5GinFIRE and the Automotive EVI

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5GinFIRE

5GINFIRE is a three years Research and Innovation action / project under the EU program Horizon 2020 (Grant Agreement no. 732497) started on 1 January 2017.

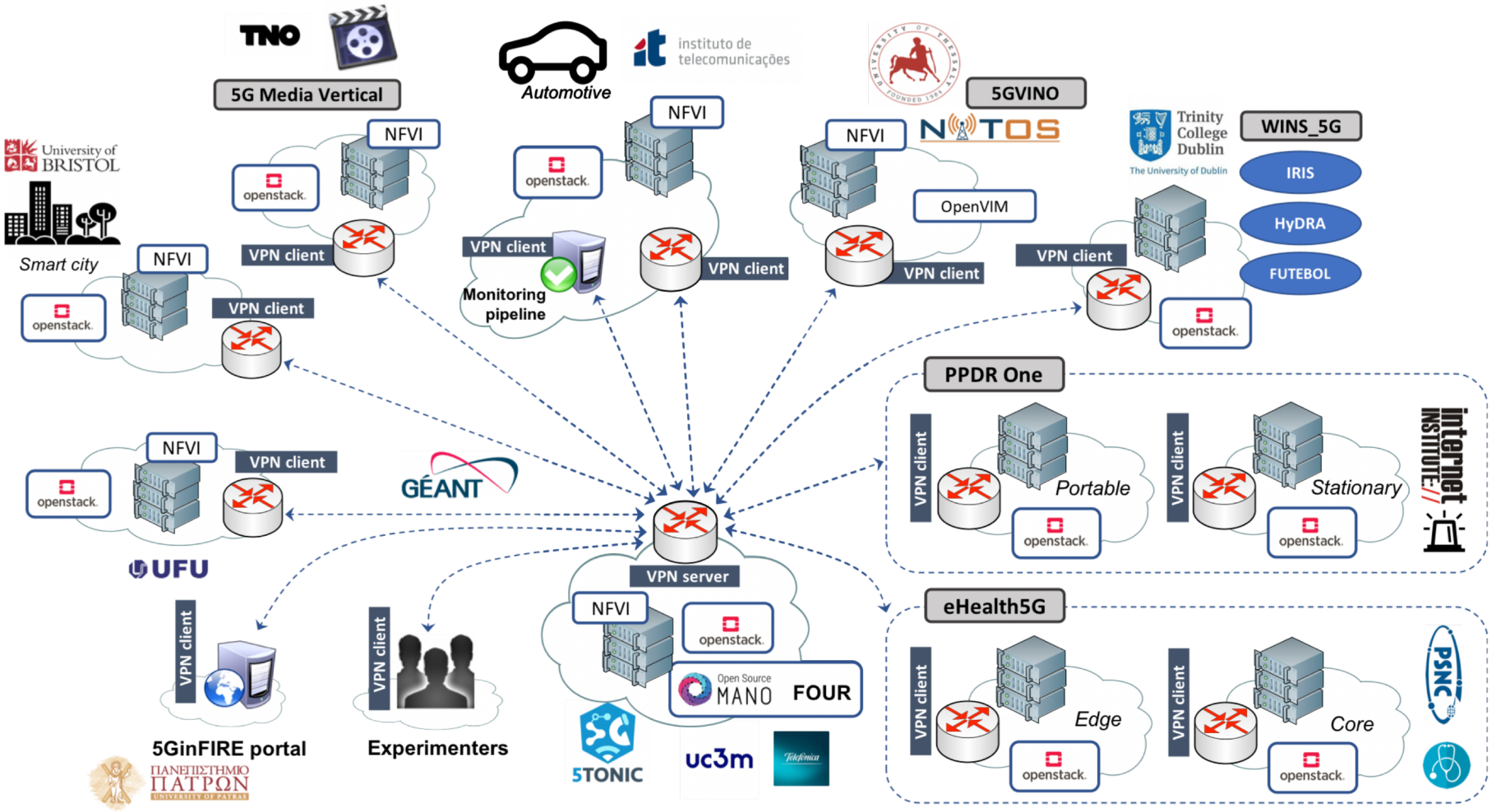
5GinFIRE

- **Main goal:** to build and operate an Open, and Extensible 5G NFV-based Reference (Open5G-NFV) ecosystem of Experimental Facilities (...) laying down the foundations for instantiating fully softwarised architectures of vertical industries and experimenting with them.

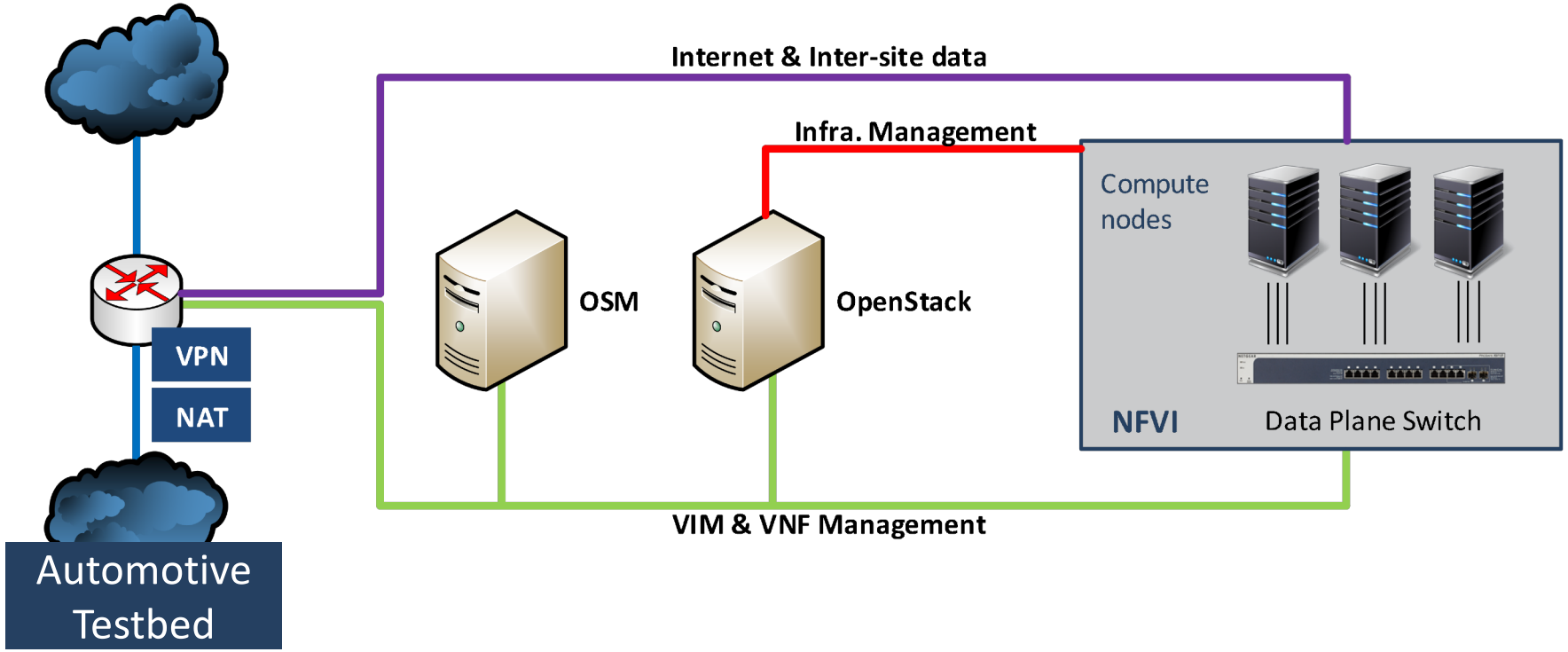
- Driven by architectural (standards) and technological (open source) convergence principle.

- Initial focus on **Automotive** & Smart Cities verticals.

5GinFIRE ecosystem

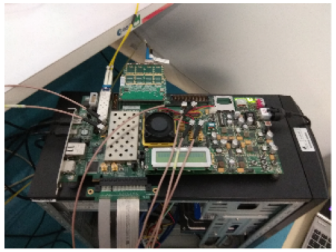


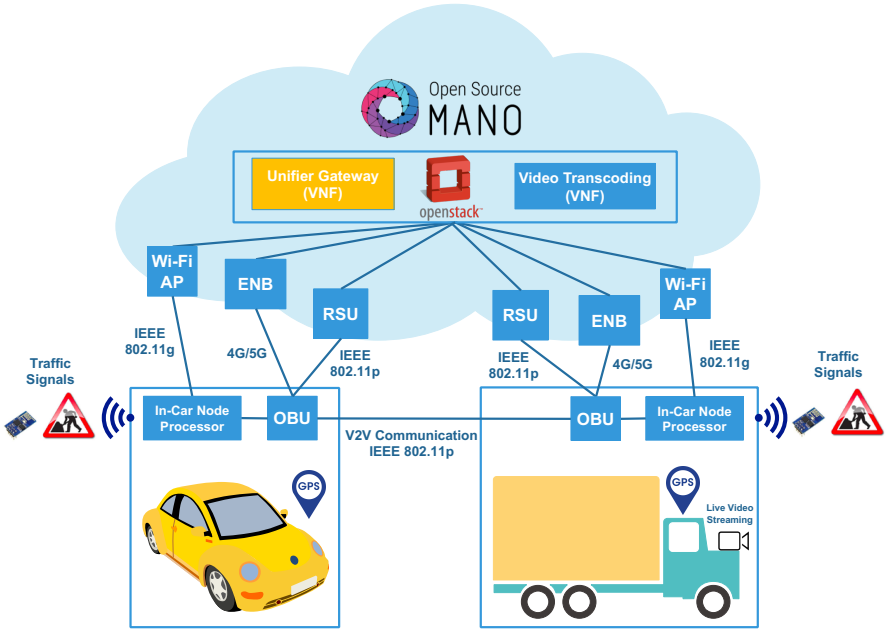
Automotive EVI inside 5GinFIRE



Automotive EVI inside 5GinFIRE

- N-PMIPv6 vehicular *ad-hoc* network with
  - IEEE 802.11p/WAVE;
  - IEEE 802.11n (Wi-Fi);
  - Small Cell C-RAN 4G supported by OAI;
  - In-car node processor with additional sensors (cameras, positioning, …).
  - Simultaneous multihoming:
    - more than one technology in use;
  - Mobility support:
    - transparent handovers for the end-user.



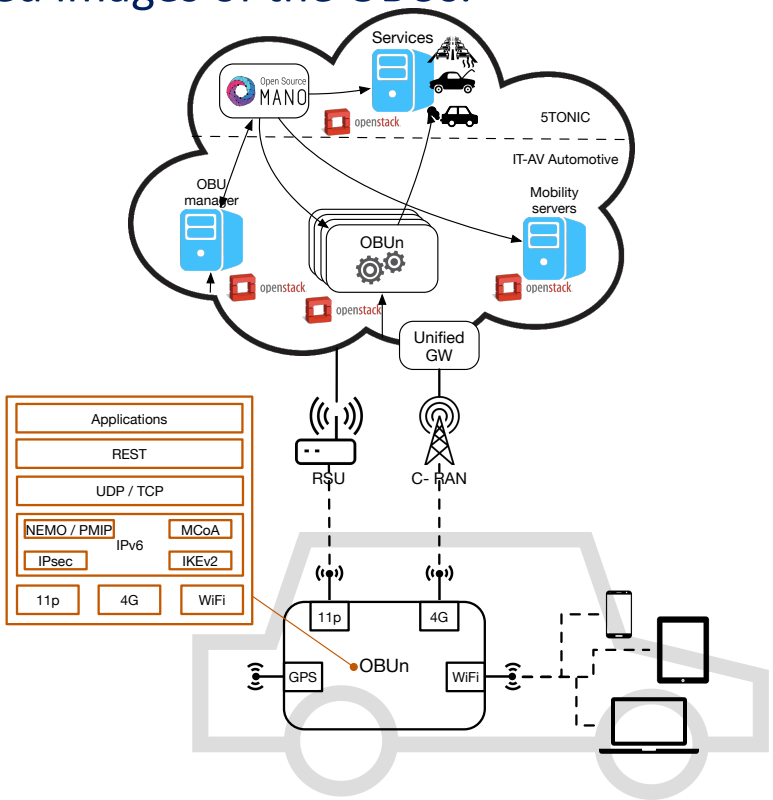


Automotive is a hot topic!

- 7 automotive 3rd party experiments within 5GinFIRE
  - Extending VANET capabilities:
    - SURROGATES (University of Murcia, Academia)
    - MIGRATE (OdinS, SME)
    - CV2XinFIRE (FERON technologies, SME)
  - Safety:
    - VRU-Safe (University of Athens, Academia)
    - 5G-CAGE (University of Murcia, Academia)
  - Multimedia/Infotainment:
    - CAVICO (iTTi, SME)
    - 5G-DT (Elios, SME)

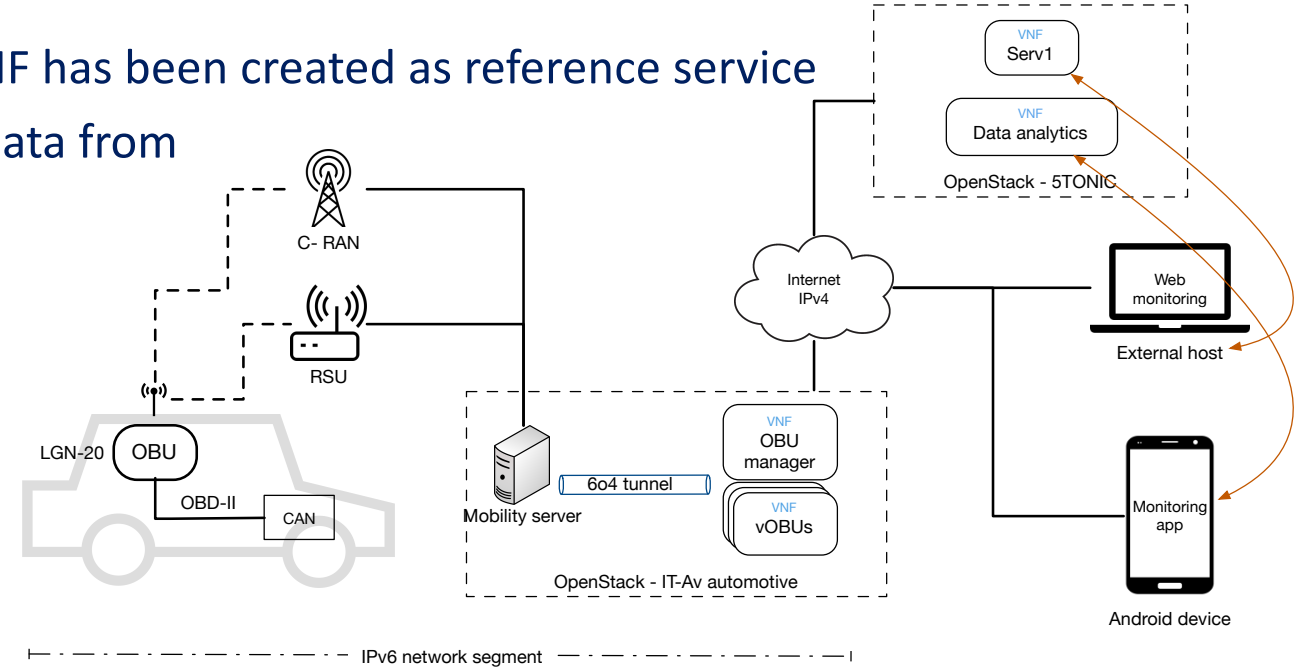
SURROGATES

- Main objective:
  - Extend the 5GINFIRE OBUs with a mobile IPv6 communication stack, and then delegate computing and cache tasks of a set of services near the edge, by means of virtualised images of the OBUs.



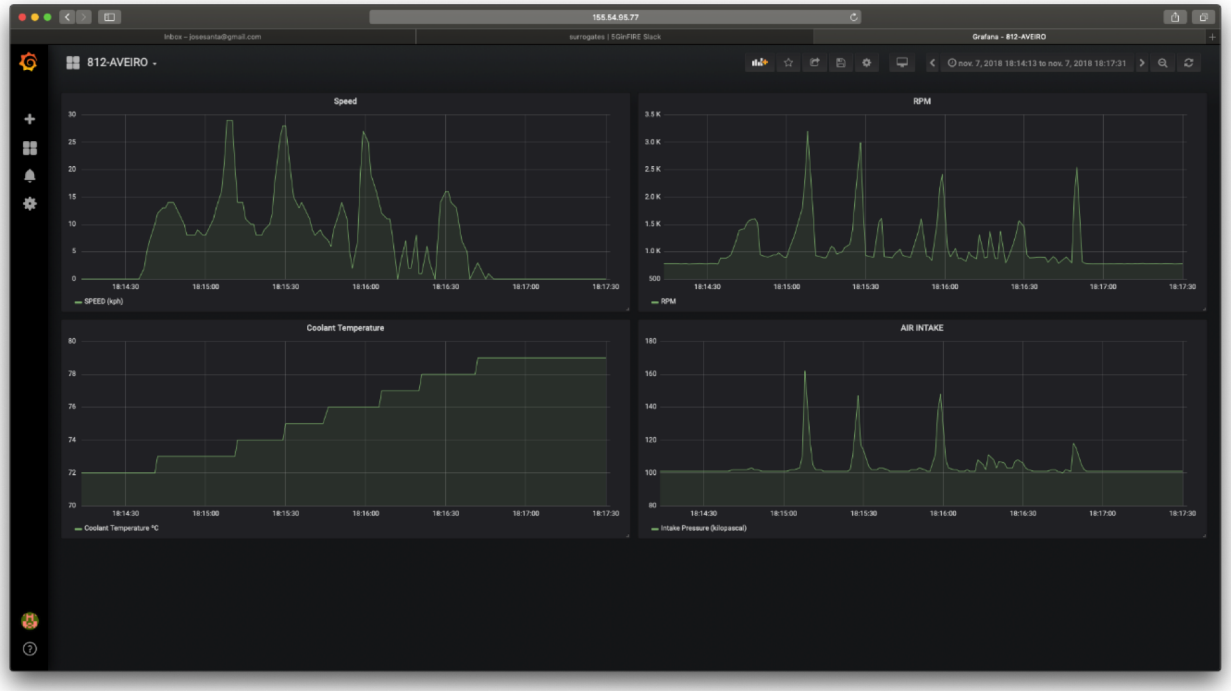
SURROGATES

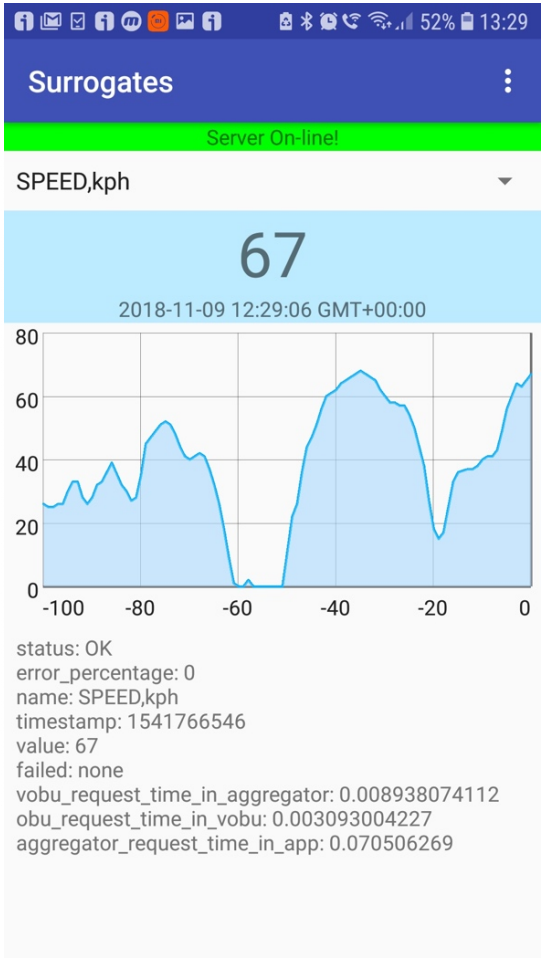
- Implementation and VxFs deployed:
  - **vOBU:** this VNF is instantiated several times to cover the virtualization needs of physical OBUs. They are deployed in the OpenStack domain of IT-Av automotive;
  - **OBU manager:** this VNF has been deployed at IT-Av premises too;
  - **Data analytics:** its global nature justifies its deployment in the central 5GINFIRE backend at 5TONIC;
  - **Service:** a general VNF has been created as reference service to collect and show data from vehicles.



SURROGATES

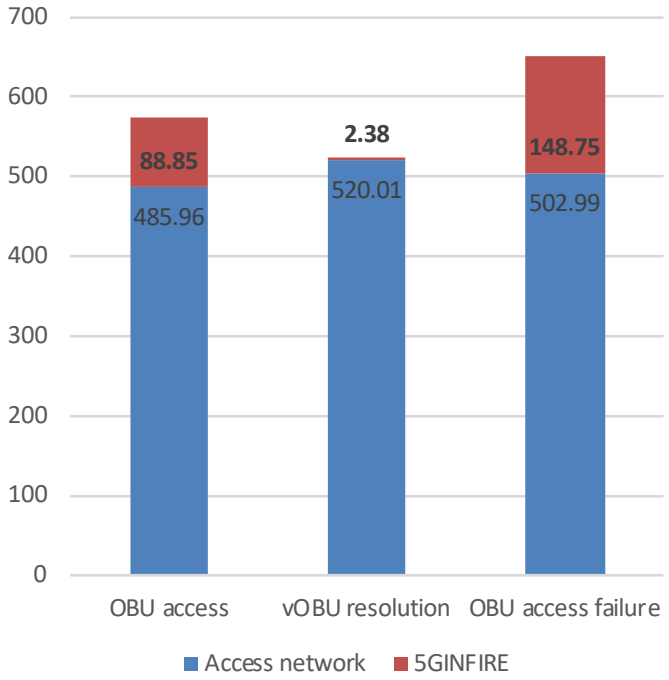
- Results:



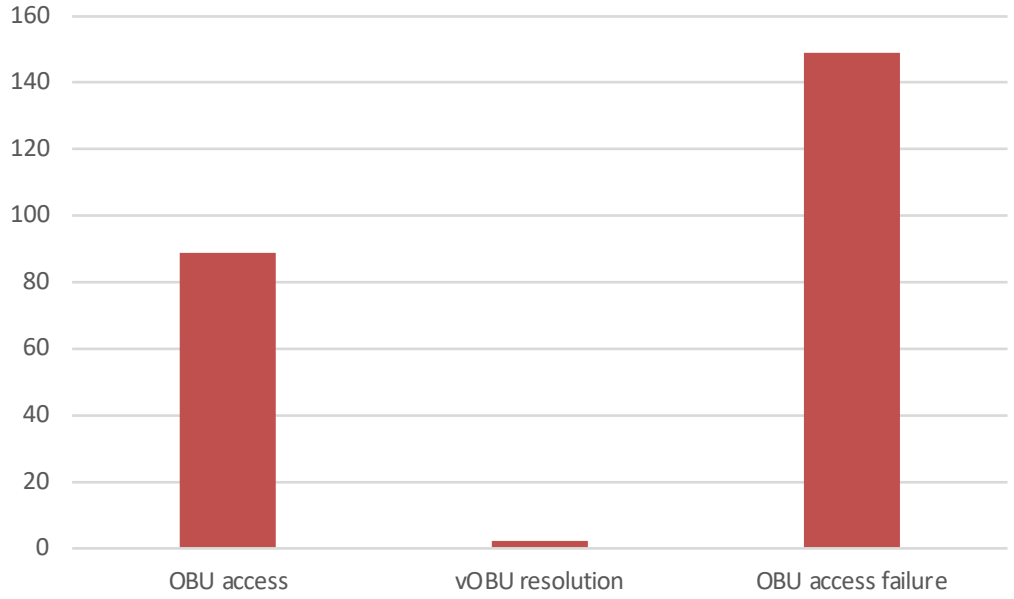


SURROGATES

- Results:



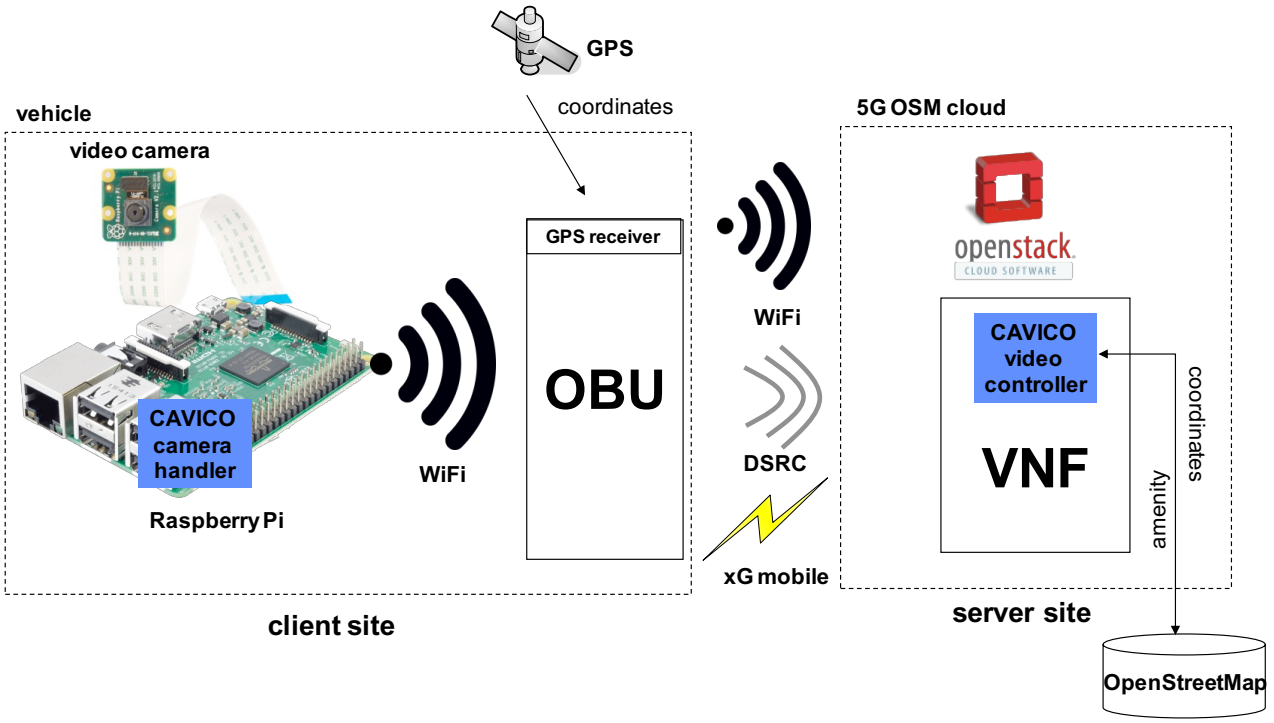
RTT delay solving data requests [ms].



RTT delay in request resolution within the 5GINFIRE framework [ms].

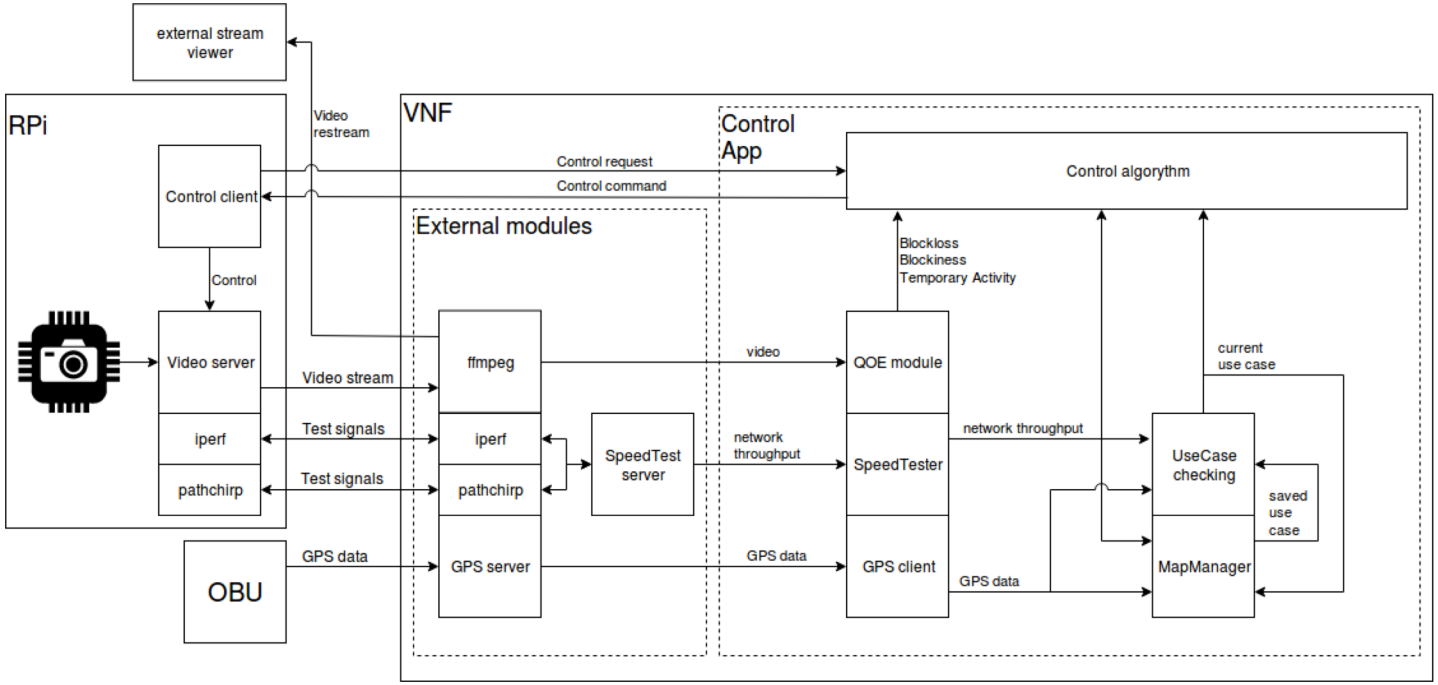
CAVICO

- Main objective:
  - to adapt CAVICO context-aware video controller as a VxF for automotive EVI environment offered by IT-Av in 5GINFIRE project and test innovative QoE features of the CAVICO solution while merging QoE and QoS parameters.



CAVICO

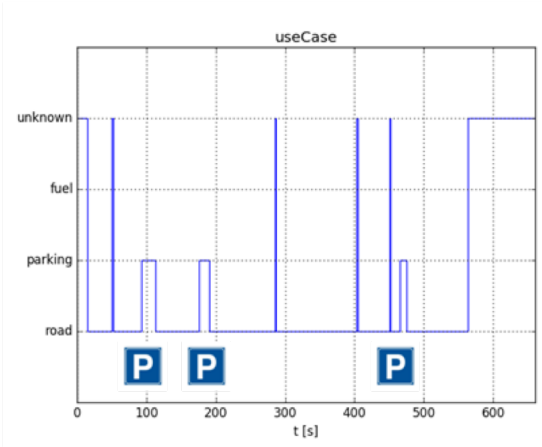
- Implementation and VxF deployed:
  - **CAVICO:** is responsible for interpretation of video stream, GPS data and network throughput. Every time, when a new request is received, the control algorithm calculates current FPS, video resolution and stream bit rate using information about the use case, observed video QoE and measured network throughput.



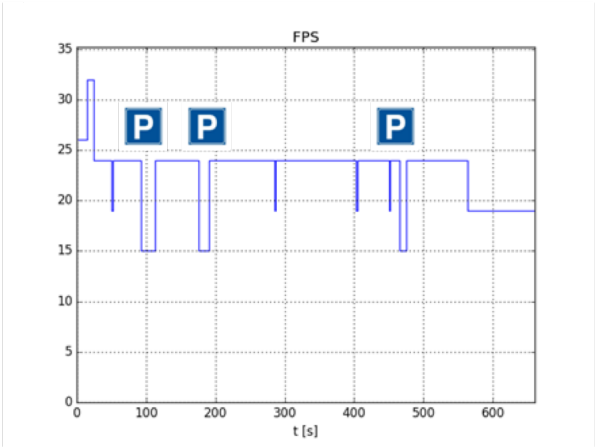
CAVICO

- Results:

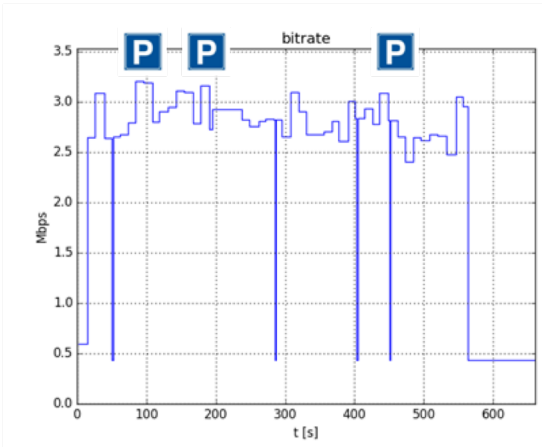
Trajectory.



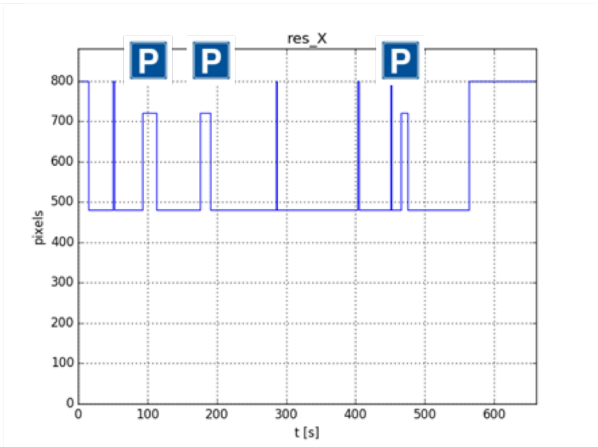
Use case.



FPS.



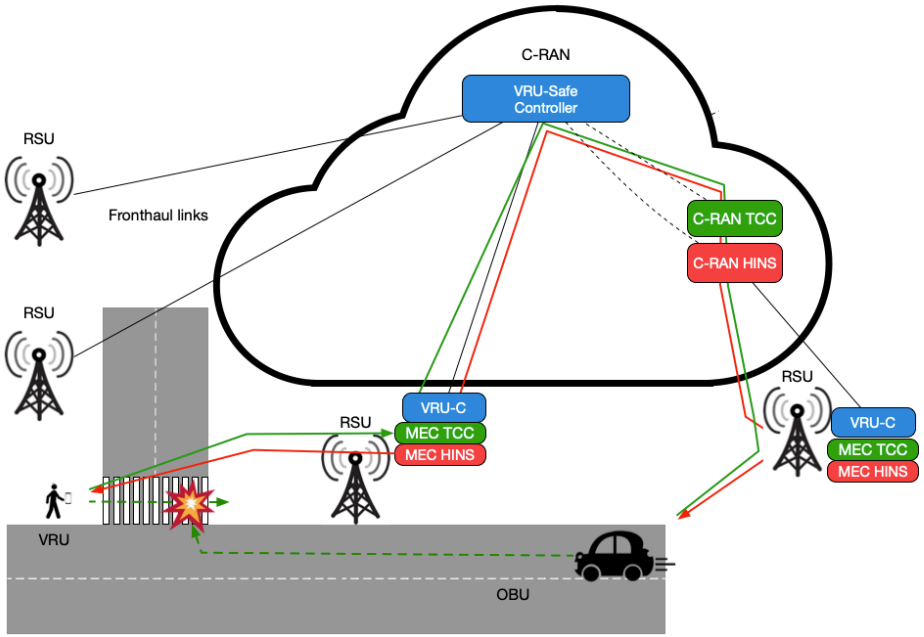
Bitrate.



Video resolution.

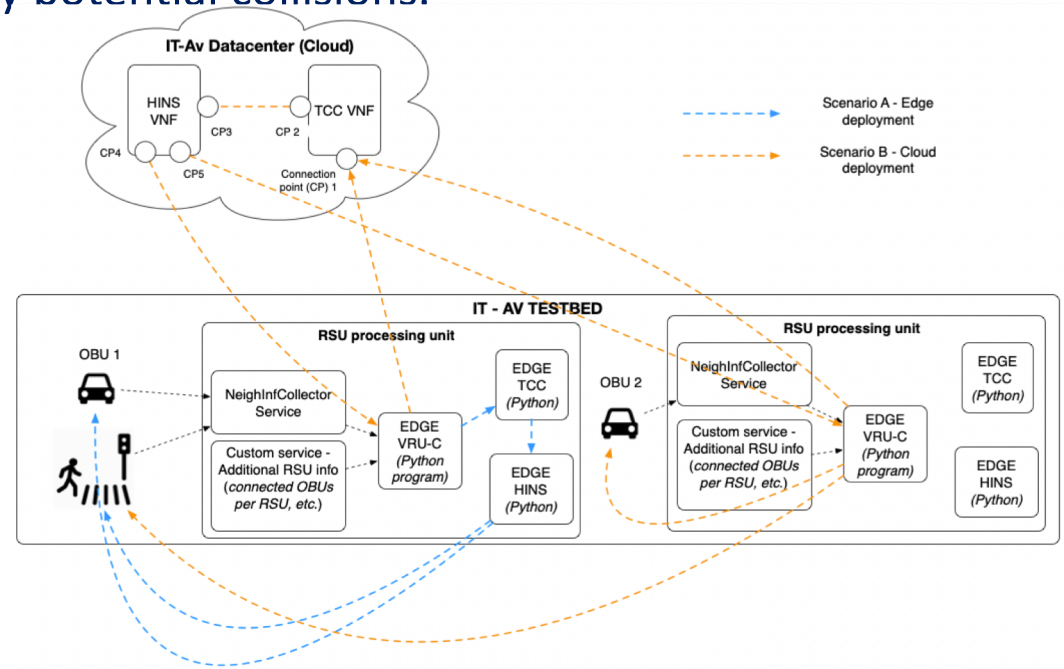
VRU-Safe

- Main objective:
  - Experimental evaluation of a network service with computing and networking capabilities to identify Connected Vehicles and Vulnerable Road Users in potentially dangerous situations based on several contexts (Vehicle & VRU position, movement direction, accelerations, etc.), by predicting their trajectories and forwarding the respective notifications to both sides.



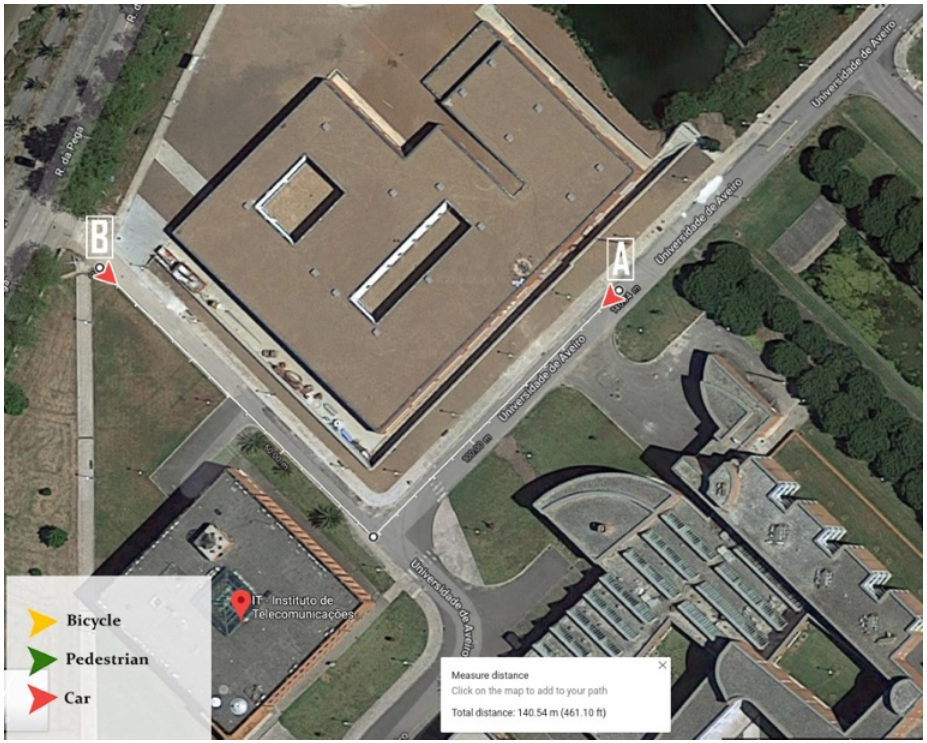
VRU-Safe

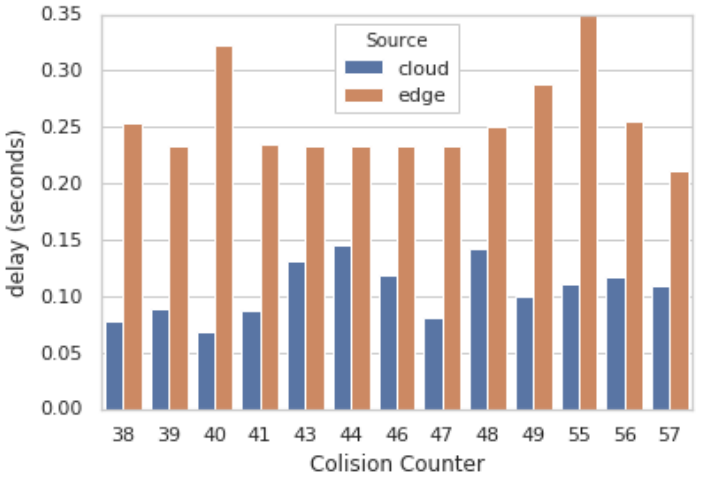
- Implementation and VxFs deployed:
  - **Trajectory Computing Component**: processes the acquired contextual information and generates position prediction matrices based on OBUs velocity, direction, etc. The matrices are then forwarded to the HINS VxF.
  - **Hazard Identification and Notification Service**: processes the information and detects any potential collisions.



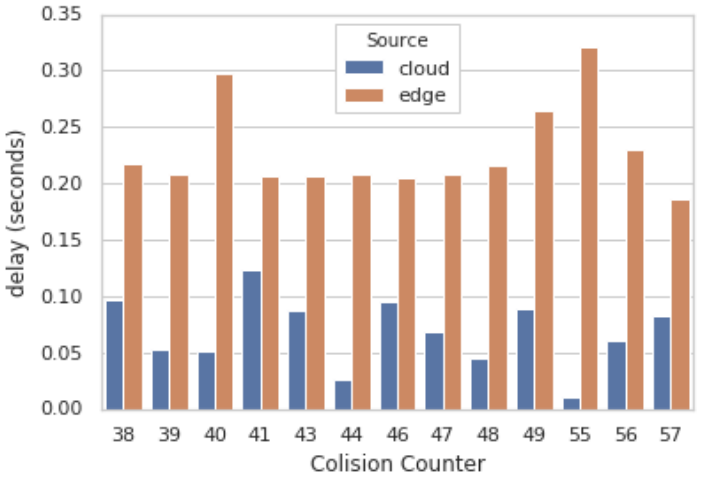
VRU-Safe

- Results:





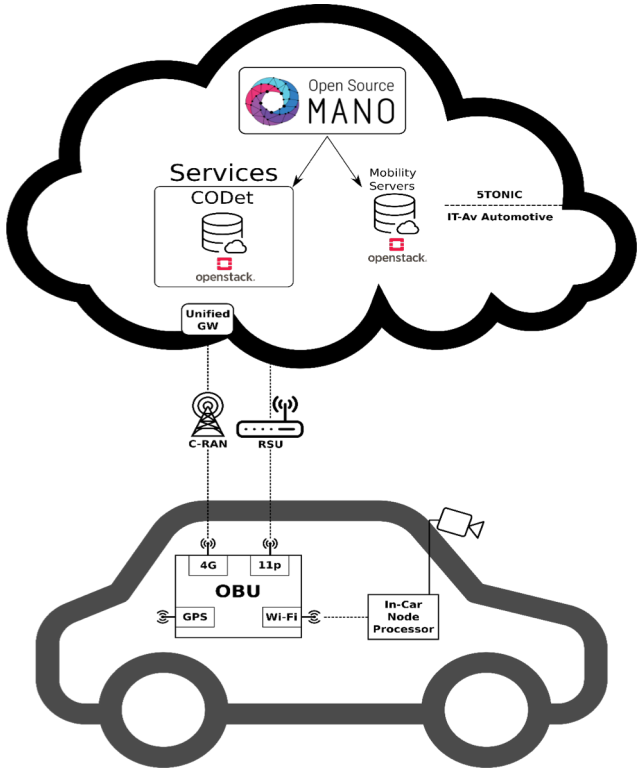
OBU A.



OBU B.

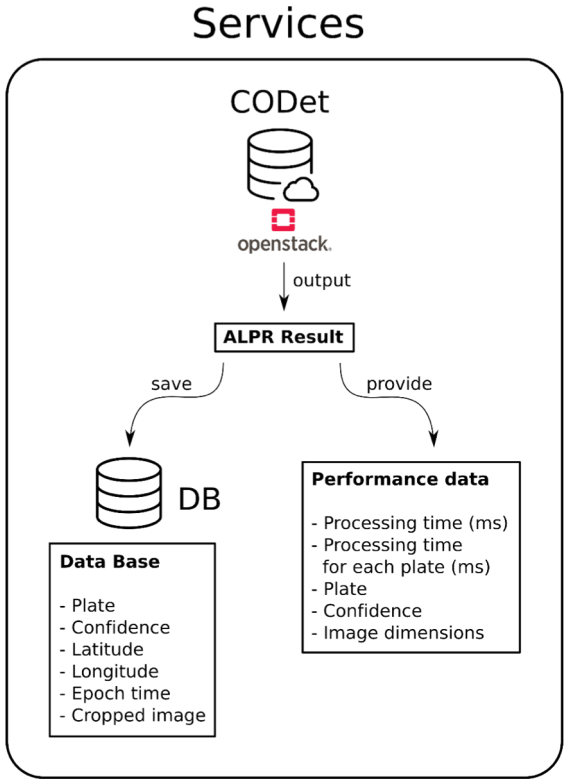
5G-CAGE

- Main objective:
  - Deploy and test a City Safety solution using monitoring and analytics of video streams collected from heterogeneous and distributed sources in order to validate a new Public Safety NFV Network Service.



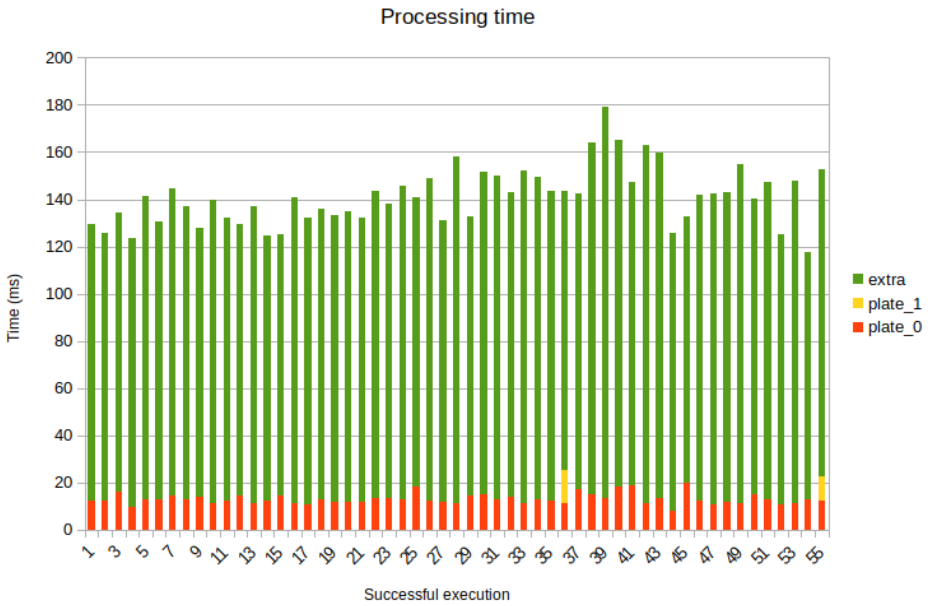
5G-CAGE

- Implementation and VxFs deployed:
  - **CODet**: It will be able to detect via Computer Vision and Machine Learning algorithms (deployed at the edge) specific objects such as car plates and brands.

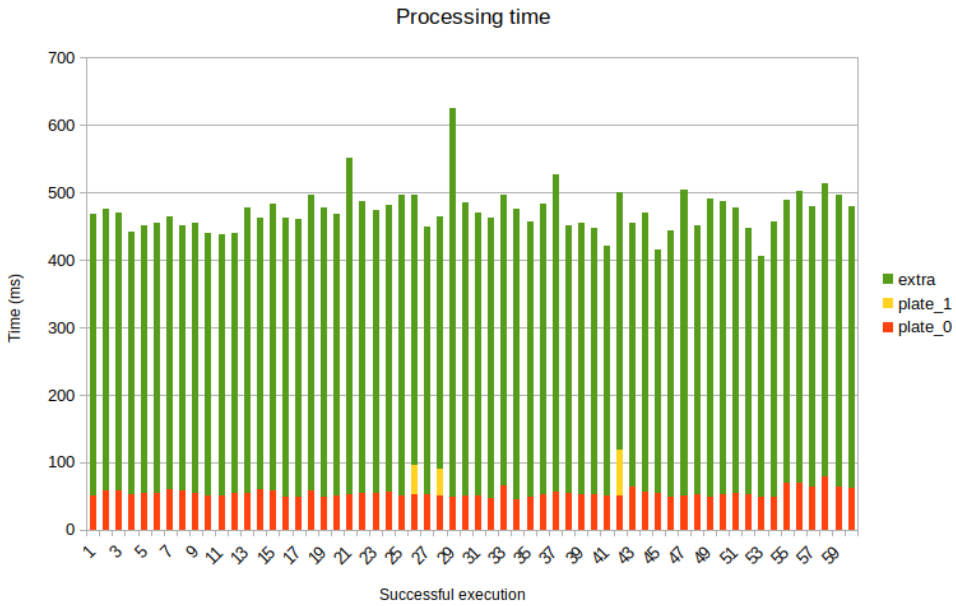


5G-CAGE

- Results:
  - Processing time



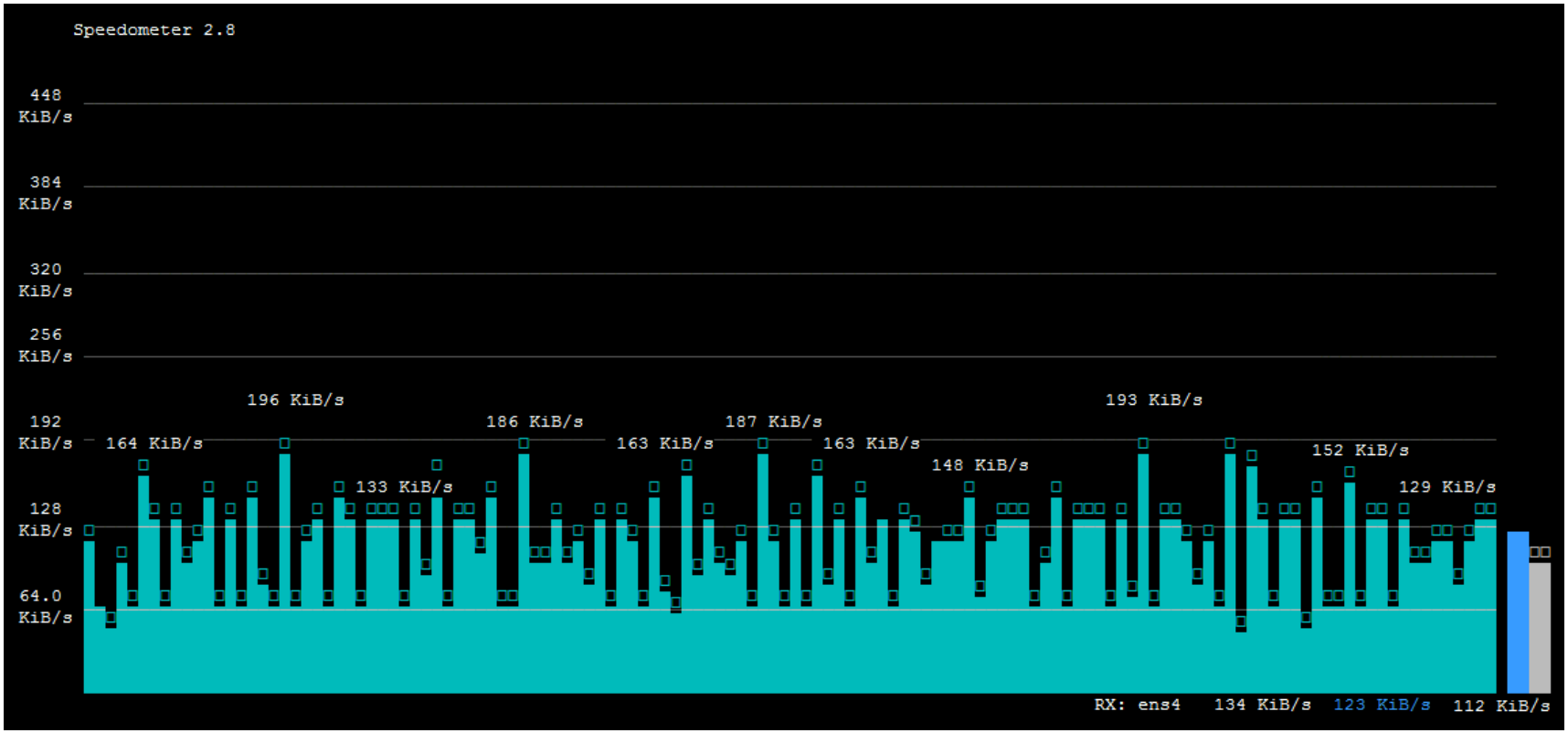
Locally processed.



Processed in the Cloud.

5G-CAGE

- Results:
  - Network load, from the OBU to the RSU.



The Future of IT-Av Automotive EVI

- Becoming a city-scale platform
  - UIA European Project: Aveiro STEAM City
    - IT-Aveiro
    - Altice Labs
    - University of Aveiro
    - Municipality of Aveiro
    - INOVARIA
    - CEDES
- With new functionalities
  - 5G RAN
  - C-V2X
  - Virtualization in the vehicles

5GINFIRE

Contributors

EURESCOM

b com

easy global market

OdinS

ELIOS srl

it

Telefónica

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Thank You!

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