

# MAVEN

(Managing Automated Vehicles Enhances Network)

## Automated driving in an urban environment

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Den Hague, Netherlands



MAVEN is funded by the EC Horizon 2020 Research and Innovation Framework Programme, under Grant Agreement No. 690727



# General Information

## □ Website

✓ [www.maven-its.eu](http://www.maven-its.eu)

## □ Duration

✓ 36 months (Sept '16 – Aug '19)

## □ Funding

✓ ~3M€ under EC H2020 programme

## □ Partners:

✓ From five countries: DE, NL, CZ, BE, UK



Gemeente Helmond



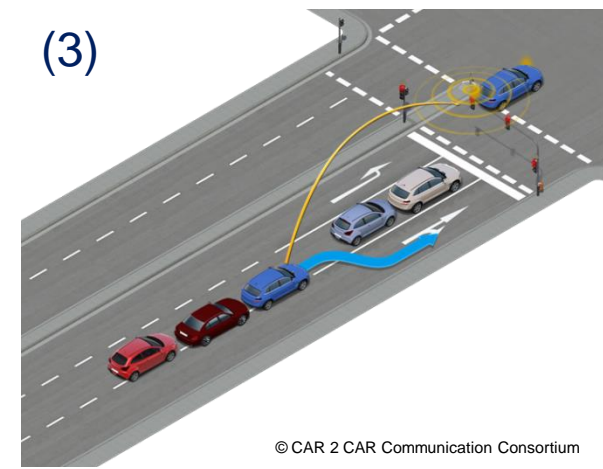
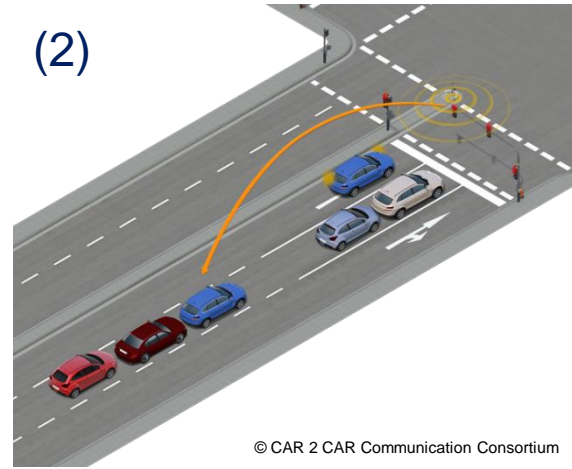
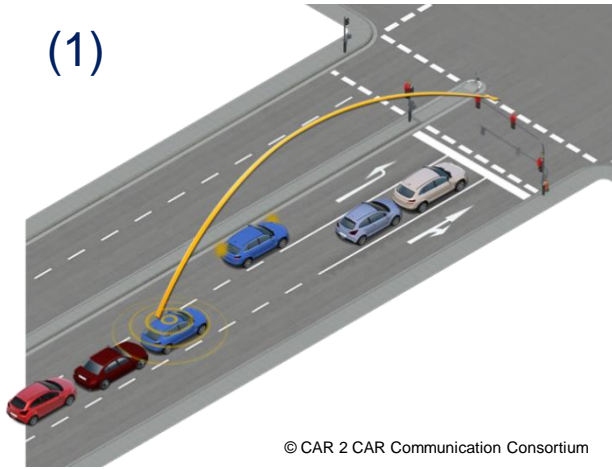
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# MAVEN I2V signal negotiation



## ❑ Negotiation (1)

- ✓ Vehicle and/or platoon transmits expected route, desired speed, platoon size, etc.

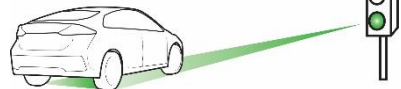
## ❑ Infra advisories - negotiation (2)

- ✓ Based on rx info, suggestions to adapt speed and/or change lanes

## ❑ Negotiation (3)

- ✓ Vehicle and/or platoon communicates if suggestion can be executed → gives more inputs for infra optimization algorithms

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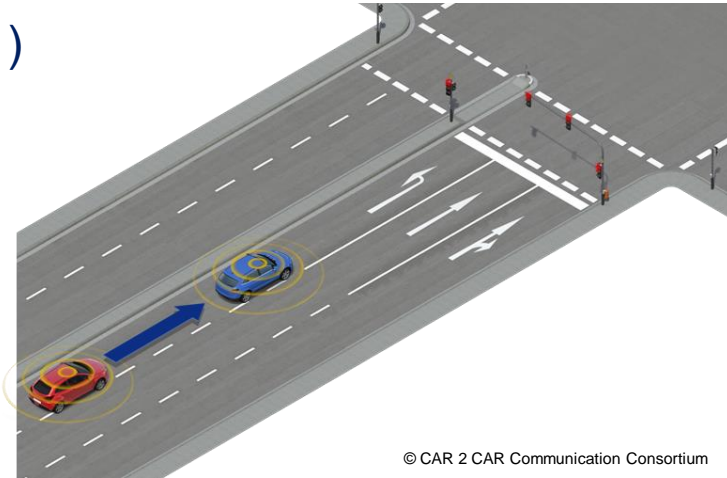


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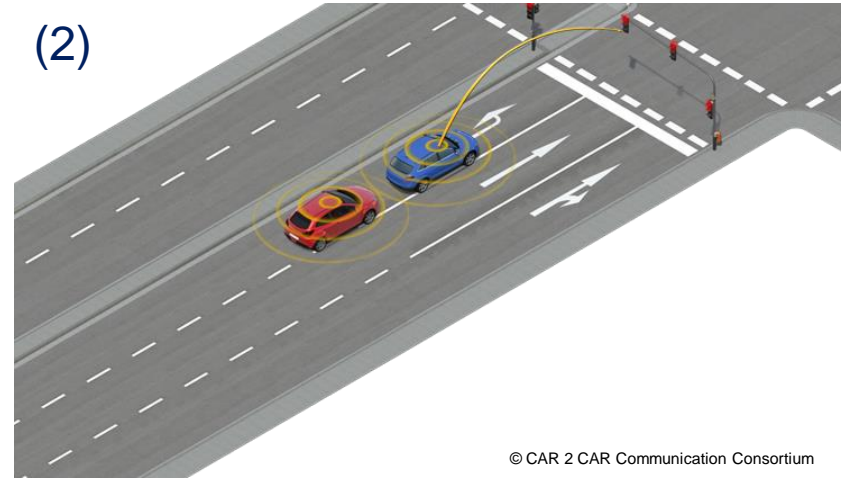


# MAVEN platooning

(1)



(2)



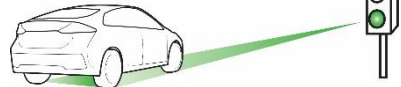
## ❑ Mix between distributed and centralized approach

- ✓ Based on common distributed algorithm and V2V exchanged info, individual vehicles form platoons and manage their operation (joining, leaving, etc.) (1)
- ✓ Yet, platoon leader has the central role of communicating platoon properties to the infra (2)

## ❑ Use of 2 parallel radio channels

- ✓ One for advertising vehicle and/or platoon characteristics to other vehicle or infra
- ✓ The other, to transport platoon control and management info

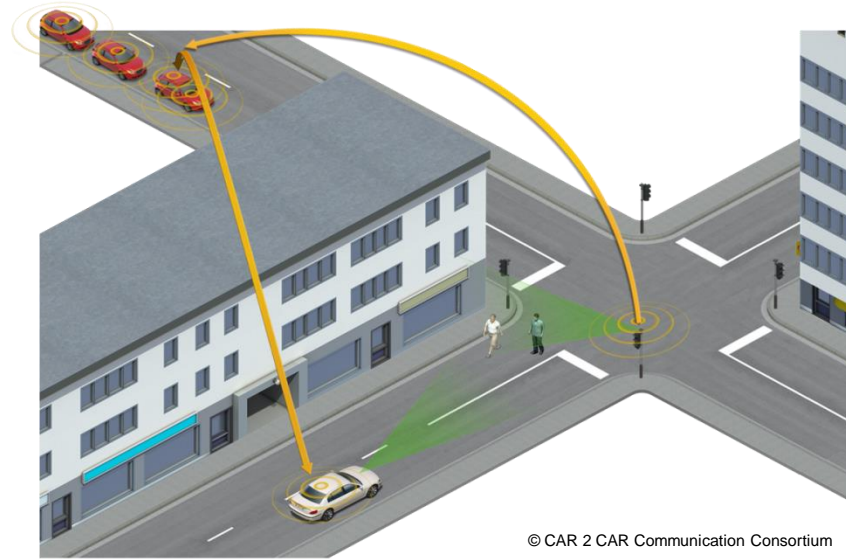
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# Inclusion of conventional traffic and VRUs



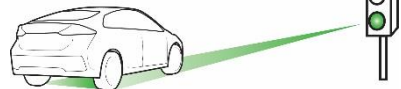
## ❑ Use of cooperative sensing for improved detection and reaction

- ✓ Both vehicles and infra can detect and share info about non-cooperative road users
- ✓ Improved awareness used to adapt vehicle trajectory for ensuring increased safety

## ❑ Management of emergency situations

- ✓ Vehicles in platoon keep monitoring the environment and controlling the system all the time to possibly undertake emergency (automated) reactions

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# Standardization of message sets

## ❑ Message sets defined for V2X communication

- ✓ Collaborative Perception Message (CPM)
- ✓ Lane Advice Message (LAM)
- ✓ Extensions to Cooperative Awareness Message (CAM)

## ❑ Standardization

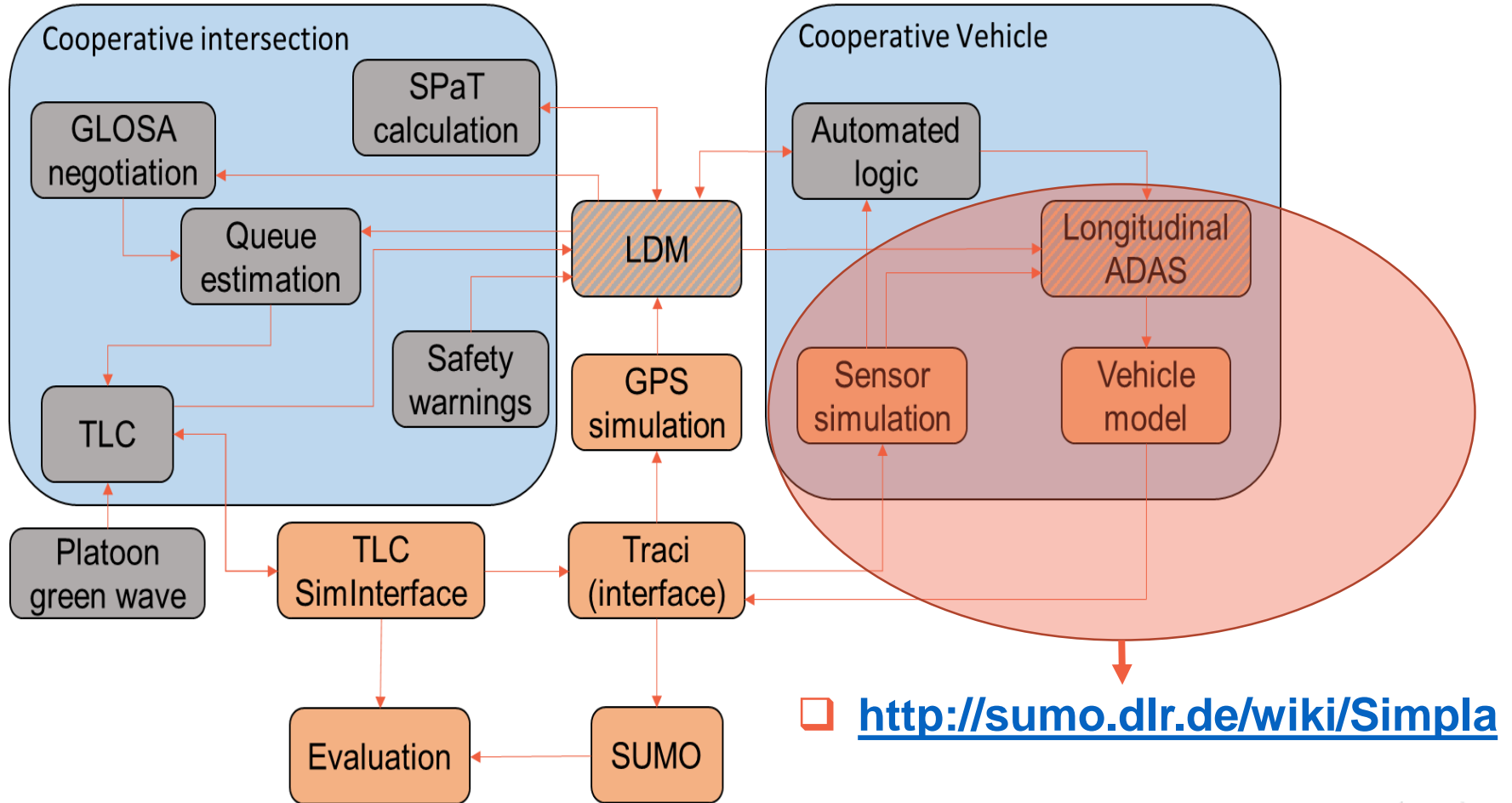
- ✓ Coordination with Car2Car Consortium about CPM
- ✓ Results are brought into ETSI for standardization

## ❑ ... do not hesitate to contact us for:

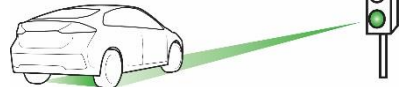
- ✓ Share ASN.1 definitions
- ✓ Design details
- ✓ Etc.



# Simulation of automated vehicles



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# Plan stabilization for adaptive control

- ❑ **Plan stabilization with flexibility required for MAVEN use cases**
  - ✓ Unstable plan leads to unnecessary acceleration/deceleration
  - ✓ Drivers will lose trust in system with instability
- ❑ **Patent granted for plan stabilization solution:**
  - ✓ Exploits possibility to only fixate the start of one signal group
  - ✓ Cost function parameter allows applying policy preferences of road operator rather than a magic number of x seconds





# Results for plan stabilization

## □ Best of both worlds: flexible and stable

- ✓ Tested on single intersection with 1 stabilized signal group
- ✓ More stable and better traffic efficiency compared to current state-of-the-art
- ✓ Policy setting changes behaviour

Scenario	Impact(s)	Delay(s)	Stops	GLOSA(%)	MSE(s <sup>2</sup> )	MRE(%)	PC(%)
Static	43.2	36.7	0.81	25	0	0	0
Actuated	36.3	29.6	0.84	19	182	84.67	7.62
Adaptive	32.7	27.0	0.72	46	47	26.38	5.65
Semi-fixed	37.4	31.0	0.80	27	62	41.89	3.82
Stabilized	32.7	27.0	0.71	53	17	15.01	3.52
Stabilized x5	35.6	29.7	0.73	51	22	7.95	2.66



*Thank you!*

*Questions?*



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