Exploiting clouds for smart cities applications
The Cagliari 2020 project

UNIONE EUROPEA
Fondo Europeo di Sviluppo Regionale

PON Ricerca e Competitività 2007-2013

Ministero dell'Istruzione, dell'Università e della Ricerca

Ministero dello Sviluppo Economico

- Alberto Masoni & Daniele Mura
- INFN, National Institute of Nuclear Physics

CAGLIARI 2020

WHO

WHERE

WHY

WHAT & WHEN

HOW

WHO

Partnership of

- Private companies

- University of Cagliari

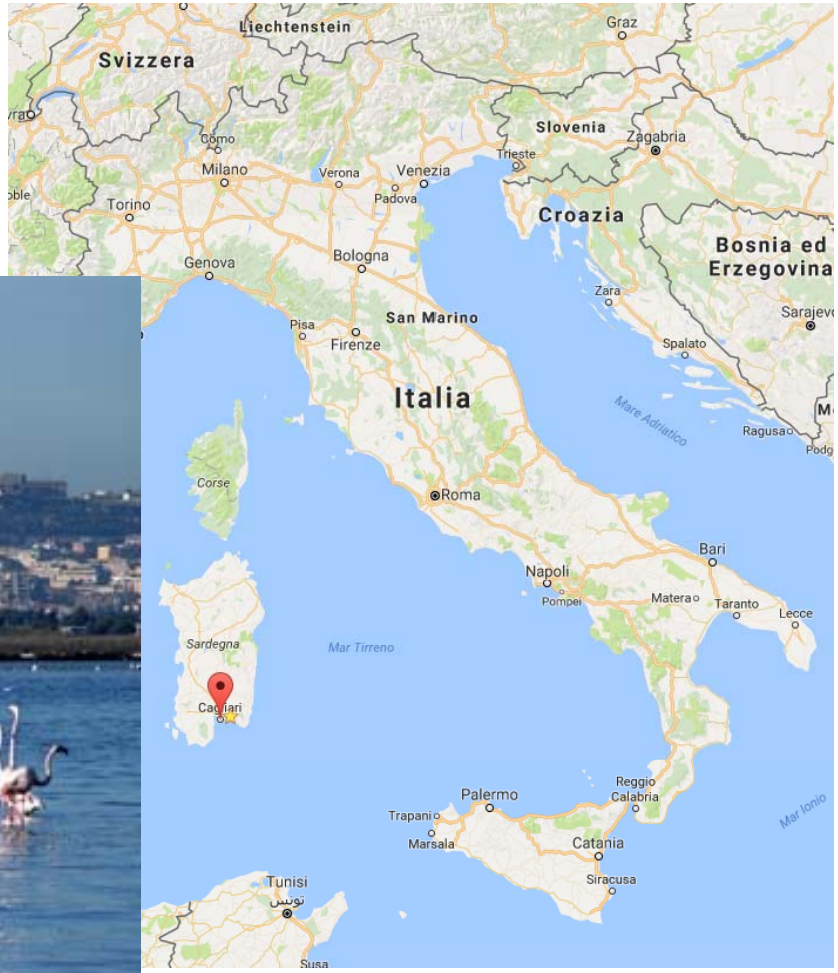
- INFN – National Institute of Nuclear Physics

- Research Centre funded by Regional Government

In cooperation with **CTM** the local **C**ompany for public **T**ransportation and **M**obility

WHERE

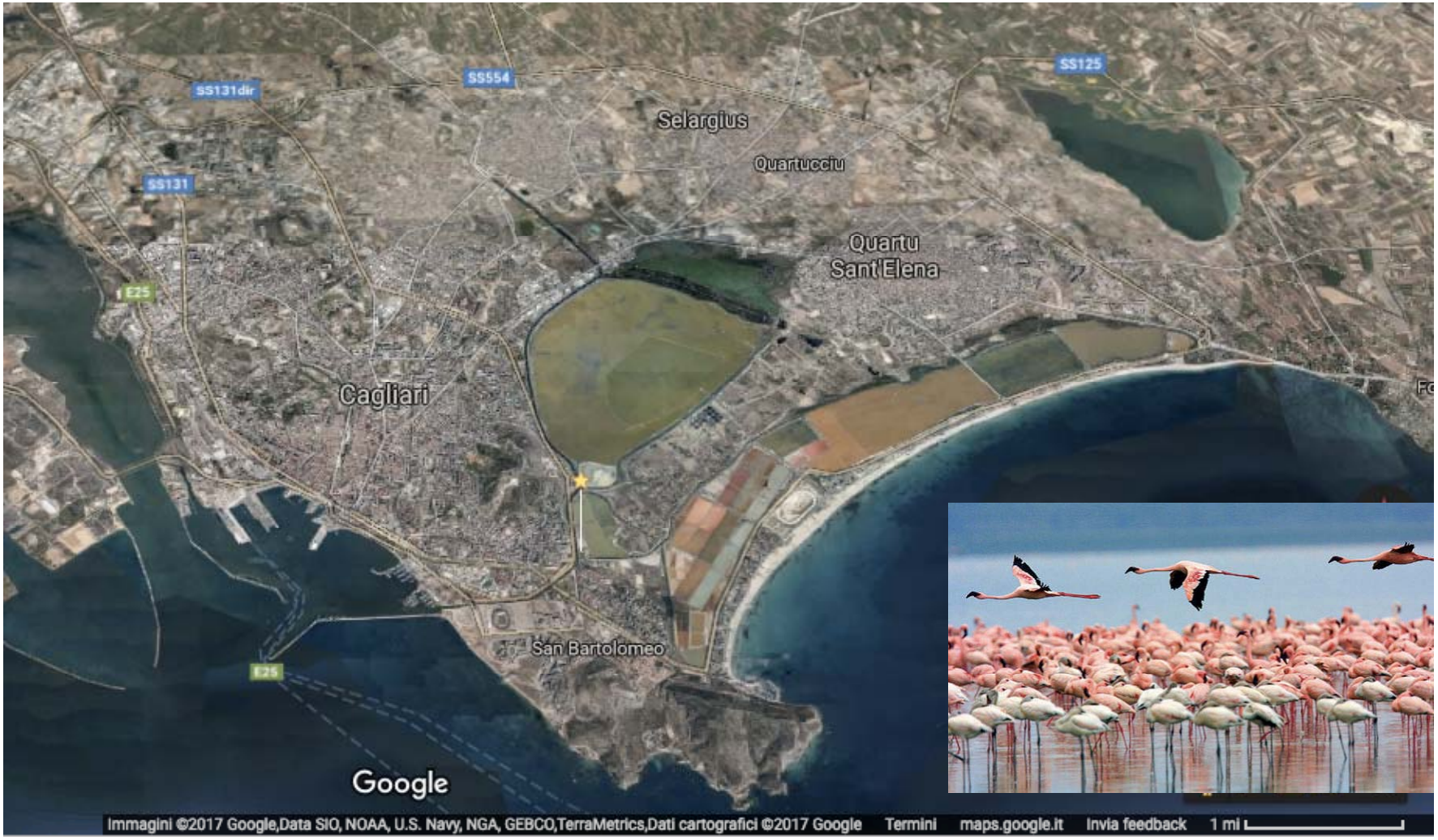
CAGLIARI



Physics is like skiing,
there are not difficult slopes…
there are slopes more interesting than other ones

Victor Weisskopf

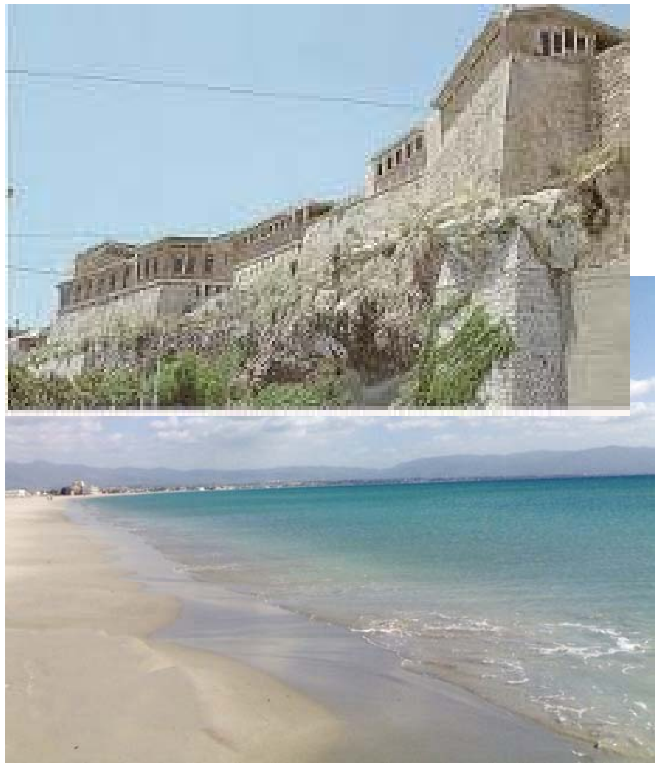
CAGLIARI an “Interesting” case for Mobility



Mobility Issues - Dictated by:

Geographical Constraints

Environment Constraints



Touristic & Lifestyle Constraints

Why

development of innovative and environmentally friendly solutions for urban/metropolitan area mobility so to boost energy and environmental performances.

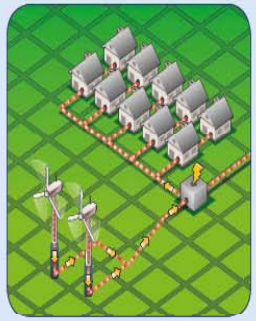
Capitalize on the advanced ICT mobility system already available


congestion


air pollution


high energy costs

better mobility


cleaner urban environment


energy efficiency

WHAT & WHEN

CAGLIARI 2020 is a **25 Million €** Project selected within the Italian National Operational Programme for Research and Competitiveness within the Measure **Smart Cities and Communities**

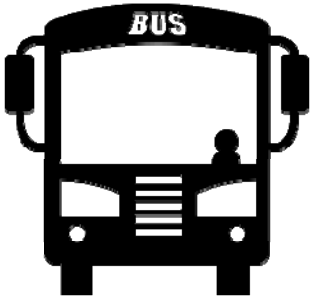
MAIN GOAL: the development of innovative and environmentally friendly solutions for urban mobility so to boost energy and environmental performances

PROJECT STARTED on January 1st 2017
DURATION 3 Years

HOW

Fixed sensors for the tracking of vehicles entering/exiting the urban area. These sensors allow real-time and/or historical analysis, especially helpful in gathering the information required to manage traffic lights systems and sending routing optimization information to interested users

Mobile sensors for the collection of environmental data. Such data will be used to feed decision-making models for the reduction of carbon emissions and the consequent improvement of air quality in the urban area.



Mobile devices for the acquisition of the motion habits of people.

Aims to

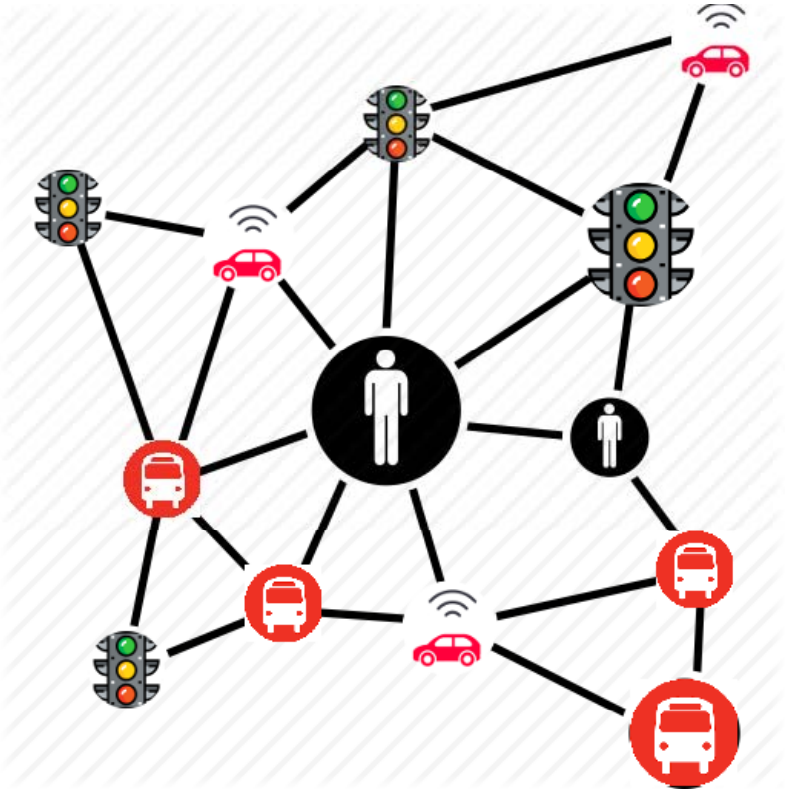
Activate a modeling of mobility flows through the monitoring of position data of personal mobile devices (anonymous) (**smart mobility**)
Activate a network of monitoring sensor-based hosted on board of public buses (**smart mobility**)

Activate a model of integration of environmental and mobility data to reduce carbon emission (**public health**)

Activate the development of tools for decision support of the PA involved in the project (**smart mobility policies**)

Approach

Application of the **netcentric paradigm** by means of a dynamic and pervasive net whose nodes can be both fixed and mobile: **the urban information grid**



- sensorial integration of the devices distributed in the urban area
- turns public transport buses into “mobile platforms” for the urban road system monitoring

Workflow

DATA

INFORMATION

Cagliari 2020

ACTIONS

DECISION MAKER

DATA

IT Problem

Cagliari2020 it's a typical **social network project**. The main ICT problem are:

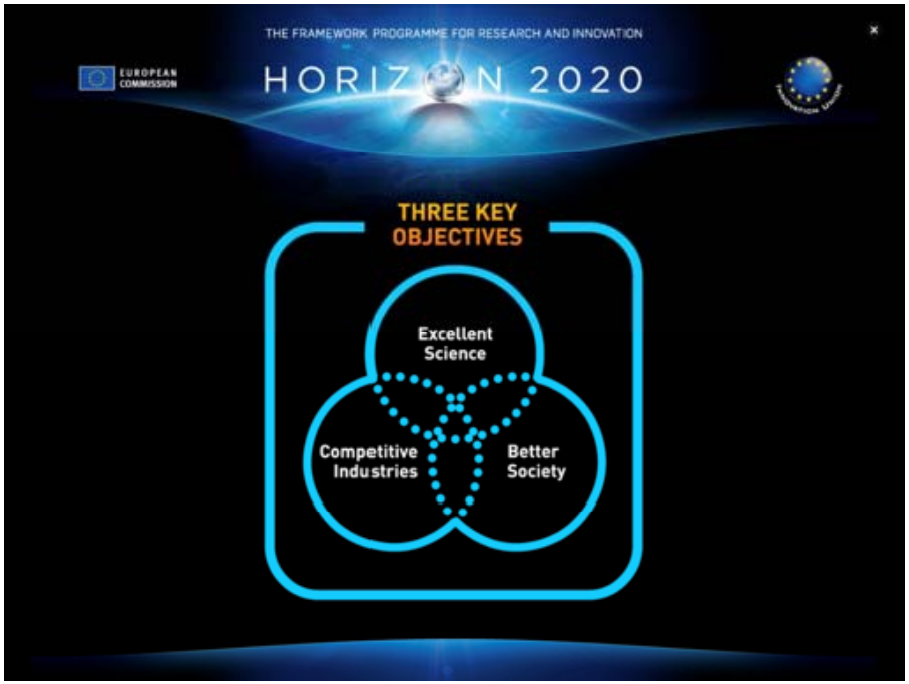
Non constant traffic flow *mobility follow the sun*

Common problems we share with other municipalities

and we aim at sharing solutions too

Why INFN

INFN Istituto Nazionale di Fisica Nucleare



INFN has a leading role in:

- Data Acquisition
- Development of Tools enabling data processing on cloud platforms

INFN brings to Smart Cities applications know-how and technologies, developed in the context of fundamental research in particle physics
In particular the experience of over 15 years of international leading role in grid/cloud computing projects

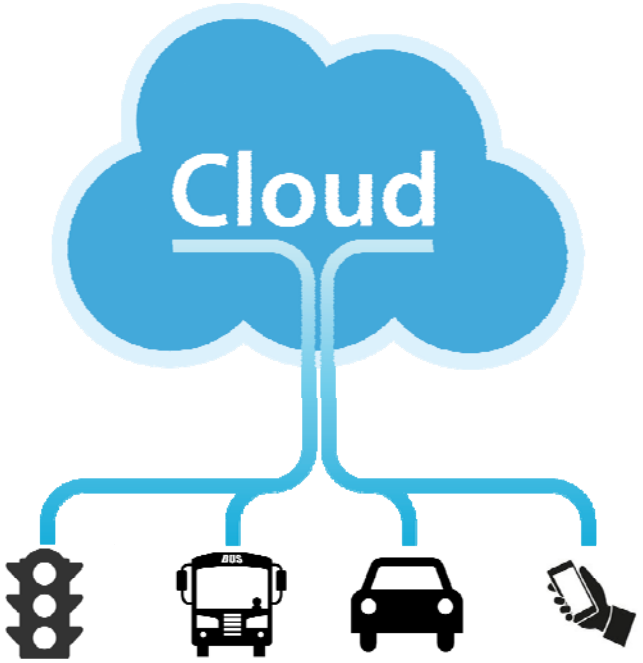
A successful combination, see e.g. Argonne National Laboratory – Chicago Partnership
https://news.uchicago.edu/article/2016/08/29/chicago-becomes-first-city-launch-array-things

Why Cloud

Scalability ability to adapt the ITC infrastructure to user and data growth

Elasticity ability to adapt the ICT infrastructure to traffic flow

Portability ability to share the ICT infrastructure and software solution with other municipalities



Workprogram

Study of main important private, public and hybrid clouds providers to choose the best solution for our project

Development of tools to integrate our applications on clouds

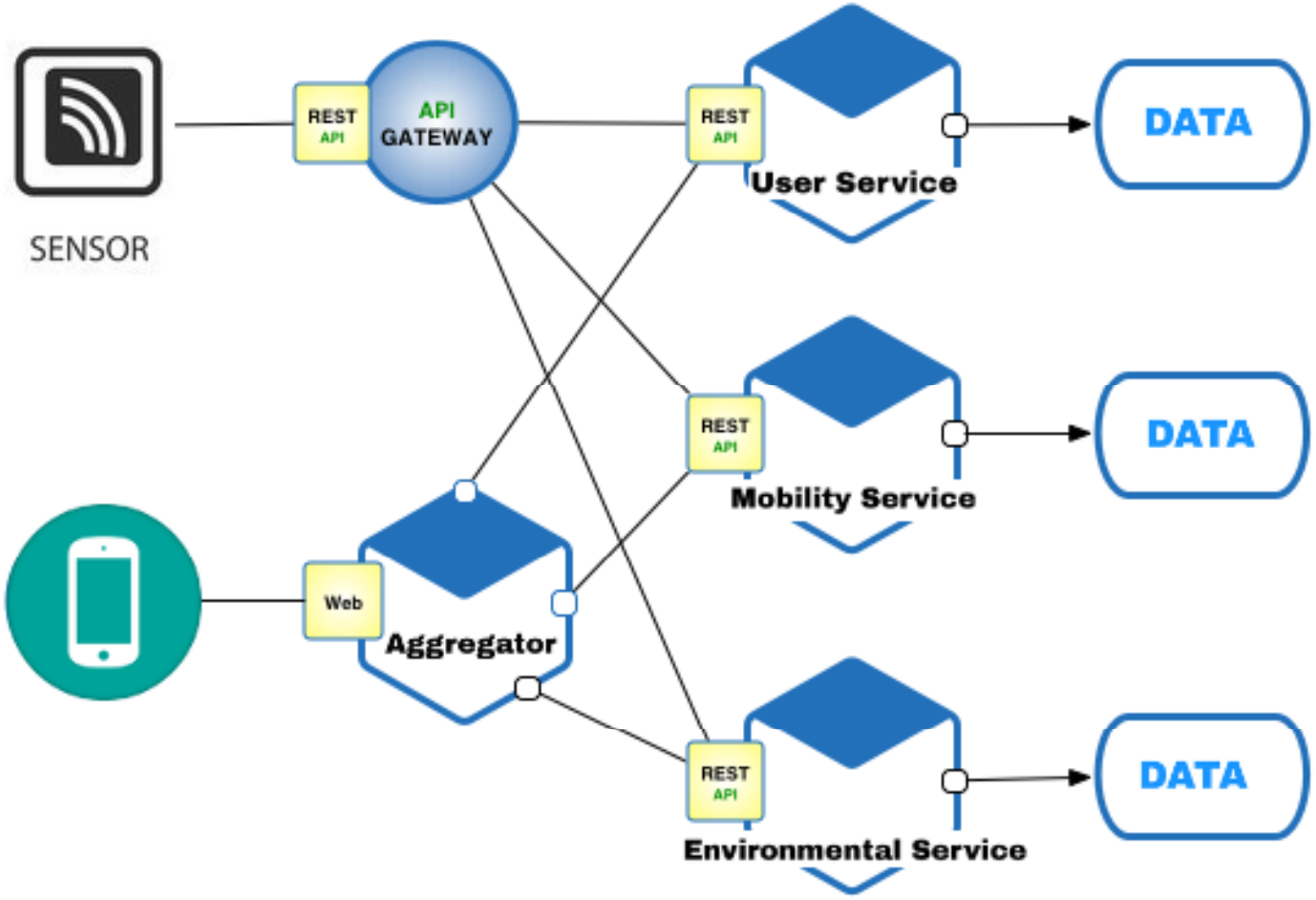
Development of tools to ensure cloud interoperability

Implement Cagliari2020 service as PaaS to perform data analysis

Implement Cagliari2020 software as SaaS to share our solutions with other municipalities

Architectural approach

From architectural point of view Cagliari2020 uses a **microservice architecture**



Why Microservices

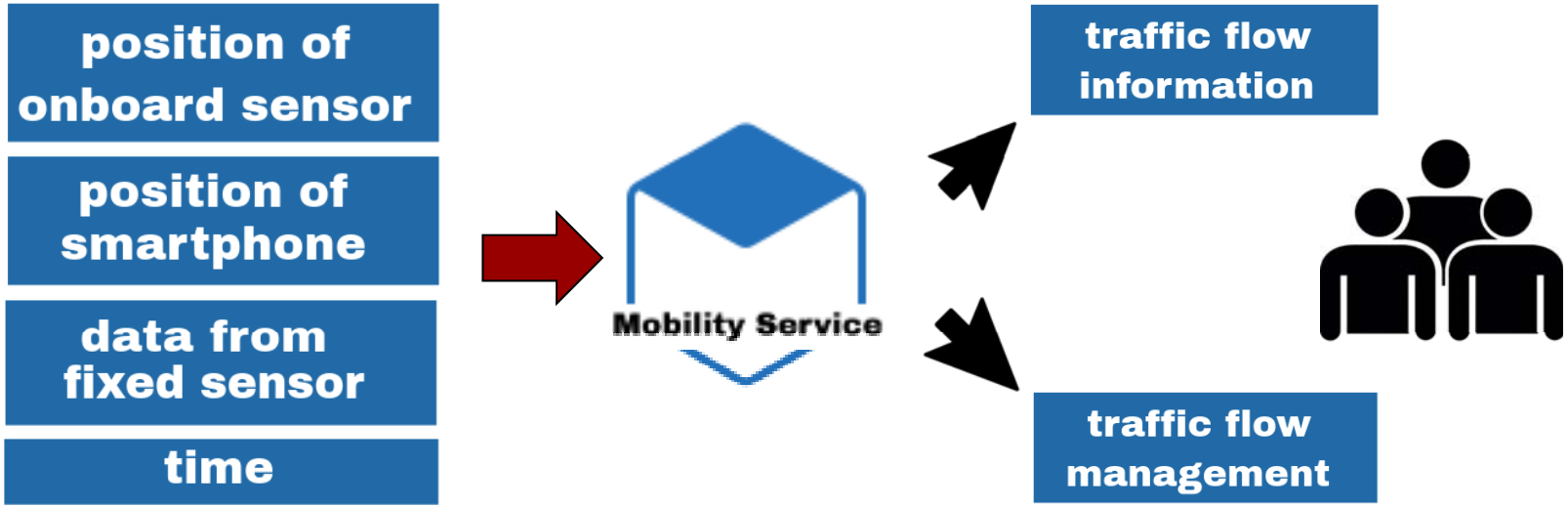
A single microservice may develop differently:
mobility service could use more resource than environmental service or user service

Microservices allow for intercloud solutions:
user service may be deployed on private cloud and mobility service on public or commercial cloud

Microservices allow for easier management, development & sharing

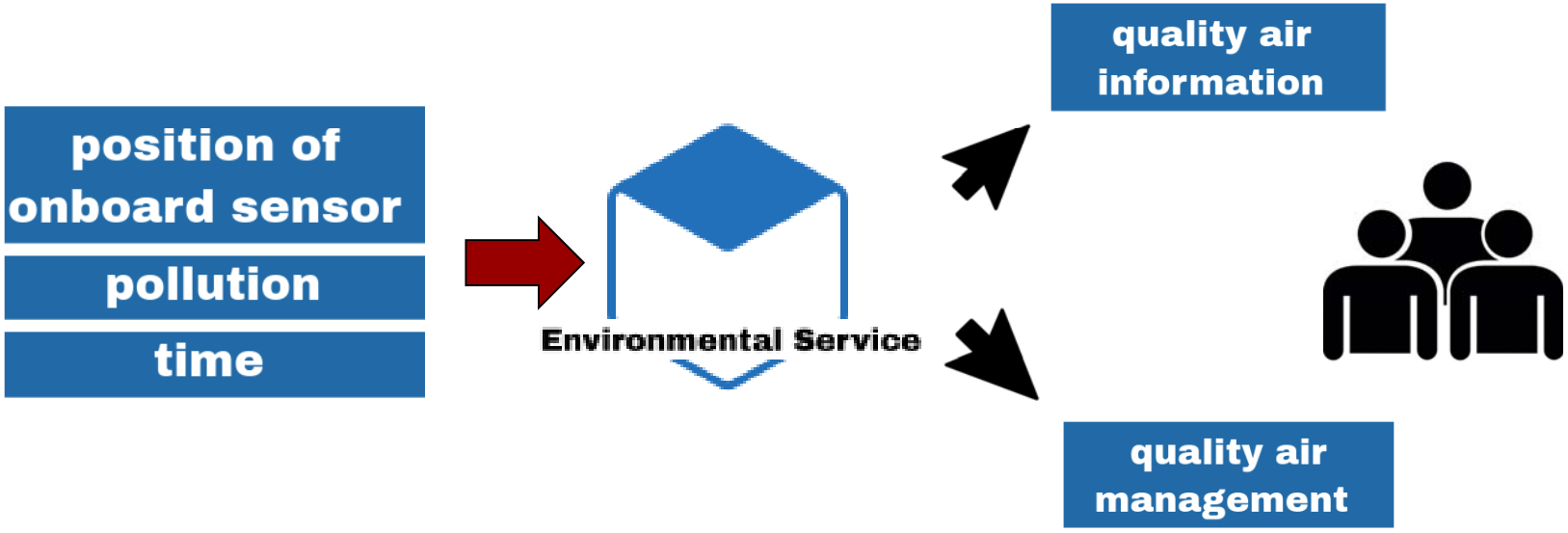
Mobility Service

Is the core service of Cagliari 2020 dedicated to traffic flow



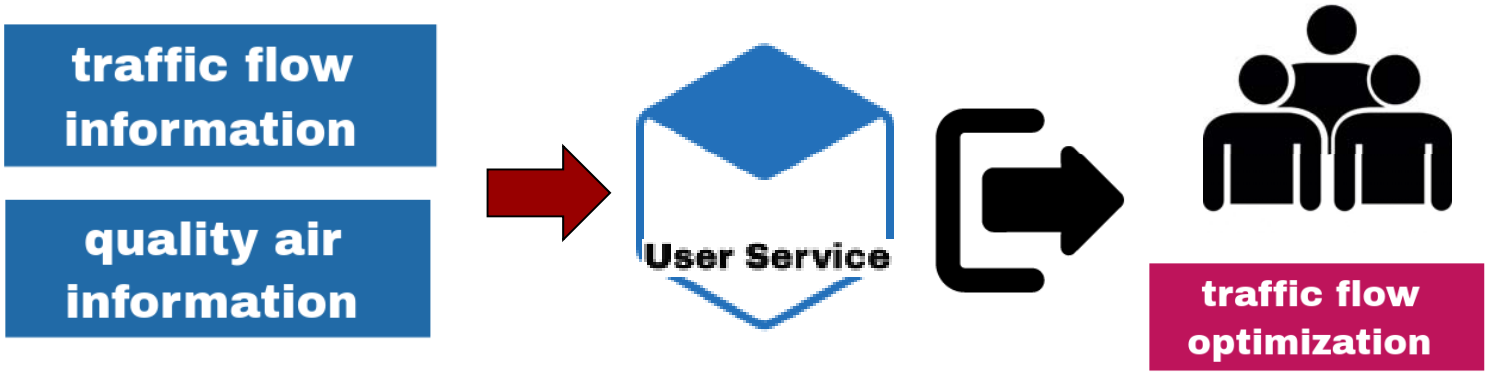
Environmental Service

It’s the service dedicated to storage & analysis of environmental data



User Service

It is the service dedicated to citizens



Key Performance Indicators

- Reduction of travel time
- Reduction of fuel consumption
- Reduction of emissions
- Improvement of air quality

IMPACT on:

- Mobility efficiency
- Urban environment
- Energy efficiency

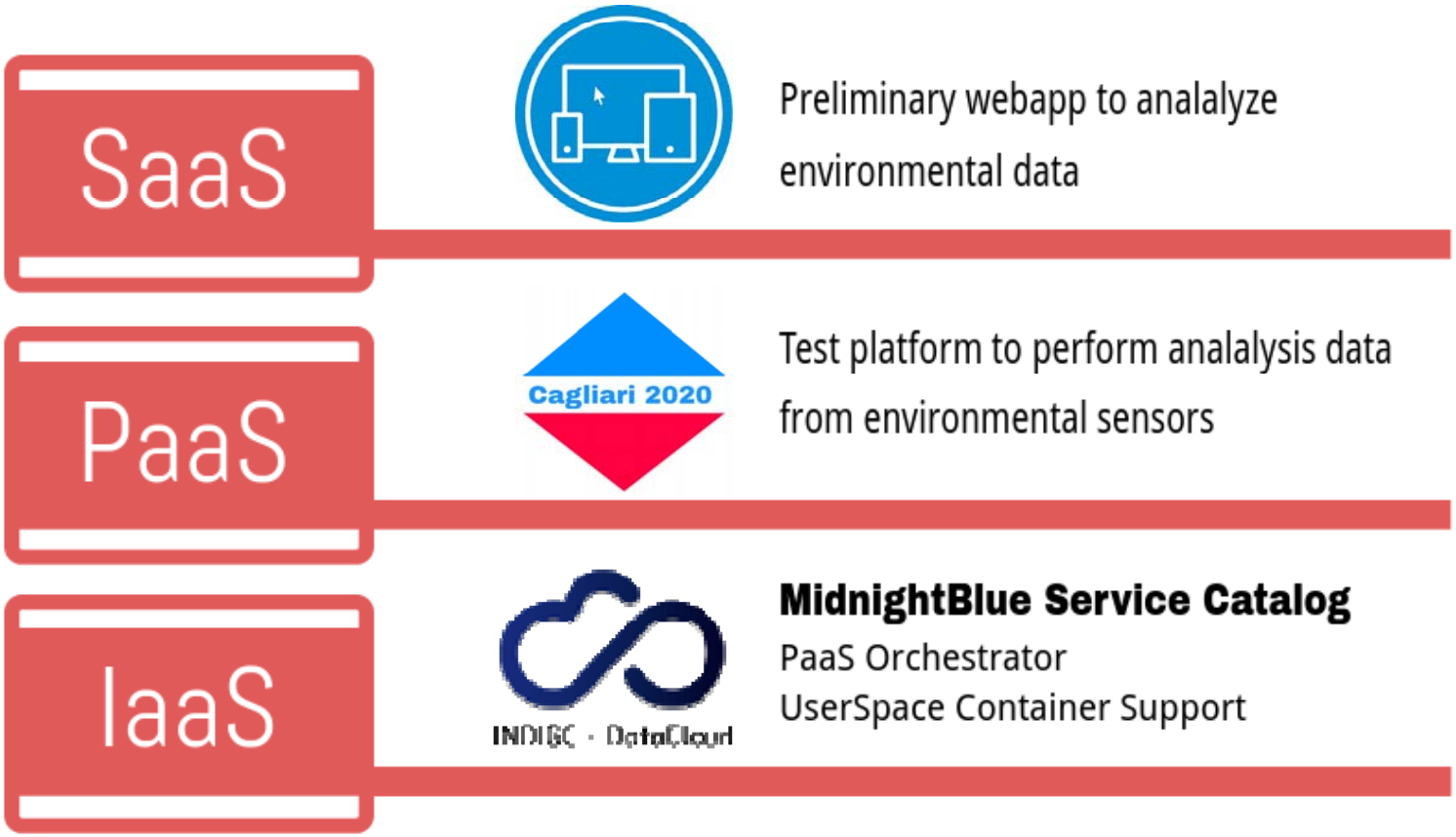
Technological components

Nginx as web server and load balancer
MariaDB as database
Redis as memory key-value database
Flask as web app framework
Node.js as runtime javascript
Memcached as memory caching

Docker container to build PaaS

First Step

For development, the first test and preliminary implementation of out PaaS we use the service catalog offered from INDIGO-DataCloud, a Cloud Stack for European Research founded under the Horizon 2020.



Thank You