



project which is jointly funded by the European Commission (grant agreement n° 723076)



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# *MiMurcia*

## Murcia Smart City Project

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Ayto. Murcia



# Smart Murcia: MiMurcia



7th city

Citizen participation

ces  
nts

S

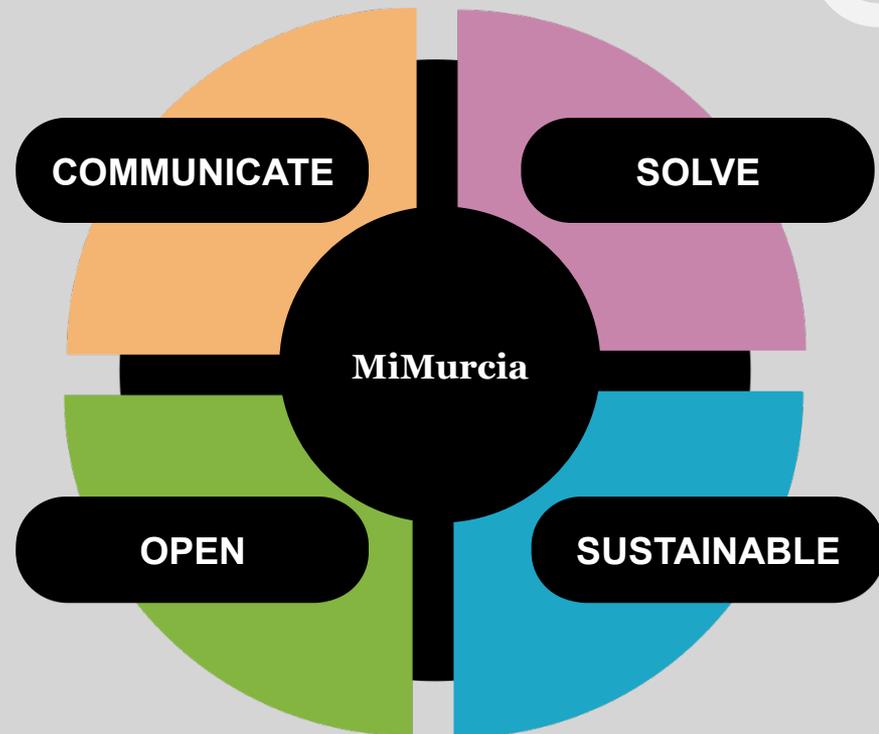
MURCIA, suitable scenario for Smart Cities

MiMurcia

# MiMurcia Vision

## ONE PERSON ONE CITY COUNCIL

- The city council in search for the citizen
- Smart city council looks for the citizen



# Vision: MiMurcia

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One person: one townhall



A town hall that has a personal differentiated and unique relation with each citizen

# Proposal objectives

- Use of the most appropriate channel
- Information:
  - Cultural, Feasts, environmental information.
  - Customized, geo-localized, useful, required and contextualized

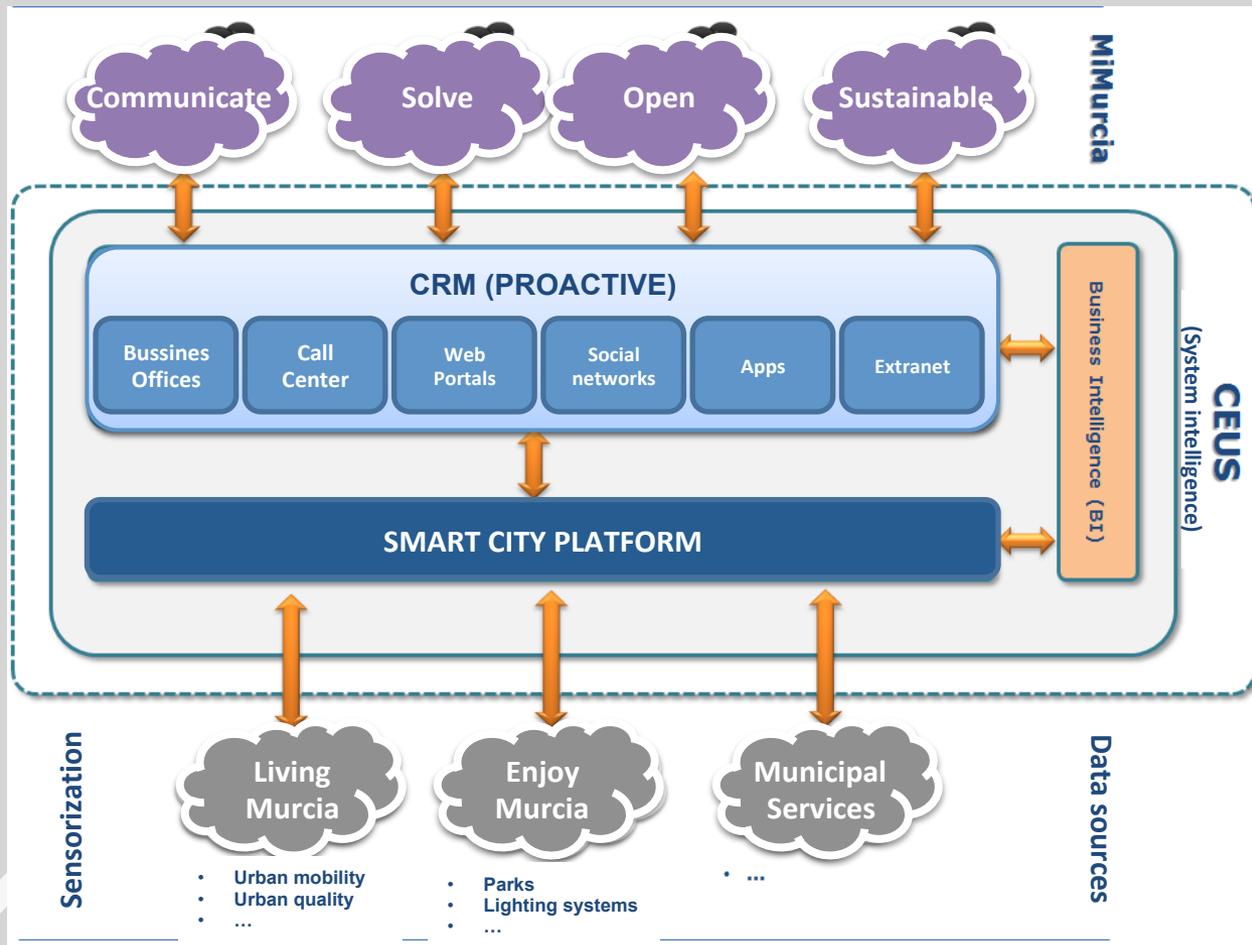
- Transparency and clarity
- Participatory democracy mechanism
- Integration into Open Data initiative
- Unified SDI-GIS
- Business attraction
- Data Marketplace and innovation support



- Innovative paperless administration.
- Close to the citizen
- Administration modernization
- Reduce the documentation  
Administration 3.0

- Smart urban mobility: State of the city, public transport ,waste collection
- Urban quality: Energy efficiency, reduction of the use of own vehicle, p&g management

# Architecture



# Smart City Platform

- Integration and interoperability layer
- Analysis and storage layer
- Advanced services layer
- Balanced scorecard
- Access identification and authorization layer
- Configuration, management and monitoring layer
- Data publishing layer (OpenData)

## Data sources

- Regulated Parking Service and private car parks
- Mix-modal public transport and the use of bicycle
  - ↳ Citizen Card
- Traffic management
- Lighting system
- Watering systems for parks and gardens
- Noisy zones detection
- Waste collection
- Incidences of citizens
- Commerce promoting in the centre of the city (iBeacons)

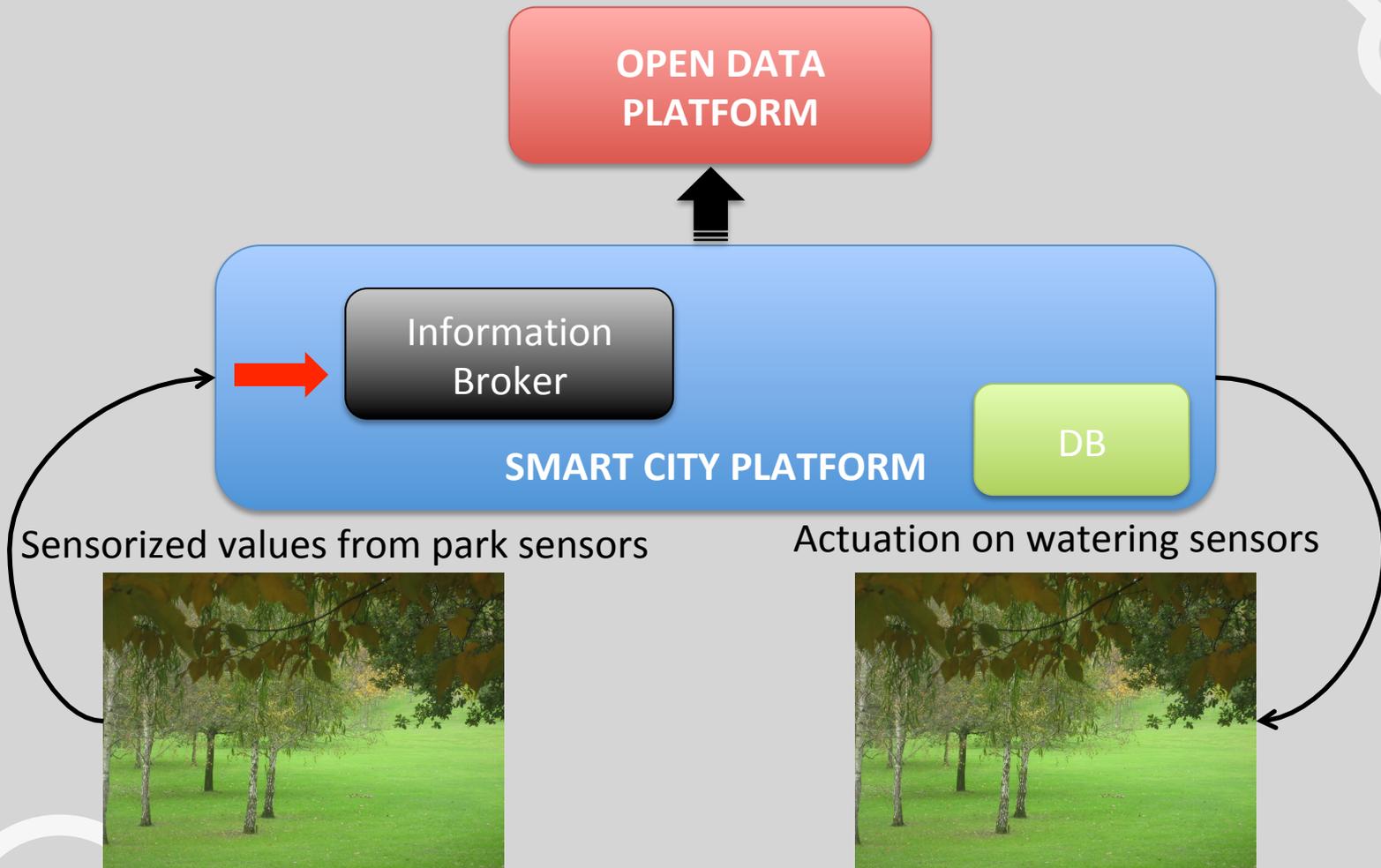
## Main Objective

- ❑ Integrate data from sensors, open data sources and internal database by means of common data model (NSGI)
- ❑ Provide facilities for orchestrating new services based on connecting different municipality areas of information
- ❑ Create new channels of communication with citizens based on social networks contextualized information
- ❑ Increase the efficiency of services and reaction time based on the real time information of the city

# Interoperability

- ❑ Create end-point for integration existing vertical
- ❑ Identify communication options to give better coverage
- ❑ Define mechanism for supporting data exchange
- ❑ Municipality agreement for requesting any further tender involving ICT components to be compatible with the Smart City platform and provide NGSI interfaces for interoperability:
  - New tenders on traffic management, public parking, garden and parks maintenance

# Integration of existing vertical



# Smart Irrigation of Garden and Parks



*MiMurcia*

# SCADA Integration

60 - JARDIN DE LAS 3 COPAS (A) MURCIA

electrohine



**Nombre del Jardín:**  
JARDIN DE LAS 3 COPAS (A)

**Población:**  
MURCIA

**Fecha ultimo riego:**  
04:41 05/05/2015

**Fecha ultima conexión:**  
01:03 06/05/2015

**Habilitar Riego:**  
SI  NO

**Fecha última comprobación de inicio de riego:**  
5 de Mayo

**Fecha y Hora del PLC:**  
MARTES 01:03:12 06/05/2015

**Hora de Inicio Riego Automático:**  
00:20

**Sin riego los días de la semana:**  
L M X J V S D

Informe de Incidencias  
Imagen del Jardín  
Mapa Ubicación  
Plano Sectores  
Gráfica de Lluvia  
Informe de Eventos  
Gráfica de Conexión  
Iniciar Fiego  
Programas de Fiego  
Actualizar Hora PLC  
Riego Programado



PROG1 AUTO ESTACIÓN 1	PROG1 AUTO ESTACIÓN 2	PROG1 AUTO ESTACIÓN 3	PROG1 AUTO ESTACIÓN 4	PROG1 AUTO ESTACIÓN 5	PROG1 AUTO ESTACIÓN 6	PROG1 AUTO ESTACIÓN 7	
PROG1 AUTO ESTACIÓN 8	PROG1 AUTO ESTACIÓN 9	PROG1 AUTO ESTACIÓN 10	PROG1 AUTO ESTACIÓN 11	PROG1 AUTO ESTACIÓN 12	PROG1 AUTO ESTACIÓN 13	PROG1 PARO ESTACIÓN 14	AUTO VALVULA MAESTRA

Concejalía de Medio Ambiente

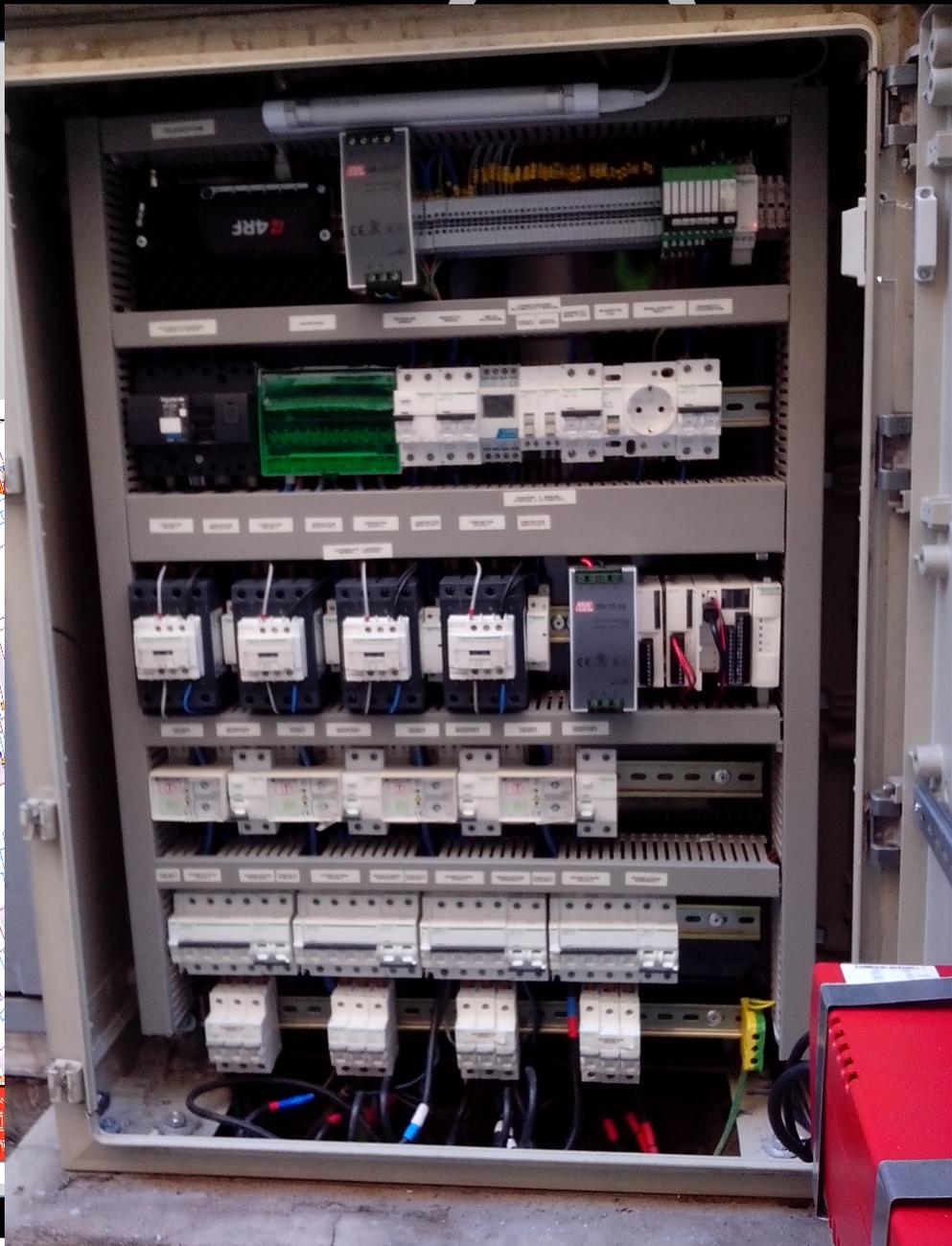
Wed May 06 2015

Murcia

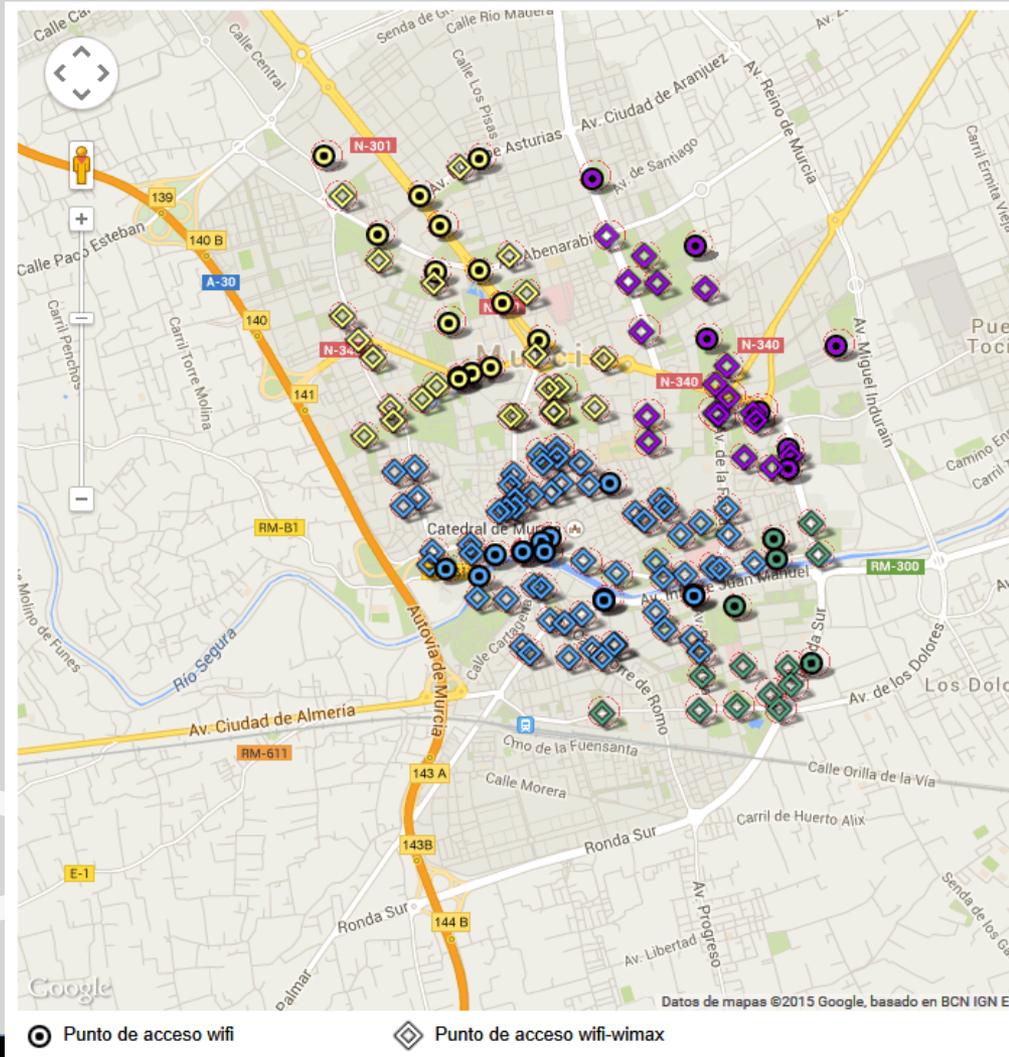
# Street Lighting



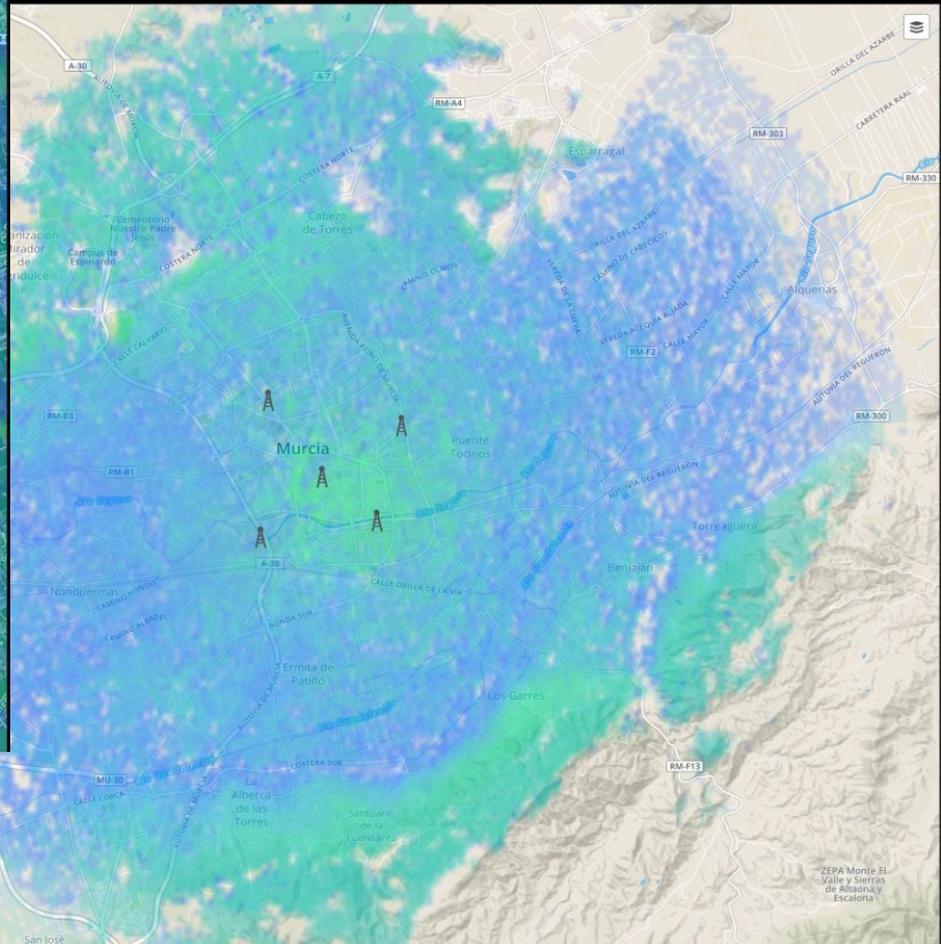
<b>MURCIA</b>	<b>CALLE PLATERIA</b> ALUMBRADO PÚBLICO EXISTENTE C.M. N°149 (Calderón de la Barca)	Oficina de Obras y Proyectos Municipales Departamento de Ingeniería Industrial Alumbrado Público
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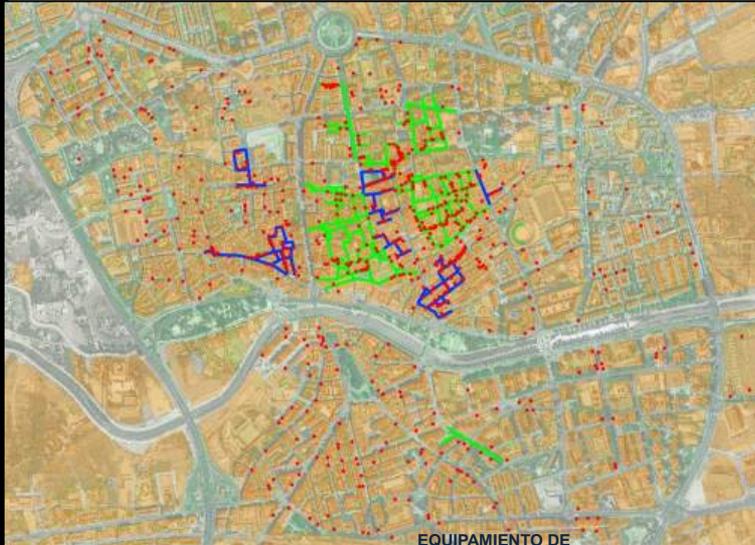
# WIFI coverage



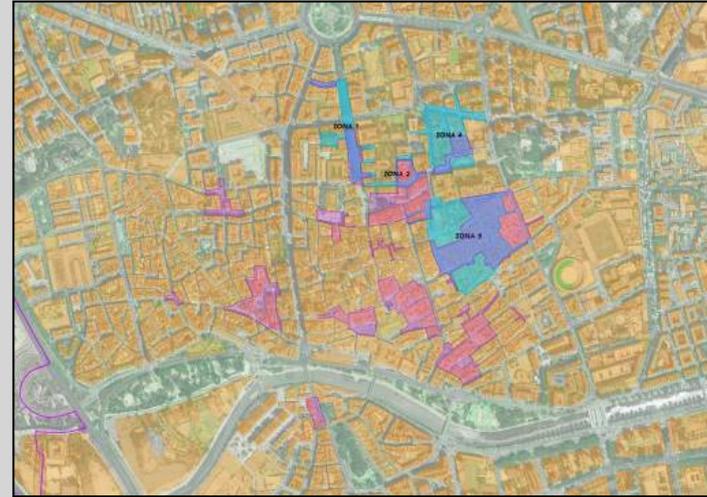
# LoRA Connectivity



# Sonometers for Noisy Area



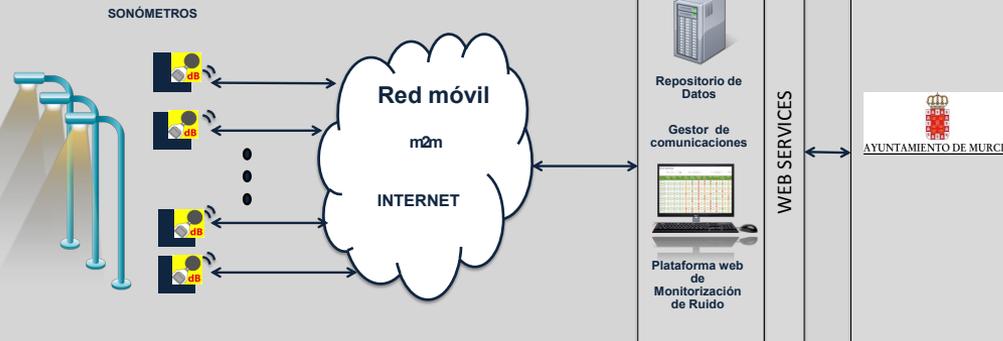
EQUIPAMIENTO DE MONITORIZACIÓN



SISTEMA DE COMUNICACIONES

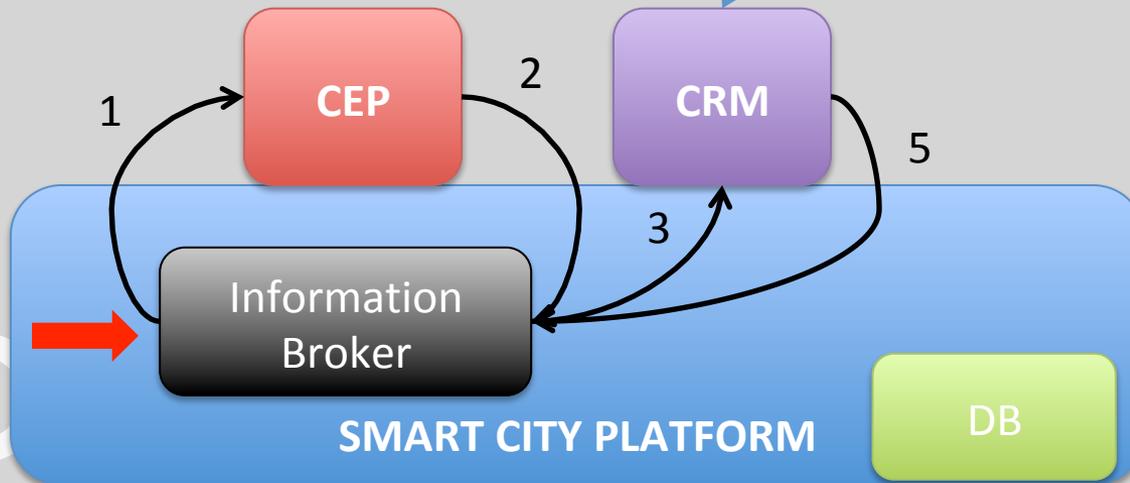
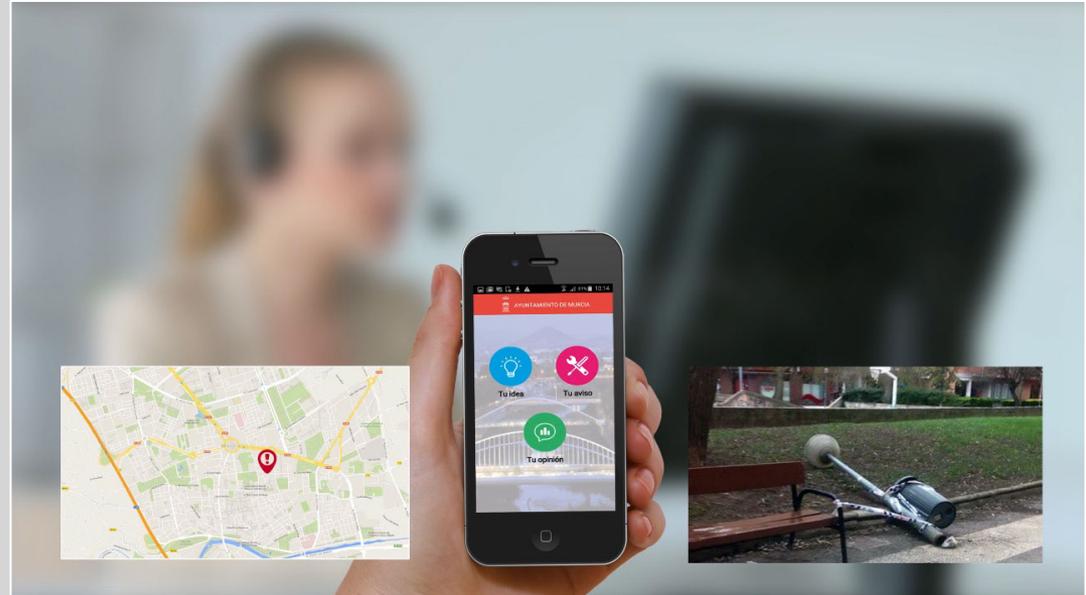
SISTEMA DE MONITORIZACIÓN DE RUIDO

PLATAFORMA SMART CITY DE MURCIA



# Informative Panels





# Visiting places and activities promoting in the city centre

iBeacon

→ Inter

→ Seno

• A

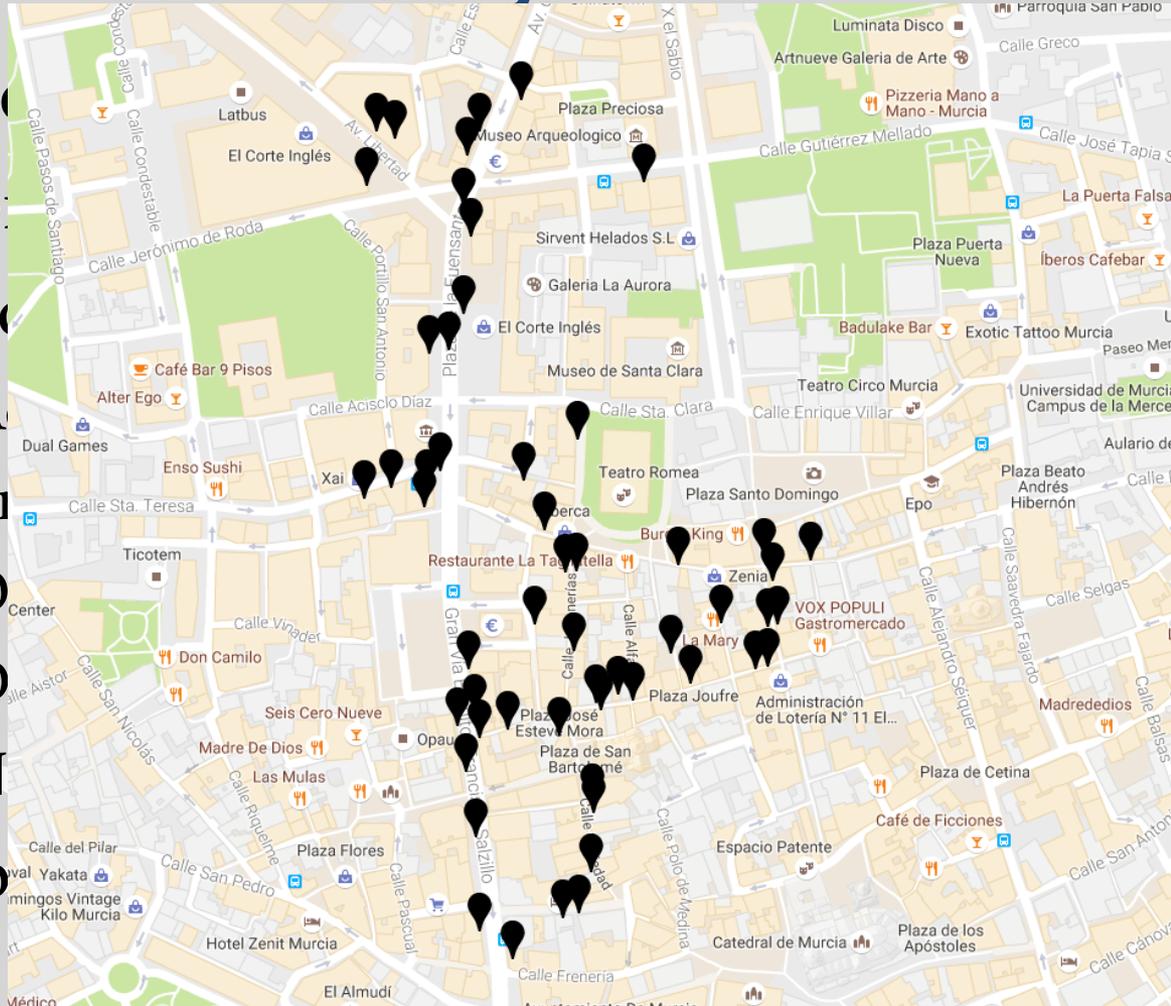
• P

• O

• D

• N

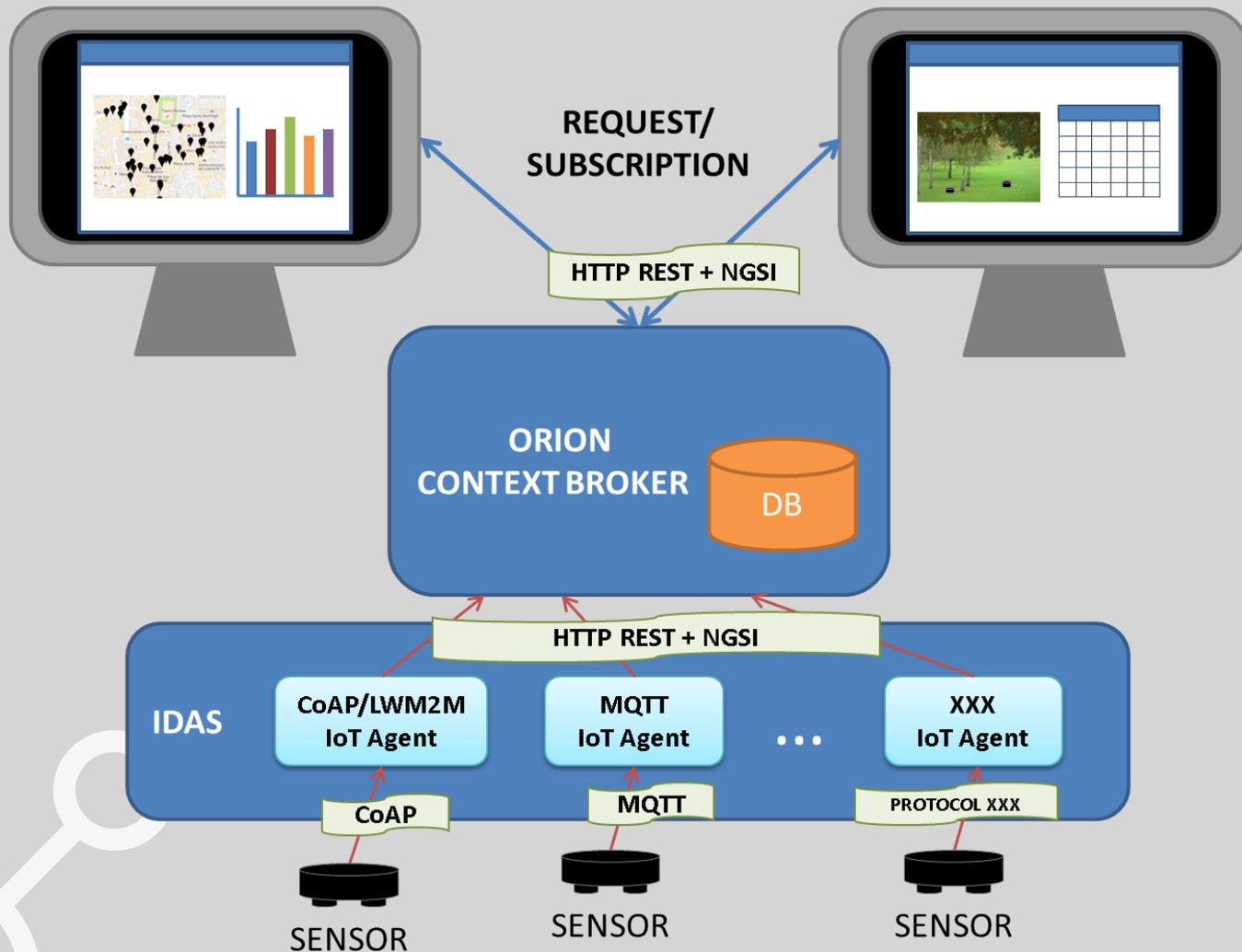
→ Dep



## Citizen profiling

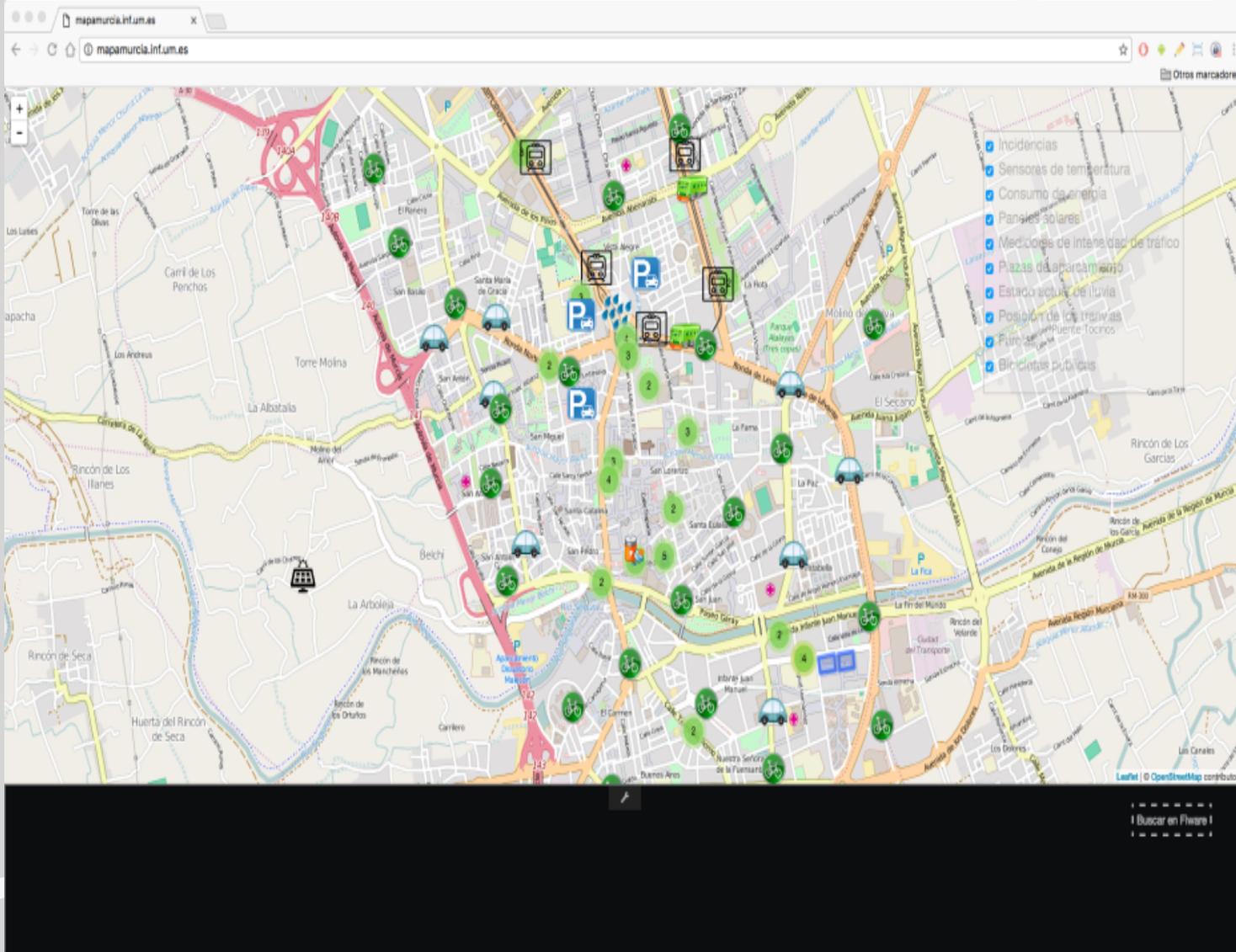
- Using location based information (cellular or beacons, etc).
  - ↳ Schedule and orchestrate a strategy for:
    - Derivate traffic improving quality of living
    - Incentivate and promote public transport
    - Balance the city council resources to assure security, confortability, and a great variety of services to tourist
    - Avoid overcrowding and provide mechanisms to handle it.
  - ↳ Identify tourist flows
  - ↳ Special dates movements and how affect city
    - Christmas
    - Summer holidays
    - Easter, ...

# PoC Platform Architecture



## FIWARE platform deployment for Smart City

- ❑ Heterogeneous information
- ❑ Different nature of sources of information
- ❑ Set up and develop different ways for integration
  - ↳ Using enablers such as COMET and CYGNUS
  - ↳ Developing new connectors to integrate the information



MiMurcia

## Integrated services

- Incidences
- Temperature of town hall buildings
- Energy consumption of buildings
- Traffic measurements
- Parking slots of parking sites
- Free parking slots of public rental bike service
- Tramp
- Bus stops and vehicle locations
- Rainfall
- Solar panels

# Service Map



Cambiar vista Panel/Gráficos

OFICINAS  
 Última actualización  
**16/6/2016 12:26:00**

POLICÍA AULAS  
 AULA 1

POLICÍA VARIOS  
 CARGADORES

Buscar en Fiware

Leaflet | © OpenStreetMap contributors

# Service Map



## Cambiar vista Panel/Gráficos

Última Actualización  
**20/7/2016 13:26:00**

Energía Activa  
**6.6 kWh**

Energía Reactiva  
**6.4 kWh**

Factor de Potencia  
**0.7**

Potencia Activa Instantánea  
**15.3 kW**

Potencia Reactiva Instantánea  
**15.6 kW**

### FASE1

F1 Energía Activa  
**1.7 kWh**

Energía Reactiva  
**1.5 kWh**

Factor de Potencia  
**0.7**

Potencia Activa Instantánea  
**4.0 kW**

Potencia Reactiva Instantánea  
**3.8 kW**

### FASE2

F2 Energía Activa  
**3.1 kWh**

Energía Reactiva  
**2.9 kWh**

Factor de Potencia  
**0.7**

Potencia Activa Instantánea  
**7.2 kW**

Potencia Reactiva Instantánea  
**7.1 kW**

### FASE3

F3 Energía Activa  
**1.8 kWh uses**

Energía Reactiva  
**2.0 kWh**

Factor de Potencia  
**0.7**

Potencia Activa Instantánea  
**4.1 kW**

Potencia Reactiva Instantánea  
**4.7 kW**

Buscar en Fiware

# Quater View

AYUNTAMIENTO DE MURCIA    MIMURCIA    MAPA DE MURCIA

**Aparcamiento de bicis**

Aparcamiento Plaza Cetina  
Plazas ocupadas  
8 de 14

57

**Sistemas de alumbrado**

Consumo energético medio  
Corriente y voltaje  
0.13 233.34

Consumo energético medio  
Corriente y voltaje  
0.15 240.82

Consumo energético medio  
Corriente y voltaje  
0.12 229.15

**Sensores ambientales**

Sensor en farola  
Presencia de personas  
Si

Temperatura y humedad  
16°C 30%

Sensor en farola  
Presencia de personas  
No

Temperatura y humedad

**Aparcamientos**

Aparcamiento Libertad  
Plazas libres  
314

Aparcamiento La Vega  
Plazas libres  
216

Aparcamiento Alfonso X  
Plazas libres  
80

Aparcamiento Centrofama

**Paradas de autobus**

La Fama  
Lineas  
R17 R20

Biblioteca la Fama  
Lineas  
R17

Jefatura de Tráfico  
Lineas  
R17

**Tweets by @AytoMurcia**

Ayuntamiento Murcia Retweeted  
José Ballesta @Ballesta\_Murcia  
Presentamos las motos eléctricas del nuevo sistema de 'motosharing' de alquiler, además de 5 nuevos puntos de carga #MurciaMásSostenible

**Tweets by @CulturaMurcia**

Cultura de Murcia @CulturaMurcia  
El talento joven sube al escenario gracias al 'X Ciclo de Jóvenes Solistas'.

Cultura de Murcia @CulturaMurcia  
'Norma' y 'Nabucco' inundan de ópera el @TeatroRomea el miércoles y el jueves de esta semana. Toda la info en teatroromea.es

**Tweets by @TurismodeMurcia**

Turismo de Murcia Retweeted  
Cultura de Murcia @CulturaMurcia  
'Norma' y 'Nabucco' inundan de ópera el @TeatroRomea el miércoles y el jueves de esta semana. Toda la info en teatroromea.es

**Weather:** Murcia, 06 Noviembre. Previsión para 7 días. +18°C H: +18°C L: +9°C

Día	Temperatura
Mar	-20° / +8°
Mié	+19° / +7°
Juv	+17° / +9°
Vie	+18° / +9°
Sáb	+19° / +8°
Dom	+17° / +12°

# Platform deployment

## □ Enablers:

- ORION Context Broker
- COMET Short Therm Historic
- CKAN Open Data
- CYGNUS

## Integration examples – Urban bus

### □ They provide an API using SOAP

- We have to develop a Python-based connector to extract the information and integrate it into our platform
- Using suds – Lightweight SOAP client

### □ Organization of the information

- fiware-service: autobuses
- fiware-servicepath: /murcia

# Integration examples – Urban bus

```
22 dictparada['type'] = 'Punto'
23 dictparada['isPattern'] = 'false'
24 dictparada['id'] = 'ParadaAutobus:' + str(parada.StopPointRef)
25 dictparada['attributes'] = [
26     {
27         "name": "nombre",
28         "type": "string",
29         "value": urllib.quote(parada.StopName[0].encode('utf-8')),
30         "metadatas": [{
31             "name": "encoded",
32             "type": "encoding",
33             "value": "url, utf-8"
34         }]
35     },
36     {
37         "name": "geoposicion",
38         "type": "coords",
39         "value": str(parada.Location.Latitude) + ', ' + str(parada.Location.Longitude),
40         "metadatas": [{
41             "name": "location",
42             "type": "string",
43             "value": "WGS84"
44         }]
45     },
46     {
47         "name": "lineas",
48         "type": "linea[]",
49         "value": map(lambda x: {
50             "id": x.LineRef,
51             "direction": x.DirectionRef
52         }, parada.Lines.LineDirection if isinstance(parada.Lines.LineDirection, list) else [parada.Lines.LineDirection])
53     }
54 ]
```

Bus-stops are represented as points.

They contain:

- Location
- Bus lines in each stops
  - Id
  - direction

# Integration examples – Urban bus

```
11 class API:
12     def __init__(self):
13         self.client = Client(config['wsdl'])
14
15     def LinesDiscovery(self):
16         request = self.client.factory.create('ns2:WsLinesDiscoveryStructure')
17         request.Request.AccountId = config['username']
18         request.Request.AccountKey = config['password']
19         request.Request.RequestTimestamp = now()
20         return self.client.service.LinesDiscovery(request)
21
22     def GetStopMonitoring(self, monitoringRef):
23         request = self.client.factory.create('ns2:StopMonitoringRequestStructure')
24         request.ServiceRequestInfo.AccountId = config['username']
25         request.ServiceRequestInfo.AccountKey = config['password']
26         request.Request.RequestTimestamp = request.ServiceRequestInfo.RequestTimestamp = now()
27         request.Request.MonitoringRef = str(monitoringRef)
28         return self.client.service.GetStopMonitoring(request)
```

Our Python module connects to the remote resource ***ns2:WsLinesDiscoveryStructure*** to get the information of bus lines.

***ns2:StopMonitoringRequestStructure*** for bus stops.

# Integration examples – Urban bus

```
import httplib
import json

from HTMLParser import HTMLParser
h = HTMLParser()

class NGSIContextBroker:
    def __init__(self, url, fiwareService, fiwarePath):
        self.url = url
        self.headers = {'Content-Type': 'application/json; charset=\''utf-8\'',
                        'Accept': 'application/json',
                        'fiware-service': fiwareService,
                        'fiware-servicepath': fiwarePath}

    def updateContextByContextElements(self, contextElements):
        conn = httplib.HTTPConnection(self.url)
        params = json.dumps({'contextElements': contextElements, "updateAction": "UPDATE" }, ensure_ascii=True)
        conn.request("POST", "/v1/updateContext", params, self.headers)
        response = conn.getresponse()
        print response.status, response.reason
        data = response.read()
        print data
        conn.close()
```

After obtaining this info. Our module put this information into the Context Broker using **updateContext** with the command **UPDATE**

# Integration examples – Bike rental service

## □ They provide a REST API

¬ We developed nodejs conector to extract the information and integrate it into our platform

## □ Organization of the information

¬ fiware-service: bicis

¬ fiware-servicepath: /murcia

# Integration examples – Bike rental

```
17 type: "Sensor",
18 isPattern: "false",
19 id: "AparcamientoBicis:" + obj[i].id_aparcamiento,
20 attributes: [{
21   name: "libres",
22   type: "number",
23   value: obj[i].libres+""
24 }, {
25   name: "ocupados",
26   type: "number",
27   value: obj[i].ocupados
28 }, {
29   name: "habilitado",
30   type: "number",
31   value: obj[i].eshabilitada
32 }, {
33   name: "descripcion",
34   type: "string",
35   value: encodeURIComponent(obj[i].descripcion.trim())
36 }, {
37   "name": "geoposicion",
38   "type": "coords",
39   "value": obj[i].latitude+", "+obj[i].longitude,
40   "metadatas": [{
41     "name": "location",
42     "type": "string",
43     "value": "WGS84"
44   }]
45 }
```

## Representation of bike parking slots:

- Id: BikeParkingSite:\*
- Free slots
- Occupied slots
- Enabled
- Description
- Location

# Integration examples – Bike rental service

Updating context to our  
FIWARE platform

```
54     var req = http.request({
55         method: "post",
56         path: "/v1/updateContext",
57         host: hostAddr,
58         port: 1026,
59         headers: {
60             "Content-Type": "application/json",
61             "Content-Length": strjson.length,
62             "Accept": "application/json",
63             "fiware-service": service,
64             "fiware-servicepath": servicePath
65         }
66     }, function(response) {
67         // TODO: Comprobar que es OK
68         response.on("data", function(dat){
69             // console.log(dat.toString());
70         });
71
72         console.log("Petición OK");
73     });
```

## Integration examples – Tramp service

### □ Two different services:

- ¬ Information in tramp stops
- ¬ Information and location of tramp vehicles
- ¬ We developed a nodejs conector

### □ Organization of the information

- ¬ fiware-service: tranvia
- ¬ fiware-servicepath: /murcia

# Integration examples – Tramp service

```
// Mandar las paradas de los tranvías:
var context = [];
for (var k in paradas) {
  context.push({
    type: "Punto",
    isPattern: "false",
    id: "ParadaTranvia:" + encodeURIComponent(k),
    attributes: [{
      "name": "estado",
      "type": "string",
      "value": encodeURIComponent(estadoParadas[k] || " ").replace("'", "min"),
    }, {
      "name": "geoposicion",
      "type": "coords",
      "value": paradas[k],
      "metadatas": [{
        "name": "location",
        "type": "string",
        "value": "WGS84"
      }]
    }]
  });
}
```

## Tramp stops:

- Id TrampStop.
- Location
- State: info of both directions

```
context.push({
  type: "Vehiculo",
  isPattern: "false",
  id: "Tranvia:" + match[1],
  attributes: [{
    "name": "geoposicion",
    "type": "coords",
    "value": match[3] + "," + match[2],
    "metadatas": [{
      "name": "location",
      "type": "string",
      "value": "WGS84"
    }]
  }]
});
```

## Tramp vehicle:

- Id Tramp.
- Location

# Integration examples – Tramp service

Updating context to our  
FIWARE platform

```
var strjson = JSON.stringify({
  contextElements: context,
  updateAction: "UPDATE"
});

var req = http.request({
  method: "post",
  path: "/v1/updateContext",
  host: hostAddr,
  port: 1026,
  headers: {
    "Content-Type": "application/json",
    "Content-Length": strjson.length,
    "Accept": "application/json",
    "fiware-service": service,
    "fiware-servicepath": servicePath
  }
}, function(res) {
```

# Comet Integration

□ We need to configure it:

```
config.server = {  
  // The host where the STH server will be started.  
  // Default value: "localhost".  
  host: 'fiware-dev.inf.um.es',  
  // The port where the STH server will be listening.  
  // Default value: "8666".  
  port: '8666',  
  // The service to be used if not sent by the Orion Context Broker in the notifications.  
  // Default value: "testservice".  
  defaultService: '',  
  // The service path to be used if not sent by the Orion Context Broker in the notifications.  
  // Default value: "/testservicepath".  
  defaultServicePath: '/',  
  // A flag indicating if the empty results should be removed from the response.  
  // Default value: "true".  
  filterOutEmpty: 'true',  
  // Array of resolutions the STH component should aggregate values for.  
  // Valid resolution values are: 'month', 'day', 'hour', 'minute' and 'second'  
  aggregationBy: ['day', 'hour', 'minute'],  
  // Directory where temporary files will be stored, such as the ones generated when CSV files are requested.  
  // Default value: "temp".  
  temporalDir: 'temp'  
};
```

□ A manual subscription was also used to start the service

# Comet/Cygnus Integration - Subscription

```
curl localhost:1026/v1/subscribeContext -s -S --header 'Content-Type: application/json' \ --header 'fiware-service: tranvia' --header 'fiware-servicepath: /murcia' --header 'Accept: application/json' -d '{...}' | python -mjson.tool) <<EOF
```

```
"entities": [
  {
    "type": "Vehiculo",
    "isPattern": "true",
    "id": "Tranvia:*"
  }
],
"attributes": [
  "geoposicion"
],
"reference": "http://sth-host:port/notify",
"duration": "P1M",
"notifyConditions": [
  {
    "type": "ONCHANGE",
    "condValues": [
      "geoposicion"
    ]
  }
],
"throttling": "PT5S"
}
```

Details about subscription

End point of subscriber

# Security components

## □ Enablers

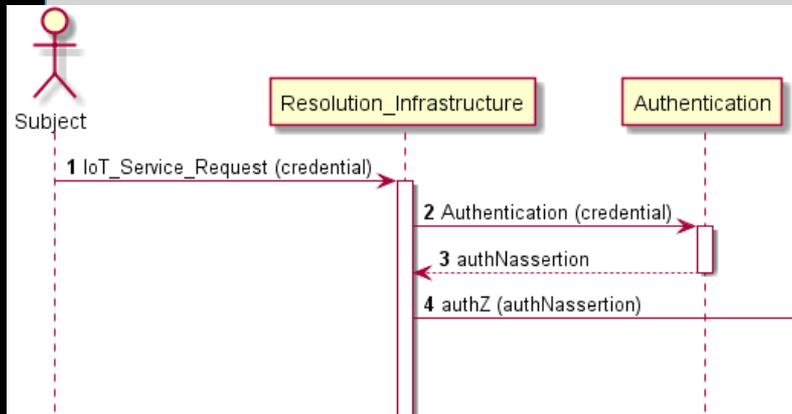
- KeyRock: Id Management

## □ New components

- Capability Manager: Authorization

- PEP\_Proxy: Authorization enforcement and data encryption using CP-ABE

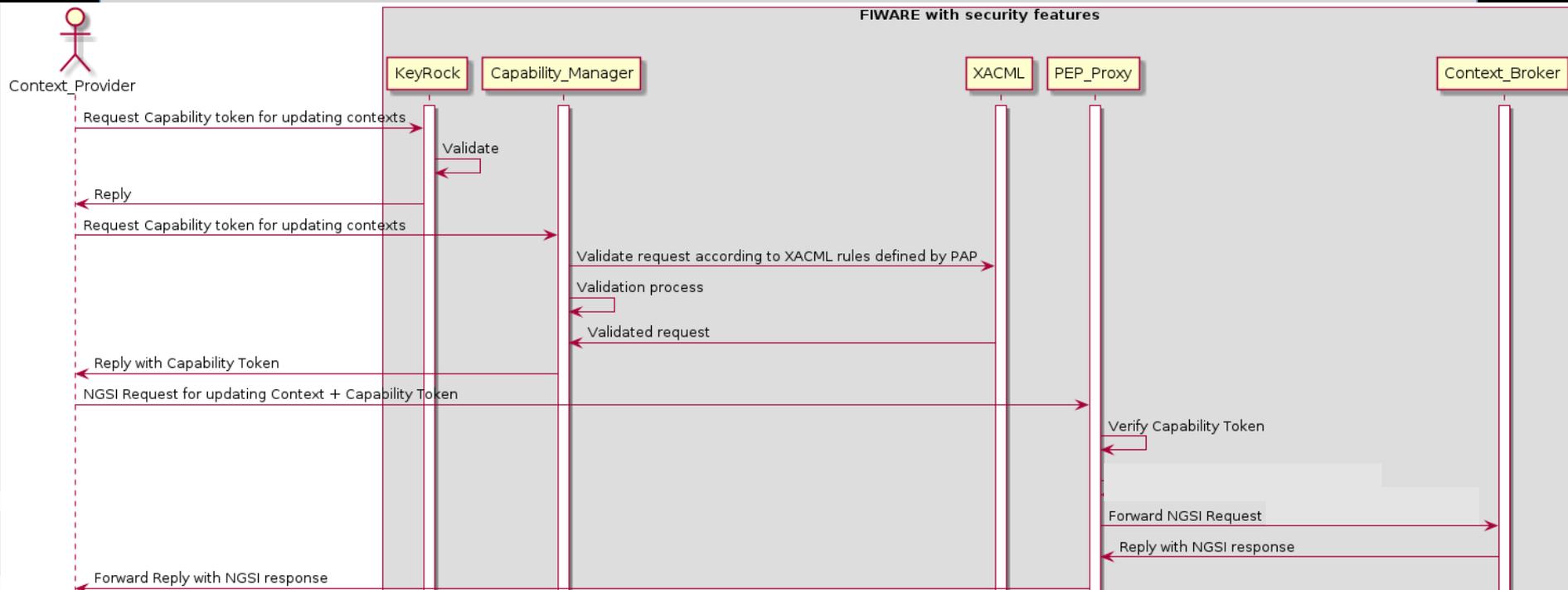
# Authentication



KeyRock is the component responsible for verifying user credentials providing authentication verdict

# Authorization

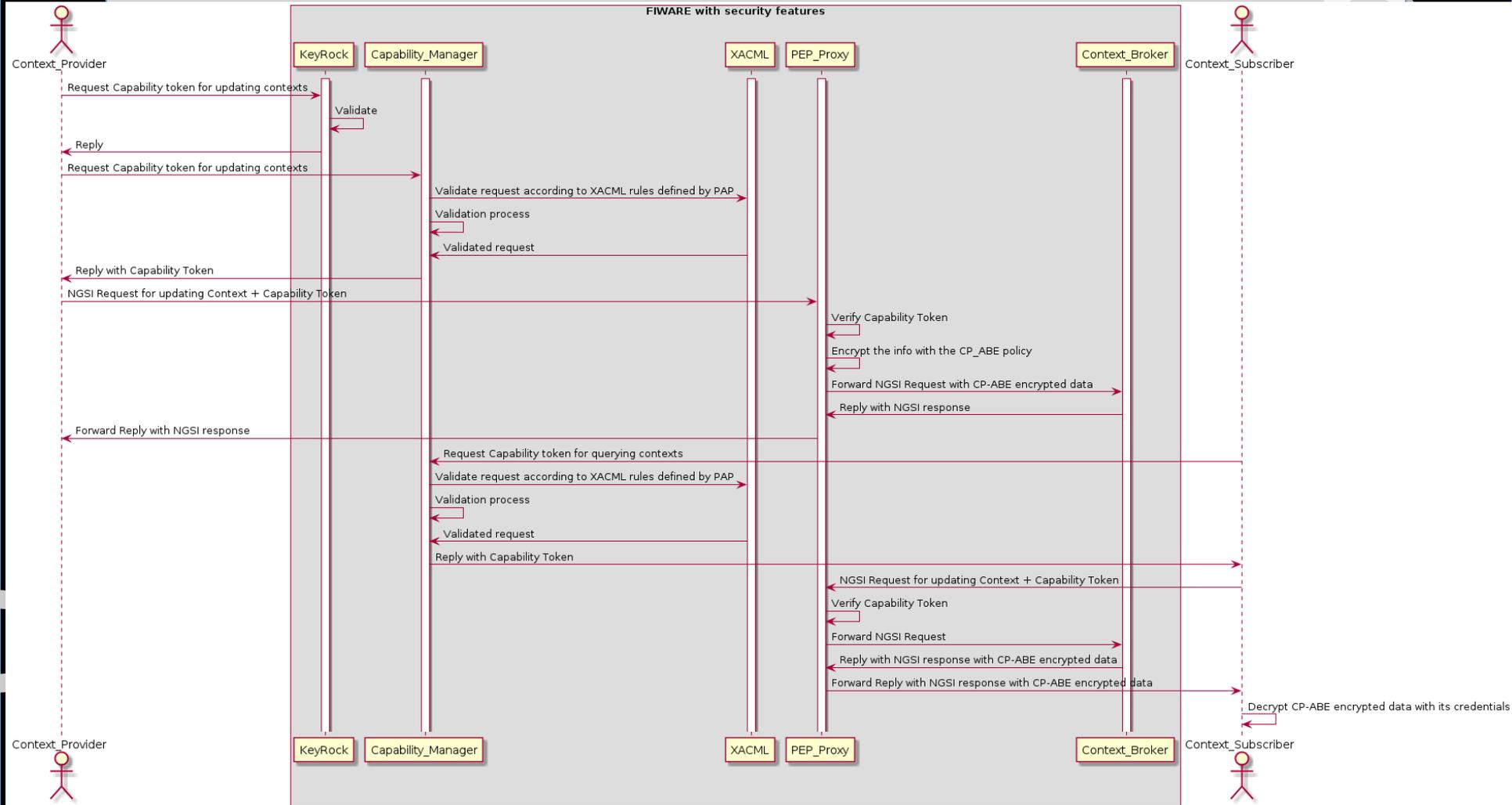
Capability Manager is accessed via POST API REST



# Authorization – Capability Token

```
{
  "id": "eg3fq:fb5r23tra3",
  "ii": 1485172121,
  "is": "issuer@odins.es",
  "su": "zNwS5FetB4rwzSKsWwSBAXm5wDa=JgLjHU8zSnmeSFQgSG9HhdsJrE8=",
  "de": "coap://sensortemp.floor1.computersciencefaculty.um.es",
  "si": "SbUudG4zuXswFBxDeHB87N6t9hR=PBQqCN3gpu7nSkuPzDk7kaR3dq1=",
  "ar": [
    {
      "ac": "queryContext",
      "re": "temperature"
    }
  ],
  "nb": 1485172121,
  "na": 1485174121
}
```

# Authentication and authorization



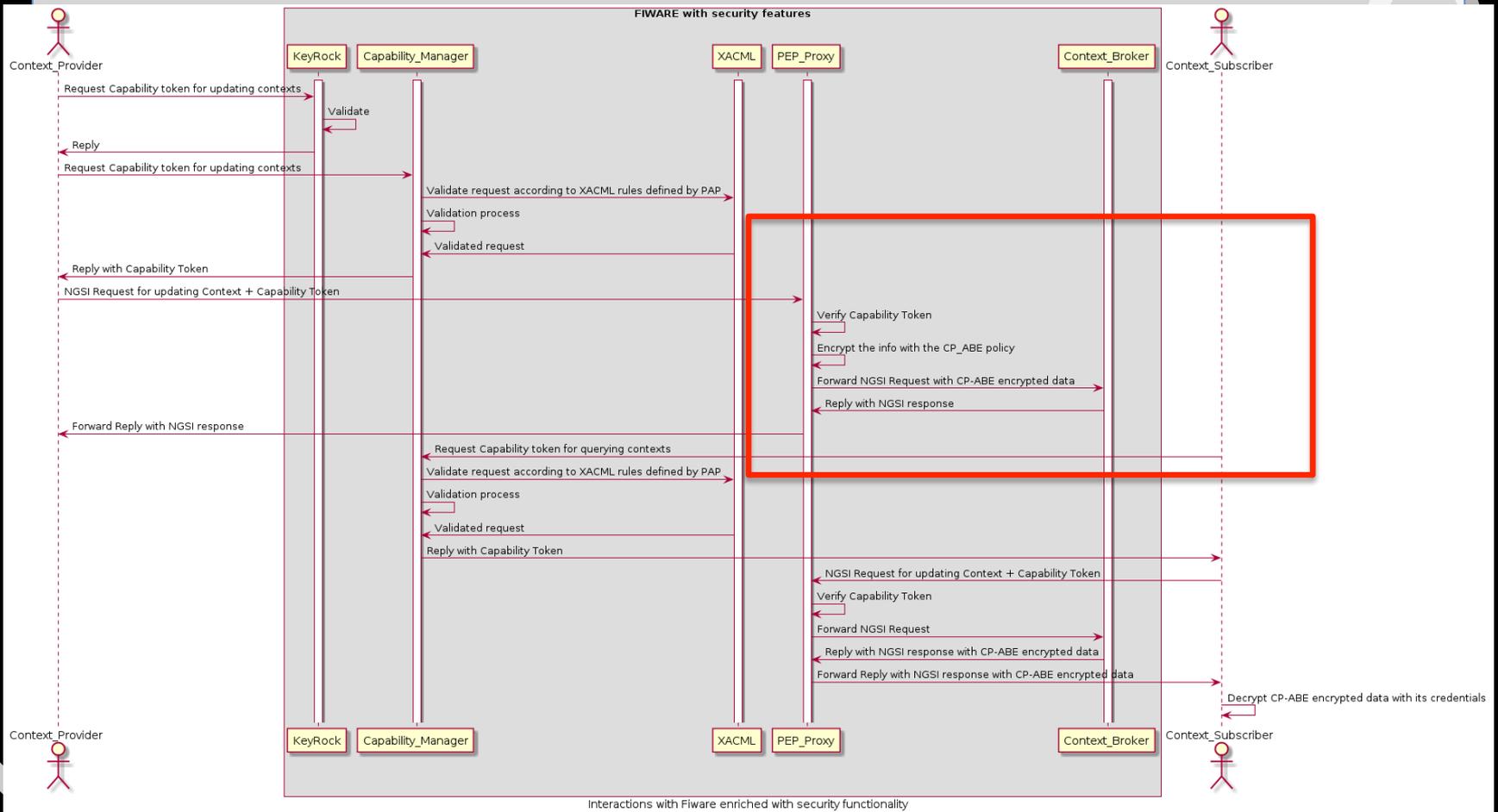
Interactions with Fiware enriched with security functionality

# CP-ABE Encryption integration

```
"contextElements": [  
  {  
    "type": "Test",  
    "isPattern": "false",  
    "id": "Test:1",  
    "attributes": [  
      {  
        "name": "cipheredAttribute",  
        "type": "cyphertext",  
        "value": "hello",  
        "metadatas": [{  
          "name": "cpabe-policy",  
          "type": "string",  
          "value": "floor1 and admin"  
        }]  
      }  
    ]  
  }  
]
```

PEP\_Proxy will use the highlighted information and encrypt the **cipheredAttribute** with the corresponding CP-ABE policy **floor1 and admin**

# CP-ABE Encryption performance

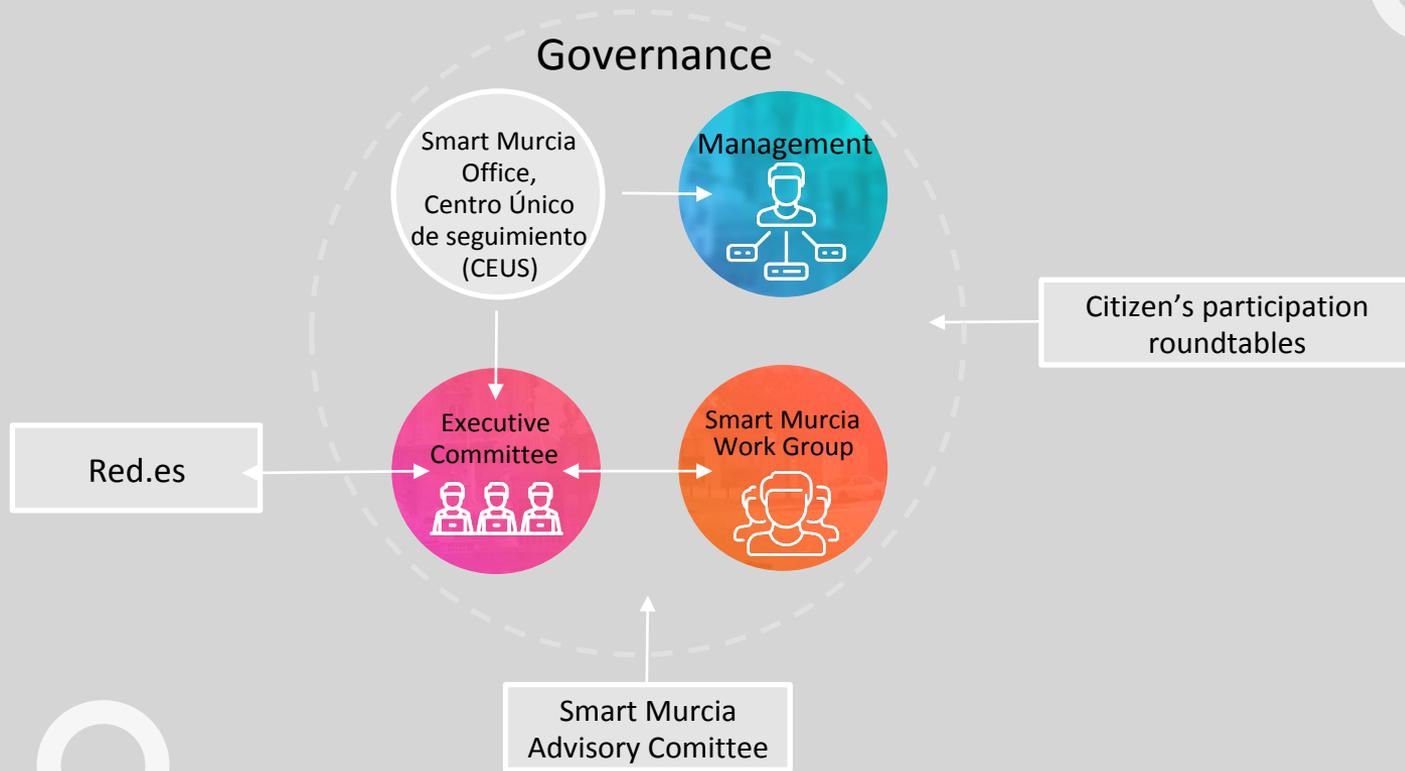


# Innovation Ecosystem

## ▣ MiMurcia Open Innovation Smart City Lab (MiOS):

- IoT-based living lab provided by MiOS with several sensors deployed over the city
- Promote and improve the business innovation using data provided by the smart city platform
- Offer possibility to define new services/apps based on the data available of the city behaviour
- Create open APIs and foster meetup and co-creation workshops

# How we achieve it



# CEUS: The intelligence of the project

- ❑ There is a huge amount of information provided by different devices and sensors along the city
- ❑ An smart brain is needed to process this information
  - Analysis of the whole information
  - Decision making
  - Action plans elaboration



## ❑ CEUS

- The intelligence of the city, coordinating actuations and areas of the city council
- Training, information and interaction point with the citizen
- A demonstration and support place for the citizen

## Conclusions

- ❑ Great complexity in City with new and legacy solutions
- ❑ We have integrated heterogeneous information into our FIWARE PoC platform.
- ❑ Important to provided security and privacy
- ❑ Most important → create a team