

FFI Fordonsstrategisk
Forskning och
Innovation



Sweden 4 Platooning TSAF Result conference 2020-09-16



Jan Dellrud, Scania
Project Manager of S4P

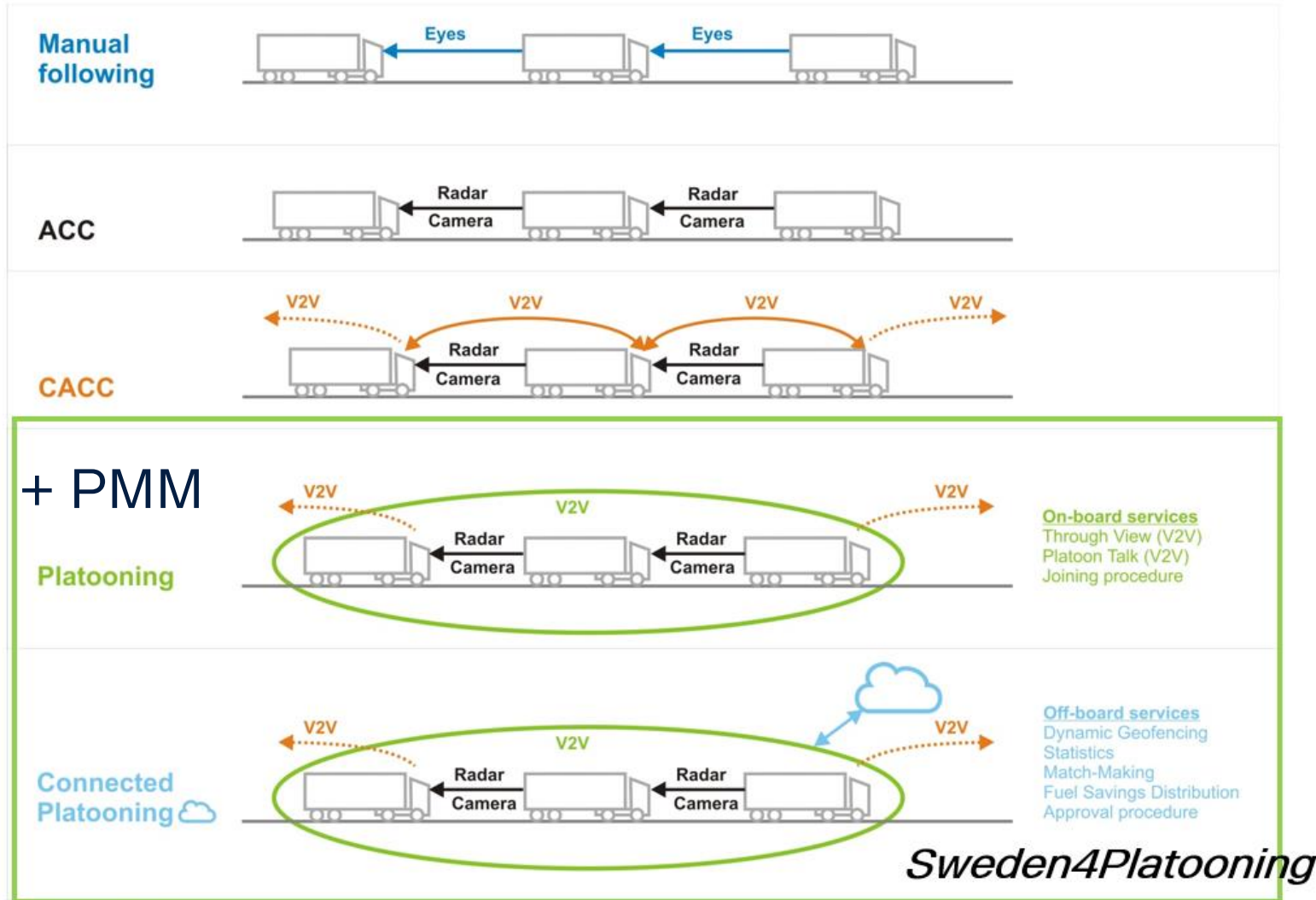
Presentation agenda

- What is platooning?
- Why Platooning
- Why Multi Brand Platooning
- Project Facts
- Sweden4Platooning Project Video

Platooning variants

What is platooning?

- A train on rubber tyres hooked up with an electronic tow bar
- Wireless communication directly between vehicles to exchange status information
- First vehicle driven manually, following vehicles automatically controlled longitudinally or both longitudinally and laterally



CAM: Cooperative Awareness Message

PMM: Platooning Management Message

Why Platooning

- Improve safety
- Improve traffic flow / road capacity
- Improve fuel economy & reduce CO2
- Improve transport efficiency by platooning with fully automated follower trucks (driver in the first vehicle only)
- The driverless following vehicles will have efficient and safe monitoring by a operator: The driver in the lead truck!
- Paving the way for driverless heavy vehicles on public roads





Why Multi Brand Platooning

- Transport companies fleet is of mixed brands
- Increases platooning impact



Project Facts: the project

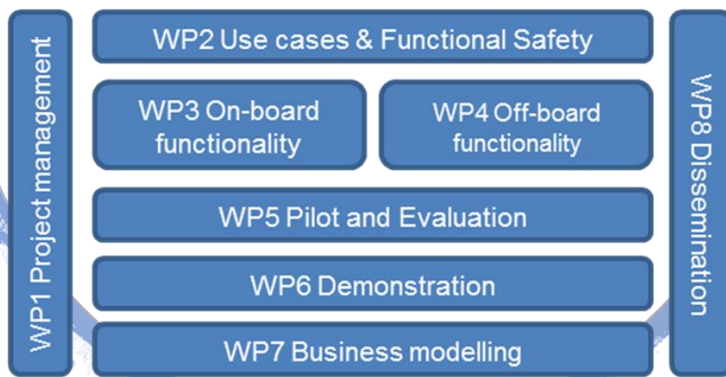
3 year project:

2017-01-01 to 2019-12-31

(EUTS part prolonged to 2020-12-31, KTH performing research)

- A joint project between 6 partners
 - Volvo Technology Corporation
 - Scania CV AB
 - DB Schenker AB
 - RISE ICT
 - KTH (Royal Institute of Technology)
 - Trafikverket (Swedish Transport Administration)
- Budget: 39 MSEK of which 18 MSEK was funded by FFI
 - Split between 2 programs
 - TSAF Traffic Safety and Automated Vehicles 4.6 MSEK
 - EUTS Efficient Connected Transport Systems 13.4 MSEK





Project Facts: S4P way of working

8 work packages addressing different aspects of platooning:

- WP1 Project Management
- WP2 Use cases and functional safety
 - Define the overall use case scenarios, e.g., activation, join, leave, maintain, dissolve platoon
 - driver <-> driver and driver<->system interactions
 - Functional safety aspects of platooning
 - Hazard analysis of system-of-system
- WP3 On-board functionality
 - Communication hardware/software, minimum performance requirements, user interface
- WP4 Off-board functionality
 - Investigating when/where/how platooning should be performed
- WP5 Pilot and evaluation of CACC
- WP6 Demonstration of platooning
- WP7 Business modelling
- WP8 Dissemination
 - Standardization, publishing of research results in journals and at conferences, workshops

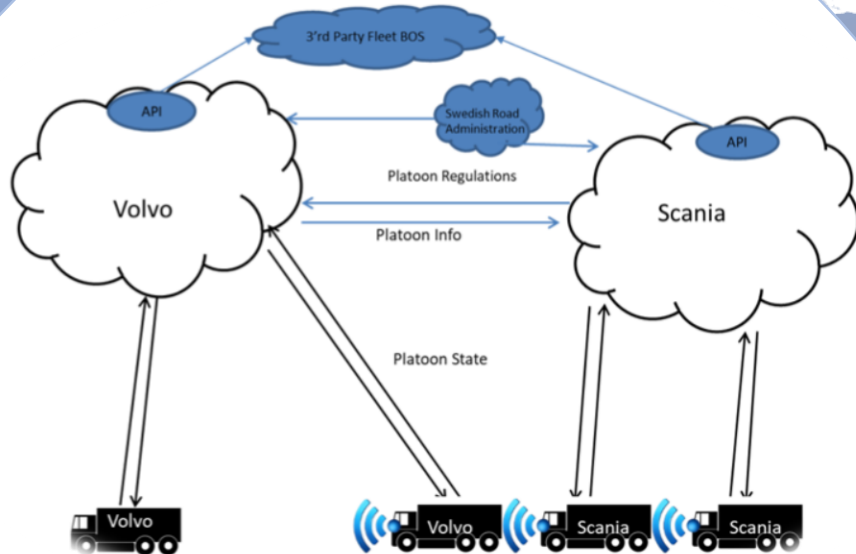


The cooperation between all partners was excellent!



Project Facts: results, main achievements

- The project has performed a pilot study where a transport company (Nordanå Transport AB) transported freight on public roads (Malmö-Jönköping) with cooperative longitudinal controlled vehicles, one Volvo and one Scania.
- The S4P V2V communication protocol has been handed over to the EU project ENSEMBLE. (All European truck brands develops and performs multi brand platooning tests)
- Cloud based services and business models for Platooning (still under progress).



"Truck Platooning Business Case Analysis"

J. Axelsson, T. Bergh, A. Johansson, B. Mårdberg, P. Svenson, V. Åkesson,
RISE Technical report 2020.
DOI: 10.23699/p0g2-te75

Project Facts: results, main achievements

- Business models analysis: Article "Truck Platooning Business Case Analysis"
- Demonstration of dual brand semi-autonomous platooning, with active driver in the first vehicle only was performed at AstaZero.



Sweden4Platooning

[Link to S4P Final Conference 2020-03-11](#)



[Show the video](#)

A semi-truck with a blue and white trailer is shown on a road. The trailer has a large blue section with white text that reads "SAVING FUEL AND IMPROVING SAFETY". Below this, in smaller white text, it says "A FUTURE TRANSPORT CHOICE BY VOLVO". The truck is moving towards the right. In the background, another semi-truck is visible, and there are streetlights. The overall scene is slightly dimmed, suggesting an overcast day or a video frame with a dark overlay.

Thank you for listening!

Project Facts: results, publications

1. S. van de Hoef, "Coordination of Heavy-Duty Vehicle Platooning" (PhD dissertation). Retrieved from <http://urn.kb.se/resolve?urn=urn:nbn:se:kth:diva-225109>
2. S. Van De Hoef, J. Mårtensson, D. V. Dimarogonas, and K. H. Johansson. 2019. "A Predictive Framework for Dynamic Heavy-Duty Vehicle Platoon Coordination". ACM Transactions on Cyber-Physical Systems. Vol 4, nr 1, Nov 2019. DOI: <https://doi.org/10.1145/3299110>
3. J. Axelsson and A. Kobetski, "Towards a risk analysis method for systems-of-systems based on systems thinking," 2018 Annual IEEE International Systems Conference (SysCon), Vancouver, BC, Canada, 2018, pp. 300-307. doi: 10.1109/SYSCON.2018.8369501.
4. J. Axelsson, "An initial analysis of operational emergent properties in a platooning system-of-systems," 2018 Annual IEEE International Systems Conference (SysCon), Vancouver, BC, Canada, 2018, pp. 308-315. doi: 10.1109/SYSCON.2018.8369506.
5. A. Johansson and J. Mårtensson, "Game Theoretic Models for Profit-Sharing in Multi-fleet Platoons," 2019 IEEE Intelligent Transportation Systems Conference (ITSC), Auckland, New Zealand, 2019, pp. 3019-3024, DOI: 10.1109/ITSC.2019.8917349
4. A. Johansson, E. Nekouei, K. H. Johansson, and J. Mårtensson, "Multi-fleet platoon matching: A game-theoretic approach," 2018 21st International Conference on Intelligent Transportation Systems (ITSC), pp. 2980–2985, Nov 2018, DOI: 10.1109/ITSC.2018.8569379
6. J. Axelsson, "Business Models and Roles for Mediating Services in a Truck Platooning System-of-Systems," in IEEE Systems of Systems Conference, Orlando, Florida, 2019, pp. 113–118. DOI: 10.1109/SYSESE.2019.8753887
7. J. Axelsson, T. Bergh, A. Johansson, B. Mårdberg, P. Svenson, V. Åkesson, "Truck Platooning Business Case Analysis", RISE Technical report 2020. DOI: 10.23699/p0g2-te75
8. A. Johansson, V. Turri, E. Nekouei, K. H. Johansson, and J. Mårtensson, "Truck Platoon Formation at Hubs: An Optimal Release Time Rule" submitted to IFAC 2020. Berlin 2020.
9. A. Johansson, E. Nekouei, K. H. Johansson, and J. Mårtensson, "Strategic Hub-Based Platoon Coordination Under Uncertain Traveling Times" submitted to IEEE Transactions on Intelligent Transportation Systems.
10. M. El-Hawwary and J. Mårtensson, "Distributing Potential Games on Graphs Part I. Game formulation" submitted to IFAC 2020. Berlin 2020.
11. M. El-Hawwary and J. Mårtensson, "Distributing Potential Games on Graphs Part II. Learning with application to platoon matching" submitted to IFAC 2020. Berlin 2020.
12. J Dellrud, "Final Report TSAF Sweden4Platooning 2020-01-30_eng". Uploaded to the VINNOVA portal and made public there.