Traffic Management for Connected and Automated Driving (TM4CAD)

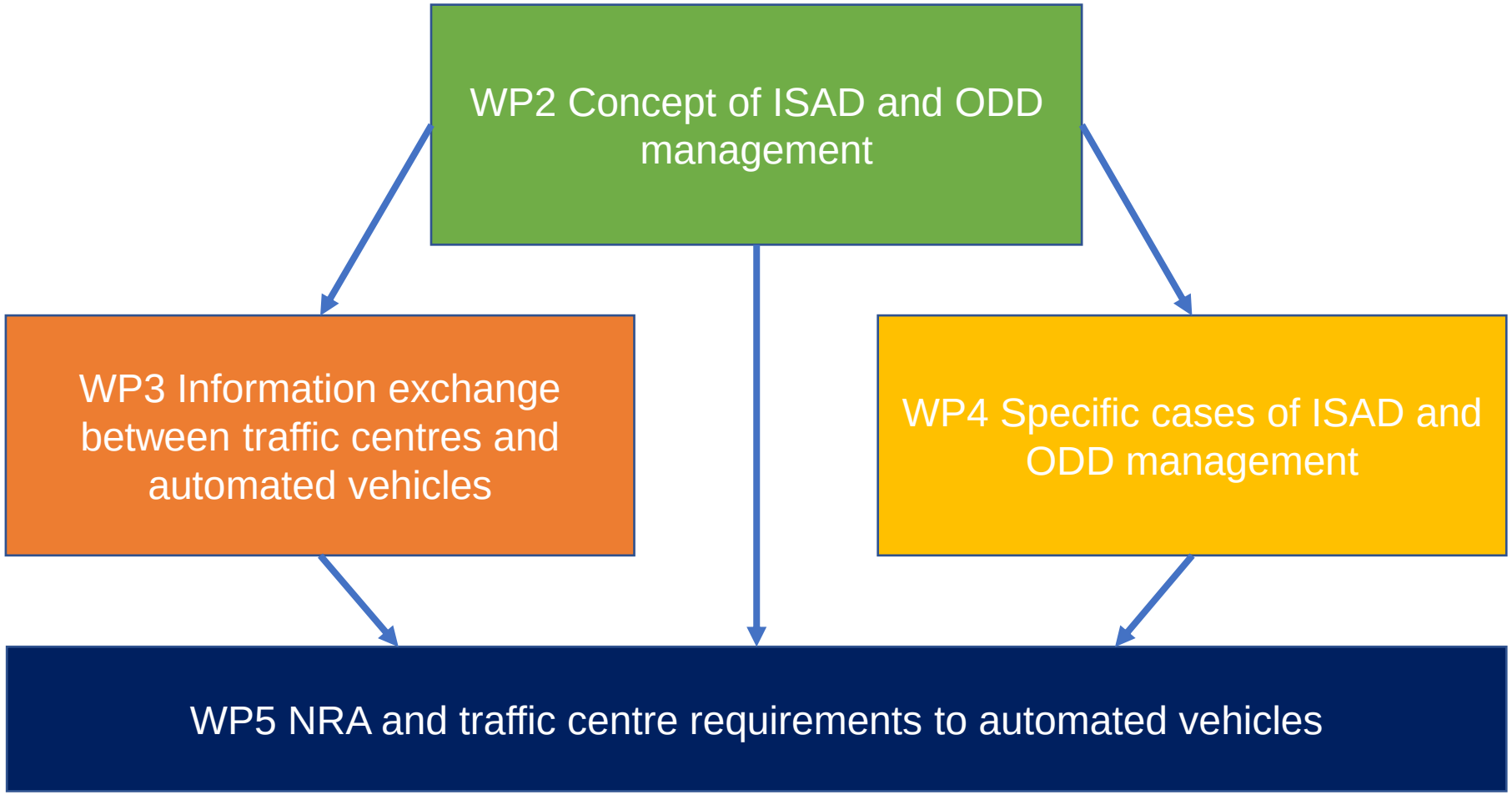
4th TM4CAD workshop – midterm

Jaap Vreeswijk, Traffic Architect Connected & Automated Mobility – MAPtm

24 June 2022, Bern

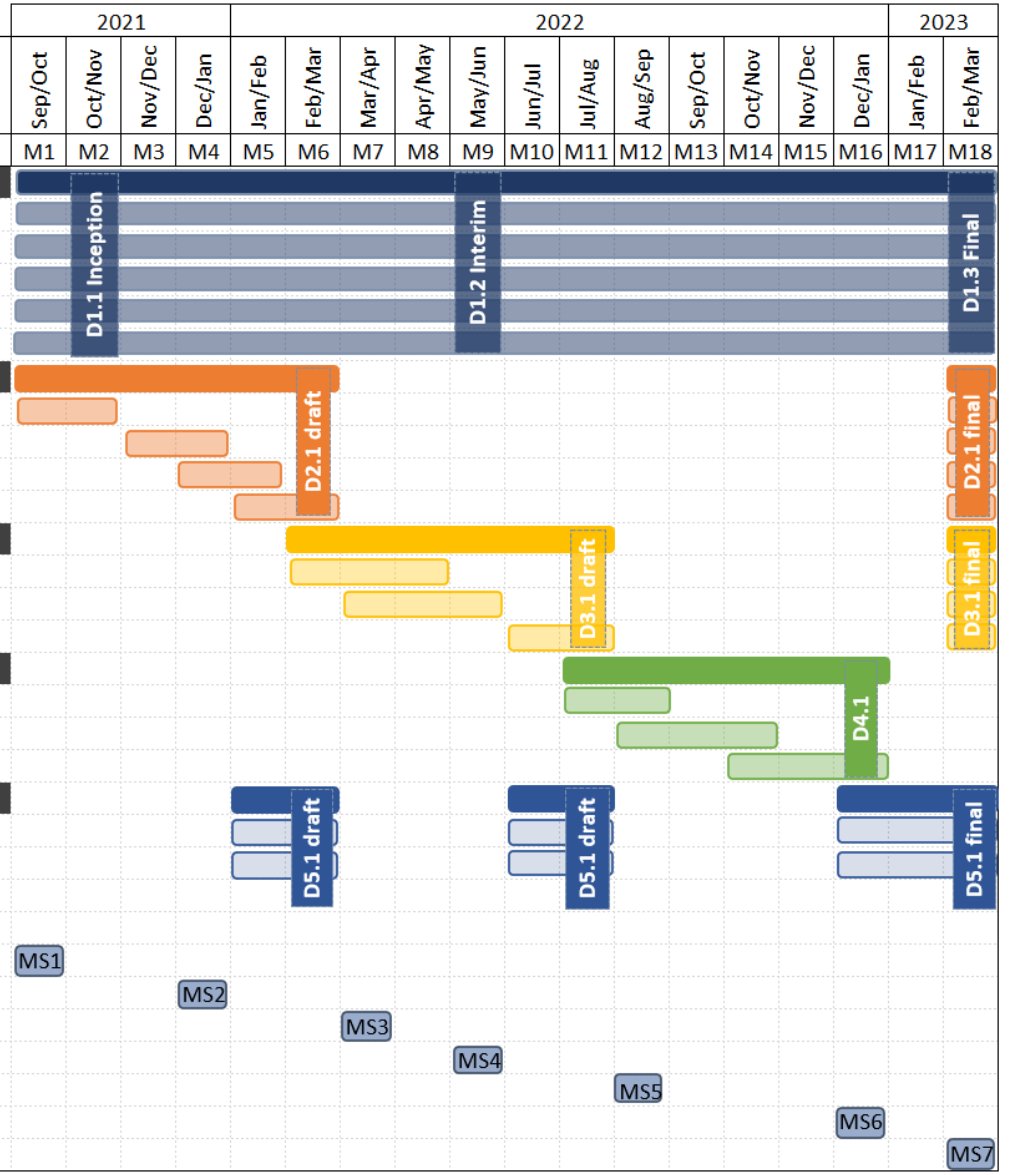
Workshop agenda

8.30	Welcome, introductions, objectives of the meeting, logistics	Jaap Vreeswijk (MAPtm)
8.50	Information needs and quality related to information exchange between traffic management centres and automated vehicles	Risto Kulmala (Traficon)
9.10	Summary of 3rd TM4CAD workshop, with vehicle manufacturers	Jaap Vreeswijk (MAPtm)
9.30	Interactive discussion: Information needs, and quality related to info exchange	All
10.30	*Break*	
11.00	Interactive discussion: Specific use cases of 'ODD management'	All
12.15	Summary and conclusion	
12.30	End workshop – start PEB (incl. lunch)	
14.00	Meeting end	


WP2 Concept of ISAD and ODD management
WP3 Information exchange between traffic centres and automated vehicles
WP4 Specific cases of ISAD and ODD management
WP5 NRA and traffic centre requirements to automated vehicles

			Duration
			months
1	**Project Management**		18
1.1	Coordination, monitoring of project activities, and quality control		18
1.2	Internal communication and cooperation		18
1.3	Financial and administrative management		18
1.4	Reporting and communication with the client		18
1.5	Dissemination and outreach activities to NRAs and other stakeholders		18
2	**Concept of ISAD and ODD management**	DEFINE	6
2.1	Identify information required for accurate ODD (and ISAD - enhanced) definition		2
2,2	ODD awareness and role of ISAD		2
2.3	Distribution ODD attribute information among various sources		2
2.4	Governance mechanism for ODD checking and compatibility		2
3	**Information exchange between traffic centres and automated vehicles**	DESIGN	6
3.1	Identification of information needs		3
3.2	Information properties and quality		3
3.3	Roles and responsibilities in information provision and exchange		2
4	**Specific cases of ISAD and ODD management**	APPLY	6
4.1	Use cases for activation and de-activation of automation (incl. ISAD)		2
4.2	Real-time ODD attribute information and evaluation of ODD boundaries (vehicle & roadside)		3
4.3	Technical implementation of control mechanisms		3
5	**NRA and traffic centre requirements to automated vehicles**	CONSOLIDATE	7
5.1	Requirements on desired behaviour of (partly) automated vehicles, including where and how they should drive		7
5.2	Requirements from a safety perspective (e.g., minimal risk manoeuvres, system disengagements and handover requests)		7

	Workshops with CEDR PEB, CEDR CAD WG and/or other relevant stakeholders (tentative schedule)
	WS1: Project kick-off, refinement of working assumptions (e.g. governance models, use cases and NRA priorities)
	WS2: ODD/ISAD architecture proposal validation workshop
	WS3: Vehicle manufacturers perspective workshop
	WS4: Joint workshop with CEDR(2020)-projects (and intermediate PEB meeting)
	WS5: Automated vehicle management use cases workshop
	WS6: Requirements to AV manufacturers and infrastructure evolution path workshop
	WS7: Joint final event with CEDR(2020)-projects

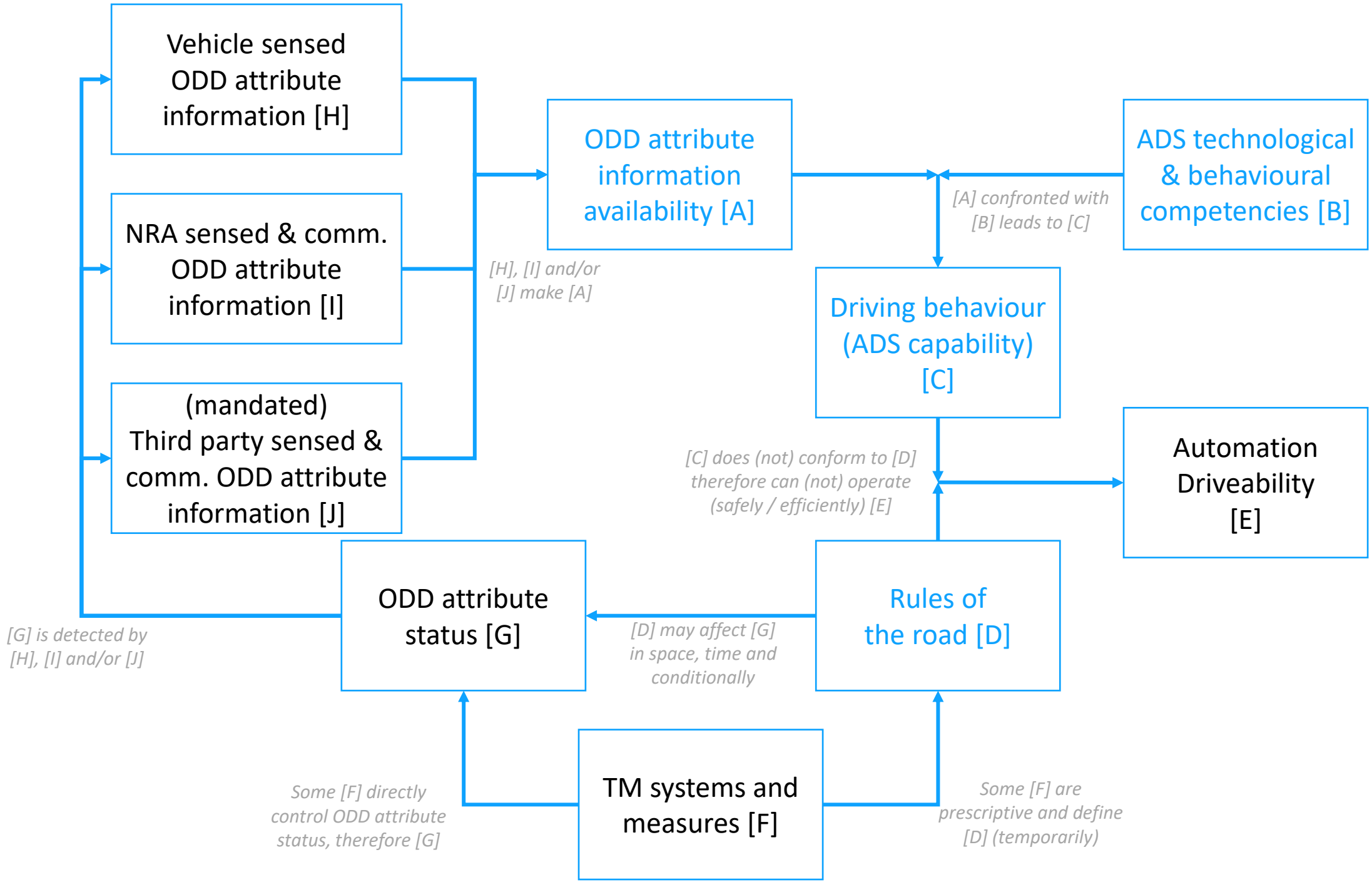


Importance of ODD

- At least as important as level of automation
- **Defined by each CAD system developer** based on their design constraints, not by any other entity
- **Different for every CAD system**, based on limitations of its technology
- To ensure safe operations, each CAD system **must remain within its ODD constraints**:
  - If ODD constraints are violated, cease automated driving
  - (Level 3) – request driver to intervene
  - (Level 4) - automatically transition to minimal risk condition (safe stop)

Need for real-time ODD awareness

- CAD system **continuously monitors ODD attributes** where it is operating to determine whether it can continue to operate
  - Safety cases and regulations should prohibit operations when ODD constraints are violated
- Anticipate **impending ODD constraint violations** to allow time for graceful transition to driver control (Level 3) or to minimal risk condition (Level 4)
- **Infrastructure cooperation** needed for information about attributes that CAD vehicle sensors cannot detect directly, such as:
  - Traffic incidents obstructing lanes beyond line of sight
  - Fog obstructing visibility beyond line of sight
  - Planned road works
  - Freezing pavement causing black ice


Vehicle sensed ODD attribute information [H]
NRA sensed & comm. ODD attribute information [I]
(mandated) Third party sensed & comm. ODD attribute information [J]
[H], [I] and/or [J] make [A]
ODD attribute information availability [A]
[A] confronted with [B] leads to [C]
ADS technological & behavioural competencies [B]
Driving behaviour (ADS capability) [C]
[C] does (not) conform to [D] therefore can (not) operate (safely / efficiently) [E]
Automation Driveability [E]
Rules of the road [D]
[D] may affect [G] in space, time and conditionally
ODD attribute status [G]
[G] is detected by [H], [I] and/or [J]
TM systems and measures [F]
Some [F] directly control ODD attribute status, therefore [G]
Some [F] are prescriptive and define [D] (temporarily)

Traffic Management for Connected and Automated Driving (TM4CAD)

Information needs and quality related to information exchange between traffic management centres and automated vehicles

Risto Kulmala & Ilkka Kotilainen, Traficon

Why information needs, priorities, and quality

- Research questions set by CEDR:
  - *RQ4: **What kind of information is to be transmitted in the interaction** (in both directions) between a traffic management centre and vehicle?*
  - *RQ5: **Which information is to be provided by the NRA/roadside** and which information can be obtained by the sensors of the moving vehicle itself?*
  - *RQ7: **How to define and measure the quality/correctness** of such information?*
- CEDR expectations on results:
  - *Determination of the **information needs and who is to provide this information** in the bidirectional interaction between TMC and vehicle;*
  - *Descriptions of the **properties of this information (availability, reliability, accuracy, detail, latency, standards, …)** and the required/desired reaction of the vehicles;*
  - *Integration of the very different perspectives of the CAD vehicle system developers and the road authorities and operators **to focus on the areas of intersection between them**;*
- Resources are limited, the stakeholders can not deploy everything immediately – a step-by-step approach is needed: start with the high priority easy-to-do local condition attributes first

Use cases: ADS/scenarios/actors

- ADS <u>on motorways/highways:</u>
  - ALKS (L3)
  - Highway autopilot (L4)
  - Automated trucks on open roads (L4)
- In three scenarios:
  - traffic jam dissolving
  - adverse weather
  - static/dynamic roadworks zone
- With regard to three actors:
  - roadworks or (winter) maintenance operator
  - traffic manager
  - automated driving system developer/OEM

Information Priority Evaluation Method

- Combined for all three use cases as the requirements were very similar
- Separately for
  - Each actor
  - Each scenario
- Overall priority level extracted by qualitative comparison (low-medium-high) between the three actors and scenarios
  - Information need, and
  - Safety criticality
- In addition, we estimated the additional cost to the actor
  - Very crude estimate
    - - possibility cost savings; 0 no costs; + low costs; ++ medium costs; +++ high costs
  - Often the additional cost affected only one or two of the actors

Information needs

- We started with information needs for each stakeholder
- Seldom differences between scenarios for the same stakeholder
- Often differences between stakeholders

Scenario	Traffic Jam			Adverse weather area			Static/dynamic Road Work Zone		
	Actor and information need			Actor and information need			Actor and information need		
Local condition / ODD attribute	MO	TM	AV (ADS)	WMO	TM	AV (ADS)	RW or MO	TM	AV (ADS)
Variable message sign contents	***	***	***	-	***	***	-	***	***
Locations where V2I/I2V communications are available	*	***	***	*	***	***	-	***	***
Locations where GNSS differential correction signals are available	-	*	***	***	*	***	*	*	***
Locations where GNSS coverage is NOT available now, by GNSS service	-	*	***	**	*	***	-	*	***

Priority survey to ADS developers/OEMs Evaluation Results

- Survey conducted before 10 June workshop in Aachen
- Responses received: N = 8
- The questionnaire asked about four ODD attribute clusters information priorities for the CAD developers:
  - Physical attributes of the roadway and its environs
  - Operational attributes of the roadway
  - Digital infrastructure support
  - Dynamically varying ambient environmental conditions
- Following slides summarise the results of
  - TM4CAD analysis of the THREE actors and THREE scenarios OVERALL priority
  - Survey responses concerning priorities

The most important and urgent?

Local condition / ODD attributes: Physical infrastructure	TM4CAD analysis of overall priority level	ADS dev Survey (n=8)
Locations of road boundaries	HIGH	7H 1L
Zone boundaries	HIGH	6H 2L
Roadside landmarks	HIGH	7H 1L
Special-purpose localization references	LOW	8L
Quality of pavement marking visibility	HIGH	6H 1M 1L
Load-bearing capacity of roadway or bridge structures	MEDIUM	6M 2L
Road surface damage	MEDIUM	2H 5M 1L
Game fence locations and condition	LOW	8L
Vegetation obscuring sight angles or visibility of signs	LOW	1M 7L
Road geometry constraints	HIGH	7H 1L
Road shoulder conditions on both sides	HIGH	5H 2M 1L
Notifications of locations with occluded visibility	HIGH	7H 1L

The most important and urgent?

Local condition / ODD attribute: digital infrastructure	TM4CAD analysis of overall priority level	ADS dev Survey (n=8)
Variable message sign contents	HIGH	7H 1L
Locations where V2I/I2V communications are available	HIGH	7H 1L
Locations where GNSS differential correction signals are available	MEDIUM	1H 5M 2L
Locations where GNSS coverage is NOT available now, by GNSS service	MEDIUM	2H 4M 2L
Electronic toll collection systems and their associated pricing	LOW	1M 7L
Locations of incidents that represent traffic impediments or safety hazards	HIGH	7H 1L
Emergency vehicle locations and direction/speed of travel of each one	MEDIUM	1H 5M 2L
Current average traffic speed and density by lane and road section	HIGH	6H 2L

The most important and urgent?

Local condition / ODD attribute: digital infrastructure	TM4CAD analysis of overall priority level	ADS dev Survey (n=8)
Current percentage of heavy vehicles in traffic stream, by lane and road section	LOW	8L
Special events creating abnormal traffic conditions and their locations	HIGH	5H 1M 2L
Temporarily blocked or closed road locations	HIGH	7H 1L
Locations with high density of pedestrians	LOW	1H 2M 5L
Locations with high density of cyclists or users of micro-mobility devices	LOW	1H 2M 5L
Highway shoulder locations occupied by vehicles or debris	HIGH	5H 1M 2L
Locations with dynamic traffic access changes	HIGH	6H 1M 1L
Remote human support	HIGH	4H 4L

The most important and urgent?

Local condition / ODD attribute: Environmental conditions	TM4CAD analysis of overall priority level	ADS dev Survey (n=8)
Wind speed range	MEDIUM	1H 4M 3L
Visibility range with rain/snow/sleet/hail in visible light spectrum	HIGH	7H 1L
Visibility range with rain/snow/sleet/hail in lidar infrared spectrum	HIGH	6H 2L
Rainfall rate in mm/hr	HIGH	6H 2L
Snowfall rate in qualitative ranges	HIGH	7H 1L
Visibility range with other particulate obscurants in visible light spectrum	HIGH	7H 1L
Visibility range with other particulate obscurants in lidar infrared spectrum	HIGH	6H 2L
Predicted significant changes in key weather attributes	HIGH	7H 1L
Qualitative ambient lighting conditions	LOW	8L
Quantitative ambient lighting conditions	MEDIUM	5M 3L

The most important and urgent?

Local condition / ODD attribute: Environmental conditions	TM4CAD analysis of overall priority level	ADS dev Survey (n=8)
Special challenging lighting conditions	MEDIUM	1H 4M 3L
Electromagnetic interference	HIGH	5H 3L
Wet pavement surface	HIGH	4H 1M 3L
Ice on pavement surface	HIGH	6H 2L
Cold pavement surface (potential for ice if wet)	HIGH	5H 3L
Road surface friction	HIGH	4H 1M 3L
Light to moderate snow/slush accumulation on surface	HIGH	6H 2L
Heavy snow/slush accumulation on surface	HIGH	6H 2L
Light to moderate flooding (puddles) on surface	HIGH	5H 1M 2L
Heavy flooding – potentially impassible to low-profile vehicles	HIGH	6H 2L

The most important and urgent?

Local condition / ODD attribute: operational infrastructure	TM4CAD analysis of overall priority level	ADS dev Survey (n=8)
Temporary static signs	HIGH	7H 1L
Maintenance vehicles using portions of carriageway	HIGH	6H 2L
Work zones	HIGH	7H 1L
Incident recovery events (crash scenes, crime scenes, dropped loads, landslides, avalanches…)	HIGH	6H 2L
Availability of specific C-ITS information services	HIGH	6H 1M 1L
Availability of real-time merging guidance or assistance at motorway interchanges or entrance ramps	HIGH	7H 1L
Real-time lane-specific speed limit information availability at specific locations.	HIGH	7H 1L
Obstacles or debris on road surface	HIGH	6H 2L
Roadside objects that change their locations over time, such as parked vehicles or trash cans	MEDIUM	5M 3L
Routing advisory information	MEDIUM	5M 3L
Traffic rules and regulations in digital form, updated in real time	HIGH	6H 2L

What did the survey tell us?

- Mostly good agreement with TM4CAD estimates (always at least half in full agreement)
- Individual variety in responses
  - one respondent regarded for more than 90% of the attributes the priority as Low; likely reflecting the issue of ADS developer/OEM liability and use of AV sensors
  - issues of interpretation?
    - Urban use cases vs highway/motorway use cases
    - Some took into account the role of the road operator (according to written comments)
- Written comments
  - many referred to the difficulties and cost for providing the attribute
  - some questioned the trustworthiness of data – highlighted at OEM workshop
  - Some attributes regarded as more long term (e.g. remote human support)

Information quality

- Build on EIP, EIP+ and EU EIP quality recommendation for traffic related information
- Complement with results of Finnish study
- Compile list of quality criteria
- Study quality wishes of ADS
- Propose quality recommendation with EU EIP C-ITS as starting point
- Propose quality measurement methods

Quality criteria for DOA and its attributes
Geographical coverage
Availability
Performance conditions
Coverage of data types
Timeliness (start)
Refreshment rate
Data transfer delay
Timeliness (update)
Latency (content side)
Location accuracy
Monitoring point density
Measurement accuracy
Reporting accuracy
Error Rate
Classification correctness (non-false positives)
Event coverage (true positives)
Missed events (false negatives)
Report coverage

Quality recommendations – draft 1/3

Quality Criteria for Distributed ODD Awareness Framework	Traffic jam dissolving	Adverse weather	Road works
Geographical coverage	100% on designated motorways with high traffic volumes	100% on designated highways with frequent weather issues	100% on highways
Availability	99.5%	99.5%	99.5%
Performance conditions	-50…+60°C	-50…+60°C	-50…+60°C
Coverage of data types	traffic flow speed, occupancy	visibility, precipitation intensity and state of matter, road surface condition, wind (gust) speed, friction	location, status, local traffic management, lane availability, detour, trajectory

Quality recommendations – draft 2/3

Quality Criteria for Distributed ODD Awareness Framework	Traffic jam dissolving	Adverse weather	Road works
Timeliness (start)	< 2 min	<5 min	< 2 min
Refreshment rate	< 2 min	< 20 min	< 20 min
Data transfer delay	< 100 ms	< 100 ms	< 100 ms
Timeliness (update)	< 1 min	< 5 min	<2 min
Latency (content side)	<1 s (C-ITS) <1 min (NAP)	<1 s (C-ITS) <1 min (NAP)	<1 s (C-ITS) <1 min (NAP)
Location accuracy	10 m	10 m	10 cm (trajectory) … 10 m (others)
Monitoring point density	each link between major intersections	critical microclimate spots, otherwise 50 km	start and end of road works

Quality recommendations – draft 3/3

Quality Criteria for Distributed ODD Awareness Framework	Traffic jam dissolving	Adverse weather	Road works
Measurement accuracy	depends on indicator	depends on indicator	depends on indicator
Reporting accuracy	± 5%	± 10%	± 5%
Error Rate	< 2%	< 5%	< 2%
Classification correctness (non-false positives)	96%	92%	99%
Event coverage (true positives)	94%	90%	98%
Missed events (false negatives)	4%	5%	3%
Report coverage	97%	97%	97%

Observations on recommendations

- DOA recommendations usually higher than for conventional information or C-ITS
- Data transfer delay new one
- Location accuracy, error rate, latency, timeliness
  - Higher than likely possible with roadside equipment alone
  - Need of vehicle-based data – for location accuracy the only option!

Quality monitoring and management methods

nr	Method
1	Continuous monitoring of equipment performance and availability
2	Manual verification of events or conditions
3	Reference testing of data collected
4	Time-space oriented reference test methods
5	Monitoring of data completeness and latency
6	Regular sampling of message or data content completeness and correctness
7	Verification and calibration of traffic / weather conditions prognosis
8	Surveys of perceived quality by users
9	Collection of direct user feedback
10	Monitoring of service use statistics

Next steps

- Adapt and improve report on the basis of the OEM workshop 10 June and the CEDR workshop 24 June
- Propose technical solutions for data exchange
- Discuss attribute information governance
- Finalise deliverable D3.1 for internal review 07/2022
- Submit D3.1 to the PEB 08/2022

Traffic Management for Connected and Automated Driving (TM4CAD)

Summary

Vehicle Manufacturers Perspective Workshop

10 June 2022, Aachen

Agenda

08:30	Walk in coffee	
09:00	Welcome, introduction to TM4CAD and research questions	Jaap Vreeswijk + Tom Alkim
09:15	Basic concepts and terminology associated with ODD definition + Distributed ODD Awareness (DOA) framework	Siddartha Khastgir
09:40	Interactive part 1: *how do OEMs understand the DOA framework?*	Sven Maerivoet
10:40	*30-min coffee break*	
11:10	What kind of roadside or other road operator information do automated driving systems likely need?	Luisa Andreone + Aria Etemad
11:40	Prioritisation of information needs	Risto Kulmala
12:00	Interactive part 2: *what information types and attributes should be prioritized for supporting automated driving and what role can road operators play?*	Risto Kulmala
12:55	Conclusions	Jaap Vreeswijk + Tom Alkim
13:00	Lunch	

Participants

List of attendants

- VW – Aria Etemad
- VW – Andreas Richter (online)
- EUCAR – Luis de Prada
- Stellantis – Luisa Andreone (online)
- Ford - Christoph Kessler
- Toyota - Nicolas Vignard
- TUV - Sven Laucke
- RWTH/fka – Adrian Zlocki
- V-Tron - Wim Vossebelt
- Rijkswaterstaat - Henk Schuurman
- Wegen en Verkeer - Kristof Rombaut
- Bast - Torsten Geissler
- MAPtm – Jaap Vreeswijk
- MAPtm – Tom Alkim
- WMG – Siddartha Khastgir
- TML – Sven Maerivoet
- Traficon – Risto Kulmala
- Traficon – Ilkka Kotilainen (online)
- Keio Uni. – Hironao Kawashima (online)

Summary

- Constructive dialogue with vehicle manufacturers, there seems to be an appetite to continue the discussion with road operators
- Many information attributes are considered high priority in general, which will truly be used is contextual
- Several hurdles to overcome for a CAV to use external information, depending on the nature and context of that information, e.g. trustworthiness, liability and cyber security
- Monitoring of ODDs can not be done by anybody else than the vehicle
- There’s a big difference between safety critical information and non-critical information
- There’s also a difference between complementing and competing information
- Discussion on whether such information is inside or outside of the vehicle's sensor range
  - If it’s inside, it can be used for redundancy
  - If it’s outside, it could be used to extend the ODD
- It would be appreciated if road operators would also become more digital
- Automating vehicles is not the same as cooperative automated traffic, more collective reasoning and traffic management considerations are needed for the latter

Summary

- Landmarks for positioning purposes are deemed useful
- Static or slowly changing information can be provided when it actually changes
- Multi brand communication protocols and connectivity are needed
- How to use and/or present the (ODD) information to users or vehicles is open for debate
- Regarding the interactions with infra: same standards should be upheld as the ones that apply for OEMs
- Ethics of automated vehicles was discussed, in terms of acceptable behaviour and (minimal risk) maneuvres: OEMs won't introduce ADS which have too frequent of MRM, also rely heavily on driver monitoring function
- Utilisation of vehicle sensor generated information can be used for traffic management and road operation, this can be a business case

Next steps

- Possibility to work together on a practical case in Hi-Drive to defragment the ODD was discussed
- Another exercise could be to check if mentioned high relevant attributes are digitally available
- In October 2022, the ODD attributes from Hi-Drive will become available

Traffic Management for Connected and Automated Driving (TM4CAD)

Discussion: information needs and quality related to information exchange between traffic management centres and automated vehicles

Risto Kulmala & Ilkka Kotilainen, Traficon

Break

Traffic Management for Connected and Automated Driving (TM4CAD)

Discussion: specific use cases of ‘ODD management’

Discussion

- Task: work out details of RW use case with OEMs and NRAs

- Understand information needs of different generations of ADS, e.g.
  - 1st generation / brand to disengage timely
  - 2nd generation / brand to navigate the RW zone (with digital and physical support)

- Revisit original RQs from the DoRN

- From NRA viewpoint what circumstances require ODD management?

Use cases: ADS/scenarios/actors

- ADS <u>on motorways/highways:</u>
  - ALKS (L3)
  - Highway autopilot (L4)
  - Automated trucks on open roads (L4)
- In three scenarios:
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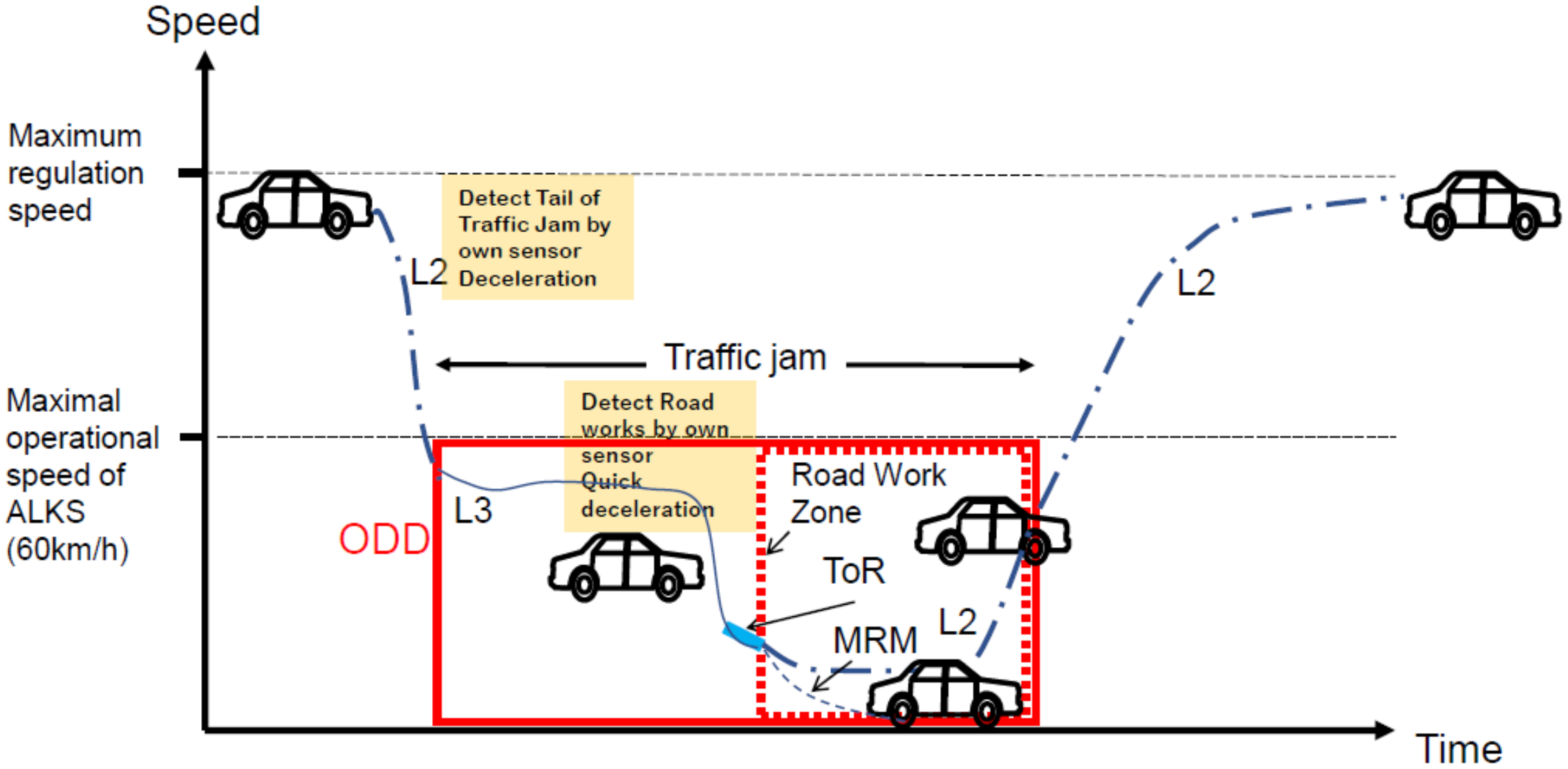

Speed
Maximum regulation speed
Maximal operational speed of ALKS (60km/h)
Detect Tail of Traffic Jam by own sensor Deceleration
L2
Traffic jam
Detect Road works by own sensor Quick deceleration
L3
ODD
Road Work Zone
ToR
MRM
L2
L2
Time

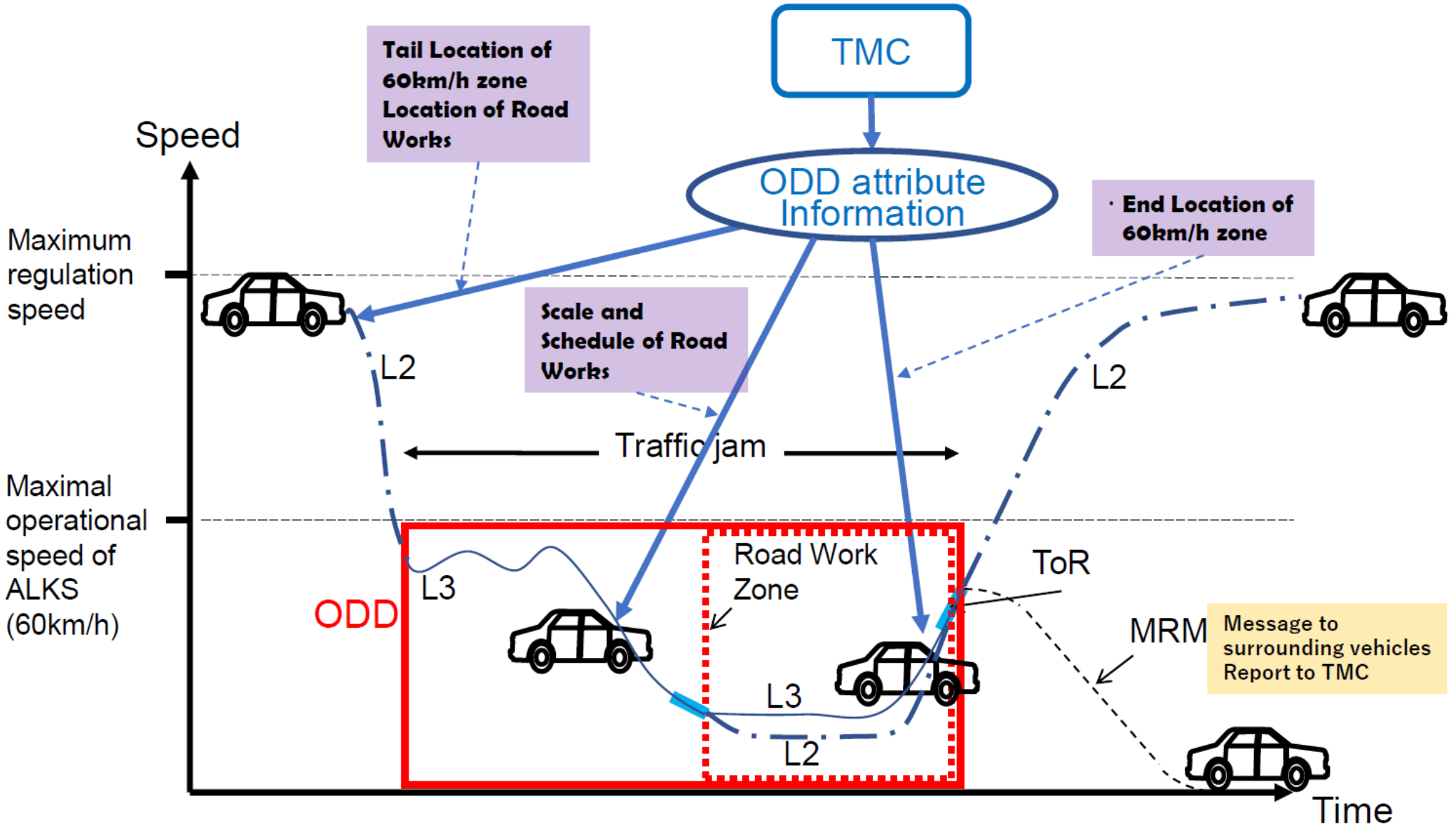
TM4CAD Objectives – CEDR Research Questions

- **RQ1**: Should NRAs set requirements on the **desired behaviour of (partly) automated vehicles** on where and how they should drive?
- **RQ2**: Do brokers between traffic management centres and vehicles/OEM back ends add value in this interaction?
- **RQ3**: **How does CCAM support** the work of traffic management centres and **how can traffic management centres support** and facilitate the deployment of CCAM?
- **RQ4**: What kind of **information is to be transmitted** in the interaction (in both directions) between a traffic management centre and vehicle?
- **RQ5**: Which information is to be provided **by the NRA/roadside** and which information can be obtained by the sensors of the moving vehicle itself?
- **RQ6**: When and how should such information be available?
- **RQ7**: How to define and measure the **quality/correctness** of such information?
- **RQ8**: Are there any **circumstances** under which the traffic control centre would need to **lower the ISAD** level in order to stop automation taking place, or vice versa: to impose automated driving?

What circumstances require ODD management from NRA perspective?

Examples:

- Peak hour lane open
- Stopped / broken down vehicle partially in lane
- Elks on the road
- Weather conditions that will affect sensor performance
- Shockwave dynamics cause alternating ODD
- …


TMC
Tail Location of 60km/h zone Location of Road Works
ODD attribute Information
End Location of 60km/h zone
Speed
Maximum regulation speed
Scale and Schedule of Road Works
L2
L2
Traffic jam
Maximal operational speed of ALKS (60km/h)
ODD
L3
Road Work Zone
ToR
MRM
Message to surrounding vehicles Report to TMC
L3
L2
Time

Codified Rules of Road: Motivation

FIRST PART: ADS Safety Topics

FRAV DDT Workstream

The ADS should drive safely

1. The ADS should be capable of performing the entire Dynamic Driving Task (DDT)
2. The ADS should recognize the
3. The ADS should detect and res
4. The ADS should comply with
5. The ADS should interact safely

FRAV ORU Workstream

3	**The ADS should respond in line with traffic laws to markings and signals used to identify the functions and**	● The ADS should respond in accordance with traffic rules upon the operational status or dedicated signals displayed by	**Scenario/Virtual test/Track test:** ● **Object:** Emergency/Special vehicle with visual signal (flash/painting), ego vehicle; ● **Case:** 2-lane road, an emergency vehicle moves at low speed (in

5.1.2. The activated system shall comply with traffic rules relating to the DDT in the country of operation.

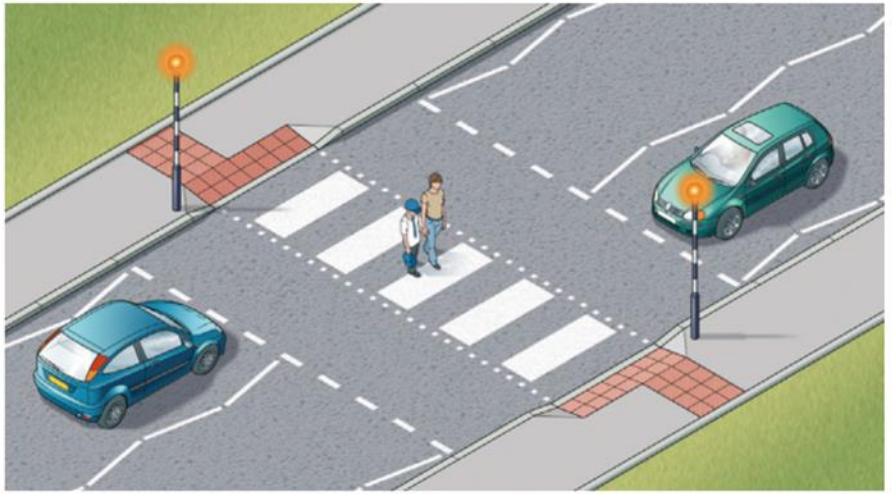
UNECE Reg 157

4.1.1. Verification of the function of "The System"

The Type approval authority shall verify "The System" under non-failure conditions by testing on a track a number of selected functions from those described by the manufacturer in paragraph 3.2. above, and by checking the overall behaviour of the system in real driving conditions including the compliance with traffic rules.

UK Highway Code: Rule 195

"As you approach a zebra crossing: look out for pedestrians waiting to cross and be ready to slow down or stop to let them cross; you MUST give way when a pedestrian has moved onto a crossing"



Rule 19: Zebra crossings have flashing beacons

How long to wait?

Behaviour | ODD | Assumptions

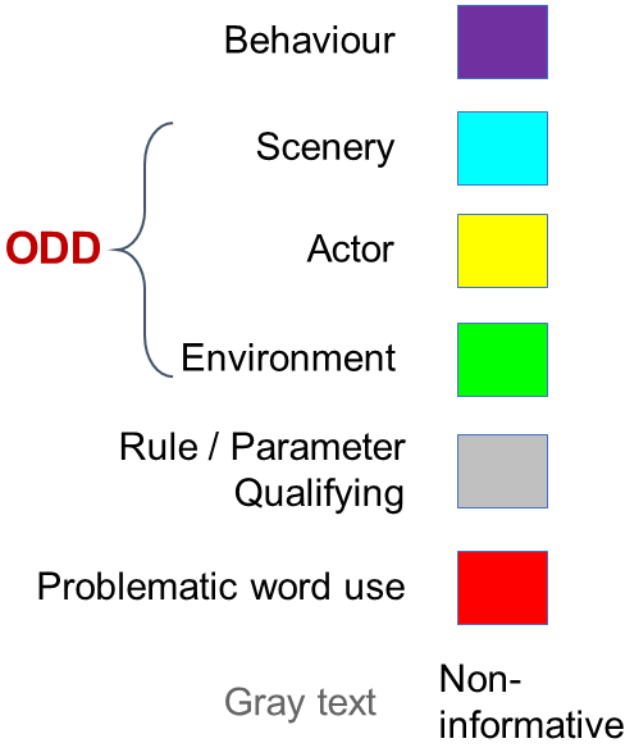
ODD Based Codified Rules of Road PROCESS

Current Rules of Road (for human drivers) = *f(Operating condition, Behaviour competency, Assumptions)*

Codified Rule of the Road = *f(Operating condition, behaviour competency, driving characteristics)*

Deriving Requirements from Rules of Road
UK Highway Code Rule 125

- speed limit is absolute maximum **and** does not mean safe speed. reduce speed when:
  - road layout or condition hazards, bends
  - sharing the road pedestrians, cyclists and horse riders, particularly children, and motorcyclists
  - weather conditions make it safer
  - driving at night



Codification of Vienna Convention Rules of Road

Chapter II

RULES OF THE ROAD

PART I

CONVENTION ON ROAD TRAFFIC

DONE AT VIENNA ON 8 NOVEMBER 1968

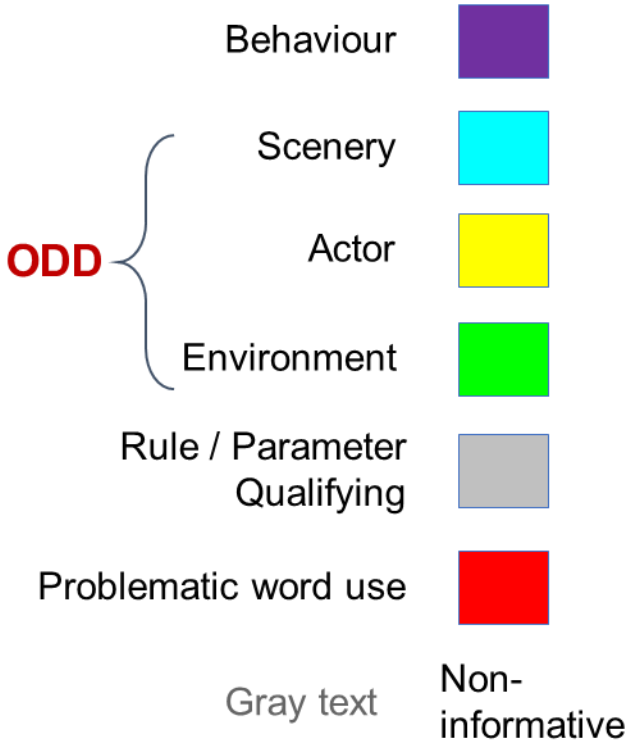
(Consolidated version)*

* Including the amendments to the Convention which entered into force on 3 September 1993 (marked in the margin with a single line) and the amendments which entered into force on 28 March 2006 (marked in the margin with a double line).

Codification of Vienna Convention Rules of Road

Chapter II - Rules of the Road – Article 11 (Overtaking - 11)

A vehicle shall not overtake another vehicle which is approaching a pedestrian crossing marked on the carriageway or signposted as such, or which is stopped immediately before the crossing, otherwise than at a speed low enough to enable it to stop immediately if a pedestrian is on the crossing.



Traffic Management for Connected and Automated Driving (TM4CAD)

Summary and next steps

Summary and next steps

- Submission D3.1 and D5.1 (2nd version) – 12th of August
- Integrate HiDrive results on ODD attributes – October 2022
- Get input from DiREC on Digital Twin and Connectivity (and RTTI)
- Breakout session @ ARTS2022
- Next workshop @ TRA (November 2022)