

# Big Data Analytics for Smart Cities: The H2020 CLASS Project

Eduardo Quiñones  
Barcelona Supercomputing Center  
Barcelona, Spain  
eduardo.quinones@bsc.es

Marko Bertogna  
University of Modena  
Modena, Italy  
marko.bertogna@unimore.it

Erez Hadad  
IBM Research - Haifa  
Haifa, Israel  
erezh@il.ibm.com

Ana Juan Ferrer  
Atos Research  
Barcelona, Spain  
ana.juanf@atos.net

Luca Chiantore  
City of Modena  
Modena, Italy  
luca.chiantore@comune.modena.it

Alfredo Reboa  
Maserati  
Modena, Italy  
alfredo.reboa@arproject.com

## CCS CONCEPTS

• **Computer systems organization** → **Cloud computing**; **Embedded systems**; • **Software and its engineering** → **Real-time schedulability**; • **Theory of computation** → **MapReduce algorithms**;

## 1 INTRODUCTION

Applying big-data technologies to field applications has resulted in several new needs. First, processing data across a *compute continuum* spanning from cloud to edge to devices, with varying capacity, architecture etc. Second, some computations need to be made *predictable* (real-time response), thus supporting both *data-in-motion* processing and larger-scale *data-at-rest* processing. Last, employing an event-driven programming model that supports mixing different APIs and models, such as Map/Reduce, CEP, sequential code, etc.

## 2 THE H2020 CLASS PROJECT

CLASS aims to create a platform that allows users to develop and execute their applications efficiently. At the resource level, *fog*[3] principles are applied, of distributing computation across the continuum using COMPSs [1], and taking decisions closer to the data origin to reduce communication. On the edge, new embedded architectures (e.g., GPUs, many-core) are used. On the cloud side CLASS aims to maximize throughput while maintaining latency requirements. Last, CLASS aims to explore a serverless polyglot event-driven platform of Apache OpenWhisk [2] and extend it with real-time requirements, both for analytics foundation and for the programming model.

## 3 SMART CITY USE-CASE

CLASS software will be evaluated in the *Modena Automotive Smart Area* (MASA), a real urban laboratory in Modena,

Italy, equipped with sensors, cellular and optic connectivity. Maserati provides prototypes of highly-connected cars with sensors, such as radars. The use-case consists of the following set of CLASS applications:

- **Intelligent traffic management**, dynamically controlling traffic lights and smart road signals based on traffic conditions, e.g., to reduce fuel consumption and providing “green routes” for emergency vehicles.
- **Advanced driving assistance** providing obstacle avoidance, dynamic path/route planning and parking assistance.

## 4 ACKNOWLEDGEMENTS

The research leading to these results has received funding from the European Union’s Horizon 2020 Programme under the CLASS Project ([www.class-project.eu](http://www.class-project.eu)), grant agreement No. 780622.

## REFERENCES

- [1] Barcelona Supercomputing Center. 2018. COMP Superscalar. (2018). <https://www.bsc.es/research-and-development/software-and-apps/software-list/compsuperscalar>
- [2] IBM / Apache community. 2018. Apache OpenWhisk is a serverless, open source cloud platform. (2018). <http://openwhisk.apache.org>
- [3] OpenFog Consortium. 2017. OpenFog Reference Architecture for Fog Computing. (February 2017). [https://www.openfogconsortium.org/wp-content/uploads/OpenFog\\_Reference\\_Architecture\\_2\\_09\\_17-FINAL.pdf](https://www.openfogconsortium.org/wp-content/uploads/OpenFog_Reference_Architecture_2_09_17-FINAL.pdf)

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