Infrastructure-based cooperative and automated road transport

Dr. Meng Lu, Dynniq Nederland B.V.

University of Zagreb, 29 May 2019

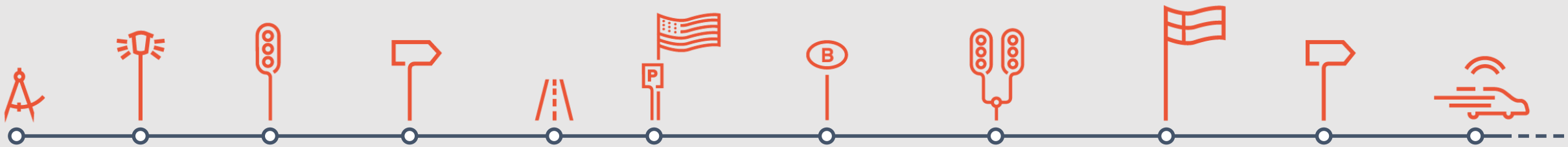
dynniq

energising mobility

Sveučilište u Zagrebu
University of Zagreb
Fakultet prometnih znanosti
Faculty of Transport and Traffic Sciences

FER

Track record



1929

Nettenbouw was founded by H. Keyser.

1936

Nettenbouw was respon-sible for the first sodium lighting in the Netherlands.

1970

Traffic related activities were added.

1972-1973

Internatio acquired full ownership of the company.

1993

Founding Imtech.

1997

The acquisition of WPS added parking to the solution portfolio whilst extending the geography to the USA and Canada.

2004

Imtech Traffic & Infra expanded its activities into Belgium.

2007

Acquired Peek Traffic and rebranded Nettenbouw to Imtech Traffic & Infra.

2010-2012

Acquired YSP and SSR to develop a stronger position in Scandinavia.

2015

The company was acquired by private equity company Egeria.

2016

Dynniq, energising mobility.

NETTENBOUW | Internatio Müller (IM) | Imtech | WPS | PEEK | ysp | dynniq

Dynniq footprint

UNIQUE in **Energising Mobility**
as **Market Leader** or in **Strong Position**

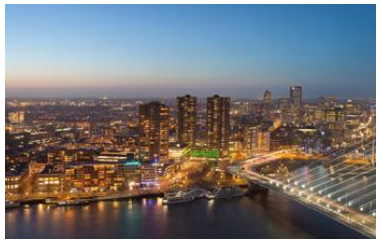
Employees
± 1,800

Around the world market shares grow.
Sustainable profitability growth

Position

Market Leader	Controllers maintenance
No. **2**	Highway management
No. **2**	Urban traffic controllers
20%	Public lighting columns

The Netherlands, with **600 Employees** *and being* **Dynniqs home** *country, is playing a* **key-role** *while* **leading the world** *into a promising and bright* **Future.**



Strong Market Position mission critical connectivity in *Belgium*

UK/Ireland

- **Market Leader** SCOOT
- **35% market share in supply and installing TLCs**
- **35% market share in supply and installing signal heads**

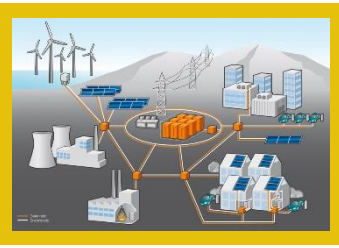
Finland: **Market Leader** infra control and **main contractor** on **largest** ongoing motorway **projects**

> 7,500,000 parking visits handled each month by WPS worldwide

Market Leader:
Brazil

Top 3 position:
Netherlands, Belgium, UK/Ireland

Netherlands



- Knowledge & execution partner **first public direct current networks**
- **1,000,000 kilometres** underground cable accommodated in 2016
- **60%** of light rail traction
- Middle voltage/High voltage automated (sub)stations design & construct

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Contents

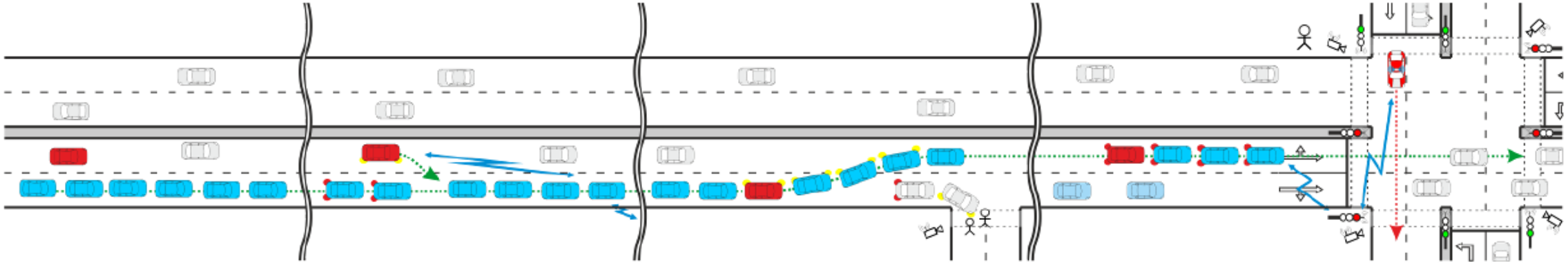
Dynniq is an engineering company. It is technical systems and service provider in the domain of Transport and Energy.
Dynniq provides services and operates in the following markets: traffic control and management (for traffic safety, efficiency and comfort), ICT infrastructure (services) and energy. Innovation activities: e.g. ITS (including connected, cooperative and automated driving), smart grids, and 5G for V2X applications.
With more than 1,800 professionals Dynniq is working for nearly 1,000 customers in and outside Europe and achieves annual revenues of around EUR 400 mil.

dynniq energising mobility

MAVEN objectives

Managing Automated Vehicles Enhances Network

- **Management regimes for automated driving in urban areas**
  - increase safety with collective perception (alternative: very slow driving)
  - increase efficiency by exploiting possibilities of automated driving
- **Monitoring, support and orchestration of movements of road users to guide vehicles at signalised intersections**
- **Further enhancement for ADAS and C-ITS applications**



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Use cases and new data elements

Managing Automated Vehicles Enhances Network

Cluster/platoon phases	Movement	Flow optimisation	Disruptive
initialisation	speed change advisory	priority	non-cooperation
joining	lane change advisory	queue length estimation	emergency situations
travelling		local routing	
leaving		network coordination	
break-up		signal optimisation	
termination		intersection negotiation	

New data element	Applicable scenario
Number of occupants	Intersection priority management.
Distance to following vehicle	Queue estimation. This information can improve queue model accuracy, leading to more optimal solutions for GLOSA negotiation and signal timing
Distance to preceding vehicle	
Platooning state	Signal optimization and intersection priority
Desired speed	Queue estimation and GLOSA negotiation
Current lane	Lane advice, multiple lanes for a certain direction
Route information	Queue estimation, signal optimization and GLOSA

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Queue modelling and negotiation

Managing Automated Vehicles Enhances Network

- **Automated vehicles have more data available**
  - intended turn direction (6% better traffic efficiency)
  - desired speed
  - number of occupants (priority input)
  - compliance to advice
- **Information enabled more accurate queue modelling**
- **Direct positive effect on several MAVEN systems**
  - lane advice
  - signal optimization
  - route advice
  - speed advice

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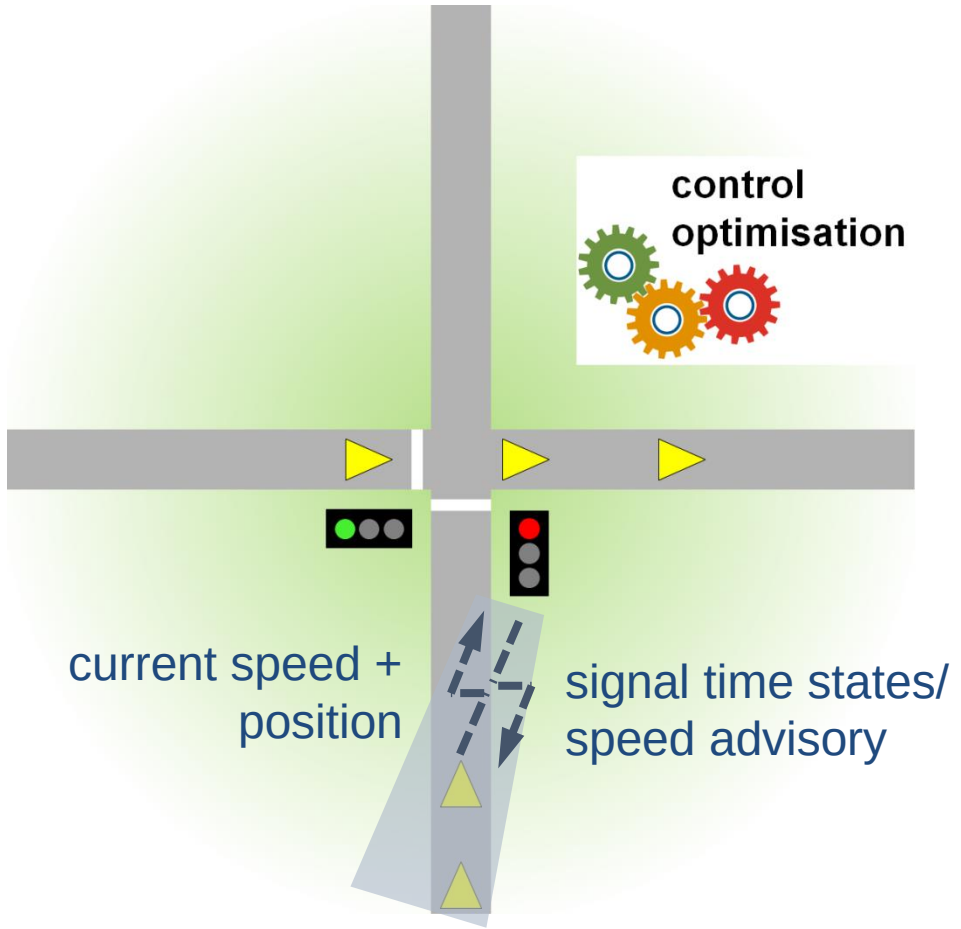
AGLOSA

Agent-Aware Green Light Optimal Speed Advice

- **Combination of vehicle-actuated control and GLOSA**
- **bi-directional communication**
- **Possible detection, e.g.**
  - V2X communication
  - video capturing
  - laser scanning
  - wireless in-road detectors
  - loop detectors



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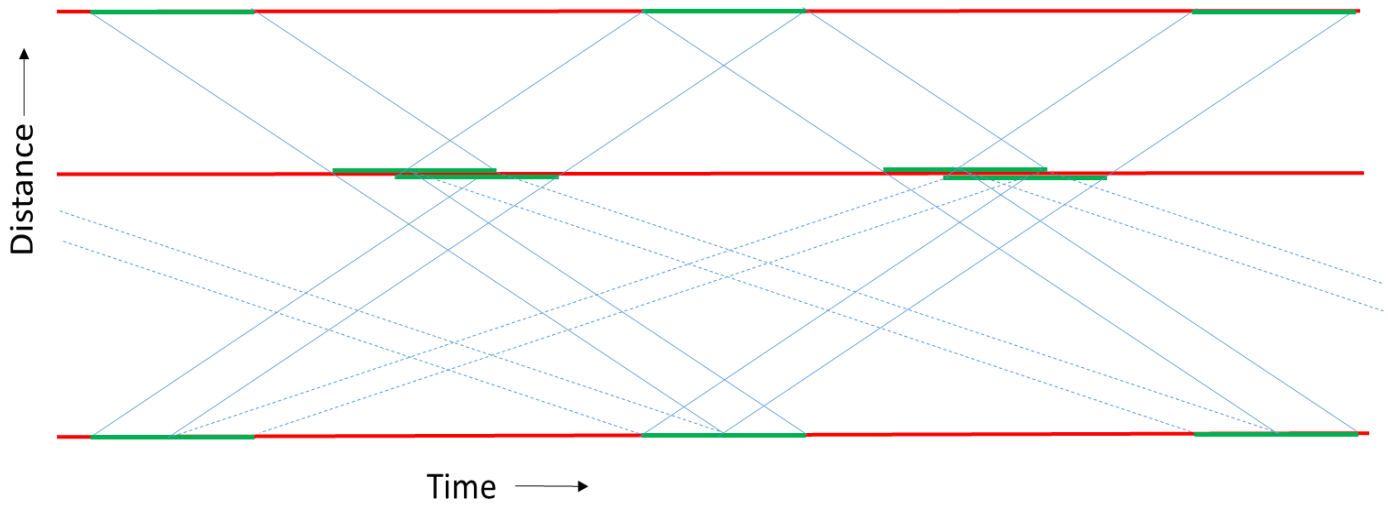
Green wave - theory

Managing Automated Vehicles Enhances Network

- **Literature research and internship assignment to compare:**
  - static control
  - Q-learning
  - agent-based adaptive control
- **Q-learning not mature enough to deal with anomalies**
- **Best performance with agent-based adaptive control**
- **Synergy with speed advice negative, more work required to improve this**



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Events invitation

Managing Automated Vehicles Enhances Network

- **European Congress on Intelligent Transport Systems on 3-6 June 2019 in Eindhoven/Helmond, The Netherlands**
  - MAVEN workshop on 06-06-2019, Eindhoven
  - Dynniq/MAVEN stand, Eindhoven
  - MAVEN demo, Helmond
  - SP/TP/SIS sessions
- **IEEE Intelligent Vehicles Symposium (IV 2019) on 9-12 June in Paris, France**
  - Joint workshop with TransAID and other related projects on cooperative and automated driving

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Contact

MAVEN - Managing Automated Vehicles Enhances Network

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Transition Areas for Infrastructure-Assisted Driving

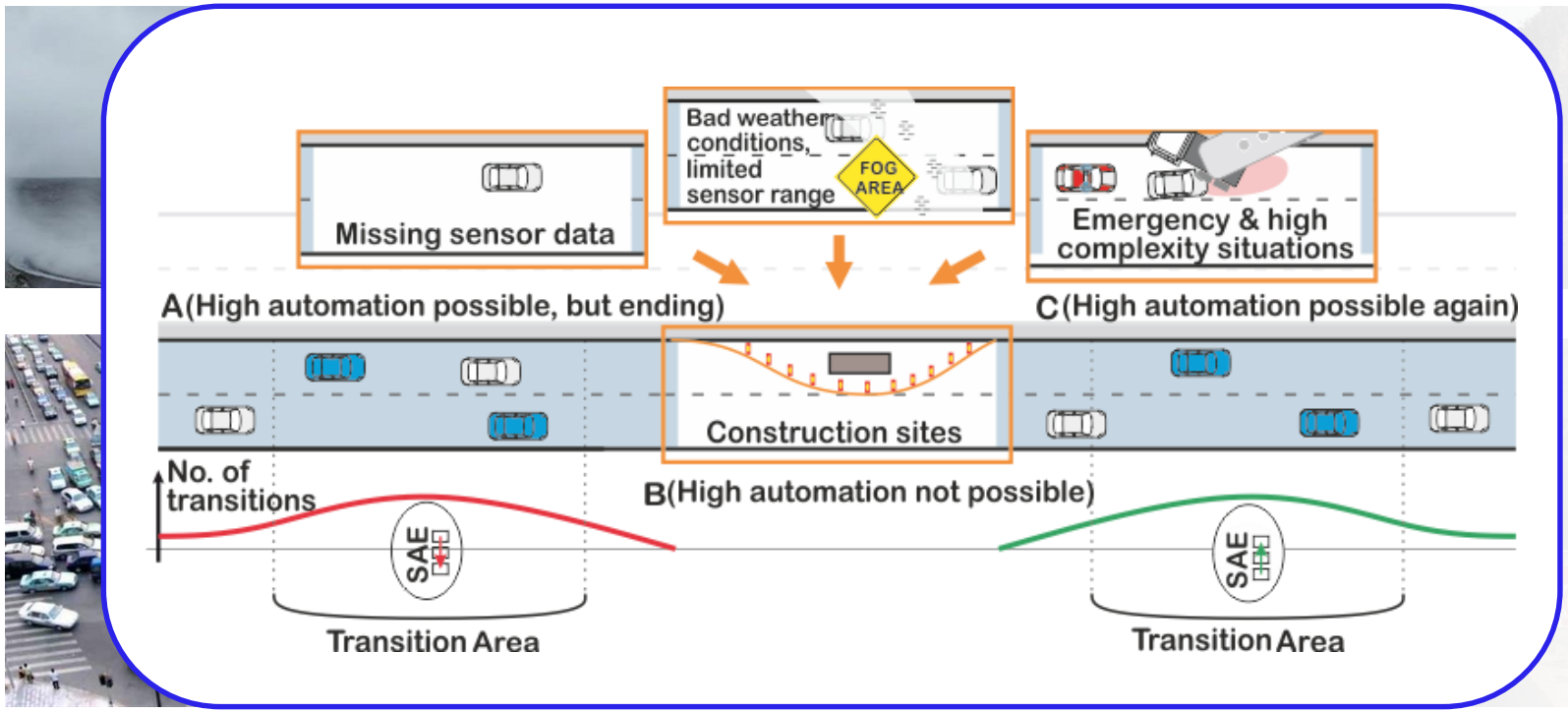
- TM during the transition phase towards full AV penetration to increase traffic efficiency and safety
- Focus on AV and preventing them from having to hand over control back to the driver in difficult situations

www.transaid.eu
@transaid_h2020
www.linkedin.com/groups/13562830/
www.facebook.com/transaidh2020/

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 723390

What if…

- …your automated vehicle is not able to solve the situation ahead?



- …this happens not to single vehicles only, but to several?
- …it always happens on the same location?

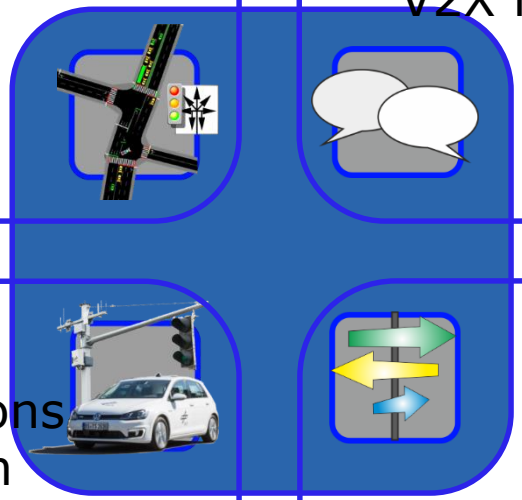
TransAID scope

Simulation

- Perform simulations with different traffic mixes
- Estimate effects of automated driving
- Identify TM measures to enhance safety and efficiency

Communication

- TM measures need to be communicated to the vehicles
- Development of new ITS-G5 V2X message sets
  - Also inform conventional vehicles



Field Implementation

- Most promising solutions will be implemented in real world inluding:
  - Automated vehicles
  - Infrastructure
  - Communication

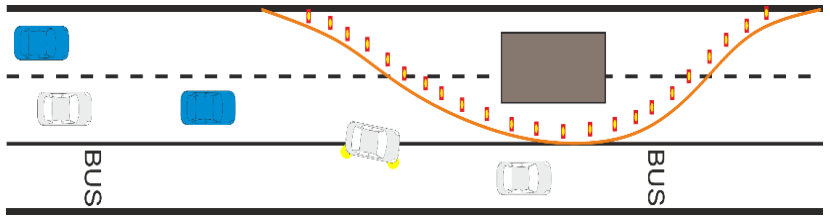
Roadmap & Guidelines

- Development of a Roadmap including guidelines for stakeholders (e.g. OEMs, road authorities, cities)
- Standardization of messages

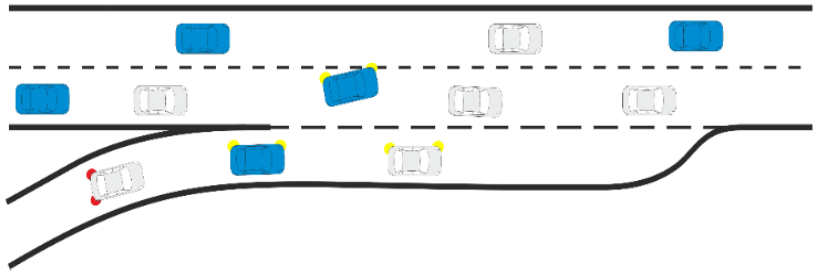
Use cases (examples)

TransAID - Transition Areas for Infrastructure-Assisted Driving

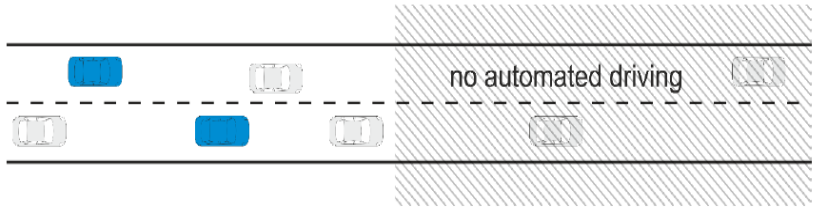
- **Roadworks/ bus lane usage**



- **Motorway merging**



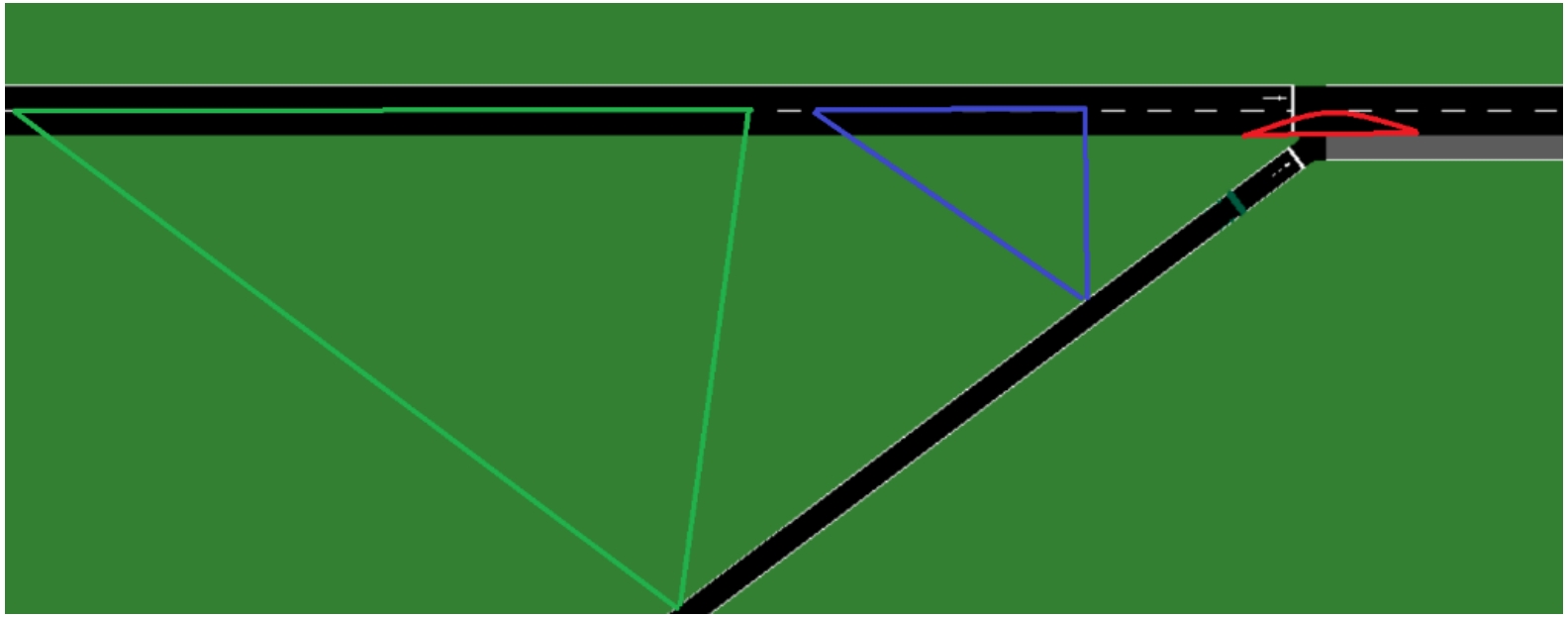
- **No automation zone, TOC (Transition of Control) spread**



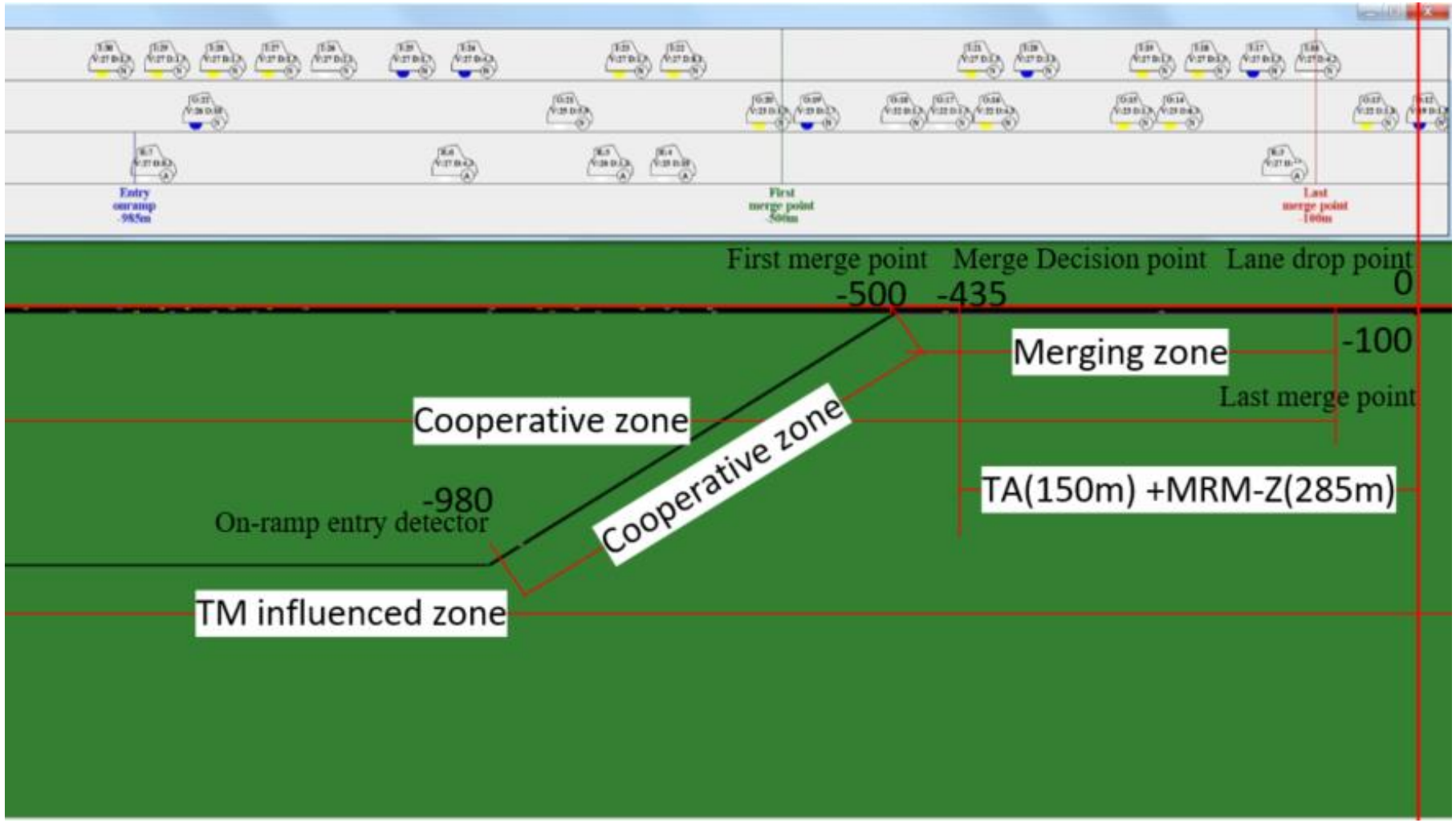
Ramp metering: perception area

TransAID - Transition Areas for Infrastructure-Assisted Driving

- New ramp metering algorithm
- New C-ITS application to assist safe merging at on-ramp
- Modelling tools for simulation of motorway on-ramp situations
- Extended message sets for providing advice for traffic merging situations to cooperative and automated vehicles



Ramp metering: scenario



Ramp metering: interactions

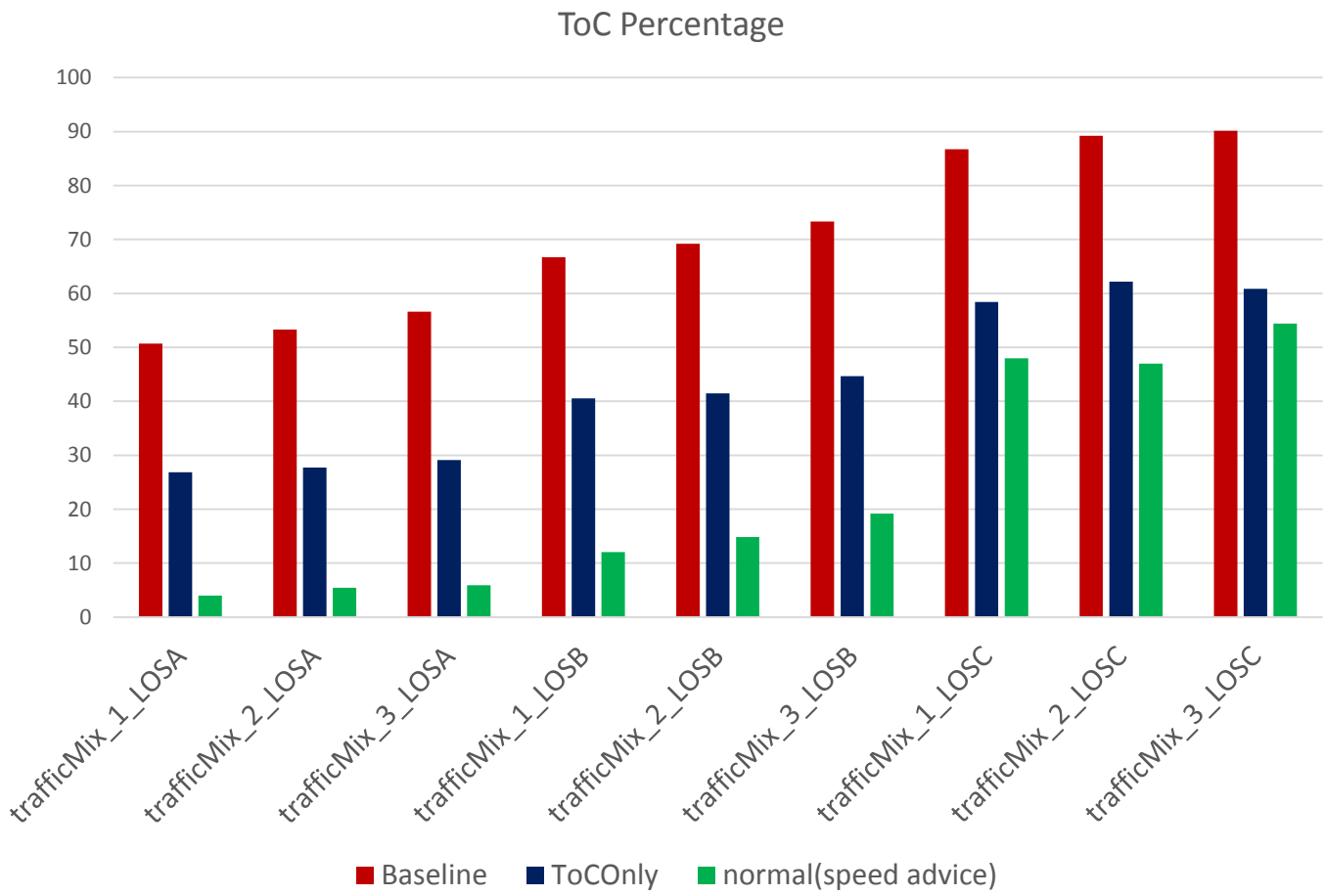
- **Non-cooperative vehicles**
  - monitor at entry detector and with the tracking camera
  - turn ramp meter to green near gaps
- **Cooperative vehicles**
  - CAM (Cooperative Awareness Message) gives regular speed and position update
  - possibility to send lane and speed advice with app
- **Automated vehicles**
  - report distance to leader vehicle
  - more precise instructions

Ramp metering: algorithm

- **Restrict return to rightmost lane**
  - more space for merging
  - increase model accuracy
- **Speed advice**
  - find first acceptable gap for vehicle when entering on-ramp
- **Transition of control fallback**
  - as soon as possible conclude whether merge is possible
  - more time for human driver to adjust
- **Create gap with another cooperative or automated vehicle**
- **Turn on ramp meter**

Ramp metering: results

TransAID - Transition Areas for Infrastructure-Assisted Driving



LOS A:
1662 veh/h

LOS B:
2646 veh/h

LOS C:
3856 veh/h

Contact

TransAID - Transition Areas for Infrastructure-Assisted Driving

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TransAID web site
www.transaid.eu

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 723390

Selected recent publications (1/2)

Dynniq R&D results

Lu, M. (Ed.) (2019). Cooperative Intelligent Transport Systems: Towards High-Level Automated Driving. Publisher: IET (Institution of Engineering and Technology). ISBN: 978-183953-012-8 (Print) / 978-183953-013-5 (eBook) (in press)

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Selected recent publications (2/2)

Dynniq R&D results

Lu, M., Blokpoel, R., Joueiai, M. (2018). Enhancement of safety and comfort of cyclists at intersections. IET Intelligent Transport Systems. Vol. 12, Issue 6, pp.527-532. DOI: 10.1049/iet-its.2017.0250

Lu, M., Blokpoel, R. (2017). A sophisticated intelligent urban road-transport network and cooperative systems infrastructure for highly automated vehicles. Paper ID EU-TP0769. In Proceedings: The 24th World Congress on Intelligent Transport Systems, 29 October – 2 November 2017, Montréal.

Lu, M., Blokpoel, R., Schindler, J. (2017). Infrastructure-based cooperative, connected and automated driving in a transition phase. Paper ID EU-TP0855. In Proceedings: The 24th World Congress on Intelligent Transport Systems, 29 October – 2 November 2017, Montréal.

Blokpoel, R., Lu, M. (2017). Signal plan stabilization to enable eco-driving. In Proceedings: The 20th IEEE International Conference on Intelligent Transportation Systems (ITSC), 16-19 October 2017, Yokohama. IEEE Xplore ISBN 978-1-5386-1526-3/17 pp.133-138.

Lu, M., Blokpoel, R., Pillado, M., Somma, G. (2017). ICT Infrastructure-based cooperative and connected systems for intelligent European road transport. Paper ID TP0972. In Proceedings: The 12th European Congress on Intelligent Transport Systems, 19-22 June 2017, Strasbourg.

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PROJECT PHASE
European Commission
FINAL STAGES
FULL DEVELOPMENT
EARLY STAGES
InnoVFin
eeef
EUROPEAN ENERGY EFFICIENCY FUND
European Investment Bank
The EU bank
EFSI
COSME
EUROPE'S PROGRAMME FOR SMEs
EUROPEAN INVESTMENT FUND
eic European INNOVATION Council
H2020 SME Instrument
Fast track to Innovation
HORIZON 2020
INEA Grants
InnoVFin Advisory
CEF programme
European Innovation Council (EIC)
European Investment Advisory Hub
Europe's gateway to investment support
Capital Development
COMMON EXPLOITATION BOOSTER
SSERR
enterprise europe network
European Investment Project Portal (EIPP)
venture capital
European IPR Helpdesk
Business Angels
seed capital
TRL 1-2 PRINCIPLES AND FORMULATION
TRL 3-4 PROOF OF CONCEPT AND VALIDATION
TRL 5-6 VALIDATION IN REAL ENVIRONMENT
TRL 7-8 PROTOTYPE DEMONSTRATION AND COMPLETION
TRL 9 PROVEN AND OPERATIONAL
TECHNOLOGY READINESS LEVEL

Thank you for your attention.

Dr. Meng Lu

Strategic Innovation Manager

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