Exploiting clouds for smart cities applications
The Cagliari 2020 project

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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 Company for public Transportation and Mobility
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
IT Problem

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

Non constant traffic

Common problems we share with other municipalities

and we aim at sharing solutions too

Non constant traffic flow mobility follow the sun
Why INFN

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.
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

- position of onboard sensor
- pollution
- time

quality air information

quality air management
User Service

It is the service dedicated to citizens

traffic flow information
quality air information

User Service

traffic flow optimization
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 our PaaS we use the service catalog offered from INDIGO-DataCloud, a Cloud Stack for European Research founded under the Horizon 2020.

**SaaS**
- Preliminary webapp to analyze environmental data

**PaaS**
- Test platform to perform analysis of data from environmental sensors

**IaaS**
- MidnightBlue Service Catalog
  - PaaS Orchestrator
  - UserSpace Container Support
Thank You