Digital Twin to Support Autonomous Driving

June 20, 2019
Martin Bauer (Martin.Bauer@neclab.eu)
NEC Laboratories Europe

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 731993.
Outline

• What is a digital twin?
• Why do we need a digital twin?
• How can we build a digital twin?
• Data model for a digital twin
• IoT platform functionality
• Next steps: Advanced digital twin functionality
• Takeaway points
Digital Twin is a concept supporting autonomous driving
What is a digital twin?

Digital twin:
• digital replica of physical assets, processes and systems
• provides both elements and dynamics of operation and life cycle (based on Wikipedia)

Digital Model

Digital Twin

This project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No 731993.
Why do we need a digital twin?

1. Real Car has limited view
2. Enable Interaction with other Twins
3. Access to environment
4. Access to history, 3D Model

I. Understand current situation
II. Predict future situation(s)
III. Recommend action

- Digital twin car in digital twin environment
- Interaction with other twins

The idea is **NOT** to remote control the car, but to provide “extended view” to improve driving.

This project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No 731993.
How can we build a digital twin?

- **Data Twin** – digital representation of the real twin incl. its state
- **Augmented Twin** – adding „augmentation“ to the data twin: new functions & new properties
- **Context-aware Twin** – information about the current situation and context of the real twin
- **Cognitive Functions** – AI and data analytics function to capture context and twin state
NGSI-LD as data model for digital twin

Information Model

Entity

Relationship

Entity

Property

Value

hasObject

hasSubject

hasValue

hasProperty

hasRel.

hasValue

rdf:type

ont:ISG-CIM:Vehicle

Vehicle

Person

StreetSegment

Pothole

3dModel

Instantiation

urn:ISG-CIM:Vehicle:B6789

speed

location

80

[49.398, 8.672]

urn:ISG-CIM:Vehicle:A4567

inFrontof

distance

20

80

[49.398, 8.673]

[49.398, 8.6731]

urn:ISG-CIM:Person:Person123

location

urn:ISG-CIM:Pothole:P3456

urn:ISG-CIM:StreetSegment:S3126

http://3dmodel...

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 731993.
• To support autonomous driving based on digital twins, efficient information retrieval is needed:
  – about the car itself, other cars and other traffic participants & environment
• NGSI-LD enables the modelling as entities, relationships and properties
• NGSI-LD API enables specifying relevant entities, relationships and properties and filtering according to values/objects and geographic location

→ NGSI-LD API + model provides a suitable basis for digital data twin
Next steps: Advanced digital twin functionality

Digital twins consist of information + intelligent processing

NGSI-LD enabled
• knowledge representation of digital twins
• relationships between twins
• efficient search & discovery of relevant digital twins

Digital twins contain active objects (‘‘augmentations’’) that realize
• analytics functionality & simulations
• cognitive situation understanding
• goal-directed behaviour for assistance
Takeaway points

• IoT information provides “extended view” to improve autonomous driving
• Transferring and processing all information in the car is not feasible
• NGSI-LD can be used for modelling of the digital twin
• IoT infrastructure connects the real twin with the digital twin
• Digital twin provides information representation and intelligent processing

→ Digital Twin is a concept supporting autonomous driving

This project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No 731993.
Thank you for your attention!