



**DIIC**

Departamento de  
Ingeniería de la Información  
y las Comunicaciones



# UMU-Eficacia Energética mediante IoT

Tenerife, Jornadas Técnicas RedIRIS

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*SPAIN*

# Smart Cities

**1950**

**2012**

**2020**

**New smart systems**

**Mobile Sensing**

**Environmental Sensors**

**Safety**

**Smart traffic**

**Smart Energy**

**Smart Economy**

**Smart People**

**Smart Governance**

**Smart Mobility**

**Smart Environment**

**Smart Living**

**Smart eHealth Systems**

**Smart Metaling**

**Smart**

**Smart Tourism**

**Smart eGovernment System**

# 'Smart' solutions are instrumented, interconnected and intelligent

**Instrumented**

*Event capture and filtering for timely response*

+



**Interconnected**

*Any to any linkage of people, process, and systems*

+



**Intelligent**

*Deep discovery, analysis and forecasting*

=



Now, what's up?

Internet-1

Internet-2

Internet-~~3~~  
0

# Internet-0: the Internet of Things

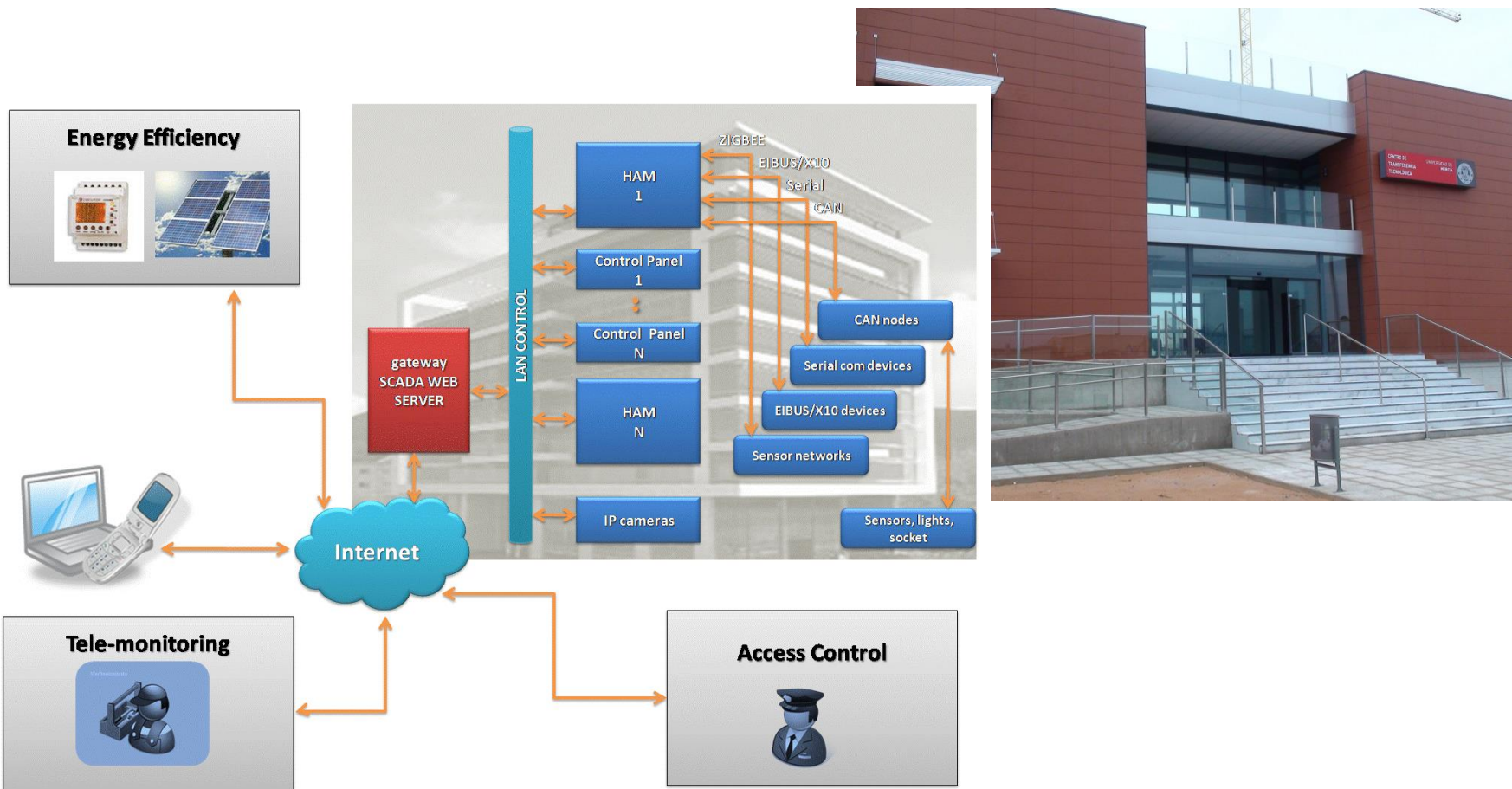


Borrowed from N. Gershenfeld

ON THE INTERNET NOBODY KNOWS YOU'RE A LIGHT BULB!

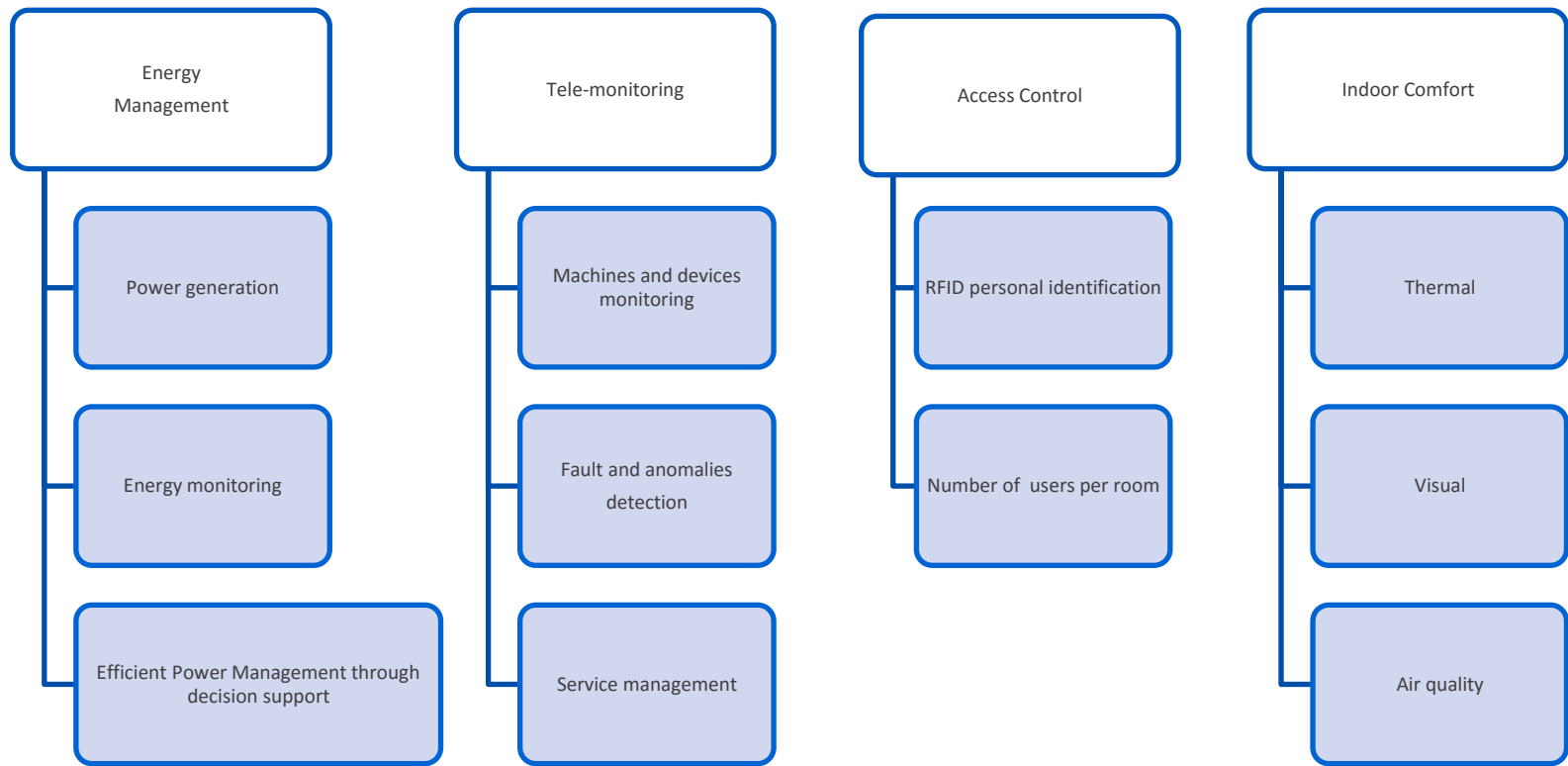
# UMU Smart Building and Smart Campus Project

- Smart buildings. Open Data Project.



# Smart Campus Use Case

## Example of the Services Provided



# Smart Campus Use Case

## Example of the Scenario – Data Collection Software

The image displays two screenshots of the Odin City Explorer software interface. The top screenshot shows a 3D floor plan of a building labeled "Planta Baja". The interface includes a top navigation bar with the Odin S logo and a toolbar with various icons. A left sidebar lists several components: "Detector (Facultad de Ciencias del Trabajo)", "PLC de Facultad de Economía y Empresa", "Detector (Facultad de Economía y Empresa)", and "Jaula ventilada Tecniplast TNPO1 (Servicio de Animales de Laboratorio)". The floor plan itself is a 3D cutaway view of the building's ground floor, with various rooms and corridors. A status bar at the bottom of this window indicates "Alertas Totales: 14 / Alertas Sin Atender: 4" and "Conectado".

The bottom screenshot shows a 3D general view of the campus labeled "Instalaciones Deportivas" and "Plano General". This view shows a larger area with multiple buildings, green spaces, and sports facilities. The interface elements are similar to the top screenshot, including the Odin S logo, toolbar, and sidebar. The sidebar lists "Detector (Facultad de Economía y Empresa)" and "Jaula ventilada Tecniplast TNPO1 (Servicio de Animales de Laboratorio)". The status bar at the bottom indicates "Alertas Totales: 14 / Alertas Sin Atender: 4" and "Conectado".

# UMU Smart Building and Smart Campus Project

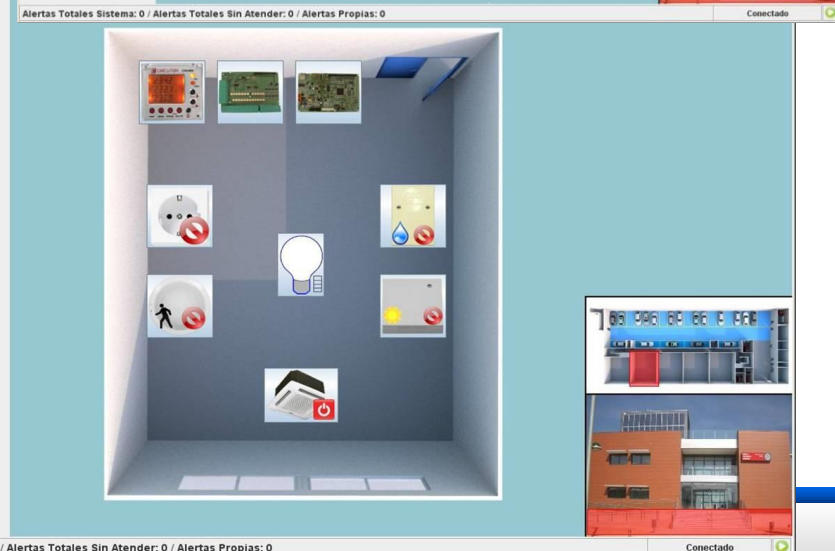
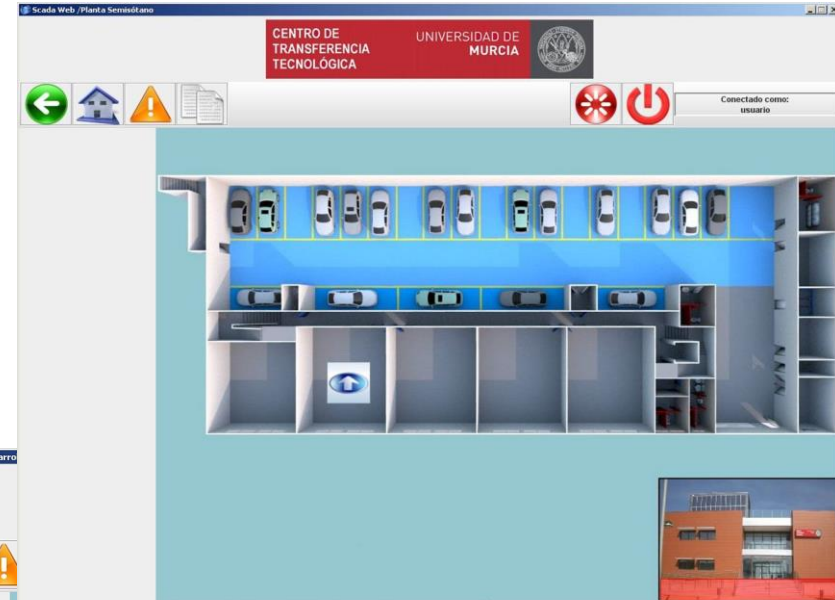
- Smart buildings: Heterogeneous distributed control system design
  - Software

The screenshot displays a SCADA web interface with two main windows. The left window, titled 'Scada Web / Instalaciones Deportivas', shows a 3D perspective view of sports facilities including tennis courts and a building. A vertical sidebar on the left lists various components: 'Bombas centralizando Tránsito de Informática', 'Bombas centralizando Tránsito de Psicología', 'PLC de Casullad de Psicología', 'PLC 1 de Servicio de Animales de Laboratorio', 'PLC 2 de Servicio de Animales de Laboratorio', and 'Grupo electrógeno (Servicio de Animales de Laboratorio)'. The right window, titled 'Scada Web / Servicio de Animales de Laboratorio / Planta Baja', shows a 2D floor plan of the laboratory building. A sidebar on the right lists components: 'Bombas', 'Servicio de Animales de Laboratorio', 'Bombas centralizando Tránsito de Informática', 'Servicio de Animales de Laboratorio', 'Servicio de Animales de Laboratorio', 'Servicio de Animales de Laboratorio', and 'Integración de Servicios Especial'. Both windows show 'Conectado como: admin' and 'Alertas Totales Sistema: 9 / Alertas Totales Sin Atender: 9 / Alertas Propias: 8'. The bottom panel shows a status overview with a 'Última Actualización' of '22/02/2011 16:09:12' and a list of system alerts, including 'No hay alarma', 'No hay prealarma', 'No hay fallo', 'No hay fallo de comunicaciones en red ID 3000', 'No hay evacuación', 'No hay equipo(s) anulado(s)', 'No está en prueba', 'No se ha introducido una clave válida', 'El instalador no ha seleccionado el silenciado permanente del zumbador', 'No está en modo sirenas retardadas', 'Las sirenas no están anuladas', 'El sistema no está en modo día', and 'El equipo de transmisión de alarma no está anulado'. A 'Volver' button is at the bottom.



# UMU Smart Building and Smart Campus Project

- Smart Building Service: telemonitoring. SCADA web can be operated from any computer with a web server and JVM. Visual and Layered design



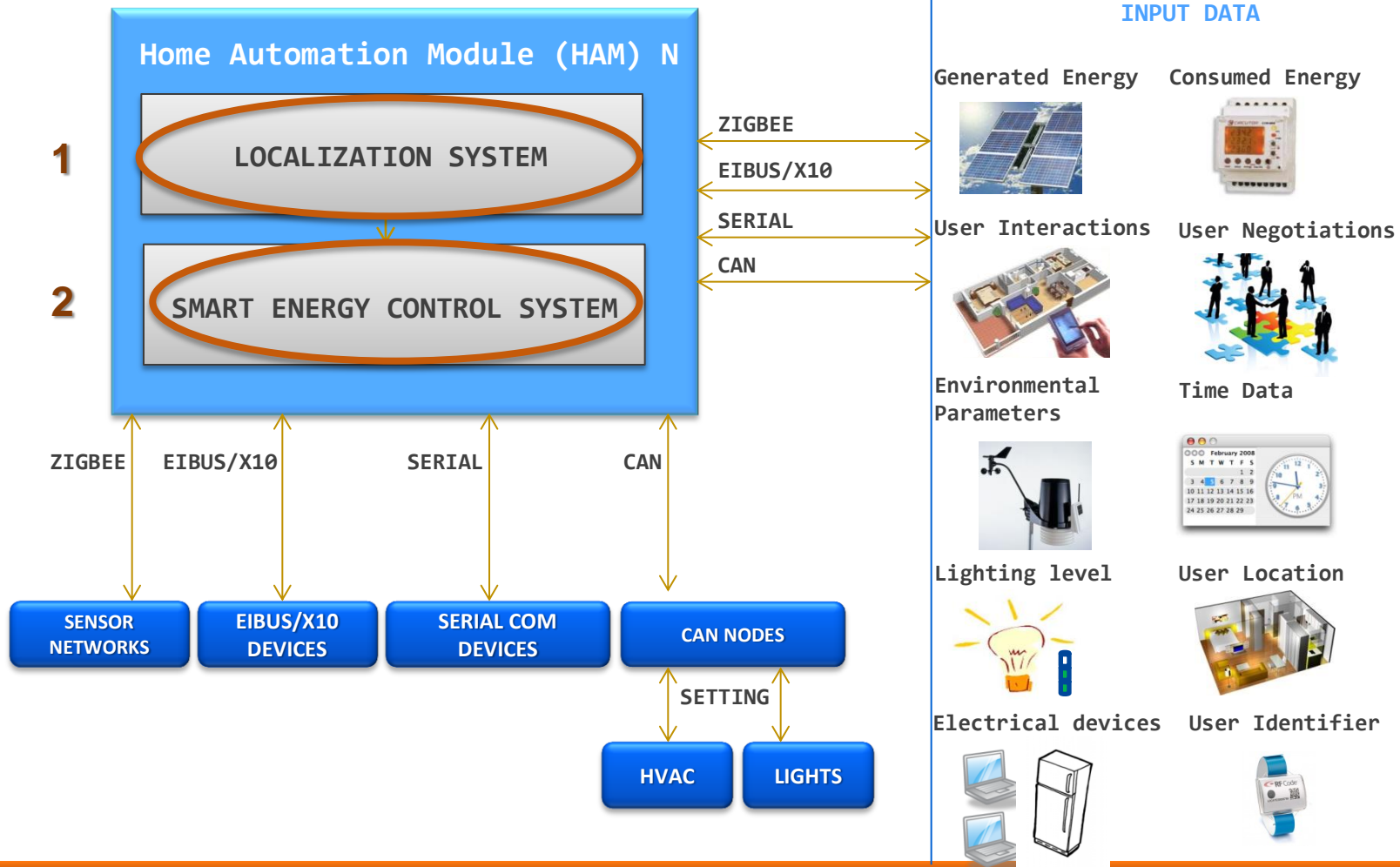
# Validation

More of 30 buildings of the University of Murcia connected to City explorer



# UMU Smart Building and Smart Campus Project

## Smart Buildings Service: Smart Energy Control System



# UMU Smart Campus Features

## Total services provided for energy efficiency

- **Access control management.** Services features:
  - Presence detection
- **Comfort.** Services features:
  - HVAC management.
  - Lighting management.
- **Air quality monitoring.** Services features:
  - Monitor of Environmental Sensors.
- **Electrical consumption monitoring in some test areas.**
  - Info about voltage
  - Info about current
  - Info about active power
  - Info about reactive power
  - Info about energy
- **Energy production monitoring.**
  - Monitoring of inverters connected to solar panels in different areas along the Campus.

# UMU Smart Campus Features

## Lighting and HVAC Management for Energy Efficiency (Energy Efficiency Service)

- **Sensors involved:**
  - Power Meters
  - Temperature and lux meters
  - Presence sensors
- **Actuators involved:**
  - ON/OFF lighting
  - ON/OFF HVAC
  - Temperature set point HVAC

# “How to connect to the platform...”

- **Interfaces to connect with the platform are divided in three levels**

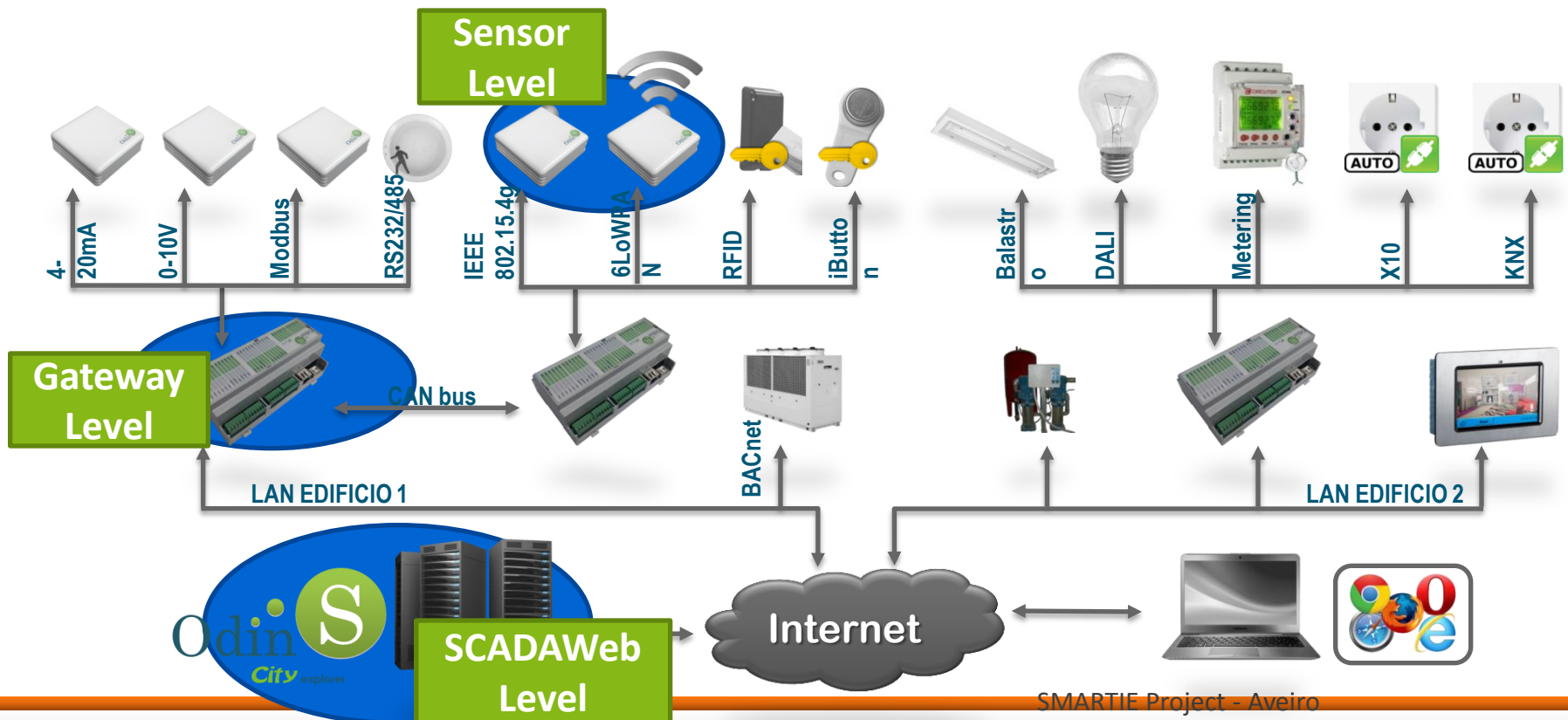
The Smart Energy Management use case includes three different levels of communication, that are Sensor Level, Gateway Level and SCADAWeb Level, each with their interfaces.

The interfaces to interact with each level have been set in accordance with the load each device is able to manage. In this sense, sensors as constrained devices will support little load in contrast with the server.

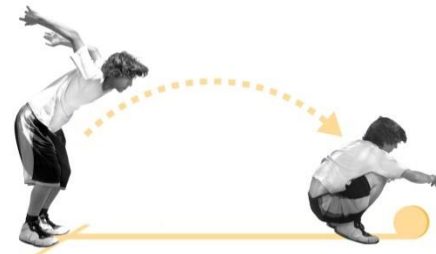
- **Sensor Level:** At this level a CoAP interface can be used to interact with the sensors. CoAP is a protocol targeted for constrained devices due to their special needs.
- **Gateway Level:** These devices are more capable, and are enabled with both MQTT and CoAP interfaces.
- **SCADA Web Level:** At this level supported protocols for the interfaces are MQTT, CoAP and REST.

# “How to connect to the platform...”

- **Sensor to platform:** IP sensors and actuators.
- **Gateways to platform:** both hardware and software gateways.
- **SCADAweb to platform:** Data Collection Software.



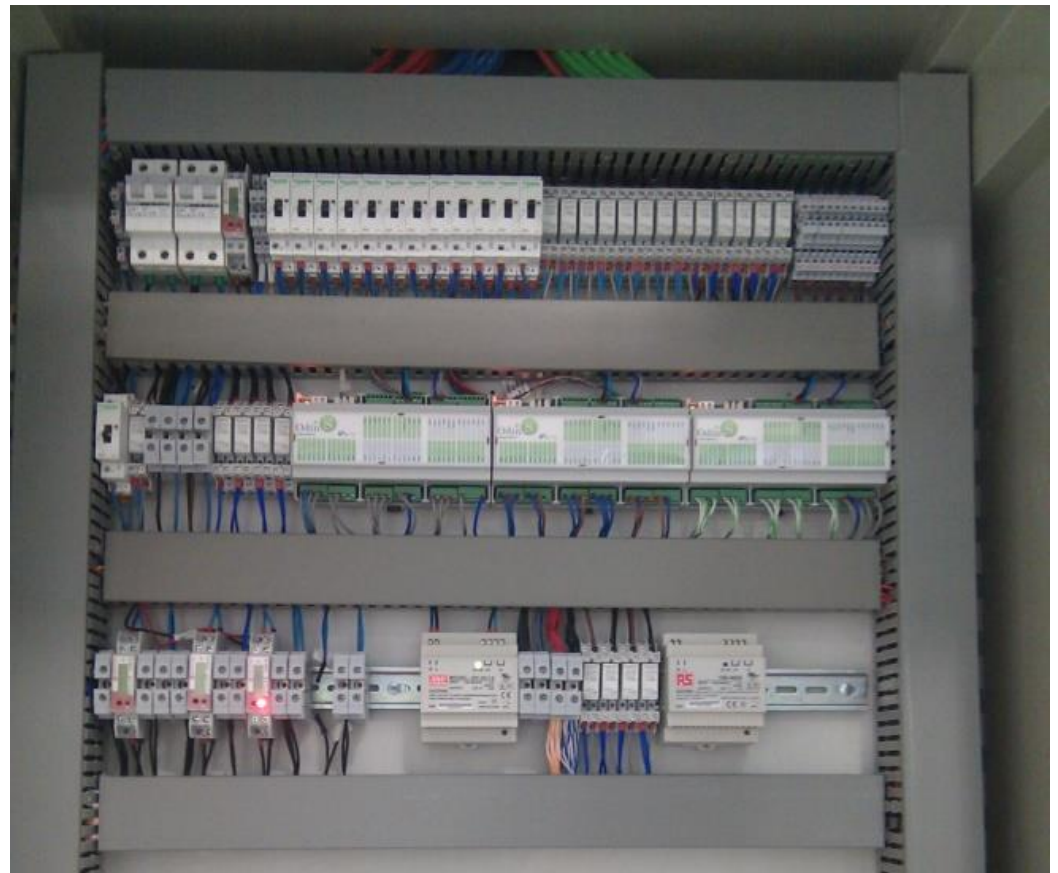
Spin-off of the University of Murcia (Spain) with more of 10 years of experience on the design and development of monitoring and control products





# Smart Campus Deployment

## Example of the Scenario 1 – Automation IP Controllers



# Smart Campus Deployment

- ✓ Integral Management
- ✓ Energy

Odin City Explorer / Clima

SMART-DRIVER

IPSO Alliance

IPSO Application Framework  
Advanced Smart Lighting Profile

COMMUNICATING

Conectado como: admin

28.3 °C Habilitado

25.2 °C AUTO Acciones

Conectado como: admin

28.3 °C Habilitado

21.9 °C Habilitado

Proyector Epson EB-410W

Deshabilitado

Acciones

Habilitado

Deshabilitado

Alertas Totales



# Smart Campus Deployment

## Example of the Scenario 1 – Platform Components

- **Sensors:** temperature, humidity, lighting, power meter, presence sensor, RFID System, etc.



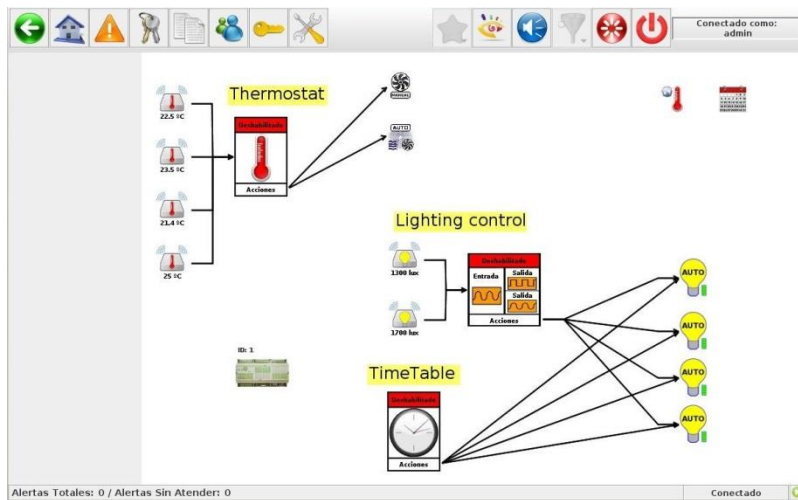
- **Control Panel:**



# Smart Campus Deployment

## Example of the Scenario 1 – Graphic Editor to define Energy Saving Strategies

### Rules Designer



### HVAC Control

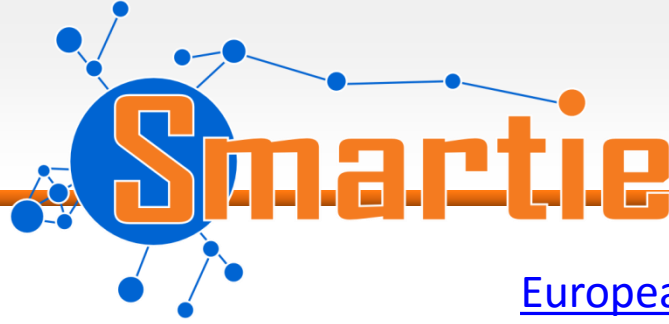


### Lighting Control



**23,12% of Annual Energy Saving in Buildings**

# Partners



Funded by:

[European Union](#) Total budget: 4,862,363 €;  
EU contribution: 3,286,144 €

Area of Activity:

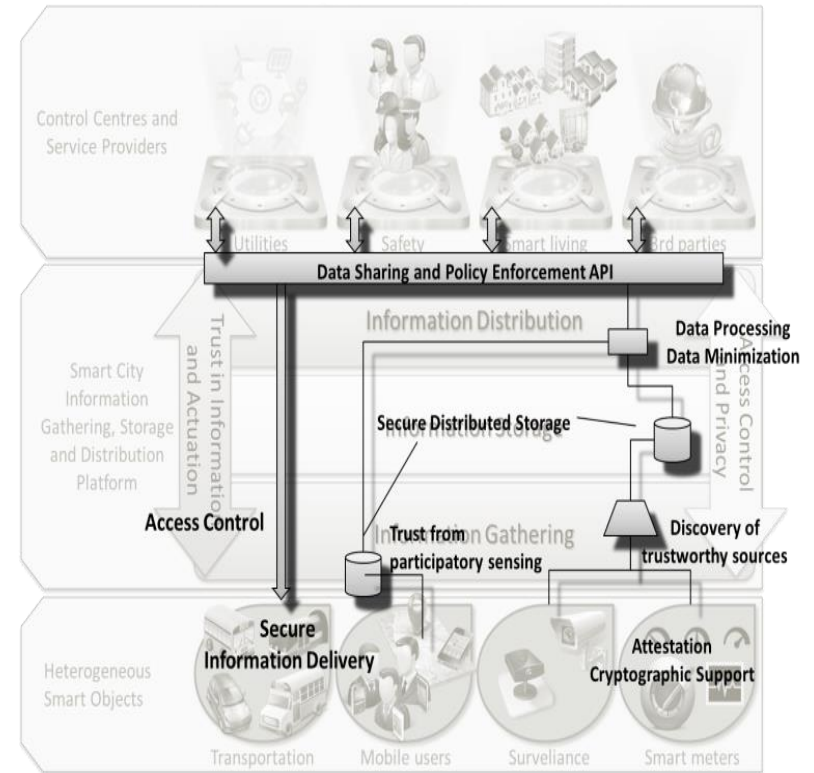
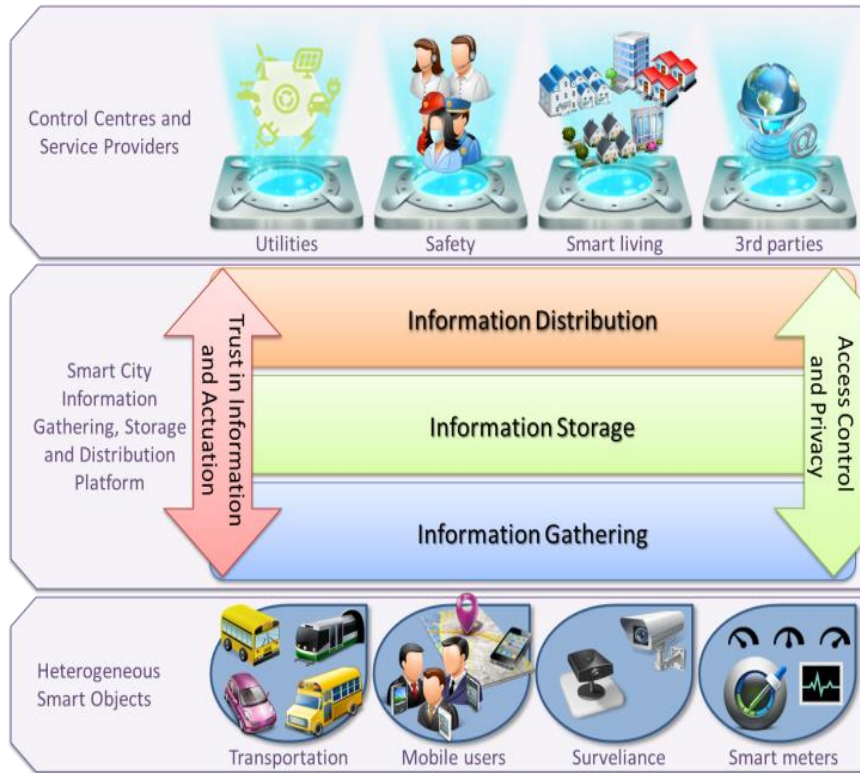
[Framework Programme 7](#) ICT Objective  
1.4 IoT (Smart Cities)

Period:

1<sup>st</sup> September 2013 - 31<sup>st</sup> August 2016



# Smart Cities and Security



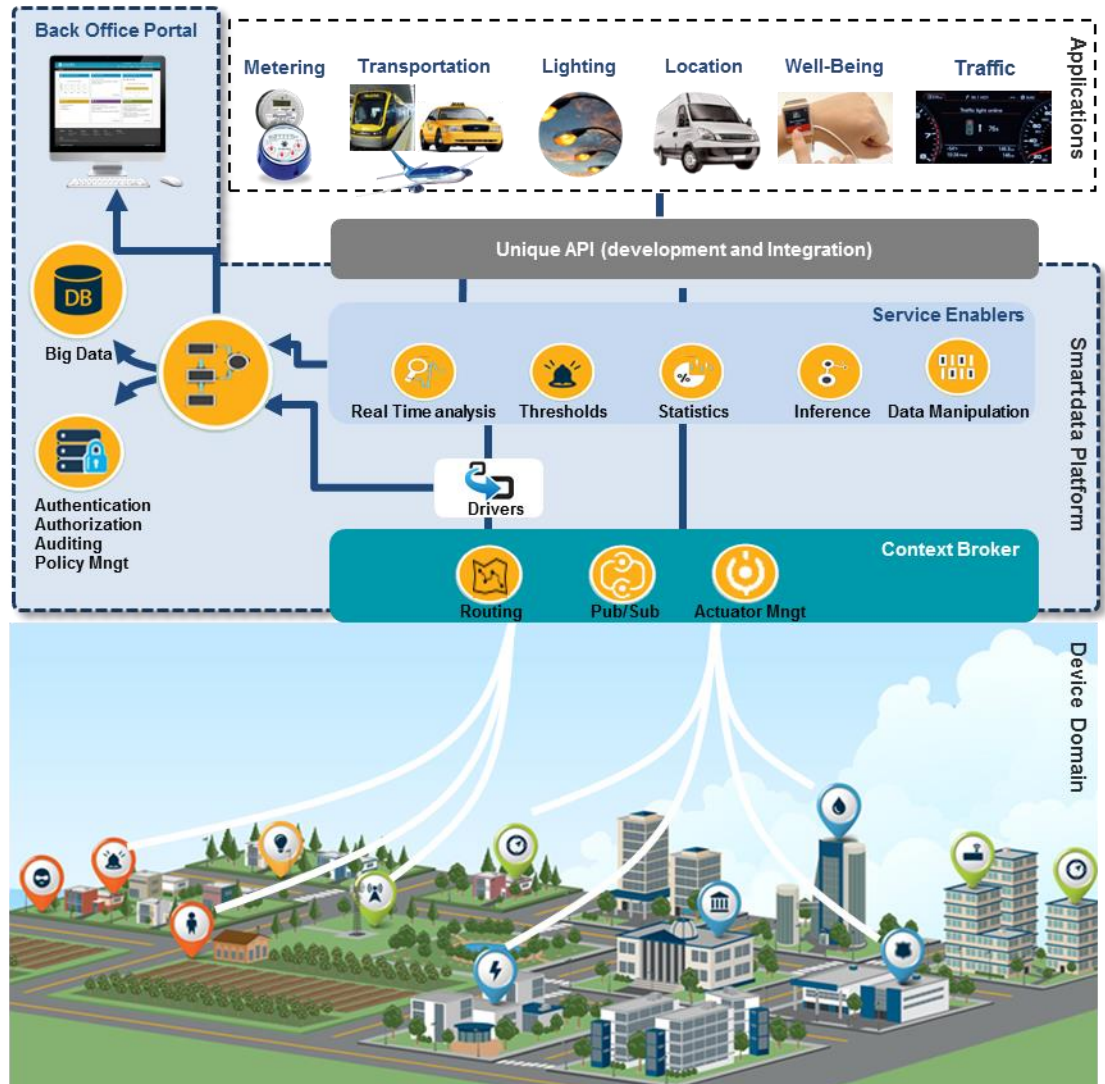
# Smartdata Platform



- Big Data Infrastructure
- Fine-grained access control for privacy-sensitive data, based on attribute-based encryption (ABE)
- Minimal disclosure



- Authentication
- Authorization
- API Token issuer
- Delegation
- Identity Governance



# SMART ENERGY CONTROL SYSTEM

## Evaluation/Validation and Next Work Line

✓ Impact of **users implication** with the system operation (understanding system feedback and through their interaction) in terms of:

- ✓ Changes in their behaviour
- ✓ Learning and adaptation of the system
- ✓ Energy consumption
- ✓ Assessments of the system

### Next Work Line:

- Integrate **Mobile Crowd-Sensing** Techniques in our mechanism for considering occupant's devices data.

