Chapter 1
Connecting Austria Project Outline

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Abstract In 2017, the core team of the Connecting Austria project faced the challenge of leveraging previous research results on cooperative intelligent transport systems (C-ITS) into the logistics domain—namely into the domain of truck platooning. Quite a lot of ideas and topics were evaluated, potential research partners explored, and funding opportunities for a cooperative research project were assessed. The window-of-opportunity opened in 2017 when the Federal Ministry on Transport, Innovation and Technology started a tender for a flagship research project on automated driving in different domains. This was the start of "Connecting Austria". The following paragraphs outline the project in a nutshell, the project objectives, technology domains targeted and the planned test procedure, use cases and finally sketch the challenges and international uniqueness of the Connecting Austria project.

Keywords Platooning use cases · C-ITS (cooperative intelligent transport systems)

1.1 Connecting Austria in a Nutshell

The flagship project Connecting Austria brings technology leaders and end-users together to demonstrate and evaluate four specific use cases for semi-automated and energy-efficient truck platoons. Key objectives is the evidence-based evaluation of energy-efficient truck platoons as a prerequisite for competitive strength of Aus-

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trian industries such as logistics, telematics and infrastructure providers, automotive suppliers, as well as vehicle development and cooperative research.

The national flagship project's unique contribution is its specific focus on infrastructure issues and on parametrised traffic perspectives when evaluating energy-efficient and semi-autonomous truck platoons. This particularly includes platoons at intersections before entering motorways and after leaving motorways.

Connecting Austria defines a truck platoon as follows: The platoon consists of two to maximum three trucks, the automation level is SAE-L1 or SAE-L2, every truck is led by a truck driver with always keeping his hands on the wheel, and the distance between the trucks for several impact analysis is about 15 m.

Connecting Austria leverages Austrian strategic strengths as pioneer in C-ITS infrastructure and continues international success stories such as ECo-AT (Austrian part of the C-ITS Corridor), coordination activities in C-Roads, as well as the pioneering role in vehicle expertise (European Green Car Initiative, electric power train in trucks). Connecting Austria is going to share its findings with European and international "Cooperative Connected and Automated" projects and initiatives (EU, DG MOVE, DG CONNECT).

Project data:

- Duration: 36 months.
- Project start: 01/01/2018.
- Project budget: 4.3 MEuro.
- Project funding (bmvit): 2.5 MEuro.
- Web: www.connecting-austria.at.
- Project Leader: Dr. Wolfgang Schildorfer.

1.2 Connecting Austria's Objectives

Key objective of the project was defined as the evidence-based evaluation of energy-efficient truck platoons as a prerequisite for competitive strength of Austrian industries such as logistics, telematics and infrastructure providers, automotive suppliers, as well as vehicle development and cooperative research.

Further objectives were defined in the project proposal as follows:

- Regarding technological targets, the feasibility and limits of energy-efficient, semi-automated and connected truck platoons in ASFINAG's road network between Hallein via Linz/Pasching to Vienna and selected streets with traffic lights and intersections will be validated.
- The commercial freight traffic target is the validation of energy savings of 15% reported by truck manufacturers in case of changing from Adaptive Cruise Control – ACC (distance of about 50 m) to semi-automated and energy-efficient truck platoons (distance of about 15 m) and the validation of the total costs of the change.

- Regarding climate and sustainability targets, Connecting Austria aims at delivering evidence-based simulations and projections of the effects of energy-efficient and semi-automated platoons on the whole traffic infrastructure including all participants on the road and including future electric power train developments.
- The economic target is defined to give a quality-proven answer to the key question for a national flagship project: How can Connecting Austria strengthen the competitiveness of one or more commercial sectors (shippers, logistics, telematics, automotive suppliers, vehicle development and cooperation research) and improve the competence of research-intensive organisations, including the horizontal and vertical integration of the value chain?
- The organisational target is defined to identify necessary measures for the implementation of truck platoons in Austria.
- Concerning road safety targets, methods and tools that evaluate road safety of semi-automated truck platoons have to be developed. Is it possible to improve road safety with cooperative control strategies?
- With regard to traffic optimisation, it will be evaluated if cooperative vehicle and traffic control strategies have positive effects on the traffic, e.g. improved traffic efficiency, prevention of traffic jams. Connecting Austria will answer this question and provide a decision base for traffic planning.
- An additional target is to spread project results out into the public. Questions on innovation politics, ethics, governance, road safety and IT security will be discussed in the context of automated driving.

1.3 Technology Domains of Connecting Austria and the Planned Testing Procedure

The project's focus in the proposal was on three technology domains:

- Sensor technology.
- Control strategies for vehicles and infrastructure.
- Data exchange technology.

Sensor Technology is the key component regarding automated driving and truck platoons. In the project, the infrastructure-based sensor technology and data exchange are in the focus of research. A mix of sensor types should detect traffic participants that are not connected and in danger (e.g. pedestrians and motorcyclists) predict their behaviour. This functionality is crucial to safely drive a truck platoon across an intersection, ensuring the safety of all involved traffic participants.

Control strategies for vehicles and infrastructure are necessary to form a truck platoon, to maintain it and to go back to a regular transport mode. From an infrastructure perspective, criteria such as traffic situation, city, countryside or motorway are the basis for the decision if a platoon can be formed or has to be dissolved in a specific area. In the vehicle, sensor data coming from the infrastructure will be connected with data coming from the vehicle to evaluate the local circumstances in short feedback circles. Consequently, it can be determined if the platoon will be set up autonomously, maintained, or dissolved.

Data exchange is the third essential element for the infrastructure- and vehicle-based management of truck platoons. Based on ITS-G5 technology and the Europe-wide harmonised message set, data elements (e.g. platoon permission from a to b) are exchanged between vehicles (V2V) and infrastructure (V2I) (C-ITS Day2 Use Case—Cooperative Platooning).

1.4 Connecting Austria Use Cases

Four use cases were defined for the core research work in Connecting Austria. Those use cases were the guiding principle for the whole project: (1) Trucks entering the motorway and forming a platoon, (2) truck platoon approaching a hazardous location, (3) truck platoon leaving the motorway and (4) truck platoon crossing an intersection. The following paragraphs outline the four use cases including a basic scenario description:

1.4.1 Use Case 1: Trucks Entering the Motorway

Scenario: Three trucks drive form the shipping point to the motorway. The trucks are informed by a road side unit, if it is suitable and permitted to form a platoon in this specific motorway section. Criteria for such adaptive permissions are, for example, traffic situation or the environmental status. The trucks form a platoon and transmit the information about the platoon's status via on-board unit, compare Fig. 1.1.

1.4.2 Use Case 2: Truck Platoon Approaching a Hazardous Location

Scenario: Three trucks have formed a platoon and approach a hazardous location. The road-side unit requests them to dissolve the platoon. The hazardous location (e.g. road works) does not allow any platoon for a certain period of time. The trucks dissolve the platoon and transmit the information about the platoon's status, compare Fig. 1.2.

1.4.3 Use Case 3: Truck Platoon Leaving the Motorway

Scenario: A platoon consisting of three trucks approaches the exit of the motorway. One truck intends to leave the motorway, and the others continue driving on the motorway. The trucks get the information via the road-side unit to dissolve the platoon when leaving. Consequently, they dissolve the platoon and one truck leaves the motorway while the other two trucks remain on the motorway, compare Fig. 1.3.

1.4.4 Use Case 4: Truck Platoon Crossing an Intersection

Scenario: A platoon consisting of three trucks drives on the road approaching an intersection with traffic lights for pedestrians, prioritised public transport and other traffic participants. The platoon transmits information about its status and its intention, respectively, via an on-board unit. Based on criteria like daytime, presence of pedestrians, prioritisation of public transport or traffic situation, the road-side unit transmits information to the platoon on how to cross the intersection under best possible conditions, either by dissolving, stretching or maintaining the platoon. Compare Fig. 1.4.

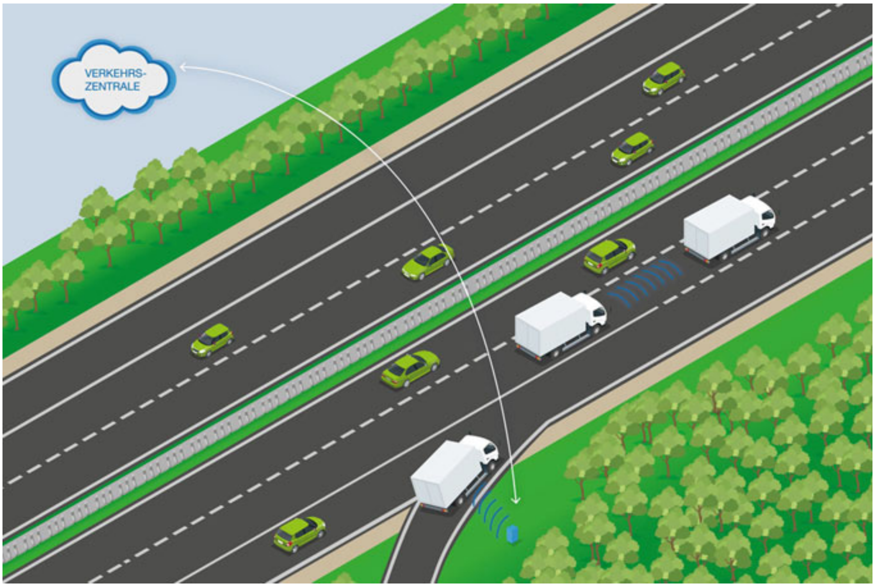

Fig. 1.1 UC1: Trucks entering the motorway. © 2018 Swarco Futurit, reproduced with permission

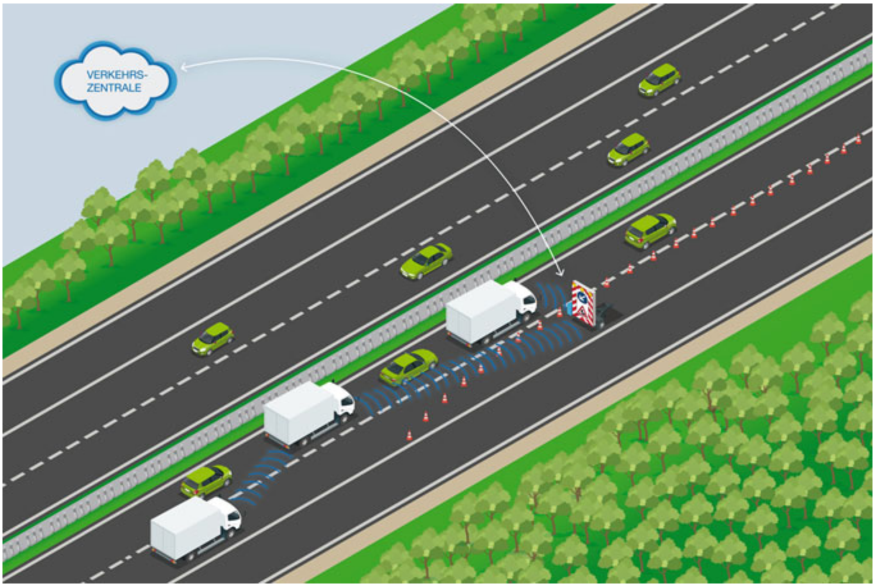

Fig. 1.2 UC2: Truck platoon approaching a hazardous location. © 2018 Swarco Futurit, reproduced with permission

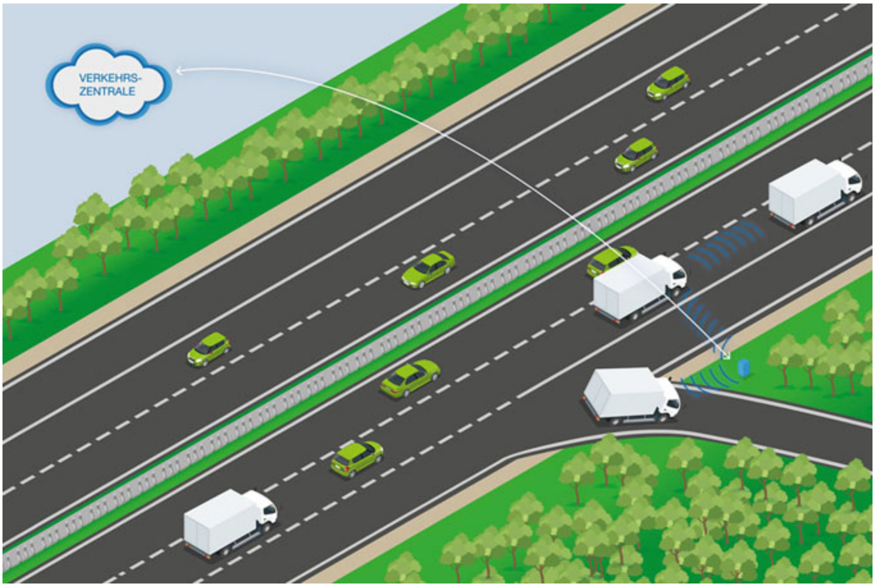

Fig. 1.3 UC3: Truck platoon leaving the motorway. © 2018 Swarco Futurit, reproduced with permission

Fig. 1.4 UC4: Truck platoon crossing an intersection. © 2018 Swarco Futurit, reproduced with permission

1.5 Challenges, International Uniqueness and Discussion

When starting the project in 2017, the main challenge was to answer the following questions. How may Austria, as a small transit country with ambitious climate goals, proactively shape the next technology for energy-efficient and automated freight transport in line with social challenges such as Vision Zero (traffic safety), electro mobility? Furthermore, how may Austria handle the transition to a heterogeneous vehicle population, as well as resolve traffic efficiency challenges, i.e. improved use of existing interurban road infrastructure and increasing goods transport? In addition, the project team asked the question how Austria may strengthen the sustainability skills of a traditionally strong telematics industry (e.g. C-ITS provider or even the Austrian road operator ASFINAG) and the logistics industry.

The above-mentioned challenges were indented to be managed by providing evidence-based answers within the project using a stepwise testing approach, compare Fig. 1.5.

Simulation: Components, subsystems as well as their performance in the entire system including vehicles, traffic and infrastructure factors are tested by complex numeric simulations.

Tests in a closed environment: Vehicle- and infrastructure-based subsystems and their integration are tested with project and cooperation partners in a closed environment.

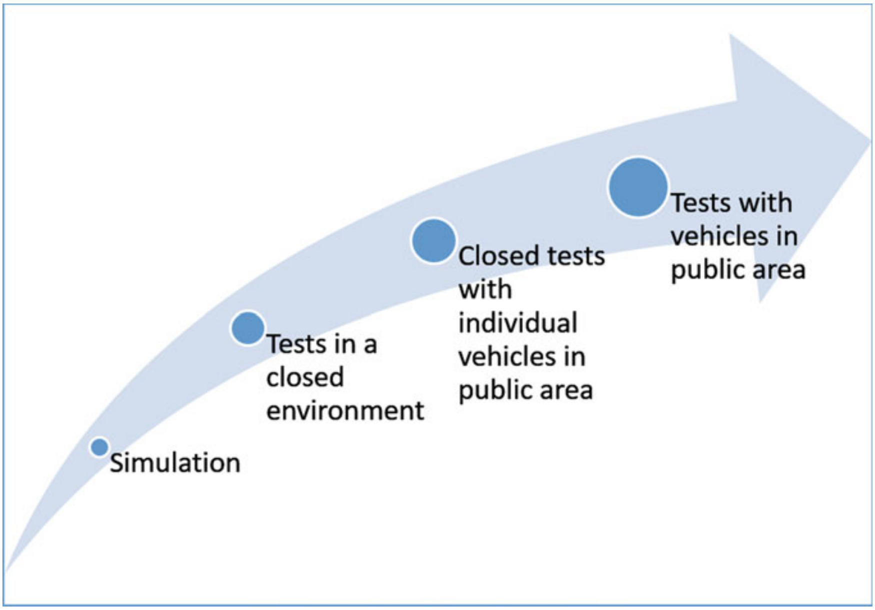

Fig. 1.5 Connecting Austria—planned testing procedure

Closed tests with individual vehicles in public area: Vehicle- and infrastructure-based subsystems and their integration are tested with project and cooperation partners on public roads. The initial plan in Connecting Austria comprised test drives of the fleet operator TRANSDANUBIA carried out without freight due to safety reasons. This is a common approach, which was also applied by the comparable EDDI project in Germany. A prerequisite for tests with freight is the successful accomplishment of test drives without freight.

Tests with vehicles in public areas: Vehicle- and infrastructure-based subsystems and their integration are tested within public testing areas on public roads. The initial plan in Connecting Austria was to integrate truck platoons in real logistics operations together with OEMs such as VOLVO, DAF, MAN, IVECO and DAIMLER. Unfortunately, the legal prerequisites for truck platooning in Austria could not be met within the project duration. However, important preparatory work for legal regulations could be developed within the project as starting point for follow-up projects.

When setting up the project in 2017, it was internationally unique in the special consideration of the intelligent infrastructure and traffic perspective and in the special consideration of investigating an urban truck platooning use case with traffic-light-controlled intersections before and after motorway entrances. The three main target groups of the project were: (1) road operators/infrastructure providers, (2) logistics operators, and (3) C-ITS industry. Especially for those target groups and policymaker, one common topic was the guiding principle—“How can safe truck platooning reduce

CO_2-emissions and how can this help to strengthen the stakeholders' role in their market or political environment?".

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Within the CCAM domain, the infrastructure role for supporting truck platoons was not clear and validated at project start. Connecting Austria investigated this important infrastructure provider role with special focus on C-ITS (ITS-G5) technology to support truck platooning on the Austrian motorways. A main question to be answered was "How can potential benefits with regard to cost savings and CO_2-reduction be positively affected by a dynamic traffic management of a road operator?".

From a logistics domain point of view, the need for innovation arose from demand to meet CO_2 targets and improve efficiency. Connecting Austria provided insights on potential efficiency gains that allow to project efficiency gains for logistics operators.

Finally, the third group—the C-ITS industry—has faced some challenges with regard to CCAM and CO_2-emission reduction. It had not been clear how C-ITS provider can proactively support traffic management in urban areas as well as on motorways to decrease CO_2-emissions with dynamic traffic management tools. Especially for the truck platooning use case, the need for assessing the direct impact of C-ITS-based dynamic traffic management was the motivation for this research project.

This book provides some answers to those above-mentioned challenges as well as interesting truck platooning-related research results. Although, open public testing with SAE-L1 or SAE-L2 truck platoons from different truck OEMs was not possible within the Connecting Austria project, very interesting research results with regard to the impact of C-ITS dynamic traffic management on CO_2-emissions, truck platooning control concepts or traffic safety requirements could be achieved.

Walter Aigner has been a kind of boundary-spanning individual [between pioneering users, public administration, research and various industries] since the early 1990s. As managing director at HiTec he prepared several national and European innovation and technology programmes and serves as an independent expert on evaluation and impact assessment. His focus is on key individuals in the European innovation system and how they nourish our commitment to contributing to a more nuanced answer for Europe's share in a global challenge to effectively cooperate with the US and Asia in a highly competitive environment of innovation, digitalisation and automation.

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Thomas Novak holds a Ph.D. in electrical engineering from the TechnicalUniversity of Vienna. Since 2008, he is with the Austrian company SWARCO FUTURIT. Starting as software project manager and later on as innovation manager, he is now working as portfolio manager. The focus is on the deployment and go2market of CCAM solutions in Europe.

Wolfgang Schildorfer is a person who likes the road he still walks to find new chances. Since October 2018, he has been Professor for Transport Logistics & Mobility at the University of Applied Sciences Upper Austria. His research focus is on innovation, business models and evaluation in transport logistics, smart hyperconnected logistics systems, (urban) mobility, sustainable transport systems and new technology markets (C-ITS, CCAM, automated driving, truck platooning).

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