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Gathering and using Big data for self driving systems

AI Transportation week – virtual conference

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12/10/2020

What we are going to talk about…

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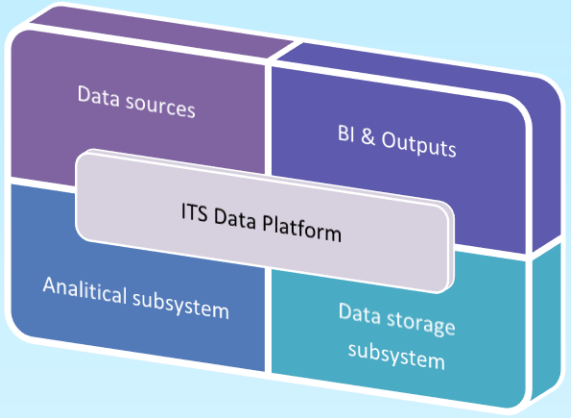
- Motivations
- Our aims to build an ITS Datawarehouse
- Examples considered
- Challenges
- The logical architecture
- Where we are right now



Well, I must warn you in advance…

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Motivations

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Everyone wants data. More data! Even more data…

Development and usage cooperative and later autonomous transportation cannot be done without test data.

- What problems are exactly needs to be solved?
- Understand complex traffic situations and how to handle them.
- Create legal regulations e.g. certification of autonomous systems
- Enhance public acceptance of such autonomous systems

Motivations cont…

Directive 2010/40/EU on ITS*

Priority areas

I. Optimal use of road, traffic and travel data,
II. Continuity of traffic and freight management ITS services,
III. ITS road safety and security applications,
IV. Linking the vehicle with the transport infrastructure.

*Framework for the deployment of Intelligent Transport Systems in the field of road transport and for interfaces with other modes of transport

Our aims to build an ITS Datawarehouse

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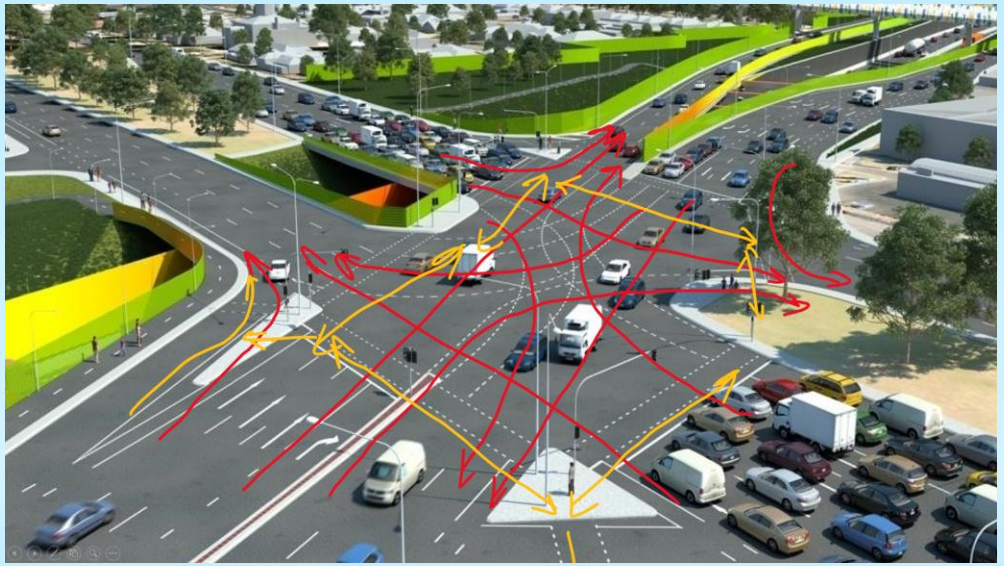
- Enhance the level of integration of already existing national data sources
- Data acquisition for effective and intelligent traffic planning
- Real-time traffic information for traffic management
- Participate in cooperative & autonomous traffic R&D project
- Data and IT environment for developing new algorithms and procedures
- Preparation for autonomous driving



Examples considered

GIDAS
GERMAN IN-DEPTH ACCIDENT STUDY

Cooperative
ITS Corridor
Joint deployment

Challenges in building a Datawarehouse

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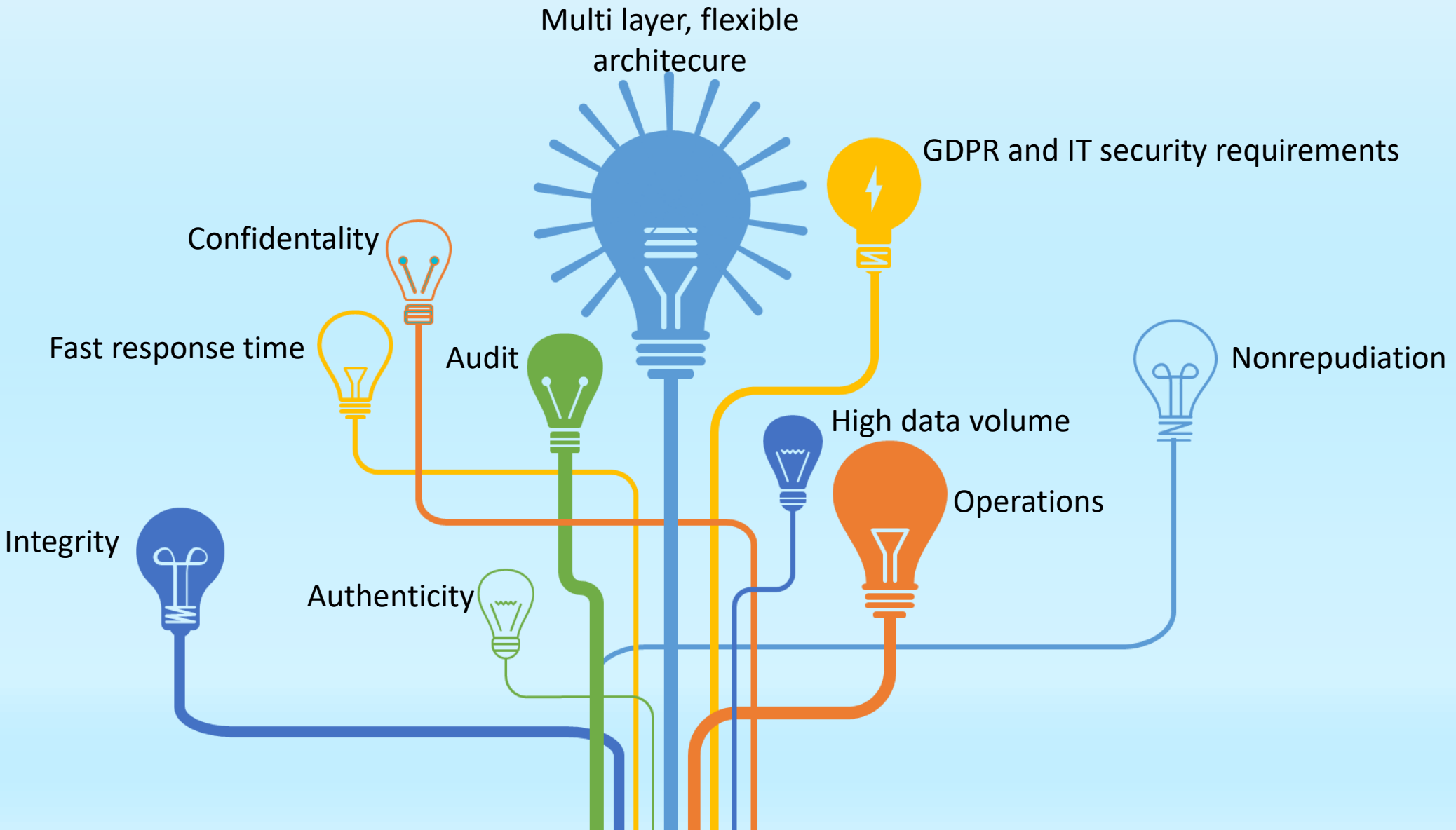

The logical architecture

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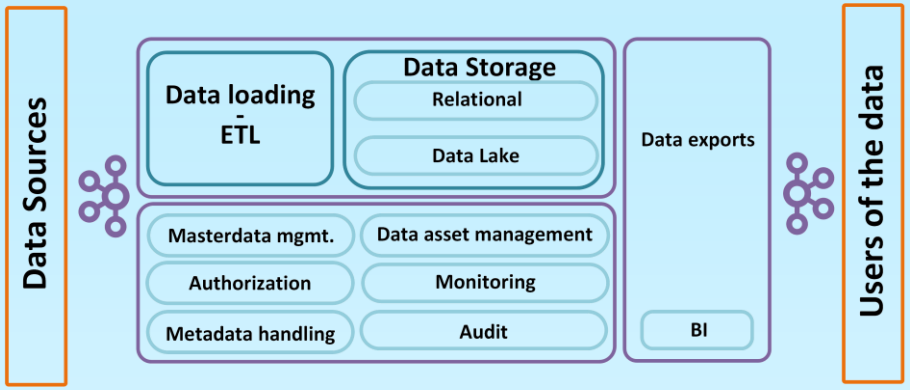
Contradictory requirements needs to be fulfilled…

Multiple roles to be supported:
- Live data processing (fast operation)
- Processing analytical data for BI (overnight long running data transformation)

Not only store but validate and distribute:
- Data from different sources must be validated
- The validated real time data must be redistributed

Data formats:
- As many data formats as stars on the night sky…

Investment:
- The investment is high and required ASAP
- It is a long-term investment (and may not be needed at all…)

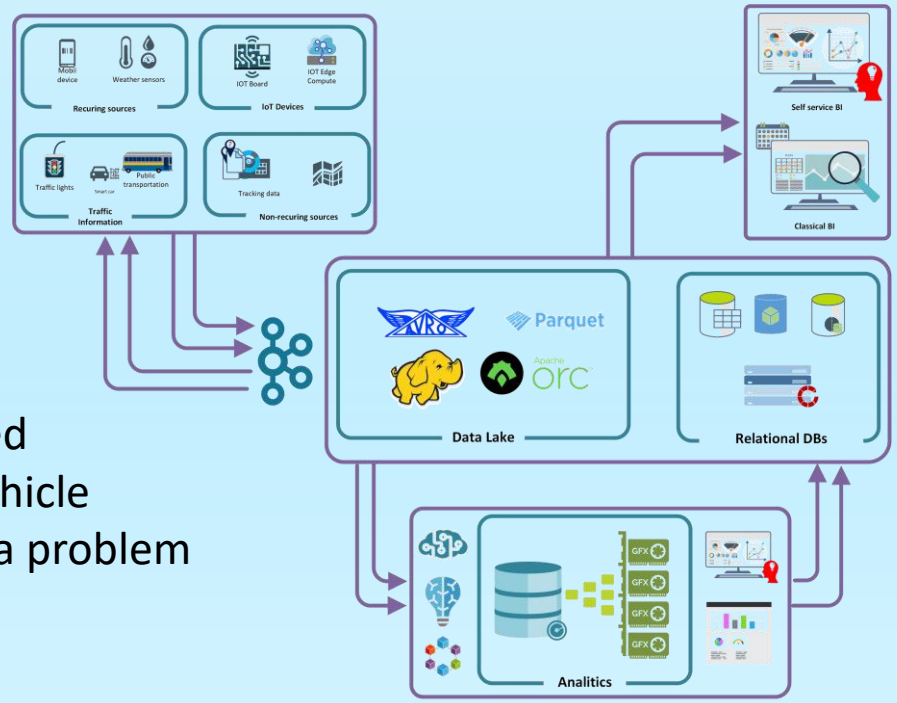


No standard rules what data must be shared by AV operators…
And let's be honest AV operators are not necessarily keen on sharing data!

The logical architecture cont…

Critical data sets to be collected in order to feed functions like:

- Object recognition and tracking
- Situation analysis
- Motion prediction



The sheer volume of data poses a challenge:

- For effective teaching of algorithms high resolution required
- A single test day may generate 100s of terabytes of data/vehicle
- Moving data from/to test vehicles and modelling system is a problem

So data needs to be kept where it was generated as much as possible:

- Efficient federation of data needs to be developed
- Good metadata structure needs to be in place in order to find data

Data security and business modell

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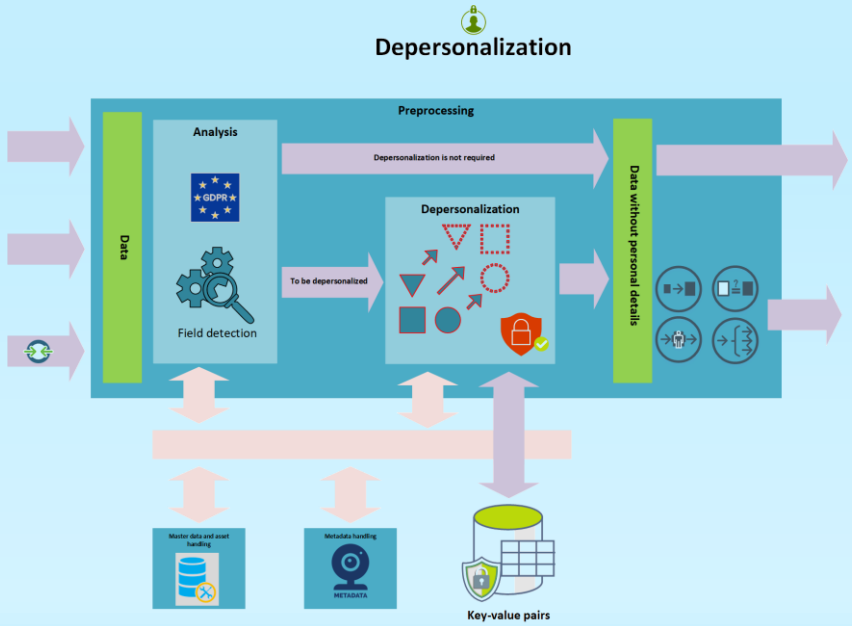
When discussing data and personal information security:

Complex rules must be considered e.g. GDPR, which of course does not help functionality

For traffic event analysis or algorithm testing the sensitive data may be removed but the links must be retained between events



No efficient business model is available yet…

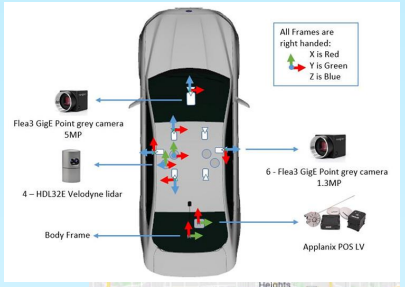
If data is provided as a service business model to be developed:

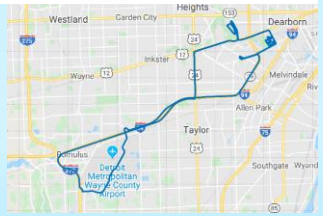
- Such a system is expensive to build and operate
- How to get development companies to share data
- How to build self-service BI services

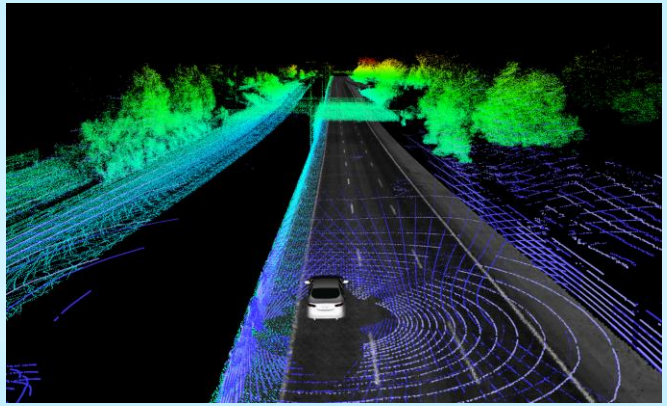
An interesting example

- **Ford Autonomous Vehicle Dataset (https://avdata.ford.com/)**

- We present a challenging multi-agent seasonal dataset collected by a fleet of Ford autonomous vehicles at different days and times during 2017-18. The vehicles were manually driven on a route in Michigan that included a mix of driving scenarios including the Detroit Airport, freeways, city-centers, university campus and suburban neighborhood.
- We present the seasonal variation in weather, lighting, construction and traffic conditions experienced in dynamic urban environments. This dataset can help design robust algorithms for autonomous vehicles and multi-agent systems. Each log in the dataset is time-stamped and contains raw data from all the sensors, calibration values, pose trajectory, ground truth pose, and 3D maps. All data is available in *Rosbag* format that can be visualized, modified and applied using the open source Robot Operating System (https://www.ros.org/).







Main site:

https://github.com/Ford/AVData

Publication:

https://s23.q4cdn.com/258866874/files/doc_downloads/2020/03/2003.07969.pdf

Considered data sources

The following is only an example how the data gathered can be used cross functional

Focus area / Data category	Static road data mgmt	Road hazard mgmt and prediction	Intelligent traffic mgmt services	Development of traffic mgmt plans	Traffic related services support	Parking management	Data exchange for Autonous driving (V2V, V2X)	Supporting Autonomous driving testing
Static road data	X	X	X	X	X	X	X	X
Traffic rules and emergency situations	X	X	X	X	X		X	X
Payment informations			X	X	X	X		
Parking informations			X	X	X	X		
Fuel and charging stations			X		X			X
Freight		X	X	X	X	X	X	X
Public transportation		X	X	X	X	X	X	
Road quality related dynamic data	X	X					X	X
Temporary changes in traffic arrangements		X	X	X				X
Roadworks	X	X	X	X			X	X
Unexpected events		X	X	X	X		X	X
Traffic management decisions	X	X	X	X				
Real-time traffic data		X	X	X	X	X	X	X
Traffic safety information	X	X	X	X	X		X	X
Parking for trucks					X	X		
Meteorological data		X	X	X	X			X
Vehicle tracking		X	X	X			X	X

Where are we right now…

In Hungary, the rules for testing AVs are quite liberal

A major test track is being built, partly operational

A strategic study and logical design had been created for the central ITS data platform within the frame of **Mobility Platform** (http://mobilitasplatform.hu/en/) was presented to authorities.

Due to the current COVID situation unfortunately slowed down all activities…

Thanks to the following people for their work in the strategic study: **Dr. Magyar Gábor , Dobán Orsolya, Erdey Levente, Gáspár Csaba, Gyires-Tóth Bálint, Csulyák Gábor, Sági András**

The end, which is only the start…

Thank you for your attention!

Contact:

Tamás Roósz

Easyway Systems Ltd.

roosz.tamas@easy-way.hu

https://www.easy-way.hu/

Additional slides if needed for discussions

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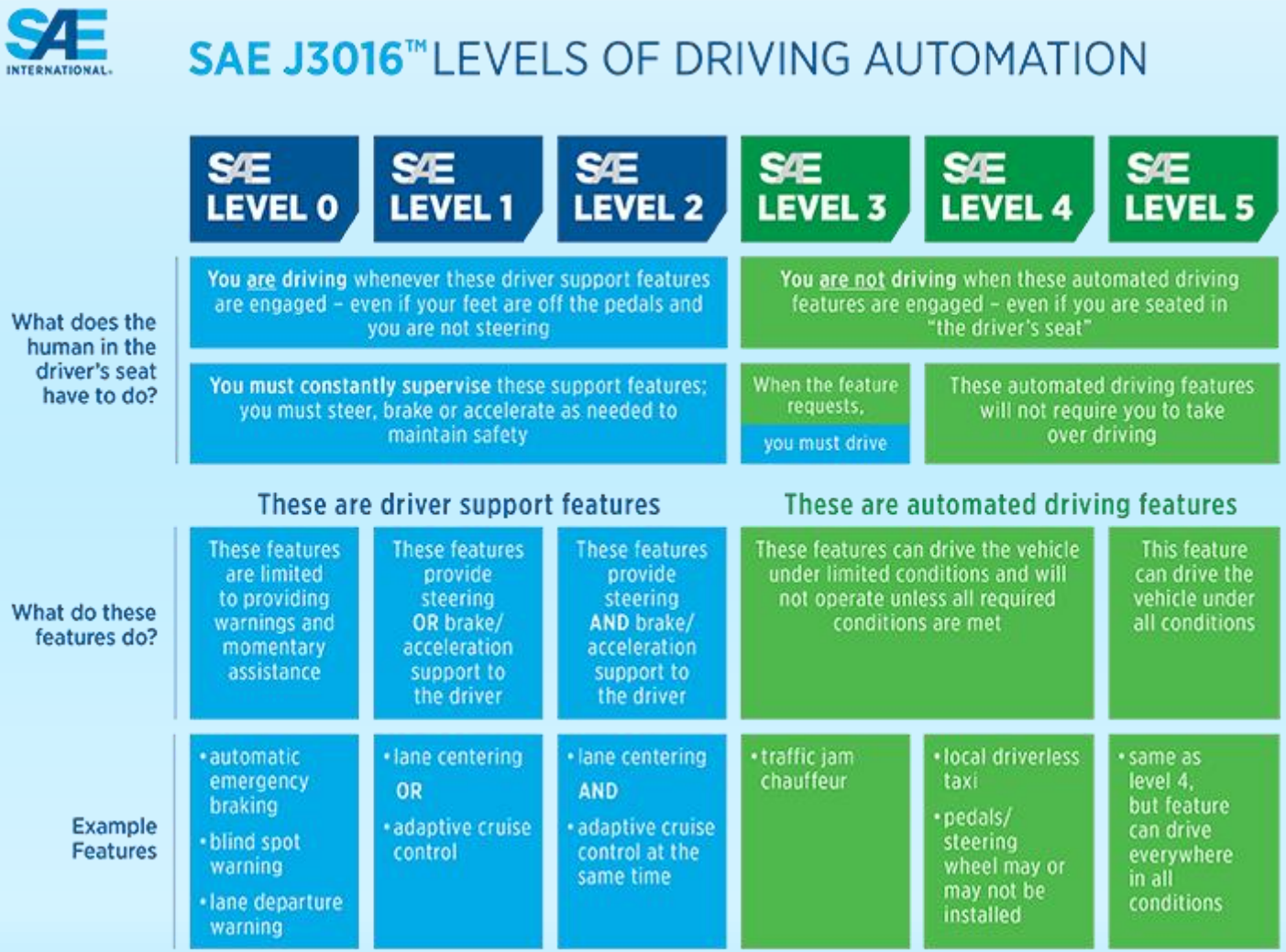
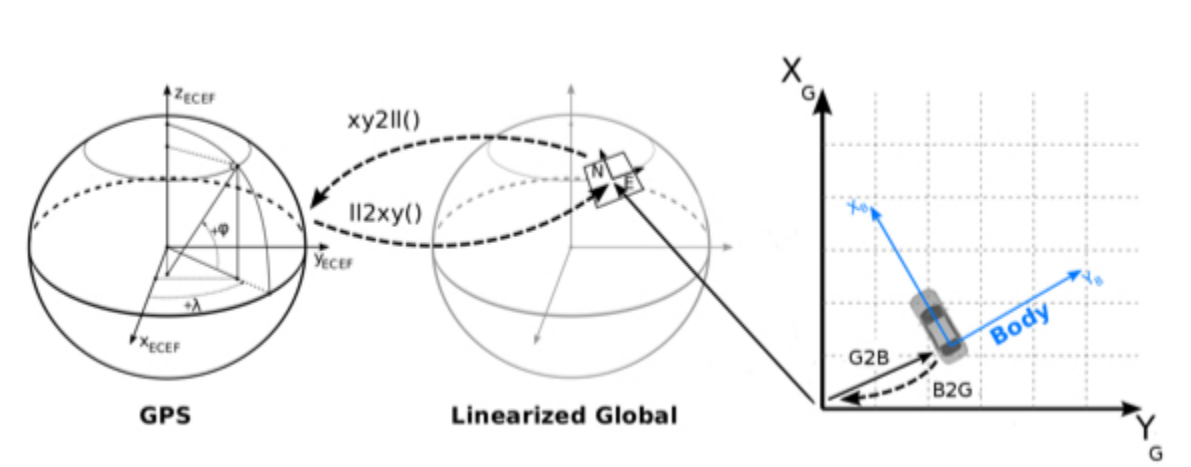
These are no normal presentation slides only meant to support discusions if required

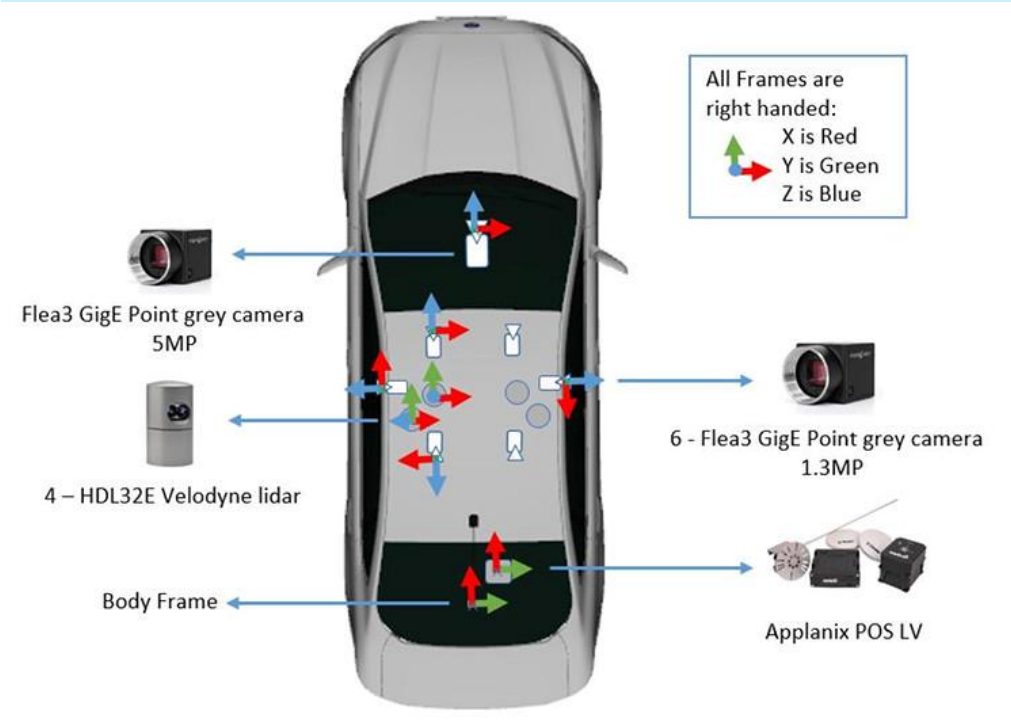
SAE levels (0-5)

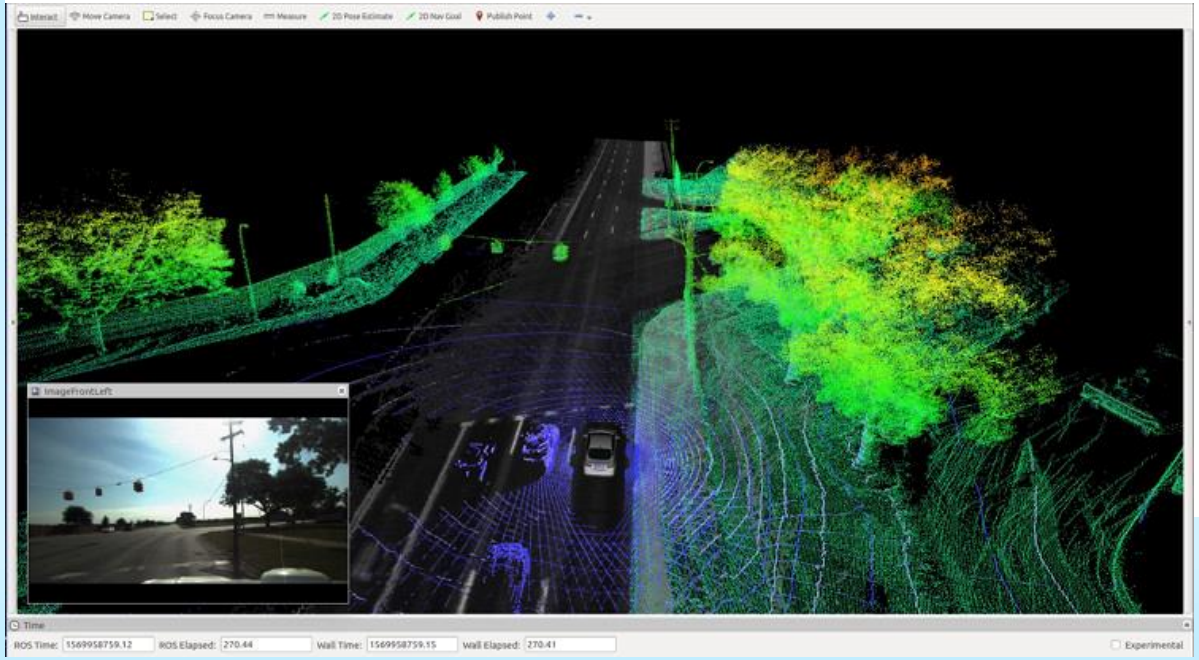


Ford data sample recording details



Right now 1.6TB data is available for download



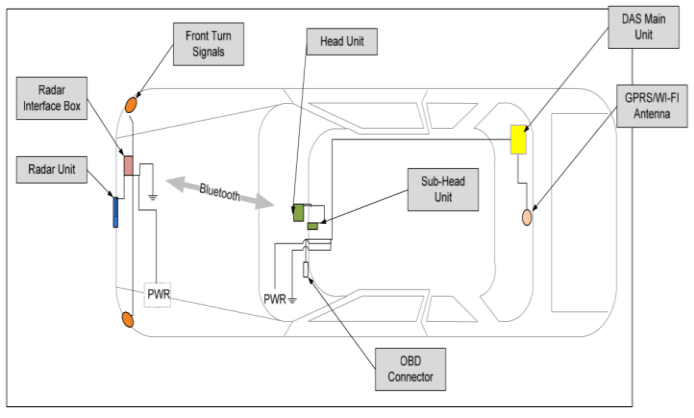


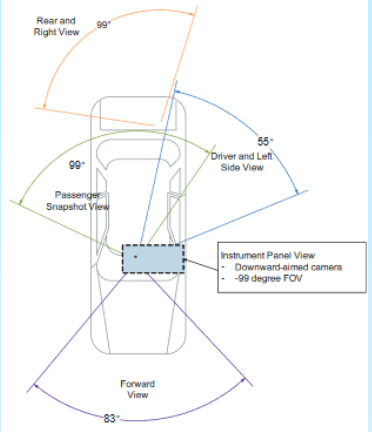
Source: https://avdata.ford.com/

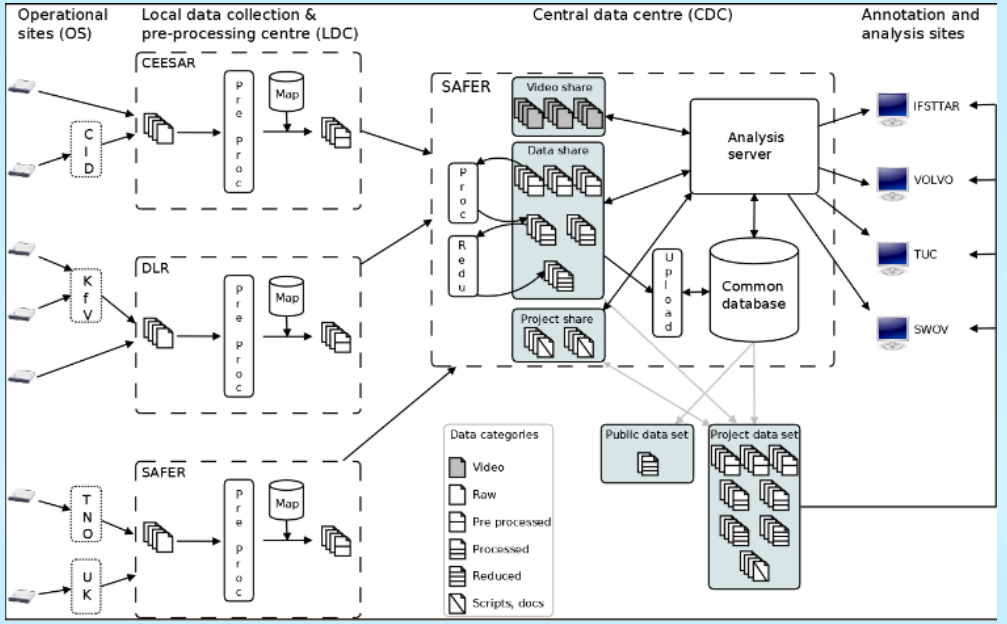
Natural driving projects

LDCs do preprocessing like map matching and only temporarily store data and deliver it the CDC.

Sources: https://www.swov.nl/en/publication/naturalistic-driving-observing-everyday-driving-behaviour https://www.udrive.eu https://insight.shrp2nds.us/documents/shrp2_background.pdf







Connected vehicle projects

Sources: https://www.cvp.nyc/ , https://www.its.dot.gov/pilots/pilots_thea.htm

The Tampa bay pilot: https://theacvpilot.com/

GOALS: The Tampa Hillsborough Expressway Authority (THEA) Connected Vehicle Pilot aims to transform the experience of drivers, transit riders and pedestrians in downtown Tampa by preventing crashes, enhancing traffic flow, improving transit trip times and reducing emissions of greenhouse gases.

THE NUMBERS

- More than **1,000** privately owned vehicles equipped with onboard units
- **10** buses equipped with onboard units
- **8** streetcars equipped with onboard units
- **46** roadside units