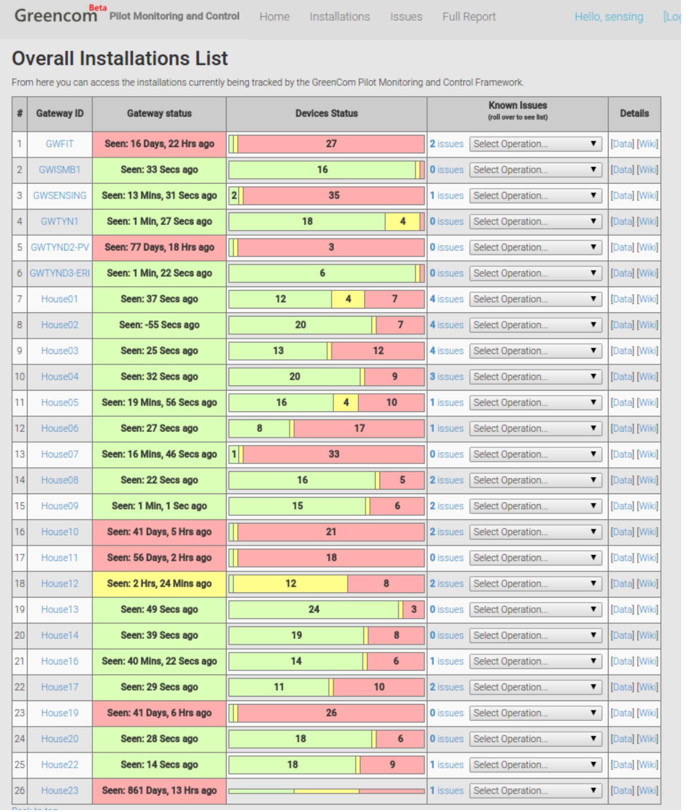
- **Developing** and **maintaining** a pilot:
  - in a remote location (Fur);
  - leveraging connection provided by user for remote access, updates, monitoring, etc.;
  - made with research SW components still at research/development level (low TRLs);
  - with real people living in houses and inter-acting with the system;
  - with some expensive hardware (e.g. high-consuming heat pumps) co-paid by users and some low-cost hardware (e.g. Raspberry PI) provided by the project.



Greencom Beta Pilot Monitoring and Control Home Installations Issues Full Report Hello, sensing

Overall Installations List

From here you can access the installations currently being tracked by the GreenCom Pilot Monitoring and Control Framework.

#	Gateway ID	Gateway status	Devices Status	Known Issues (roll over to see list)		Details
1	GWFIT	Seen: 16 Days, 22 Hrs ago	27	2 issues	Select Operation...	[Data] [Wiki]
2	GWISMB1	Seen: 33 Secs ago	16	0 issues	Select Operation...	[Data] [Wiki]
3	GWSENSING	Seen: 13 Mins, 31 Secs ago	2 35	1 issues	Select Operation...	[Data] [Wiki]
4	GWTYN1	Seen: 1 Min, 27 Secs ago	18 4	0 issues	Select Operation...	[Data] [Wiki]
5	GWTYND2-PV	Seen: 77 Days, 18 Hrs ago	3	0 issues	Select Operation...	[Data] [Wiki]
6	GWTYND3-ERI	Seen: 1 Min, 22 Secs ago	6	0 issues	Select Operation...	[Data] [Wiki]
7	House01	Seen: 37 Secs ago	12 4 7	4 issues	Select Operation...	[Data] [Wiki]
8	House02	Seen: -55 Secs ago	20 7	4 issues	Select Operation...	[Data] [Wiki]
9	House03	Seen: 25 Secs ago	13 12	4 issues	Select Operation...	[Data] [Wiki]
10	House04	Seen: 32 Secs ago	20 9	3 issues	Select Operation...	[Data] [Wiki]
11	House05	Seen: 19 Mins, 56 Secs ago	16 4 10	1 issues	Select Operation...	[Data] [Wiki]
12	House06	Seen: 27 Secs ago	8 17	1 issues	Select Operation...	[Data] [Wiki]
13	House07	Seen: 16 Mins, 46 Secs ago	1 33	0 issues	Select Operation...	[Data] [Wiki]
14	House08	Seen: 22 Secs ago	16 5	2 issues	Select Operation...	[Data] [Wiki]
15	House09	Seen: 1 Min, 1 Sec ago	15 6	2 issues	Select Operation...	[Data] [Wiki]
16	House10	Seen: 41 Days, 5 Hrs ago	21	2 issues	Select Operation...	[Data] [Wiki]
17	House11	Seen: 56 Days, 2 Hrs ago	18	0 issues	Select Operation...	[Data] [Wiki]
18	House12	Seen: 2 Hrs, 24 Mins ago	12 8	2 issues	Select Operation...	[Data] [Wiki]
19	House13	Seen: 49 Secs ago	24 3	0 issues	Select Operation...	[Data] [Wiki]
20	House14	Seen: 39 Secs ago	19 8	0 issues	Select Operation...	[Data] [Wiki]
21	House16	Seen: 40 Mins, 22 Secs ago	14 6	1 issues	Select Operation...	[Data] [Wiki]
22	House17	Seen: 29 Secs ago	11 10	2 issues	Select Operation...	[Data] [Wiki]
23	House19	Seen: 41 Days, 6 Hrs ago	26	0 issues	Select Operation...	[Data] [Wiki]
24	House20	Seen: 28 Secs ago	18 6	0 issues	Select Operation...	[Data] [Wiki]
25	House22	Seen: 14 Secs ago	18 9	1 issues	Select Operation...	[Data] [Wiki]
26	House23	Seen: 861 Days, 13 Hrs ago		1 issues	Select Operation...	[Data] [Wiki]

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THE ALMANAC PROJECT

- **ALMANAC – Reliable Smart Secure Internet Of Things For Smart Cities** is a 3 years EU funded project from the call FP7-SMARTCITIES-2013
- ALMANAC aims to develop a **service delivery platform** with technologies that integrate Internet of Things (IoT) edge networks (also called capillary networks) with Telco's metro access networks

enabling

Smart City Information System for green and sustainable Smart City applications.

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CONSORTIUM OVERVIEW

Istituto Superiore Mario Boella

ISMB Istituto Superiore Mario Boella

ALEXANDRA INSTITUTE

Fraunhofer FIT

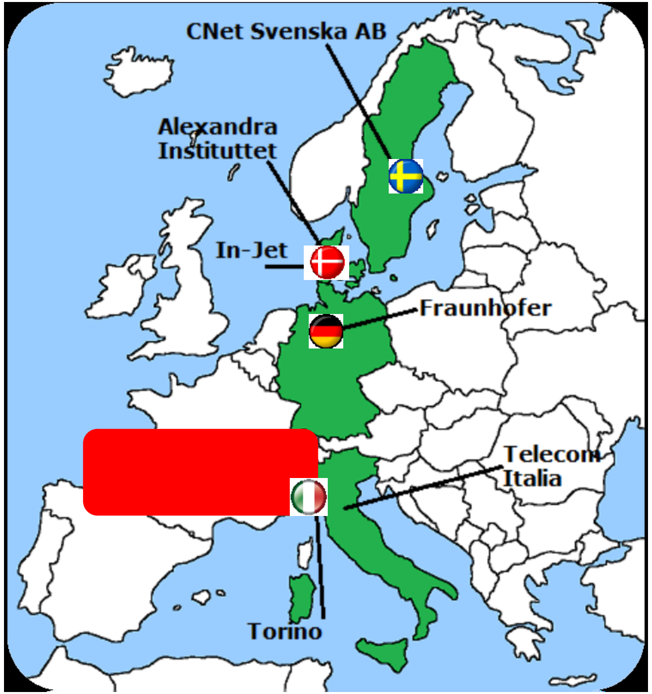
CITTA' DI TORINO

CNet SVENSKA AB

TELECOM ITALIA

IN-JET APS

4 Countries / 7 partners / 36 months



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ALMANAC PLATFORM

ALMANAC is developing a platform for **connected devices and objects**

creating

SMART ENVIRONMENT

integrating the next generation of devices, embedded systems and other network technologies

Supporting security and privacy features and considering interoperability, dependability and scalability issues.

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ALMANAC PLATFORM

ALMANAC has selected three applications for **proof-of-concept implementation and evaluation**

Professional Applications
Waste Management
Water Supply

Citizen-centric Application
Citizen Engagement

expected to act as enablers for future **large-scale demonstrators**

ALMANAC is being designed taking into consideration scalability and expandability issues

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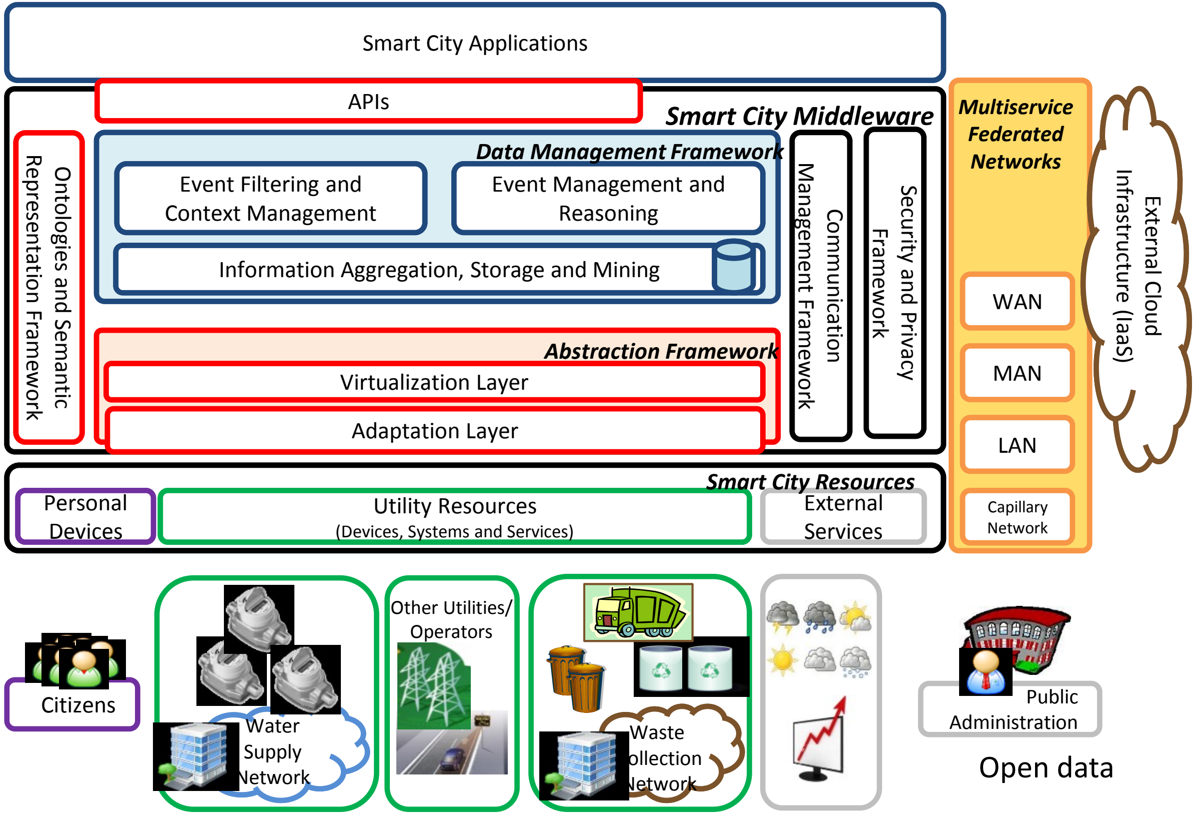
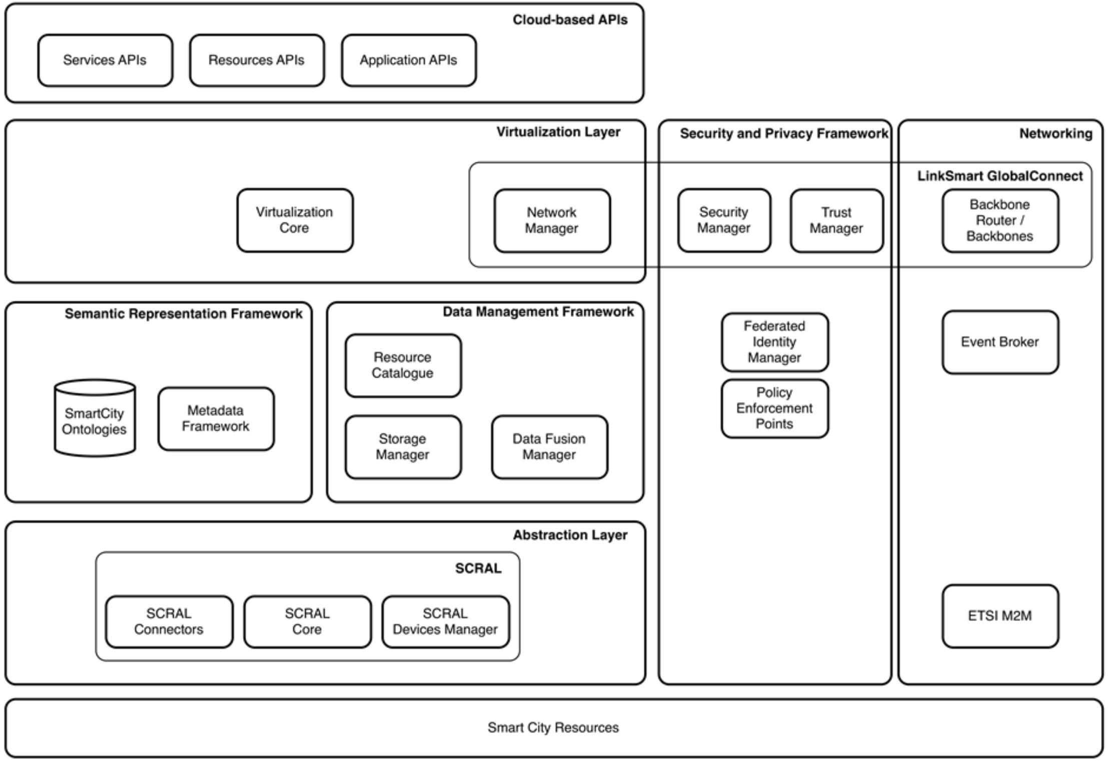
ALMANAC: INITIAL ARCHITECTURE



ALMANAC: ARCHITECTURE EVOLUTION



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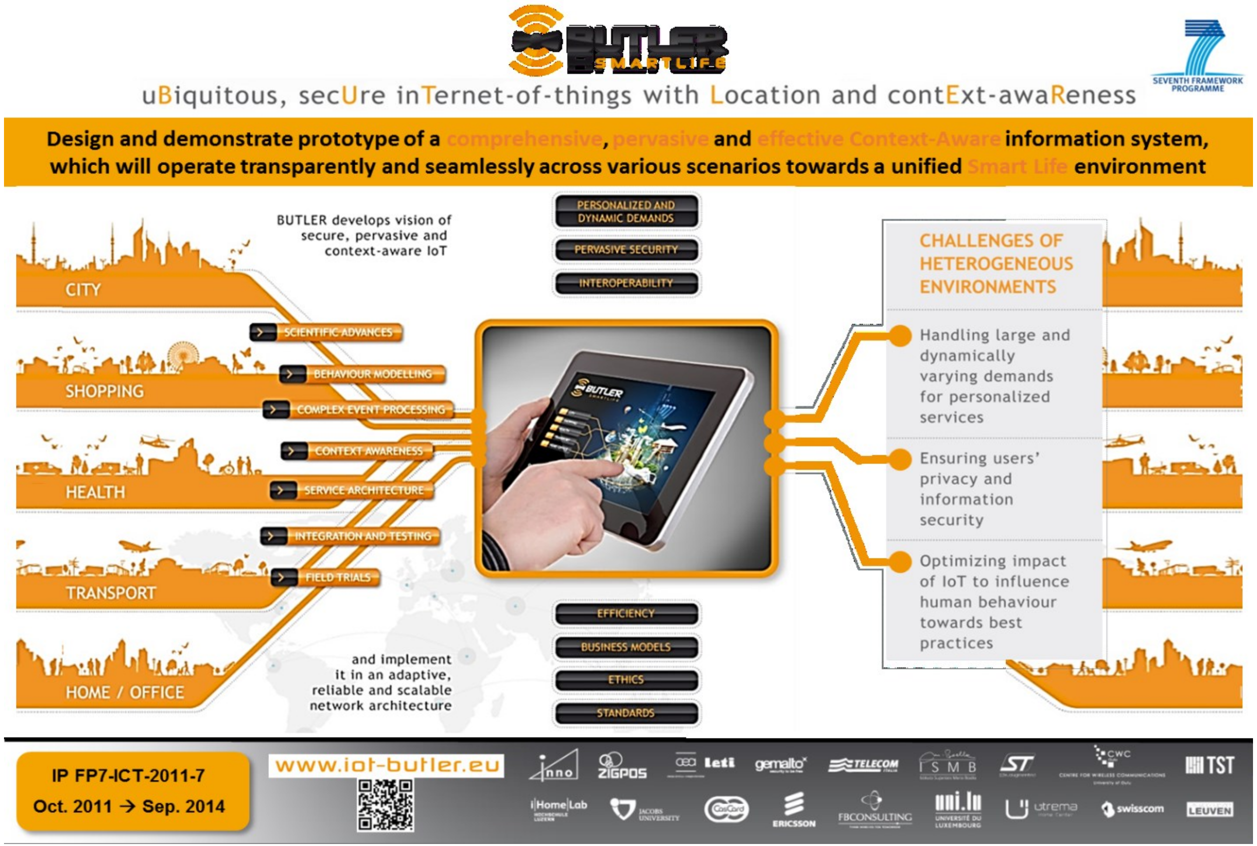
BUTLER



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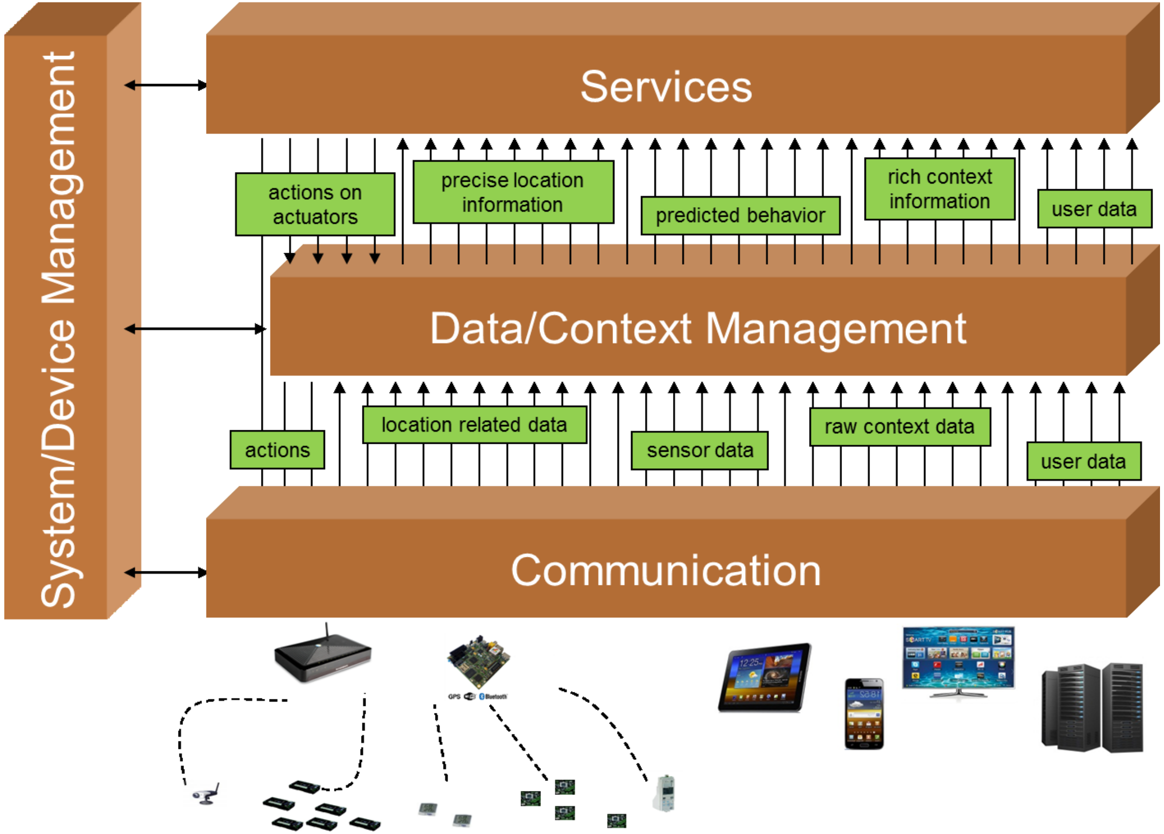
BUTLER ARCHITECTURE



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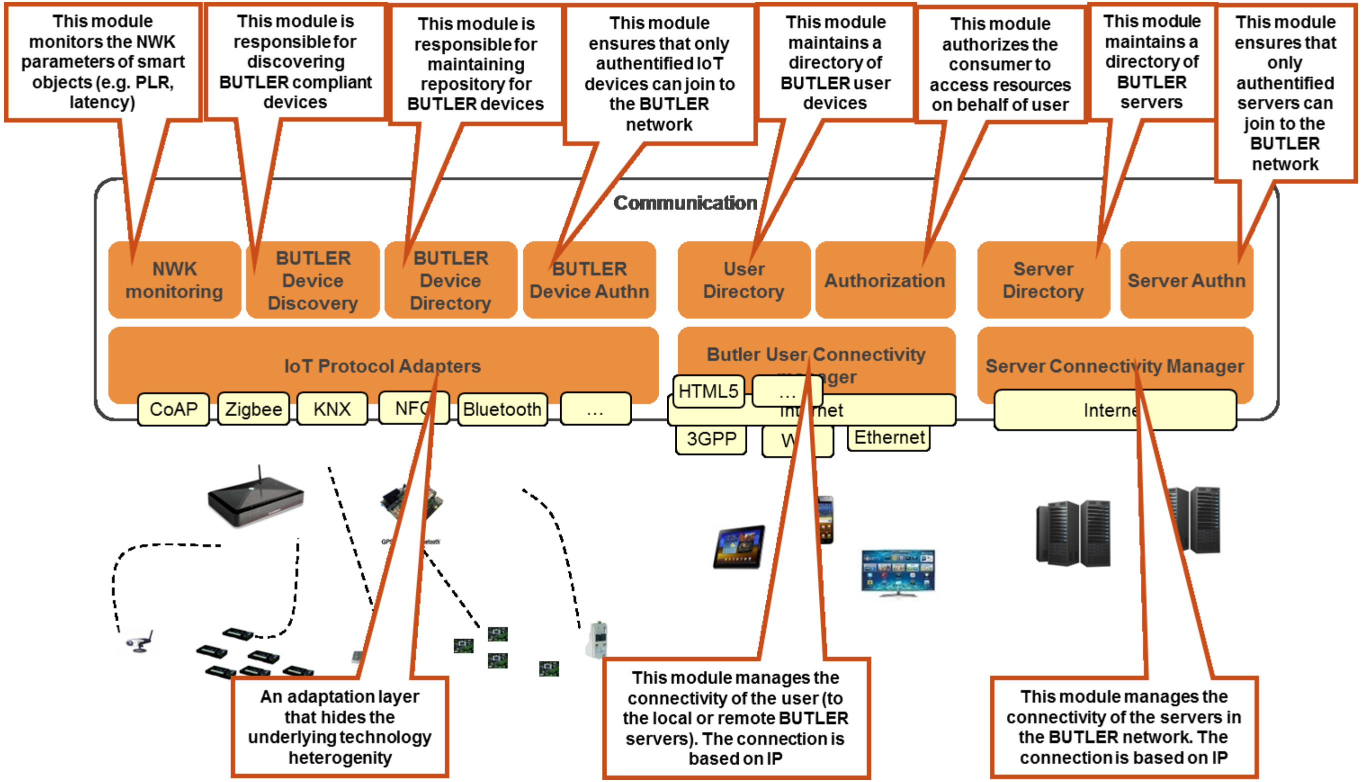
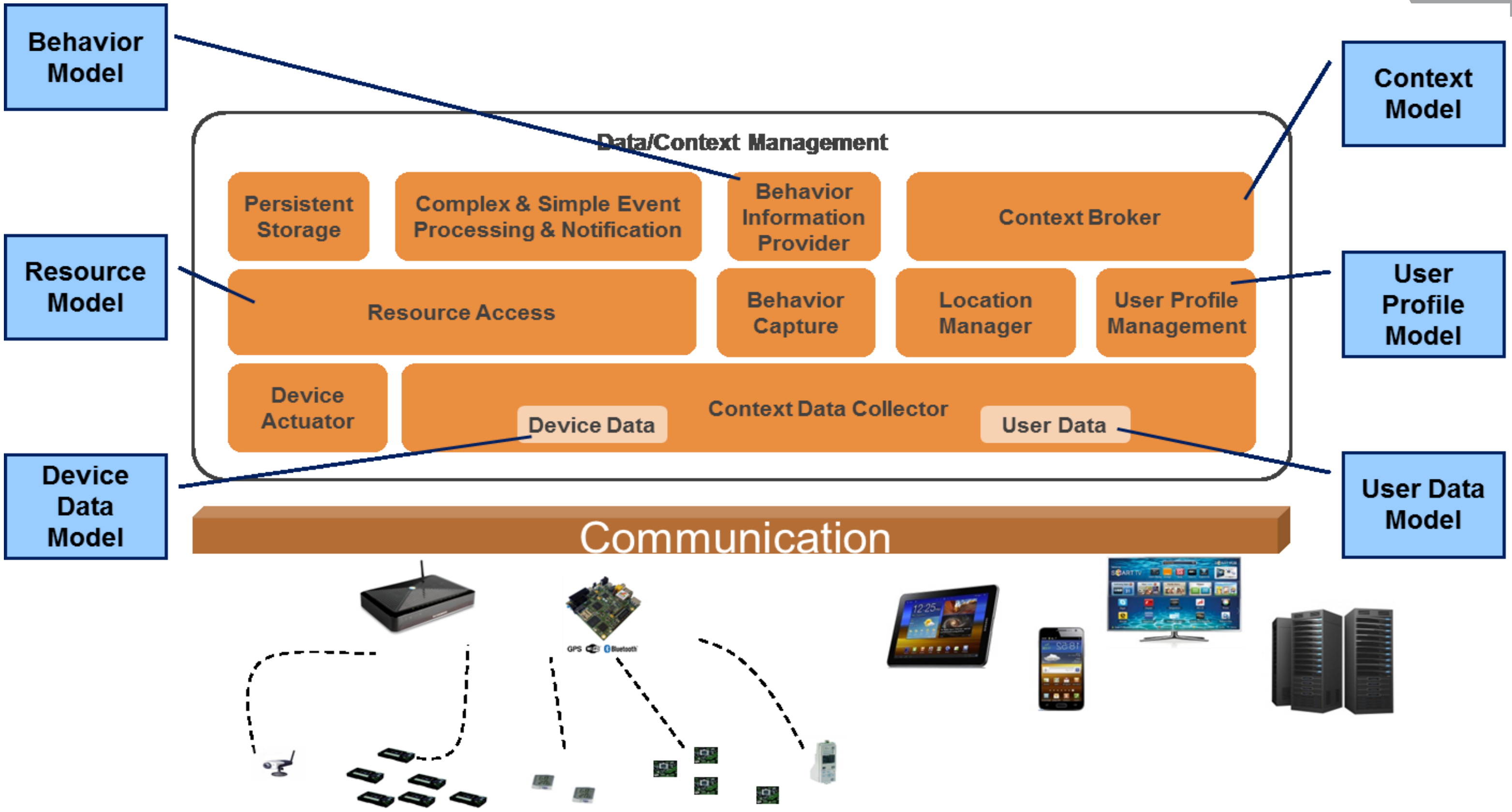
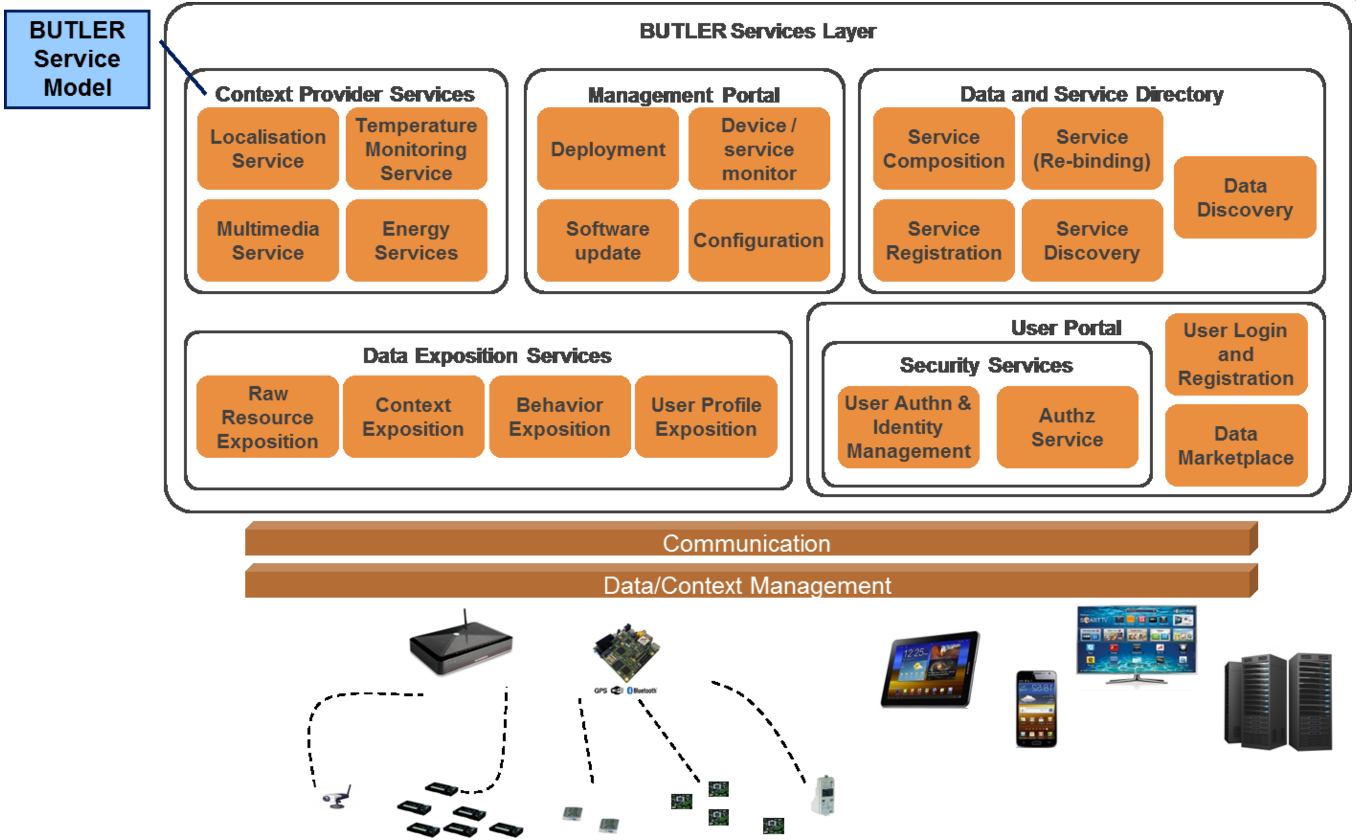
BUTLER ARCHITECTURE: COMMUNICATION



BUTLER ARCHITECTURE: DATA/CONTEXT MGT



BUTLER ARCHITECTURE: SERVICES



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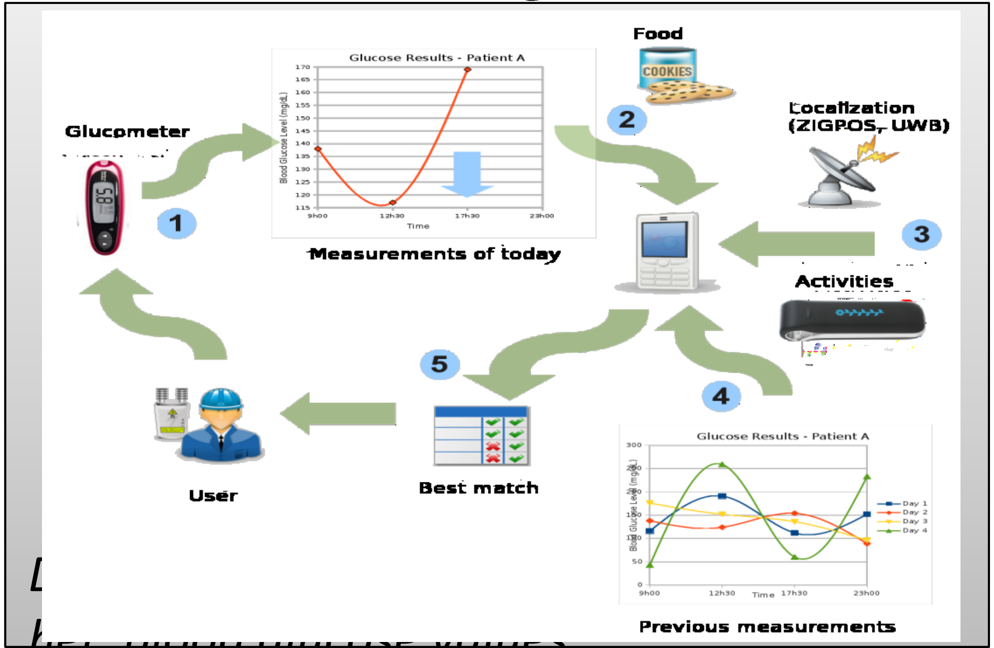
Story Line



her blood glucose values ...

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IMPRESS: VISION AND AIM

To realize a platform for realizing IoT platforms

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IMPRESS: ONE STEP BACK

- Until now research on IoT platforms focused on
  - Techniques for abstraction of physical devices and objects
  - Most suitable communication protocols for monitoring and control
  - Context-awareness features, filtering and aggregation features, network management features… Features, features and more features

IMPRESS: WHAT'S NEW?!

- **Project objectives**
  - Developing **an Integrated Development Environment (IDE)** to facilitate Model-Driven Development of Smarter Society Services
  - Providing a Service-Oriented **Middleware to support Mixed Criticality Applications on Resource-Constrained Platforms**
  - Developing easy-to-use and configurable tools for **Cloud-based Data Analysis and Context Management**
  - Developing tools for easy integration of heterogeneous devices and physical objects
  - Creating efficient **Deployment Tools for Internet of Things applications**

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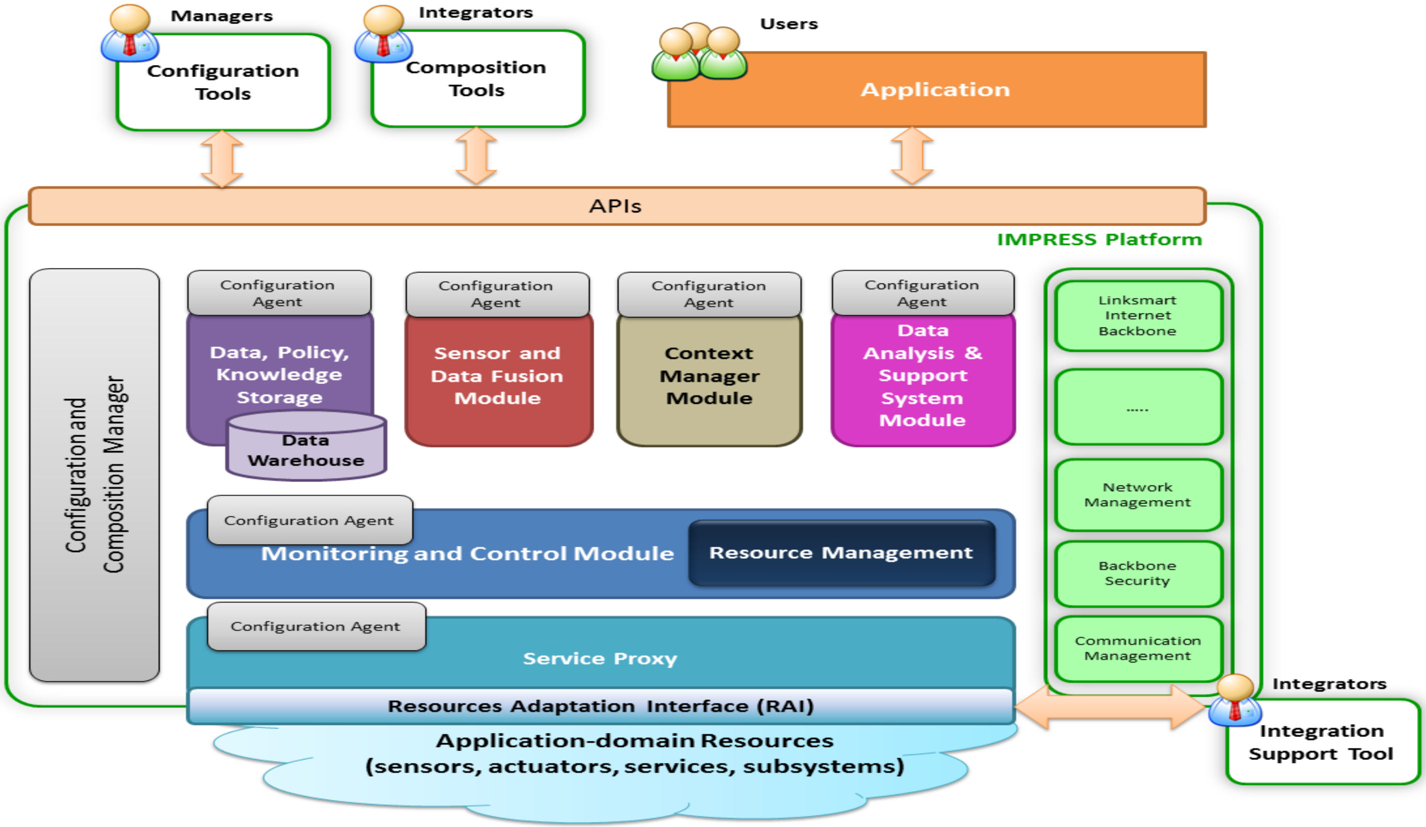
IMPRESS ARCHITECTURE



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THANKS FOR YOUR ATTENTION !

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