Federating open innovation in cities

Fed4Cities – phase 2

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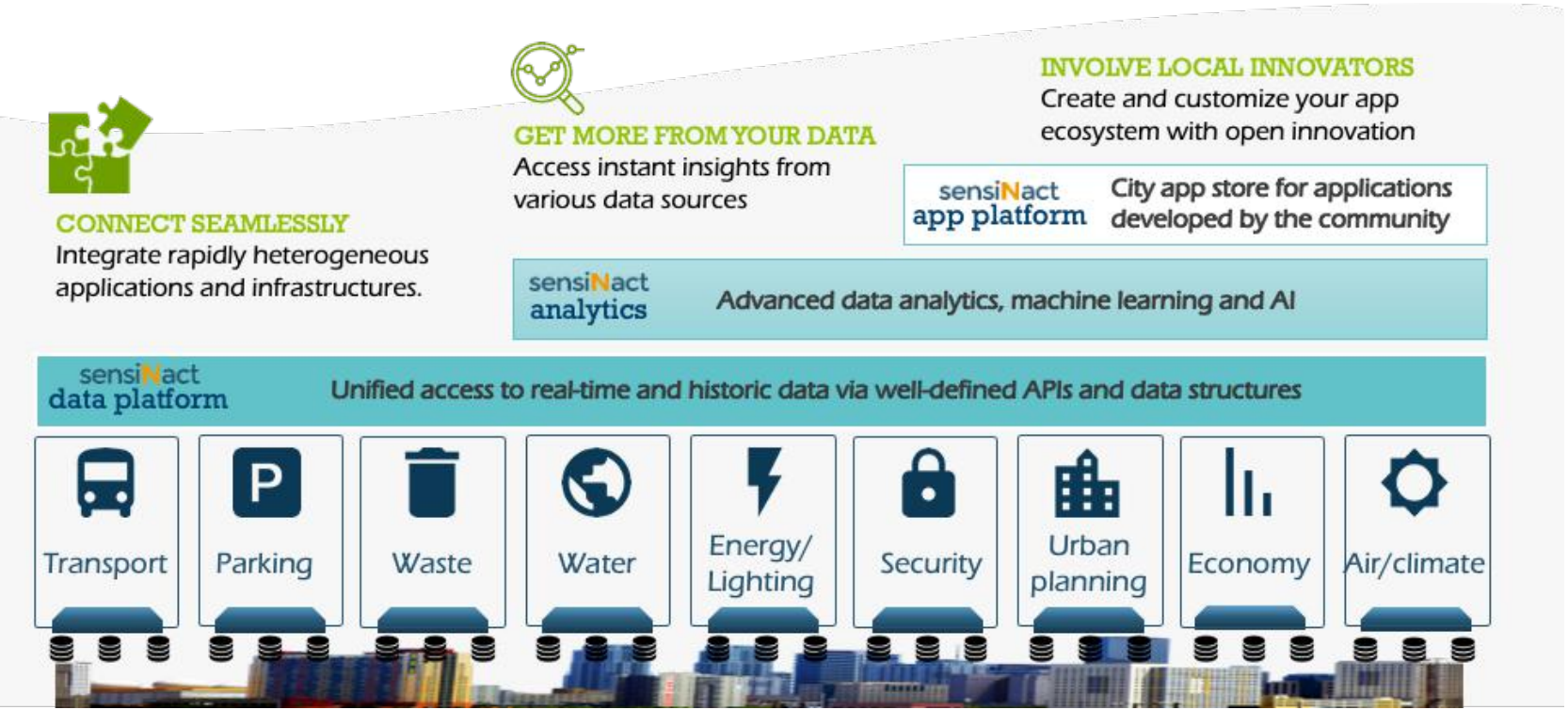
Christophe Munilla

Levent Gürgen

Kentyou's horizontal open approach fostering innovation



Concept & Objectives

Going beyond data hub –> Distributed data analysis

Main goals of the experiment:

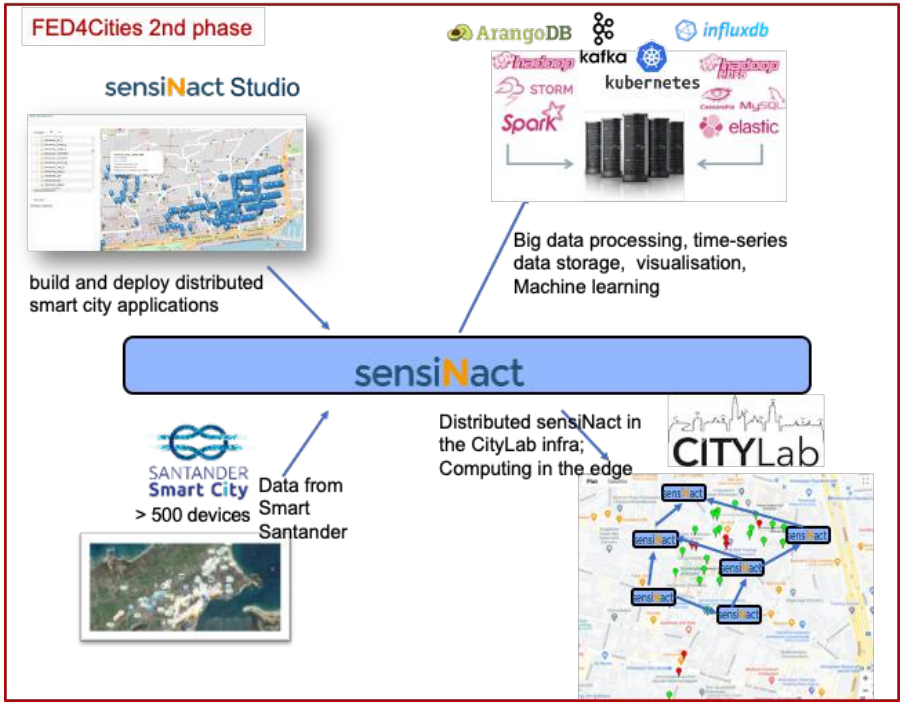
- Integrating heterogenous data sources (1st phase)
- Testing sensiNact's distributed approach (2nd phase)
- Analyzing collected data to provide insights and predictions (2nd phase)

Experiment set-up, overall architecture

sensiNact – Distributed data analysis

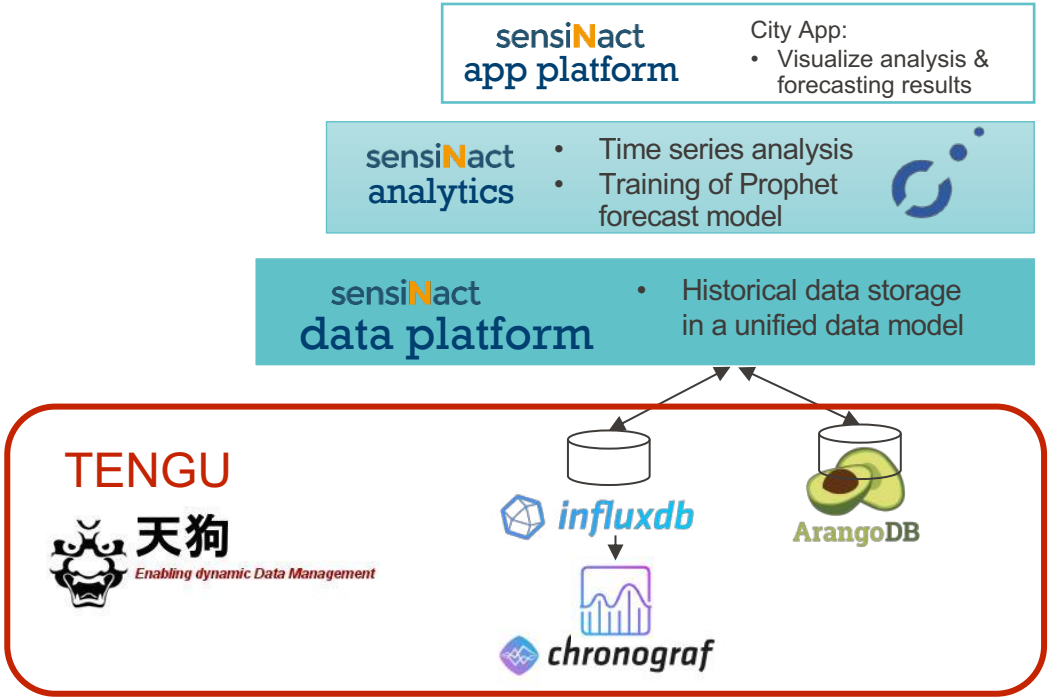
- Configuration of the testbed using JFed Tool
- Deployment of sensiNact instances among CityLab testbed nodes
- Connection to SmartSantander through the subscription API (certificate required)
- Data recording into Tengu's InfluxDB instance

Interconnection of the different testbeds required the configuration of port forwarding intermediates



Experiment set-up, overall architecture

Parking Analysis



Parking Analysis main goals

1. Understand topology of parking spots
    - Dense parking areas and proximity of parking spots
2. Analyze data and provide parking forecasts for different geographic granularities:
    - Entire Santander city
    - Smaller neighborhoods

   … and different temporal granularities:
    - Next 15 mins
    - Next day

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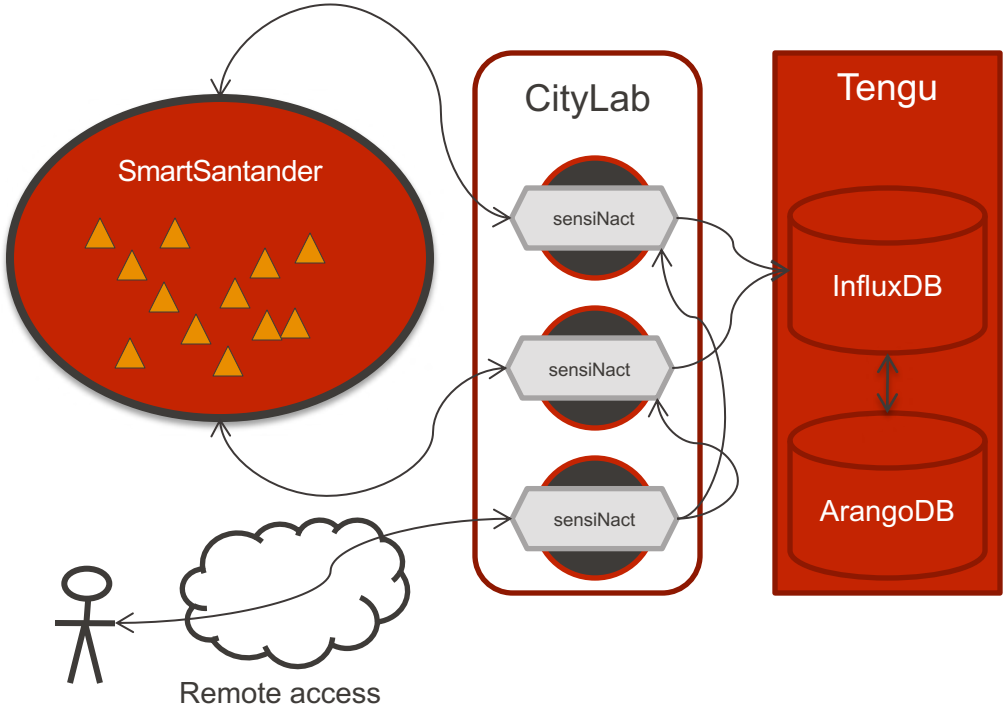
PROJECT RESULTS

Measurements

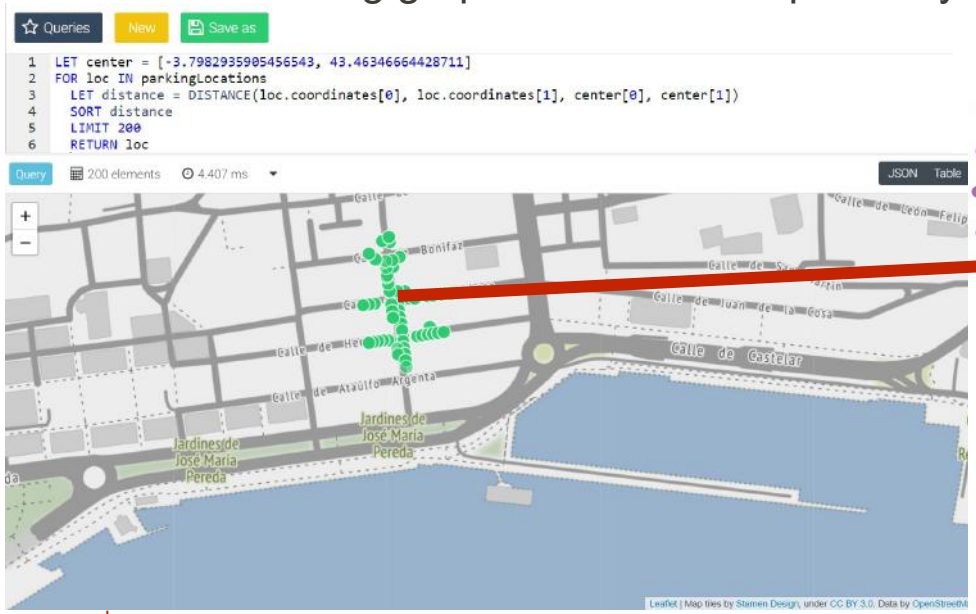
sensiNact – Distributed data analysis

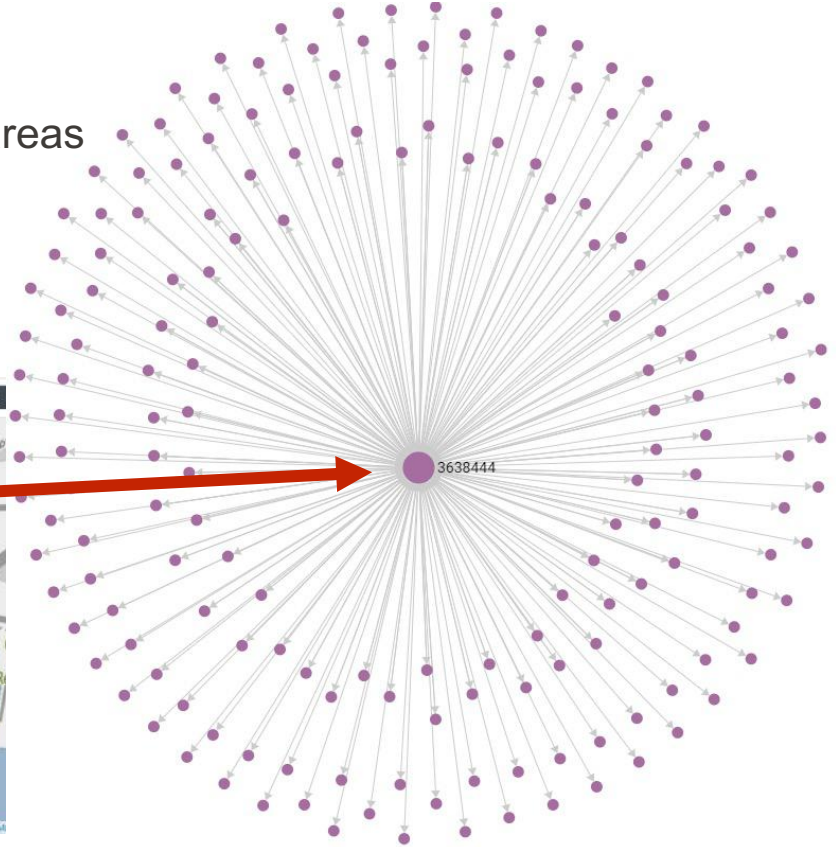
- Integration of SmartSantander, CityLab and Tengu testbeds
- More than 350 nodes connected (parking sensors, environmental sensors, etc. - fixed and mobile) to sensiNact instances
- Less than 2 seconds (average : 1.689s) to collect data from Santander into CityLab instances, to process and to store them into Tengu's InfluxDB dedicated database
- Definition of a sensiNact disk image to easy deployment on CityLab nodes : distribution among 3 nodes ➔ business logic and concerns decoupling priority before distribution-for-itself.
- Five applications created related to parking places and environmental data (real-time information on environmental data, real-time parking space finder, historic parking data analysis, prediction of parking place, correlation of environmental data with pollution data (on-going), etc).



Parking Analysis – Results (1/4)

1. Understand topology of parking spots
    - Querying ArangoDB revealed dense areas
    - Plotting graph revealed their proximity

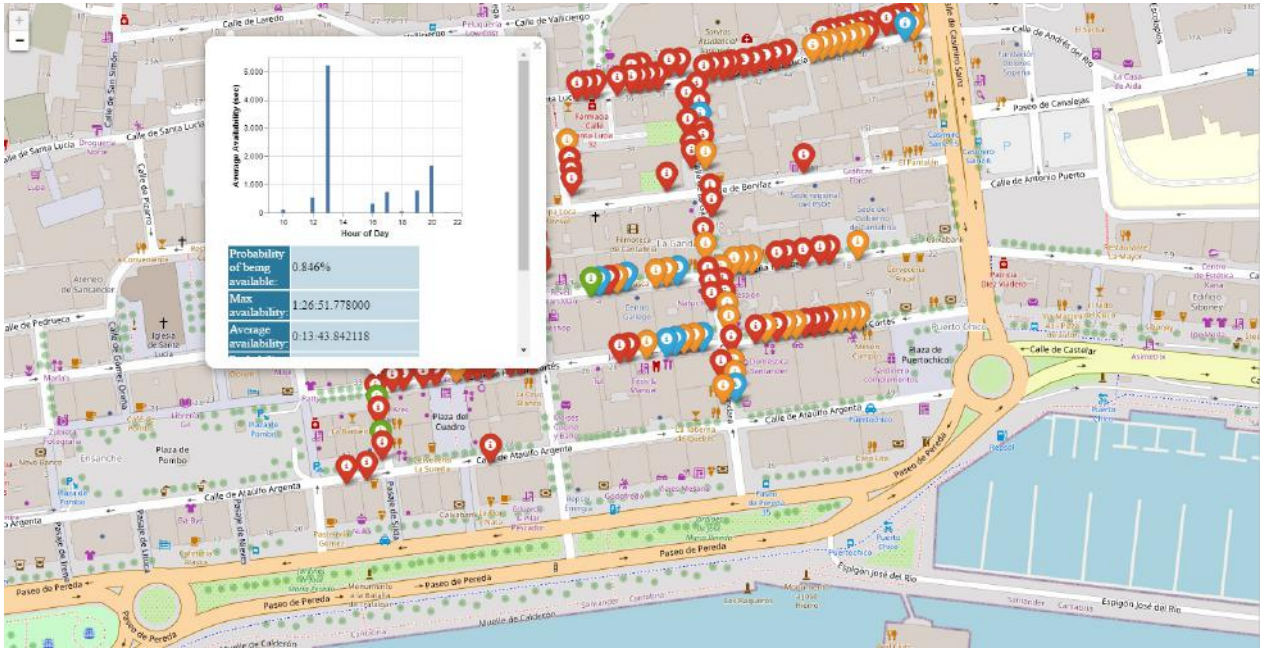




Parking Analysis – Results (2/4)

Analyze data:

- Average availability/occupancy duration over time
- Max availability/ occupancy duration
- Probability of being available/occupied



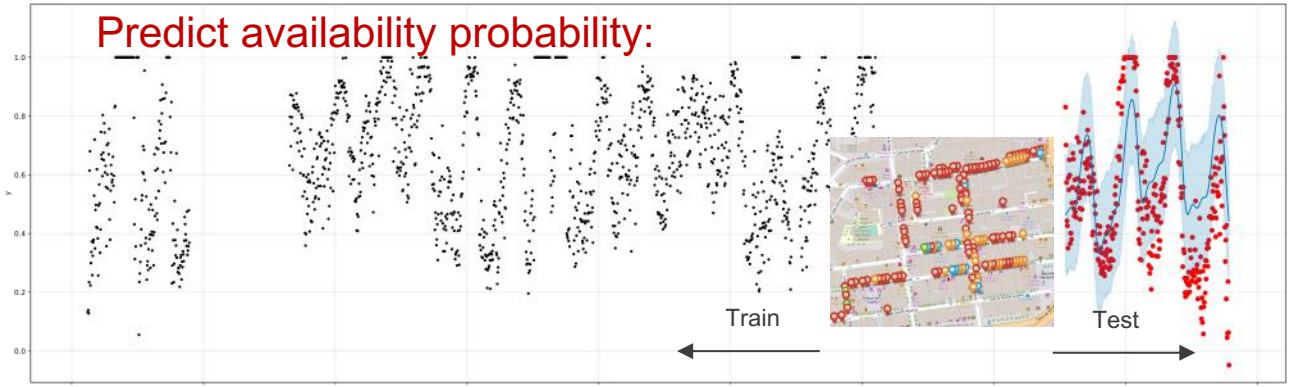
Parking Analysis – Results (3/4)

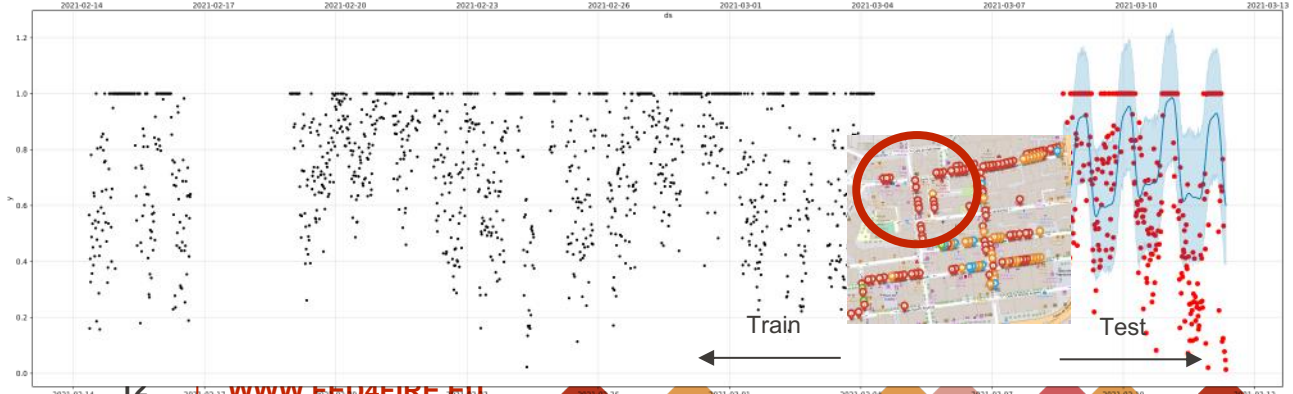
Visualization of historical data with Chronograf Dashboard

- Quick understanding of downtimes
- Real-time monitoring of parking and environmental data

Parking Analysis – Results (4/4)

GEO-GRANULARITY





TIME GRANULARITY

Now: 2021-03-08 18:44:23.827

After 15 mins: 70.2%
After 1 day: 66.2%

Now: 2021-03-08 16:59:37.012

After 15 mins: 22.43%
After 1 day: 21.18%

sensiNact – Distributed environment & data analysis

Lessons learned

- Continuous improvement of sensiNact distribution management :
  - Need to handle load balancing mechanism for a stable distributed front-end (implies disconnected mode or specific session storage)
  - Improvement of inter-sensiNact instances communication mechanism
- Improvement of automatic storage schema for time-series databases
- Advancements in data analysis by using time-series and graph-based databases
- Need for spatio-temporal fine-grained forecasts

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BUSINESS IMPACT

Business Impact

Why FED4FIRE+?

Smart city solutions should be validated in real life environments

- Smart Santander provides the unique possibility of working with real devices and close to operational environment
- Tengu provides environment for testing algorithms requiring high intensive big data processing
- City Lab provides a distributed edge environment, where edge processing gains increasing importance vs cloud environments
- Startups and SMEs can not setup such large scale infrastructures
- Unique opportunity for small companies

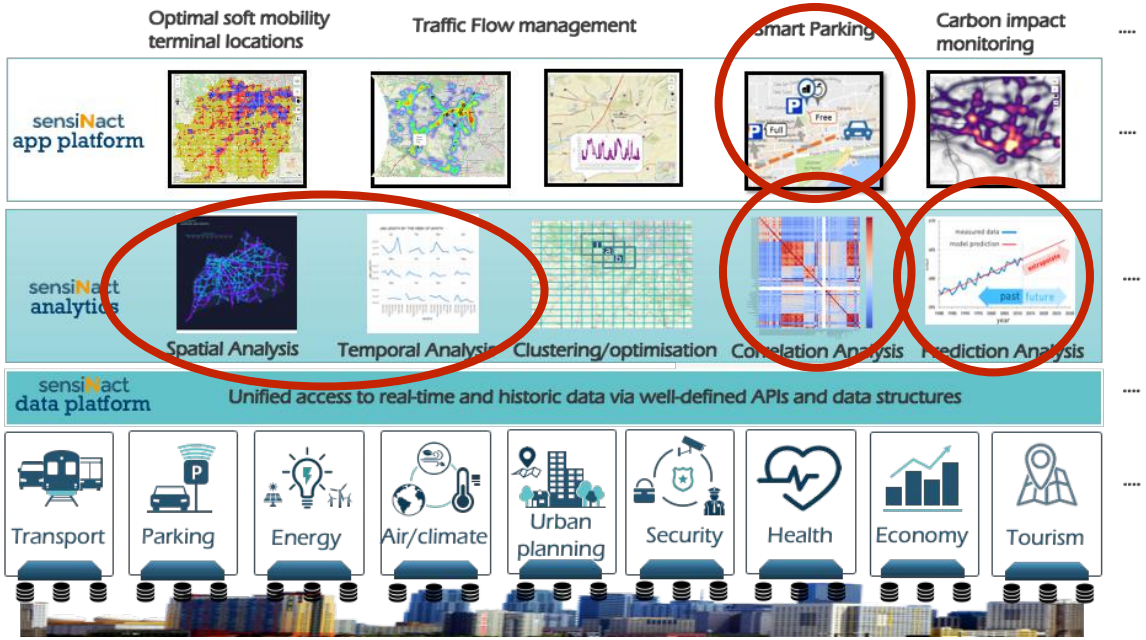
Business Impact

Opportunity to demonstrate our added value:

- Breaking silos, building easily cross-domain applications
- Distributed deployment of micro-services
- Composition of micro-services at the edge platforms
- Predict parking availability for different areas and time periods
- Semantic modeling of city data (parking, weather, transportation) to enable further innovation (transportation recommendations)

Business Impact

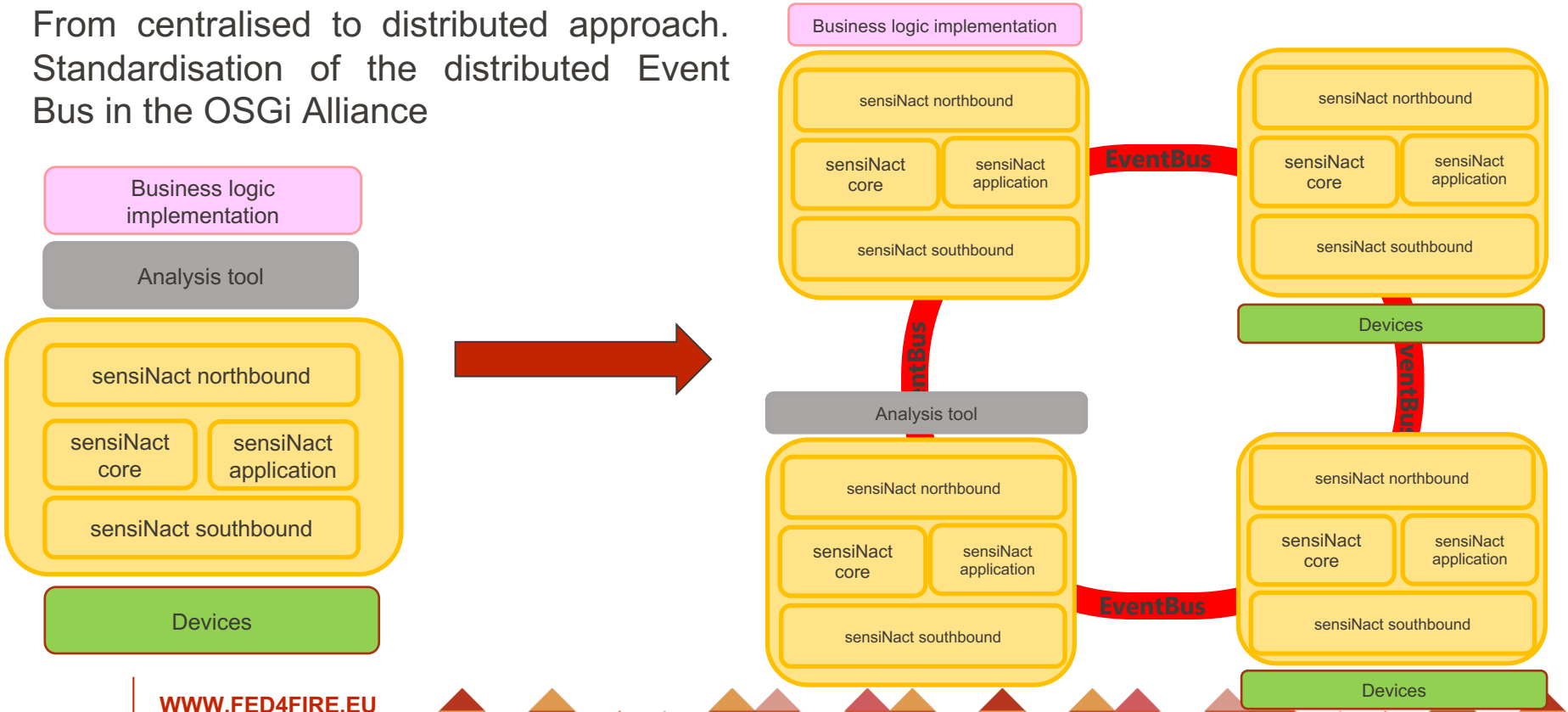
Parking Place Prediction use case to be integrated to our application catalogue related to mobility!



Business Impact

Integration of the distributed features to sensiNact

From centralised to distributed approach. Standardisation of the distributed Event Bus in the OSGi Alliance



Other value perceived

- Access to real life data from Santander
- Experimenting for the first time with tools and frameworks (InfluxDB, ArangoDB, Chronograf, etc.)
- Quick prototyping, experimentation setup
- Wide range of sensor devices, data types, hardware on which to experiment
- Wide range of network topologies possibly defined
- Helpful in precising system limits

天狗
Enabling dynamic Data Management

FED4FIRE

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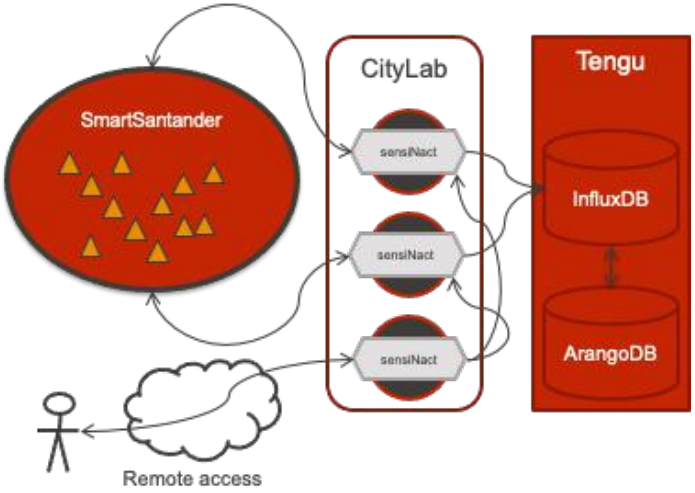
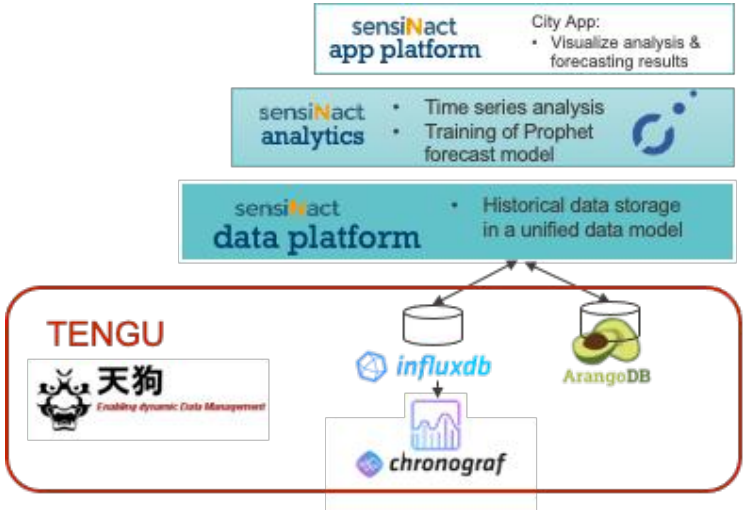
FEEDBACK

FED4Fire – Used Tools

- Configuration and execution of the test using the JFed graphical interface
- A sensiNact disk image was created allowing an easy deployment of the sensiNact distribution and of the java runtime environment



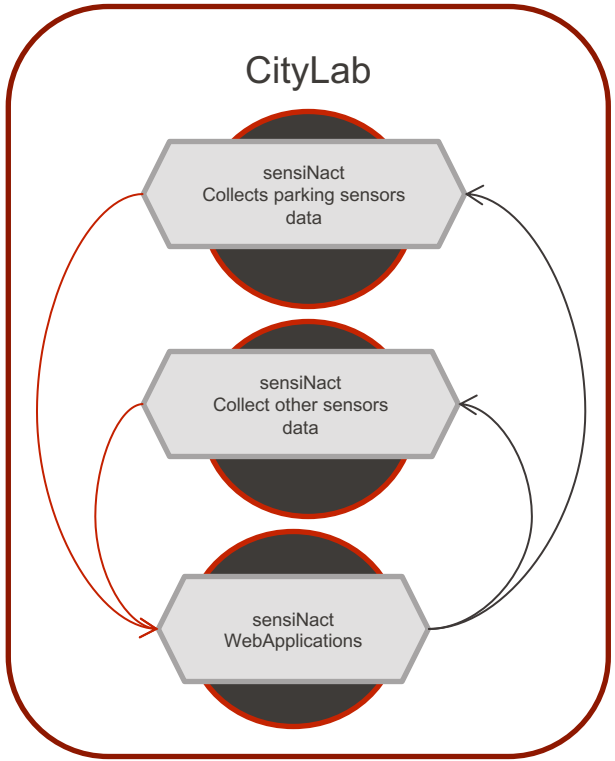


FED4Fire – Used Resources

- As for phase 1, all resources providing events in SmartSantander testbed were reified in the sensiNact platform(s). Three CityLab nodes where configured to run the test(s)
- Three CityLab nodes where configured to run the test(s)
- One InfluxDB container was available on Tengu platform, as well as one ArangoDB container
- Two external nodes (on premises nodes) where used to enable SSH port forwarding and to allow interconnection between testbeds
- As it was the case in phase 1 an external webservice allowing to retrieve the coordinates of an address has been used

Other Feedback

- Encountered issues at putting the EventBus in place in the context of the experiment (network configuration issues and security requirements)
- Decided to use the already existing peer to peer solution to enable the communication between sensiNact instances
- Referents for each testbed in use provided the support helping at facing the encountered issues during the experiment set up
- The documentation for each testbed is abundant and contains a lot of relevant information. For some part it may need to be updated but it is generally more than enough to initiate the work



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