



Highlights on Operational Design Domains

EU EIP 4.2 Torino Workshop
Torino, 1st October 2019

Luisa Andreone, FCA-CRF
L3Pilot Piloting Leader

www.L3Pilot.eu

[Twitter@_L3Pilot_](https://twitter.com/_L3Pilot_)

[LinkedInL3Pilot](https://www.linkedin.com/company/l3pilot)

Highlights on Operational Design Domains

Automated Driving Vehicle Functions

Automated Driving Vehicle Functions have different deployment time frames:

1. **PARKING CHAUFFEUR**
2. **TRAFFIC JAM CHAUFFEUR**
3. **MOTORWAY CHAUFFEUR**
4. **URBAN CHAUFFEUR**

“Parking” and “Traffic jam” will enter the market first and then the others.

“Motorway” follows “Traffic jam” and “Urban” will come later for its variety of dynamic situations.

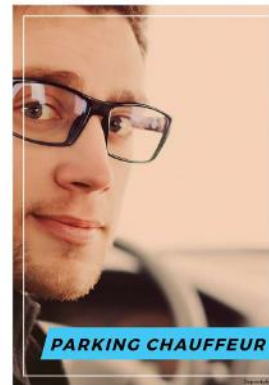
Highlights on Operational Design Domains

Automated Driving Vehicle Scenarios



Highlights on Operational Design Domains

L3Pilot Automated Driving Vehicle Functions



1,000 drivers

100 cars

10 European countries

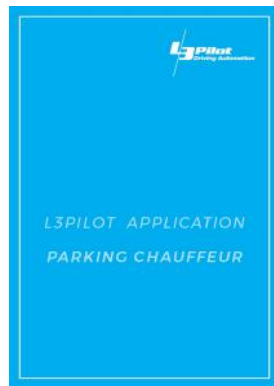
1.10.2019

EU EIP 4.2 Torino Workshop



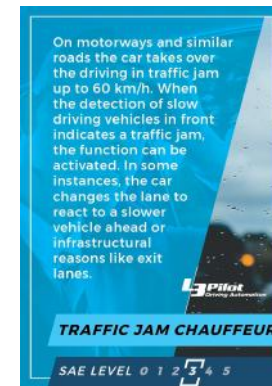
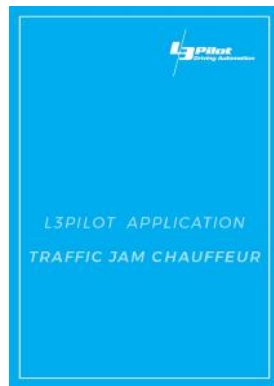
Highlights on Operational Design Domains

L3Pilot Automated Driving Vehicle Functions: parking chauffeur



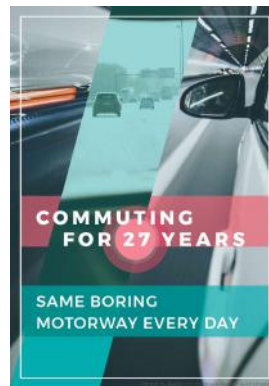
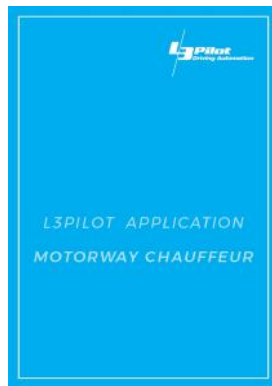
Highlights on Operational Design Domains

L3Pilot Automated Driving Vehicle Functions: traffic jam chauffeur



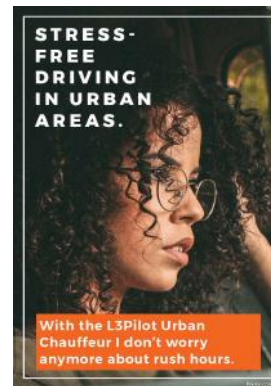
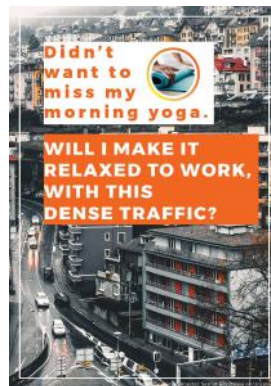
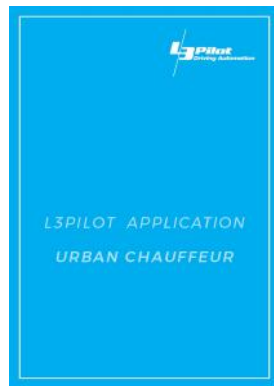
Highlights on Operational Design Domains

L3Pilot Automated Driving Vehicle Functions: motorway chauffeur



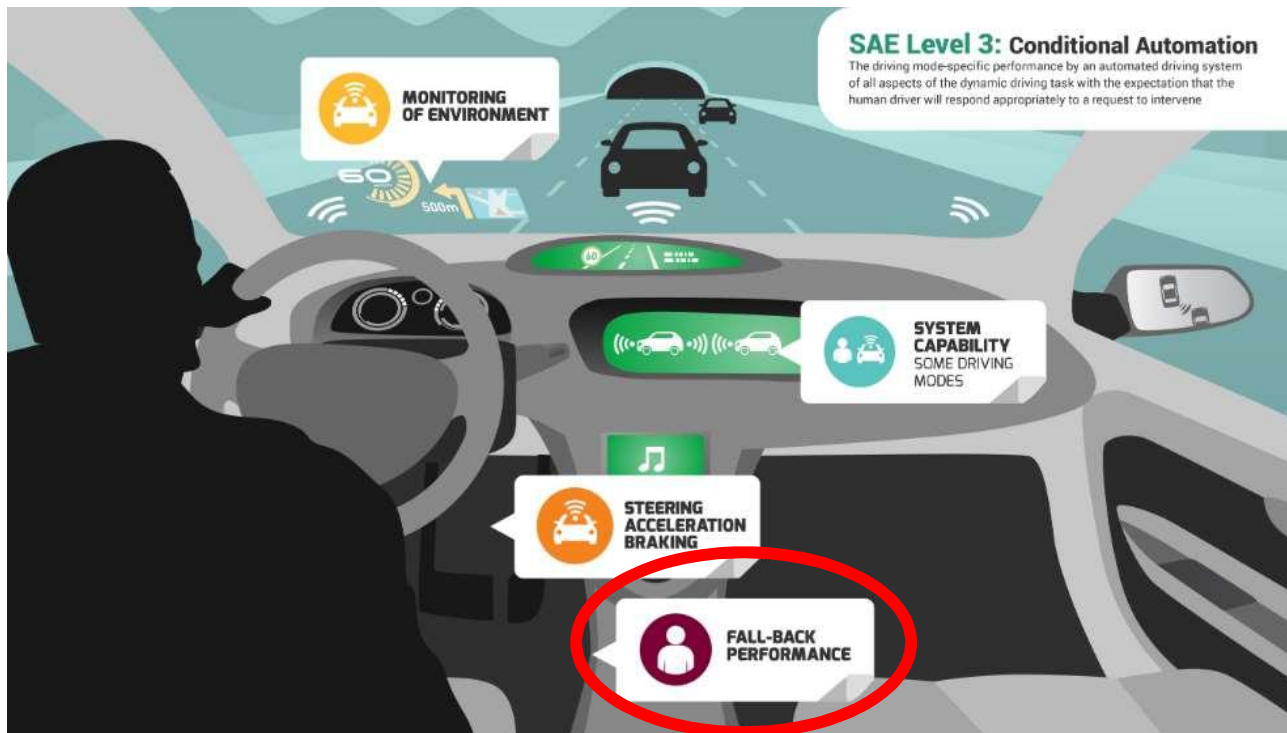
Highlights on Operational Design Domains

L3Pilot Automated Driving Vehicle Functions: urban chauffeur



Highlights on Operational Design Domains

Automated Driving Vehicle SAE Level 3



1.10.2019

EU EIP 4.2 Torino Workshop



Highlights on Operational Design Domains

Automated Driving Vehicle SAE Level 4



Highlights on Operational Design Domains

ODD contextualization

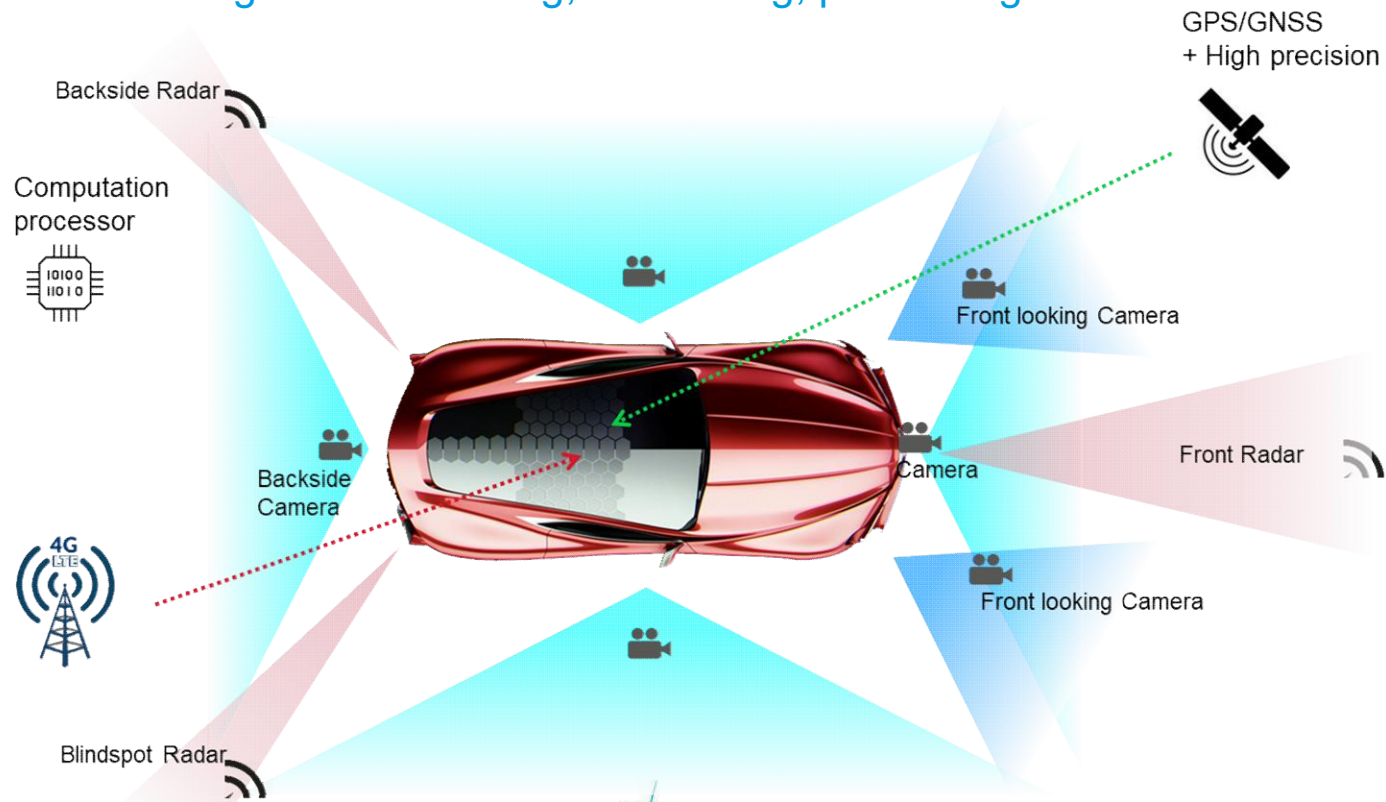
Operational Design Domain

- Describes the specific conditions under which a given Automated Driving System (ADS) is intended to function.
- The ODD is the definition of where (such as what roadway types and speeds) and when (under what conditions, such as day/night, weather limits, etc.) an ADS is designed to operate.

[NHTSA, Automated Driving Systems: a vision for safety Sept.2017]

Highlights on Operational Design Domains

Automated Driving Vehicle sensing, connecting, positioning



Operational Design Domains: what's next?
open a dialogue among "Vehicles and Roads"

INTERACTIVE SESSION

Per each **ODD characteristic** let's open a dialogue:

Shall the vehicle, the road operator, or other actor deal with it?

Shall it be a cooperation among different actors?

Operational Design Domains: what's next?

Which are the ODDs elements?

1. **Operational terrain, and associated location-dependent characteristics** (e.g., slope, camber, curvature, banking, coefficient of friction, road roughness): dramatic changes can occur in relatively short distances.
2. **Environmental and weather conditions** such as surface temperature, air temperature, wind, visibility, precipitation, icing, lighting, glare, electromagnetic interference, clutter, vibration, and other types of sensor noise.
3. **Operational infrastructure** such as availability and placement of operational surfacing, navigation aids (e.g., beacons, lane markings, augmented signage), traffic management devices (e.g., traffic lights, right of way signage, vehicle running lights), keep-out zones, special road use rules (e.g., time-dependent lane direction changes) and vehicle-to-infrastructure availability.

[Philip Koopman, Frank Fratrik Carnegie Mellon University, Edge Case Research, Jan 19]

[Lemmer, K., PEGASUS, April 6, 2017 US Dept. of Transportation, DOT HS 812 442, Sept. 2017]

Operational Design Domains: what's next?

Which are the ODDs elements?

- 4. Rules of engagement** and expectations for interaction with the environment and other aspects of the operational state space, including traffic laws, social norms, and customary signaling and negotiation procedures with other agents (both autonomous and human, including explicit signaling as well as implicit signaling via vehicle motion control).
- 5. Considerations for deployment to multiple regions/countries** (e.g., blue stop signs, “right turn keep moving” stop sign modifiers, horizontal vs. vertical traffic signal orientation, side-of-road changes).
- 6. Communication modes** bandwidth, latency, stability, availability, reliability, including both machine-to-machine communications and human interaction.

[Philip Koopman, Frank Fratrik Carnegie Mellon University, Edge Case Research, Jan 19]

[Lemmer, K., PEGASUS, April 6, 2017 US Dept. of Transportation, DOT HS 812 442, Sept. 2017]

Operational Design Domains: what's next?

Which are the ODDs elements?

- 7. Availability and freshness of infrastructure characterization** data such as level of mapping detail and identification of temporary deviations from baseline data. (e.g., construction zones, traffic jams, temporary traffic rules such as for hurricane evacuation).
- 8. Expected distributions of operational state space elements** including which elements are considered rare but in-scope (e.g. toll booths, police traffic stops), and which are considered outside the region of the state space in which the system is intended to operate.

[Philip Koopman, Frank Fratrik Carnegie Mellon University, Edge Case Research, Jan 19]

[Lemmer, K., PEGASUS, April 6, 2017 US Dept. of Transportation, DOT HS 812 442, Sept. 2017]



H2020 DT-ART-06-2020

Large-scale, cross-border demonstration of connected and highly automated driving functions for passenger cars



Thank you for your kind attention.

Luisa Andreone



FCA-CRF Global Innovation

Networking, collaborative research

phone: +39 011 9083 071
mobile: +39 335 7755243
email: luisa.andreone@crf.it



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 723051.

© L3Pilot project/photographers:
depositphotos/Solomin Viktor, Andrey Popov, leungchopan, fbmadeira, natlit, Nils Kampendonk; Volkswagen AG; Unsplash/Dawid Zawila, Samuel Zeller, NeONBRAND, Brooke Cagle, Axel Antas-Bergkvist, Paul Gilmore

www.L3Pilot.eu

[Twitter@_L3Pilot_](https://twitter.com/_L3Pilot_)

[LinkedInL3Pilot](https://www.linkedin.com/company/L3Pilot)