



Overview of the project

Marika Hoedemaeker, TNO

Why multi-brand platooning?



PATH

CHAUFFEUR I/II

Energy ITS

GCDC

GCDC 2

Cooperative Driving

Communication

Platooning Optimization / Coordination

Standardization

1990

2000

2010

2016

2022

OTTO

KONVOI

SARTRE

Companion

European Truck
Platooning Challenge



1990

OTTO

KONVOI

Adapted from [An Overview on Approaches](#)

ENSEMBLE: Facts & Figures

- 
- TNO:** coordination and technical work:
 - **The European truck manufacturers:**
DAF, DAIMLER Truck, IVECO, MAN, SCANIA, VOLVO Group (Volvo trucks and Renault trucks)
 - **The European suppliers**
CLEPA
 - **Suppliers:**
Bosch, Brembo, Continental, NXP, ZF
 - **ERTICO:**
Link to the European Truck Platooning Community.
 - **Knowledge partners:**
IDIADA, Université Gustave Eiffel, KTH, VU Brussel.

- Innovation Action no. 769115
- 4 year EU project (June 2018 – March 2022)
- 20 million EUR EC funding
- 19 partners representing the full value chain of the automotive sector

Objectives of the project



Pave the way for the adoption of multi-brand truck platooning in Europe

- ✓ Standardization of multi-brand specifications
- ✓ Implementing platooning in differently branded trucks
- ✓ Demonstrating under real world traffic conditions
- ✓ Assessing impacts

Success!



Support VS Autonomous function



Platooning as Support Function (PSF)	Platooning as Autonomous Function (PAF)
Lead truck driver responsible for driving task	Lead truck driver responsible for driving task
Following truck driver responsible for driving task	Following truck driver NOT responsible
Longitudinal support	Both longitudinal and lateral control
Time gap ~ 1.5 s	Time gap ~ 0.3 to 1.2 s
Quick deployment on road	Limited ODD
HOW the function should work	What the function should DO
Improved safety and traffic flow	Improved driver productivity. Improved fuel efficiency

Implementation of PSF

1. Reference implementation
 - Tested and verified HIL simulator
2. OEM specific implementations
 - Equipping the trucks
 - Mono-brand testing
3. Dual/triple/quadruple-brand testing
4. Multi-brand testing



Platooning Support Function (PSF)



State-of-the-art: ACC and AEBS

Normal driving ($\text{acc.} < 3.5 \text{ m/s}^2$): automatic distance & speed control

- ACC
- (only) uses vehicle sensors, e.g. radar

ENSEMBLE's PSF

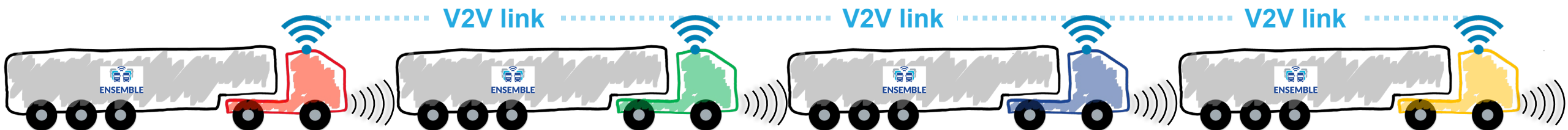
*safer
following*

- ACC + **V2V**
- faster reactions
- improved string stability

Emergency braking ($\text{acc.} > 3.5 \text{ m/s}^2$): warn driver & automatic braking to mitigate collision

- AEBS
- radar needs $\sim 0.5 \text{ s}$ to detect event

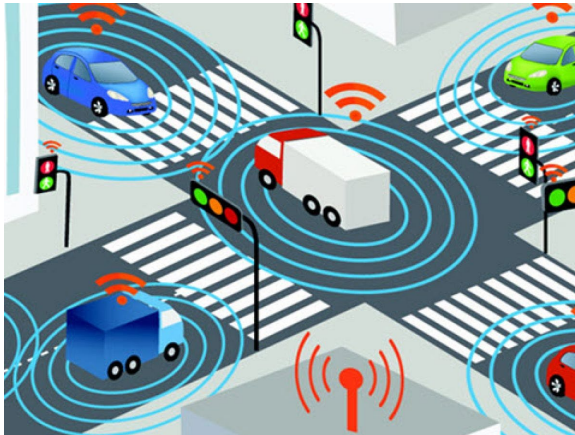
- AEBS + **V2V**
- almost instant warning



C-ITS vs ENSEMBLE platooning

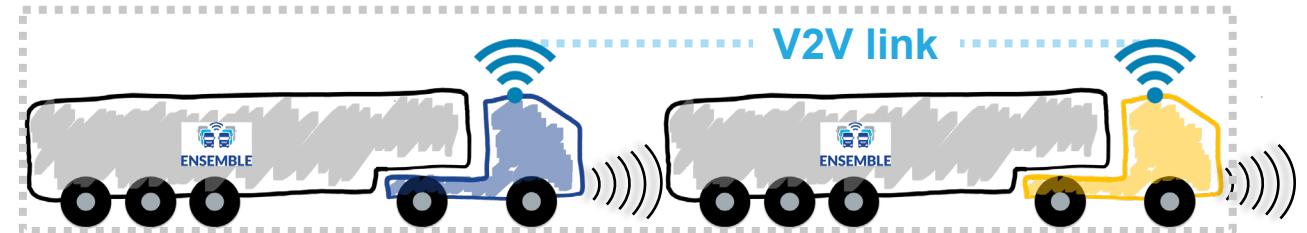


C-ITS



- Vehicles share behaviour with the entire traffic
- Standard messages
- No encryption
- Limited frequency of messages
- **Focus: cooperative awareness**

ENSEMBLE platooning



- Separate entity in the (C-ITS) traffic consisting of vehicles connected with each other
- Standard + **new** messages created for ENSEMBLE Platooning
- Encryption
- High Frequency messages
- **Focus: Safety/Short time gaps/Automation**

Platooning Autonomous Function (PAF)



- Responsibilities:
 - First truck driver:
 - Safety of own vehicle
 - Bringing the platoon to destination (mission)
 - Respecting traffic rules for entire platoon
 - Following trucks system (driverless):
 - Safety of the ego vehicle =
Obstacle detection, collision avoidance
- ODD = Hub to Hub
 - Split of the platoon needs to be avoided
 - If needed: following trucks will stop themselves in a safe way



Reducing the time gap in a safe way (PAF)

- Time gap between 0.3 s and 1.2 s
- Brake performance estimation!
 - Brake status (temperature/wear/brake force)
 - Tyres (type/wear/pressure)
 - Load (axle loads, weight)
 - Road surface type
 - Road conditions (dry/wet/damp/snow/ice)

} Predict and adapt time gap



ENSEMBLE contribution to standardization



- The **platooning protocol** support both the PSF and the PAF
- **New** platooning communication protocol fitting in already existing ecosystem of ITS protocols
- Contributed to ISO/CD 4272 "Intelligent transport systems — Truck platooning systems (TPS) — Functional and operational requirements"
- Contributed to ETSI TR 103 298 "Intelligent Transport Systems (ITS); Platooning; Pre-standardization study"

ISO/CD 4272

Bibliography

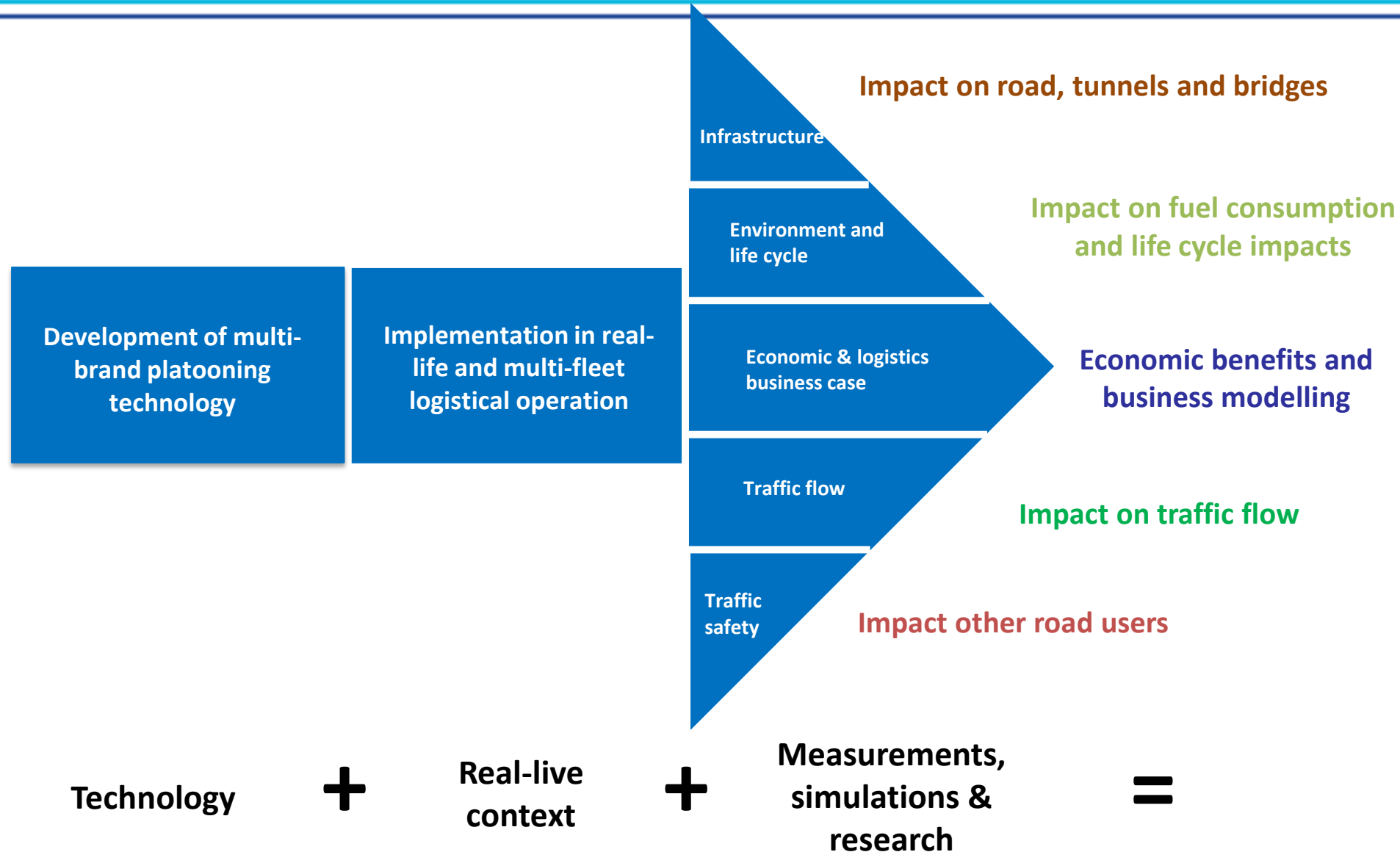
- [1] COMPANION D3.1; Component Specifications for the Overall Architecture
- [2] ENSEMBLE D2.3; V2 Platooning use cases, scenario definition and Platooning Levels
- [3] ENSEMBLE D2.5; Final Version Functional specification for white-label truck
- [4] ENSEMBLE D2.6; Functional specification for services - Strategic and Services Layer
- [5] ENSEMBLE D2.8; Platooning protocol
- [6] ETSI TR 103 298; Intelligent Transport Systems (ITS); Platooning; Pre-standardization study

ETSI TR 103 298 V0.0.4 (2019-01)



Intelligent Transport Systems (ITS);
Platooning;
Pre-standardization study

Towards impacts of multi-brand platooning





Thank you for your attention



ENSEMBLE

platooningensemble.eu

Consortium leader
Marika.hoedemaeker@tno.nl