ELASTIC

**A Software Architecture for Extreme-ScaLe
Big-Data AnalyticS in Fog CompuTIng Ecosystems**

Overview of the ELASTIC project and the elasticity concept
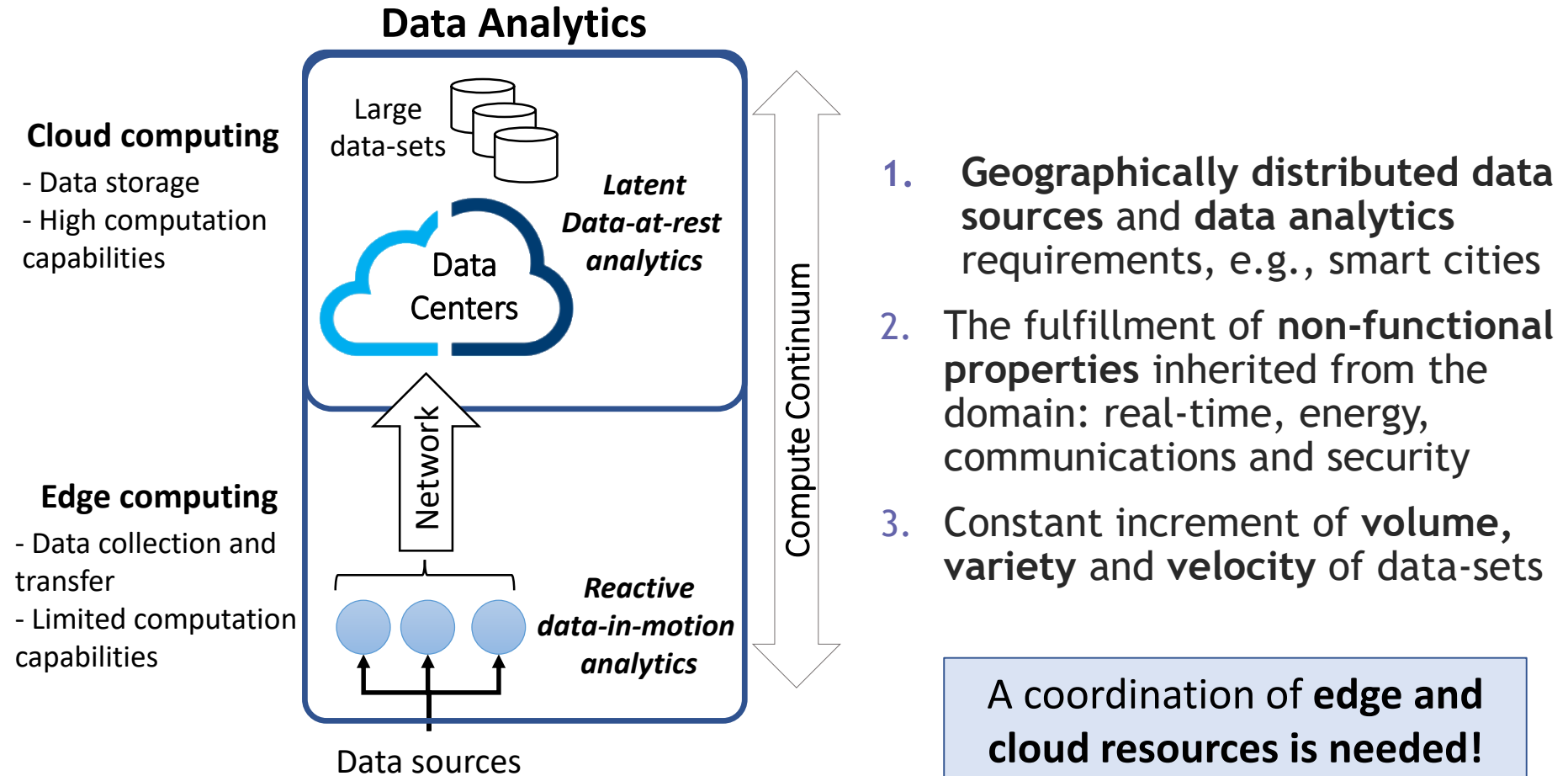
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04/11/2020

- **ELASTIC**: a software architecture for **E**xtreme-sca**L**e big-data **A**nalytic**S** in fog compu**TI**ng e**C**osystems
  - Under the scope of the H2020 call ICT-12-2018-2020: *Big Data technologies and extreme-scale analytics*

- 36 month project (starting Dec 2018); 6 million € budget

Motivation: The Importance of ELASTIC

Data Analytics

Cloud computing

- Data storage
- High computation capabilities

Edge computing

- Data collection and transfer
- Limited computation capabilities

1. **Geographically distributed data sources** and **data analytics** requirements, e.g., smart cities

2. The fulfillment of **non-functional properties** inherited from the domain: real-time, energy, communications and security

3. Constant increment of **volume, variety** and **velocity** of data-sets

A coordination of **edge and cloud resources is needed!**

Complex data analytics workflows across the compute continuum

Large data-sets

Cloud Computing

Network

Compute Continuum

Edge Computing

Data sources
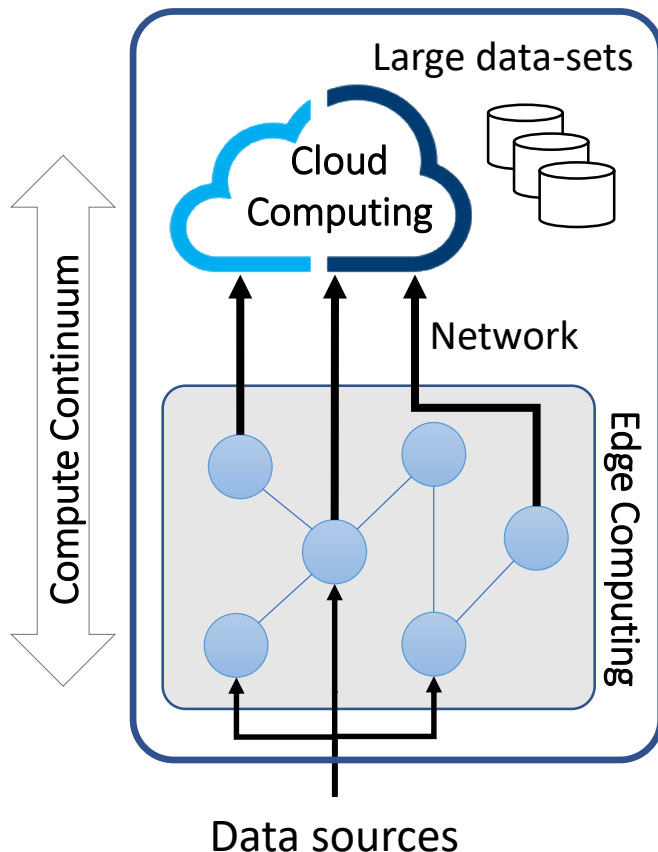
1. Significantly **increase the capabilities** of the data analytics
   - Integrate both responsive data-in-motion and latent data-at-rest analytics in a **single complex workflow**

2. **Fulfill** the non-functional properties inherit from the domain

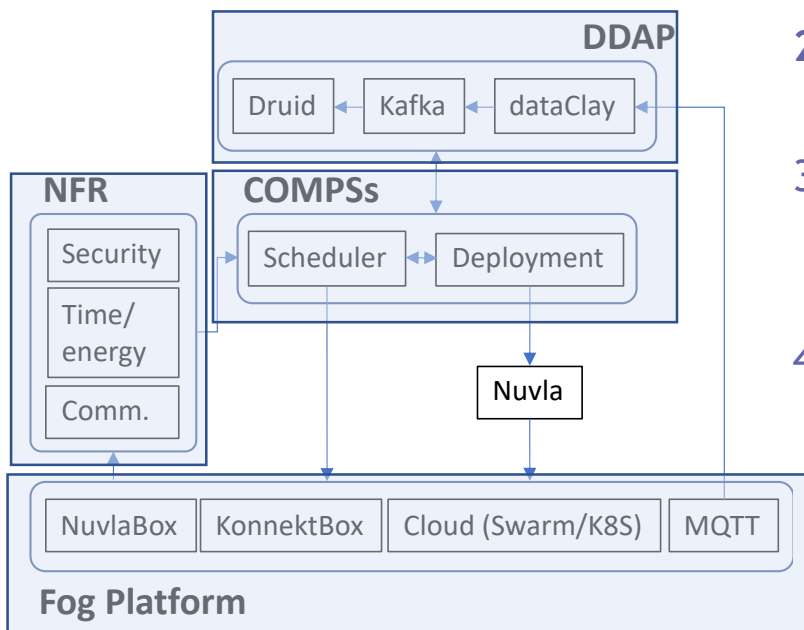3. Use **advance parallel and energy-efficiency embedded** platforms at edge side

Productivity
- + **Programmability**
- + **Portability/Scalability**
- + **Performance**

Converging multiple computing areas

1. SoA programming models for data-analytics workflow development, supported with a **Distributed Data platform (DDAP)**

2. **Advanced orchestraction** methods for workflow scheduling and deployment

3. Non-functional analysis inherited from the **cyber-physical** domain to monitor the execution of workflows

4. Fog-based platforms including

   - **Cloud-based** Container as a Service (Caas) technologies for resource auto-scaling
   - **IoT** cyber-secured communication and network protocols
   - Advanced highly parallel and energy-efficiency **embedded** platforms

DDAP

| Druid | ← | Kafka | ← | dataClay | ← |

NFR

COMPSs

Security

| Scheduler | ↔ | Deployment |

Time/ energy

Comm.

Nuvla

| NuvlaBox | KonnektBox | Cloud (Swarm/K8S) | MQTT |

Fog Platform

Smart Mobility Use-Case

City of Florence

- Test and highlight the benefits of the ELASTIC Software architecture

- Deployed on the Florence tramway network (Italy)

Florence Tramway network

- Tram vehicles equipped with
  - Advanced parallel embedded processor architectures
  - V2X communication
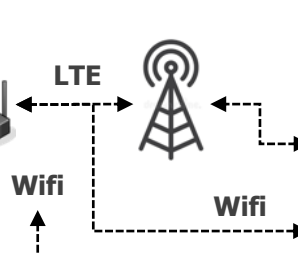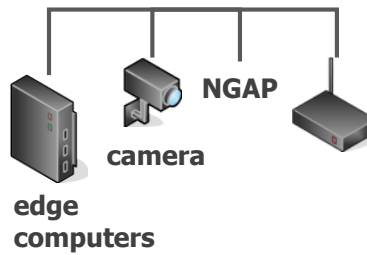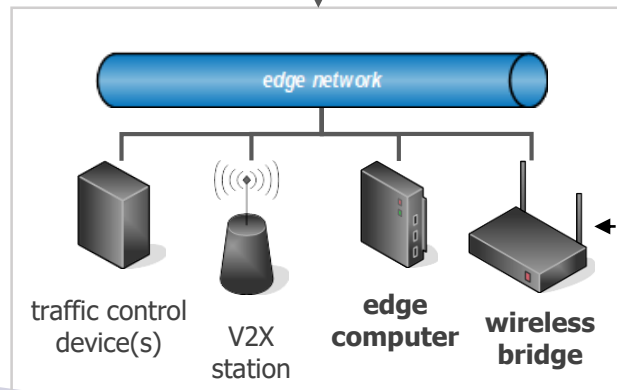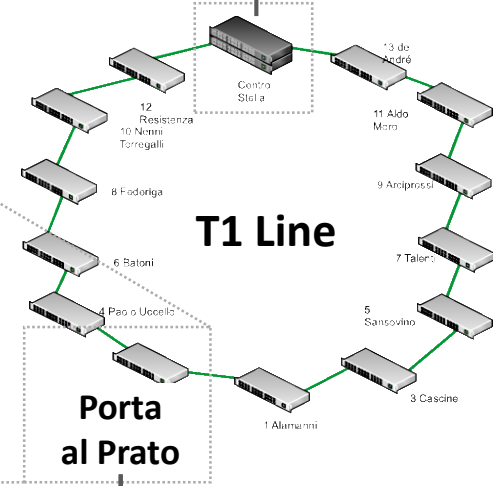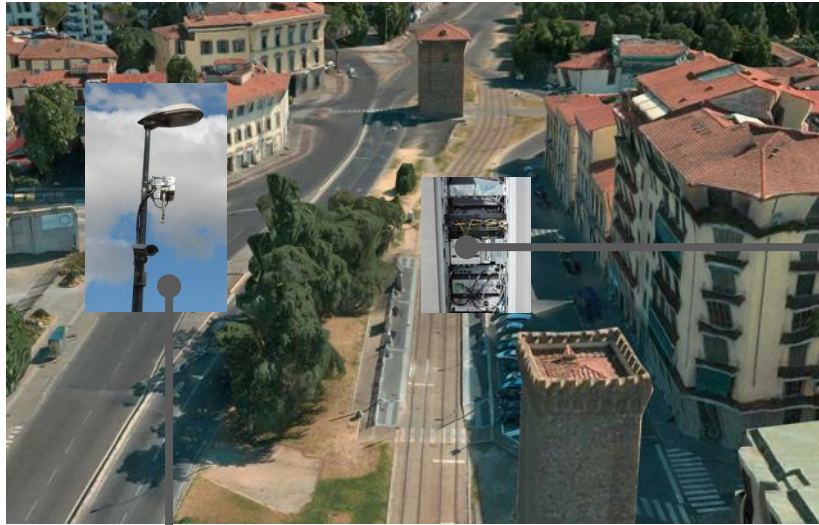 - Variety of sensors (cameras, radars/LIDAR, IMU, etc.)

Tram vehicle from the Florence Tramway network

1. **Next Generation Autonomous Positioning (NGAP) and Advanced Driving Assistant System (ADAS)**
   - Autonomously localize tram vehicles to support ADAS functionalities (i.e. obstacle detection and collision avoidance) based on data fusion coming from network and vehicle sensors

2. **Predictive maintenance**
   - Monitor the operation of the tramway to identify failures before they happened
   - Driving optimization based on energy consumption, acceleration and speed

3. **Interaction between the public and the private transport in the City of Florence**
   - Enhance the transportation system to better manage interactions between different transportation networks, i.e., public and private
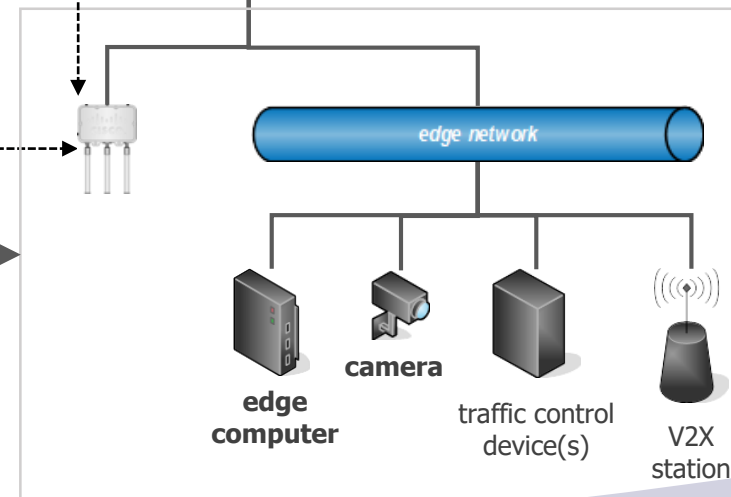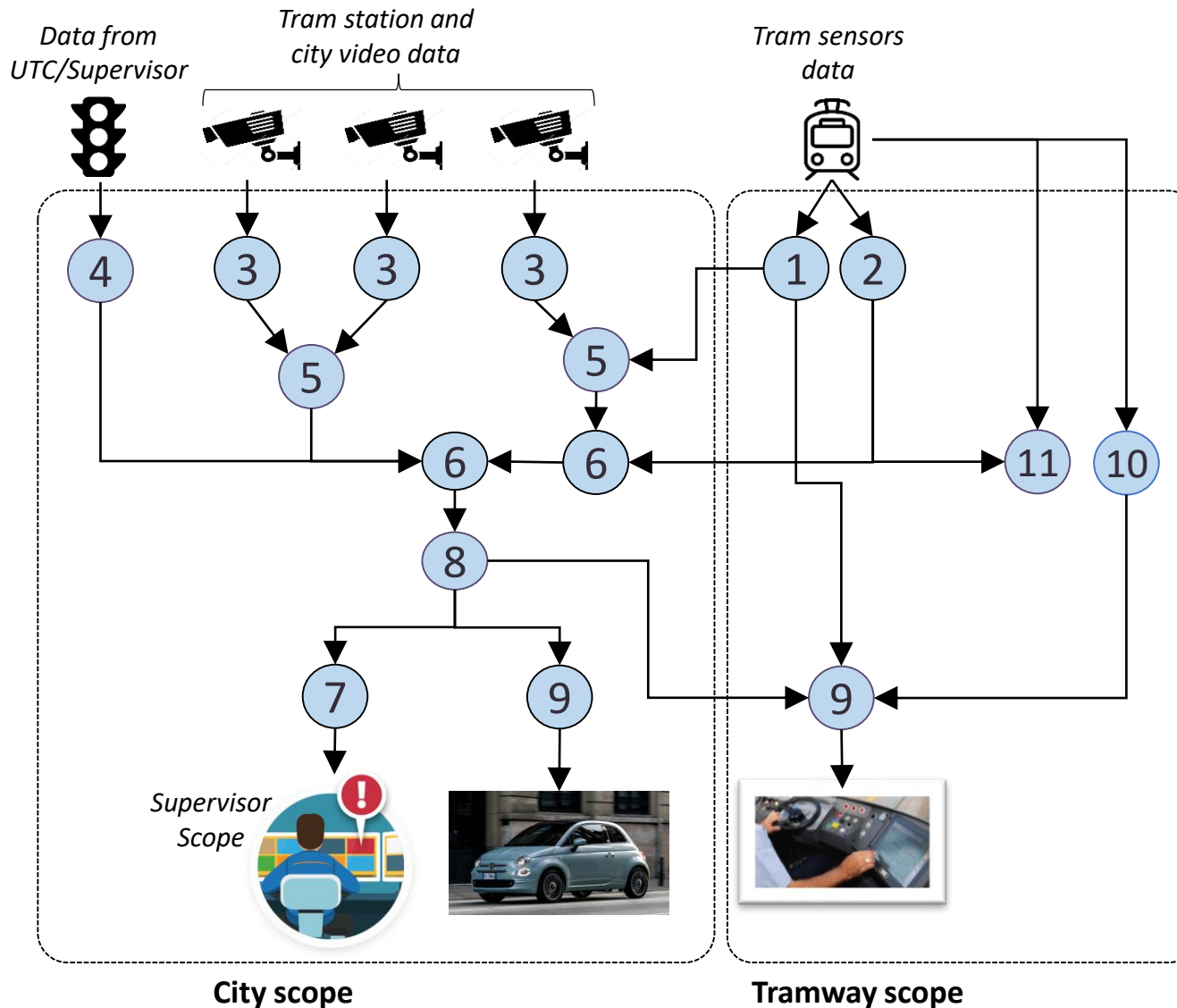
Cloud (GEST depot)

NGAP
camera
edge computers
LTE
Wifi
Wifi

T1 Line

Porta al Prato

edge network

traffic control device(s)
V2X station
edge computer
wireless bridge

edge network

edge computer
camera
traffic control device(s)
V2X station

Field cabinet (e.g. pole / semaphore / other)

Track cabinet (at stops)

ELASTIC Data-Analytics Workflow

Data Analytics methods

Data Analytics methods
1. Sensor fusion
2. Tram position
3. Object recognition
4. UTC/Supervisor consolidation
5. Data fusion
6. Data aggregation and model creation
7. Dashboard
8. Hazard detection
9. Alert visualization (cars/trams)
10. Electric power consumption
11. Defect Detector

ELASTIC

1. ELASTIC aims to develop a novel **software architecture** with the following capabilities:
   - Increase data analytics capabilities by efficiently combine data-in-motion and data-at-rest analytics into **complex workflows**
   - Increase the development and deployment **productivity** of systems requiring data-analytics
   - Guarantee the non-functional properties inherited from the domain

2. ELASTIC aims to apply the software architecture to develop a distributed sensing/computing infrastructure within the Florence tramway network for advanced urban mobility applications

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www.elastic-project.eu

Stay Tuned!

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