EU-JAPAN COLLABORATIVE PROJECTS ON IoT AND SMART CITIES

CLOUT

BIGCLOUT

FESTIVAL

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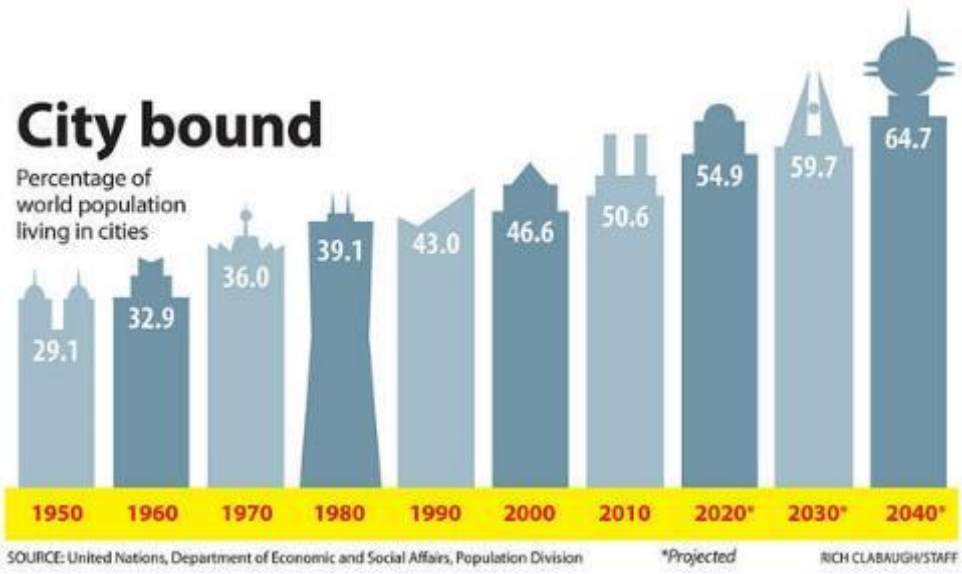
Outline

- Why Cities Need to be Smarter?
- Cloud of Things for smarter cities: ClouT and BigClouT projects
- Experimentation Platform for smart ICT services – FESTIVAL project
- Summary and Perspectives

WHY CITIES NEED TO BE SMARTER?



- More than half of the world population lives in cities
- Urban population percentage is around 75% in Europe

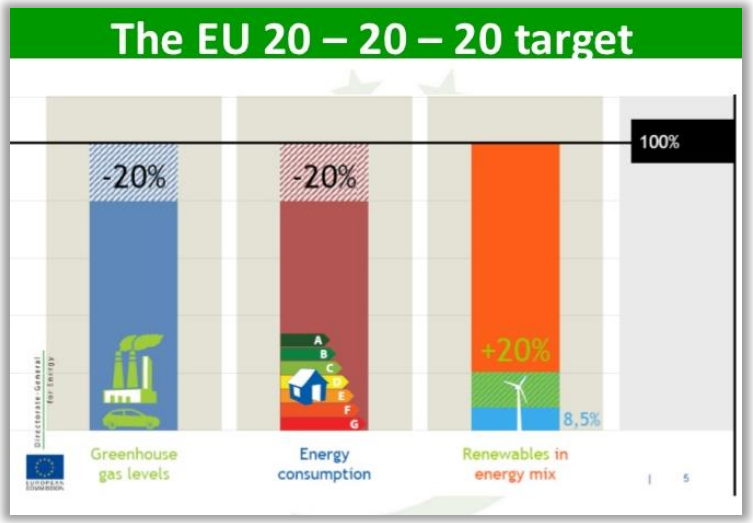
- On 2% of the earth's surface, cities use 75% of the world resources

Resources in civil infrastructure (water, energy, public transportation, parking spaces, buildings, roads, bridges, etc.) to be shared by the increasing population

=> direct consequences on the city life

Uexküll, Jakob. Shaping our future: Creating the World Future Council. Foxhole, Devon,

Energy



In Europe, **50%** of energy consumed today is imported – expected to reach **70%** by **2030**

Water

Worldwide, up to **60%** of water is lost due to leaky pipes—to the tune of **US$14 billion every year.**[1]

IBM

TRANSPORT

In Europe and US, drivers spend **from 5 to 10 working days** per year **stuck in the traffic**

WHAT IS SMART CITY?

- **Smartness: [ˈsmɑːtnɪs] *N.* ability to think and respond quickly and effectively**
  - To be responsive to all going around
  - Fast to analyse, reason, plan and make decisions
  - Fast to react with desirable effects

WHAT IS SMART CITY?

- **Smartness: [ˈsmɑːtnɪs] *N.* ability to think and respond quickly and effectively**
  - To be responsive to all going around
  - Fast to analyse, reason, plan and make decisions
  - Fast to react with desirable effects
- **Smart city: [smärt sĭtʹē] city with ability to think and respond quickly and effectively**
  - To be responsive to all going around - **capture all events going around (with sensors, social networks, crowd sensing, etc.)**
  - Fast to analyse, reason, plan and make decisions – **integration, real-time big data analytics, complex event processing, rule engines, business intelligence**
  - Fast to react with desirable effects – real-time actuating, apply quick measures, collect feedbacks and iterate…

City data sources

Smart City Platform

Data collection, analysis, knowledge, extraction, planning, action

Social networks

Mobile applications

WorldWideWeb

Legacy Devices

IoT Devices

City data sources

Citizen-centric services

Smart City Platform

Data collection, analysis, knowledge, extraction, planning, action

Social networks

Mobile applications

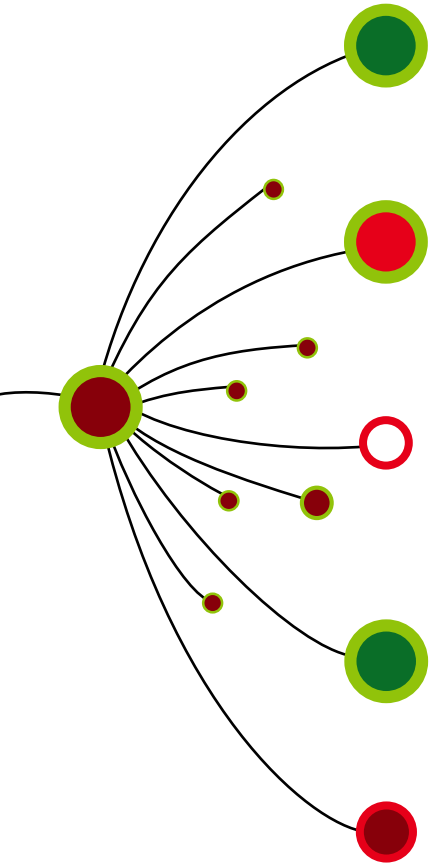
WorldWideWeb

Legacy Devices

IoT Devices

City data sources

MANY CHALLENGES



Heterogeneity/Interoperability: How to handle the numerous types of devices, protocols, standards?

Scalability: How to handle the big number of connections/big data coming from millions of devices?

Dynamicity: plug&play, self-configuration, self-management, self-mathcmaking

Dependability: rapid prototyping yet reliable dependable applications

And privacy…

EU-JAPAN COLLABORATION FOR SMARTER CITIES

Cloud of Things for empowering the citizen clout in smart cities
http://clout-project.eu/

Big data meeting Cloud of Things
http://bigclout.eu/

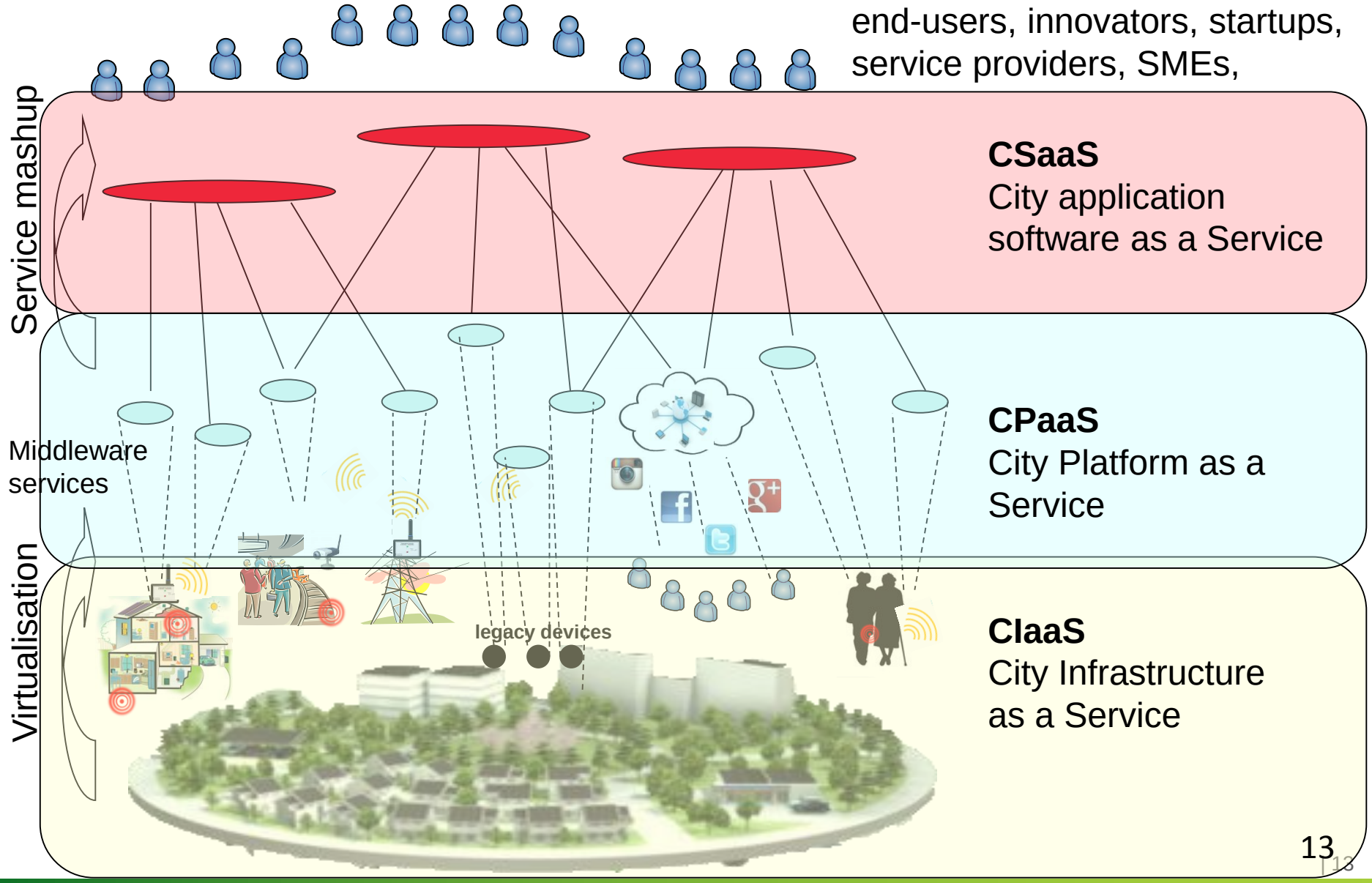
FESTIVAL - Federated interoperable smart ICT services development and testing platform

http://www.festival-project.eu/

CLOUT PROJECT

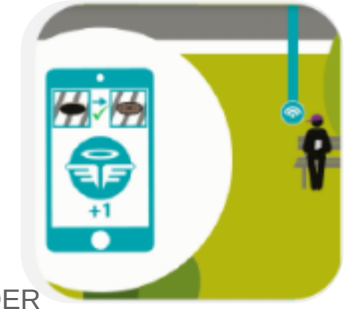
Cloud of Things for empowering the citizen clout in smart cities

CLOUD MODEL FOR IOT SERVICES



FIELD TRIALS IN 4 PILOT CITIES

PARTICIPATORY SENSING



SANTANDER

HEALTH MANAGEMENT

MITAKA

CLOUT

SAFETY AND EMERGENCY

GENOVA

SMART SPACES

FUJISAWA

SMART SANTANDER INFRASTRUCTURE

Environmental monitoring

Smart irrigation

mobile nodes on city buses and taxis

Parking sensors

Guiding drivers

Trafic sensors

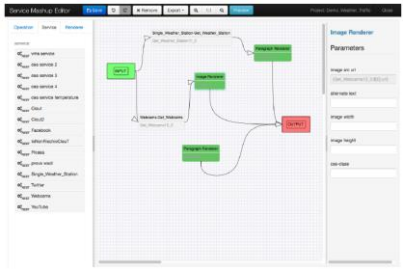
GENOVA ENVIRONMENTAL DATA IN THE CLOUD

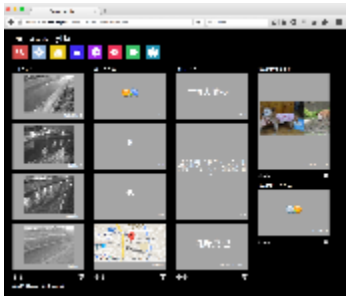
MOBILE ATMOSPHERIC SENSING WITH GARBAGE COLLECTING CARS

➢ Going out support for active seniors

First results: field trial run from 15th to 26th October 2014 with 30 senior users; Bluetooth Low Energy tags and Near Field Communication tags have been distributed in 31 places in the Mitaka city. **Users' eager involvement to the application and the effect on motivating elderly people to go out confirmed.**

INTERCONTINENTAL TRIAL





Service development tool

Data Mashup

City dashboard

Intercontinental coopetition

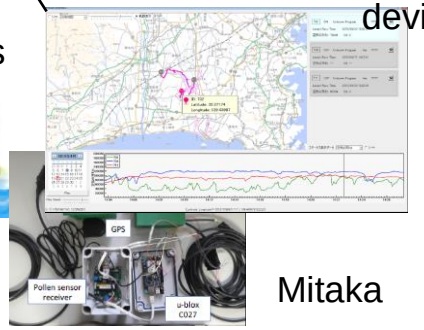
> 10 000 physical devices

> 150 physical devices

> 150 physical devices + > 500 000 virtual devices

Santander

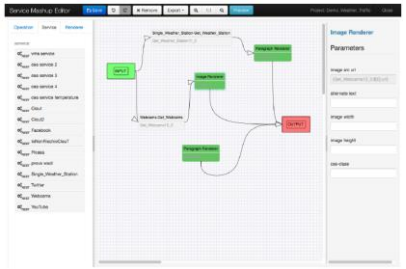
Genova

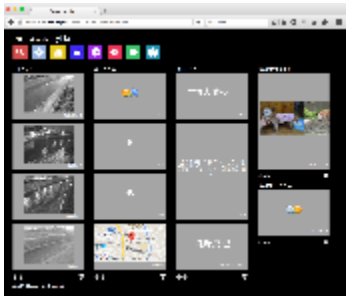


Mitaka

Fujisawa

INTERCONTINENTAL TRIAL





Service development tool

Data Mashup

City dashboard

Intercontinental coopetition

sensiNact

Studio

sensiNact

Web sensorizer

Keio University

SOXFire

Keio University

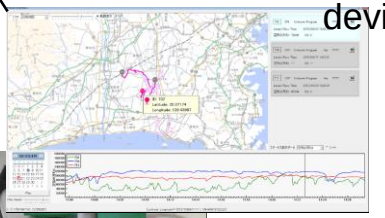
150 physical devices + > 500 000 virtual devices

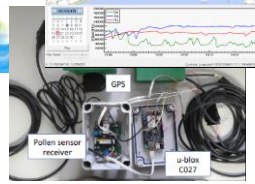
> 10 000 physical devices

> 150 physical devices

Santander

Genova



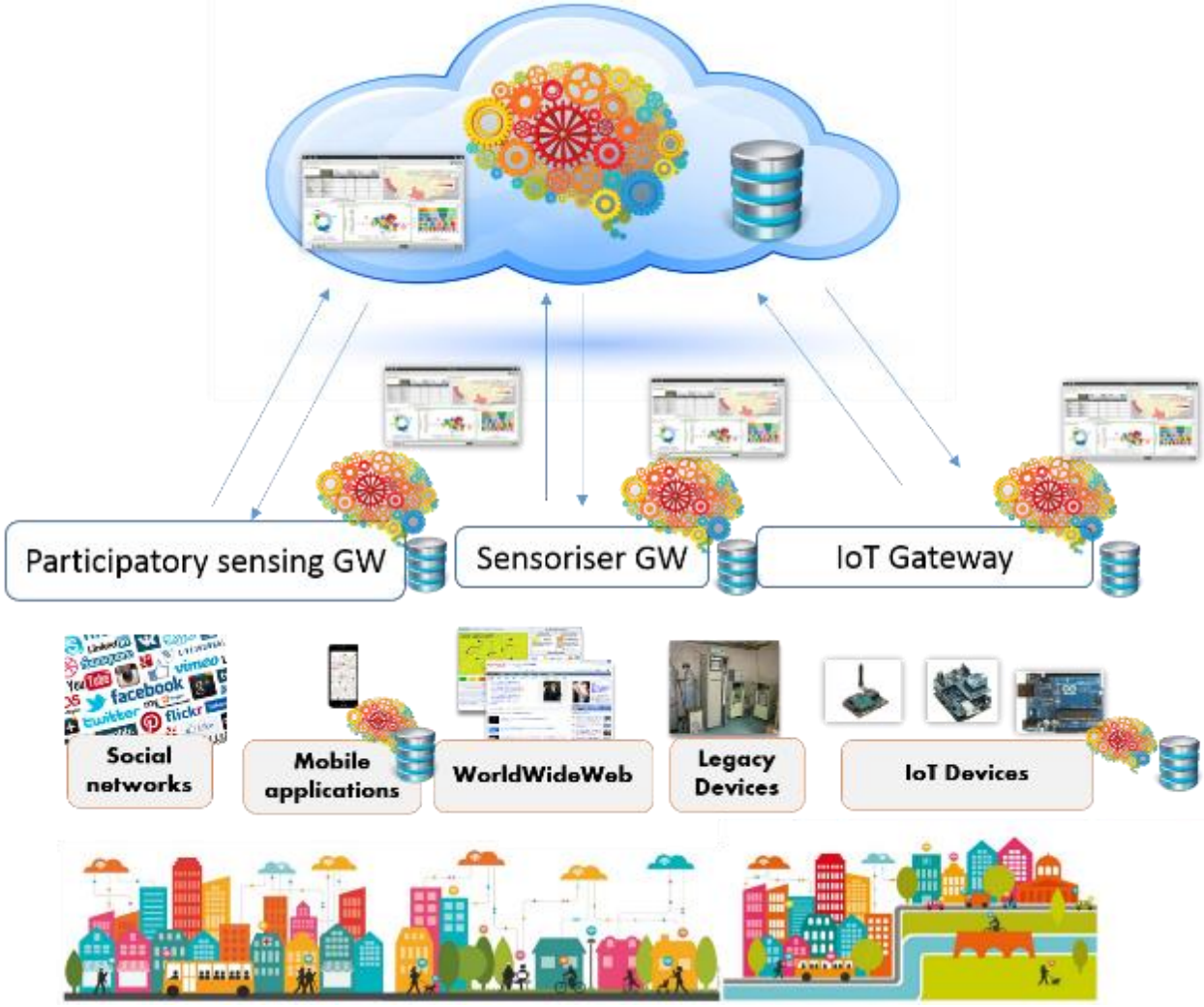


Mitaka

Fujisawa

CLOUT EXPANDED WITH BIG DATA AND NEW CITIES (GRENOBLE, BRISTOL, TSUKUBA)

BIGCLOUT



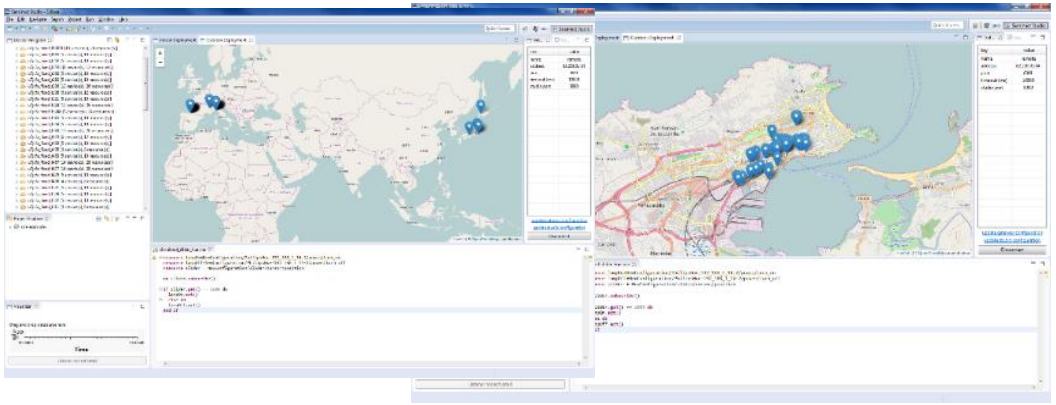
Cloud computing, analysis and visualisation on aggregated big data

Edge computing for adaptive processing, distributed intelligence and management.

Programmable city data platform including IoT and other data sources

SENSINACT – IOT PLATFORM FOR SMARTER CITIES

sensiNact **Studio**



Tool for **rapid and dependable** application building

Various **northbound** protocols

RESTful API
GET PUT POST DELETE

JSON-RPC

oma Open Mobile Alliance

LWM2M

XMPP

MQTT.ORG

SNIA

CDMI

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

sensiNact **Platform**

Various **IoT** protocols and platforms

IEEE 802.15.4

Green. Smart. Wireless enocean

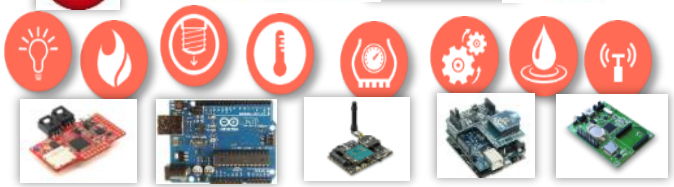
LoRa

MQTT.org

XMPP

SIGFOX One network A billion dreams

orion



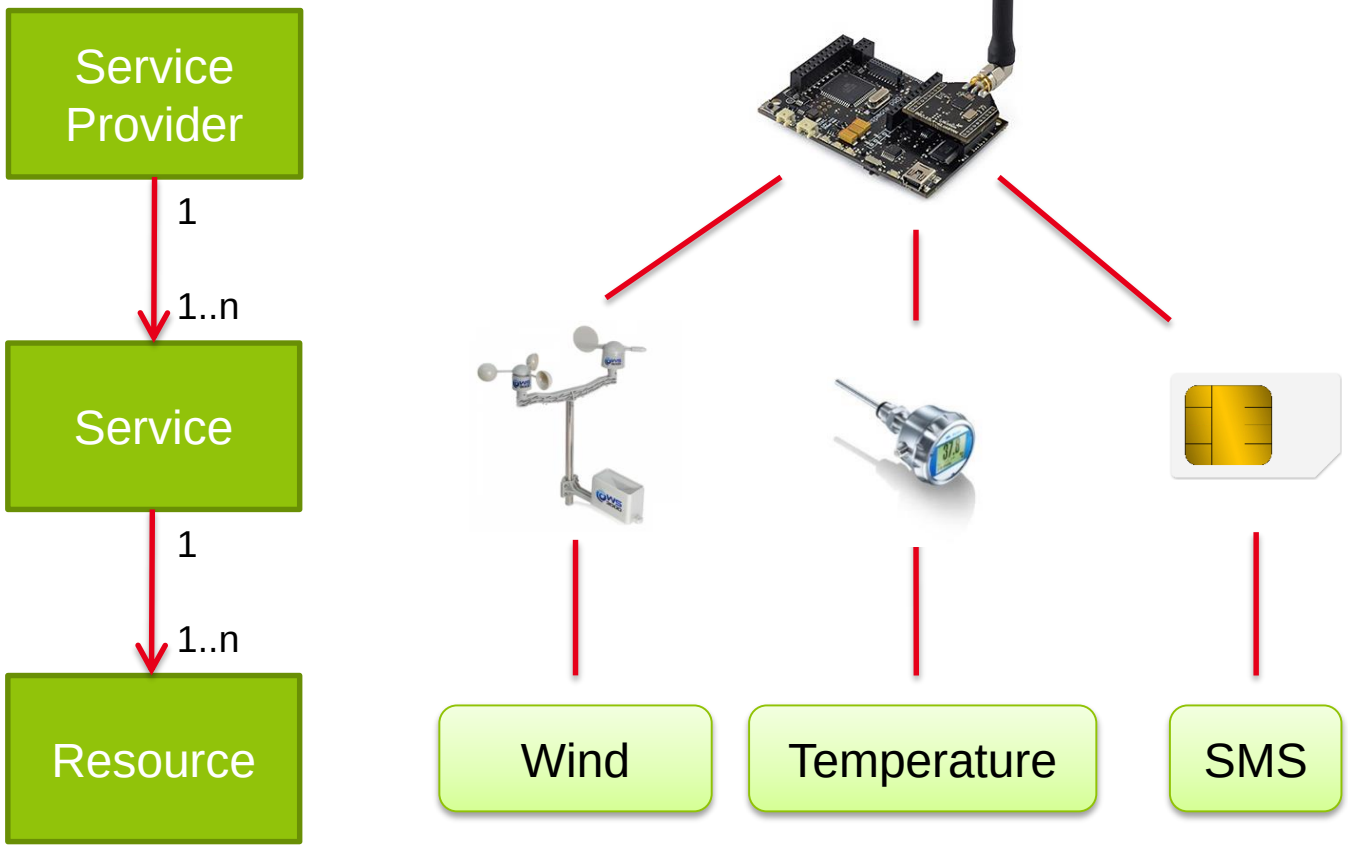
IoT platforms

Heterogeneous IoT devices and platforms

SENSINACT – IOT PLATFORM FOR SMARTER CITIES

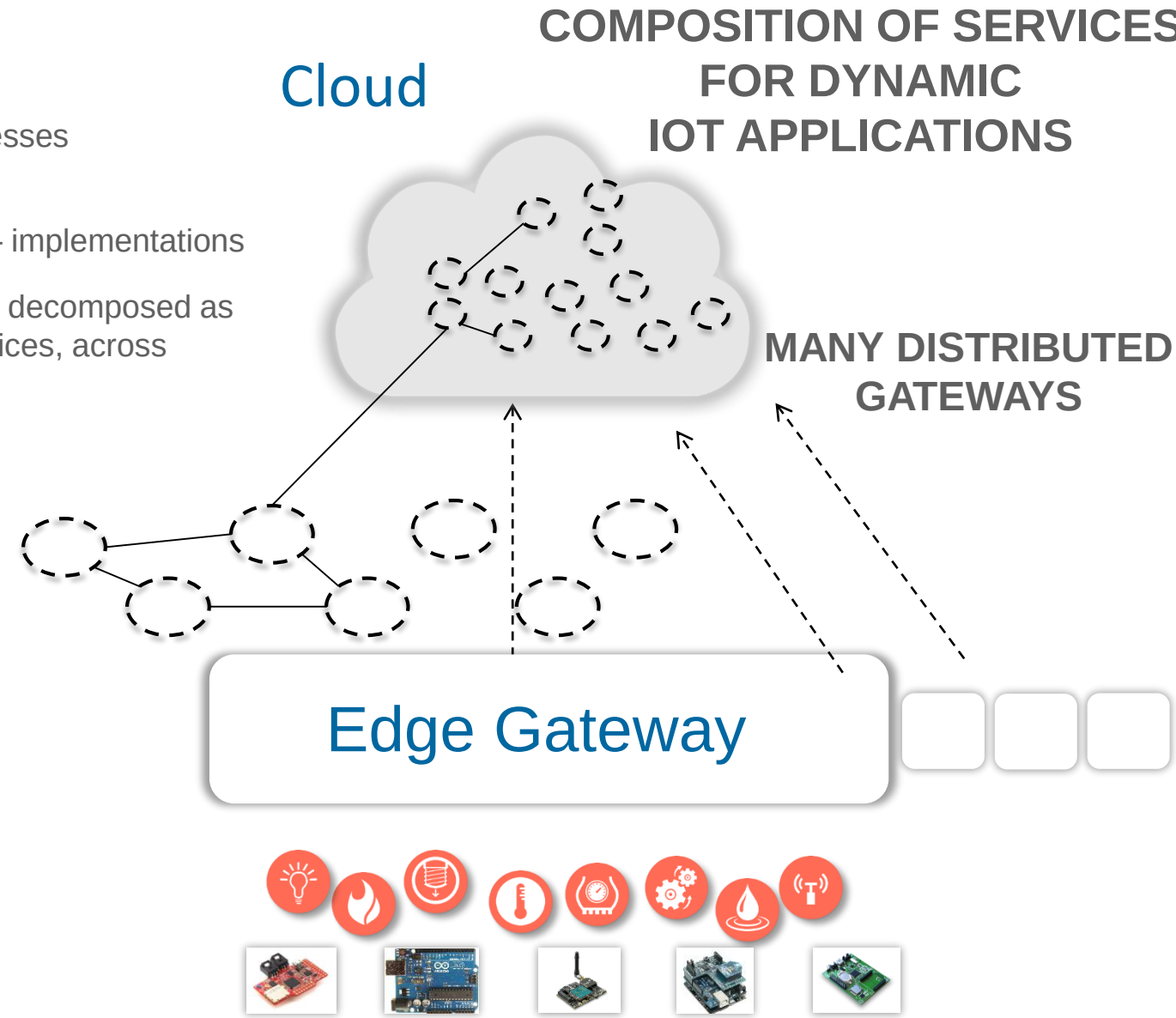
- **Plug&play**: Device as a Service Approach. Flexibility of adding/removing/updating devices with a minimum impact on the running platform.
- **Modular**: Modular development and deployment for enhanced system maintenance and evolution
- **Dependable**: sensiNact's formal data and service models facilitate reliable IoT applications development.
- **Scalable**: sensiNact's three layers architecture (device/gateway/cloud) allows distribution of data processing at different levels.
- **Easy&quick**: sensiNact's comprehensive data model and APIs help to rapidly build IoT applications.

EXAMPLE SENSINACT SERVICE PROVIDER



SERVICE-ORIENTED APPROACH

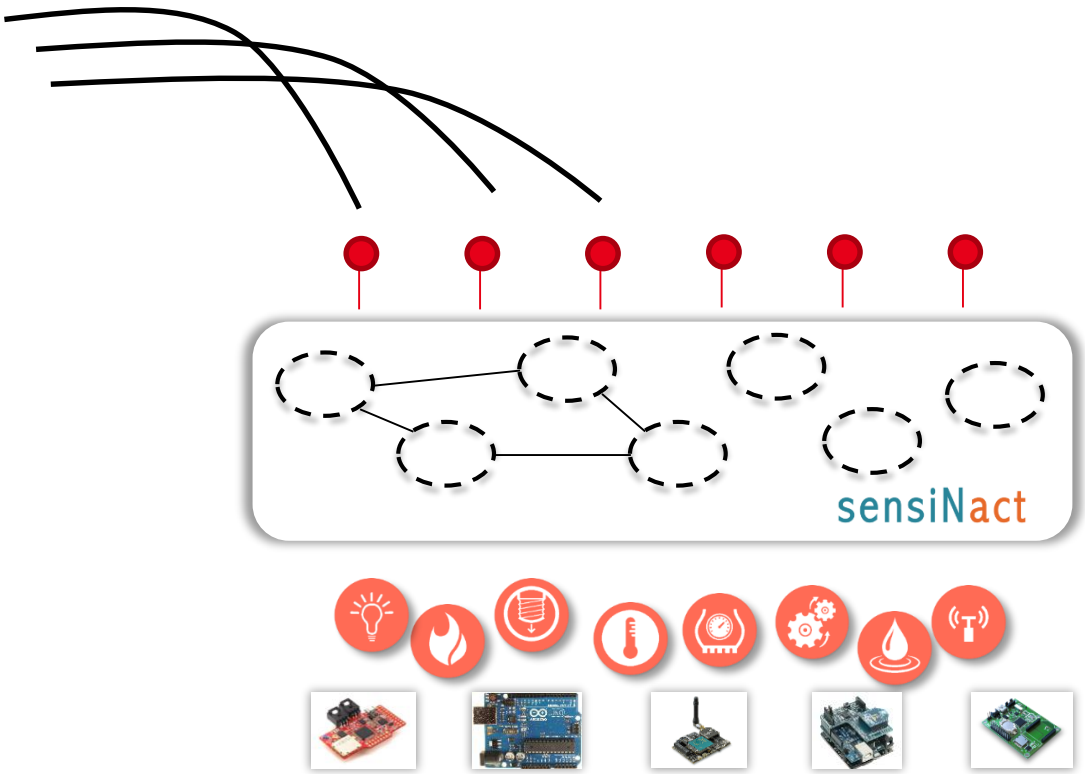
- Abstracting business processes from underlying technology
- Loosely coupled services – implementations
- Monolithic vertical systems decomposed as reusable and sharable services, across organizational boundaries



sensiNact STUDIO - DEVELOPMENT ENVIRONMENT

DEVELOPPERS

develop, deploy,
monitor, manage



APIs

sensiNact STUDIO - DEVELOPMENT ENVIRONMENT

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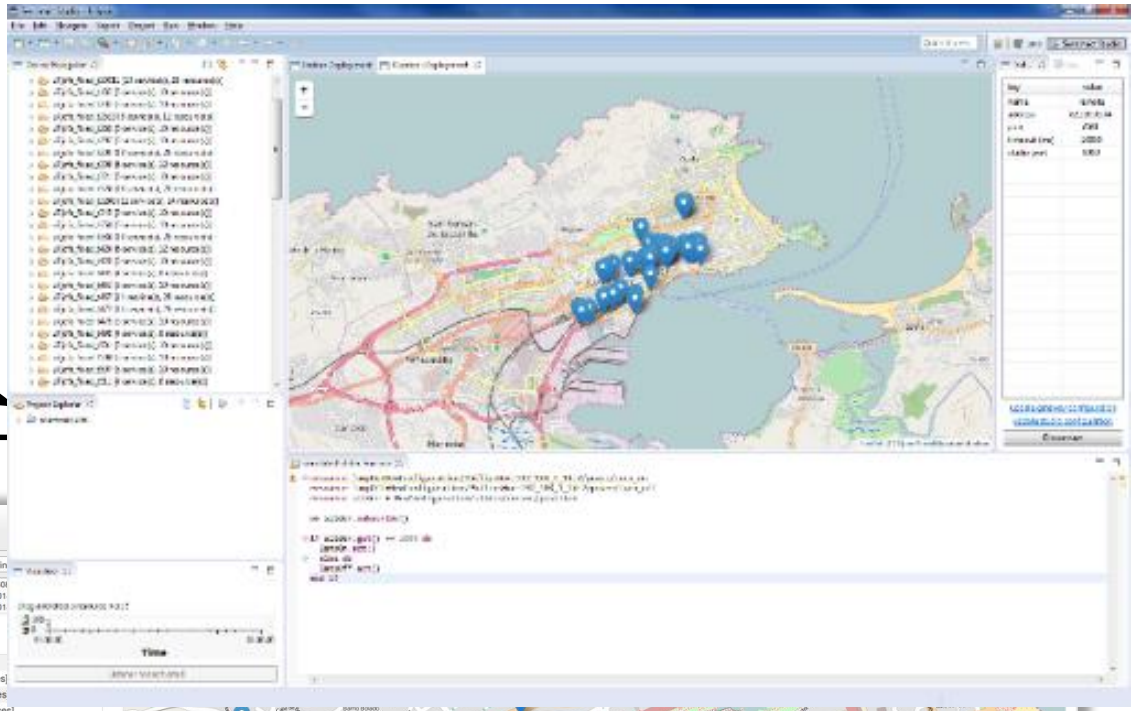
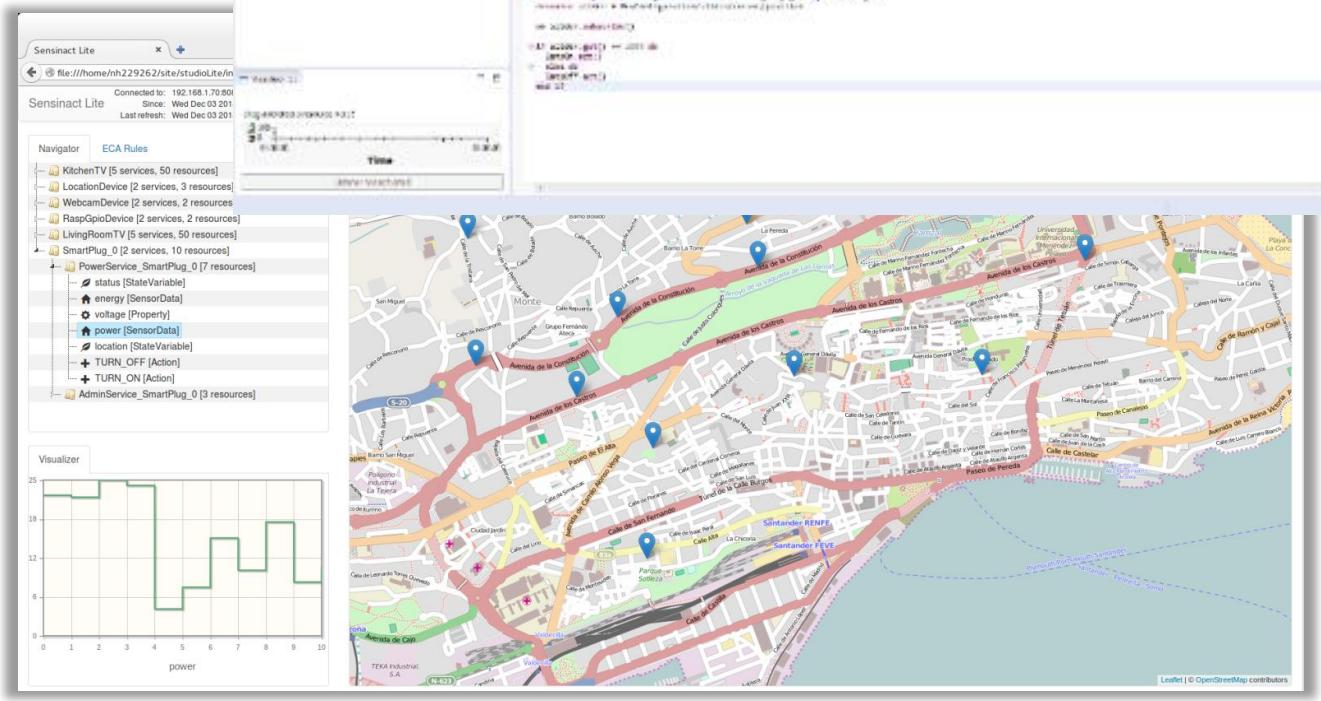
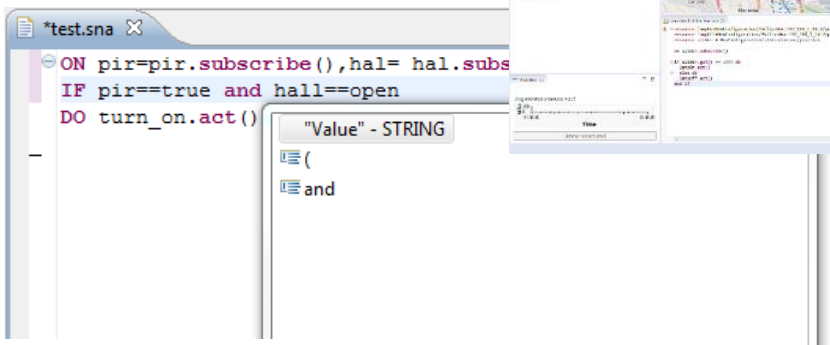




DEDICATED DOMAIN SPECIFIC LANGUAGE

- **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();
```

SENSINACT IN COLLABORATIVE PROJECTS

OUTSMART - Provisioning of urban/regional smart services and business models enabled by the Future Internet

Technical coordinator

BUTLER - uBiquitous, secUre inTernet-of-things with Location and contExt-awaReness

coordinator

CLOUT - Cloud of Things for empowering the citizen clout in smart cities

SOCIOTAL - creating a socially aware and citizen-centric Internet of Things!

coordinator

FESTIVAL - Federated interoperable smart ICT services development and testing platform

WP leader

ORGANICITY - Co-creating smart cities of the future

WP leader

WISE-IoT - Wordlwide Interoperability for SEmantics IoT

coordinator

BigClouT – ClouT with Big Data with Bristol and Grenoble

Unify-IoT - Supporting Internet of Things Activities on Innovation Ecosystems

IoF2020 - Internet of Food and Farm 2020

WP leader

ACTIVAGE - ACTivating InnoVative IoT smart living environments for AGEing well

SUMMARY AND CONCLUSIONS

- **The IoT world is heterogeneous. Smart objects and (legacy) platforms should interoperate.**
  - Modular gateways with support for various protocols. Loosely coupling service implementations, abstracting heterogeneous devices
- **Continuous operation and evolution, even against context changes (physical environmental, system, etc.)**
  - Powerful run-time environment for the dynamicity, application lifecycle management, reduced maintenance costs
- **Openness and short learning curve for reduced time-to-market and avoiding vendor lock-in.**
  - Open specifications, open source implementations, increasing number of tools, modularity reducing development complexity

Boot the Open Smart City

with Sustainable Physical and Cyber Sensing

Takuro Yonezawa

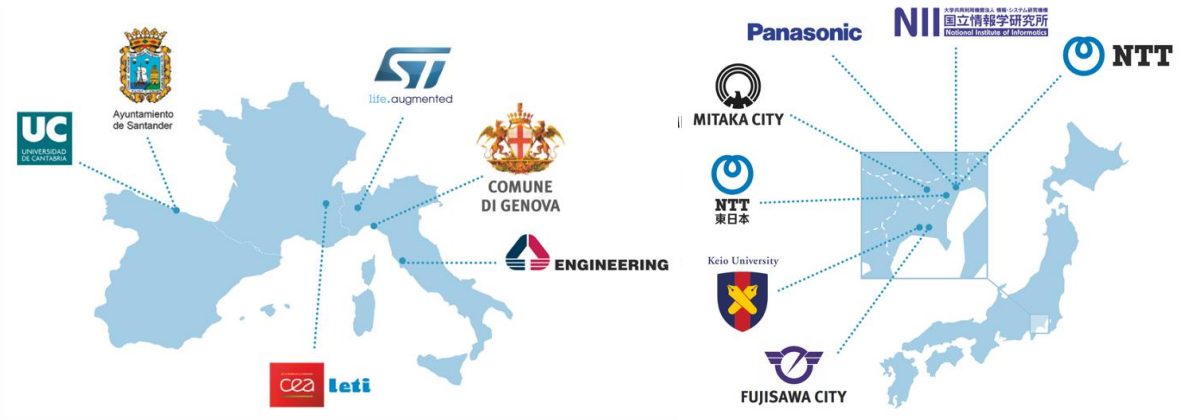
Keio University

ClouT/BigClouT Projects

ClouT Project

Funded by FP7/NICT

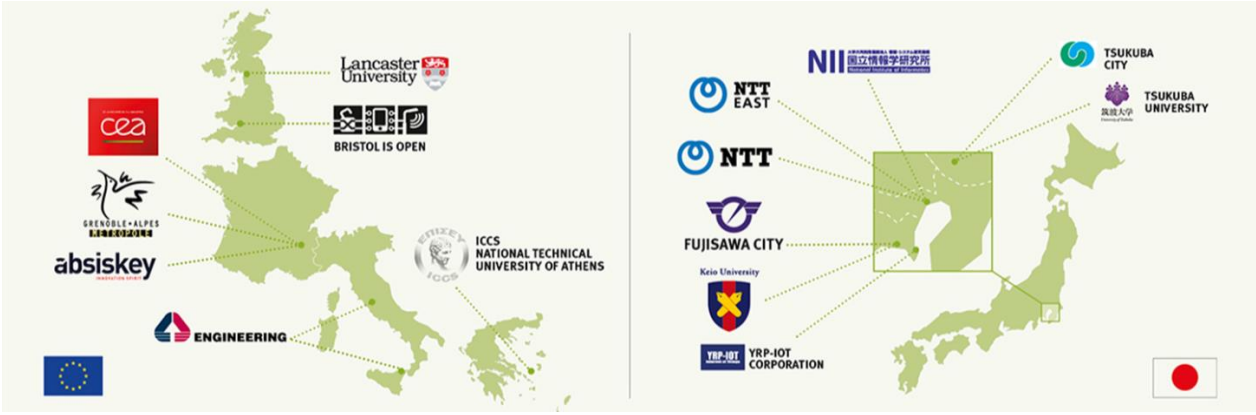
(2013-2015)

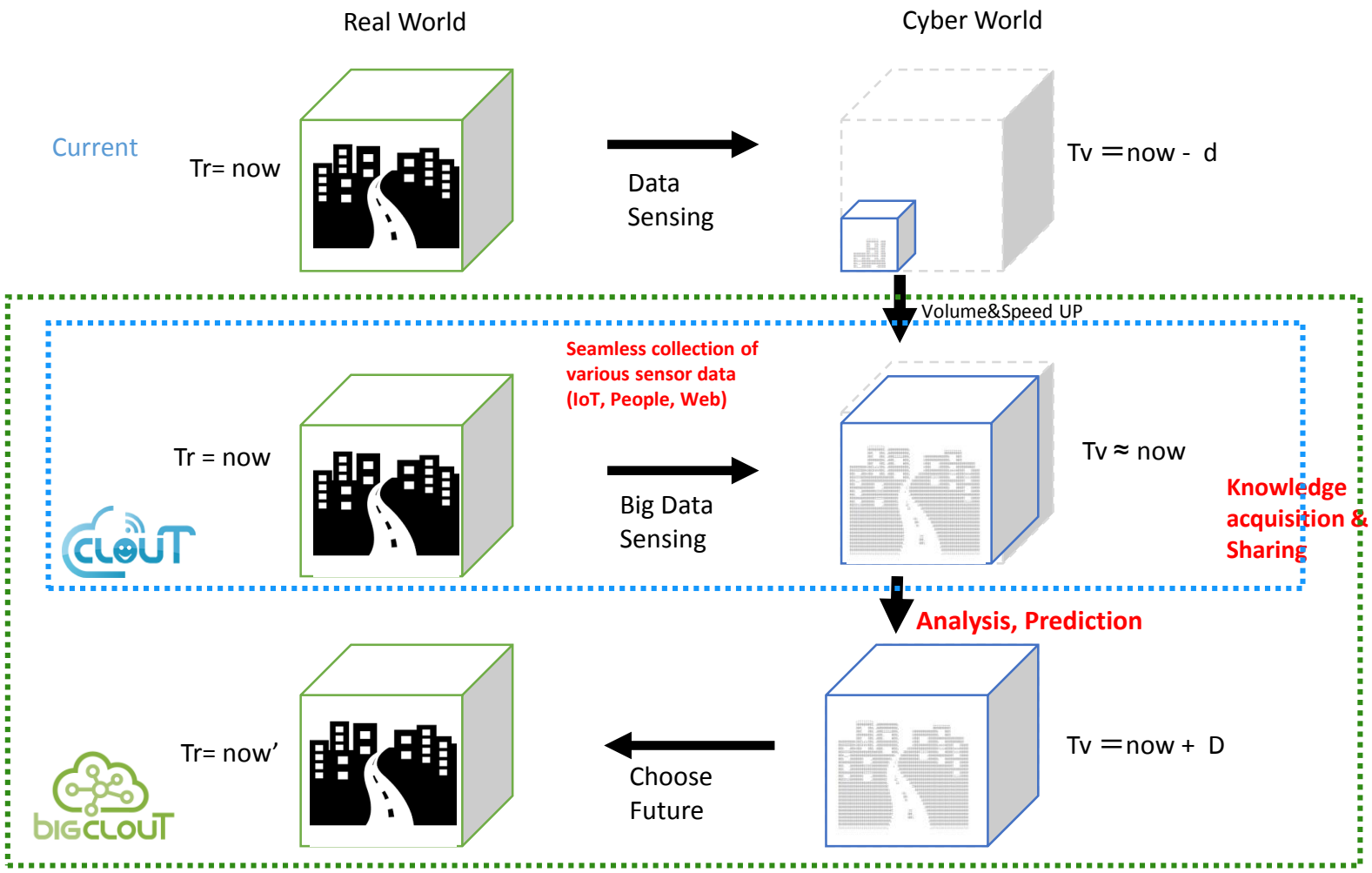


BigClouT Project

Funded by Horizon2020/NICT

(2016-2018)




Real World
Cyber World
Current
Tr= now
Data
Sensing
Tv ＝now - d
Volume&Speed UP
Seamless collection of
various sensor data
(IoT, People, Web)
Tr = now
Big Data
Sensing
Tv ≈ now
Knowledge
acquisition &
Sharing
CLOUT
Analysis, Prediction
Tr= now'
Choose
Future
Tv ＝now + D
BIGCLOUT

What is ‘Smart’ City

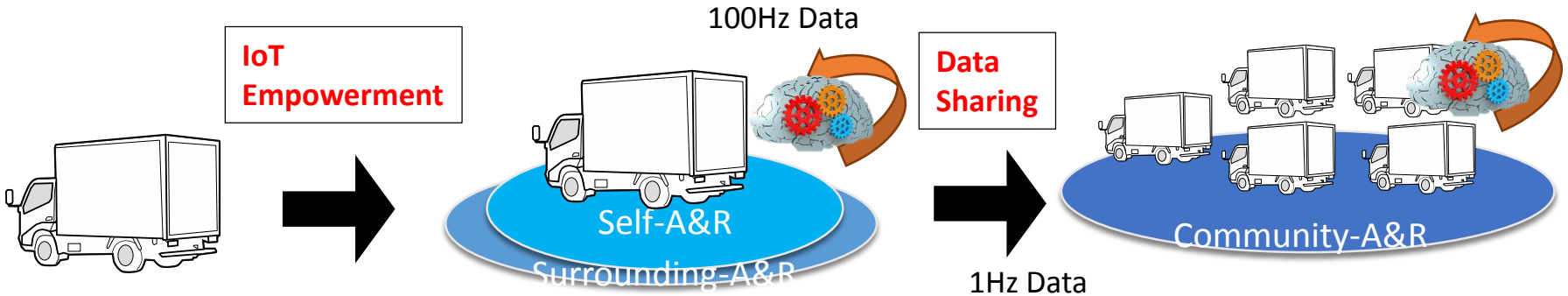
- City which has **A&R**: **Awareness** and **Responsiveness**
  - **Awareness: Understand/Predict City in Real-Time**
  - **Responsiveness: Change city’s functions/behaviors according to it’s situation**

From Legacy City Elements to Smart Community, City

Legacy
City Element

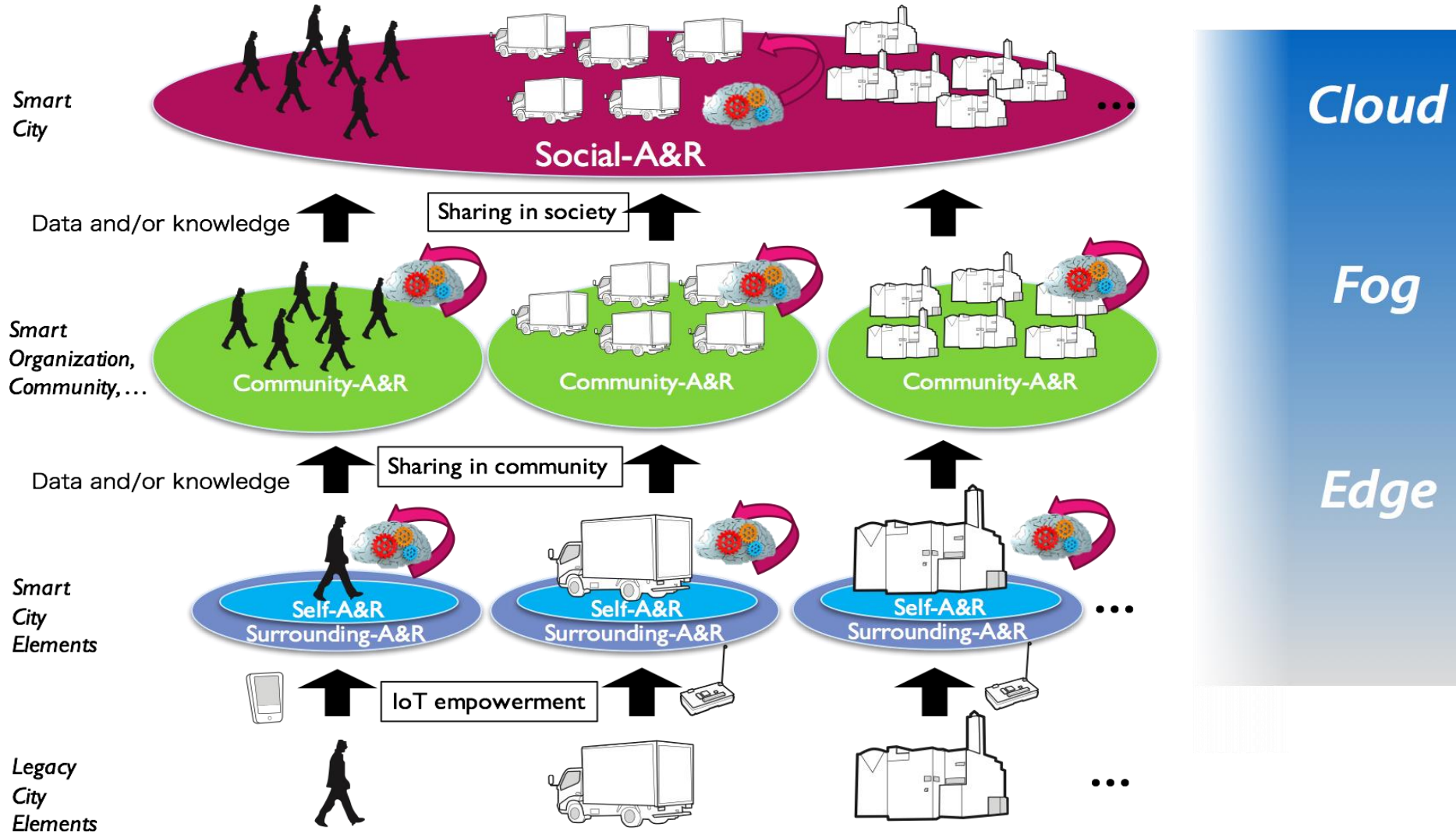
Smart
City Element

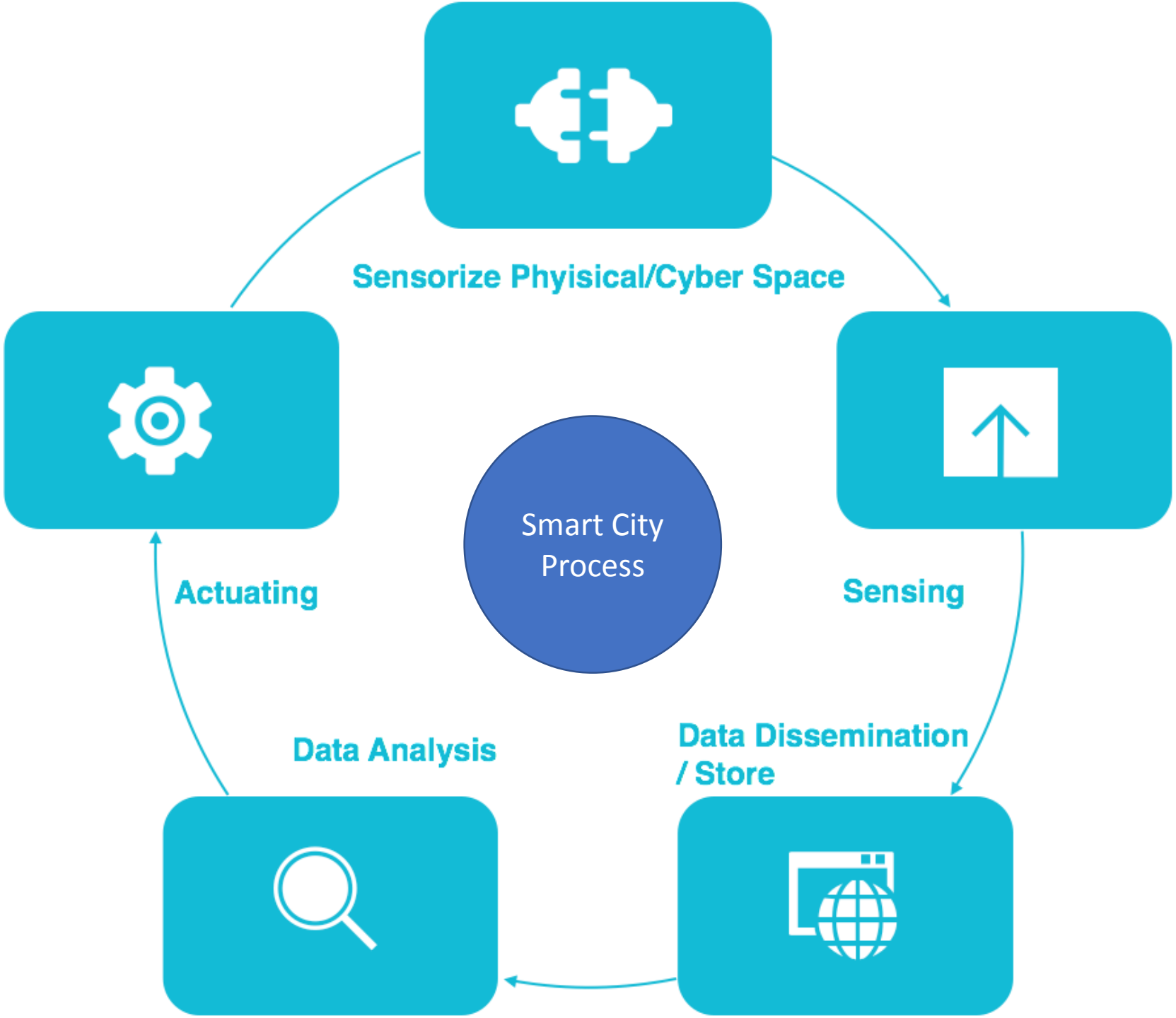
Smart
Organization,
Community..



Application
Automated Driving
Smart Navigation etc.

Application
Smart Delivery
Scheduling
etc.


Smart City
Social-A&R
Data and/or knowledge
Sharing in society
Smart Organization, Community, …
Community-A&R
Community-A&R
Community-A&R
Data and/or knowledge
Sharing in community
Smart City Elements
Self-A&R
Surrounding-A&R
Self-A&R
Surrounding-A&R
Self-A&R
Surrounding-A&R
IoT empowerment
Legacy City Elements
Cloud
Fog
Edge


Sensorize Phyisical/Cyber Space
Sensing
Data Dissemination / Store
Data Analysis
Actuating
Smart City Process

How can we collect/share massive city data in a sustainable way ?

Not only for rich cities - for Any Cities

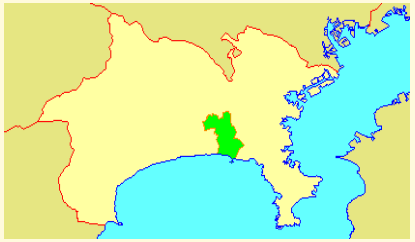
Boot the Smart City

by maximize utilization of existing city assets

Smart Fujisawa Project

Fujisawa

- South area of Tokyo metropolis
- 50km from center of Tokyo
- 6.6km x 12km
- 420,000 population
- Bed town
- 18,000,000 tourists per year



江の島

Collaboration of Fujisawa city and Keio University

Toward better city management through real problem analysis

Toward better society through latest research and development

Social Problems

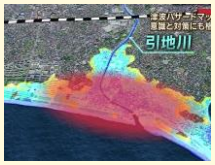
Technology

Cooperation Agreement

Smart City Project

City Problems

- Ambulance Navigation
- Road condition monitor
- Environmental monitor
- Reducing garbage
- Garbage station manage
- Garbage car management
- Pet problems



- Disaster management
- Tourism support
- Evacuation support
- Evacuation Training
- Danger place detection
- Elderly healthcare
- Children healthcare

Sensorize Physical Space

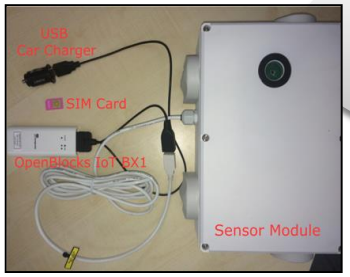
Fine-grade City Sensing with Sensorized Garbage Truck

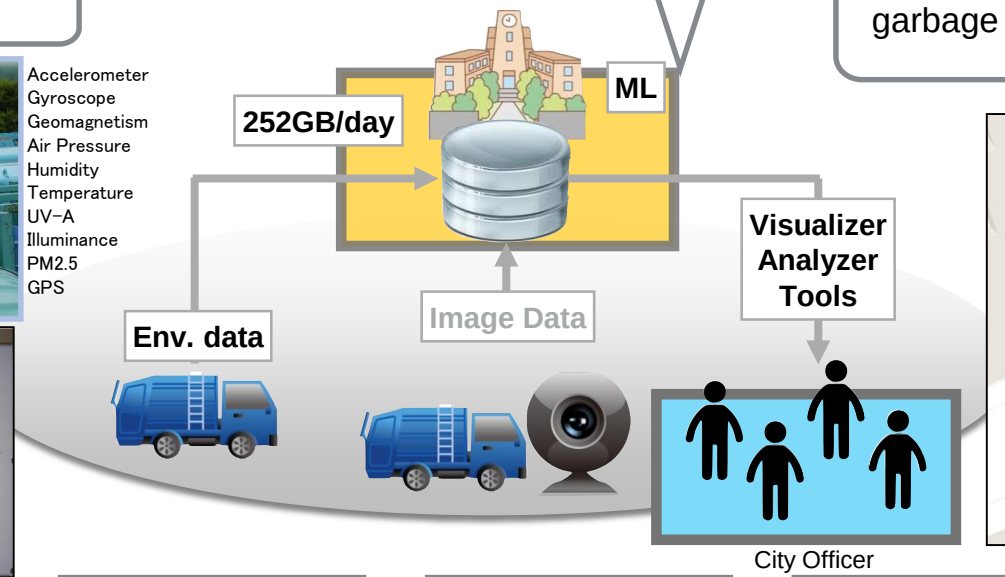
Collecting garbage and city information by attaching sensors to garbage trucks

Analysis and Prediction with Machine Learning

Efficient city management by leveraging real-time data sensing and sharing. Promoting citizen to reduce garbage volume

Accelerometer
Gyroscope
Geomagnetism
Air Pressure
Humidity
Temperature
UV-A
Illuminance
PM2.5
GPS





Road condition

Garbage Truck Location

City Monitoring When Disaster

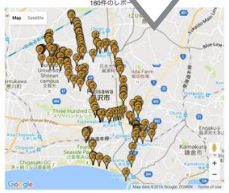
Sensorize City Staffs： **Fujisawa MinaRepo**

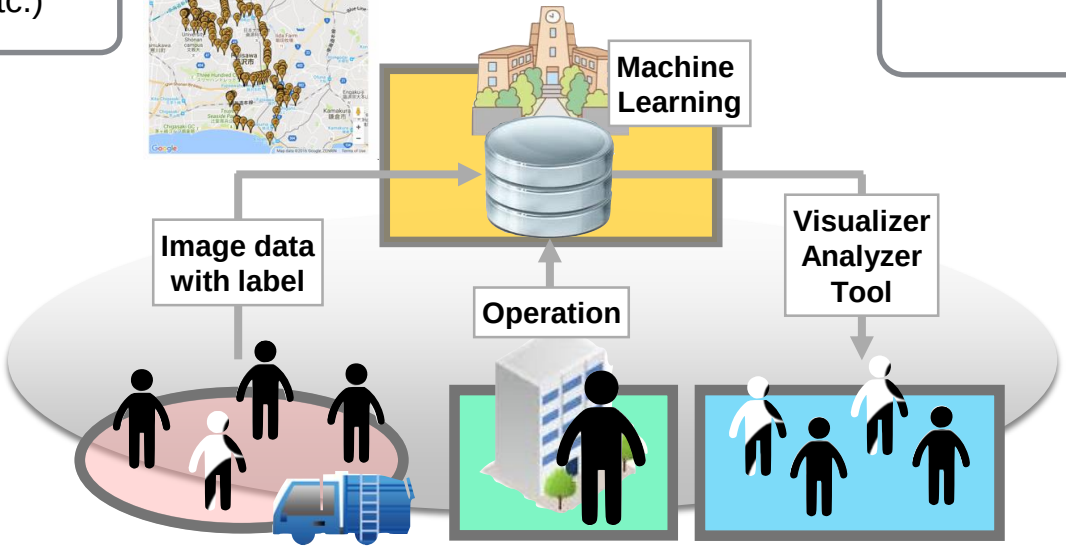
Data collection while city staffs' daily working (such as illegal garbage, road condition, graffities, disaster impact etc.)

藤沢 みなレポ

Visualization and Analysis of collected data

Keio Univ.



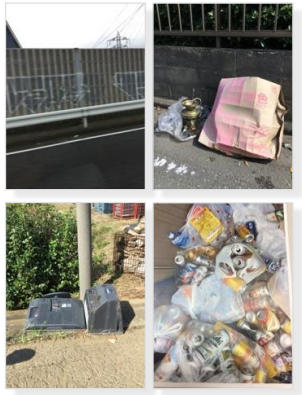


City Staffs, Related company

Environmental Section In Fujisawa City

Related section In Fujisawa City

Sharing various information among city staffs. Providing efficient city operation and problem findings.



Smart Phone Appilcation
Web Viewer Application

Labeling to photos

緊急時初動

Problem monitoring

Started from 2016 Oct.
Total Report (2017 Jan.)

1000~

Sensorize Cyber Space

WEB as Sensor

Transform WEB(without APIs) to IoT Data Stream instantly

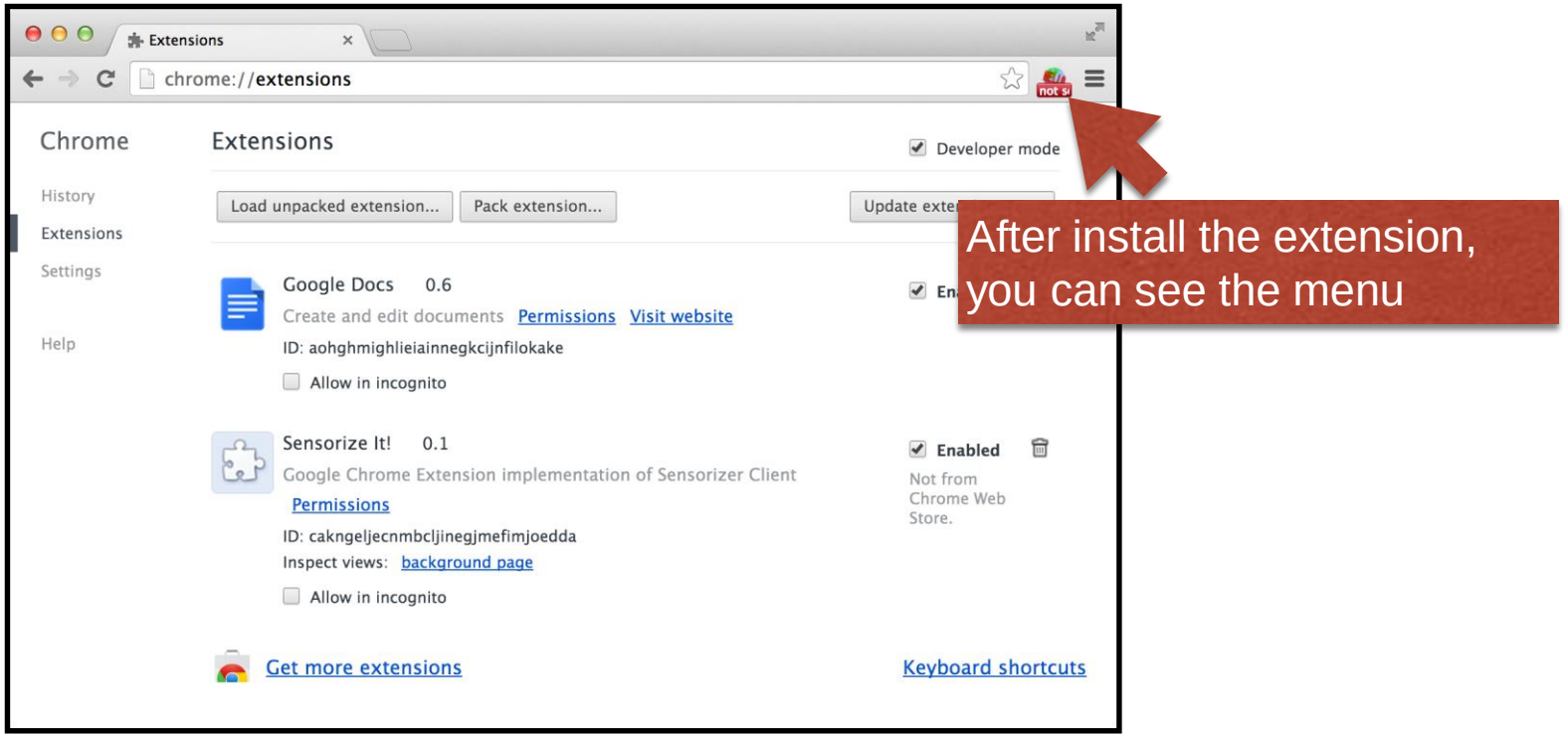
- Websites about city already exist a lot
- Some of them are periodically updated
  - Act alike sensors

Change such websites to real IoT data stream

One billion websites

Install

- Install the Chrome Extension of Sensorize It! to Google Chrome
  - Sensorize It! can be downloaded from Google Chrome Store

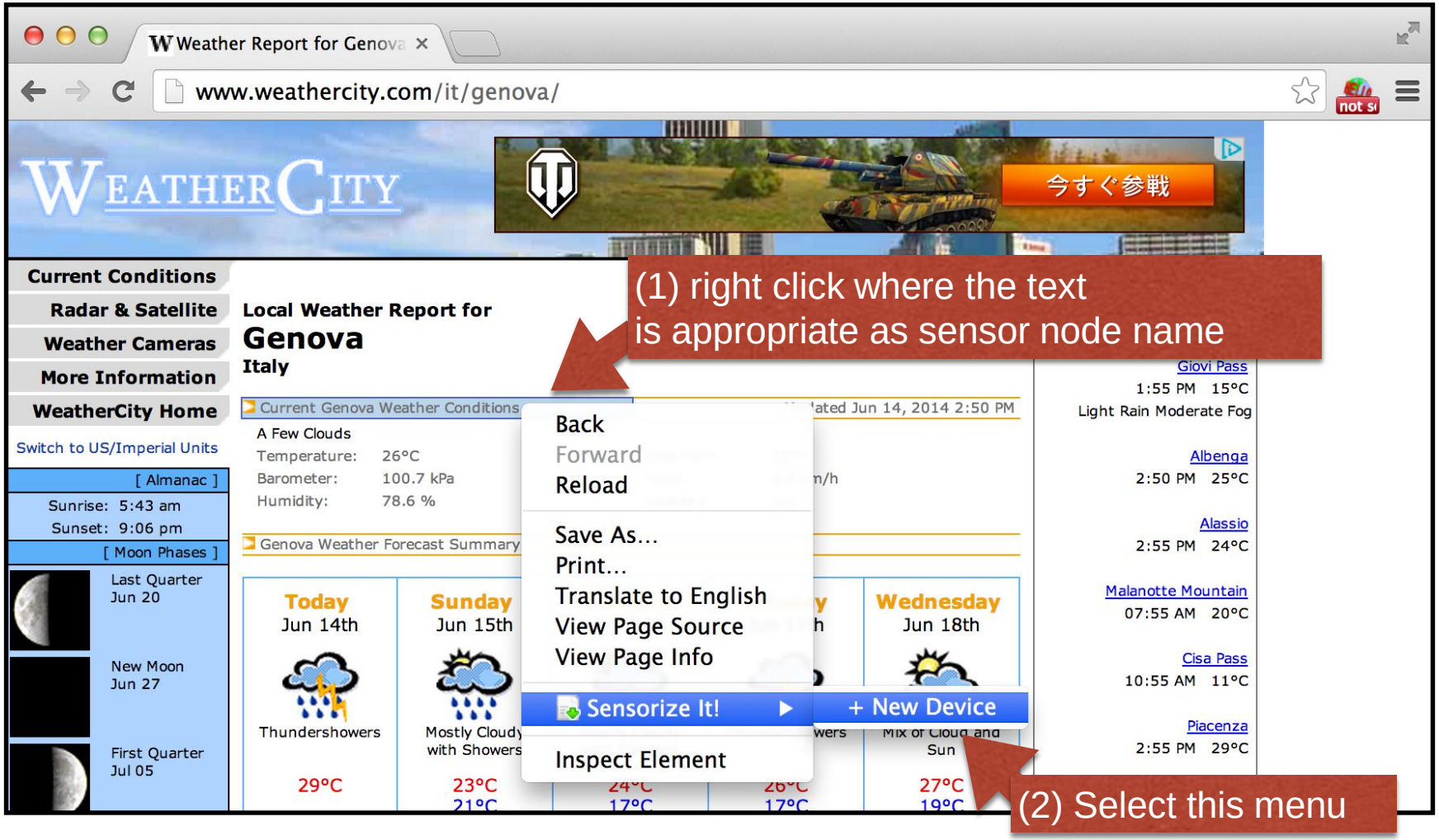


Usage Process

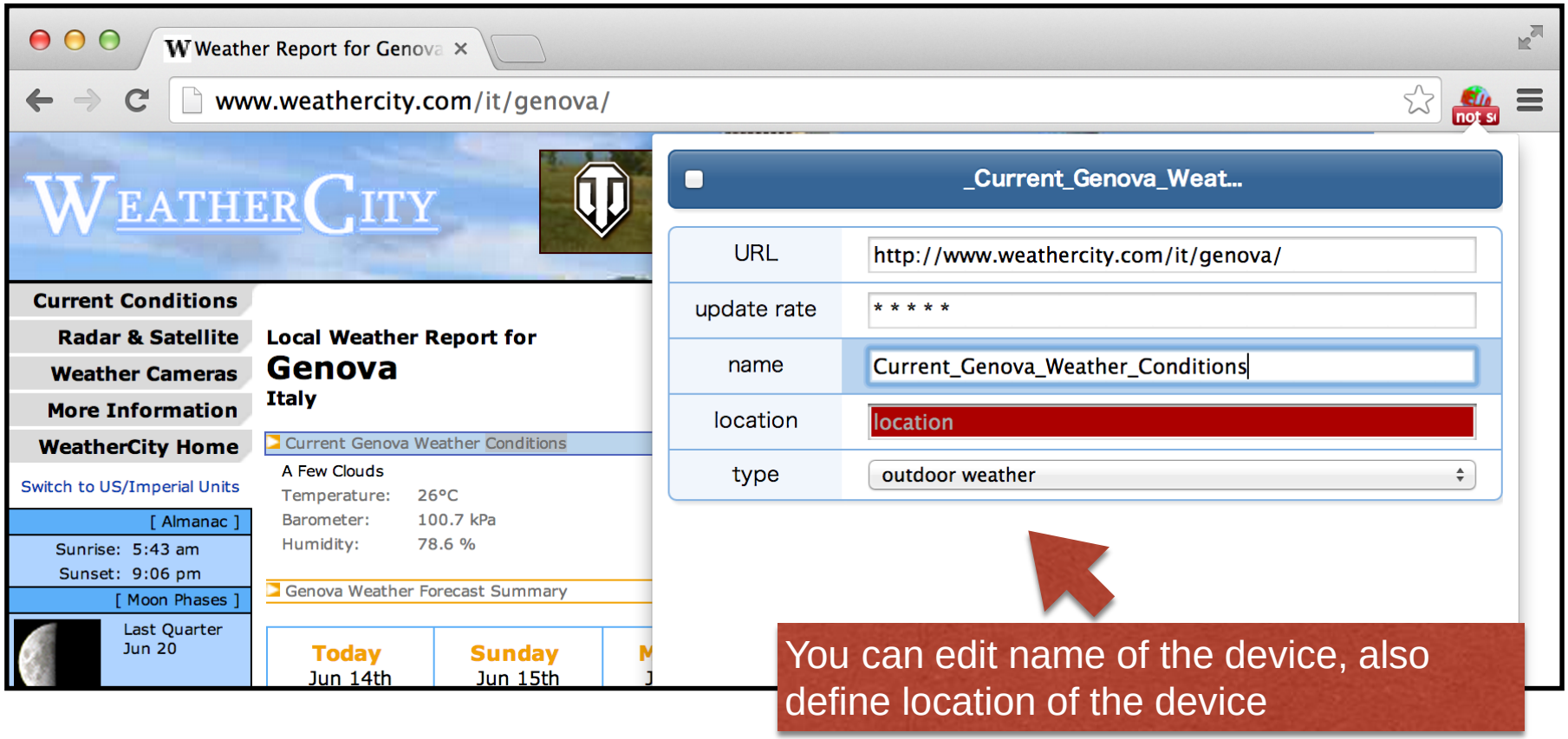
Just 4 steps :)

1. Create a virtual sensor device
2. Add sensors(we call transducers) to the virtual sensor device
3. Configure the information of the device and transducers
4. Sensorize !

1. Create a virtual sensor device

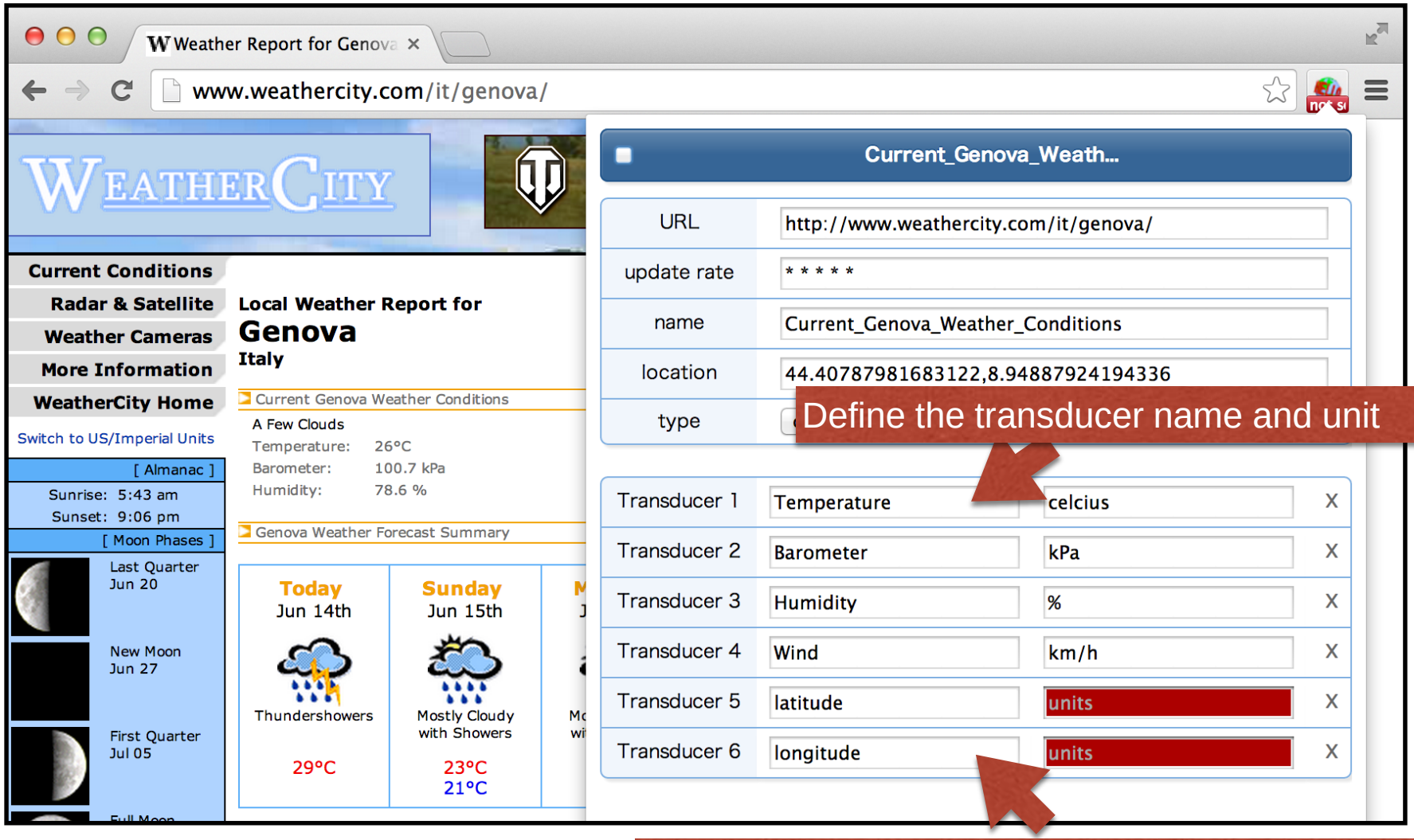


1. Create a virtual sensor device



2. Add transducers to the device

3. Configure the information of the node and transducers



Example of city data volume and diversity

- **Environment Type**

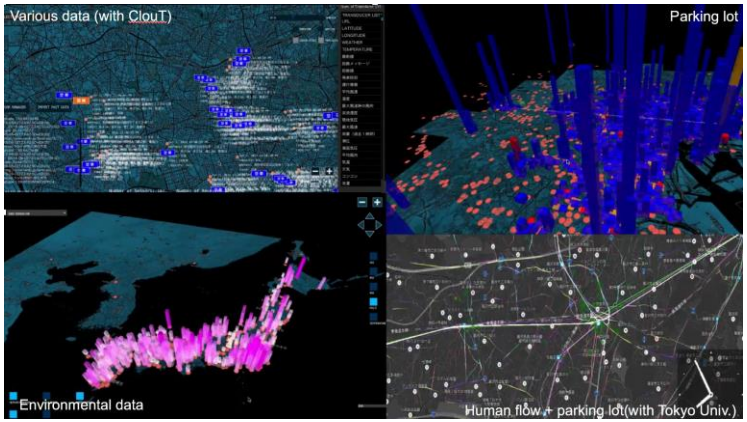
Temperature・Humidity
Weather・UV
Pollen・PM2.5/NOX/NO2..
Rain・River Level・Sea Level
Earthquake

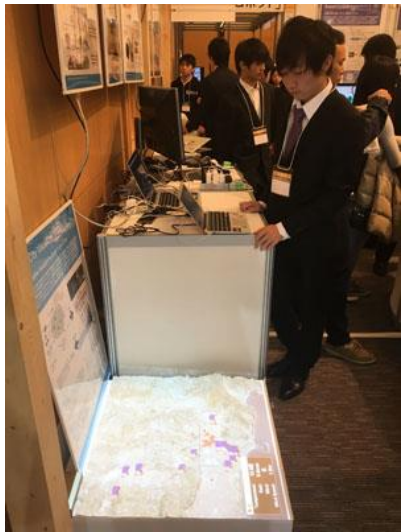
- **Industry Type**

Stock price
Gas price
Catch of Fish
Public transportation info.
Blood donation
Advertisement num.
Job offer
Housing price

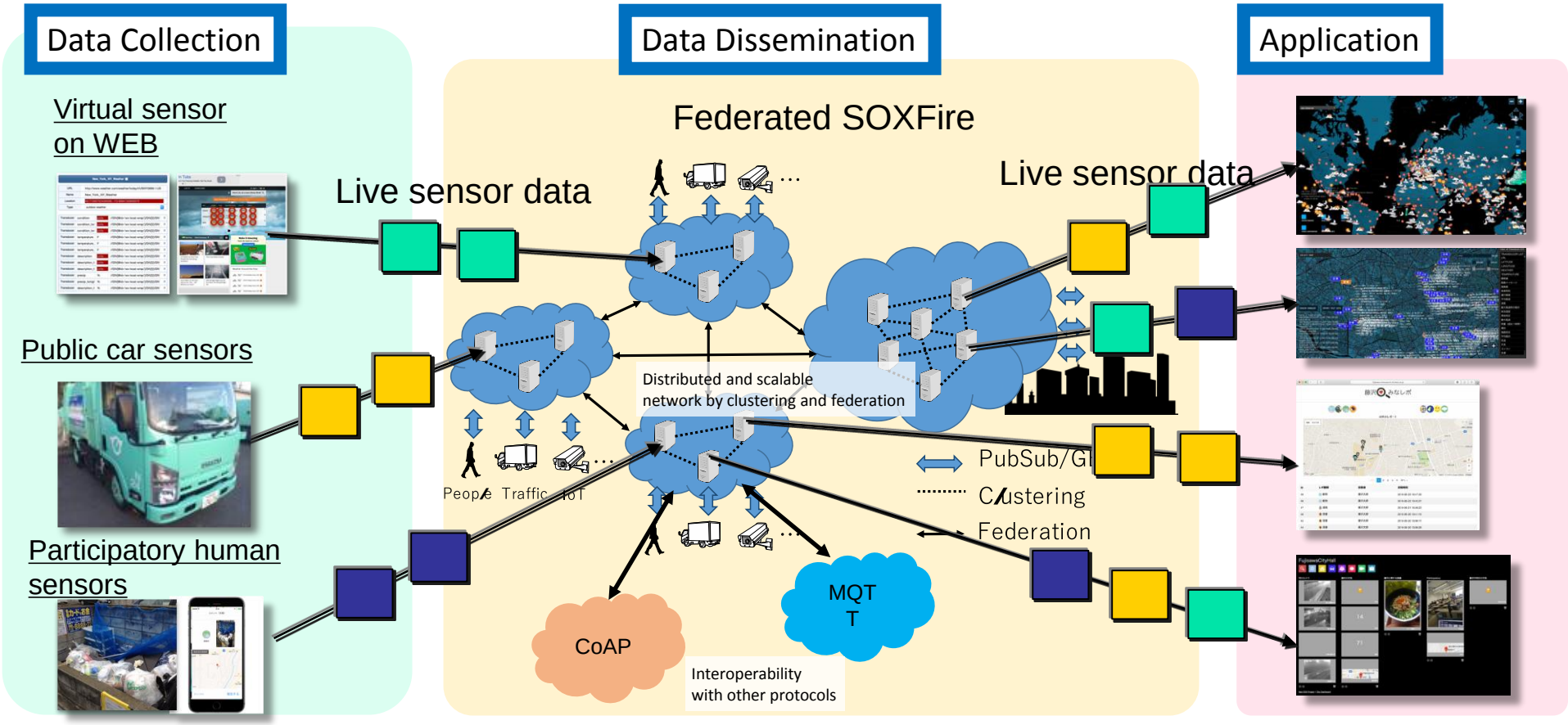
- **Human flow**

Parking lot info.
Traffic congestion
Number of tweets
Safety info.
Num. of people in Beach
Police information
Construction info.
Energy Power Consumption
Amount of garbage
Congestion of buses
Hotel availability
Number of Crime
Participatory Sensing
….





Open Smart City Platform

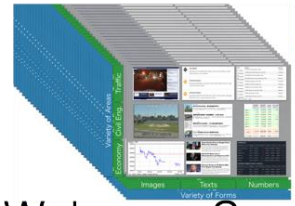


Data Dissemination Platform:
SOXFire (http://sox.ht.sfc.keio.ac.jp)
based on XMPP protocol

Data volume and diversity

Physical Sensor

Human as a Sensor



Web as a Sensor

CLOUT

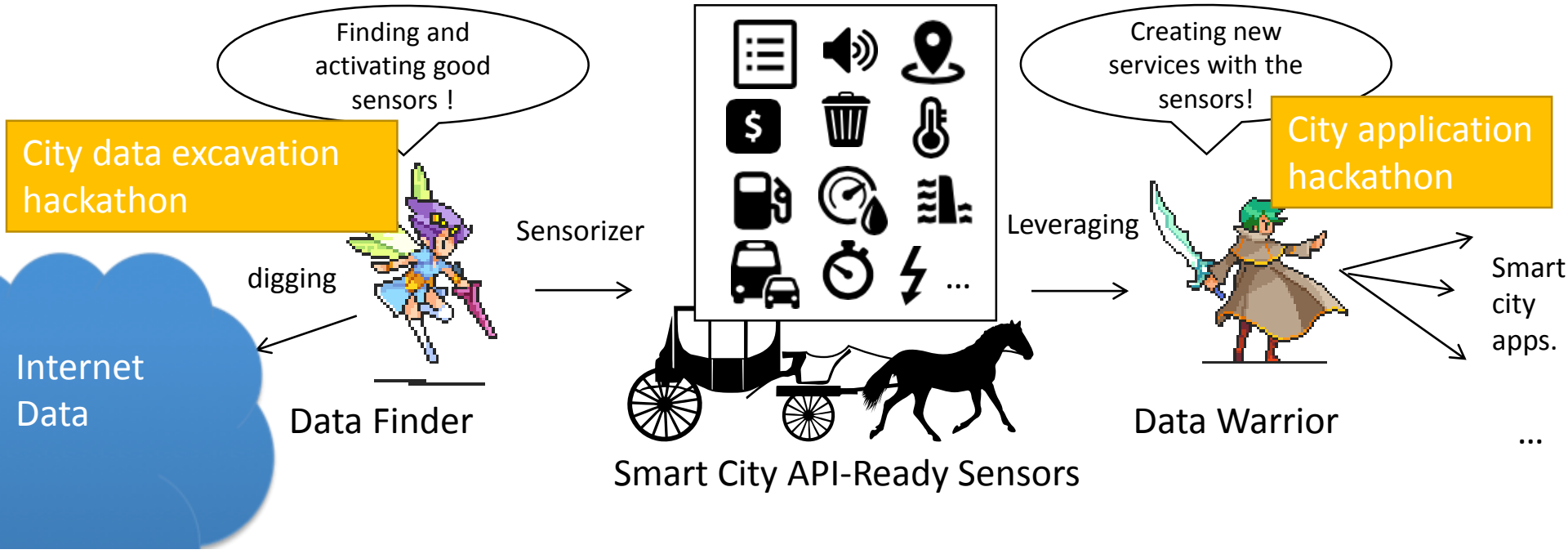
500,000
Virtual Sensor Nodes

5,000,000
Sensor Data Stream

20
GB/Day

Data Excavation Hackathon

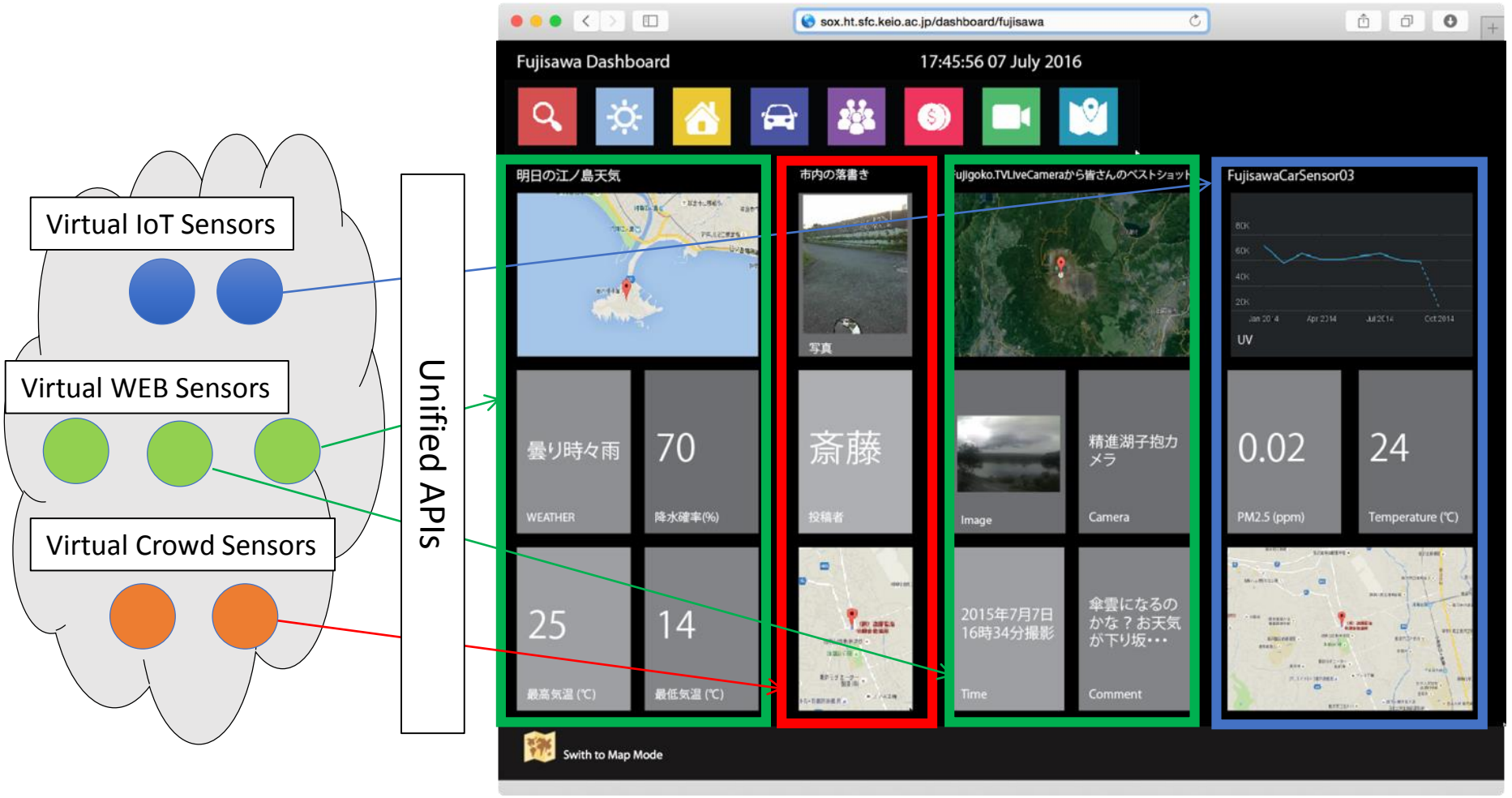
not only use already-opened data, but also find&sensorize data



Data Excavation Hackathon @Toyama, Japan

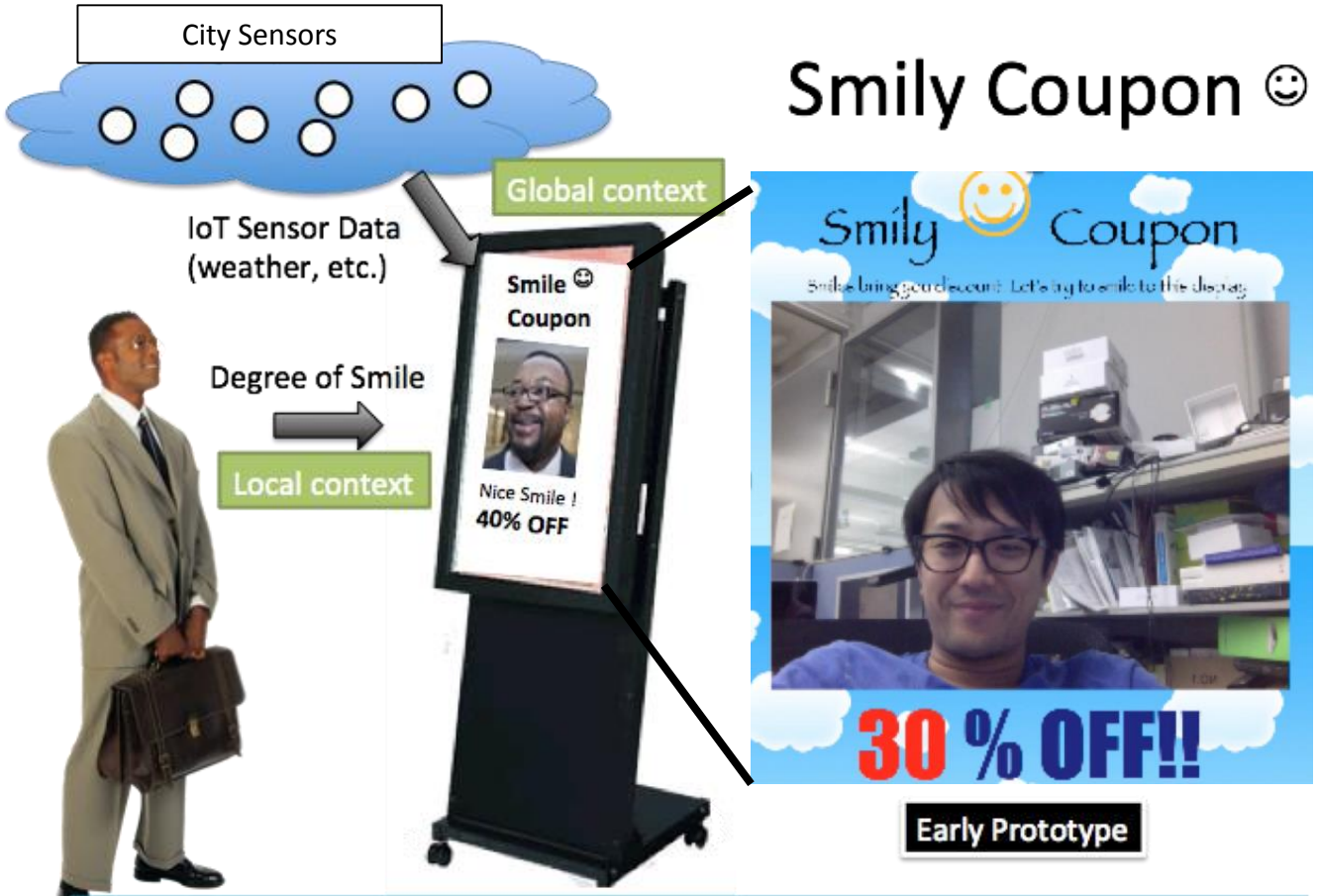
Multi-sensors integrated applications

City Dashboard



International Field Trials

Smily Coupon ☺



Early Prototype

- Leveraging local context (smile) + city context (via ClouT) for dynamic coupon system
- Enhancing affection to the coupon for changing human behavior !

Fujisawa, Japan

Santander, Spain

Lessons Learnt

- Only big companies / cities can lead smart city ?
  - should be NOT !
- Possibility to
  - leverage daily city service as sensing tasks
    - “sharksucker” sensing with public cars
    - City staffs acting as sensor
  - generate massive IoT data stream without new IoT deployment
- Possibility to leverage any city information to enhance any existing services
  - Open the data, then open community can leverage the data
  - Open Smart City Ecosystem

Thank you !

Information about our platform: http://www.sfcity.jp http://sox.ht.sfc.keio.ac.jp
Contact: takuro@ht.sfc.keio.ac.jp

FESTIVAL

FEderated interoperable SmarT ICT services deVelopment And testing pLatform

FESTIVAL Project

FEderated interoperable SmarT ICT services deVelopment And testing pLatform

Martino Maggio

Engineering Ingegneria Informatica SpA

martino.maggio@eng.it

FESTIVAL Project overview

FEderated interoperable SmarT ICT services deVelopment And testing pLatform

- Duration
  - October 2014 – September 2017
- Program
  - Horizon 2020 - EUJ-4-2014: Experimentation and development on federated Japan - EU testbeds
  - Japanese side: project funded by NICT (National Institute of Information and Communication Technology)

FESTIVAL Consortium

European Partners	Country
Commissariat à l'énergie atomique et aux énergies alternatives (CO)	France
Universidad de Cantabria	Spain
Engineering Ingegneria Informatica SpA	Italy
Easy Global Market	France
Inno TSD	France
Ayuntamiento de Santander	Spain
Sopra	France

Japanese Partners	Country
Osaka University (CO)	Japan
Japan Research Institute for Social Systems	Japan
Kyoto Sangyo University	Japan
Knowledge Capital Management Office	Japan
JR West Japan Communications	Japan
Ritsumeikan University	Japan
ACUTUS Software	Japan

Context and motivation

- Technologies and services developed for smart ICT need **adequate platforms for testing and validation**
- **Testbeds difficult and expensive to setup** for stakeholders that want to experiment their smart services
- There are **different testbeds** in Europe and in Japan that can be accessed by stakeholders; but mostly **domain specific isolated** testbeds, heterogeneous access methods, **lack of interoperability**
- IoT applications are quite **dependant to physical locations**. **Real-life testbeds** are thus necessary.

FESTIVAL Approach: Homogeneous access to a federated testbed platform with an "**Experimentation as a Service**" model for testing added value services in different domains (city, building, health, public services, art/culture, etc.) with real-life physical testbed environments **involving real end-users**

FESTIVAL Testbeds

Federation through an Uniform Access Layer offering **Experimentation as a Service**

Open Data Federation

SANTANDER

VILLE DE LYON

› Access to city data sets

IoT Gateway

Experimentation Facilities

SmartSantander
Large scale smart city

iHouse

› Experimental SmartHouse

› Experimental datacenter facility

ATR DC

PTL

› Advanced Microelectronics
› Integration Testbed

IT Resource Manager

Platforms

FIWARE Lab by ENGINEERING

› Cloud Environment
› Manage Virtual Machines
› Access Generic Enablers

JOSE

› Japan-wide
› Open Testbed
› Wireless Sensors
› SDN capabilities
› Cloud ressources

Living Lab Manager

Living Labs

TUBA - Lyon

The Lab - Osaka

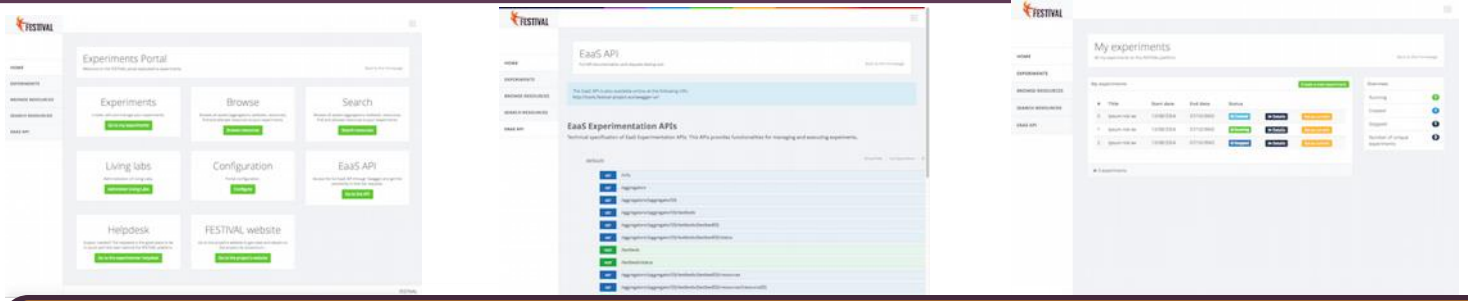
› Access to large base of end users
› Co creation processes
› Feedback from citizens

Project challenges

- Technical federation of different technologies and distributed/virtualised testbeds
- Definition of a uniform data model and API to access to heterogeneous resources and services
- Provisioning of a integrated platform to support (smart city) experimentations

FESTIVAL federation

FESTIVAL Portal



Experiment based federation

Experimentation as a Service API

Resource based federation

Resources

Open Data Federation

IoT Gateway
Experimentation Facilities

IT Resource Manager
Platforms

Living Lab Manager
Living Labs

Testbeds

DATA

SANTANDER

PTL

SmartSantander
Large scale smart city

JOSE

FIWARE Lab
by ENGINEERING

TUBA - Lyon

The Lab - Osaka

ATR DC

iHouse

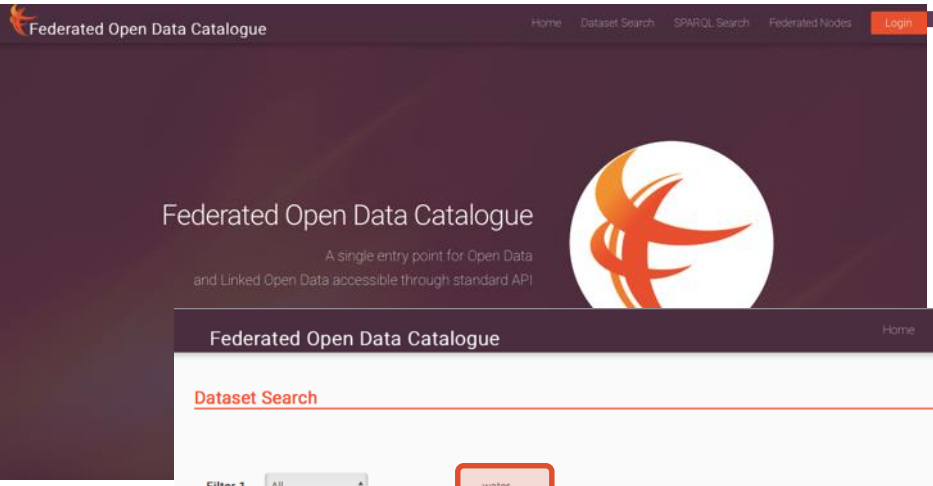
Open Data

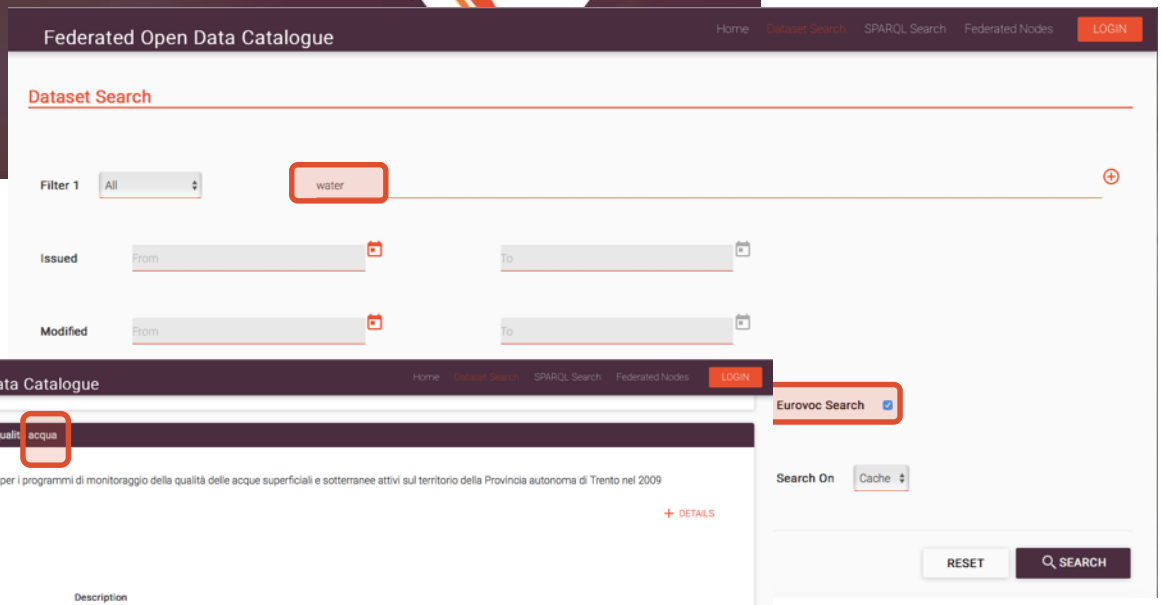
IoT Sensors

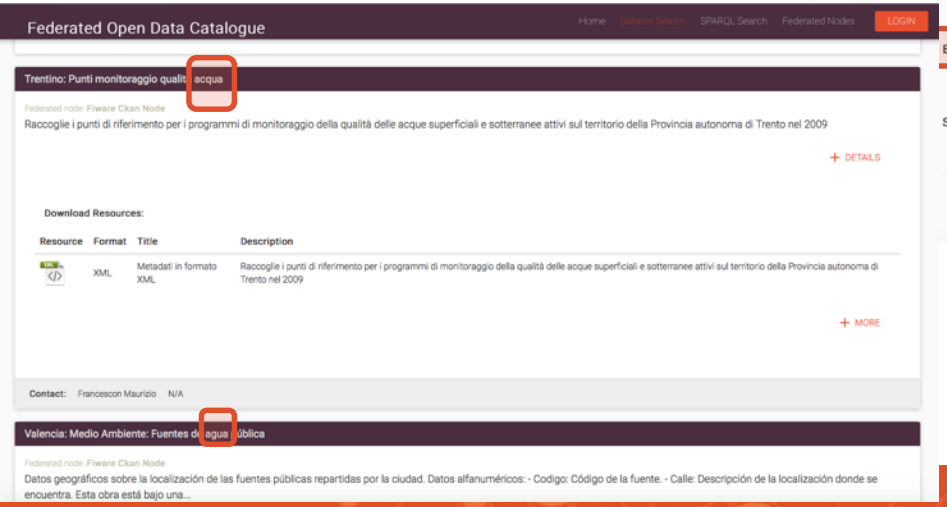
Virtual resources

People

Federated Open Data Catalogue







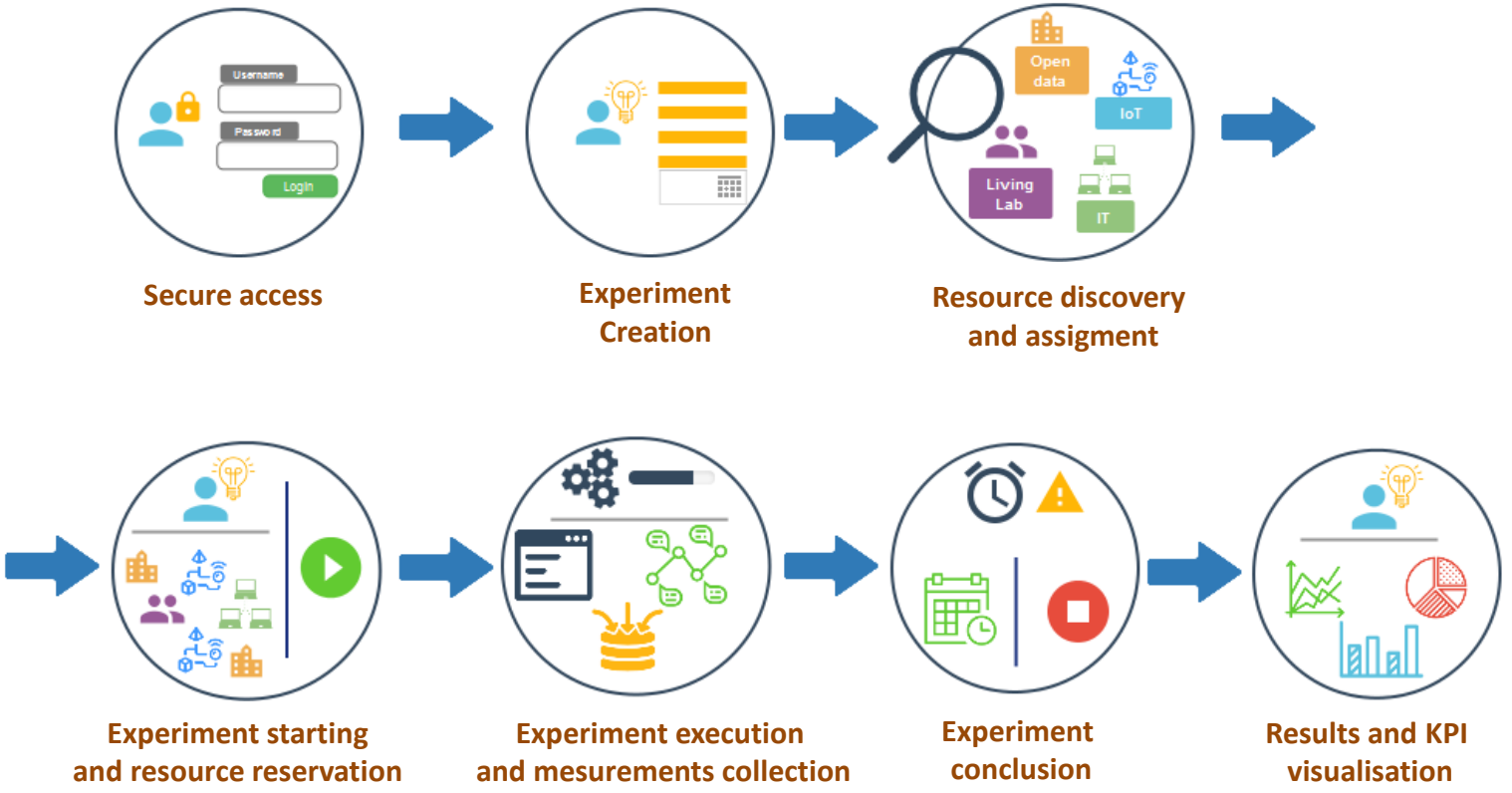
- The **Federated Open Data Catalogue** allows to search for open datasets, in a federated way, on multiple open data management systems

- **Multilanguage** search using Eurovoc thesaurus (http://eurovoc.europa.eu)
- Planned extension for **Japanese language**
- **API access for third party application**
- **Open source platform**

http://odplatform.eng.it/

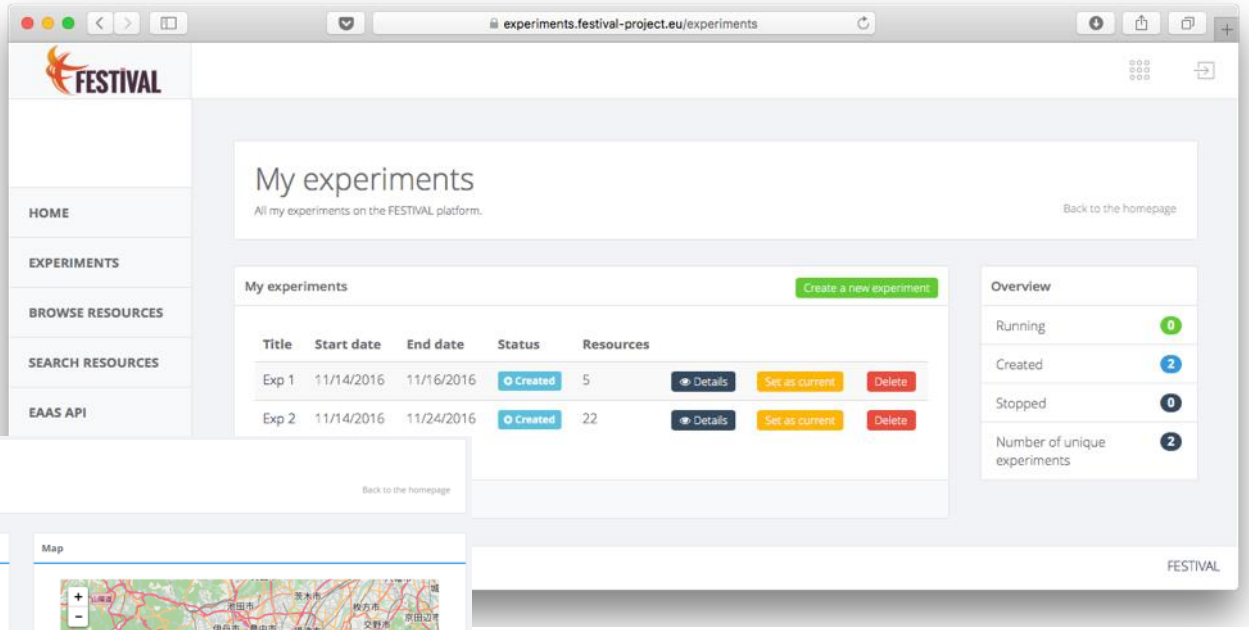
Experimentation Portal

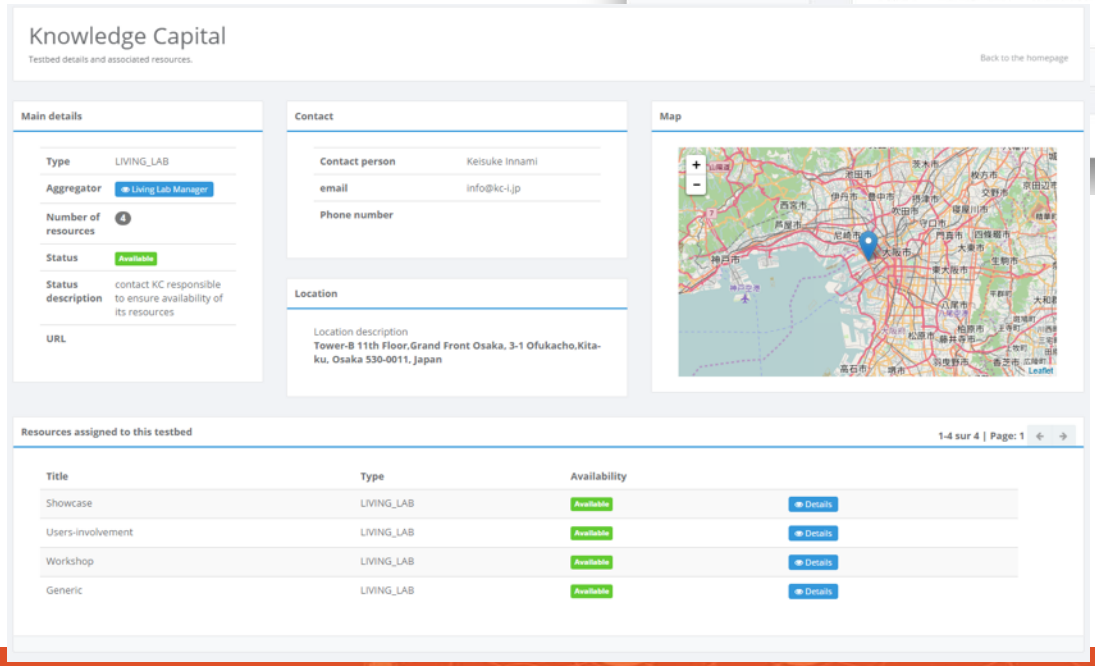
The experiment workflow



Experimentation Portal

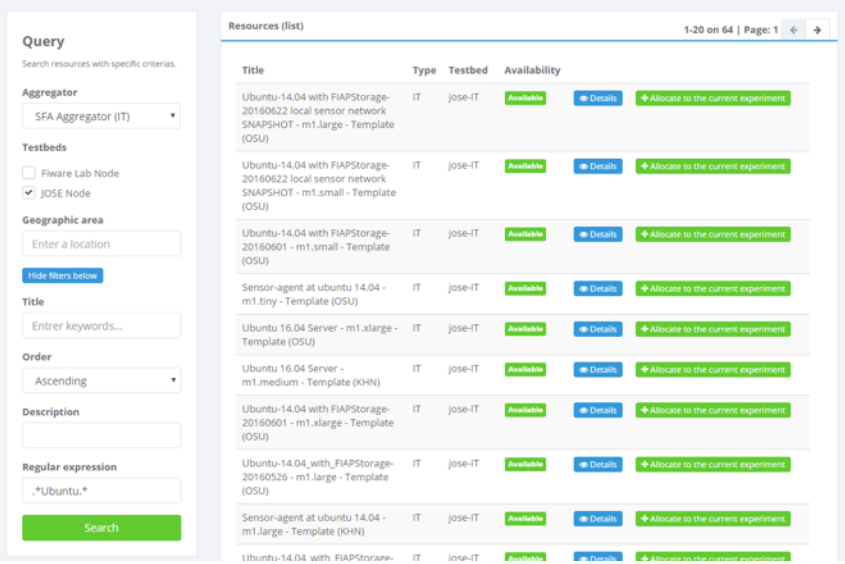
List of experiments





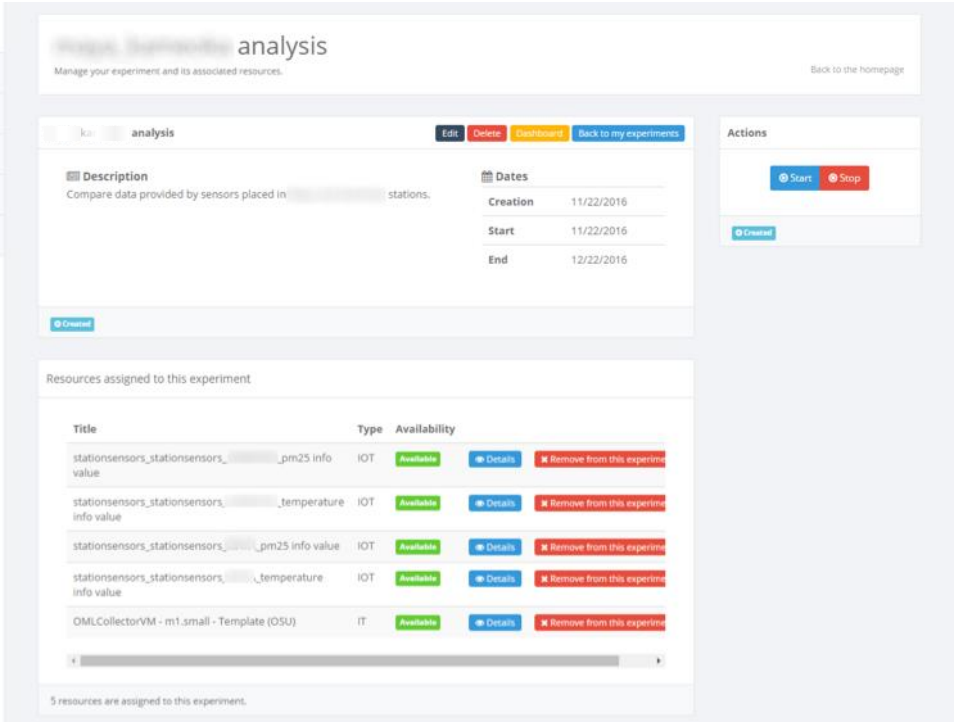
Resource discovery

Experimentation Portal



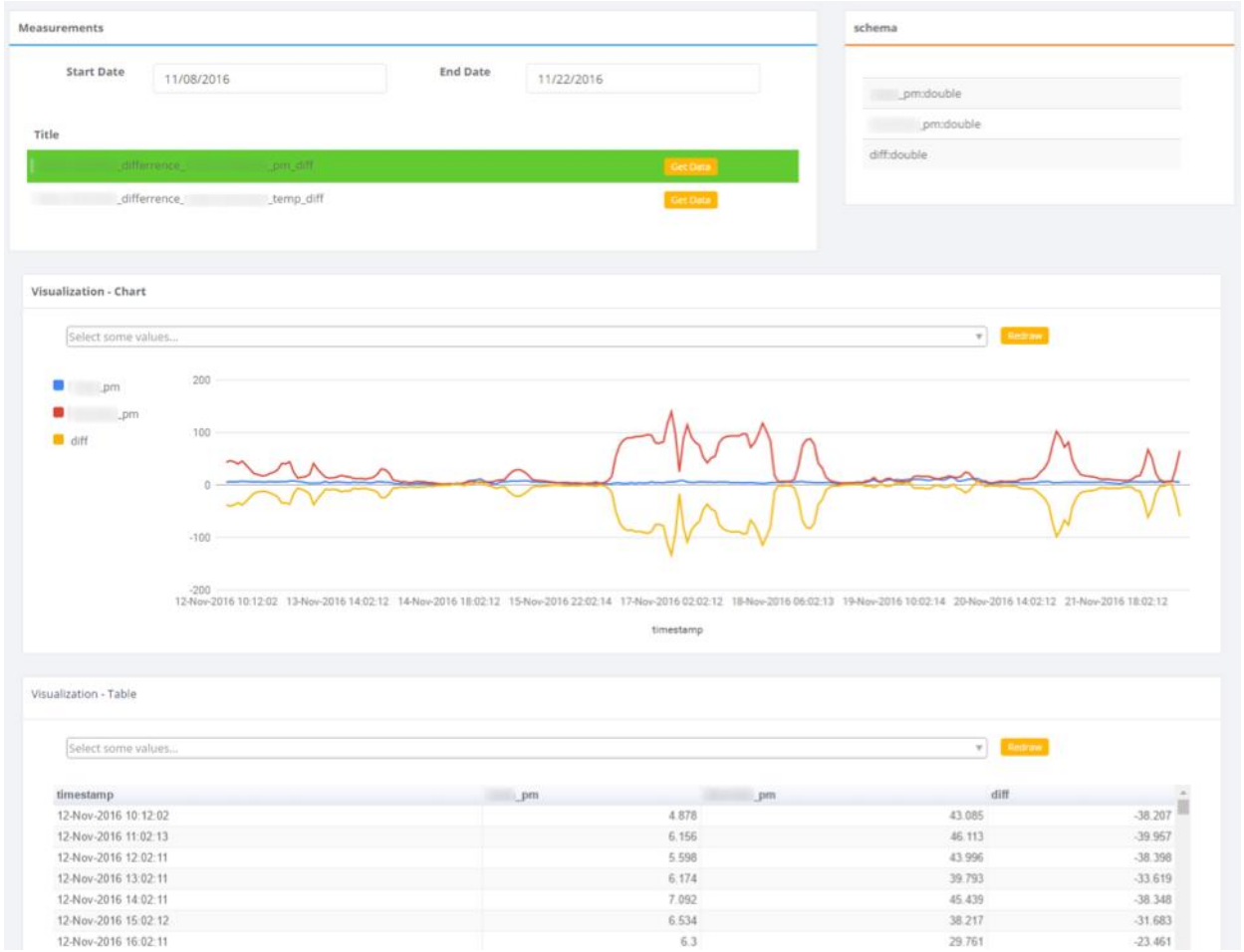
Advanced resource discovery

Experiment management



Experimentation Portal

Visualization of measurements collected during execution



3 Target application domains

Smart energy

Smart building

Smart shopping

iHouse

PTL

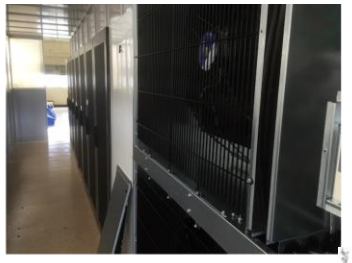
GFO – The Lab

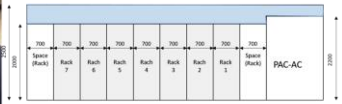
Santander

Selected applications and experiments

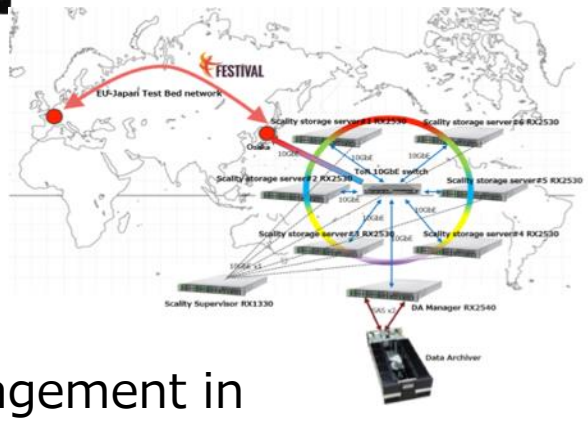
@Santander
Mercado del Este
Connected shop
Advertised premium discount

@Tokyo ATR Data Center
Smart Data Center

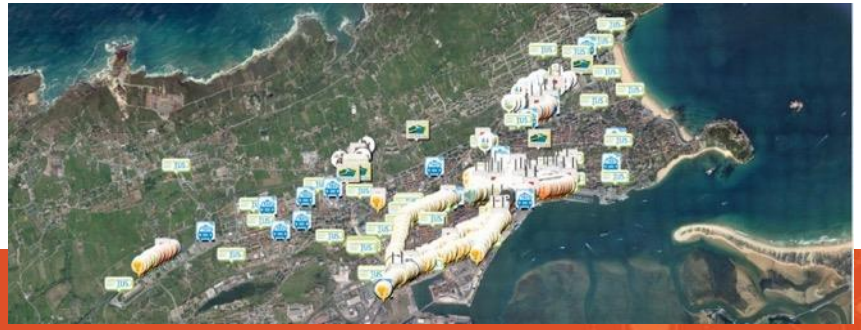




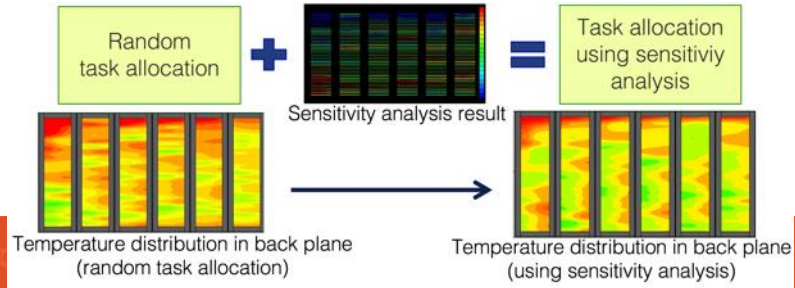
Cold Storage
Geo-replication



@Santander SmartSantander
Sensor data from SmartSantander are provided as Open Data

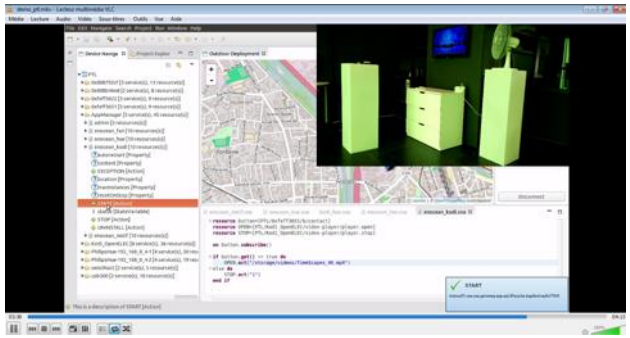


Energy Management in Data Center (xEMS)



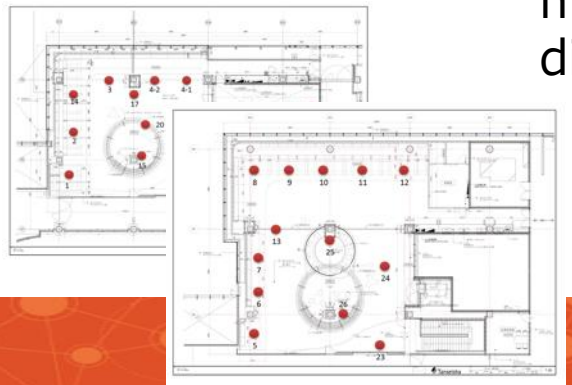
Selected applications and experiments

@Grenoble, PTL
Smart Energy Management in Experimental Smart House

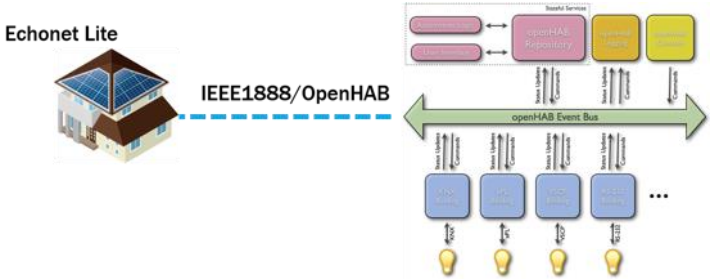


@Kobe, Minato Kanko (Bus company)
Safe driving support system

@Osaka, The Lab.
Recommendation analysis system



@Ishikawa, iHouse
Energy Management in Protocol Agnostic Smart House



@Kobe & Kyoto, Maya, Kameoka Station (JR)
Environmental monitoring using digital signage space

Several other applications will start up soon

Expected impacts

Building Interoperability

"Developing joint open architecture for federation of testbeds"

"Validating Interoperable Technologies for IoT and Smart ICT"

Federation of Smart (ICT) Testbeds

"federation of testbeds with world scale dimension in view of re-usability with other international experimental platforms"

"Enlarging the scope and facilitating the access to Japanese and European experimental facilities to a larger community of researchers in both regions"

Small and Large Scale Experimentations

"Enabling very large experimentation and trials including end-users or citizens"

"Addressing common social, economic and cultural aspects between Japan and Europe."

Smart Growth: developing local ICT ecosystems with a global reach around testbeds

Inclusive, bottom up innovation : user engagement in trials

Openness and Interoperability : reaching to a larger community of testbeds and experimentations

FESTIVAL Call for Experimenters

FESTIVAL offers key IoT resources in Europe and Japan

- For who? Researchers, SMEs, startups, innovators, developers…
- For what? To experiment with FESTIVAL testbeds in Europe and in Japan from smart building, smart energy, smart shopping and smart city domains.
- How? Through federated FESTIVAL Platform with easy-to-use APIs and the Experimenters Portal

The experimenters will benefit from the state of the art IoT testbeds and access to large quantity of IoT devices, open data repositories and computing resources in Europe and in Japan.
A Kit for Experimenters will be available on the FESTIVAL website from November 1st !

- **Call remains open from Nov. 2016 to April. 2017, New applicants will be selected every month**
- **No financial support. Support will be provided to experimenters through the online documentation, webinars and a helpdesk**

Contact : enduser@festival-project.eu
Web link : http://www.festival-project.eu/en/?page_id=941
Twitter : @Festival_EU_JP

For more information

www.festival-project.eu

THANK YOU FOR YOUR ATTENTION

ありがとうございます

Join us!

We are joining forces to build a global alliance for open and smart cities

Want to join us ? Contact: levent.gurgen@cea.fr