BRAIN-IoT

model-Based fRamework for dependable sensing and Actuation in INtelligent decentralized IoT systems

February 19[0] 2019 - Grenoble

ECLIPSE TECHNOLOGIES TO DEVELOP BRAIN-IOT FRAMEWORK

ECLIPSE IOT DAY

Maria Teresa Delgado (Eclipse Foundation) & Levent Gurgen (CEA)

OUTLINE

- WHAT IS BRAIN-IOT?
- BRAIN-IOT USE CASES
- ECLIPSE FOUNDATION IN BRAIN-IOT
- ECLIPSE PAPYRUS AND ECLIPSE SENSINACT
- ECLIPSE TECHNOLOGIES INTEGRATION IN BRAIN-IOT

WHAT IS BRAIN-IOT

EU RESEARCH PROJECT

- Co-funded by the Horizon 2020 programme of the European Union
- Research and Innovation Action

3 YEAR DURATION

- January 2018 – December 2020

12 PARTNERS

- From 5 European countries: Italy, Germany, Spain, France and UK
- Including SMEs, Industry and Academy

POWERED BY ECLIPSE TECHNOLOGIES

- Eclipse Papyrus and Eclipse SensinAct

IOT EUROPEAN AND PRIVACY PROJECTS

- BRAIN-IoT is part of the IoT-ESPP cluster

COLLABORATIONS

- Strong relationship with OSGi Alliance
- European IoT Large Scale Pilots projects
- Strong involvement in W3C consortium to define the WoT standard

THE CONSORTIUM

Istituto Superiore Mario Boella

life.augmented

eclipse

cea

SIEMENS

IDATE DIGIWORLD

UNIVERSITÉ Grenoble Alpes

AIRBUS DEFENCE & SPACE

Paremus

Robotnik

improving metrics

emalcsa

BRAIN-IOT FOCUS

- Framework for composability and deployment of heterogeneous IoT platforms

Considering:

- Complex scenarios involving smart autonomous actuation
- Critical requirements in terms of dependability, security, privacy and safety
- Tightly integrated IoT and CPS systems

OPEN ISSUES IN IOT DOMAIN

HETEROGENEITY AND (LACK OF) INTEROPERABILITY

Heterogeneity of protocols, APIs, device models and data interchange formats hamper interoperability in IoT

SECURITY AND SAFETY

Autonomous actuation in IoT systems calls for strong security requirements

SUSTAINABLE BUSINESS MODELS

Many IoT solutions on the market adopt fully centralized, cloud-oriented approaches but singular point of failures makes survivability and resiliency difficult in the long term

IMPLEMENTING "SMART BEHAVIOURS" IN OPEN COLLABORATION CONTEXT

Difficulty to generically "bind" AI and ML solutions to IoT and CPS platforms
Lacking a solution that enables collaboration to achieve common tasks

ENFORCEMENT OF PRIVACY AND DATA OWNERSHIP POLICIES

A comprehensive solution able to give back control of privacy aspects to users is still missing

MARKET FRAGMENTATION

IoT platforms focused on verticals often associated with technology stacks

BRAIN-IOT FEATURES

IoT Cross-Platform Interoperability & Federation

Fully de-centralized, composable and dynamic federations of heterogeneous IoT platforms

Adoption of shared semantic models

Smart Behaviour

Facilitates the deployment of smart, cooperative behavior by employing modular AI features

Security and Privacy

Establish Authentication, Authorization and Accounting (AAA)

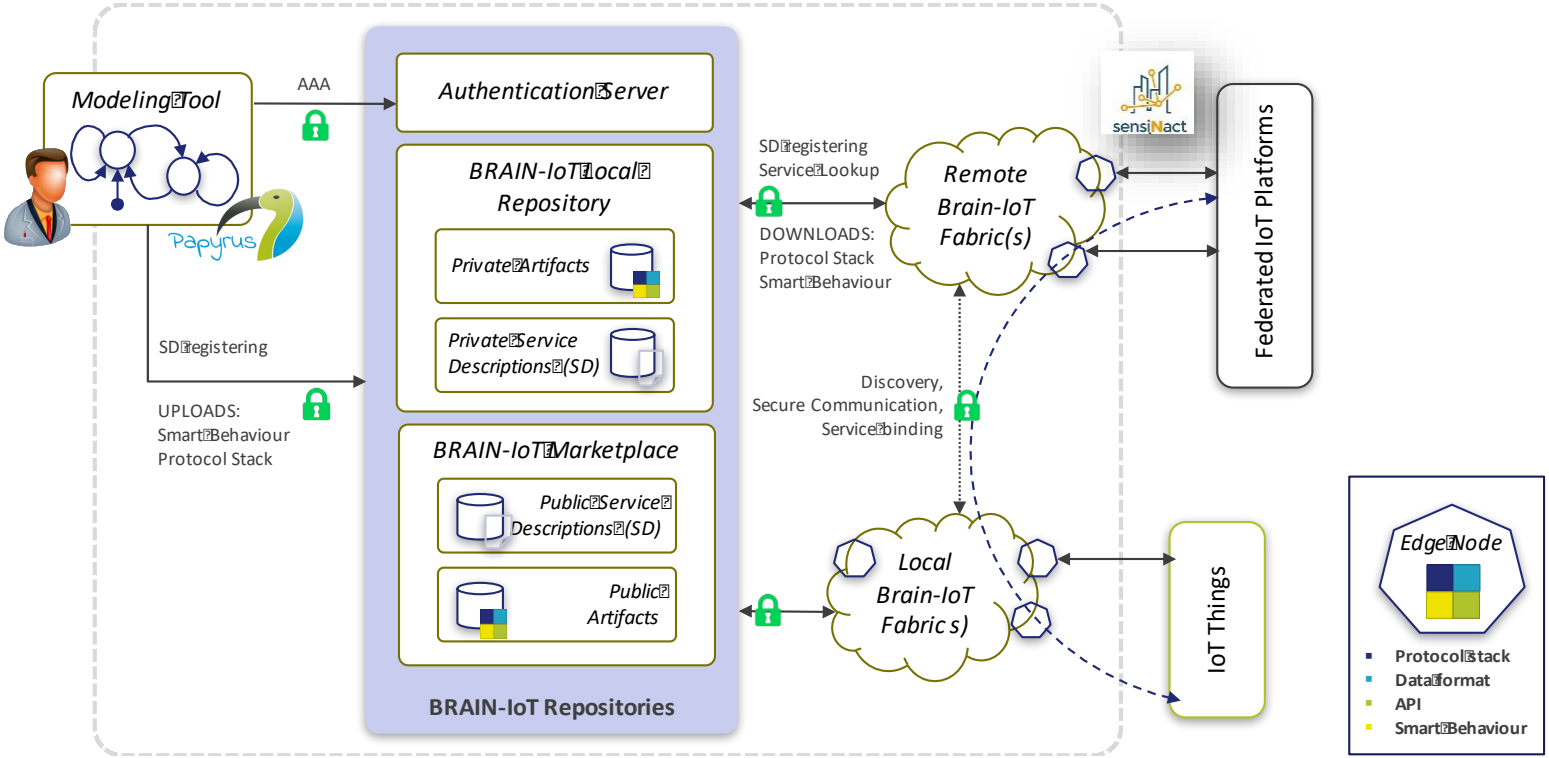
Embedded privacy-awareness and privacy control features

Commissioning and reconfiguration

Dynamic commissioning and reconfiguration choosing among available platforms, modules implementations and services, along with edge-cloud balancing

Model-based approach

BRAIN-IOT HIGH-LEVEL ARCHITECTURE



SCENARIOS

The viability of the proposed approaches is demonstrated in **two usage scenarios**, namely Service Robotics and Critical Infrastructure Management, as well as through a series of proof-of-concept demonstrations in **collaboration with on-going IoT large-scale pilot** initiatives.

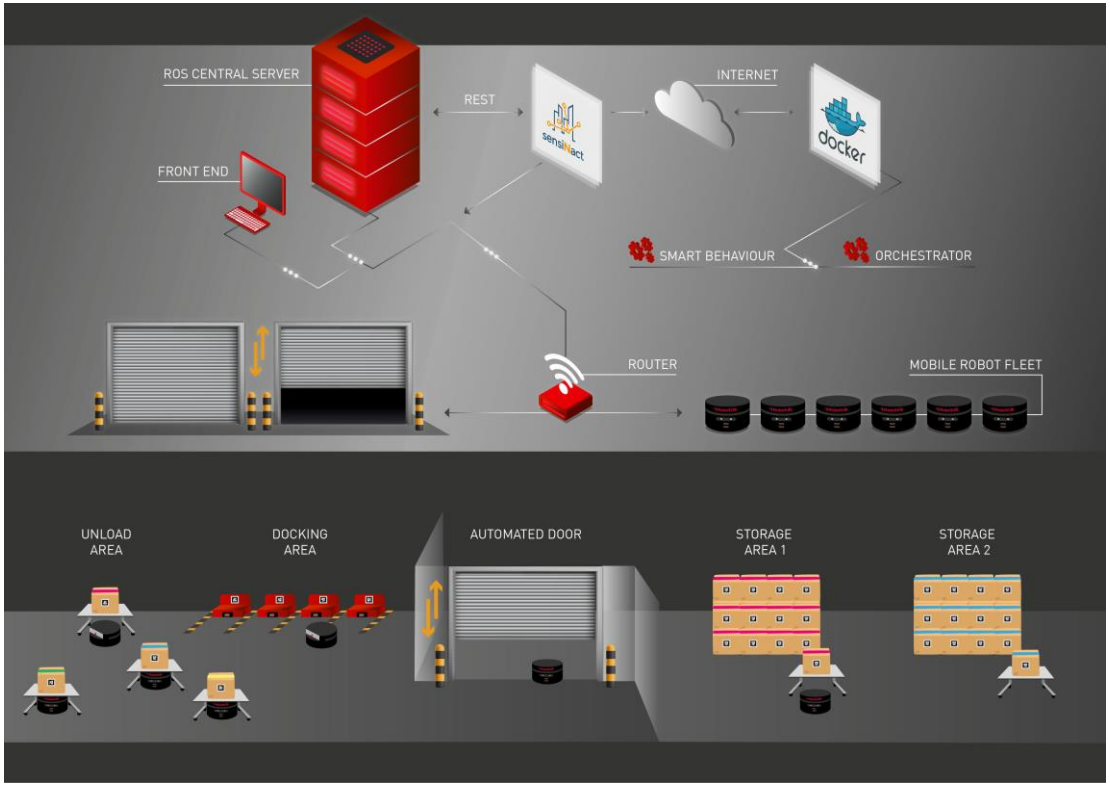
The Critical Water Infrastructure Monitoring and Control use case focuses on the management of the water urban cycle in metropolitan environment of Coruña.

Service Robotics | **Critical Infrastructure Management** | **Links with European IoT Large Scale Pilots**

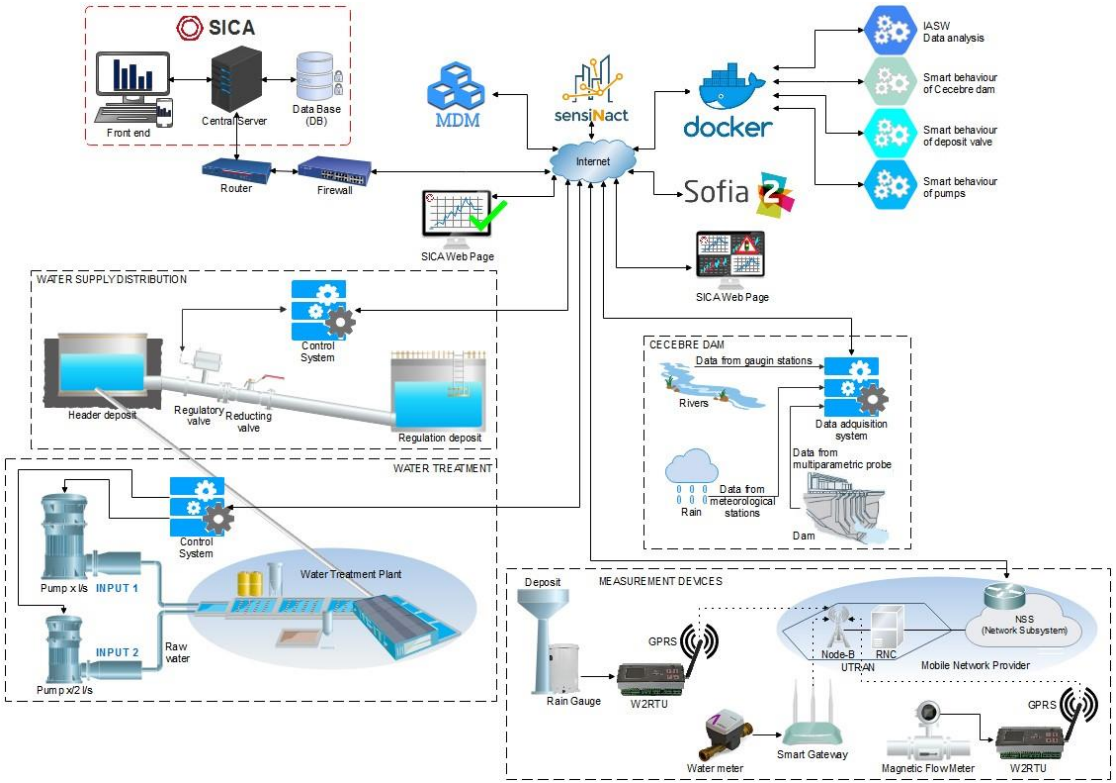
The Service Robotics use case will involve several robotic platforms, like the open-source Robotics Operating System (ROS), which need to collaborate to scan a given warehouse and to assist humans in a logistics domain.

In addition to the first two usage scenarios, few other scenarios will be derived creating a link with European IoT Large Scale Pilots where BRAIN-IoT partners are involved in.

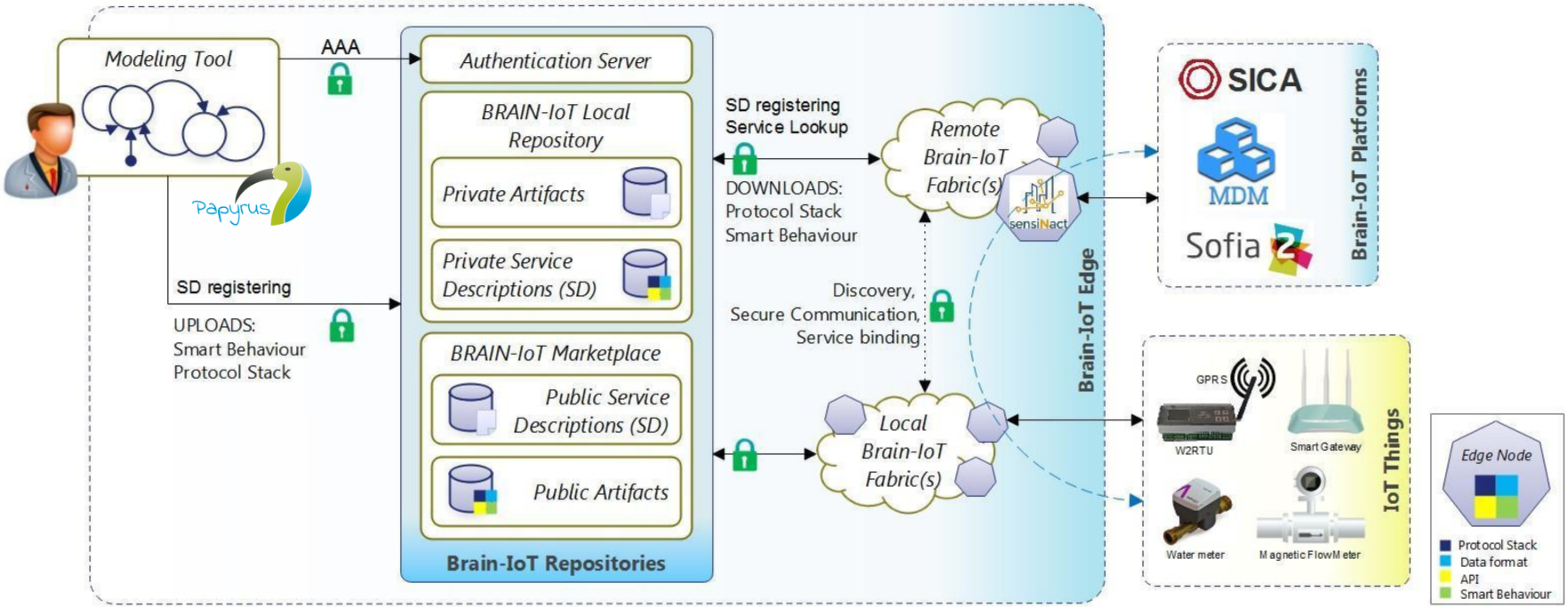
LOGISTIC ROBOTICS SCENARIO



WATER MANAGEMENT USE CASE



WATER MANAGEMENT USE CASE



ECLIPSE FOUNDATION IN BRAIN-IOT

- Promoting use of Eclipse Technologies in research projects
  - Eclipse Papyrus and Eclipse SensinAct (but not only!)
- Community building around project results (like today ☺)
  - Updating and engaging Eclipse community in EU projects
  - Supporting publication of project results in the Eclipse Foundation platform

Research @ Eclipse Foundation

IoT Gateway

Safety Assurance & Certification

GDPR Dev Tools

IoT Model-based Interoperability

Industry 4.0 Standard

OSS Data Mining

Robotic Platform Standard

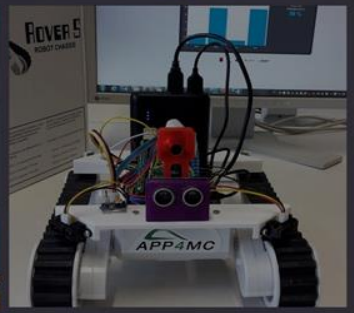
Automotive & Smart Mobility

ECLIPSE FOUNDATION

BRAIN-IoT

Research@ ECLIPSE FOUNDATION™

eclipse.org/research



BRAIN-IoT

model-Based fRamework for dependable sensing and Actuation in INtelligent decentralized IoT systems

ECLIPSE TECHNOLOGIES IN BRAIN-IOT

Levent Gurgen

CEA LETI

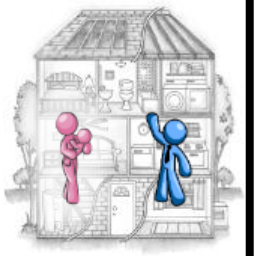
ECLIPSE SENSINACT: OPEN PLATFORM FOR SMARTER CITIES

Dr. Levent Gürgen
levent.gurgen@cea.fr

Eclipse IoT Days, Grenoble
February 19th 2019

TODAY: DOMAIN-CENTRIC, VERTICAL SOLUTIONS

SmartHome



- Monitoring and controlling
- Saving energy comfortably
- Interacting with appliances
-…

SmartHealth

- Monitoring medicine intake
- Personalized diabetes assistance
- Providing training tips
- …

SmartTransport

- Promoting carpooling
- Minimizing taxi delays
- Avoiding traffic jams
- …

SmartCity

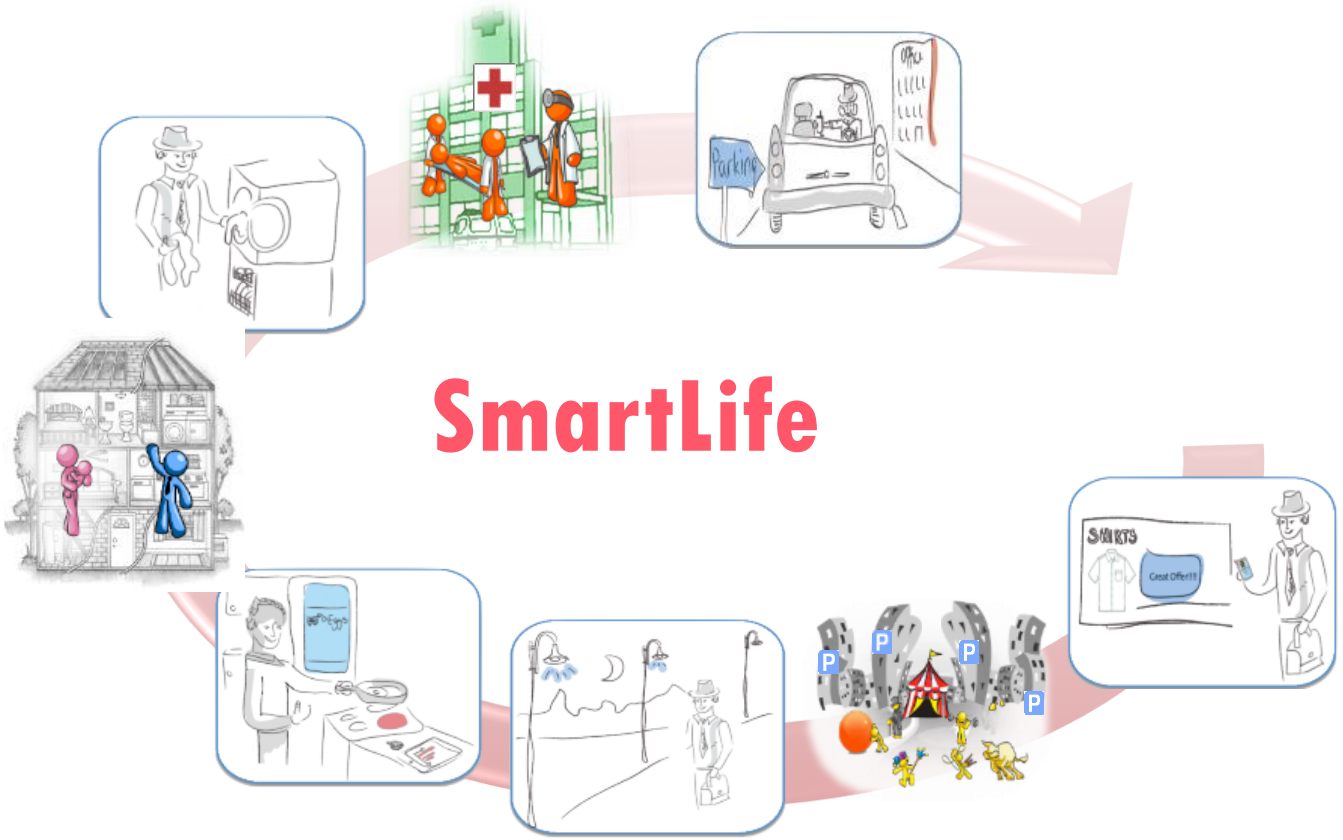
- Managing parking space
- Lighting up a city efficiently
- Monitoring Air Quality
- …

SmartShopping

- Managing deals
- Getting advice on buying goods
- Retrieving discount
- …

Illustrations from the EU FP7 BUTLER project

TOMORROW, HORIZONTAL SMART SOLUTIONS



Illustrations from the EU FP7 BUTLER project

SENSINACT – IOT PLATFORM FOR SMARTER CITIES

Tool for **rapid and dependable** application building

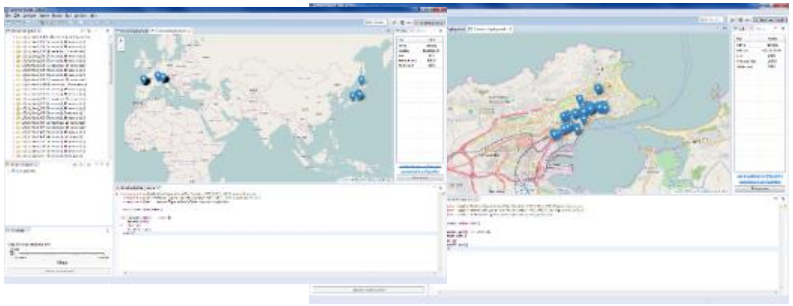
Various **northbound** protocols

Homogeneous Access
- to **real-time data**: on-demand, periodically, event-based
- **historic data**

Various **IoT** protocols and platforms

Heterogeneous IoT devices and platforms

sensiNact **Studio**



RESTful API GET PUT POST DELETE

JSON-RPC

oma LWM2M

oneM2M

XMPP

MQTT SNIA CDMI

sensiNact **Platform**

Bluetooth 4.0 Low Energy

IEEE 802.15.4

enocea

LoRa

Z-WAVE

MQTT

sigfox

NETATMO

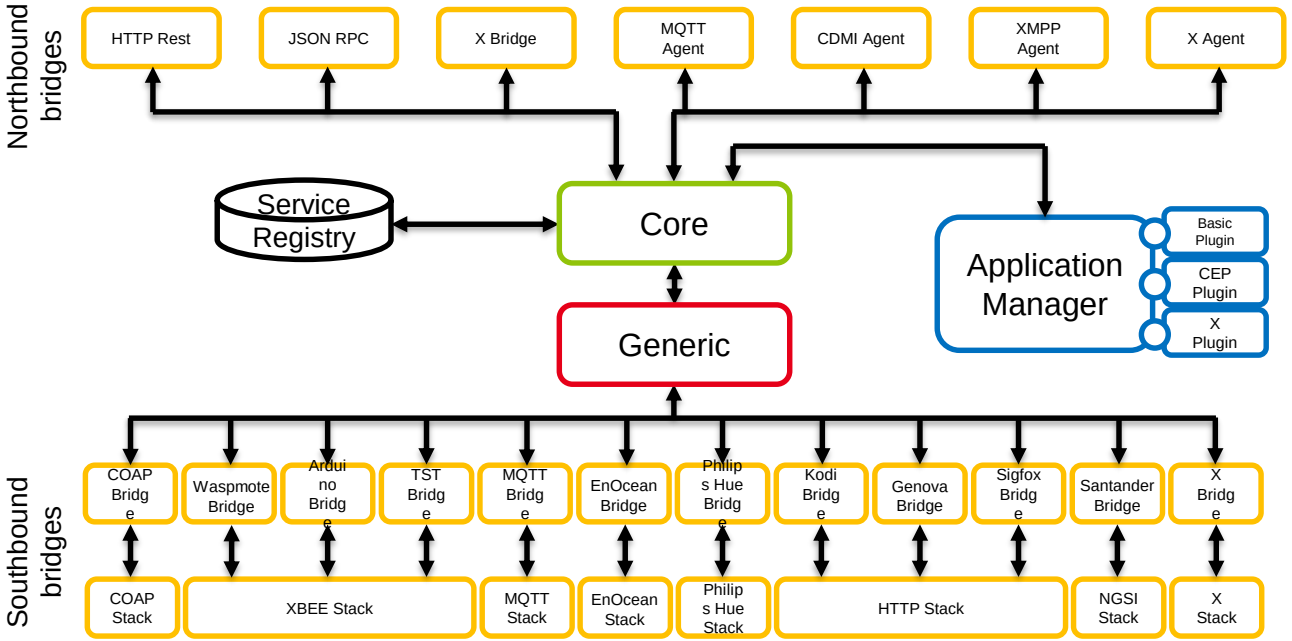
orion

PHILIPS hue

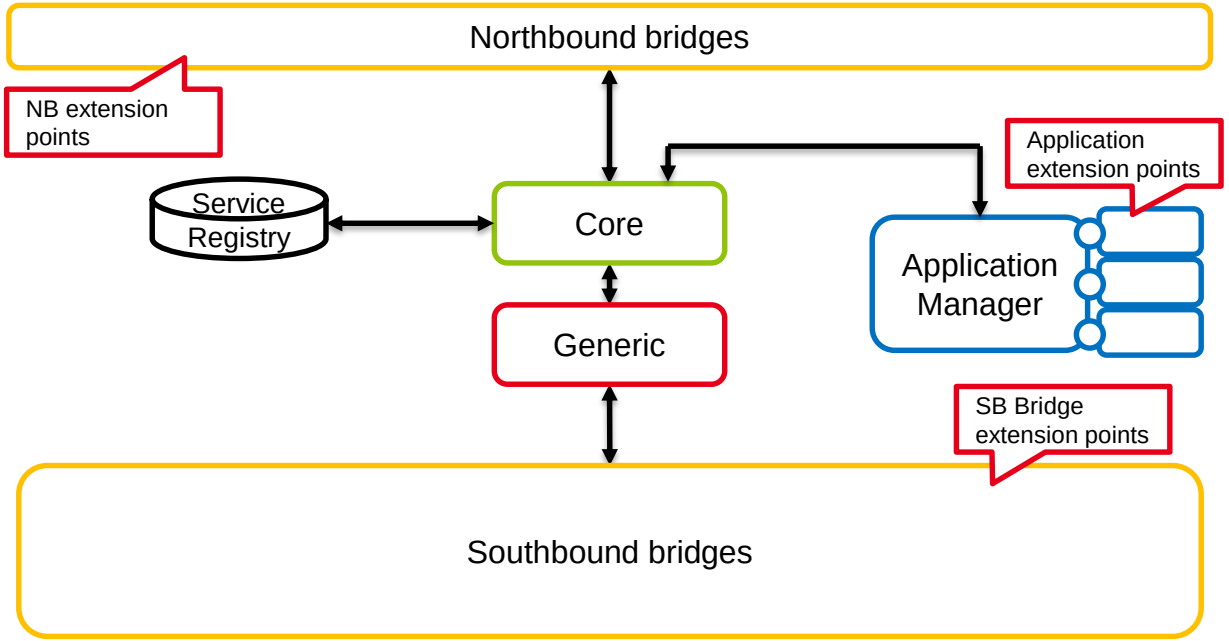
Datavenue Live Objects

IoT platforms

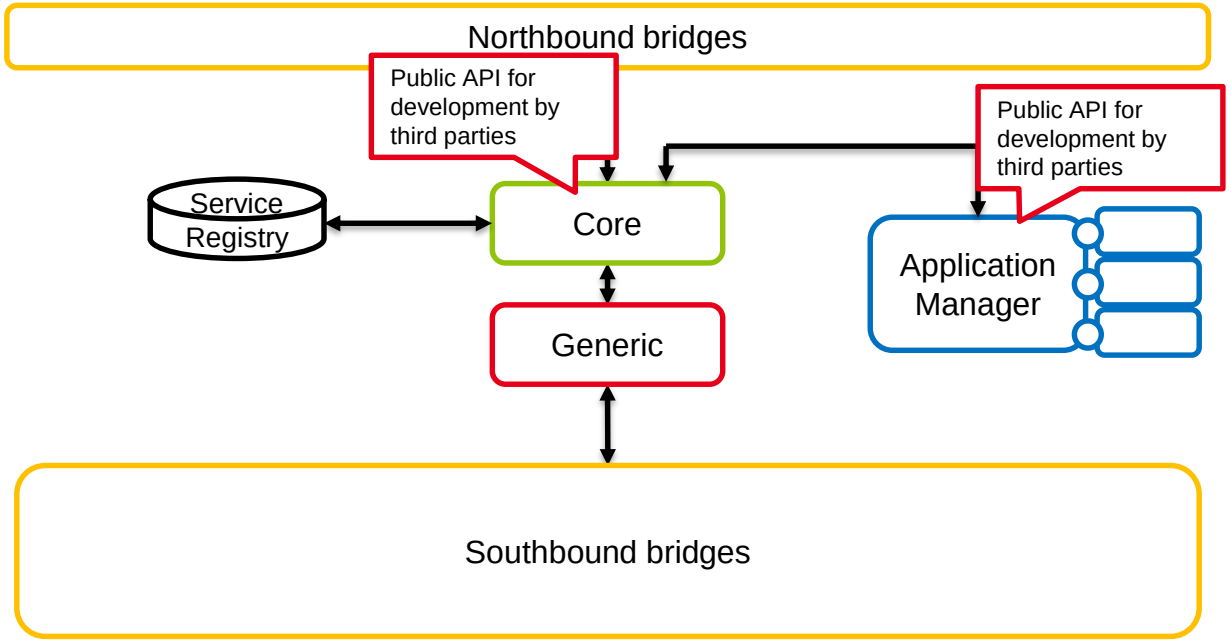
MODULAR ARCHITECTURE



EXTENSION POINTS

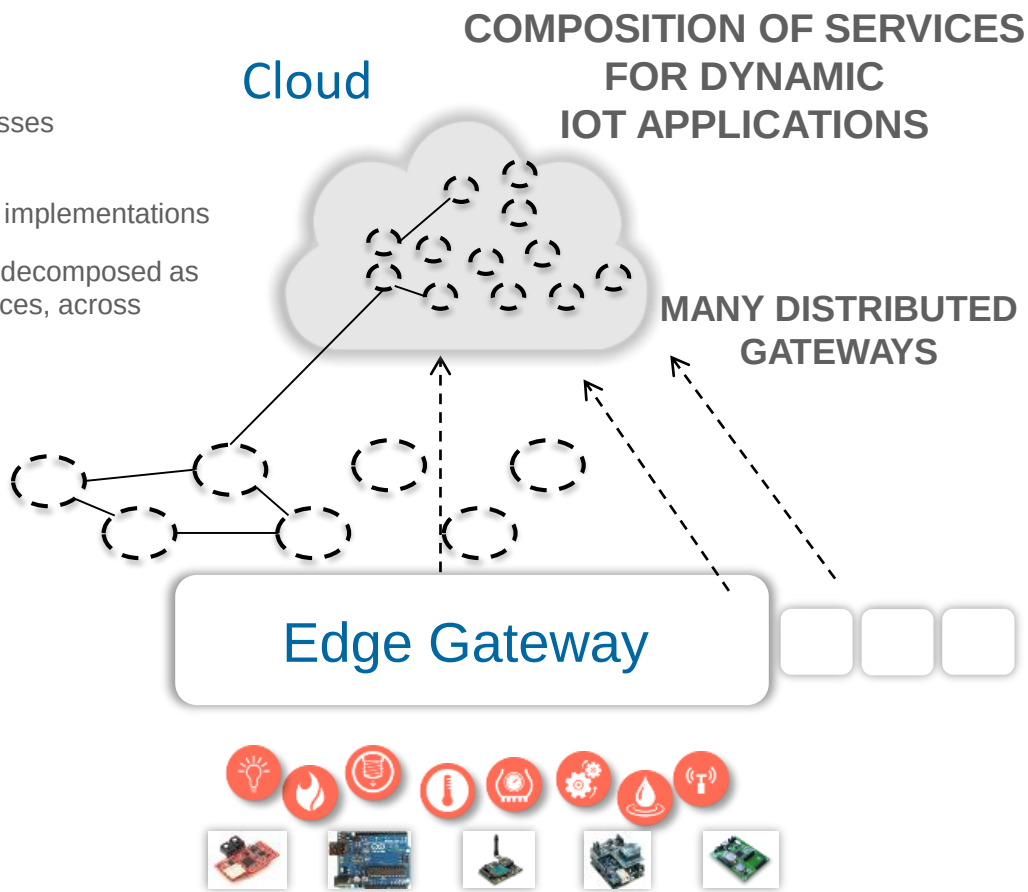


OPEN APIs FOR THIRD PARTY DEVELOPERS

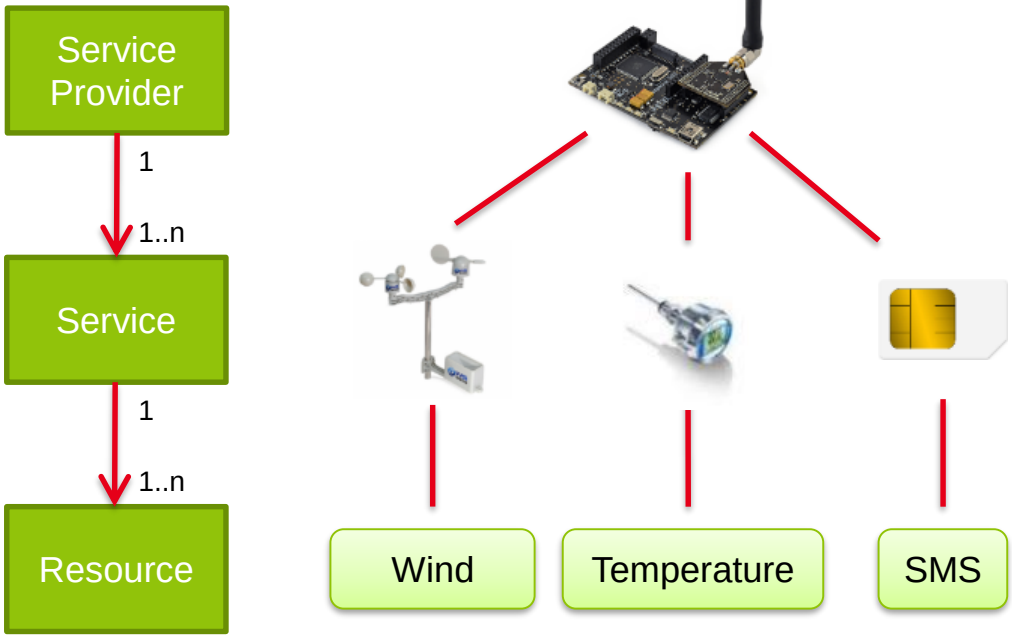


SERVICE-ORIENTED APPROACH

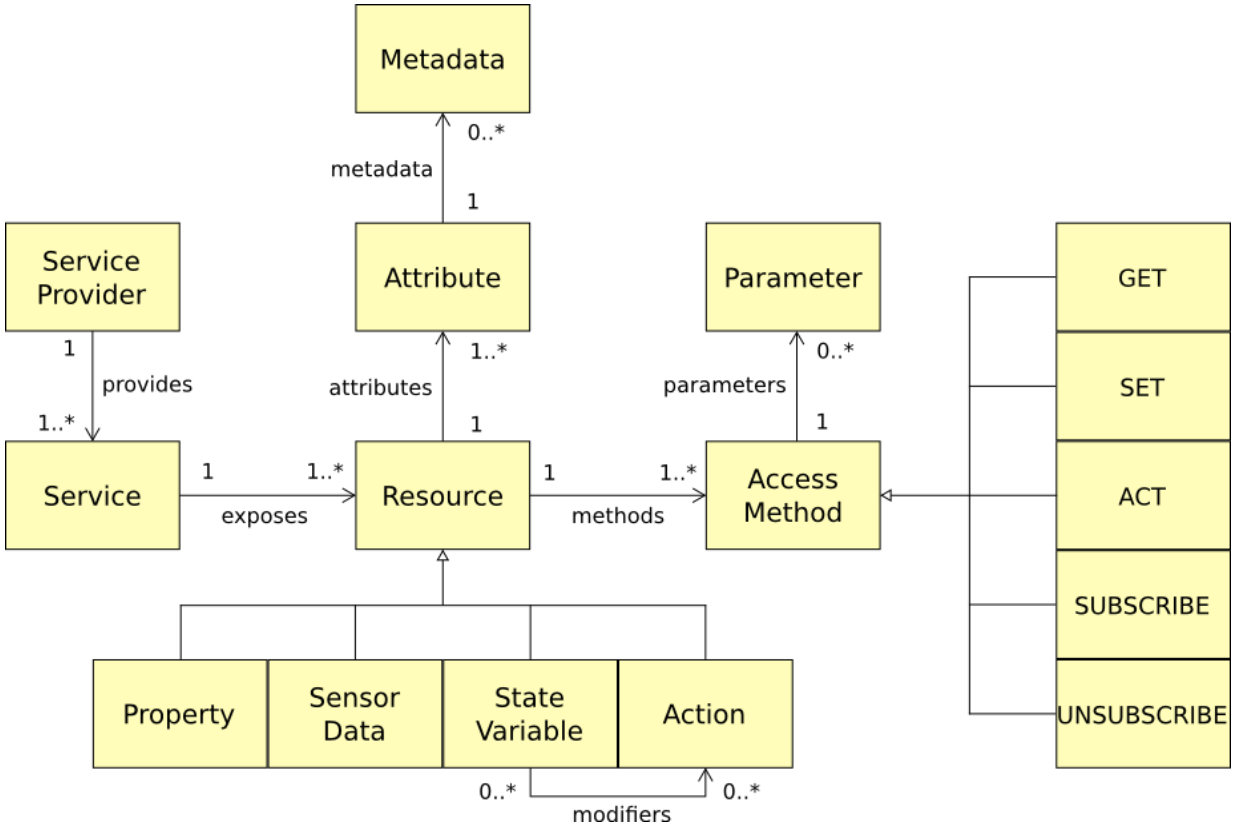
- Abstracting business processes from underlying technology
- Loosely coupled services – implementations
- Monolithic vertical systems decomposed as reusable and sharable services, across organizational boundaries



EXAMPLE SENSINACT SERVICE PROVIDER



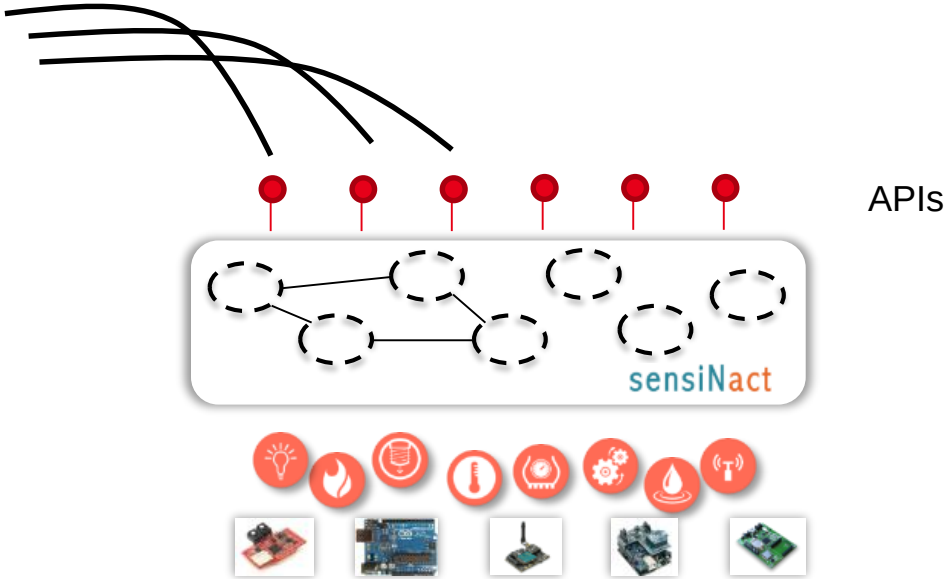
SENSINACT SERVICE MODEL



SENSING AND ACTUATION SERVICES

DEVELOPPERS

develop, deploy,
monitor,
manage

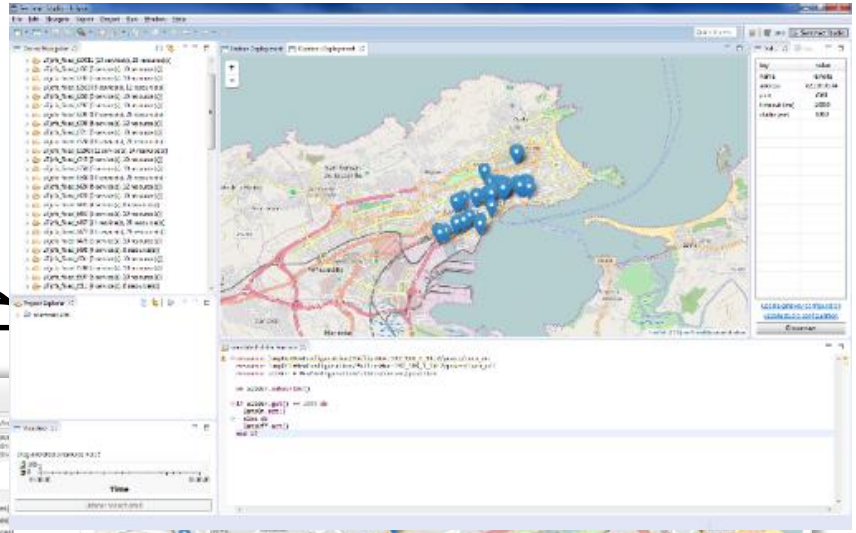


APIs

SENSINACT STUDIO - DEVELOPMENT ENVIRONMENT

DEVELOPPERS

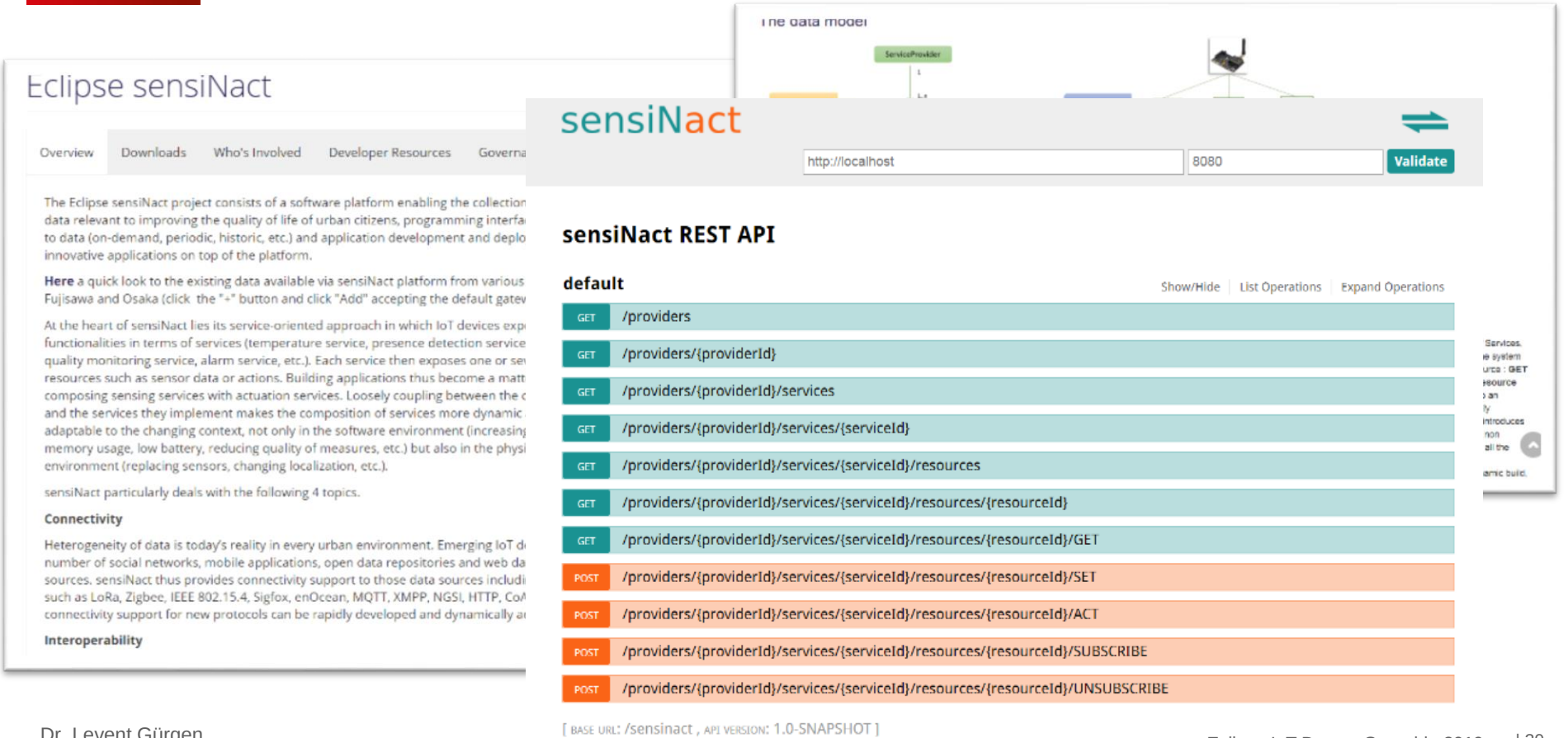
develop, deploy,
monitor,
manage



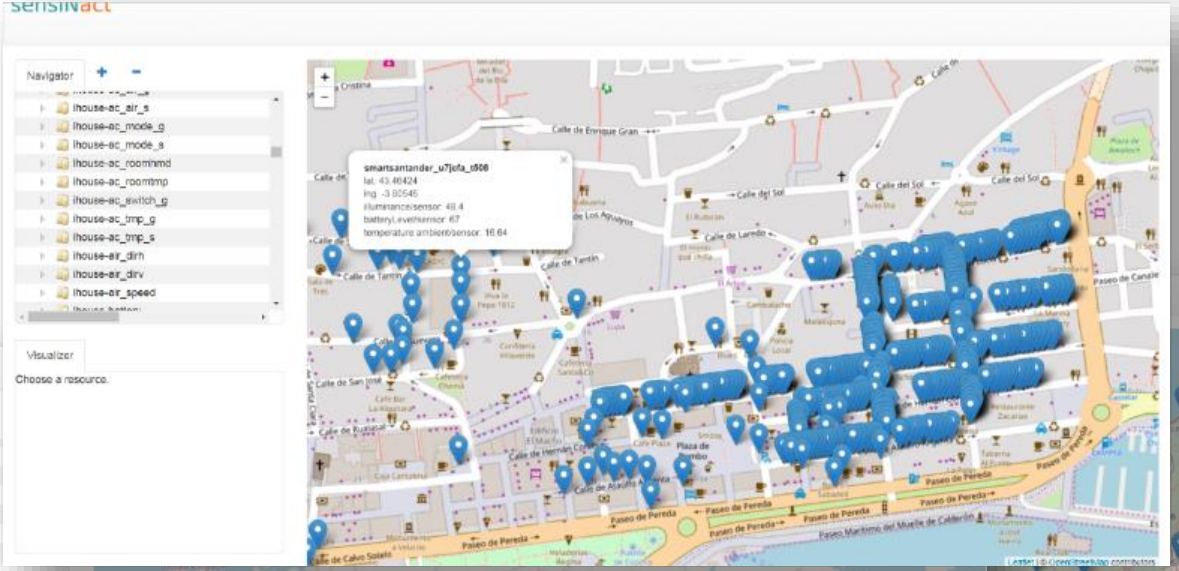
sensiNact **smart city platform has joined** eclipse

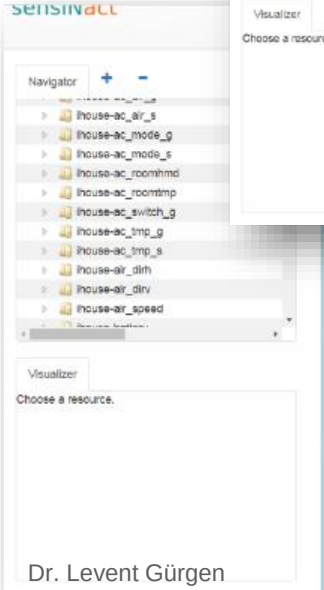
https://projects.eclipse.org/projects/technology.sensinact

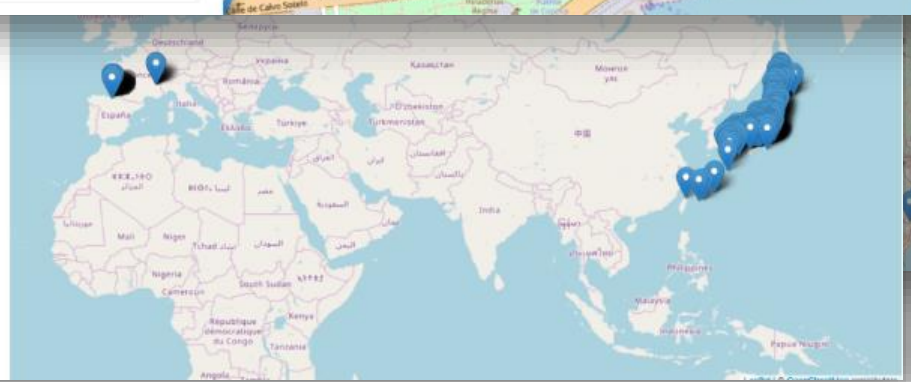
LOOKING FOR CONTRIBUTIONS!

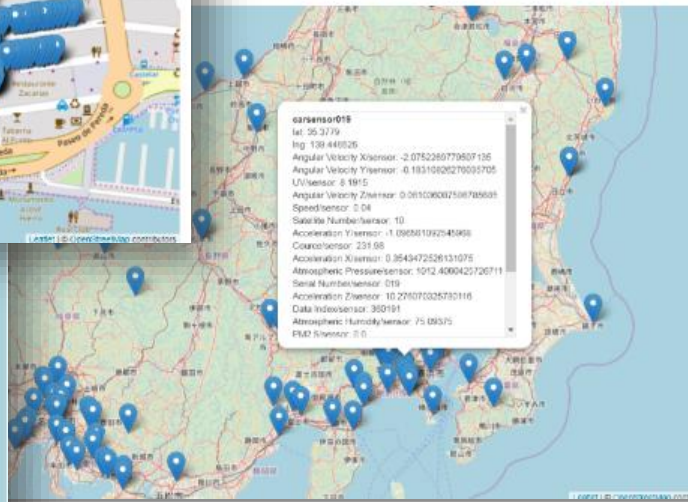


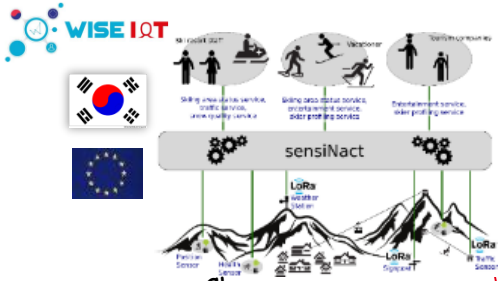
ACCESS TO VARIOUS CITY REAL-LIFE DATA IN REAL-TIME











Chamrousse, PyoengChang

smart ski station

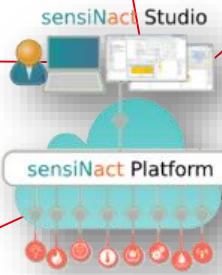
PTL

iHouse

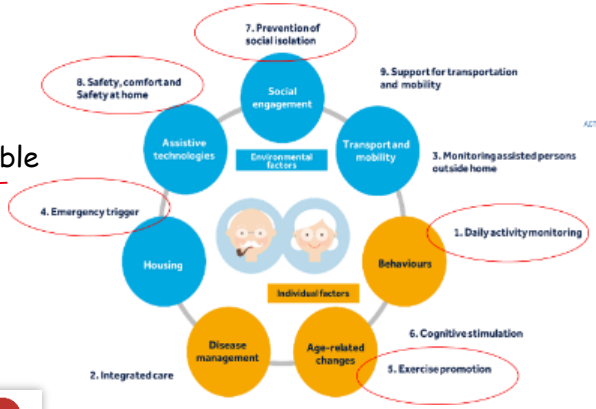
Smart home

Kameoka, Maya, Osaka

smart train station



Grenoble



Smart living & well-ageing

Smart farming

Bordeaux, Dubourdieu Wineyard

Smart city

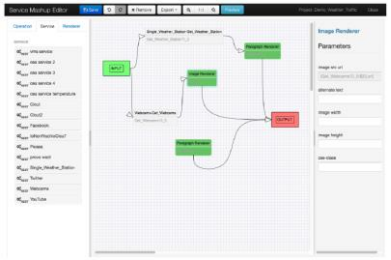
Genova, Santander, Mitaka, Fujisawa, Grenoble, Tsukuba, Bristol, London, Aarhus

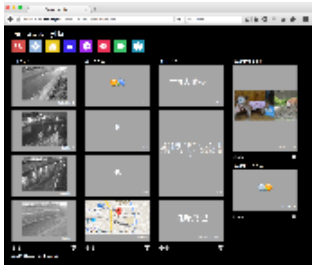
CLOUT PROJECT

Cloud of Things for empowering the citizen clout in smart cities

INTERCONTINENTAL TRIAL

sensiNact Studio





Service development tool

Data Mashup

City dashboard

Intercontinental coopetition

sensiNact

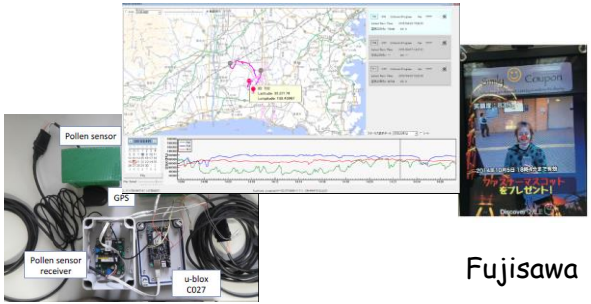
> 10 000 physical devices

> 150 physical devices

> 150 physical devices + > 500 000 virtual devices

Santander

Genova

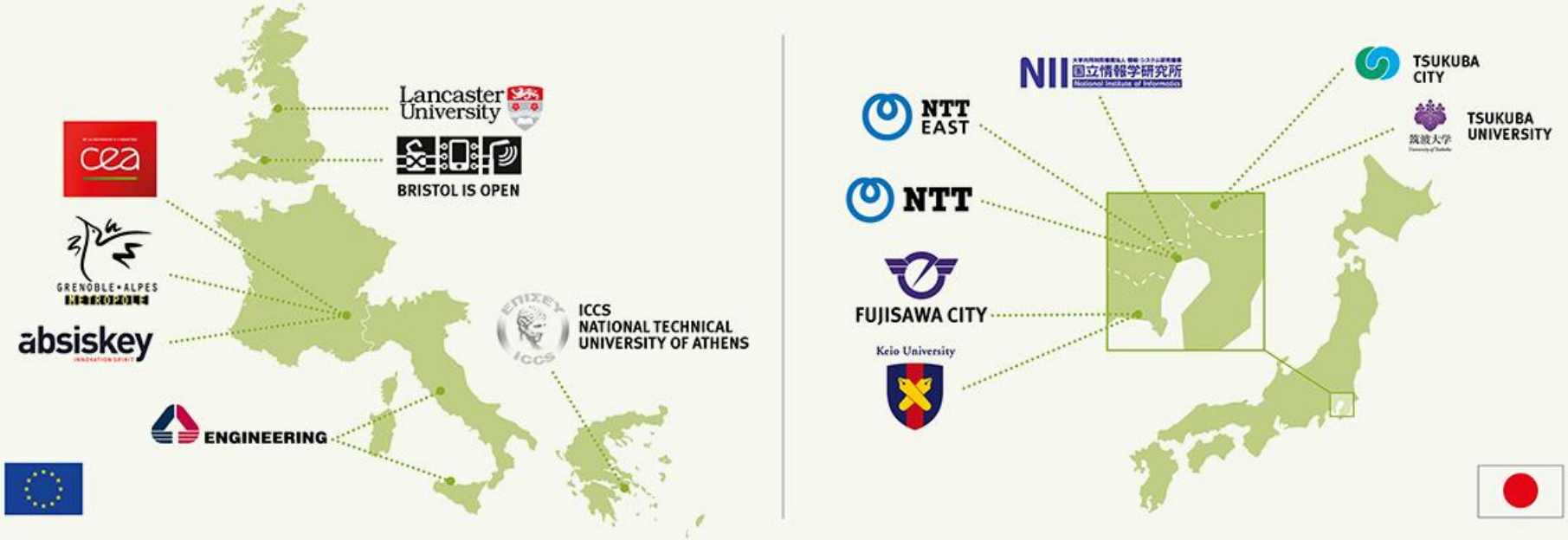


Mitaka

Fujisawa

BIGCLOUT: BIG DATA MEETING CLOUD OF THINGS

HTTP://BIGCLOUT.EU



TRIALS PLANNING IN PILOT CITIES

GRENOBLE

- Business Tourism Monitoring
- Industrial Estates Monitoring

BRISTOL

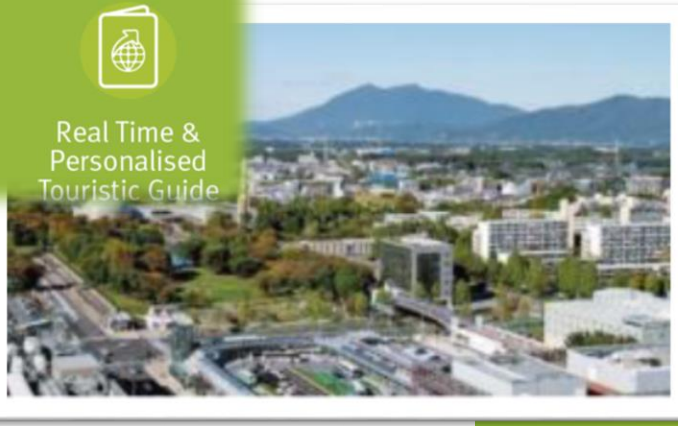
- Smart Energy
- Mobility Prediction

FUJISAWA

- CrowdSensing
- City Infrastructure Management

TSUKUBA

- Multilingual Concierge Service
- Real Time & Personalised Touristic Guide



GRENOBLE TRIAL ARCHITECTURE

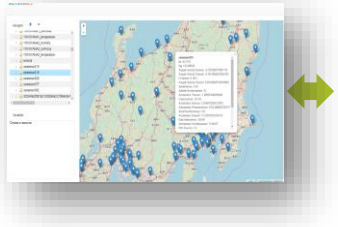
MyIno App
Easy to use application for citizens

inovallée

InoVallée SI
Enrich data with companies directory, event management,…

Proxy service and API Gateway

API Gateway
API inline with InoVallée Custom needs



Tool for monitoring, and for **rapid and dependable** application building

Eclipse sensiNact gateway

sensiNact

Eclipse sensiNact
Unified Data Model

Events

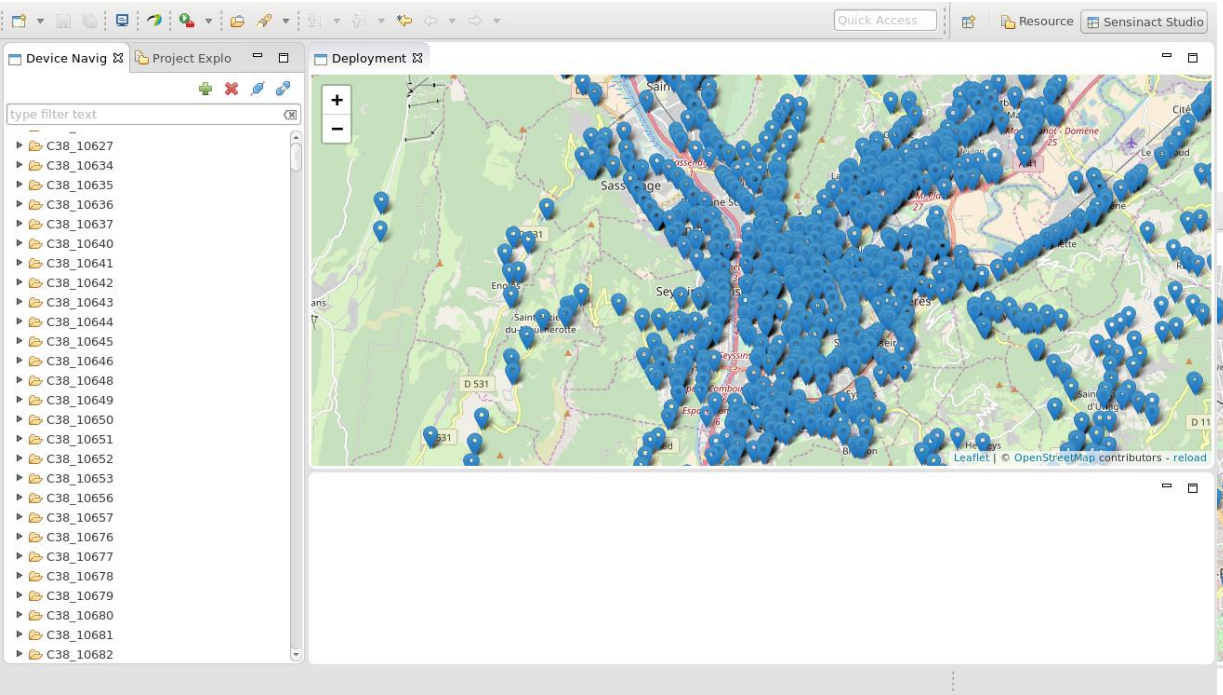
elior

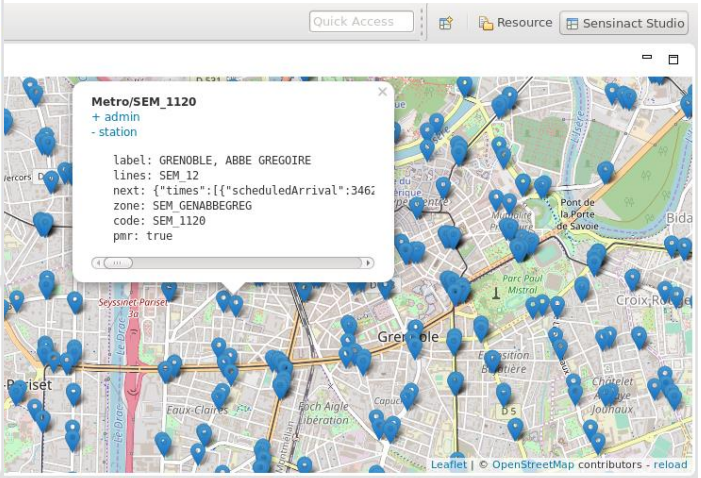
Restaurants

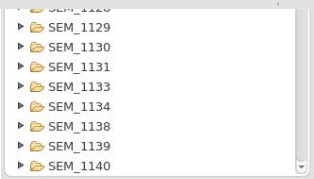
Mobility

Heterogeneous data sources
Heterogeneous data models

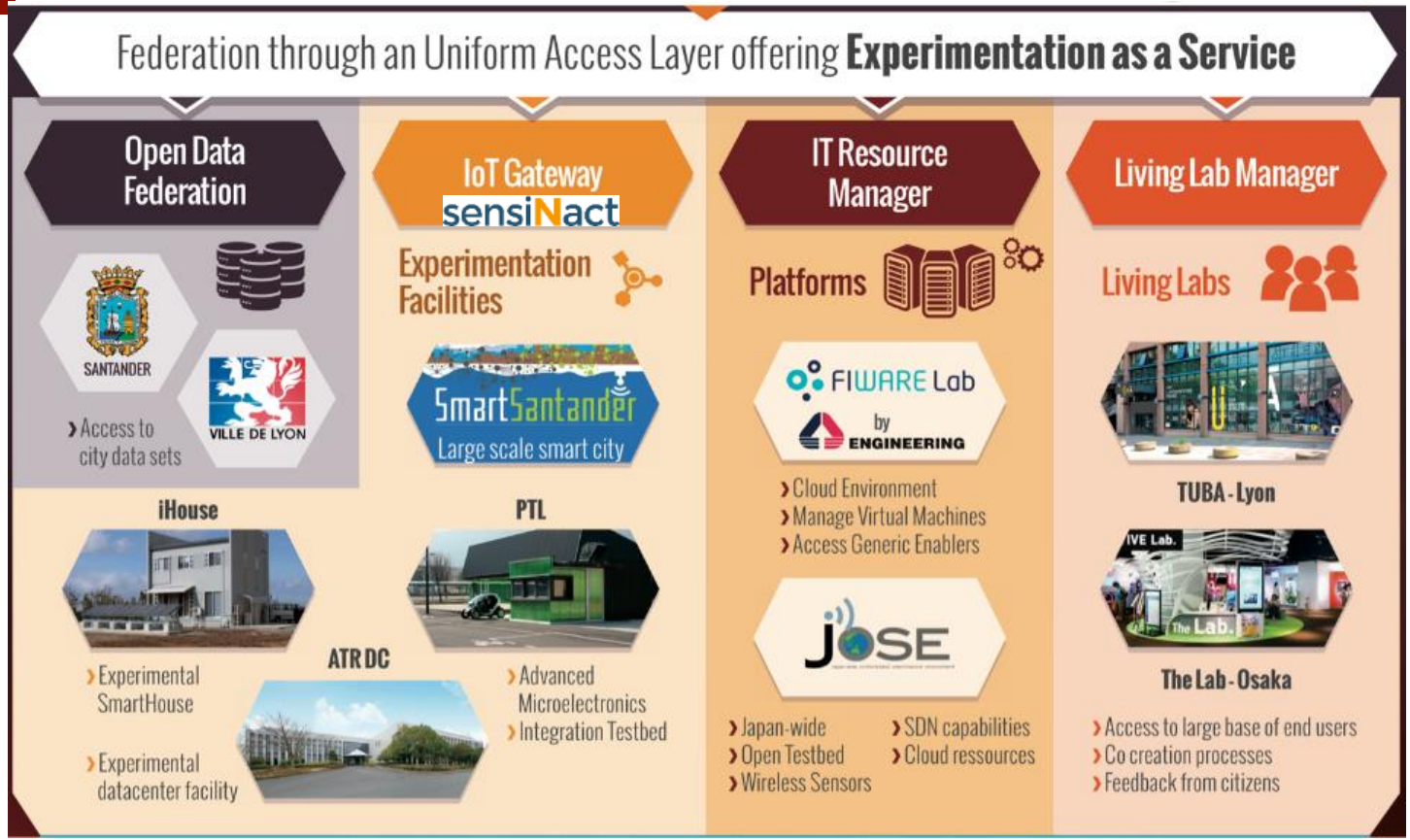
GRENOBLE METROPOLE - MOBILITY DATA







EXPERIMENTATION AS A SERVICE

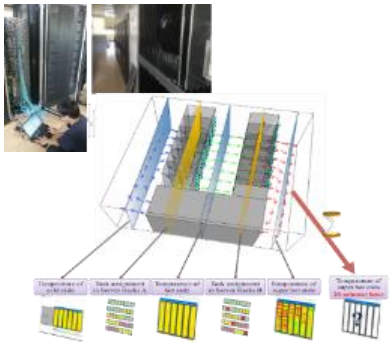


EXPERIMENT EXAMPLES WITH FESTIVAL PLATFORM

Smart Station

Maya, Kameoka, Osaka stations

Smart Energy Management



Privacy friendly person tracking

PTL - Grenoble

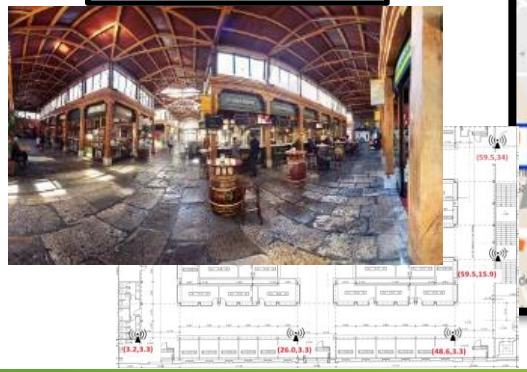
Smart home

iHouse - Japan

Art & Science

Grenoble <-> Osaka

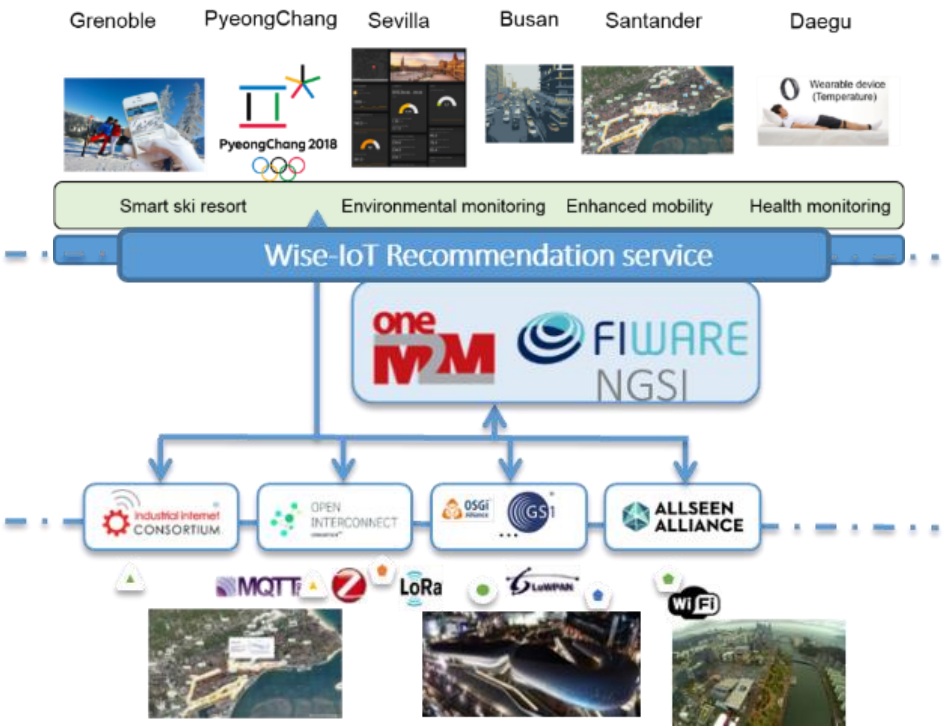
Smart Shopping



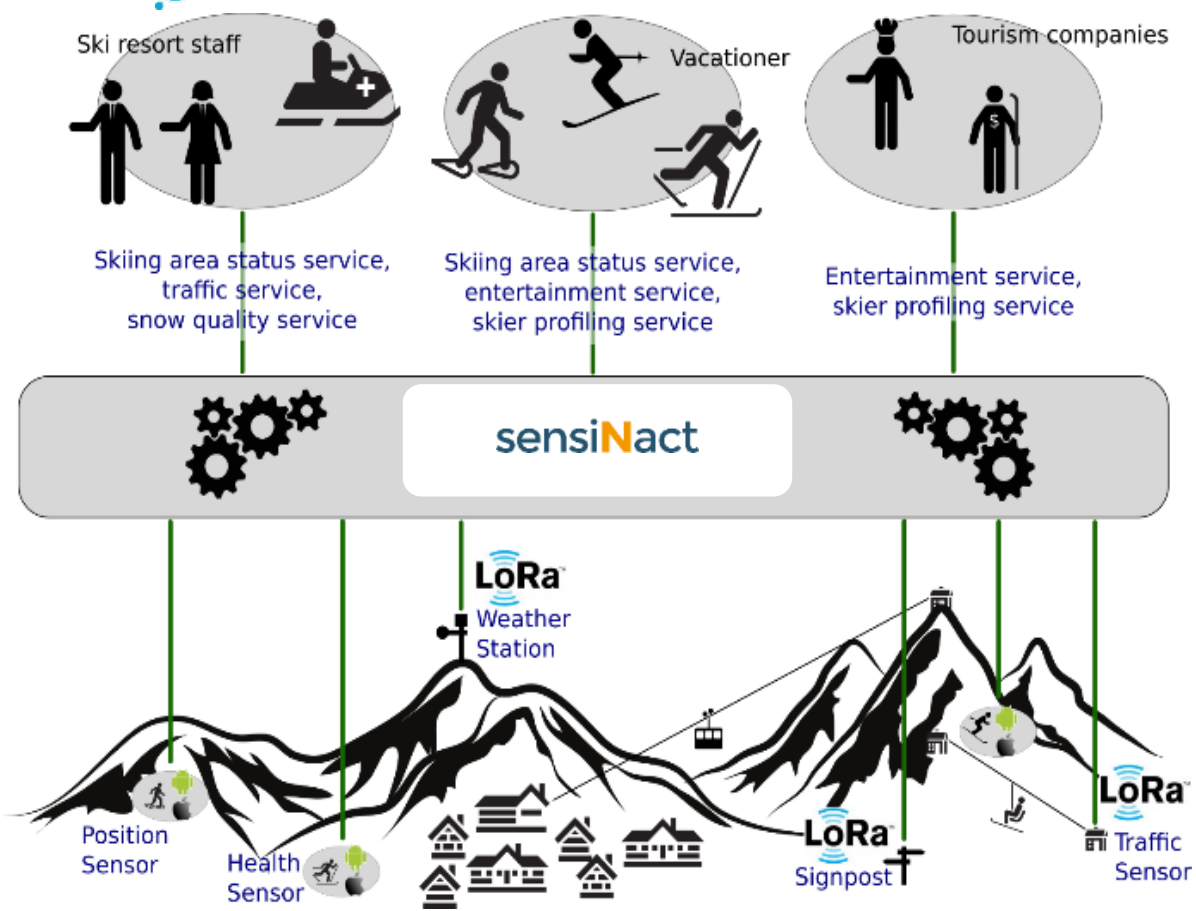
Route Recommendation

Santander

Wordlwide Interoperability for SEmantics IoT

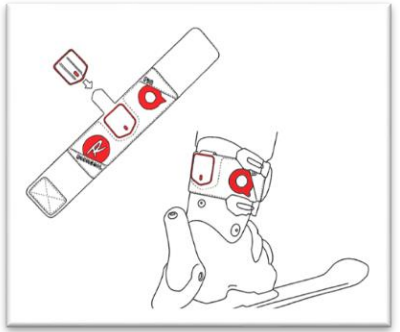


IOT FOR SMART SKI RESORTS

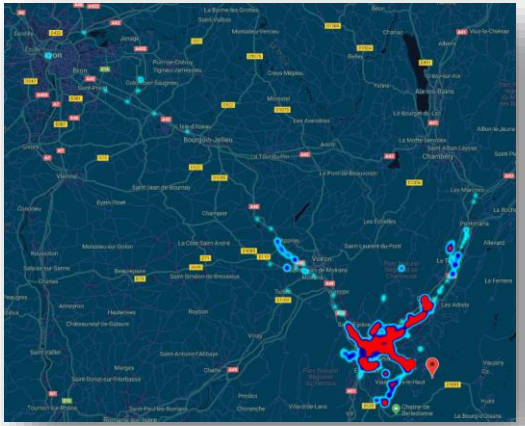


COLLECTED DATA

- **LoRa band**
  - GPS location
- **PIQ Robot**
  - Number of turns with maximum angle ski
  - Maximum angle of the skier from the vertical
  - Number of turns with maximum velocity
  - Maximum speed of entry into the turn of the skier
  - Number of jump with maximum air time
  - Maximum air time
  - Number of jump with best score rotation
  - Complexity of the jump
  - Descent height
- **Crowd detector**
  - Number of persons in a given area



IOT INFRASTRUCTURE



LoRa Gateway

CHAMROUSSE Alpes - France 1700

Innovative use cases

sensiNact

eclipse

cea

Skier (position, descent height, carving, jumps, ...)

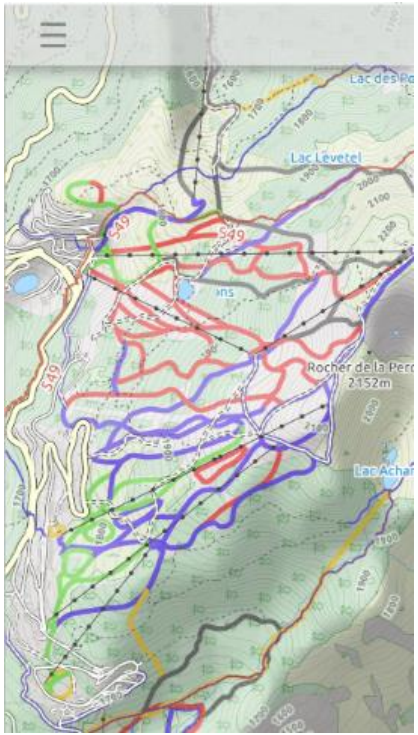
Weather (temperature, wind, ...)

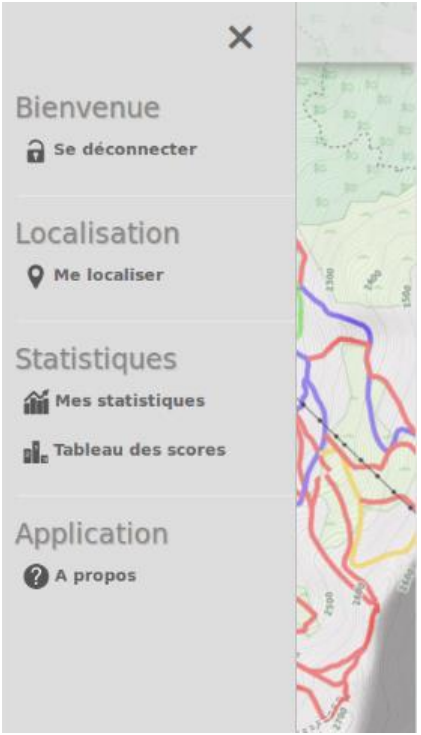
Station (webcam)

SOLUM

PIQ

THE APPLICATION





HACKATHON ORGANIZED AT ECLIPSE IOT DAYS 2018

Transfo part en station imaginer la Station du Futur à Chamrousse

Start-up et développeurs participent à un Hackaton et à un Ideathon.

Le Hackathon Eclipse IoT Days : développer et tester des nouvelles applications et technologies autour de la plateforme Eclipse sensiNact en s'appuyant sur un réseau LoRa dédié aux objets connectés

L'Ideathon : ouvert aux start-up et acteurs qui souhaitent imaginer des innovations et tester les nouveaux usages de la station du futur.
Les participants auront la liberté de chausser les skis pour tester leurs prototypes in situ, le long des pistes, sur le snowpark auprès des skieurs/snowboarders de la station.

Remise de prix et ski nocturne.

Winning idea: Dynamic slope ranking

PRICE: 1 year ski-pass in Chamrousse

DEMONSTRATION / VIDEO

IoF2020: Internet of Food and Farm 2020

BIG WINE OPTIMIZATION - OBJECTIVES

- Improve the vine yield and wine production by defining, and implementing an IoT system able to gather the data, coming from different vineyards and cellars, to perform data analysis, system and risk management, and decision making.
- Provide to middle and small winegrowers and producers new tools to optimize resources (manpower, fertilizers, materials, electricity, water, etc.) and preserve the environment by reducing the use of pesticides, carbon print, etc.
- Deploy a cost effective precision viticulture management and a global vineyard control system in order to increase competitiveness.
- Optimize the use of inputs in wine-making by controlling all environmental factors affecting the process (temperatures, humidity, oxygen, etc.).

DENIS DUBOURDIEU DOMAINES
Vignerons à Bordeaux depuis 1794

The forest in the area of the IOT application

The Reynon vineyard with some elevation points

WEATHER AND WINERY: SENSORS

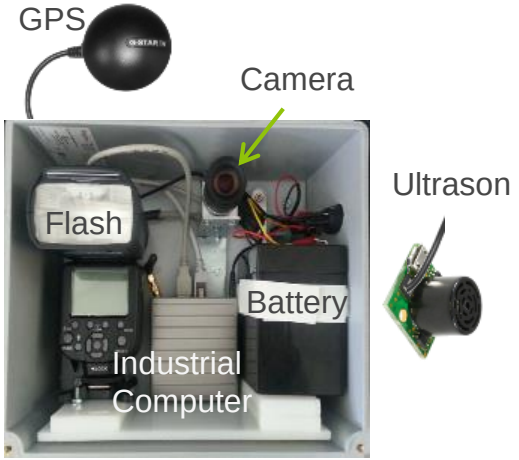
- Sensors for monitoring weather conditions: distributed in 5 vineyards of 125 hectares, with a density of at least 1 device every 2.5 hectare.
  - ✓ 9 Weather stations sensing Temperature, Hygrometry, Barometric pressure, Wind speed and direction, Solar radiation, Rainfall.
  - ✓ 35 sensors for Temperature and Hygrometry
- Sensors for monitoring winery conditions.
  - ✓ 27 sensors for Temperature and Hygrometry.
  - ✓ 26 Water meter readers.
  - ✓ 9 Electricity meter readers.

PHENOLOGICAL STAGES: FIXED SENSORS

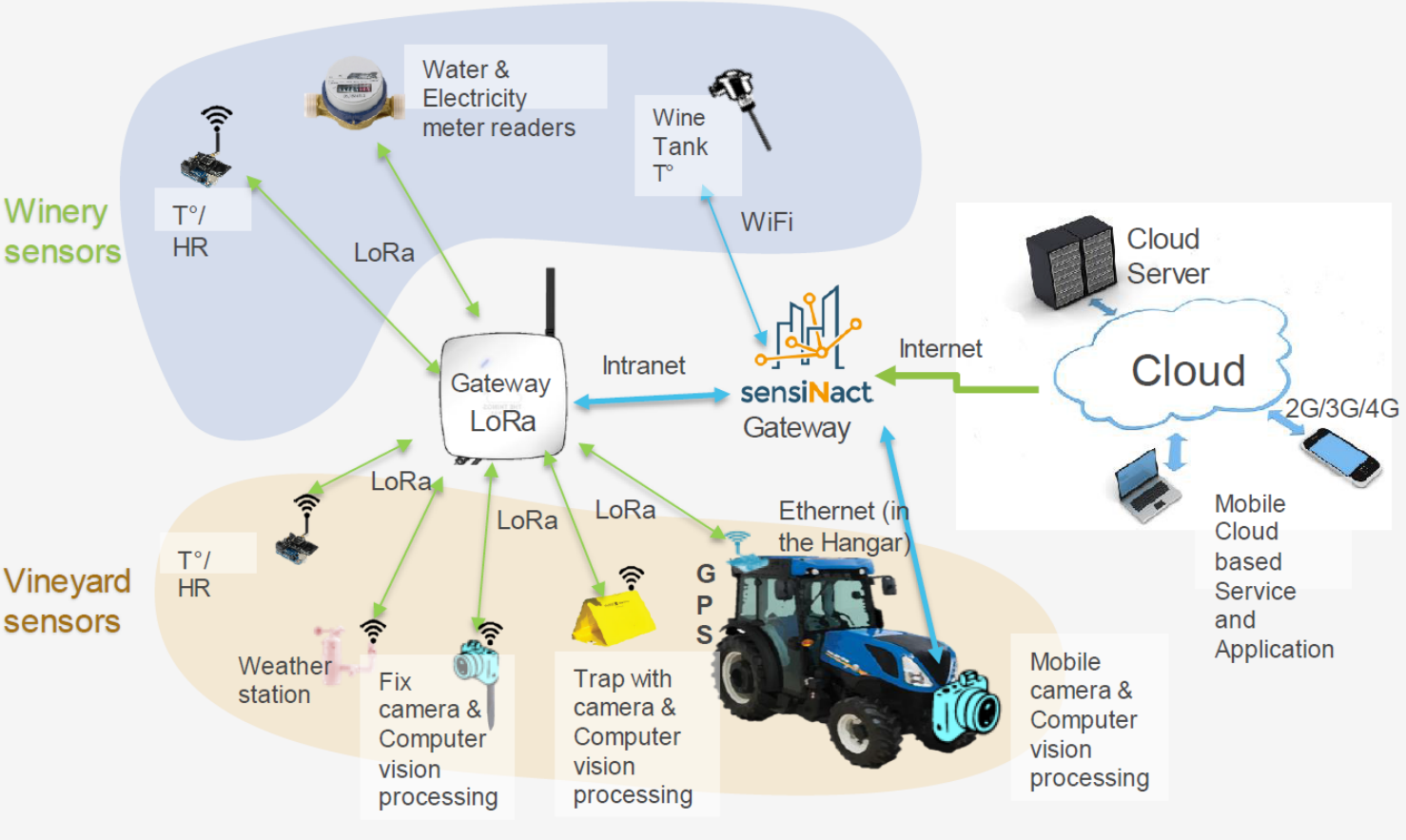
- Fixed sensors monitor, night after night, the evolution of the vine.
  - ✓ Specific camera and lighting for visible and near Infra Red images of the vine. On board processing reduces drastically the data length sent to the gateway.
  - ✓ Low spatial density but high temporal density.
- Data collected:
  - ✓ Phenological stages.
  - ✓ Disease symptoms.
- Low cost technologies for large distribution in the vineyard.
- A variation of this sensor exists for counting bugs in traps.

PHENOLOGICAL STAGES: MOBILE SENSORS

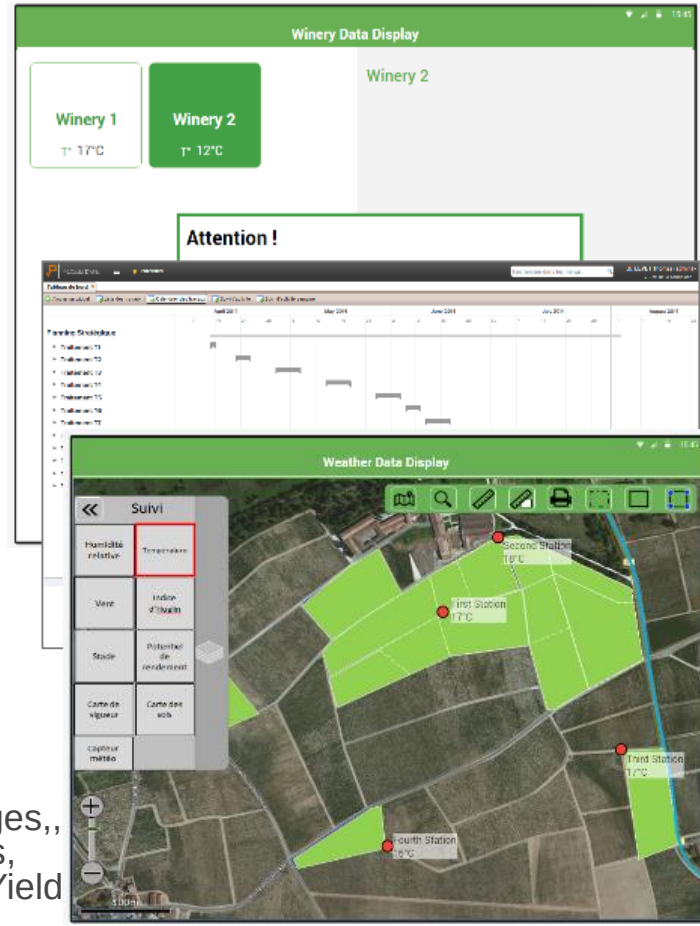
- Mobile sensors are mounted on tractors.
- They acquire images every meter along the tractor track with a dedicated camera.
- Images are stored on board all along the trip and transferred to gateway via WiFi once in the hangar.
- Data collected:
  - Phenological stages.
  - Vine vigor estimation.
  - Yield prediction.
- Data with high spatial density and low time density are then acquire.



OVERALL DEPLOYMENT ARCHITECTURE



DATA ANALYTICS



Meteorological weather stations

Insect traps

Number of insects

- ✓ Temperature
- ✓ Hygrometry,
- ✓ Barometric pressure
- ✓ Wind speed
- ✓ etc.

sensiNact

Process2Wine

Temperature (vineyard and celars) Images for Phenological stage and disease symptoms

Vineyard sensors

- ✓ Data collection, analysis and visualization (Phenological stages,, disease symptoms, Vigor estimation, Yield prediction
- ✓ Automatic actions scheduling (blocks spraying)

Smart living and well-ageing

ACTivating InnoVative IoT smart living environments for AGEing well

ACTIVAGE PROJECT

49 partners

7 countries

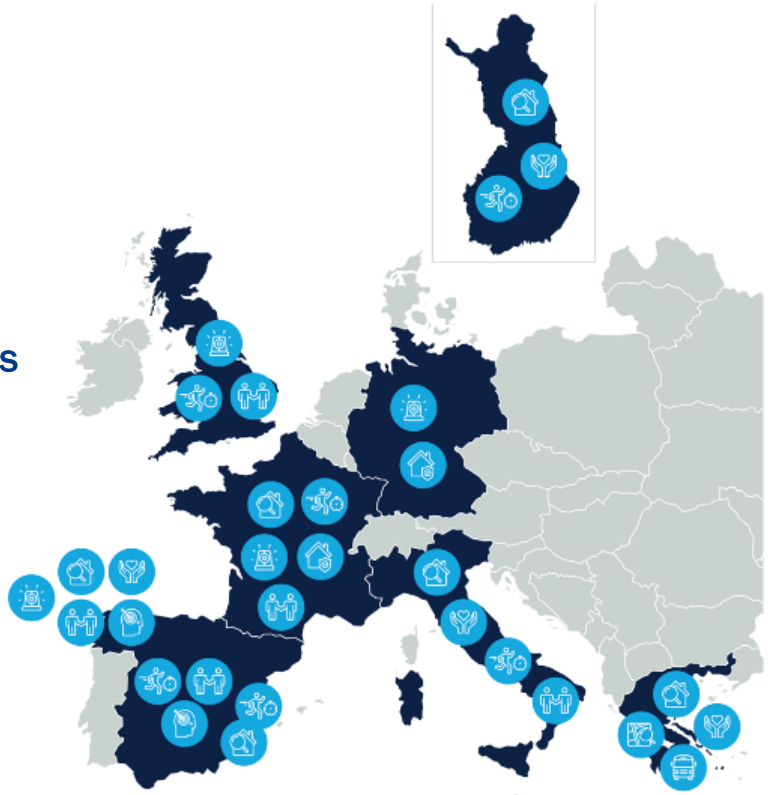
9 Deployment Sites

10k users

9 Use Cases

43k sensors

25M€ budget



- Daily activity monitoring at home
- Integrated care for chronic conditions
- Monitoring outside home
- Emergency trigger
- Exercise promotion
- Cognitive stimulation
- Prevention of social isolation
- Safety, comfort and security at home
- Support for transportation and mobility

Isère deployment

Deployment Site Context

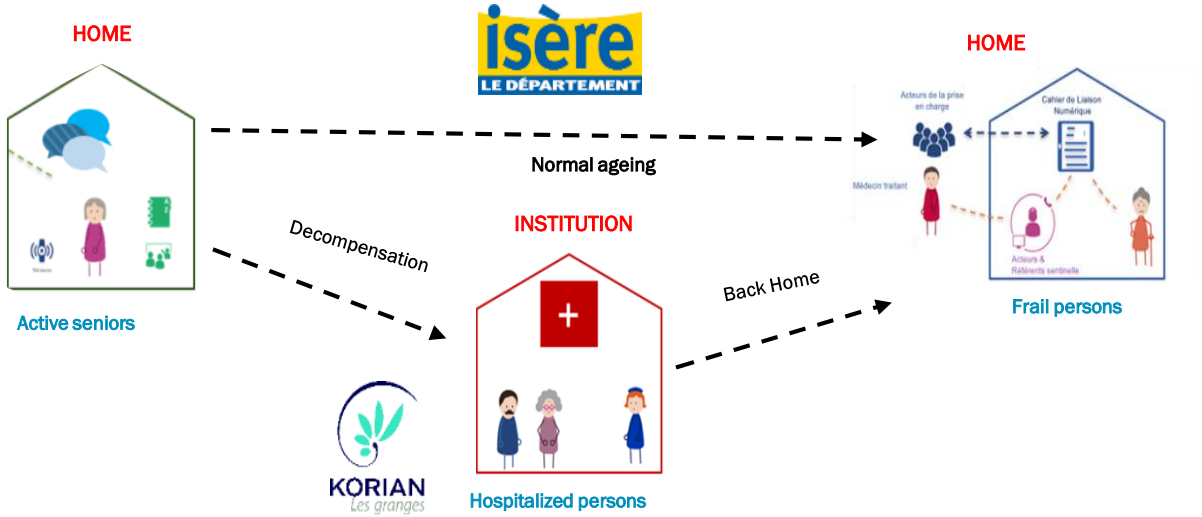
Goal

To Create a **continuum of care** that combines **human and technical assistance**, bridging the different moments in elderly person's life to limit the loss of autonomy and avoid unnecessary hospitalization.

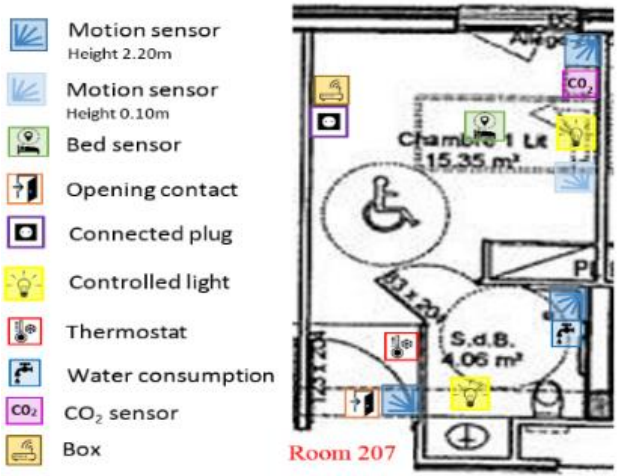
Isère, France
13 cities & Alps villages

3 Panels – 5 Use Cases

- Daily activity monitoring
- Emergency trigger
- Exercise promotion
- Prevention of social isolation
- Safety, comfort, Security at home



Isère deployment



10 Partners

Targets for deployment

70 Homes

140 Elderly

100 Carers

10 Clinic rooms

1200 IoT Devices

BRAIN-IoT

model-Based fRamework for dependable sensing and Actuation in INtelligent decentralized IoT systems

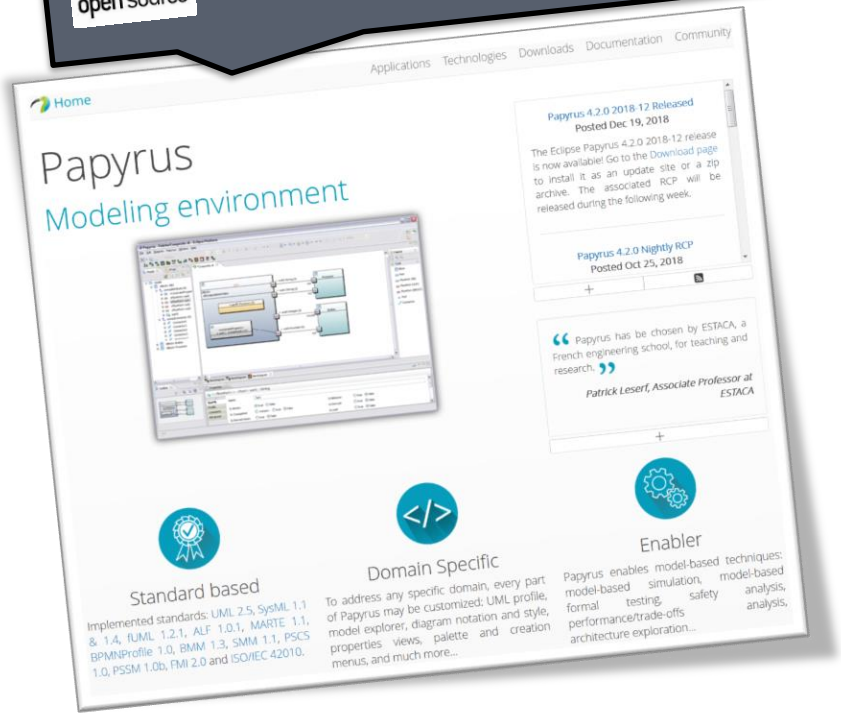
Eclipse Papyrus and Eclipse sensiNact in BRAIN-IoT

Levent Gürgen

CEA LETI

WHAT IS PAPYRUS?

Eclipse Project for UML & its DSMLs.



Few figures:

- Started in 2007
- Eclipse project in 2010
- >100 m.year effort
- >2,5 millions LoC, 150 modules, 20k unitary and functional tests
- >30k downloads worldwide, each update

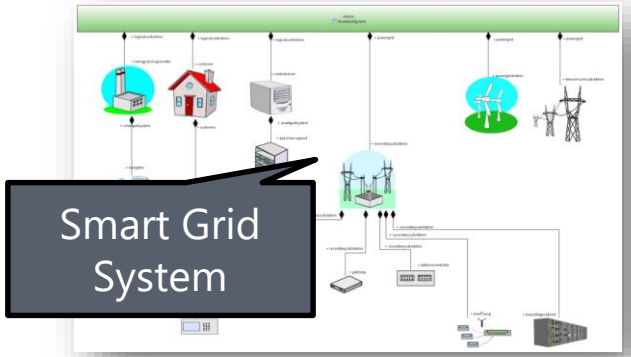
F. Noyrit et al., "Facade-Metamodel: Masking UML", proc of Models 2012.

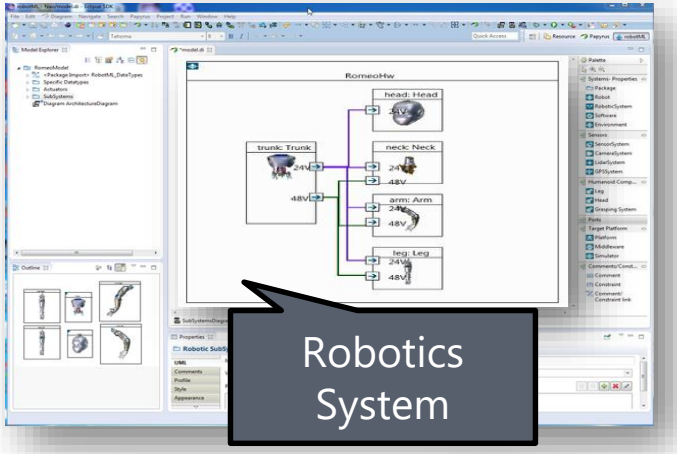
S. Gérard et al., "Papyrus: A UML2 Tool For Domain-specific Language Modeling Model-based Engineering Of Embedded Real-time Systems", 2011.

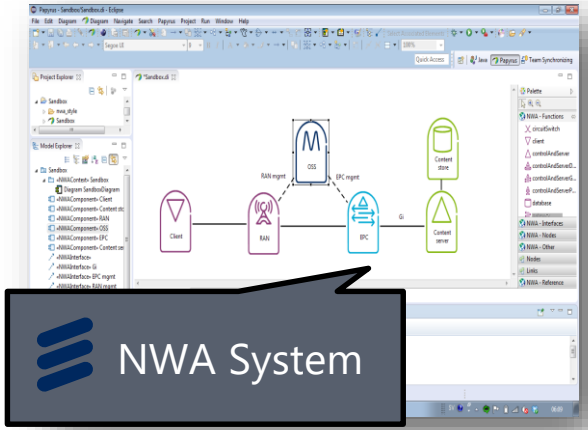
PAPYRUS MODELING

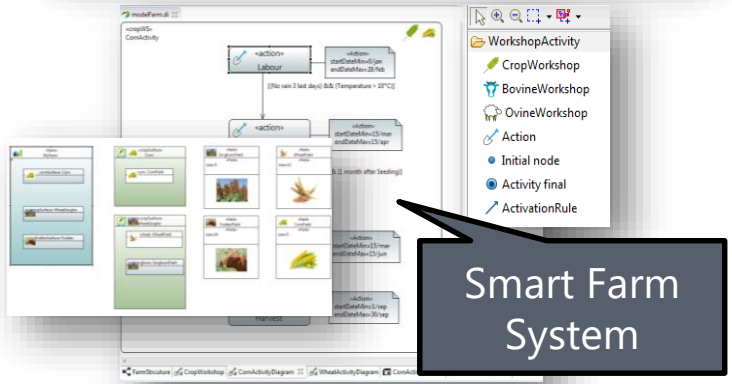
http://www.eclipse.org/papyrus

PAPYRUS CUSTOMIZATION FOR DOMAIN-SPECIFIC MODELING

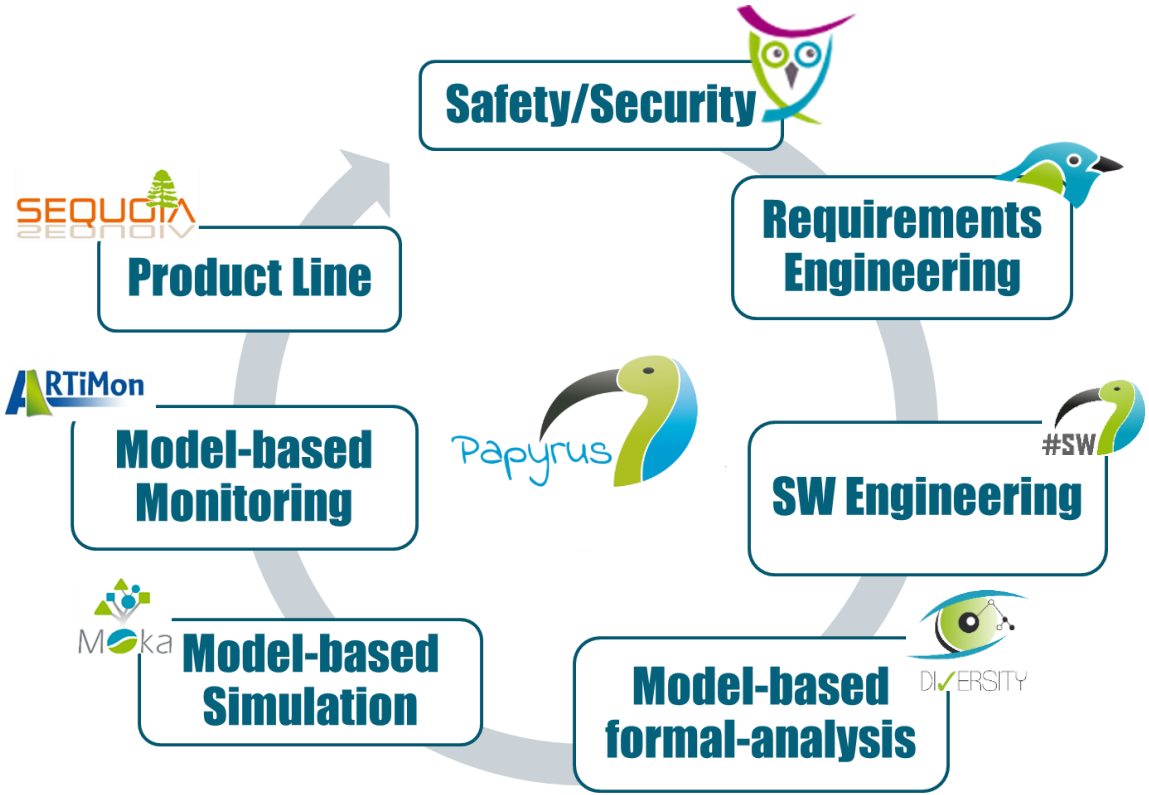








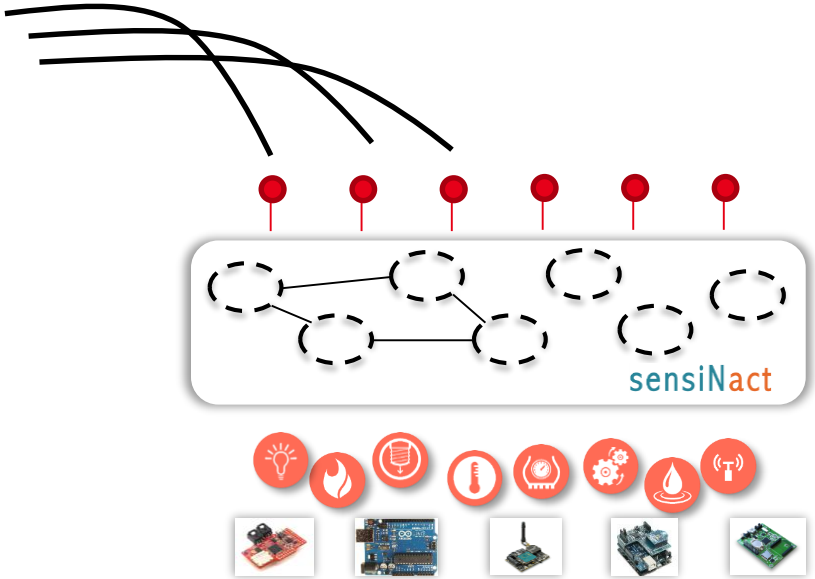
PAPYRUS ECO-SYSTEM



SENSING AND ACTUATION SERVICES

DEVELOPPERS

develop, deploy,
monitor,
manage

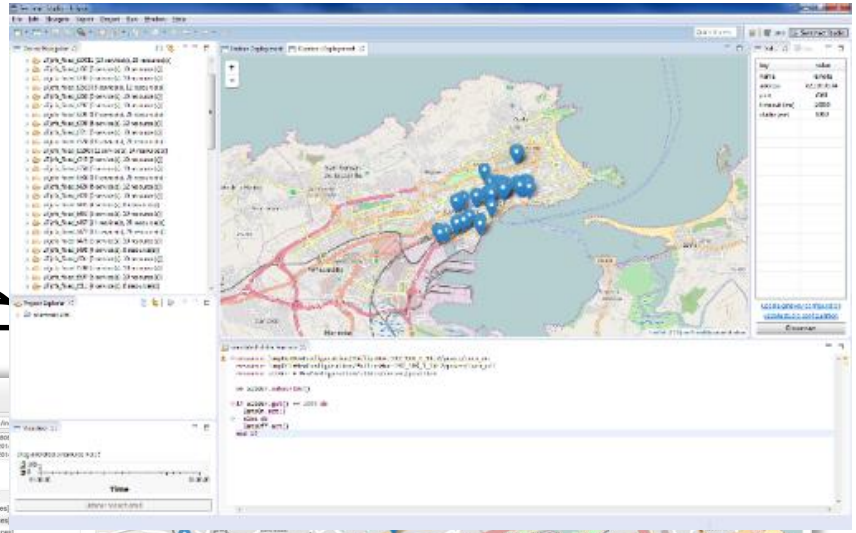


APIs

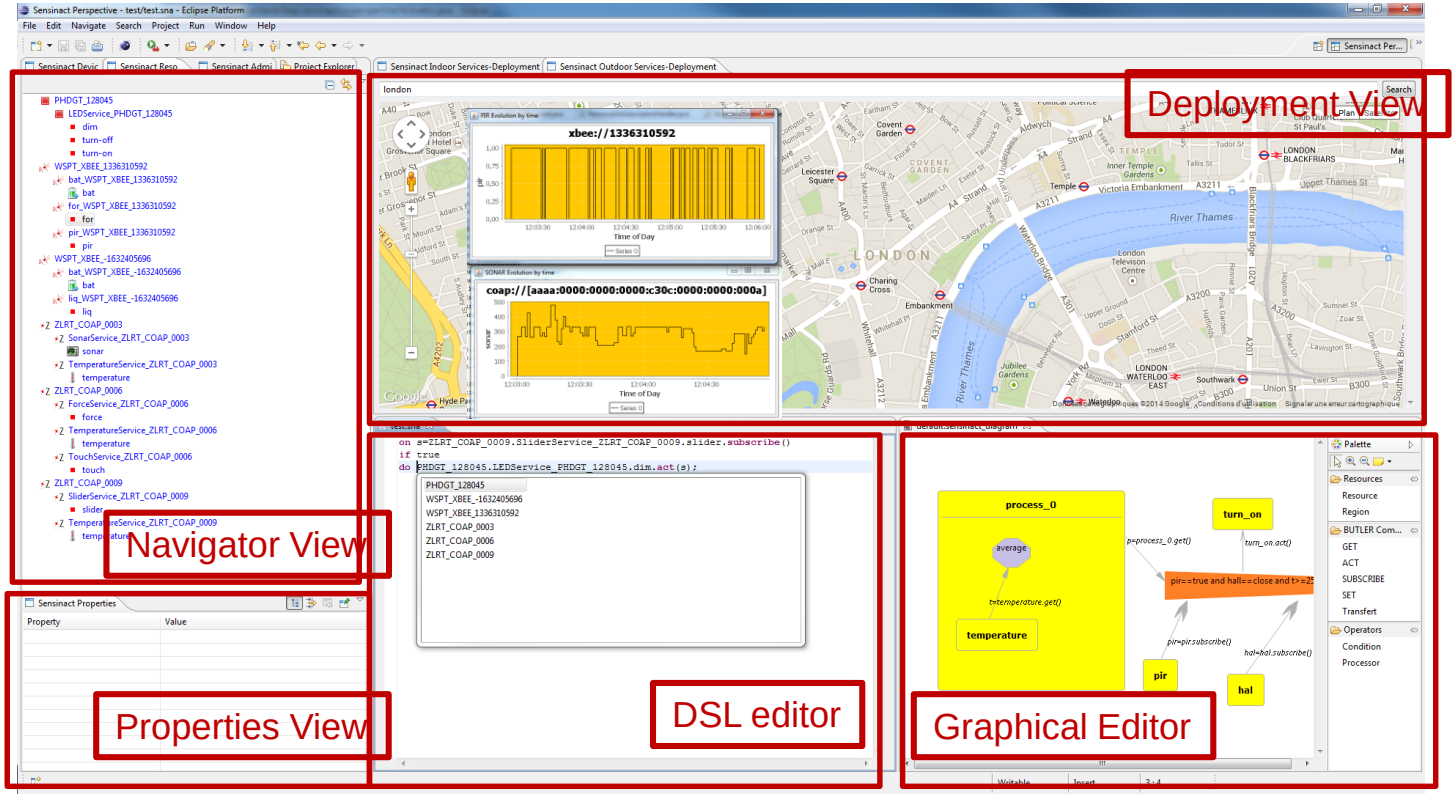
SENSINACT STUDIO - DEVELOPMENT ENVIRONMENT

DEVELOPPERS

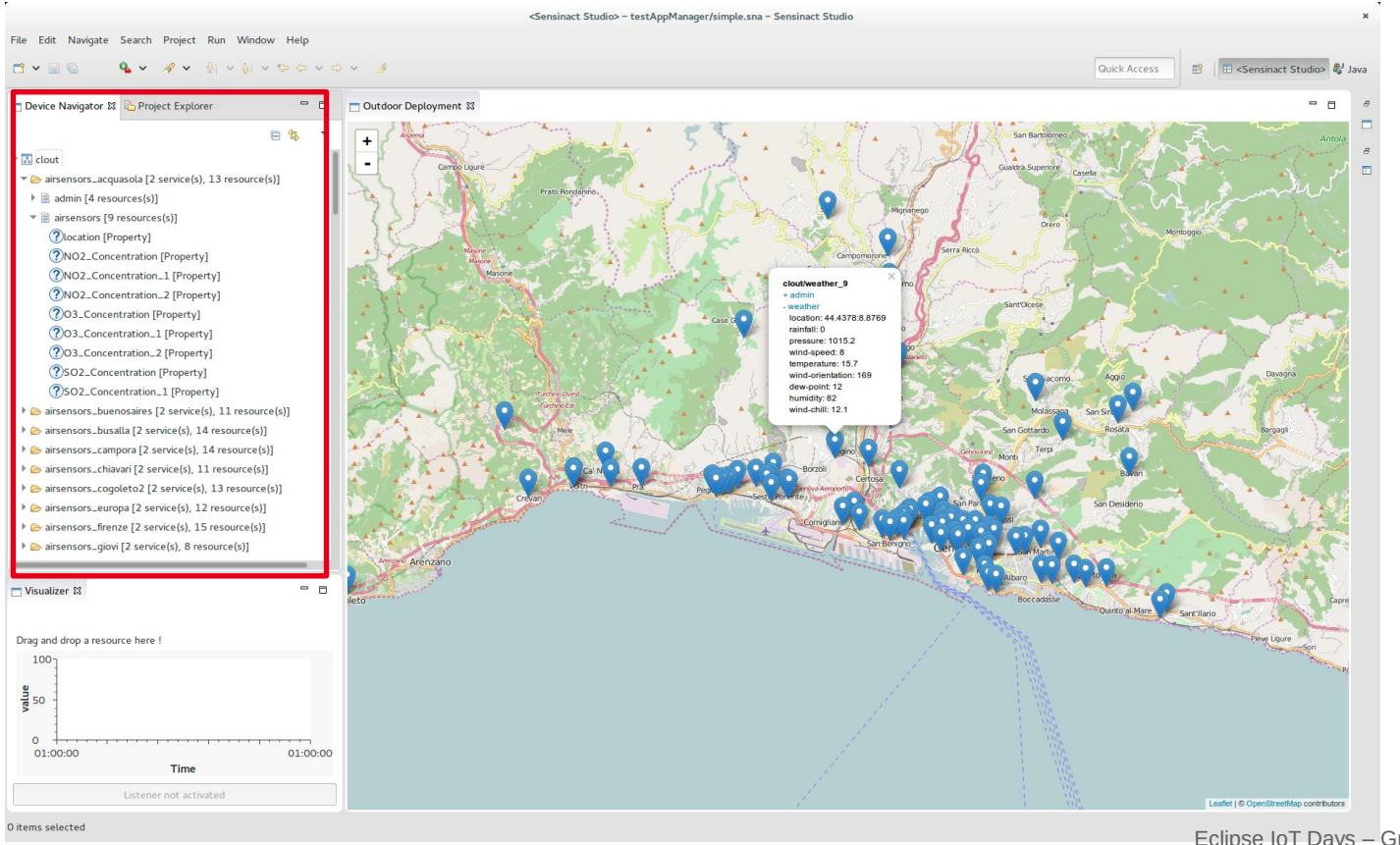
develop, deploy,
monitor,
manage



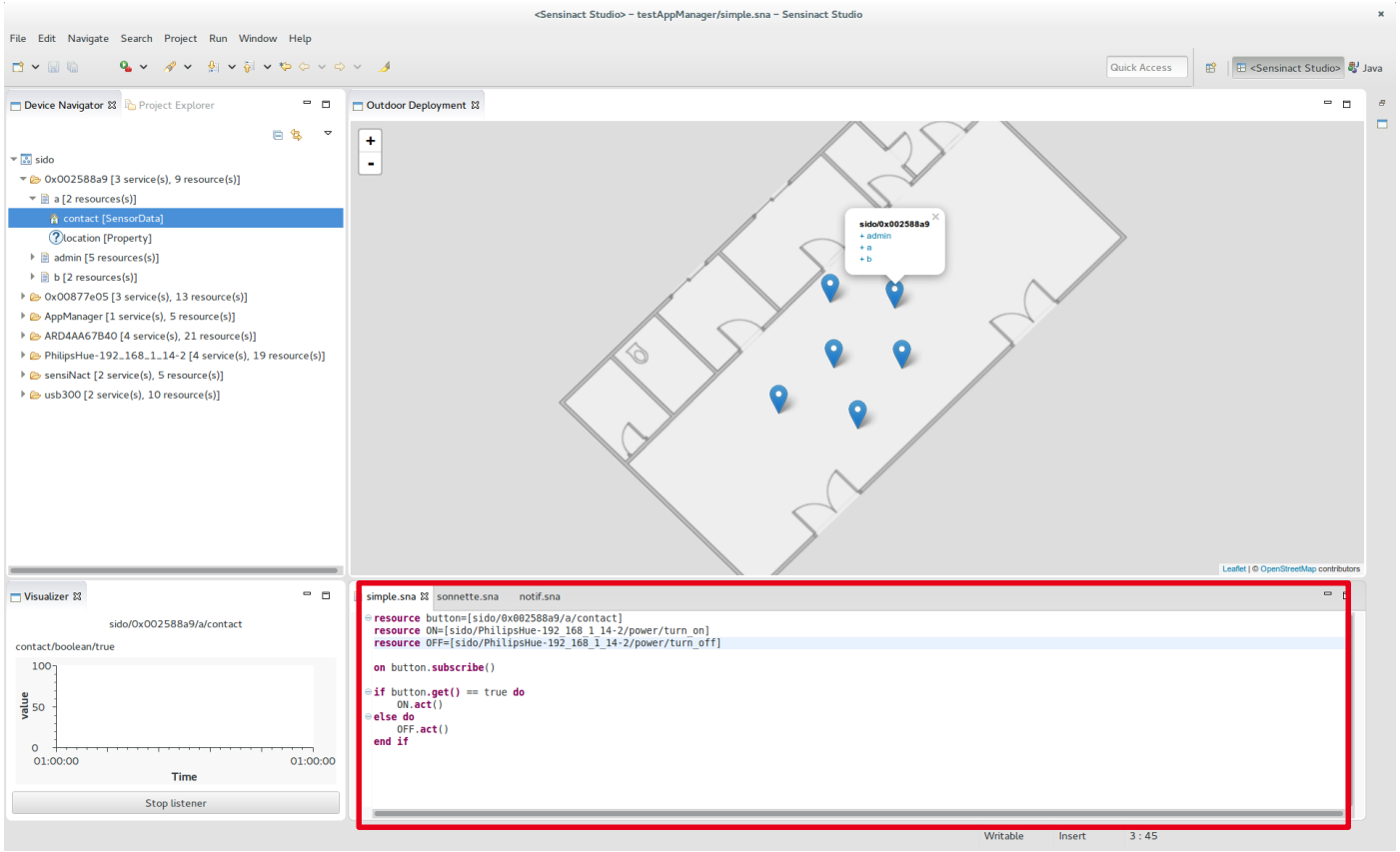
SENSINACT STUDIO: TOOL FOR IOT APPLICATION DEVELOPMENT AND DEPLOYMENT



SENSINACT STUDIO: TOOL FOR IOT APPLICATION DEVELOPMENT AND DEPLOYMENT

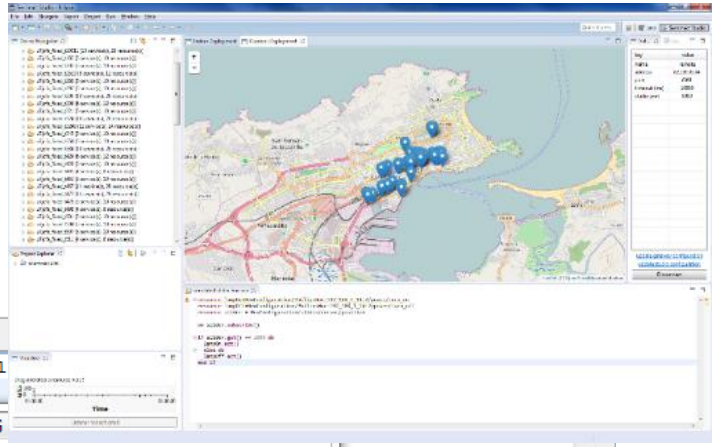


SENSINACT STUDIO: TOOL FOR IOT APPLICATION DEVELOPMENT AND DEPLOYMENT

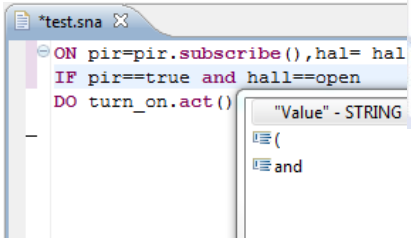


DEDICATED DOMAIN SPECIFIC LANGUAGE

- **A DSL for building IoT applications based on Event Condition Action rules**
- **ON Event IF Condition DO Action**



```
ON presence=PIRService.pir.subscribe()
IF presence==true
DO  LightService.lightOn.act();
ELSE
DO  LightService.lightOff.act();
```




```
ON presence=during(PIRService1.pir.subscribe()==true,
                   PIRService2.pir.subscribe()==true,
                   3)
IF presence==true
DO  LightService.lightOn.act();
ELSE
DO  LightService.lightOff.act();
```

Xtext

Smart IoT IDE

publish

fetch

query

Repository of intelligent behaviors

publish

publish

RESTful API
GET PUT POST DELETE

RESTful API
GET PUT POST DELETE

Paremus

Eclipse sensiNact platform

sensiNact

Eclipse sensiNact platform

sensiNact

AAA

SMART IOT IDE POWERED BY SENSINACT AND PAPYRUS

Human or meta-learner

task

design choice

IoT-ML model (developer view)

sychronize
- Resources
- States
- Tasks
- Historic data

generate

{Java, C, C++}

publish

fetch

deploy

sensiNact data model (advanced user view)

query
- deploy
- control
- monitor

RESTful API

Eclipse sensiNact platform

Eclipse sensiNact platform

Repository of intelligent behaviors

CONTACTS

SHUAI LI

Project Manager, Research Engineer

CEA LIST

shuai.li@cea.fr

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 780089.

BRAIN-IoT

model-Based fRamework for dependable sensing and Actuation in INtelligent decentralized IoT systems

Urban Technology Alliance

Worldwide testing environment for smart city solutions

UTA provides city scale tesbeds

Smart city solutions need technical, economic, social validation before large scale deployment

UTA provides a matchmaking platform

Cities need neutral guidance, industry needs testing environment, researchers need real requirements

UTA provides best practices among cities all around the globe

Yes, each city is unique; yet, today's wordwide urban challenges are very similar

What is UTA's main mission?

Bringing relevant stakeholders together to

test and validate smart city solutions

Cities come with their **problems** and **experimentation space**

Small and large companies come with their **innovative solutions**

Researchers and NPOs come with their **expertise and neutral guidance**

JOIN FORCES AND ORGANIZE SMART CITY DEPLOYMENTS, PROVIDE RECOMMENDATIONS AND

UTA current members

A vibrant community with important international actors

Initial testbed cities: **Grenoble, Taipei, Busan, Daejeon, Sejong, Santander, Bordeaux, Fujisawa, Saitama, Tsukuba, Bristol, Belfast, West Midlands, Lodz, Hong Kong, Vancouver, etc**. and many others are joining in the coming days

Grenoble Capital of the Alps Capital of Innovation

Smart ski resort in Chamrousse

Prestigious institutions, experts in smart cities: CEA, KAIST, Keio University, Knowledge Capital, KETI, University of Tsukuba, Osaka University, University of Grenoble-Alpes, U. of Cantabria, etc. Continuously growing community…

Large international tech companies, network operators, device vendors, integrators, innovative SMEs and startups, law firms, consulting firms, insurance companies, artists, designers, etc.

Thank you for your attention!

JOIN US

Interested in being part of the UTA's vibrant community?

contact@urbantechnologyalliance.org

Urban Technology Alliance

www.urbantechnologyalliance.org

STAY TUNED!

BRAIN-IoT

Subscribe to our newsletter!

http://www.brain-iot.eu/