



A Software Architecture for Extreme-Scale
Big-Data AnalyticS in Fog ComputIng Ecosystems

Assessing the Infrastructure and Technologies Required to Implement Smart Mobility



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- H2020 ICT European Project
 - ELASTIC: a software architecture for Extreme-scaLe big-data AnalyticS in fog computIng eCosystems
 - www.elastic-project.eu



Project Information

ELASTIC

Grant agreement ID: 825473



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End date

31 May 2022

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EU contribution
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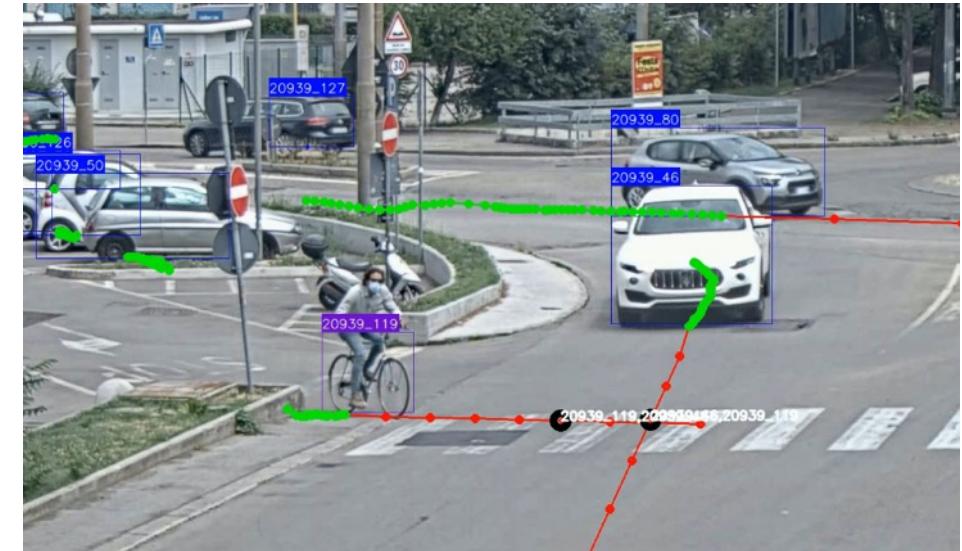
From Data to Real-time Knowledge

Data

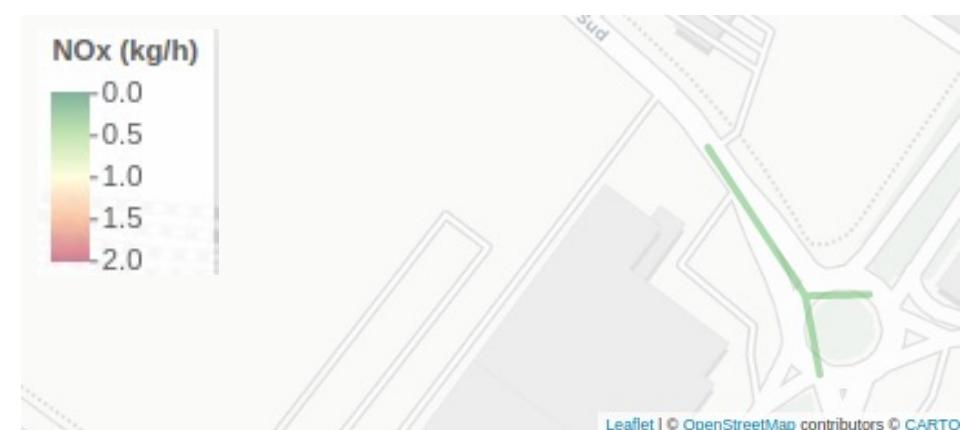


Knowledge

*Collision
Detection*



*Air
Pollution
Estimation*

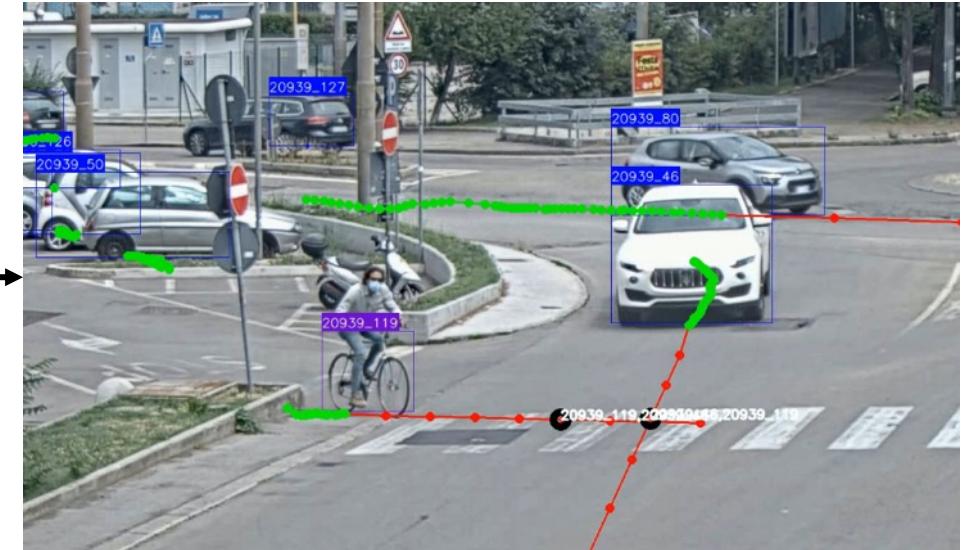
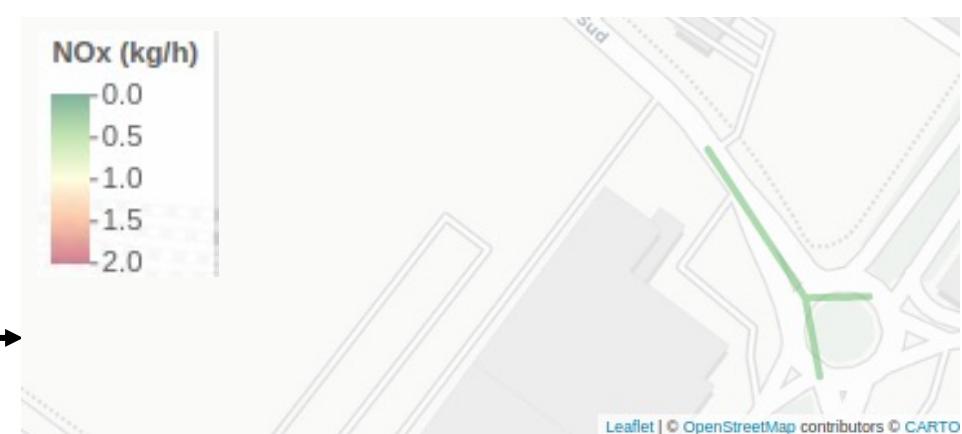
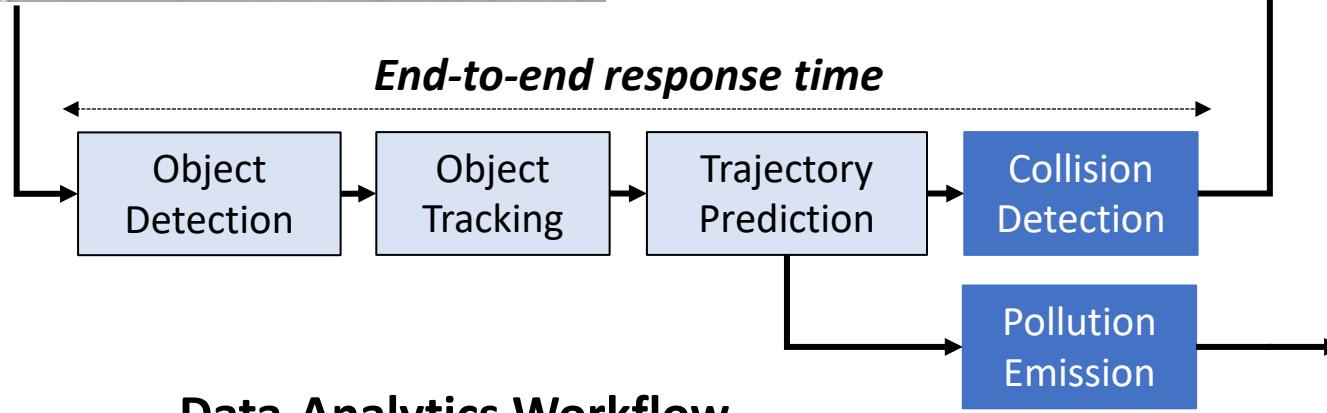


From Data to Real-time Knowledge

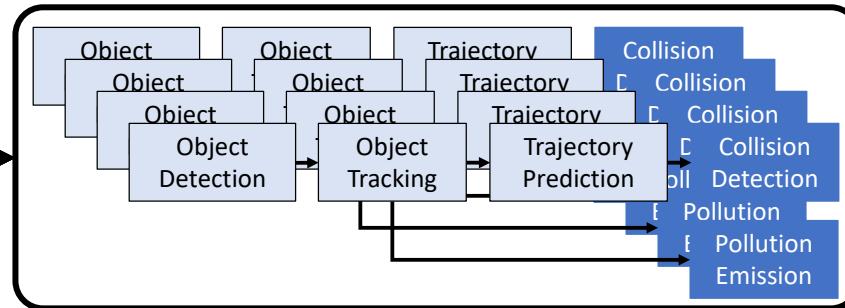
Data



Knowledge

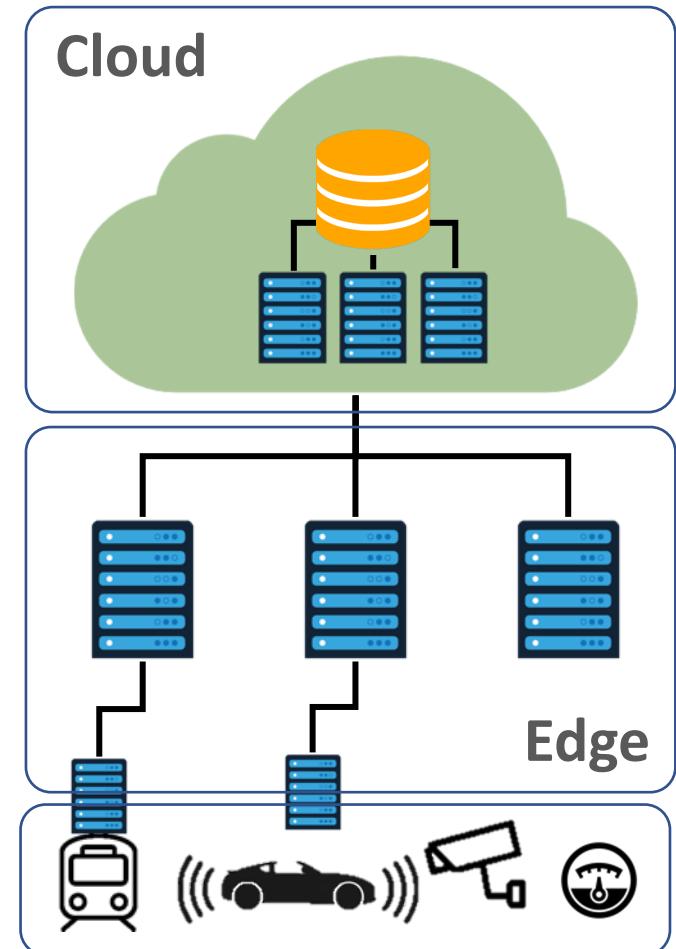
*End-to-end response time*

From Data to Real-time Knowledge

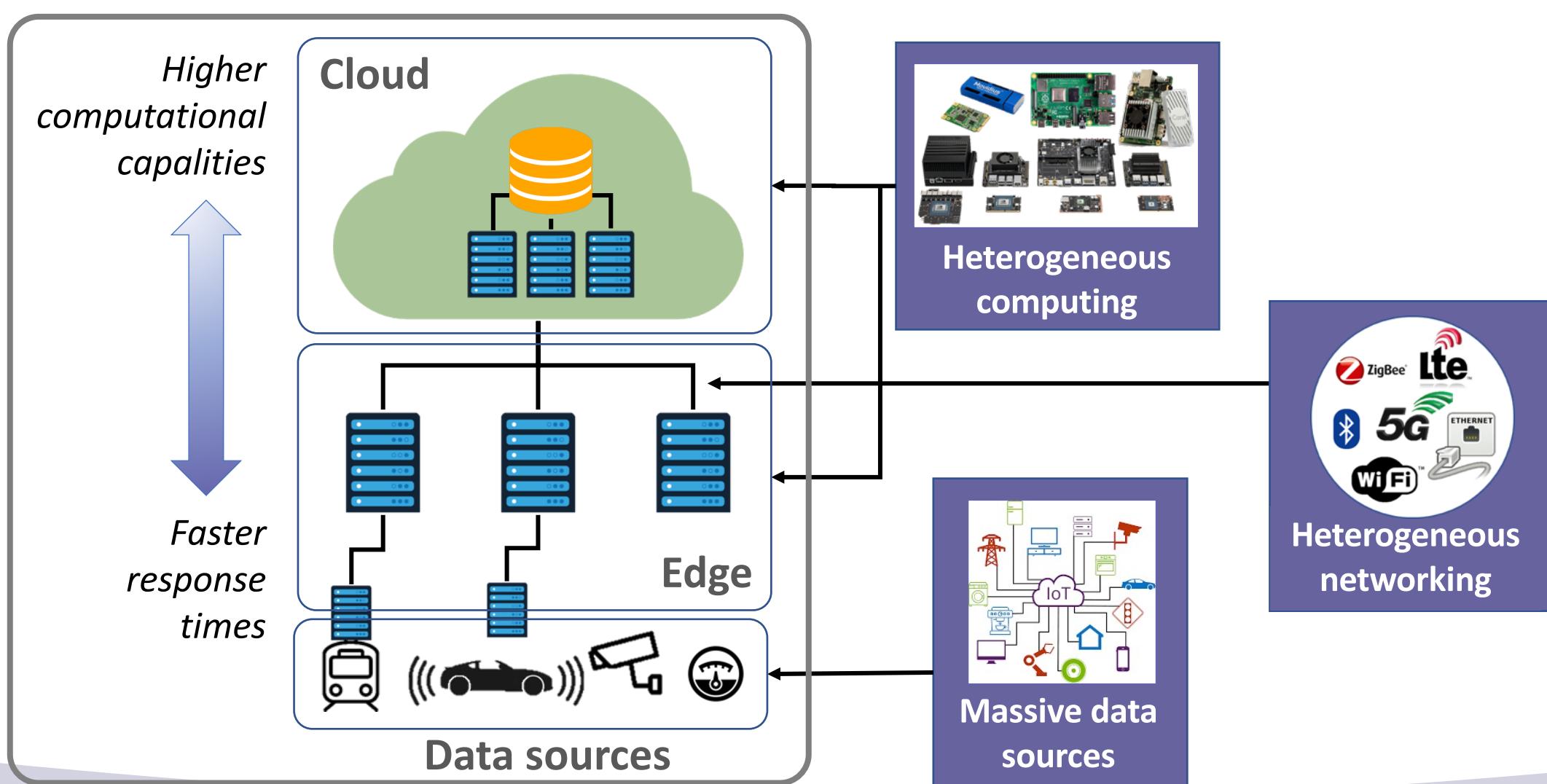


How are the data-analytics workflows developed and mapped to the available **computing/communication resources**?

Computing/Communication
City Resources

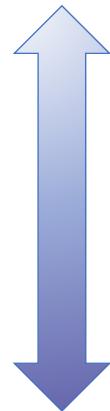


ELASTIC Vision: The Compute Continuum

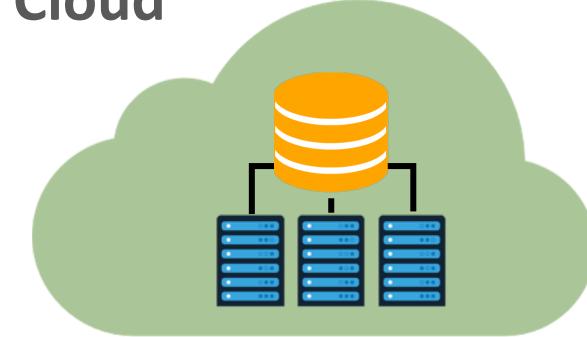


Compute
Continuum

*Higher
computational
capabilities*

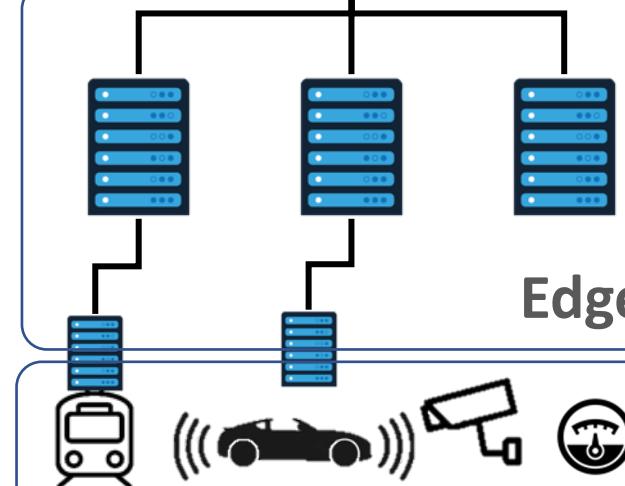


Cloud



*Faster
response
times*

Edge

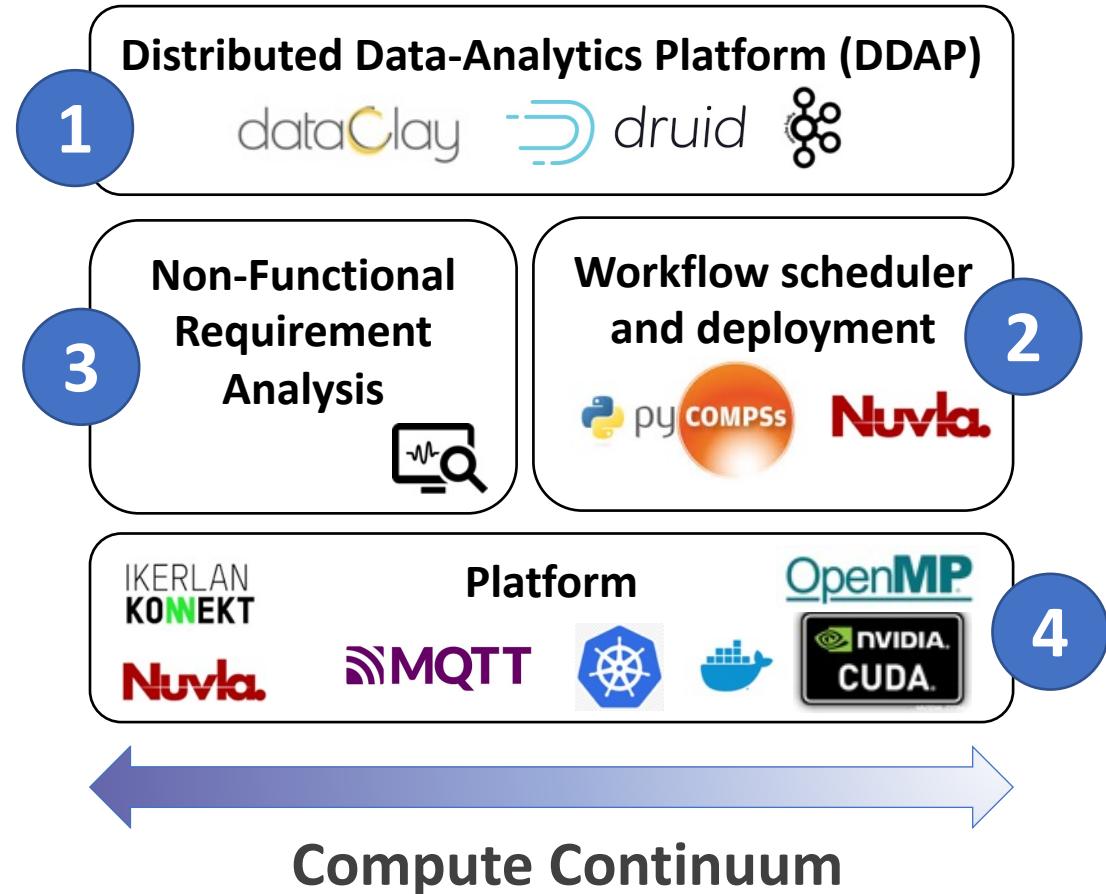


Data sources

ELASTIC Vision:
The Compute Continuum

1. Facilitate the development of **complex data analytics workflows** independently of the platform
2. Increase the **capabilities** of the data **analytics** by distributing them across the compute continuum
3. Fulfill the **non-functional requirements** inherited from the application domain, e.g., real-time, privacy

Main Contribution: The ELASTIC Software Architecture



Abstracts the compute continuum

1. Powerful API for the development of advanced **data-analytics workflows**, supported with a **Distributed Data platform (DDAP)**
2. Advanced orchestration methods workflow scheduling and deployment
3. Non-functional analysis inherited from the cyber-physical domain
4. Infrastructure support
 - Cloud-based Container as a Service
 - IoT cyber-secured communication
 - Advanced highly parallel and energy-efficiency edge platforms

ELASTIC Smart Mobility Use Case: the City of Florence Tramway Network



THALES



CITTÀ
METROPOLITANA
DI FIRENZE

GEST



ELASTIC Smart mobility use case: The Tramway Vehicle

Towards
autonomous
vehicles



Towards smart and
safer mobility

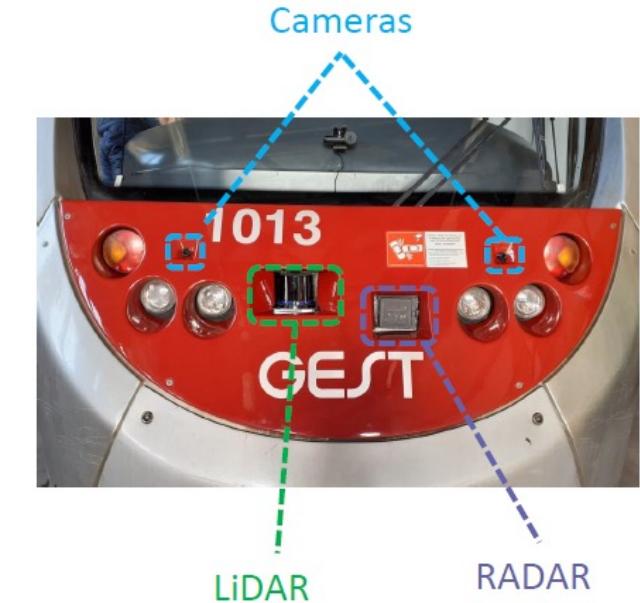
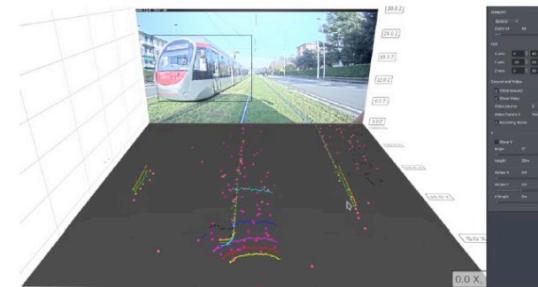


Towards enhanced
maintenance
services

- ✓ Next Generation Autonomous Positioning (NGAP)
- ✓ **Advanced Driving Assistant System (ADAS)**

- Sensorized trams

- Inertial Measurement Unit (IMU)
- Odometer
- GPS
- Lidar
- Radar
- Cameras



- Advanced parallel edge processor platforms
- WiFi and LTE connectivity

ELASTIC Smart mobility use case: The City

Towards
autonomous
vehicles

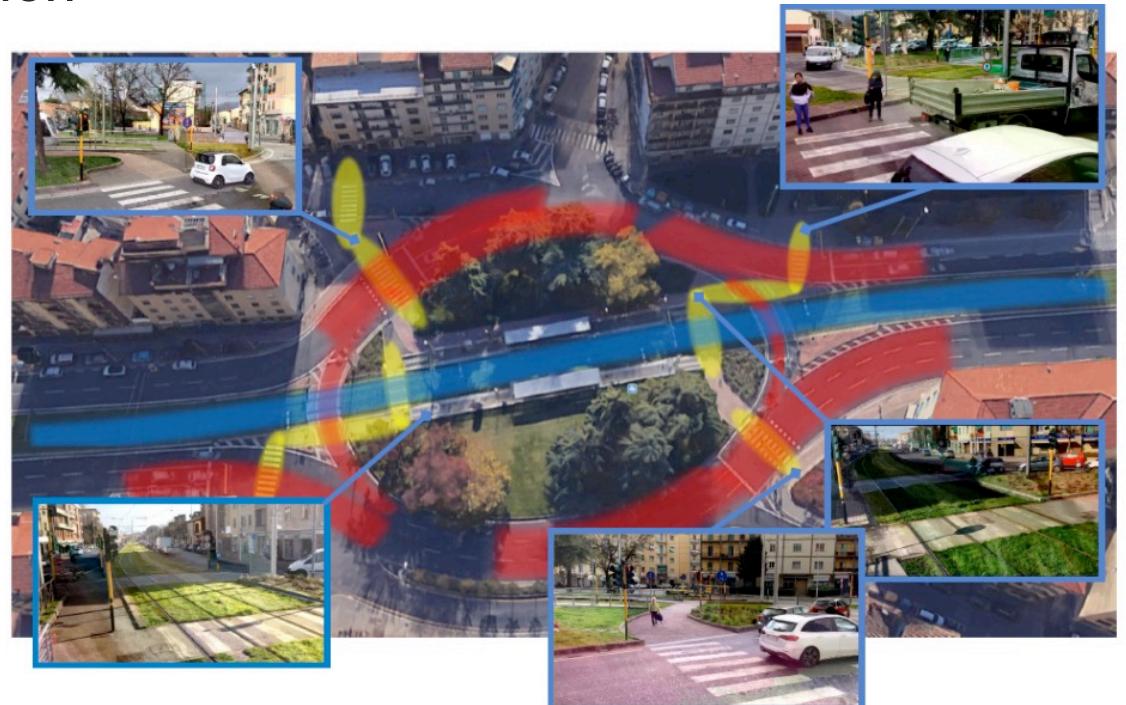


Towards smart and
safer mobility



Towards enhanced
maintenance
services

- ✓ Interaction between the public and the private transport in the City of Florence
 - Real-time event detection and hazard alerts
 - Offline analytics for traffic management and air pollution estimation
- Sensors
 - Cameras



ELASTIC Smart mobility use case: The Tramway Infrastructure

Towards
autonomous
vehicles

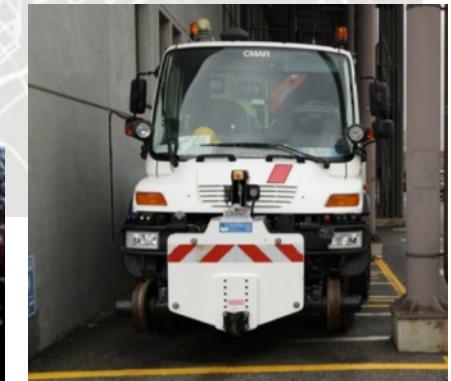
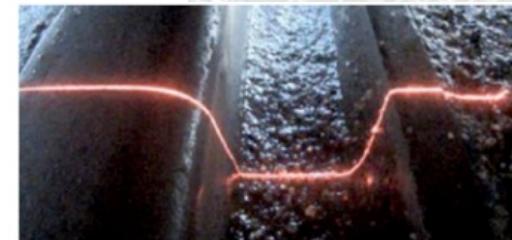


Towards smart and
safer mobility



Towards enhanced
maintenance
services

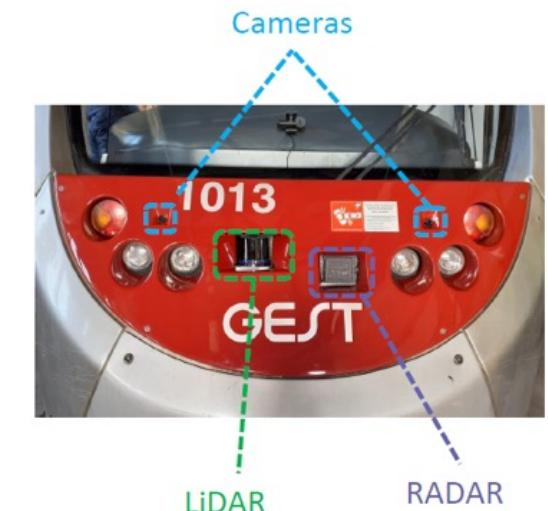
- ✓ Predictive maintenance
 - Track profiling and automatic detection of track wear
- Sensors employed
 - Energy extraction unit
 - Laser measuring heads
 - Accelerometers
 - Cameras
 - Odometers
 - Inertial platform

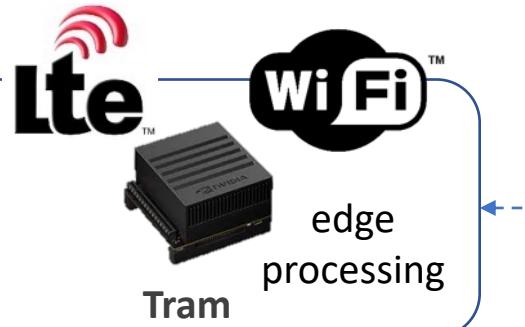


ELASTIC Smart Mobility Use Case

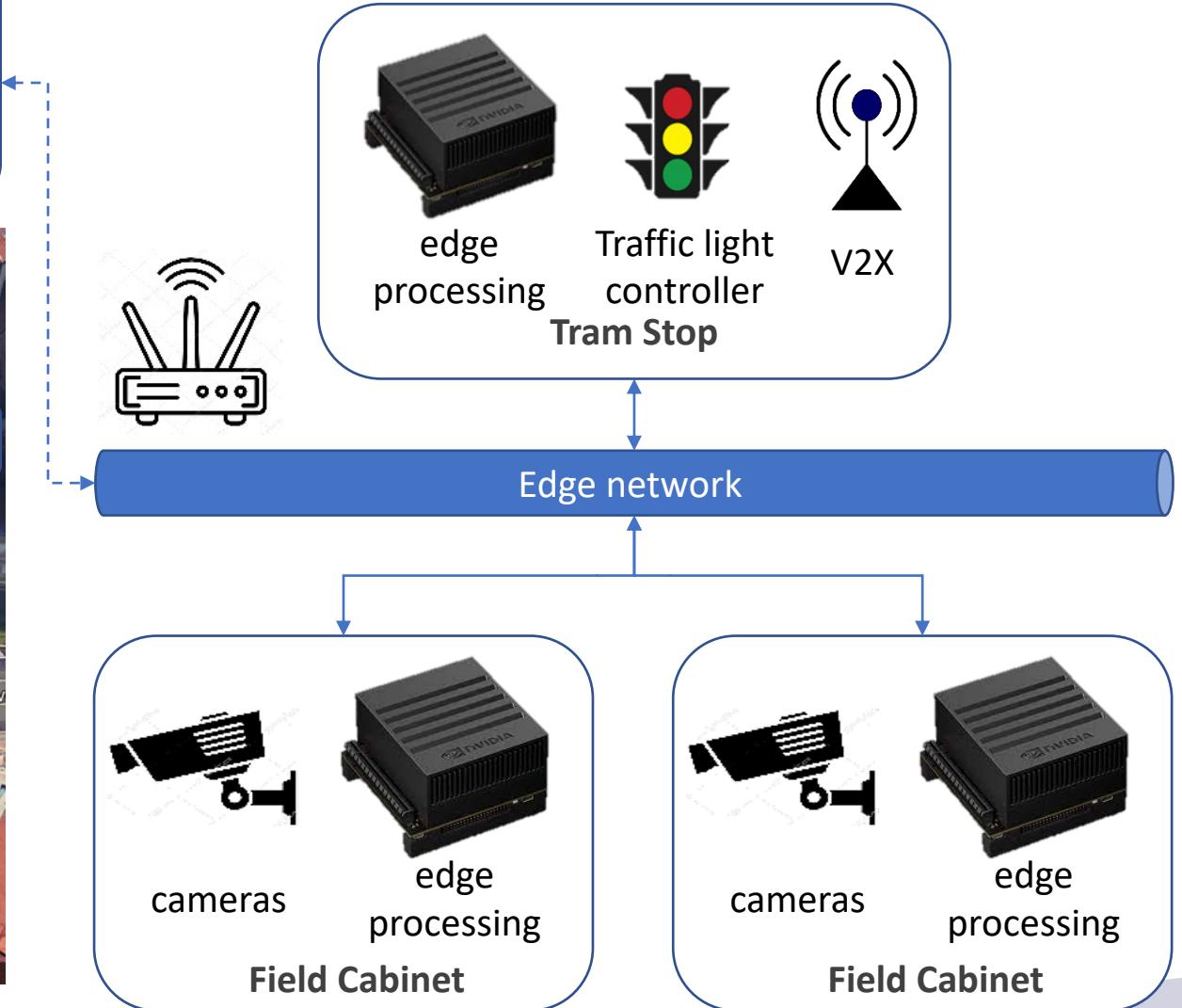
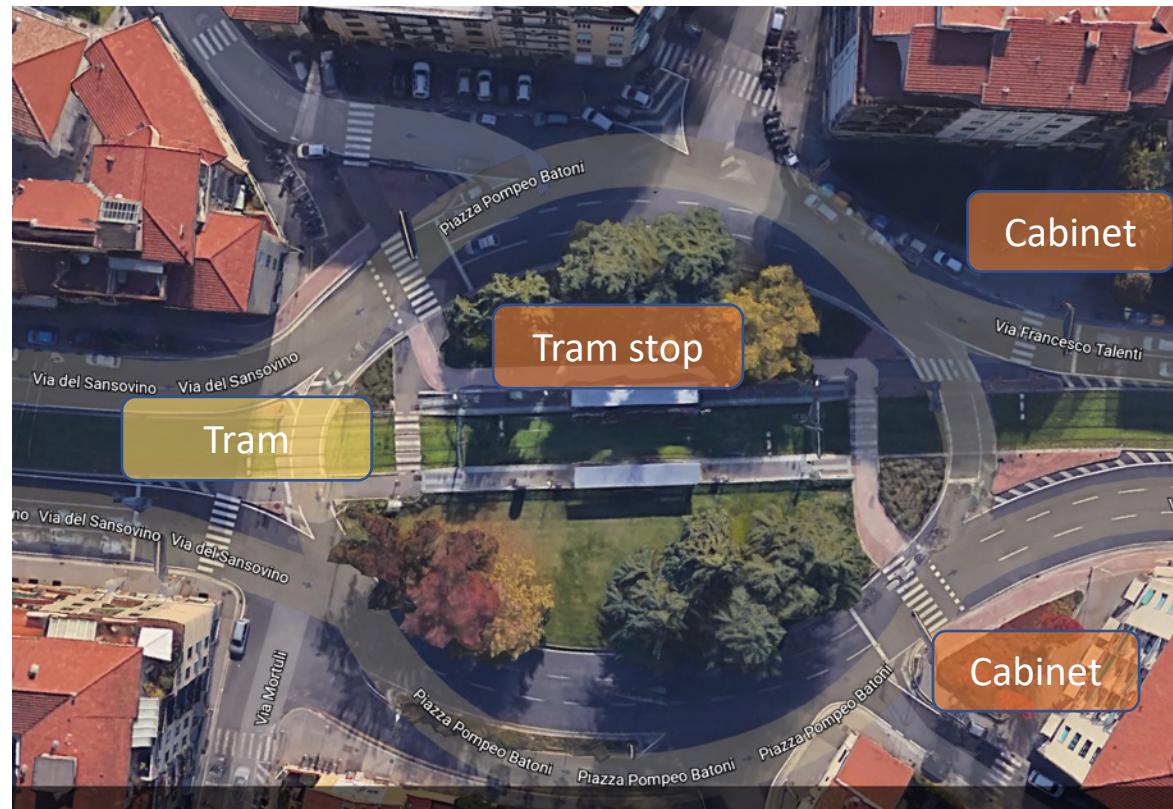


- Three tramway stops
- Three sensorized tram vehicles

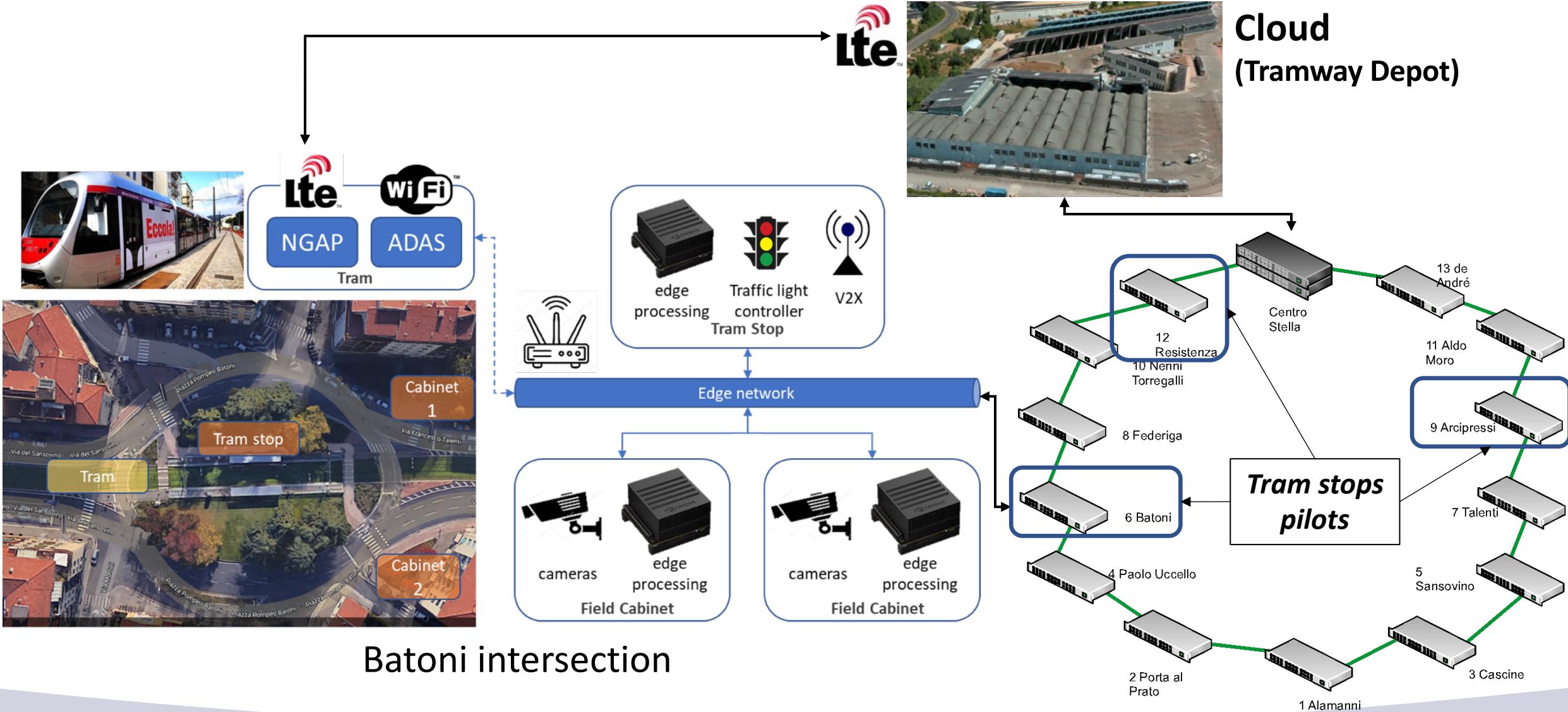




The ELASTIC Compute Continuum: Tram Stops



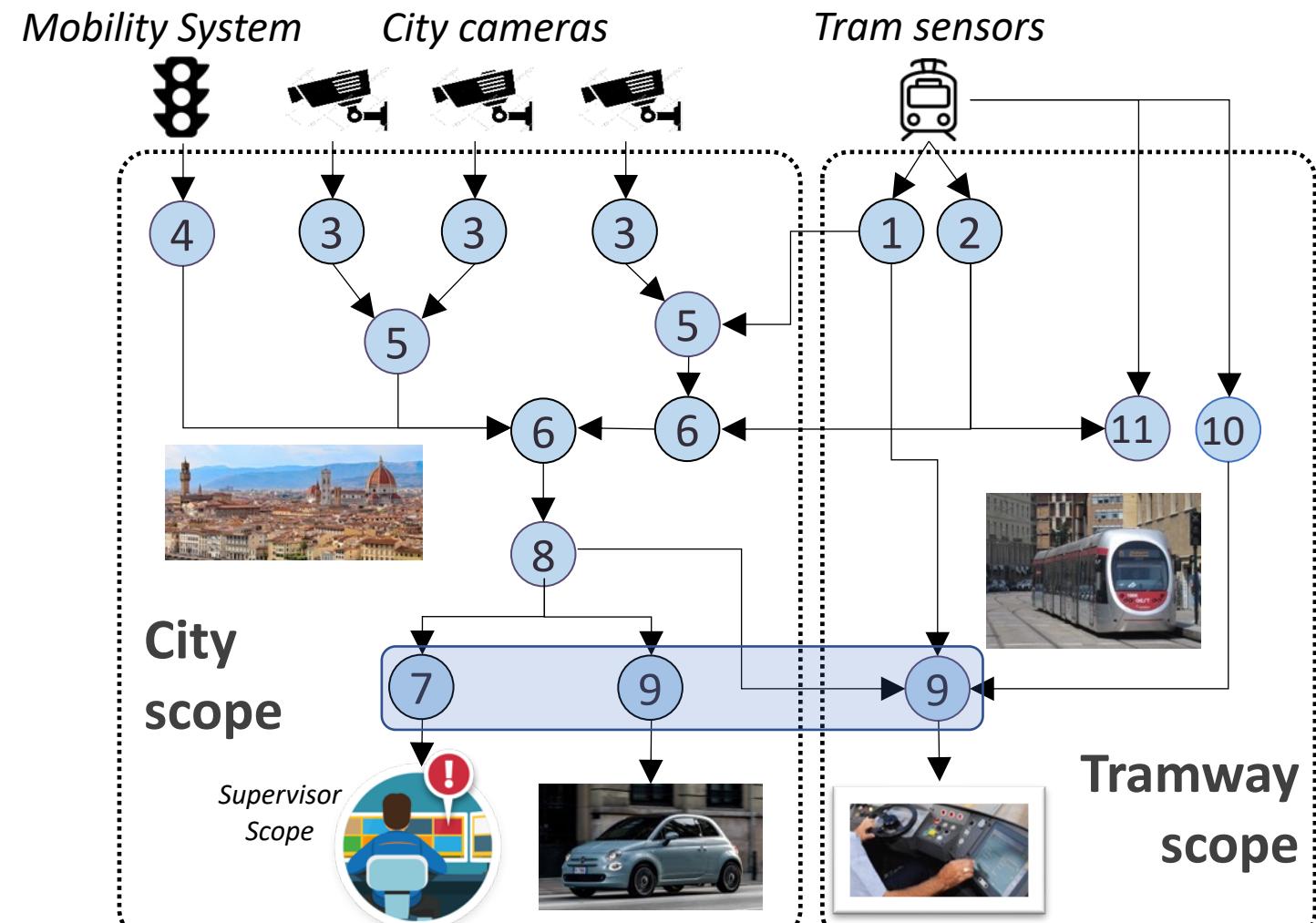
The ELASTIC Compute Continuum: the Cloud



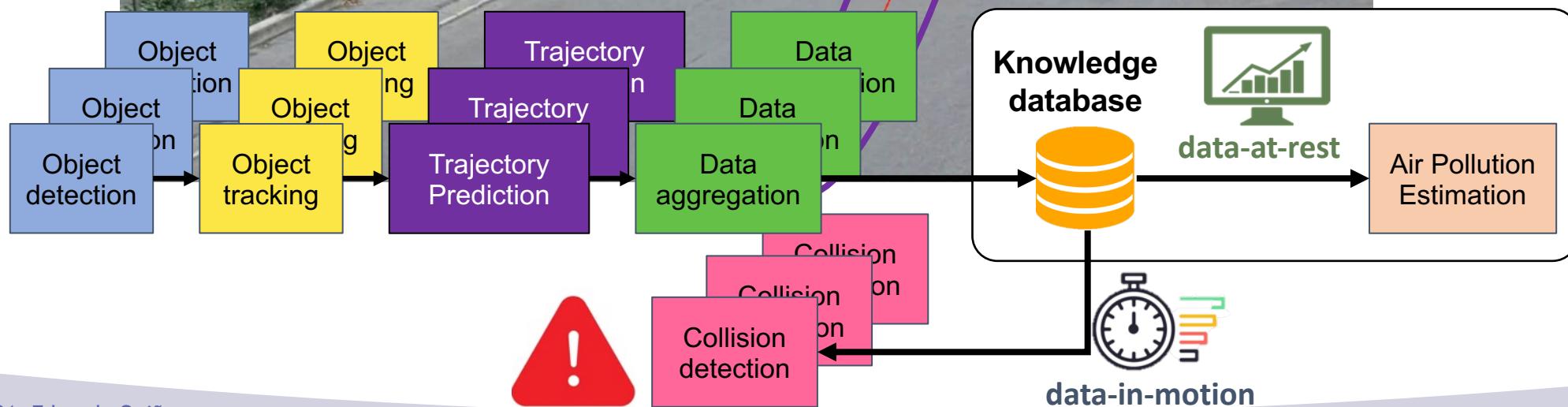
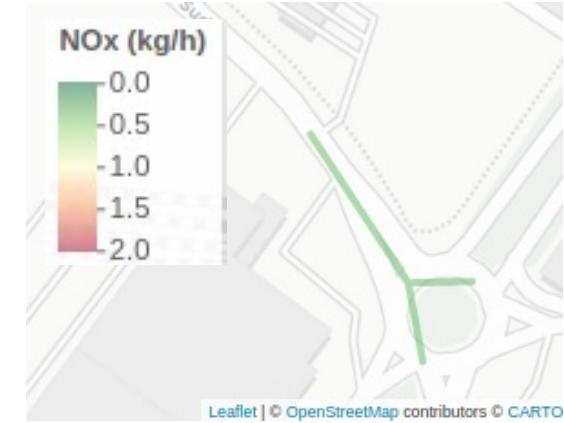
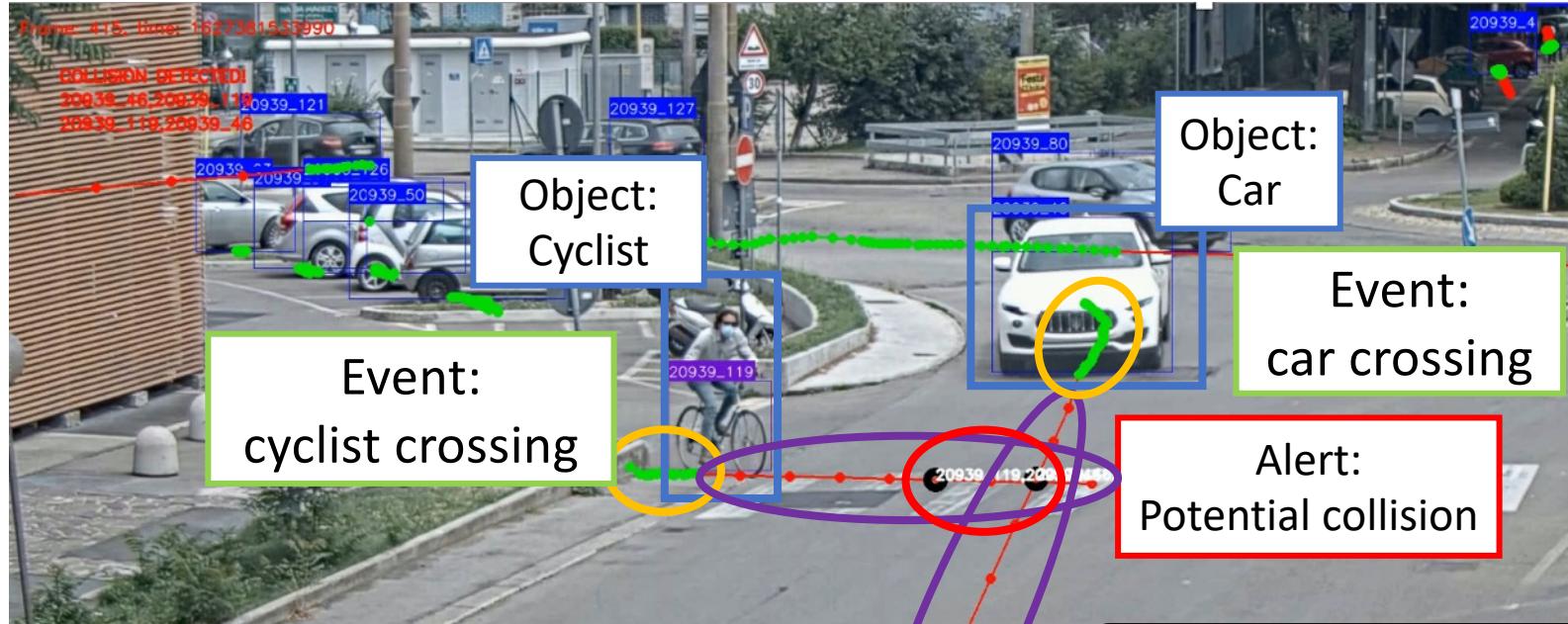
The ELASTIC Data-Analytics Workflow

Data Analytics Methods

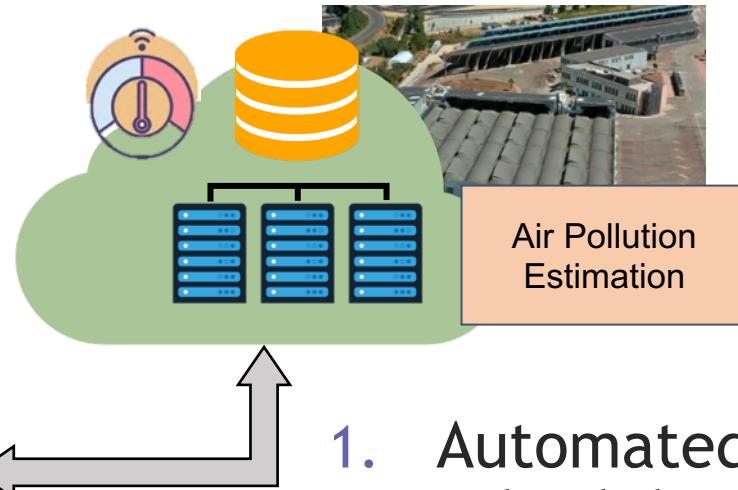
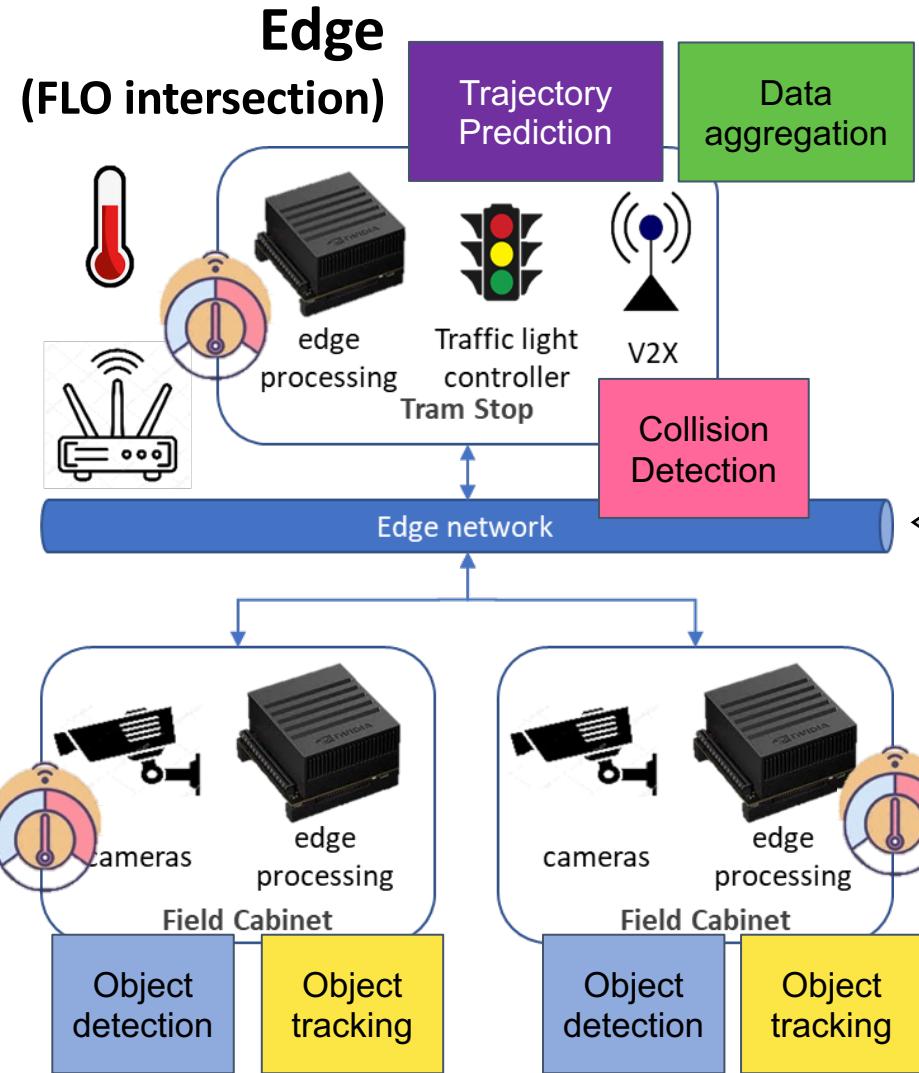
1. Sensor fusion (ADAS)
2. Tram position (NGAP)
3. Object detection
4. UTC/Supervisor consolidation
5. Data fusion
6. Data aggregation
10. Electric power consumption
11. Defect Detector
- 7. Dashboard**
- 8. Hazard detection**
- 9. Alert visualization (cars/trams)**



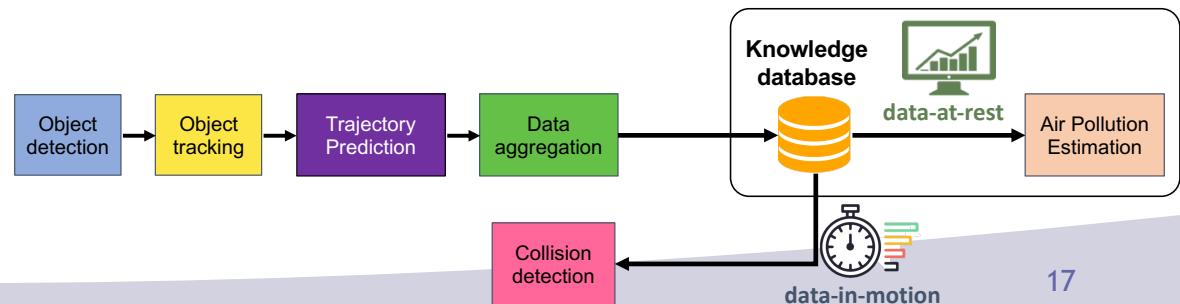
Functional perspective: from Data to Knowledge



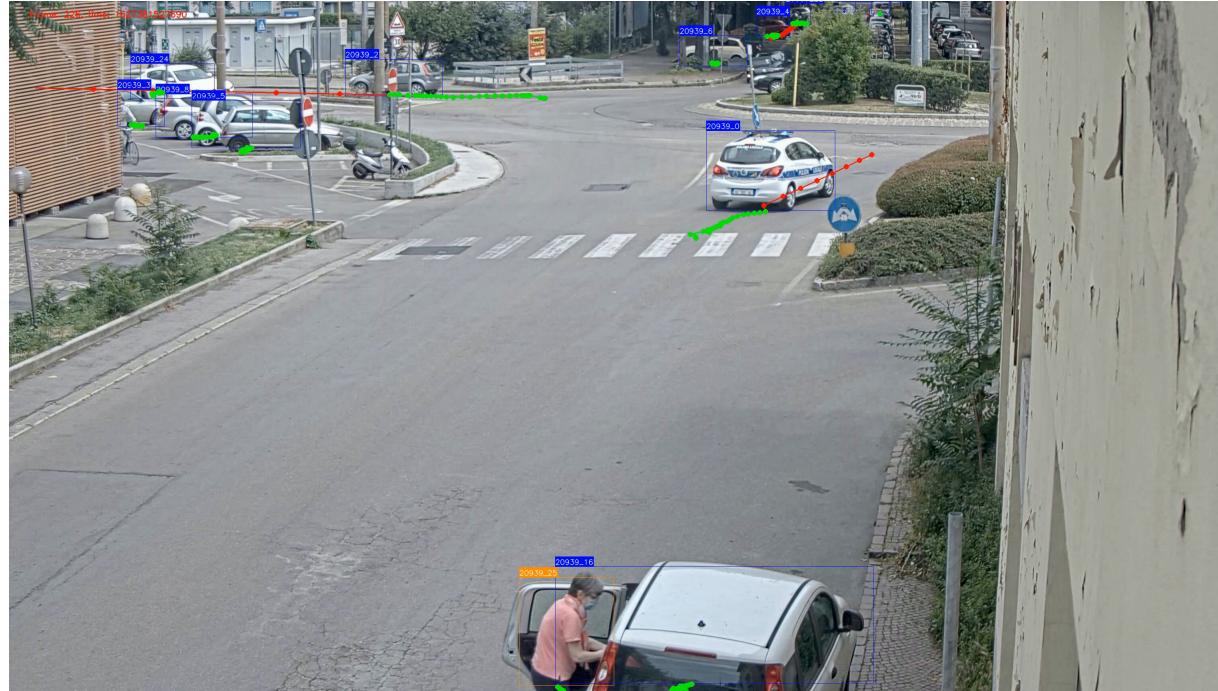
Execution of Data-Analytics across the Compute Continuum



1. Automated deployment and scheduling of data-analytics
2. Constant monitoring of execution
3. Re-scheduling on-the-fly if a requirement is violated



Execution of Data-Analytics across the Compute Continuum





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Stay Tuned!

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