



# The ODD Issue

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- ODD – Operational Design Domain
- A description of the specific operating conditions in which the automated driving system is designed to properly operate, including but not limited to roadway types, speed range, environmental conditions (weather, daytime/nighttime, etc.), prevailing traffic law and regulations, and other domain constraints *[Waymo2017]*

# ODD

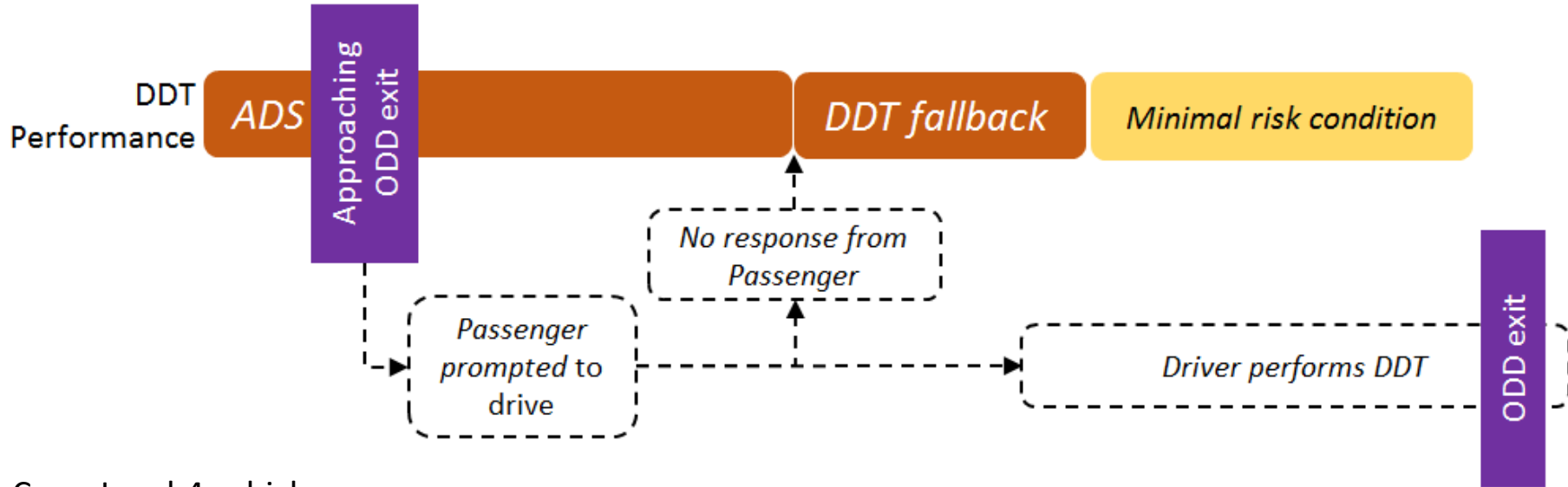
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### Operational Design Domain

Level	Name	Narrative definition	DDT		DDT fallback	ODD
			Sustained lateral and longitudinal vehicle motion control	OEDR		
Driver performs part or all of the DDT						
0	No Driving Automation	The performance by the <i>driver</i> of the entire DDT, even when enhanced by <i>active safety systems</i> .	Driver	Driver	Driver	n/a
1	Driver Assistance	The <i>sustained</i> and ODD-specific execution by a <i>driving automation system</i> of either the <i>lateral</i> or the <i>longitudinal vehicle motion control</i> subtask of the DDT (but not both simultaneously) with the expectation that the <i>driver</i> performs the remainder of the DDT.	Driver and System	Driver	Driver	Limited
2	Partial Driving Automation	The <i>sustained</i> and ODD-specific execution by a <i>driving automation system</i> of both the <i>lateral</i> and <i>longitudinal vehicle motion control</i> subtasks of the DDT with the expectation that the <i>driver</i> completes the OEDR subtask and supervises the <i>driving automation system</i> .	System	Driver	Driver	Limited
ADS ("System") performs the entire DDT (while engaged)			System	System	Fallback-ready user (becomes the driver during fallback)	Limited
3	Conditional Driving Automation	The <i>sustained</i> and ODD-specific performance by an ADS of the entire DDT with the expectation that the DDT fallback-ready user is receptive to ADS-issued requests to intervene, as well as to DDT performance-relevant system failures in other vehicle systems, and will respond appropriately.				
4	High Driving Automation	The <i>sustained</i> and ODD-specific performance by an ADS of the entire DDT and DDT fallback without any expectation that a user will respond to a request to intervene.	System	System	System	Limited
5	Full Driving Automation	The <i>sustained</i> and unconditional (i.e., not ODD-specific) performance by an ADS of the entire DDT and DDT fallback without any expectation that a user will respond to a request to intervene.	System	System	System	Unlimited

SAE 2016

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Case: Level 4 vehicle

DDT = Dynamic Driving Task

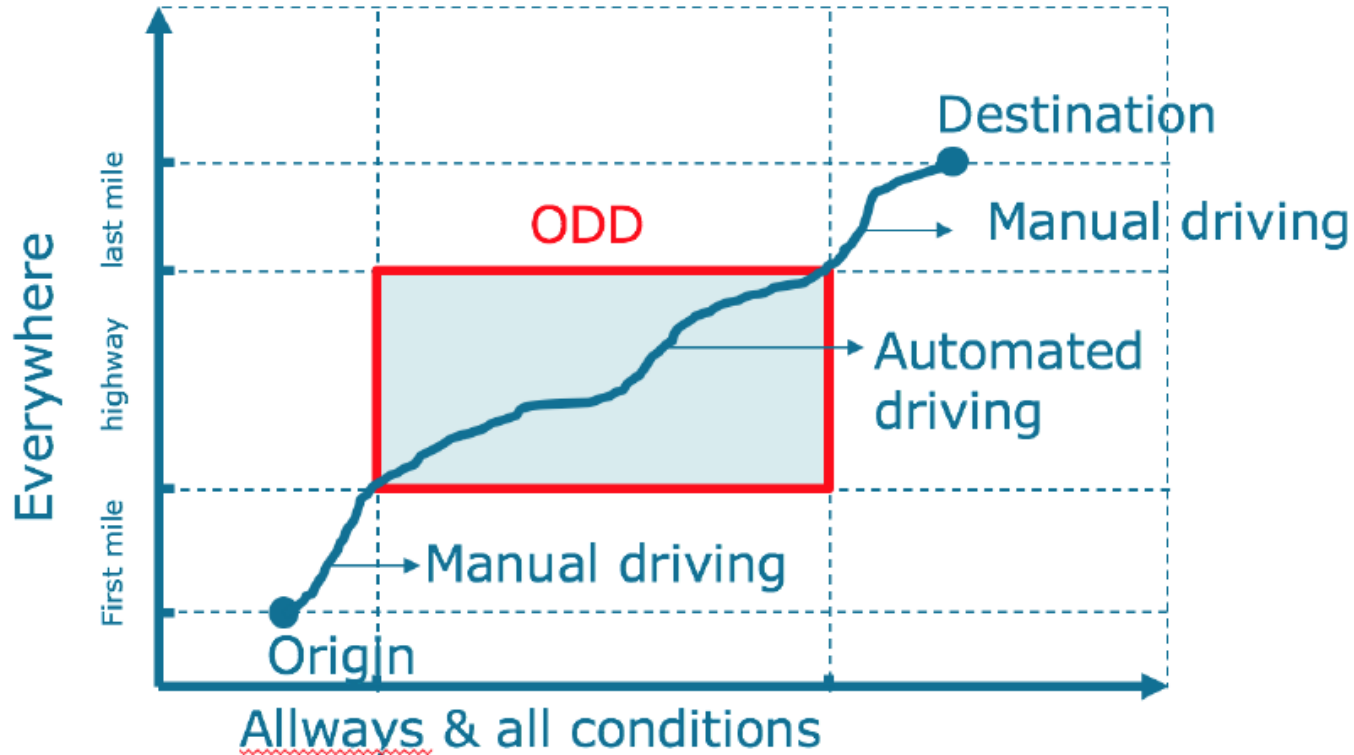
ADS = Automated Driving System

Minimal Risk Condition: the vehicle will park itself safely until the passenger or remote supervisor takes control as a driver; or the circumstances change so that the ODD again applies

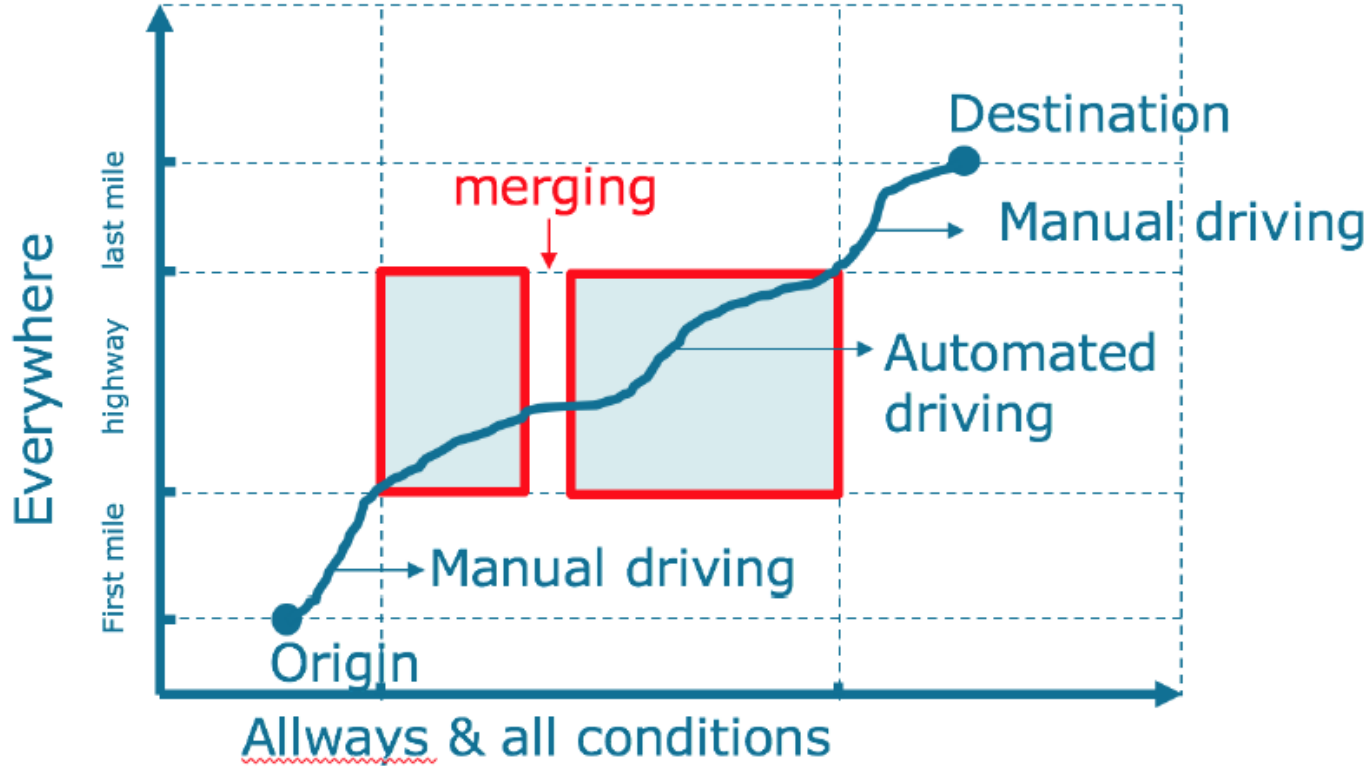
Note: dotted lines represent optional condition

SAE 2016

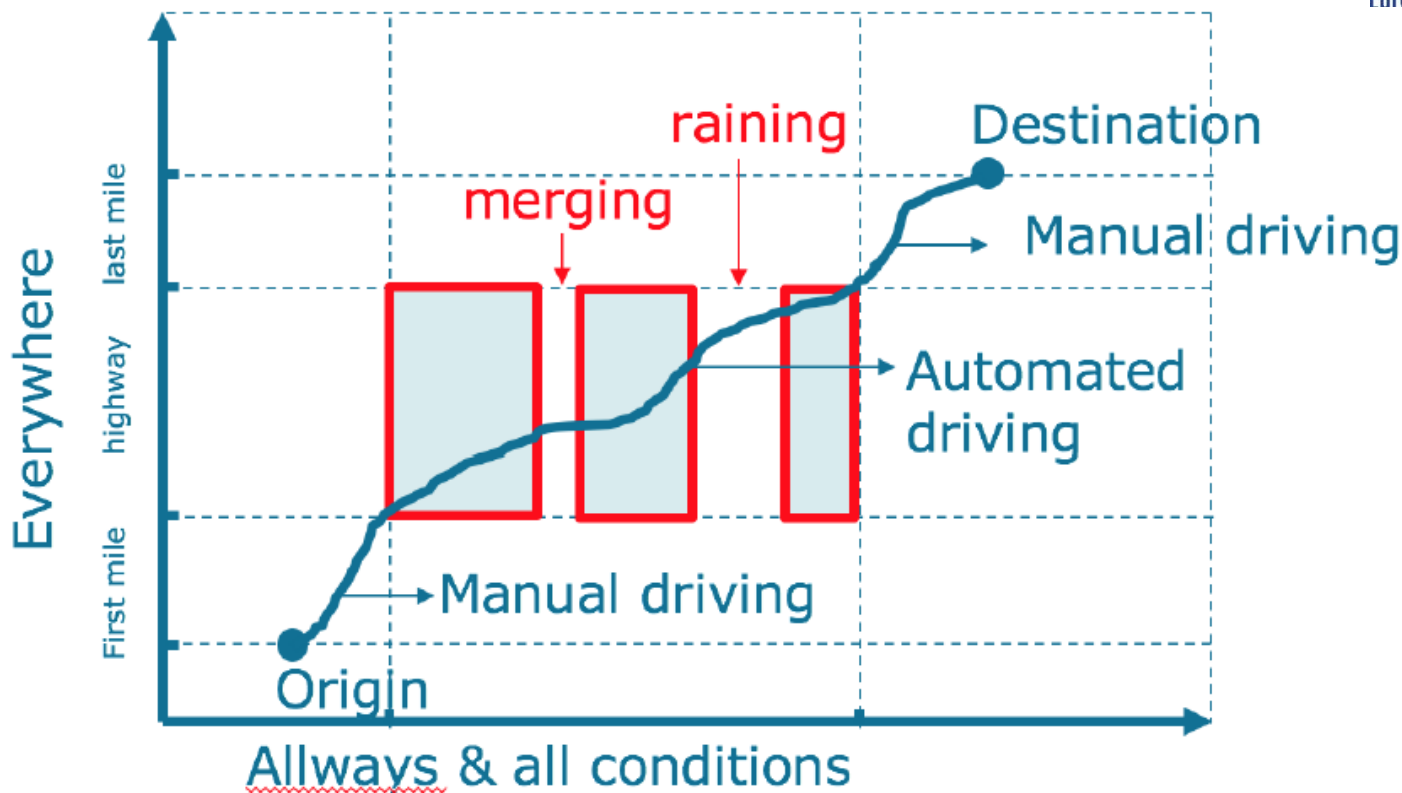
# ODD Example #1



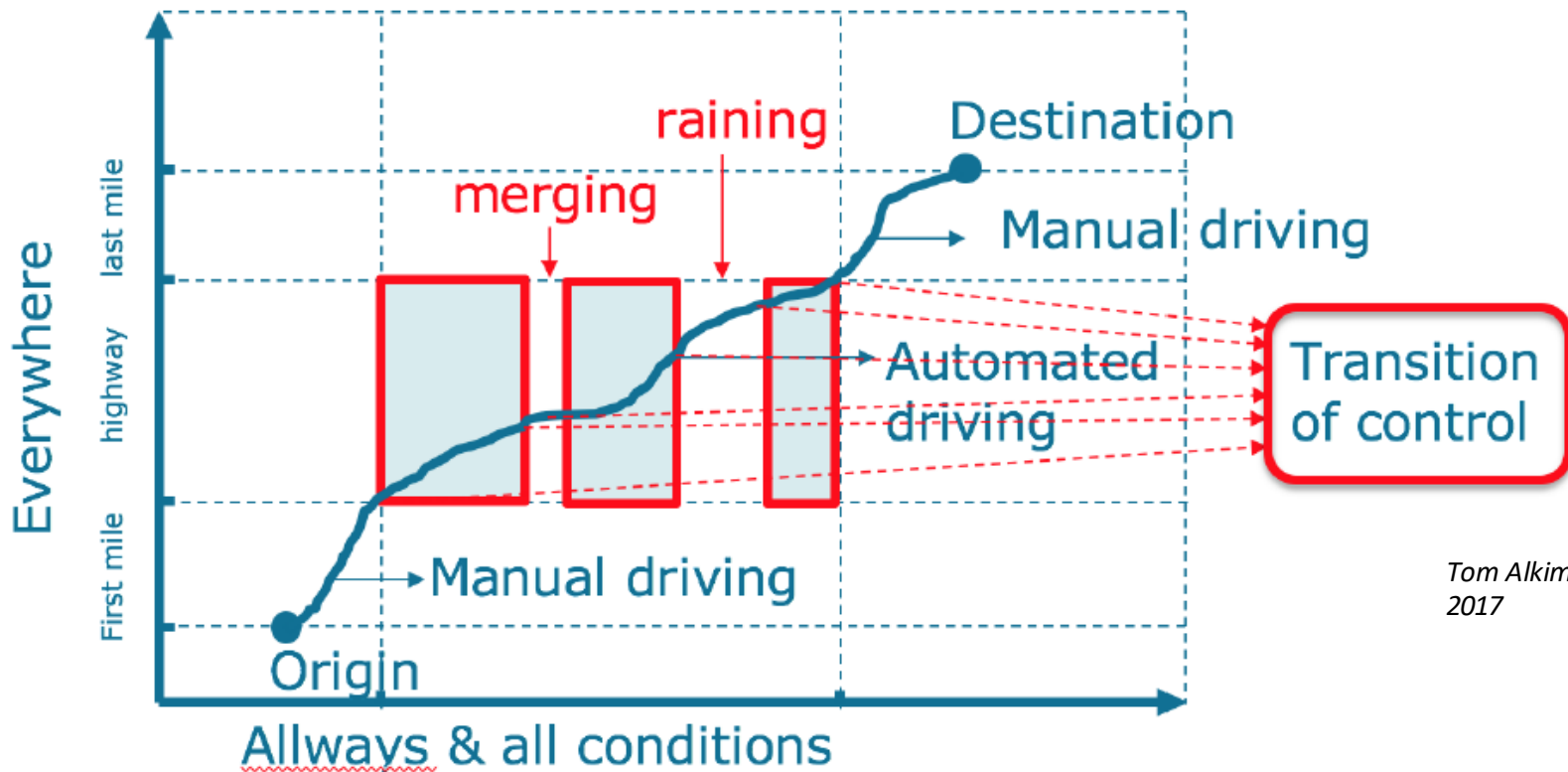
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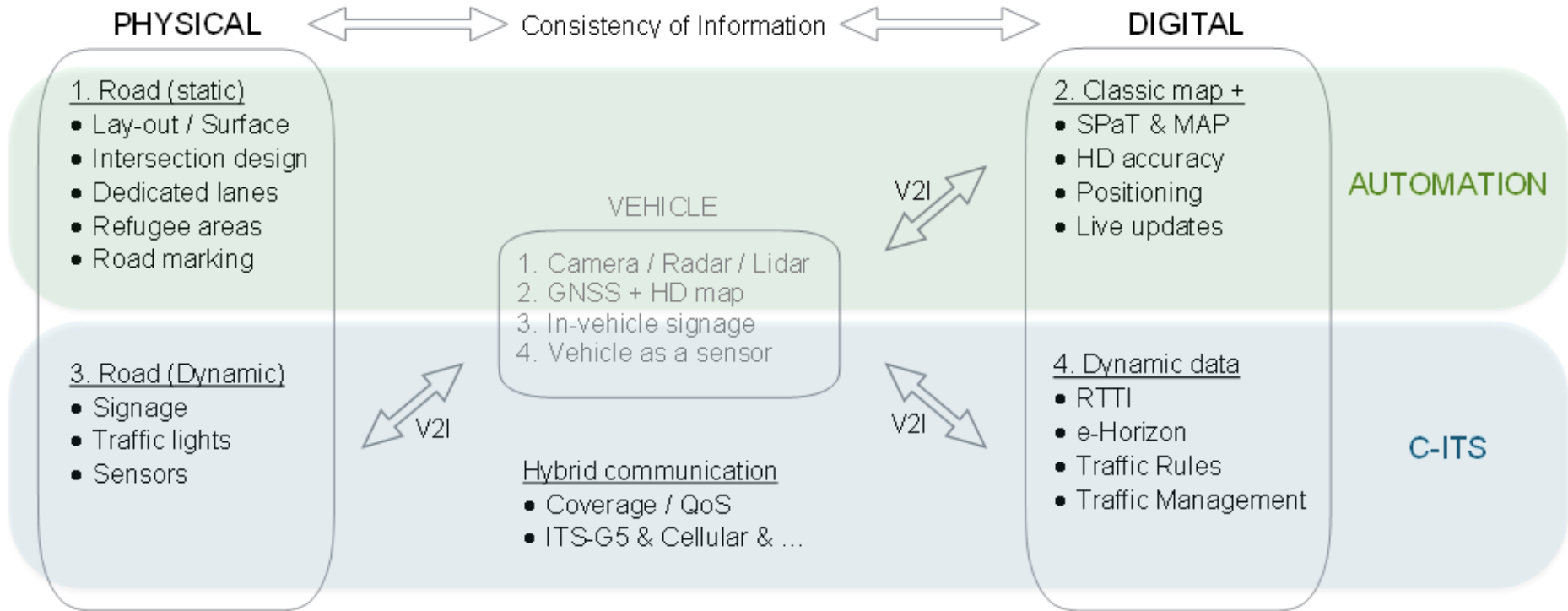
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- Physical and digital infrastructure are very important for ODD



- Example: Accurate positioning
  - reference to road markings etc – lighting, weather, snow, water
  - reference to LIDAR DNA/fingerprint – rapid changes such as snowing, snowdrifts, stopped vehicles, temporary road furniture, etc.
  - digital maps – changes such as road works, road damage, temporary road furniture, etc.
  - satellite positioning – availability of visible satellites and/or land stations
  - landmarks – “visibility” to sensors, possibly temporarily obscured by rain, snow, etc.
  - ...

- ODD crucial to use as such and user acceptance
- To reap full benefits from automated driving, we need to
  - Maximise the ODD length
  - Avoid transitions between manual and automated, i.e. maximise continuity of ODD in space and time
- The vehicle must know when approaching end of ODD
  - Geofencing in digital and dynamic maps
- Roles and responsibilities still quite unclear
- We need discussions and agreements between automotive and P&D infrastructure stakeholders to solve the ODD issues!
  - Workshop Athens 25 October 2018 by L3Pilot & EU EIP



Thank You  
for your  
attention!