EDGE AND CLOUD COMPUTATION:
A HIGHLY DISTRIBUTED SOFTWARE
FOR BIG DATA ANALYTICS

Big Data Analytics for Smart Cities
The H2020 CLASS Project

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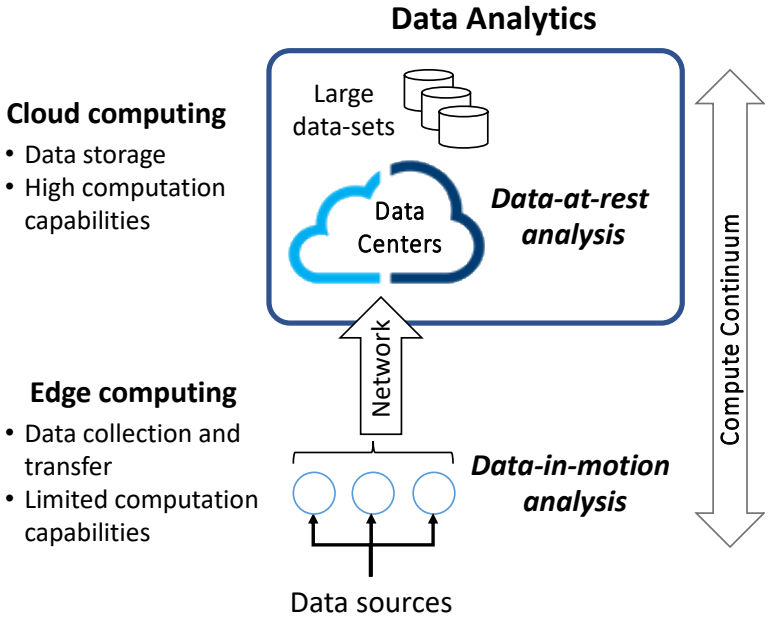
Motivation

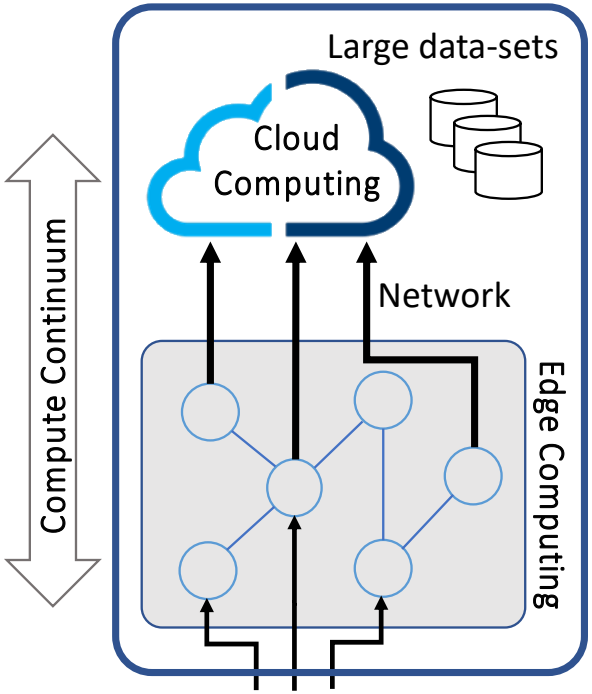


- There is a need to devise new data analytics architectures due to
  1. The pressure of a constant increment of **volume, variety** and **velocity** of data-sets on the compute continuum
  2. The newest smart systems with **distributed data sources**, and **data analytics and real-time** requirements, e.g., smart cities
  3. New **highly parallel embedded** processor architectures increase computation capabilities of the edge

Our Vision

The challenges of the newest smart systems can be addressed by devising a **fully distributed architecture in which edge and cloud computing resources are coordinated**, enabling a **combined data-in-motion and data-at-rest analytics**

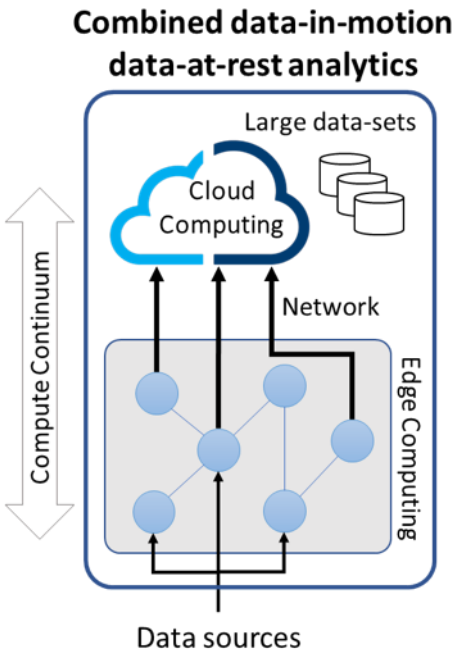
Combined data-in-motion data-at-rest analytics



Distributed data sources

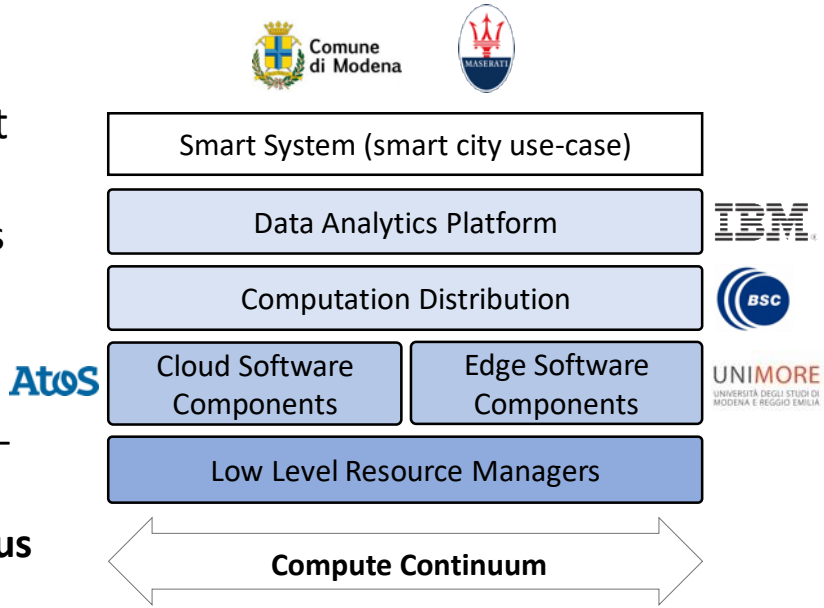
Main Contribution

- Develop a **novel software architecture** for **distributed computing architecture** capable of
  1. **Coordinate** edge and cloud computing resources
  2. **Distribute and coordinate** big-data workloads with **real-time requirements** along the compute continuum
  3. **Combine** data-in-motion and data-at-rest analytics
- **Increase productivity** in terms of programmability, portability/scalability and (guaranteed) performance



Software Architecture

- Integrate technologies from different **computing domains** into a single development framework
  1. Use the most advance data analytics solutions
  2. Apply **high-performance techniques** to distribute computation across edge and cloud resources
  3. Apply of **timing analysis techniques** from real-time embedded domain
  4. Use the most advanced **parallel heterogeneous** embedded platforms



Smart City Use-case

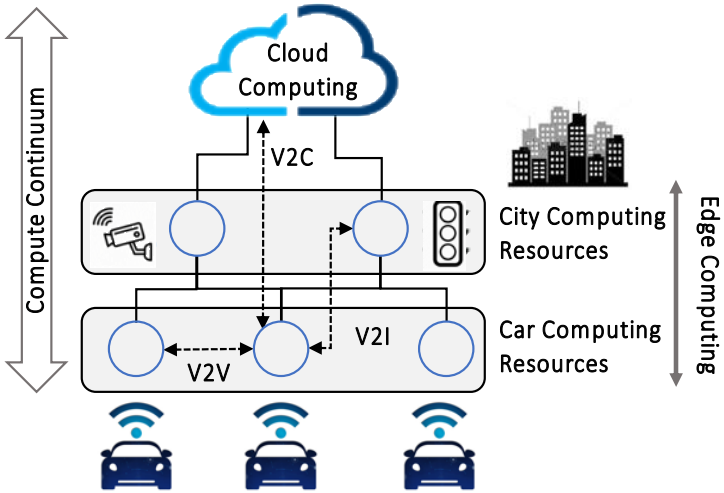
- Test and highlight the benefits of the CLASS SA
- Deployed on the *Automotive Smart Area* in the city of Modena (Italy)
  - 1 Km^2 urban area with connectivity that enables IoT devices (e.g., smart cameras, traffic scanner) to exchange information
- Three highly-connected cars equipped with
  - *Vehicle-to-infrastructure* (V2I), *vehicle-to-cloud* (V2C), *vehicle-to-vehicle* (V2V)
  - Cameras @4K, long-range and middle range radars and ultrasound sensors

Automotive Smart Area

V2V, V2I, V2C connectivity

Prototype car intended to be used

Smart City Use-case

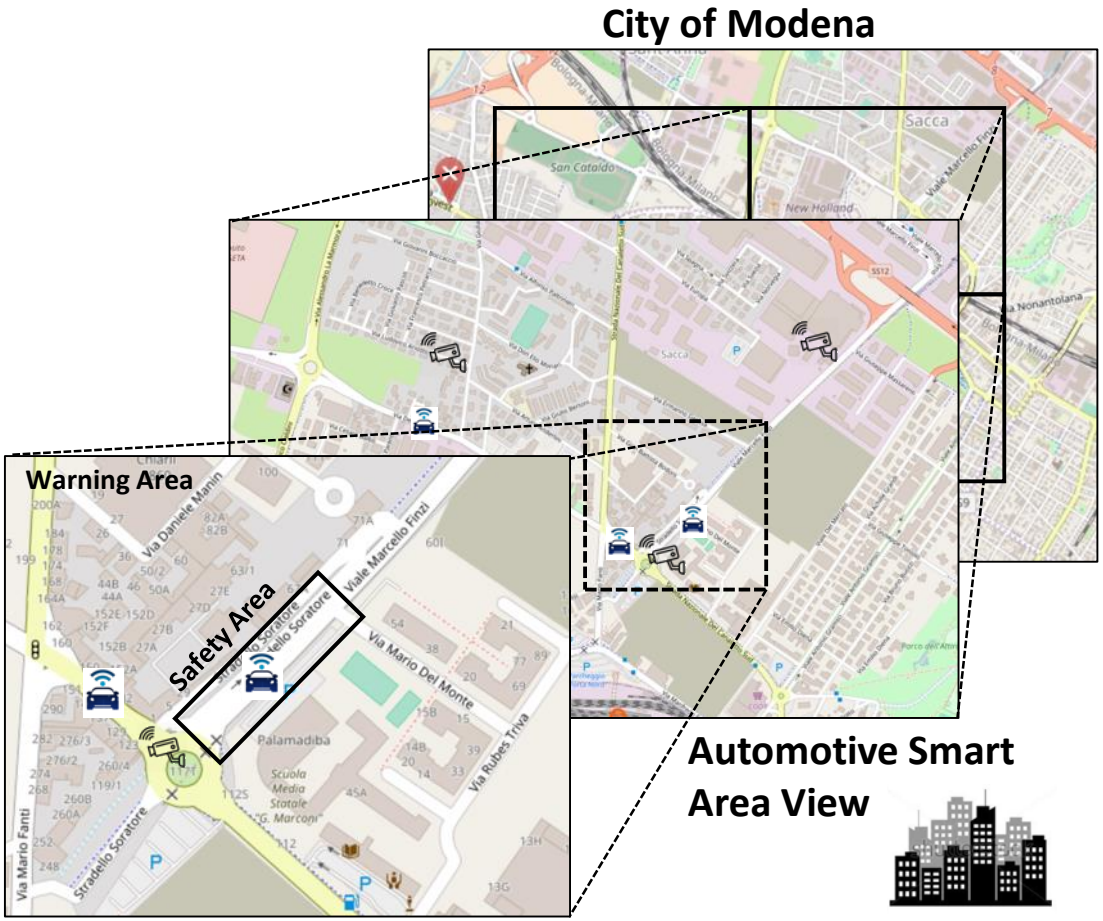


- **Data analytics** and **real-time** requirements
- **11.4 GB/s** of heterogeneous data-sets considering 3 cars and a 1 km^2 sensing area

1. *Intelligent traffic management*, acting on traffic lights and smart road signals
   - "Green routes" for emergency vehicles
   - Traffic enhancement based on intelligent cross road management
2. *Advanced driving assistance systems*
   - Intelligent cross road management based on obstacle detection
   - Automated valet parking systems

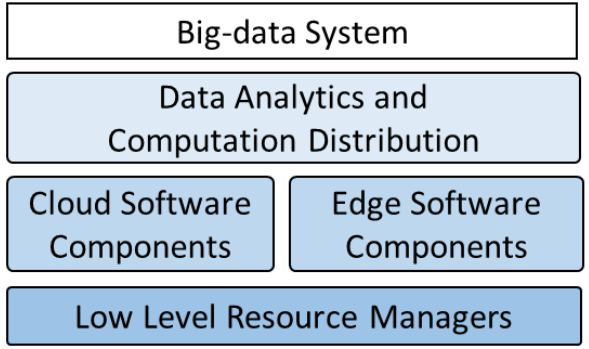
Knowledge Base

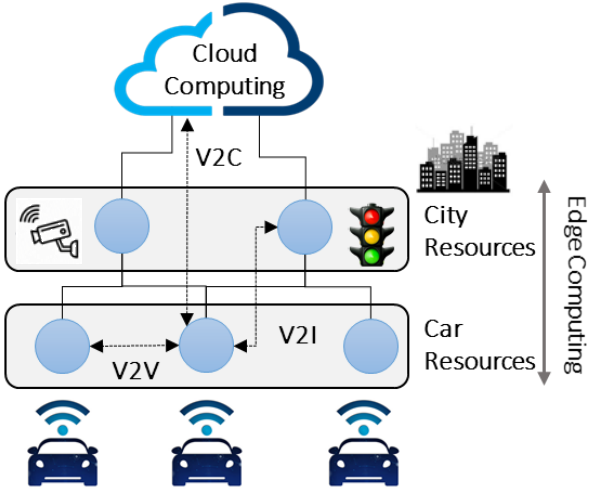
- Application use-cases are based on **sensor fusion** disperse city/vehicle data sources
  - Consistent view of the city among all involved actors



Conclusions

1. CLASS aims to increase **productivity** on the implementation of big data systems by developing a novel SA for **distributing and coordinating** big-data workloads along the compute continuum while providing **real-time** guarantees
2. CLASS aims to **increase data analytics capabilities** by efficiently **combine** data-in-motion and data-at-rest analytics
3. CLASS aims to apply the SA to develop a distributed sensing/computing infrastructure within the Modena Automotive Smart Area for advanced urban mobility applications with **data analytics and real-time requirements**





Thanks for your attention.

CLASS

Stay tuned!

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