eCoMove

Cooperative Mobility Systems and Services for Energy Efficiency

D2.1	**System concept, functionality, requirements and use case description**

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Abstract	The eCoMove project is targeting at reducing fuel consumption and CO_2-emissions with 20% by supporting drivers of both vehicles and trucks to drive more efficient, to plan their routes more efficient and traffic managers to manage traffic more efficiently. Information from road side units, traffic management center, ecoMaps and also from other vehicles are exchanged to determine the best route, the most efficient driving strategy and the optimal traffic management and control strategy and settings. This document is the first deliverable of the Core technology & integration sub project (SP2) and describes the results of the work package 2 activities on use cases, requirements and system concept definition. This deliverable describes an integrated view of how the application subprojects ecoSmartDriving (SP3), ecoFreight&Logistics (SP4) and ecoTrafficManagement&Control (SP5) are working together to realise a cooperative eCoMove system. As a starting point the approach that is used for the WP2 activities is described. In this approach first stakeholders and users for the eCoMove applications have been identified and their main needs have been collected. Based on this, the development of the use cases started. In parallel, the inefficiencies that occur in the current situation have been analysed. The inefficiencies that are targeted by the eCoMove project can be divided into pre-trip and on-trip related inefficiencies. Post-trip no inefficiencies have been identified, since the post-trip phase concentrates on analysing the inefficiencies that have occurred pre-trip and on-trip. The use cases that have been defined in the application sub projects are analysed in more detail in this document on how the interact with each other, which type of information is exchanged between them, what level of cooperativeness they require / can profit from and to which inefficiencies they relate. In the system concept description an overview of given of how the different subsystems work together to realise a cooperative eCoMove system. Also the shared subsystems, components, databases and their interfaces have been identified and described: the eCoMove communication platform, the ecoSituational and ecoStrategic models and the ecoMap. Finally the requirements to these shared subsystems, components and databases as well as the interface requirements have been identified.

Control sheet

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TERMS AND ABBREVIATIONS

For the duration of the project also a common Terminology document has been setup where all terms and definition that are used within the project duration are listed. This will be a living document. Definitions on these pages reflect the definitions used for this document and are not necessarily the same for the next phases of the project.

Abbreviation	**Definition**
CAM	Cooperative Awareness Message
DENM	Decentralised Environmental Notification Message
DoW	Description of Work
ecoFVD	eco Floating Vehicle Data
ecoTSD	eco Traffic Situation Data
I2V	Infrastructure to Vehicle communication
ICT	Information and Communication Technologies
ITS	Intelligent transport systems
NGO	Non Governmental Organisation
OBD	On-board Diagnostics
RQ	Requirement
UC	Use Case
V2V	Vehicle to Vehicle communication
V2I	Vehicle to Infrastructure communication
WLAN	Wireless Local Area Network

Term	**Definition**
ecoSituational Model	this model has the task to describe the current driving situation and to provide the relevant information with regard to fuel consumption such as speed limit, inclination etc. Additionally the ecoSituational model predicts how the situation will evolve in different time horizons (100m, 500m, 1000 m etc.). In the DoW several terms have been used for this model, i.e. Situational operation model, situational operational model and ecoSituational model.
ecoStrategic Model	Where the ecoSituational model works on the microscopic level, the ecoStrategic Model translates the knowledge (included in the situational level) about what causes fuel consumption to be high or low to the macroscopic level (a route or a network). The ecoStrategic Model will thus provide information about hot spot events that have a major impact on fuel consumption. In the DoW the ecoStrategic Model was named Strategic model.
Use Case	Description of tasks, situations and scenarios, during the different trip phases, where the eCoMove applications can achieve a CO_2-emission reduction and improved fuel efficiency in driving, including: • Road situations – inefficient situations

	• Traffic situations – inefficient situations • Vehicle state (e.g. load) • User actions (incl. different user perspectives, e.g. driver, planner) • eCoMove System actions – how to reduce the inefficiencies • eCoMove System **inter**actions – how to reduce the inefficiencies This definition does not fit with the use case definition in the FESTA handbook. When taking these definitions into account we are talking about use scenarios in this document (which is also the name of the chapter).
User	Actor that is directly interacting with the eCoMove system(s)
Stakeholder	Actors that are affected by the eCoMove system(s)
User need	User needs are per definition entirely user oriented and are not necessarily consistent. They describe the expectation of the user to the system. The user needs are collected as part of the stakeholder needs.
Stakeholder need	The stakeholder needs describe the expectations of the different stakeholders to the targeted system. Stakeholders include both internal and external stakeholders as well as users.
Requirement	Requirements describe what the eCoMove systems, applications and components should do and in which way they should do this. Requirements are verifiable statements that identify a necessary or desired attribute, capability, characteristic or quality of the eCoMove system in order to make it valuable and useful for the stakeholders. Requirements are deduced from the stakeholder needs and use cases and are used as input to the design and testing phases.
Functionality	Functionalities are a description of the functions that the eCoMove systems and applications should perform / include.
System	A set of interacting or interdependent applications, components and databases forming an integrated whole. A sub-system includes only the parts integrated at the roadside or vehicle. For example: routing of traffic in combination with traffic light control or traffic light control in combination with individual travel information.
Application	An entity that performs an action with direct interaction with a system user. It is a functional entity that is perceived from a user as the implementation of one or more use cases. For example a

traffic light that switches to green, a roadside system that is activated, or a speed or route advice that is send to a vehicle.

Components:	an entity that performs an activity without direct interaction with a system user. Components can be both software and hardware. These are information sources for applications and content providers of databases. For example: estimation and prediction of traffic state and emissions.
Database:	an entity that contains data and does not perform an action or an activity and has no interaction with a system user. They hold geo-referenced historical, real-time, and predicted information. For example energy use in the road network, route patterns in the network and speed averages in the road network.
Process:	a set of interrelating or interacting activities which transforms inputs into outputs.

1. Introduction

This document describes the results of the first phase of the eCoMove research project. It describes the overall, integrated, eCoMove system concept, its functionalities and the requirements the overall system needs to fulfil. Another important part of this deliverable is the description of the use cases that show how the eCoMove system will realise the aimed fuel consumption reduction.

1.1. Purpose of this deliverable and relation to other sub projects

The eCoMove project is split up into six sub projects (see Figure 1). The systems and applications are developed in the sub projects 3, 4 and 5 and integrated in sub project 2. Sub project 6 focuses on validation and evaluation of the eCoMove systems.

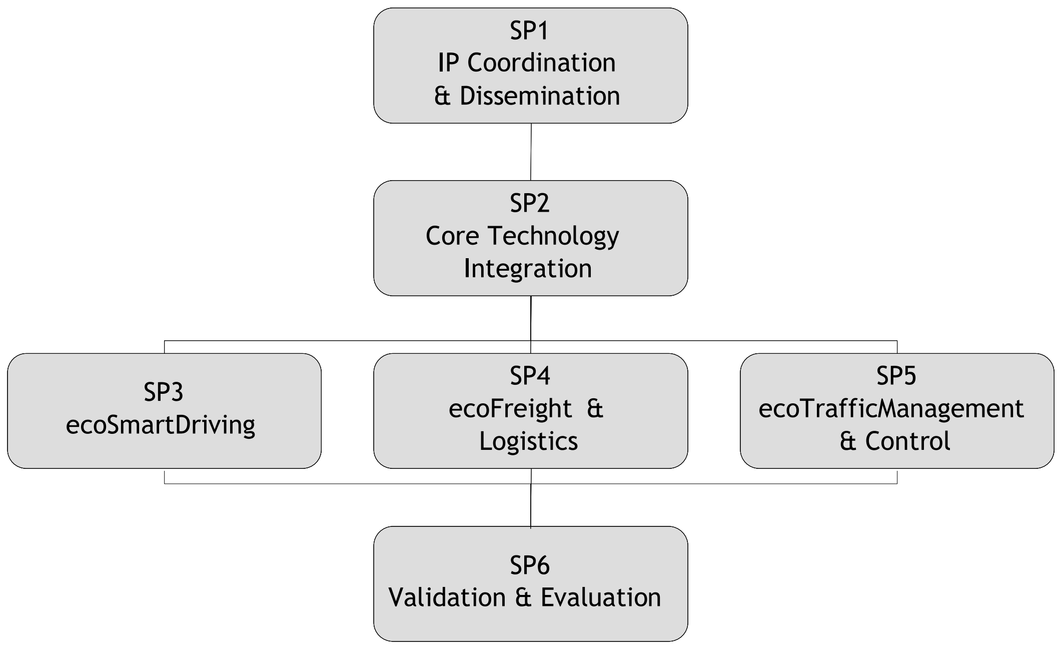

Figure 1: eCoMove sub projects

This document, as first deliverable of the SP2 Core Technology Integration, brings together the results of the work in work package 2 of the applications subprojects (see also D3.1, D4.1 and D5.1 [2]-[4]). The common goal of the WP2 activities is to outline an integrated and shared view on the eCoMove systems and functionalities that is agreed with all partners and subprojects. In this way it is ensured that the individual subprojects will not work on sub-optimised solutions for their application area and maximum CO_2-reduction can be achieved.
The Work Package structure that is used in the eCoMove project is shown in Figure 2. and shows how the WP2 work relates to the other Work Packages and subprojects.

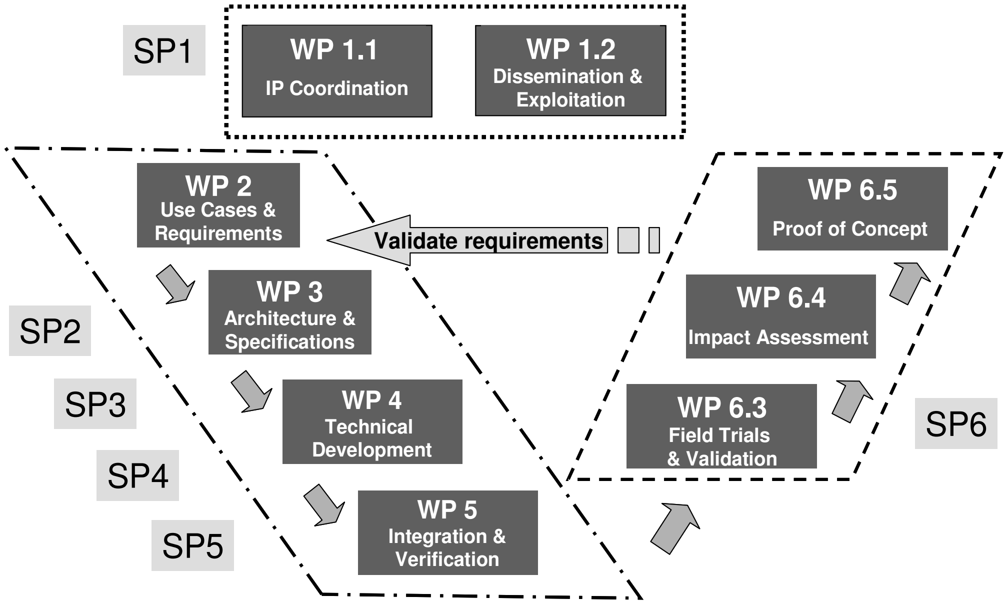

Figure 2: V-model work-flow diagram projected on the eCoMove WP-structure

1.2. Methodology

Within eCoMove the methodology that has been used to develop a common understanding of the eCoMove system concept is shown in the figure below (Figure 3). This scheme shows the relation among User Needs, Use Cases, Functionalities and Requirements, based on the V-model which is used in Software and System Engineering practice.

These are the main basis for the development of the eCoMove applications. Each of the SPs should have a clear view of its contribution to the total eCoMove system and should be aware of its interfaces to the other SPs.

This document will describe the results achieved within the eCoMove Project for the left branch down to the transition to the specifications.

The approach that has been shared among the application subprojects contained the following steps:

- Identification of user needs and stakeholder needs;
- Identification of inefficiencies;
- Definition of use cases;
- Definition of functionalities;
- Definition of system concept;
- Requirements collection.

These steps are described in the sections below. For more details, please look at the M2.1 Use case & requirement guidelines document [1].

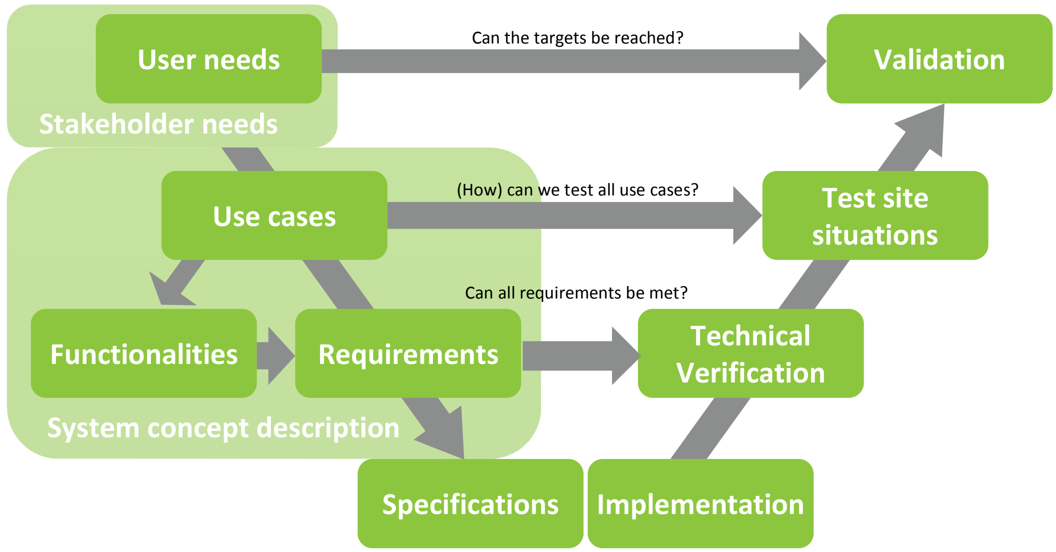

Figure 3: Relation between Stakeholder / User Needs, Use Cases and Requirements (V-model)

1.2.1. User needs and stakeholder needs

User and stakeholder needs are the basis of the development of the eCoMove systems and functionalities.

In this first phase both Stakeholder and User needs will be collected. eCoMove users are those who directly interact with the applications and therefore are within the eCoMove system boundaries. Stakeholders are those actors that are affected by the eCoMove system(s). Examples of stakeholders are cities, NGO's (Non-governmental organisations, like environmental organisations) and are outside the eCoMove system boundaries.

User needs are per definition entirely user oriented and are not necessarily consistent.

1.2.2. Identification of inefficiencies

In the eCoMove project the use case definition step is preceded with an additional step: the identification of the inefficiencies that can be targeted by eCoMove. The inefficiencies form the basis for the use cases.

Since fuel consumption and CO_2-emissions are caused by vehicles, the vehicle perspective is the main perspective for the inefficiencies. Traffic management & control measures influence the way vehicles are driven through the network and therefore indirectly relate to the inefficiencies. In Chapter 4 this approach is described in more detail.

1.2.3. Use case definition

In general the purpose of a use case is to describe and specify the behaviour of a system. Within the eCoMove project it is important that the use cases describe the situation in which a specific system should work and how the system works and interacts with the different users.

The Use Case description in eCoMove should enable the identification of all those tasks, situations and scenarios where the eCoMove applications can contribute to a CO_2-emission reduction and improved fuel efficiency.

1.2.4. Definition of functionalities

Based on the user needs and use cases the eCoMove functionalities can be determined. This step is also a means to identify the scope and system boundaries of the eCoMove system: what is within the focus of the eCoMove project and what is not.
To collect the eCoMove functionalities a Function Tree is used. This is a schematic representation of the main functions and sub functions of a system. Figure 4 could be the high level function tree for the eCoMove system. The function tree is only used within the D3.1, 4.1 and 5.1 to describe the functionalities of the subsystems [2]-[4].

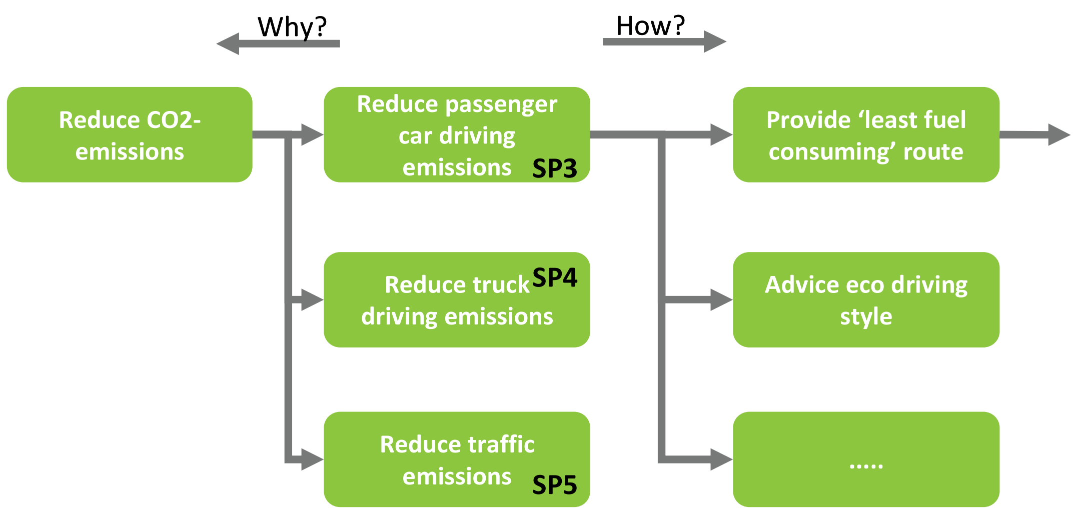

Figure 4: Example of possible high level function tree for eCoMove

1.2.5. Definition of system concept

The system concept creates a common understanding of the total system and the subsystems within the total system.
It includes a description of the system boundaries, the entities (applications & components) and actors within the systems and the users of the systems, as well as the interfaces between the different subsystems.

1.2.6. Requirements collection

Based on the user needs, stakeholder needs, use cases and functional analysis the requirements can be collected.
The requirements should describe what the eCoMove systems, applications and components should do (functional) and in which way they should do this (non-functional). The functional analysis is the main basis for describing the functional requirements where the other items contribute to the definition of the non-functional requirements.

1.3. Reading guide

This deliverable D2.1 should preferably be read in combination with the deliverables D3.1, D4.1 and D5.1. This document is therefore structured in the same way as the D3.1, D4.1 and D5.1 deliverables [2]-[4].
This introduction is followed by Chapter 2 which contains a description of the current situation in which the eCoMove system should become operational.
Chapter 3 summarises the results from the user and stakeholder analysis done in the sub projects 3, 4 and 5 including the main overall user- and stakeholder needs.
Chapter 4 describes the inefficiencies targeted by the eCoMove project and the reasons why these inefficiencies occur in the current situation.
What is needed to tackle these inefficiencies, is subject of Chapter 5, dedicated to the eCoMove innovations.
In chapter 6 an analysis of the Use Scenarios that have been developed in the application subprojects is described.
Chapter 7 then describes the overall eCoMove system concept including the shared core technology components.
Chapter 8 provides the general eCoMove requirements and the requirements for the shared technologies.

The structure of this document is based on the OCD/SSS and IRS documents of the MIL498-standard and also checked with ISO/IEC 15288.

2. Current situation for eCoMove

2.1. Background

The eCoMove project will tackle the problem of energy efficiency in road transport by applying the latest vehicle-to-infrastructure and vehicle-to-vehicle technologies to create an integrated solution comprising cooperative eco-driving support and eco-traffic management. The project will focus on reducing wasted energy with the aim to demonstrate that the combination of these new ICT measures can potentially deliver up to 20% overall fuel savings and CO_2-emission reductions (see Figure 5).

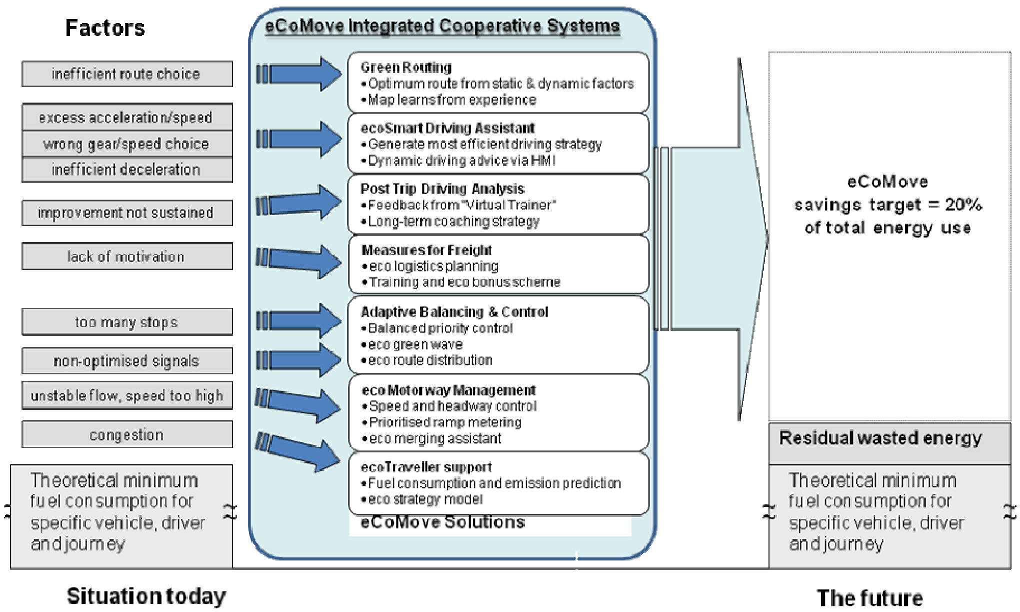

Figure 5: eCoMove contribution to reducing wasted energy

The road transport sector alone is responsible for some 70% of all transport greenhouse gas emissions that in turn make up around 20% of global emissions.
Many studies have been carried out to understand factors which cause waste in fuel consumption in road transport ([6]~[18]). The main estimated contributing factors, which can be targeted by eCoMove, were found to be:

- 22% Inefficient deceleration, lack of anticipation
- 15% Congestion
- 11% Driving too fast
- 11% Inefficient traffic light control
- 11% Poor management of construction sites, traffic incidents.

This analysis shows that these factors can be divided into two main categories:

- Driving behaviour
- Traffic management and control

Energy waste due to driving behaviour can be addressed by eco driving systems including pre-trip planning, real-time eco-driving support and post-trip feedback. That due to inefficient traffic management can be addressed by eco-traffic management. What does "eco" mean in this context? It means simply a specific variant of some ITS measure that is specially configured for improved energy efficiency.

The eCoMove concept is that by exchange of data describing their current state, both the vehicle (and the driver) and the traffic system can benefit from extra information that helps them to perform better and to reduce their energy consumption.

The eCoMove project will develop an eco-cooperative system built around information exchange via advanced V2V (vehicle-to-vehicle) and V2I (vehicle-to-infrastructure and vice versa) communication. Each eCoMove application will use cooperative data exchange in some way, as either originator or recipient. In the system, an individual vehicle equipped with an on-board eco-driving system and communication platform can exchange data with infrastructure and other equipped vehicles. Likewise, an eCoMove roadside traffic management unit will be equipped with a fully compatible communication platform able to exchange data with equipped cars, trucks, etc.

This mutual data exchange is formalised in eCoMove by the definition of a number of eco-messages. eCoMove vehicles transmit an eco Floating Vehicle Data (ecoFVD) message, and receive eco Traffic Situation Data (ecoTSD) messages from infrastructure and ecoFVD messages from other vehicles. The following figure illustrates the concept of the eco cooperative system and key technical components. Note that the eCoMove concept is in principle valid for petrol and diesel engines, hybrid and even electric vehicles, so the eCoMove results can help to improve energy efficiently for all type of engines and vehicles.

The eCoMove solutions are intended to bring major improvements to road vehicle energy use through a set of mainly independent but interacting applications and services.

The ways these would function are illustrated in the scenarios below, showing how eco-cooperative systems might work in real life. The first scenario describes a regular commuter's trip by car, the second a heavy goods vehicle delivering to a city-centre supermarket.

2.2. Objectives

The eCoMove project, and therefore the system that is developed in the project, aims to create an integrated solution for road transport energy efficiency by developing systems and tools to help drivers sustainably eliminate unnecessary fuel consumption (and thus CO_2-emissions), and to help road operators manage traffic in the most energy-efficient way. By applying this combination of cooperative systems using vehicle-to-infrastructure and vehicle-to-vehicle communication, the project aims to reduce fuel consumption and CO_2-emissions by 20% overall.

In addition to the primary goal to reduce fuel consumption and CO_2-emissions, eCoMove also aims to assess how current ITS platform developments can be deployed for achieving the primary goal.

2.3. Fuel efficiency improvement

The eCoMove project will tackle three main causes of avoidable energy use by road vehicles:

- Inefficient trip planning & route choice;
- Inefficient driving performance;
- Inefficient traffic management & control.

To reduce these inefficiencies means finding solutions that help drivers to achieve the lowest possible fuel consumption for a given journey, and at the same time enables the traffic system to balance vehicle movements so that energy consumption is as low as possible for a given demand. In Chapter 4 a more detailed description of the inefficiencies is given.

The eCoMove project aims at reducing the fuel consumption and CO_2-emissions by 20%. To achieve this overall target as average value in Europe, the eCoMove project will develop, test and evaluate[1] ICT tools, systems and services to:

- Help a driver apply the appropriate actions and driving strategy to use the least possible fuel for a journey by finding the "greenest" route, the most economical use of vehicle controls, the best path through surrounding traffic and how to negotiate the next traffic signals with least chance of stopping;
- Improve truck/cargo energy efficiency by introducing a self-learning "driver coaching system" based on incentives for energy efficiency gains, and a cooperative planning/routing system that selects the most economical route for a truck while the traffic system optimises traffic lights to avoid unnecessary stops;
- Allow the traffic system and its manager to adapt traffic signal parameters and apply other traffic measures so that the ensemble of vehicles in the network consumes the least possible energy, while offering an advantage to specific types of vehicle that consume most fuel and to vehicles whose drivers adopt the most energy-efficient behaviour.

While existing systems and measures for eco-driving support (e.g. gear-shift indicator) and eco-traffic management (e.g. adaptive urban traffic control system) are certainly capable of reducing some of this loss of efficiency, new research and development is needed to find solutions that apply ICT to generate a substantial and sustainable impact. Research challenges include the following questions:

- What are the most important factors of driver action and vehicle control that influence instantaneous fuel consumption, and how can they be integrated into a model that provides real-time advice to help a driver to "eco-drive"?
- What are the best ways to present eco-driving advice to a driver and to ensure that economical driving behaviour is sustained in the long term?

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[1] *More specificaly, validation of the functionality of the integrated eCoMove system and evaluation of the impact will be carried out at quoted validation test site by the validation team. Beforehand verification tests of several eCoMove applications (i.e. before integration) will be carried out within the applications Sub-Projects according to respective verification plans.*

- What additional map attributes and content are needed so that a driver can be guided along the most energy-efficient route to his destination?
- What kind of information and guidance would a driver need in order to find the optimum driving strategy with respect to nearby vehicles and traffic lights, and how can they be predicted in the short and medium term?
- What information would an eco-driving assistance system need to receive from the traffic management and control system in order to optimise its advice?
- How are the principles of eco-driving different for a goods vehicle, and how can they be integrated into a self-learning driver coaching system that adapts for each driver of a particular vehicle?
- Are the principles and factors of eco-driving different for fuel, hybrid or electric vehicles?
- What data exchange between a goods vehicle, its back-office fleet management system and the traffic management system would be needed to reduce energy losses due to congestion, vehicle stops at red lights and inefficient route choice, and how could these be integrated into one solution?
- What information would a traffic management system need to receive from vehicles in the road network in order to estimate overall energy consumption, and how could the system be adapted to minimise the consumption?
- What kind of information and guidance sent by the traffic management system to a vehicle would have the most impact in reducing that vehicle's energy consumption, would such a system be feasible in real operation?
- Finally, how far can such "in-vehicle strategies" remain compatible with "traffic system strategies", since mutually influence each other?

2.4. ITS platform deployment and contribution to standardisation

Although the primary goal of eCoMove is to prove that it is feasible to reduce fuel consumption and CO_2-emissions by 20%, eCoMove will also assess how current ITS platform developments can be used for eCoMove deployment.

The project will use V2V and V2I communication to enable new kinds of interaction between vehicles, and between vehicles and infrastructure. eCoMove applications will calculate the most efficient route, driving strategy and traffic control strategies. They will then provide support to follow the route and advise on the most economic driving style. This V2V /V2I platform consists of both hardware and software and will be based on related projects developments such as CVIS, SAFESPOT, COOPERS, GeoNet, PRE-DRIVE C2X, COMeSafety, SIM-TD, C2C-CC demonstration etc. All available V2V / V2I hardware and software will be evaluated and the most appropriate ones will be selected based on technical requirements from the application SPs (this will be done in within Work package 4 of the Subproject 2 Core technology integration). The selected hardware and software will further be improved to fulfill the requirements and will be compliant with the latest standards developed by ETSI TC ITS.

The ITS communications architecture (ETSI EN 302 665), the standardised message for exchanging data between vehicles, the Cooperative Awareness Message or CAM (ETSI TS 102 637-2), and the standardised message for broadcasting useful

information on road traffic conditions, the so called Decentralised Environmental Notification Message or DENM (ETSI TS 102 637-3) are used as a basis for the cooperative applications in the eCoMove project.
And in this way the eCoMove project can both contribute to assess these standards for eCoMove deployment and to provide feedback how these standards could be extended for environment related purposes.

2.5. Scope

The idea behind the eCoMove project is that, for a given trip in a particular vehicle, there is a theoretical minimum energy consumption that could be achieved by the "perfect eco-driver" travelling through the "perfectly eco-managed" road network (see Figure 6). In current situation, both drivers and traffic management system fall short of the ideal, and much energy is wasted and CO_2 emitted unnecessarily.
However, information and communication technologies (ICT) have the potential to target this avoidable energy consumption ***without impairing the quality of mobility of people and goods***. Thus any type of demand management measure is not included amongst the measures presented.

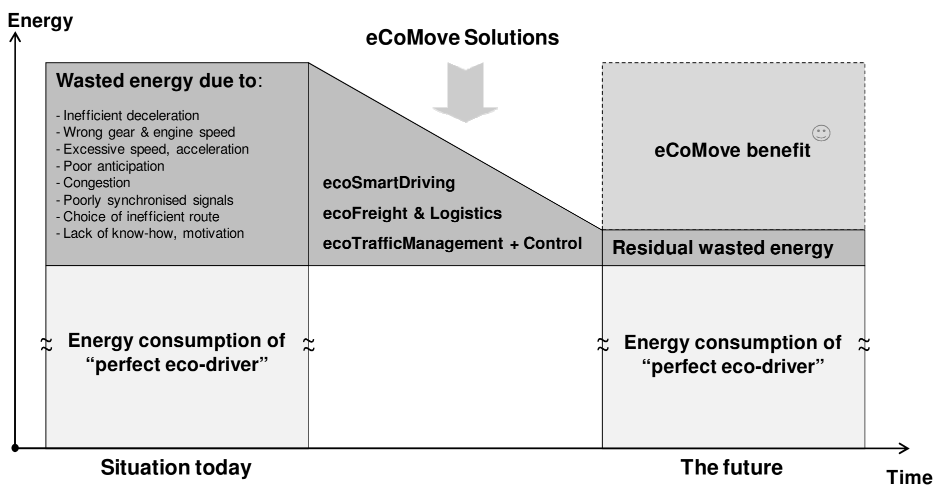


Figure 6: The eCoMove vision

For passenger cars this means that the eCoMove project will develop applications that assume that the trip and the vehicle as such are a given and therefore does not aim to influence the trip choice as such (except from proposing an advantageous start time) or the selected vehicle. However, the applications that will be developed for passenger cars will focus on how a given trip in a given vehicle can be made in the least fuel consuming way. This means that applications will be developed that help the driver to plan his trip better by e.g. providing a route with least fuel consumption, and once on the road to drive as fuel efficient as possible. Next to optimising primary driving tasks this also means helping the driver to optimise the vehicle condition, like tire pressure, unnecessary loading and to manage the use of on-board energy consumers.

For freight / logistics the eCoMove perspective does not question the requested goods transport as such, but aims to optimise the way this transport is organised from planning stage to the way the driver is driving. This means that for example a different trailer-truck combination, a different loading or an alternative route can be proposed, as well as on-trip driver coaching to reduce fuel once the route has been determined. So also for freight & logistics the applications will be aimed at planning the least fuel consuming transport and once the driver is on the road how he / she can drive in the most fuel efficient way.

The ecoTraffic Management and Control measures that will be developed within eCoMove are based on the assumption of fixed traffic demand including the time of travel. Therefore topics like demand management, road pricing and multi-modal travelling are out of the scope of this project. Clearly less vehicles means less fuel consumption, but the primary aim of the ecoTraffic Management and Control subproject is to reduce fuel consumption based on the current traffic situation. Two approaches have been identified in this sub-project to reduce fuel consumption. One approach aims to improve the operation of traffic systems like traffic lights and ramp metering installations in a way that is more fuel efficient. The other approach aims to provide vehicles and drivers with roadside information and tailored advices that enable them to improve driving behaviour, and to then provide feedback to show how effective that measure was in that particular situation

2.6. Limitations and constraints in the current situation

Besides the limitation that eCoMove does not want to influence the mobility demand another important constraint of the eCoMove project is that it is not targeted to automatically control the vehicle. ***The impact of the eCoMove project should be achieved by influencing the driver and to help him/her change his/her driving behaviour and provide support for secondary driving tasks (e.g. routing).*** This means that solutions that contain autonomous driving or autonomous platooning are outside the project scope and will not be included.

Above all traffic safety has to be preserved at all times. Many systems seen as measures to improve accessibility are in fact safety systems, for example traffic lights or variable message signs with incident detection.

Another important limitation for the project is that it will not be possible to change the road network as such within the scope of the project.

Last but not least, mobility is acknowledged as a common good. From that perspective measures in favour of fuel savings have to be realistic. That means they have to be acceptable for vehicle drivers, demanded by authorities and aligned with other objectives that are important for stakeholders involved.

Although the eCoMove project is a research project and does not aim to have a sellable product at the end of the run-time, it is important that proposed solutions have a certain degree of technical and economical feasibility.

2.7. Description of the situation today

In the picture (Figure 7) below the situation today in which the eCoMove system is meant to be implemented is shown: vehicles, both trucks and passenger cars, are moving around in a road network that is monitored by traffic control centres through sensors of several types like loops, cameras and probe vehicle monitoring (Floating Vehicle Data FVD). Most modern vehicles in EU are able to receive real time traffic information via broadcast or mobile communication and have navigation units on board (either build-in or nomadic devices) that help the driver to find his / her way.

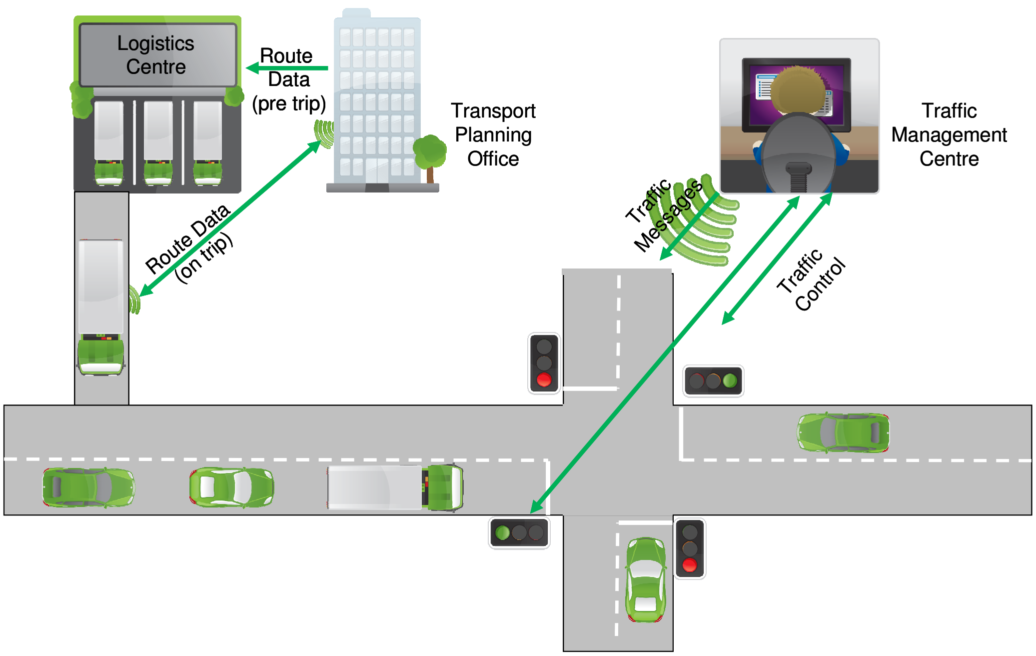


Figure 7: Current situation

In the current situation vehicles do not have the ability to communicate to other vehicles or to road side units or other infrastructure components in an intelligent way. Existing eco-traffic management (e.g. adaptive urban traffic control system) are therefore only able to reduce some of the inefficiencies.

New vehicles are already nowadays equipped with technical means that help the driver to choose the right gear (gear shift indicators), greenest route or even to give the driver feedback on his driving behaviour (e.g. Ford ECOmode, FIAT Blue&me, Renault Trucks Infomax). There are also some navigation devices and applications for smart phones that can help the driver to drive more fuel efficient. These so-called nomadic devices are in the best case connected to the vehicle via the OBD-port, providing basic driving parameters from the vehicle-CAN.

Today, there are few traffic management and control measures that explicitly operate based on fuel efficiency criteria. In most cases, systems designed for accessibility reasons like (dynamic) green waves, parking guidance and traffic information have been evaluated on their environmental impact and proved to be also successful in reducing emission and fuel consumption. This is not surprising as in many cases improvements in accessibility (i.e. travel time, throughput, etc.) will also improve environmental conditions. However, when it comes to significant improvements, an approach is needed that explicitly addresses environmental targets such as fuel consumption.

For more specifics regarding the current situation for passenger cars, trucks and traffic management & control, please check the Deliverables D3.1 (Passenger cars), D4.1 (Trucks) and D5.1 (Traffic management & Control) [2]-[4].

2.7.1. Trip phasing

For the description of the situation today it is important to identify the trip phasing eCoMove is looking at. Three phases are relevant: pre-, on- and post-trip. They are defined based on the driver action state. Based on the driver intention, the driver action state can be sub-divided into the following three states (see also Figure 8):

- ***Pre-trip phase - Planning***: in this phase the driver creates travel plans (in case of a fleet operators it could also be the fleet planner). Planning as such does not directly impact fuel consumption or CO_2-emissions. However, decisions made in this phase can influence the actual execution of the trip. This phase starts when the driver plans his / her trip and checks the vehicle. The driver can do this either in the vehicle or at home / office / etc.. It ends with the driver starting his / her vehicle to drive to the planned destination;

- ***On-trip phase - Acting:*** in this phase the driver drives the vehicle within a network that is controlled by the traffic management centre. Here the driver's choices and actions directly affect energy consumption (such as driving behaviour, destination changes, etc). This phase starts with the moment the driver starts the vehicle to drive to the planned destination. The phase ends with driver switching the engine and ignition off and trip-destination had been reached.

- ***Post-trip phase - Analysing:*** in this phase the driver receives feedback and learns how his / her driving behaviour and route choices have impacted the fuel consumption and what possibilities he / she has to improve this in the future. Therefore this phase indirectly affects energy consumption.

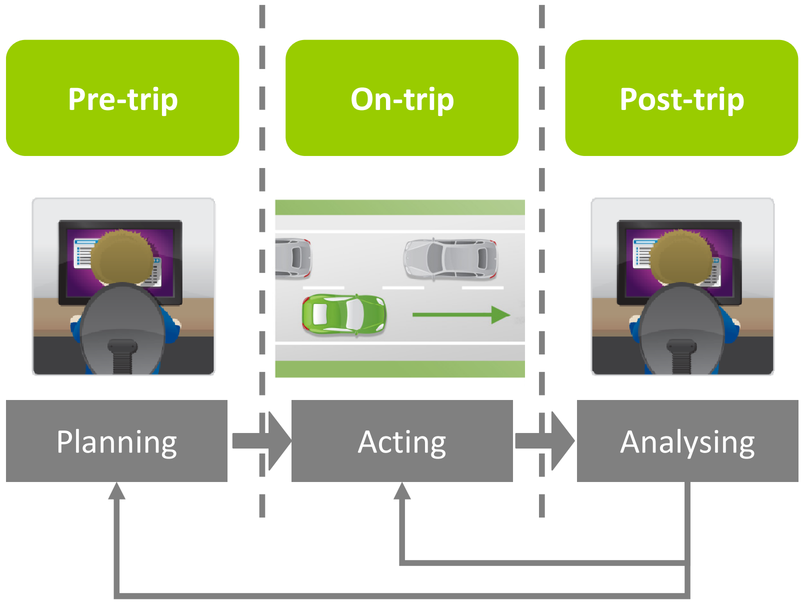


Figure 8: Trip phasing

2.7.2. Performance of existing systems

With existing systems only a limited reduction of CO_2-emissions can be achieved:

- supporting the driver to drive more fuel efficient: eco-driving potential is estimated to be able to reduce fuel consumption up to 20-25% (EU project EcoDriven); currently the best available method for learning eco-driving is following an eco-driving course, however, it has also been demonstrated that gains achieved directly after training are not sustained by most drivers;

- supporting the driver / fleet manager to choose the route with lowest fuel consumption:
  - fuel-optimised navigation has shown a reduction potential of -4% overall, -8% cities (Lund)
  - navigation reduces distance travelled (preventing erratic driving): -16% (TNO/TomTom)
  - navigation reduces fuel consumption, CO_2: -12% (NAVTEQ)

- traffic management to optimise system energy efficiency: several existing studies have demonstrated a fuel consumption / CO_2-emission reduction potential, based on single experimental systems:
  - adaptive network vs. local control: -18% fuel (Braun et. al.)
  - green wave vs. non-synchronised control: -20-25% fuel (ADAC)
  - cooperative adaptive vs. adaptive control: -7-16% fuel (Turksma et. al.)

2.7.3. Provisions for safety, security & privacy

Article 8 of the Charter of Fundamental Rights of the European Union expressly recognises the fundamental right to the protection of personal data. With the increasing number of ITS systems data protection and privacy becomes an increasing important topic.

In the existing situation like described in Figure 7 no private data exchange takes place yet between vehicles among each other and between vehicles and infrastructure and therefore no specific provisions are made for data security or privacy. With the emergence of ITS systems this is expected to change.

Some examples for some very specific cases are already known where private data are exchanged. For example, the truck tolling system in Germany uses an on board unit that calculates the toll-fee to be paid based on GPS data based on the route the truck has driven. Theoretically this would give a tremendous amount of data on the movements of trucks on the German roadnetwork. However, legislation restricts the usage of these data to the sole purpose of toll collection. Even in a known case where a crime was committed with a German truck with such on-board unit, it was not allowed to use this data.
Another example is from Navigon and TomTom who both use in their high-end devices GSM as a back channel and also collect information on the quantity of cars in the network and moreover to optimise their route suggestions since they know the actual speed on routes used by their customers. However, this is anonymous data and drivers have to agree that their data is being used. No private data is sent from the vehicles.

Regarding safety there are limitations in certain European countries that restrict the usage of navigation devices and mobile phones while driving on the road. This should be taken into account when developing the eCoMove applications.

3. Users and Stakeholders for eCoMove

This chapter describes the Users and Stakeholders for the eCoMove system on the highest level. For detailed Stakeholder overviews please check D3.1, D4.1 and D5.1 [2]-[4].
For the collection of stakeholders and the refinement of stakeholder needs two workshops have been held where also stakeholders that are not included in the eCoMove consortium have been invited and have given there input to the project.

3.1. Users vs. Stakeholders

In this first phase both Stakeholder and User needs have been collected. eCoMove users are defined as those parties who directly interact with the applications and therefore are within the eCoMove system boundaries. Stakeholders are those actors that are affected by the eCoMove system(s) and do not necessarily reside within the eCoMove system boundaries.

3.2. Users for the eCoMove system

The main users that have been identified for the eCoMove systems are the following:

- **Drivers**, both passenger car drivers as well as truck drivers: these users directly interact with the systems that are inside the vehicle (on-trip) and some of the pre- and post-trip applications (SP3 and SP4);
- **Transport planners**: for the freight and logistics subproject (SP4) the transport planner is the actor that directly interacts with the pre-trip planning application and in some cases also on-trip and post-trip applications.
- **Road operator**: Traffic managers & traffic engineers: these users directly interact with the applications defined in the Transport management & control subproject (SP5).

For a more specific description of the needs of these users and how they interact with the systems, please check the deliverables of the application subprojects (SP3-5) as well as the first deliverable of SP6 on driver needs and motivational factors ([2]-[5]).

3.3. Stakeholders

In each of the application SPs' (SP3-SP5) a stakeholder analysis has been done. Stakeholders have been identified and the relations they have with the eCoMove system have been described in stakeholder diagrams.
To identify the needs of the different stakeholders, two stakeholder workshops have been conducted where external stakeholders have been invited to give feedback to the eCoMove project team on the intended applications and use cases.

3.4. Important stakeholder needs

Based on the stakeholder workshops that have been held, interviews with stakeholders and web-based inquiries the stakeholder needs have been collected. For an overview per application subproject, please look at D3.1, D4.1, D5.1 [2]-[4] and D6.1 [5].

Summarised: the most important stakeholder needs for the eCoMove project are that the system is safe, secure, sustainable, and reliable. This goes for both the users of the eCoMove system and those affected by it.

4. Targeted Inefficiencies

The main goal of eCoMove is to reduce fuel consumption and CO_2-emissions by 20% compared to the current situation. To be able to develop applications that can contribute to achieving this reduction it is first of all important to know which inefficiencies occur and in which situations they occur. Only then it is possible to identify in which situations which type of applications could contribute to the overall goal of reducing fuel consumption and CO_2-emissions by 20%.

4.1. Structure for inefficiencies

Based on the trip phasing definition as presented in 2.7.1 the inefficiencies are also structured based on when they occur: pre-trip or on-trip. Inefficiencies cannot occur in the Post trip phase since this is 'only' an analysis phase. Principally all pre- and on-trip inefficiencies can be analysed in the post-trip phase and possibilities to reduce the inefficiencies can be identified.

The inefficiencies table has been cross-checked with all application SPs' to include all relevant inefficiencies that can be targeted by the eCoMove system.

4.2. Pre-trip inefficiencies

The pre-trip inefficiencies that are targeted within the eCoMove Project are listed in Figure 9 and described in more detail below.

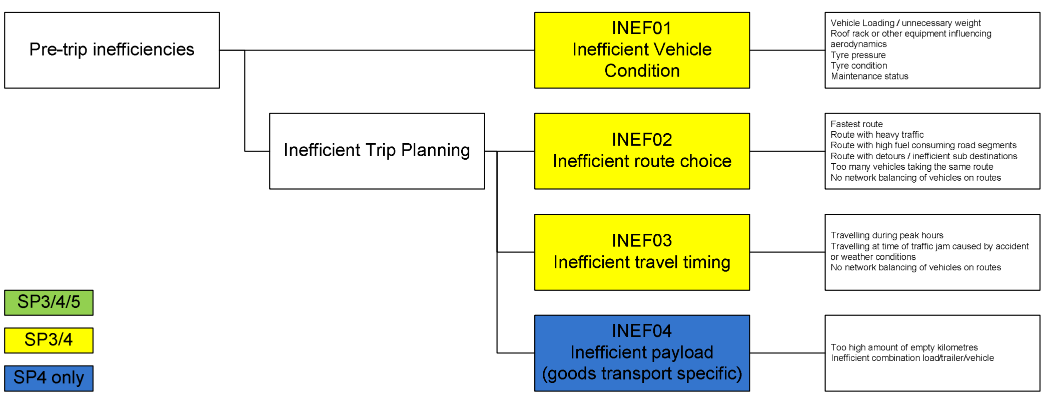
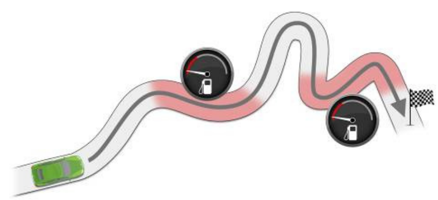


Figure 9: Pre-trip inefficiencies

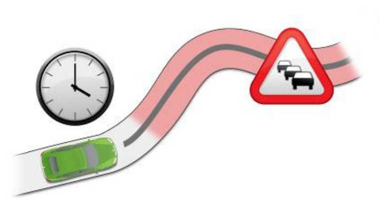
- ***INEF01: Inefficient vehicle condition***; this inefficiency can be split into:
    - Conditions that can be measured/recognised by systems in the vehicle, like tire pressure and maintenance status;

- Conditions that cannot be measured / recognised by the vehicle like unnecessary weight in the vehicle, carriers that influence aerodynamics, tire condition.

- ***INEF02: Inefficient route choice***; when planning a trip the driver can already select a certain route which is not necessarily the best one from fuel consumption perspective. Reasons for an inefficient route choice could be lack of knowledge on traffic state on selected route, insufficient knowledge about route-alternatives, or insufficient knowledge about factors influencing fuel consumption on the route.



- ***INEF03: Inefficient travel timing***; not only the route as such but also the time a trip should take place (or the chosen start / targeted arrival time) can impact the fuel consumption due to e.g. heavy traffic that causes congestions and therefore inefficient driving. Travel timing is chosen before the trip and if it is possible to adjust the timing to e.g. traffic conditions the trip could be covered with less fuel.



- ***INEF04: Inefficient payload***; Maximising the payload (on volume or weight) of his vehicles is one of the main objectives of the transport planner. Thereby a high payload does not necessarily mean high efficiency. Only the use of the right vehicle under the right conditions with an optimum payload leads to high efficiency. Finding this ideal combination will be the main objective for the ecoTour Planning system.

  Nevertheless it can happen that no transport orders are available and the truck is driving half-loaded or even empty. This may lead to the situation that one or more half-loaded trucks are driving through a city or on a highway. This is of course from traffic and safety point of view not desirable. Several ideas exist to solve this issue (e.g. centralised transport planning or warehouses at city limits). Often they infringe with economic principles and could even endanger market mechanism. Instead of regulations only addressing the actual payload, cities should think about policies and incentives that address the inefficiency itself. Therewith they could force carriers to corporate themselves to be more efficient.

4.3. *On-trip inefficiencies*

The on-trip inefficiencies that are targeted within eCoMove consist of a much longer list compared to the pre-trip inefficiencies and can be structured into the following categories:

- Inefficiencies in vehicle condition and (electrical) energy consumers on board;
- Inefficiencies in secondary driving tasks: the focus of eCoMove is limited to the task of finding your way to your destination / in the traffic / in the road network.
- Inefficiencies in primary driving tasks: primary driving tasks are those tasks that concern the operation of the vehicle (e.g. accelerating, decelerating, using gears, keeping speed, idling). The inefficiencies in this category can be induced by different conditions / causes like traffic, road, dynamic traffic signals, driver, or environmental (weather / road conditions).

In the scheme of Figure 16 the colours indicate which inefficiencies relate to which subprojects. Below the inefficiencies are described in more detail and illustrated with some pictures.

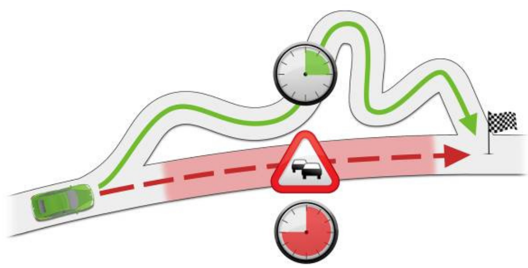
- Non-driving task related inefficiencies:
    - ***INEF05: inefficient use of (electrical) energy consumers***: many drivers are not aware of the additional fuel that is consumed when many auxiliaries are used when driving a vehicle. Electrical energy consumption has a direct effect on fuel consumption of a vehicle.

- *INEF06: inefficient on-trip vehicle condition*: this inefficiency is similar to INEF01, but in the case the driver is already driving. Examples of relevant inefficiencies are driving with open windows or reduced tire pressure during the drive.

- Secondary driving tasks related inefficiencies:

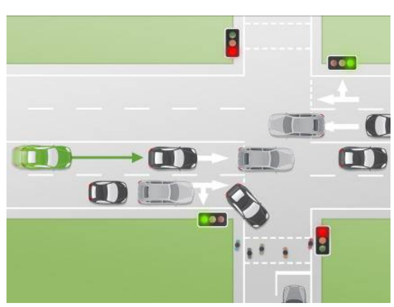
  - ***INEF07: inefficient routing***. During the trip the driver has to find his/her way to the destination, with or without using a navigation system. In addition to the route choice itself several other routing inefficiencies can occur that are relevant for ecoSmartDriving:

    a. Caused by traffic situation: if there is a sudden congestion (e.g. due to an accident) the selected route does not necessarily still be the best route from fuel consumption perspective;



    b. Caused by road design/traffic: lane changing behaviour, knowing which lane to choose for the next turn, etc.;

    c. Caused by traffic signals: currently it is not possible to adjust the route to traffic light green status;



d. Caused by external influences: for example obligatory driving times could be exceeded due to traffic situations or loading/unloading time takes longer then expected and route needs to be adjusted based on these changes.

e. Caused by the situation at the chosen destination: e.g. when arriving at the destination a parking place is not available which then causes additional distance to be driven.

- Primary driving task related inefficiencies: the inefficiencies that are included in this category relate to the longitudinal control of the vehicle by the driver – everything he/she does to achieve, maintain or reduce speed, including gear shift. For each of the inefficiencies, reasons that cause these inefficiencies are listed: they can be traffic induced, road induced, weather/environment induced, driver induced, traffic signal induced or vehicle induced:

    - ***INEF08: inefficient acceleration***
    - ***INEF09: inefficient deceleration***
    - ***INEF10: inefficient (unnecessary) idling***
    - ***INEF11: inefficient speed***
    - ***INEF12: inefficient gear/rpm***
    - ***INEF13: unnecessary stops***

In Figure 16 the complete matrix is shown that describes the inefficiencies and their possible causes. The colour coding shows also which inefficiencies are relevant for which application subprojects.
In the pictures below several examples of scenarios in which these inefficiencies occur are shown (Figure 11, Figure 12, Figure 13, Figure 14, Figure 15).
INEF13 (Figure 10) is only relevant for SP5 Traffic Management & Control since the inefficiencies included here are caused by and can only by solved by this subproject. For more details please look into D5.1.

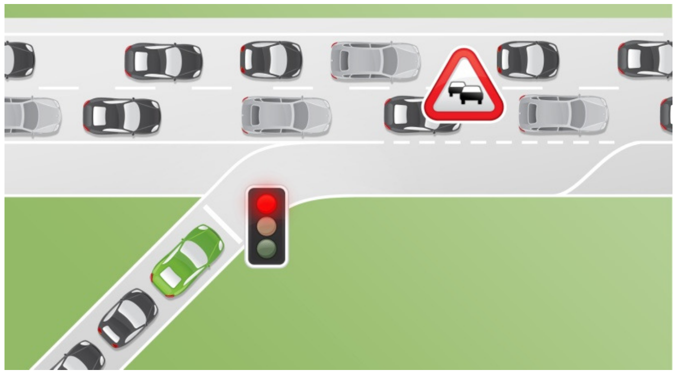


Figure 10: INEF13 - Unnecessary stops

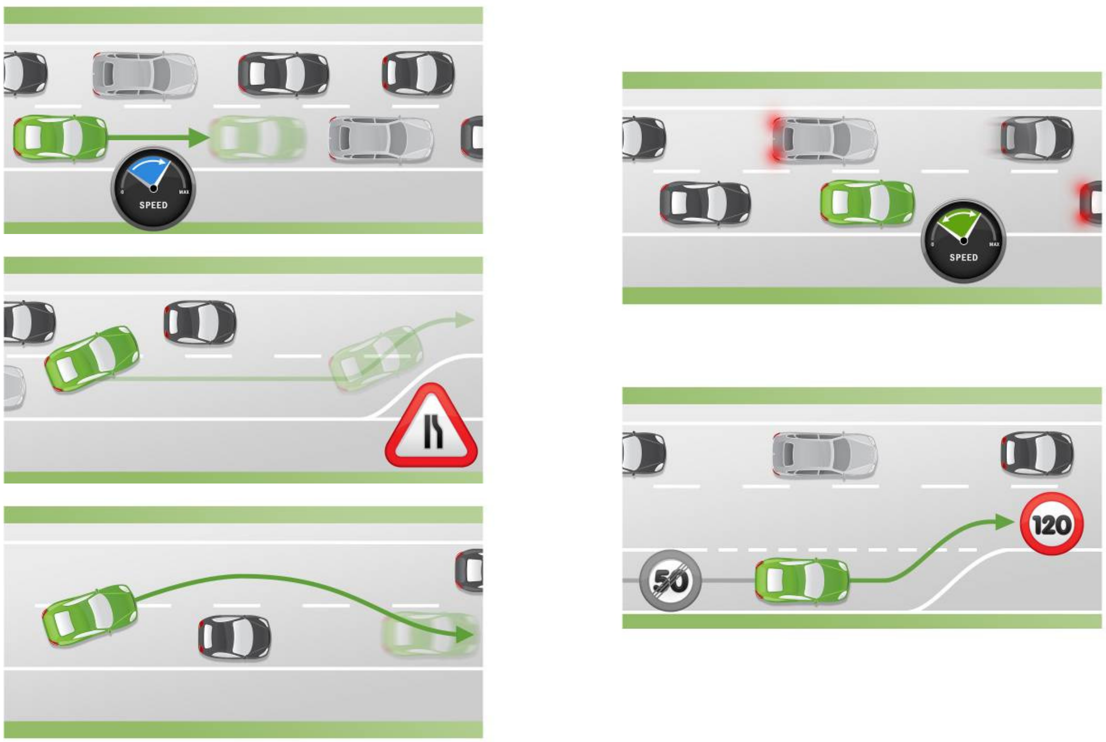


Figure 11: INEF08 - Inefficient acceleration scenarios

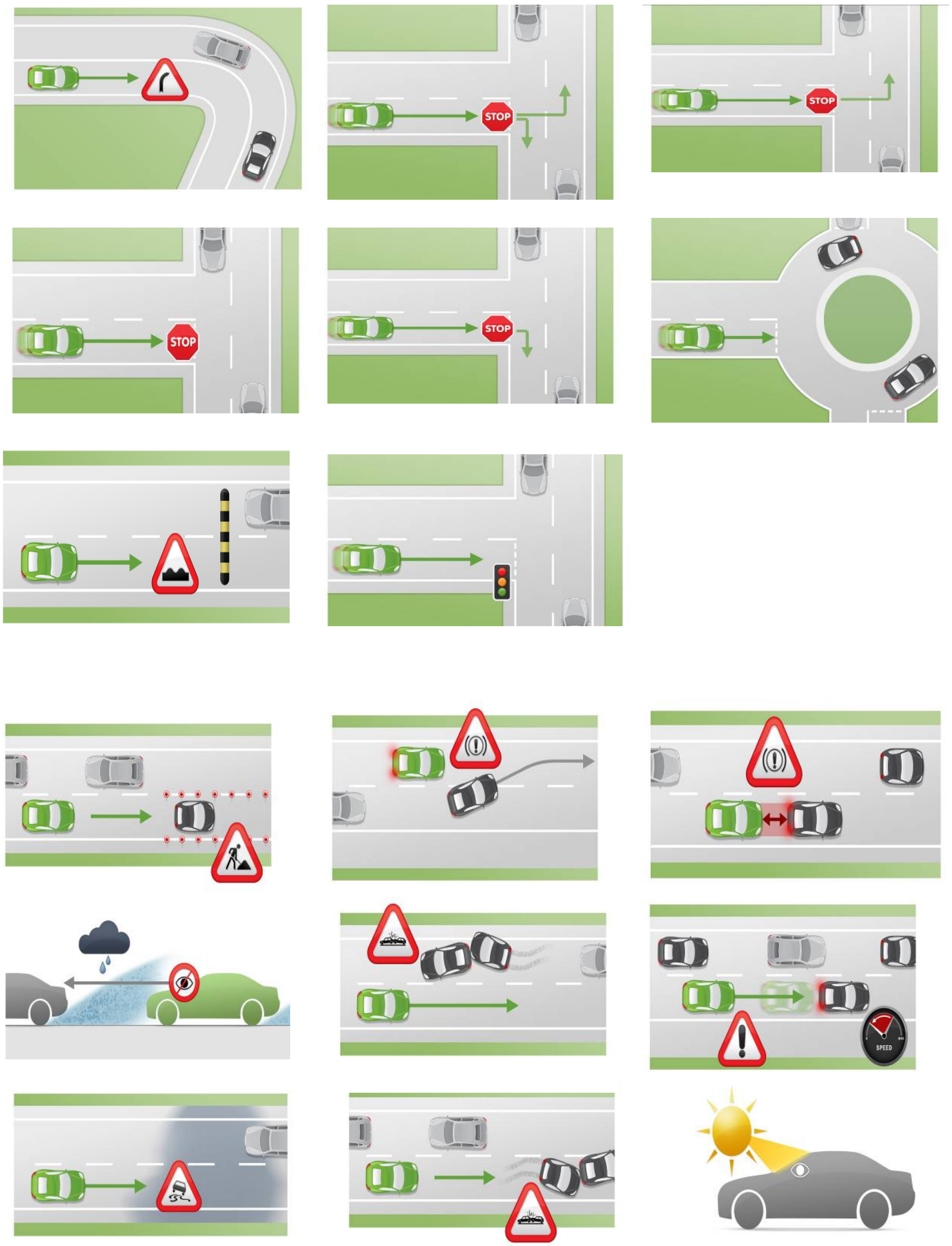


Figure 12: INEF09 - Inefficient deceleration scenarios

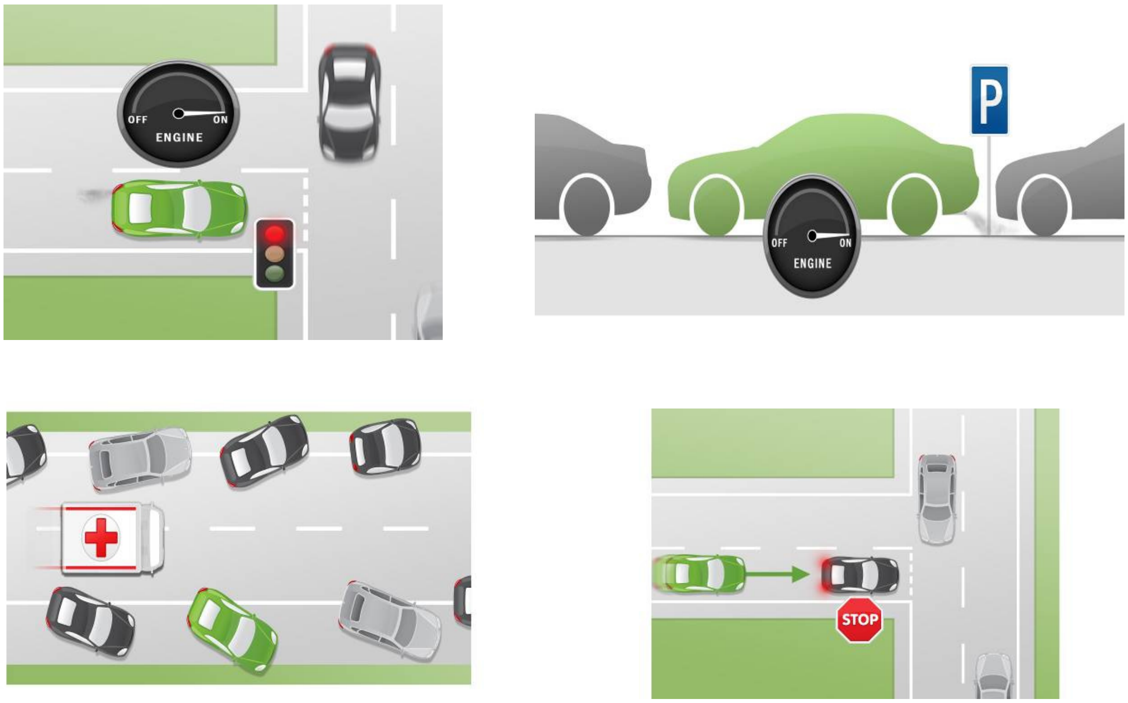


Figure 13: INEF10 - Unnecessary idling scenarios (vehicle stopped, engine not turned off)

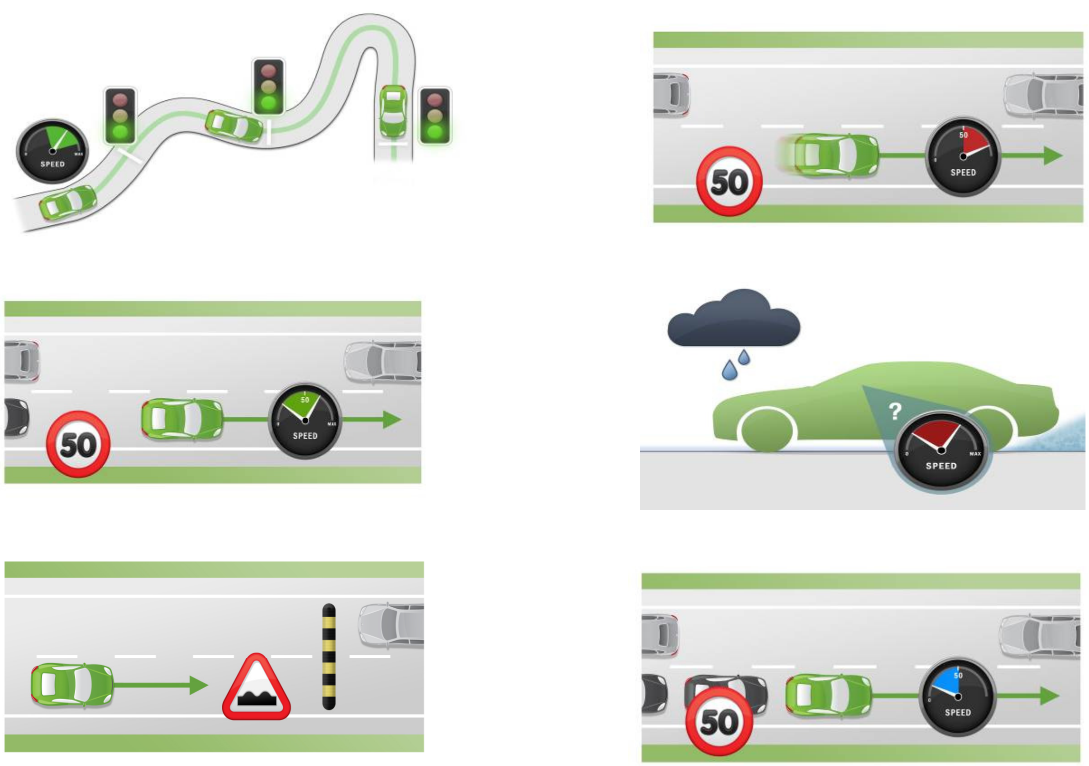


Figure 14: INEF11 - Inefficient speed

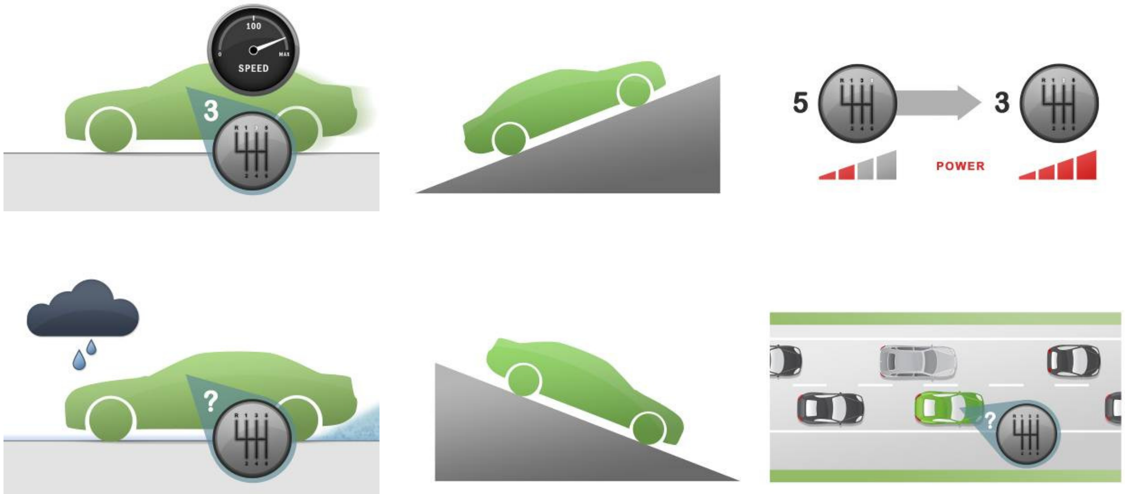


Figure 15: INEF12 - Inefficient gear

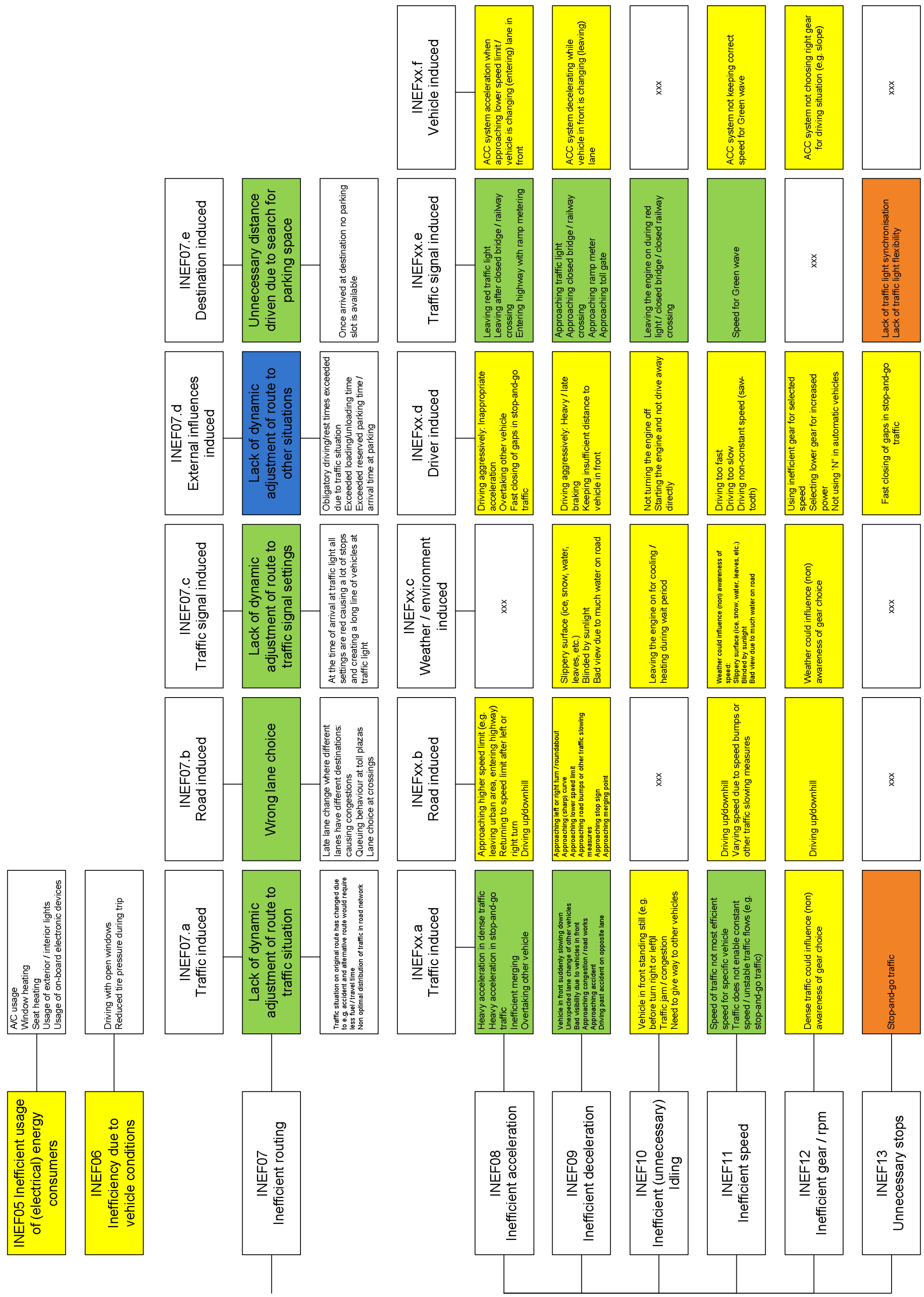


Figure 16: On-trip inefficiencies targeted by eCoMove

4.4. Prioritisation of inefficiencies

For the prioritisation of the inefficiencies several aspects are of importance:

- How big is the inefficiency – or in other words: what can theoretically be saved?
- How often does the inefficiency occur – if an inefficiency occurs very often the absolute saving potential might be much bigger for an inefficiency that is in essence small, but occurs often compared to an inefficiency that is in essence big, but occurs only very seldom.
- How easy or difficult can the inefficiency be influenced – also here it might be more useful to focus on a small inefficiency that is very easy to influence instead of a big inefficiency that can hardly be influenced.

The prioritisation of the inefficiencies has been done on a subproject level, since on that level the applications that aim to reduce the inefficiencies are developed. Please check D3.1, D4.1 and D5.1 for details [2]-[4].

4.5. Inefficiencies and ideas that will not be addressed by eCoMove

The boundaries for the eCoMove project have been chosen quite stringent. Especially during consultations with different stakeholders various ideas and suggestions to reduce CO_2-emissions and fuel consumption have been mentioned that are outside the boundaries of the eCoMove project and will therefore not be targeted.

The ideas / inefficiencies that will not be targeted are:

- Bad occupancy of vehicles: motivating people for car sharing or car pooling initiatives: within eCoMove the boundary is clearly defined that trip as such and vehicle as such are a given, therefore inefficiencies due to bad occupancy are not addressed;
- Trying to prevent a trip: since trip as such is a given the eCoMove project does not want to prevent a trip. The biggest efficiency gain can be achieved when a trip can be prevented, however this inefficiency also falls outside the scope of the project;
- Inefficiency due to non-optimal modality choice: also here the eCoMove boundary of taking trip and vehicle as a given limits the ideas into this direction. The same is valid for the freight transport: here the transport of freight by road transport is also not questioned.
- Inefficiencies due to controlling vehicle longitudinal control: currently adaptive cruise control systems can regulate the vehicle speed depending on the distance to the vehicle in front. However, since the system boundary for the eCoMove project excludes autonomous driving or controlling vehicle functions, this falls outside the scope of the project. Within the eCoMove project no active automatic control of the vehicle will take place; all impact will be realised through influencing the driver, not the vehicle.

4.6. Use of inefficiencies throughout the eCoMove project

Since reducing CO_2-emissions and unnecessary fuel consumption with 20% is the main goal of the eCoMove project the way the inefficiencies can be reduced within eCoMove are a very good means to track the progress of the project.

Therefore all subprojects include a reference for each application, component and use case which inefficiencies are targeted.

In Chapters 6 and 7 several overviews are given of how the inefficiencies are targeted by the use cases and applications of the subprojects 3, 4 and 5. From these overviews it also becomes clear that there are many cross-links between the subprojects.

5. eCoMove innovations

This chapter describes the main innovations in the eCoMove project. The specific innovations for the SP3, 4 and 5 application subprojects have already been highlighted in the corresponding deliverables D3.1, D4.1 and D5.1 [2]-[4] and will therefore not be described here. The main highlights here are the innovations needed for the overall integration of the eCoMove system into a cooperative system for reducing fuel consumption and CO_2-emissions.

5.1. Innovations in eCoMove

The essence of the innovation of the eCoMove project is that all foreseen applications of the applications subprojects ecoSmartDriving, ecoFreight&Logistics, ecoTraffic Management&Control will be working within a ***cooperative system that aims to minimise total excess fuel / achieve maximum energy efficiency***.
Several solutions aiming at increased energy efficiency already exist on the market as stand-alone solutions. Their full potential can however not be reached without communication and cooperation with the other road users / entities. One example is eco-driving support which already can be found in numerous new car models. Currently this function is not able to take into account the information about traffic light phasing or behaviour of surrounding vehicle, or give a preview of the situation ahead. eCoMove will prove energy efficiency benefits that numerous applications enhanced by cooperation between vehicles and with the infrastructure will bring.

In the overview below the progress beyond the state-of-the-art of the eCoMove core technology innovations is described more specifically. These core technology innovations ensure that the applications that are developed in the application subprojects SP3, 4 and 5 can cooperate in order to achieve the targeted fuel consumption reduction.

These innovative core technologies are:

- ***eCoMove communication platform***: full integration of V2V and V2I/I2V support, communication management optimised for eCoMove application requirements;

- ***eCoMove messages***: extends the scope of existing FVD and TSD messages used for traffic monitoring and cooperative system applications by creating first FVD messages to include fuel consumption and emissions data, and vehicle’s trip destination;

- ***ecoMap***: first digital map database enhanced with extra attributes needed to support eCoMove driver assistance and navigation applications for energy efficiency;

- ***ecoSituation model***: the first model combining a description and short-term prediction of the dynamic state of traffic surrounding a vehicle and the status of relevant traffic system infrastructure, needed to define eco-driving strategy in real time.

In addition to these core technologies it is important to highlight the ***ecoCooperative Horizon*** which is also one of the key elements of the eCoMove innovation and which provides the ecoSituational model with data input. This ecoCooperative Horizon is developed within the ecoSmartDriving subproject. The ecoCooperative Horizon will include all types of information that are related to fuel consumption coming from maps, traffic management systems, other vehicles and infrastructure/ roadside systems.

Last but not least it is important to mention that the applications to be developed are able to reduce fuel consumption / CO_2-emissions both within a cooperative system as well as stand-alone. However, total impact will be the highest if the individual applications are working within a cooperative system, but also if no cooperative system is installed (everywhere) there is still a good potential to achieve an improvement in energy efficiency.

6. Use scenarios

The use scenarios within eCoMove describe and specify the intended behaviour of the system, the situation in which a specific system should work and how the system works and interacts with the different users and are called Use Cases. The use case descriptions in eCoMove should enable the identification of all those tasks, situations and scenarios where the eCoMove applications can contribute to a CO_2-emission reduction and improved fuel efficiency.

The deliverables D3.1, D4.1 and D5.1 [2]-[4] reflect the Use Cases from subprojects ecoSmartDriving (SP3), ecoFreight & Logistics (SP4) and ecoTrafficManagement & Control (SP5). In these deliverables the specific use cases for each of the eCoMove subprojects are described. This chapter does not repeat those use cases in detail, but shows how they relate to each other as a basis for the overall eCoMove system concept as described in chapter 7.

6.1. Overview of SP3, 4 and 5 Use cases

Table 1 below gives an overview of the use cases "headline" per subproject along with the use case identifier and short name. Details are found in Deliverables D3.1, D4.1 and D5.1 [2]-[4].

Table 1: Overview of the described eCoMove use cases

UC short name	**UC Identifier**	**UC Headline**
SP3 Use Cases		
Checking Vehicle Condition	UC_SP3_01	A system supports the driver to check the vehicle condition before a trip
Planning ecoTrip	UC_SP3_02	The driver identifies a destination, time of travel and parking needs before a trip
EcoUse of Vehicle Systems	UC_SP3_03	The energy use during a trip is checked and recommendations are provided to the driver
Dynamic ecoNavigation	UC_SP3_04	Adaptive routing by dynamic input from vehicles, roadside infrastructure and traffic
Dynamic ecoGuidance	UC_SP3_05	Lane level dynamic vehicle guidance considering local traffic and infrastructure
Support ecoDriving	UC_SP3_06	Driving task is supported by predicting and indicating an optimal energy use of the vehicle
In-Vehicle ecoTripFeedback	UC_SP3_07	A trip feedback system based on logged information of the vehicle and driver behavior
Off-Board ecoTripFeedback	UC_SP3_08	Recommendations based upon post trip individual or group evaluation of driver behavior, followed routes
SP4 Use Cases		

UC short name	UC Identifier	UC Headline
Manage Policies	UC_SP4_01	Public officers are enabled to maintain policy parameters in support of most eco-efficient delivery trip in city centers
Plan ecoTrip	UC_SP4_02	Logistics company planner dynamically schedules tours by considering multiple inputs
Authorize ecoTrip	UC_SP4_03	Public Authority/City Administrator officers to authorize travelling through the city centre
Prepare driving	UC_SP4_04	Pre-trip briefing and coaching of the driver
Guide driver	UC_SP4_05	Adaptive fuel efficient navigation, guiding the driver
Support ecoDriving	UC_SP4_06	Vehicle, route and environment aware driving support, considering legal restrictions
Driver evaluation	UC_SP4_07	Monitor and evaluate the driver, inform him/her and back-office planner about the results
Carbon footprint calculation	UC_SP4_08	Emissions/fuel predictions for individual driver/vehicle support the planner, actual measurements help evaluation
SP5 Use Cases		
Improve parking guidance	UC_SP5_01	Support drivers and (navigation) systems with real time parking information
Improve network usage	UC_SP5_02	Fuel efficient network operation with individual driver support, and reference for other eCoMove technologies
Improve driver information	UC_SP5_03	Offer traffic information and travel/driving advice to drivers and vehicles before and during the trip
Coordinate traffic controllers	UC_SP5_04	Macro and micro traffic data is collected for road operators to dynamically steer traffic controllers to adjust vehicle speeds/flow
Support merging	UC_SP5_05	Roadside monitoring and information systems to support smooth merging manoeuvres of vehicles
Improve intersection control	UC_SP5_06	Use vehicle and road infrastructure input to optimize intersection controllers for fuel and emission efficiency
Balance intersection control objectives	UC_SP5_07	Dynamically prioritize vehicle categories and vehicle flows (clusters) via flexible and fixed signal group
Improve ramp control	UC_SP5_08	Macroscopic and microscopic (vehicle) control variables for anticipating traffic conditions at ramps

UC short name	UC Identifier	UC Headline
Improve lane usage	UC_SP5_09	Traffic operator distributes vehicles over available lanes
Improve approach velocity	UC_SP5_10	Traffic operator - vehicle interacting to anticipate the approach of a traffic disruption
Improve traffic flow stability	UC_SP5_11	Traffic operator - vehicle interaction to stabilise traffic flow

6.2. Use cases and eCoMove trip phase

The three relevant phases of an eCoMove trip: pre-, on- and post-trip, have been described in Chapter 2.5.1. These particular phases are defined based on the driver action state. The driver action state can be sub-divided into the following three states reflecting the driver intention: planning, acting and analysing. Figure 17 indicates that there are six pre-trip use cases and four post-trip ones. However, the majority of the described eCoMove use cases (17) belong to the on-trip phase.

Figure 17: Use Cases and eCoMove trip phases

6.3. Use Cases and cooperativeness

One of the main innovations of the eCoMove project is that the project is focussed on realising its goals with the help of cooperative systems. The use cases, as developed in the applications subprojects, are therefore categorised according to the following structure:

- Can be implemented independent from other vehicles or traffic management and control – meaning that they are not cooperative,
- Can be implemented without support of other vehicles or traffic management and control, but can achieve a significant performance improvement if supported by other vehicles or traffic management and control – meaning that the potential fuel saving / CO_2-reduction is higher when being cooperative,
- Can only be implemented with support of other vehicles, infrastructure or traffic management and control – meaning that they are cooperative. One can identify:
    - Vehicle to Vehicle (V2V)
    - Vehicle to Infrastructure, including traffic management (V2I and I2V)
    - Back office, with no direct impact on the driver (I2I)

Table 2 gives an overview of the eCoMove use cases and the level of cooperativeness. As can be seen from this table most use cases cooperative. The non-cooperative use cases are all use cases in the pre- and post-trip phase.

Table 2: Use cases and level of cooperativeness

UC Short name	UC Identifier	Non - cooperative (Independent)	Independent but cooperative approach beneficial	Cooperative (V2V)	Cooperative (V2I, incl traffic management)	Cooperative (I2I)
SP3 Use Cases						
Checking Vehicle Condition	UC_SP3_01	X				
Planning ecoTrip	UC_SP3_02		X		X	
EcoUse of Vehicle Systems	UC_SP3_03		X		X	
Dynamic ecoNavigation	UC_SP3_04			X	X	
Dynamic ecoGuidance	UC_SP3_05			X	X	
Support ecoDriving	UC_SP3_06		X	X	X	
In-Vehicle ecoTripFeedback	UC_SP3_07	X				
Off-Board ecoTripFeedback	UC_SP3_08	X				

UC Short name	UC Identifier	Non - cooperative (Independent)	Independent but cooperative approach beneficial	Cooperative (V2V)	Cooperative (V2I, incl traffic management)	Cooperative (I2I)
SP4 Use Cases						
Manage Policies	UC_SP4_01	X				
Plan ecoTrip	UC_SP4_02				X	X
Authorize ecoTrip	UC_SP4_03					X
Prepare driving	UC_SP4_04	X				
Guide driver	UC_SP4_05				X	X
Support ecoDriving	UC_SP4_06		X	X	X	
Driver evaluation	UC_SP4_07		X		X	
Carbon footprint calculation	UC_SP4_08	X				
SP5 Use Cases						
Improve parking guidance	UC_SP5_01		X		X	
Improve network usage	UC_SP5_02		X		X	
Improve driver information	UC_SP5_03				X	
Coordinate traffic controllers	UC_SP5_04		X		X	X
Support merging	UC_SP5_05			X	X	X
Improve intersection control	UC_SP5_06		X		X	
Balance intersection control objectives	UC_SP5_07		X			
Improve ramp control	UC_SP5_08		X		X	X
Improve lane usage	UC_SP5_09				X	
Improve approach velocity	UC_SP5_10				X	
Improve traffic flow stability	UC_SP5_11			X	X	

6.4. Use cases interactions

Use case interactions are presented in two figures:

- Figure 18 illustrates the interactions between use cases of SP3 and SP5, whereas
- Figure 19 shows the interactions between use cases of SP4 and SP5.

There are no direct interactions between the use cases of SP3 and SP4. The data exchange of ecoFVD will take place via the eCoMove communication platform, but is not direct interaction between use cases.

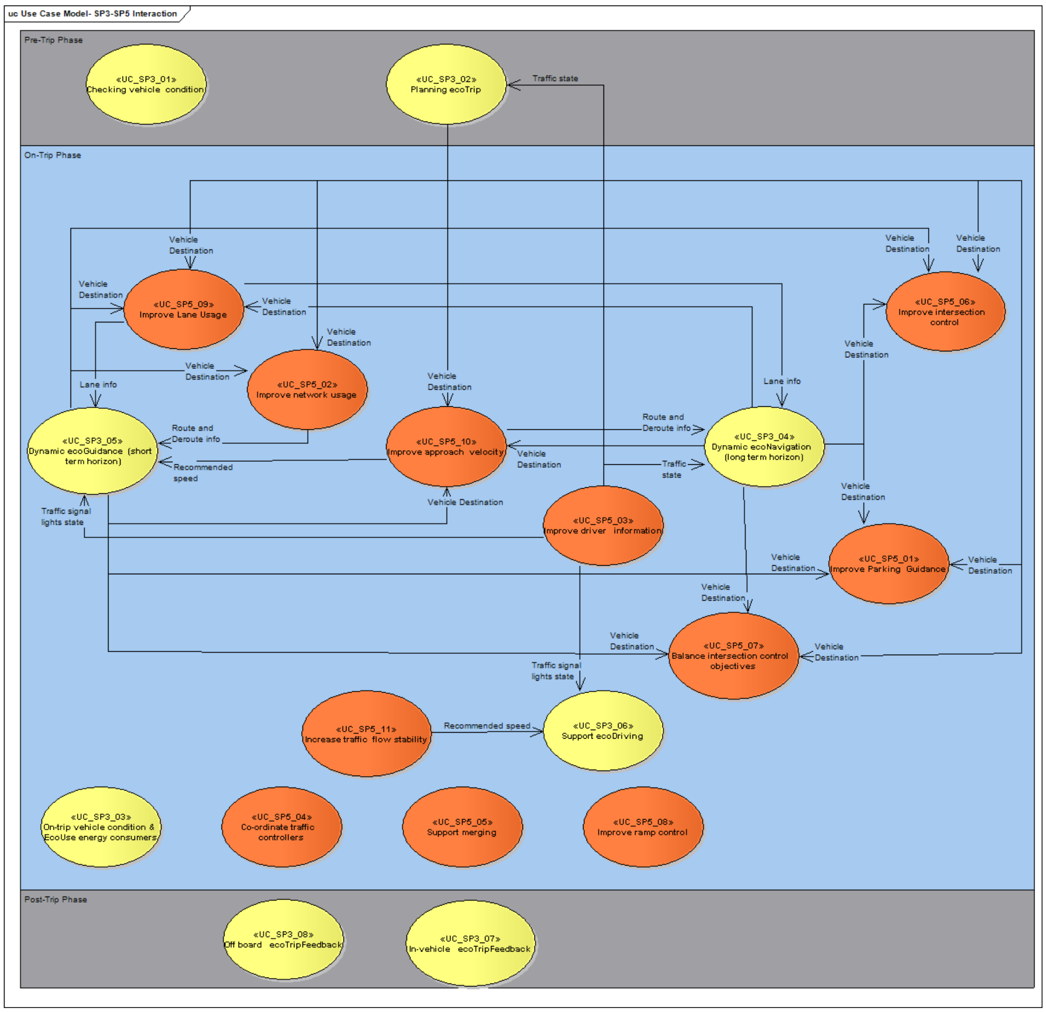


Figure 18: eCoMove use case interaction between SP3 and SP5

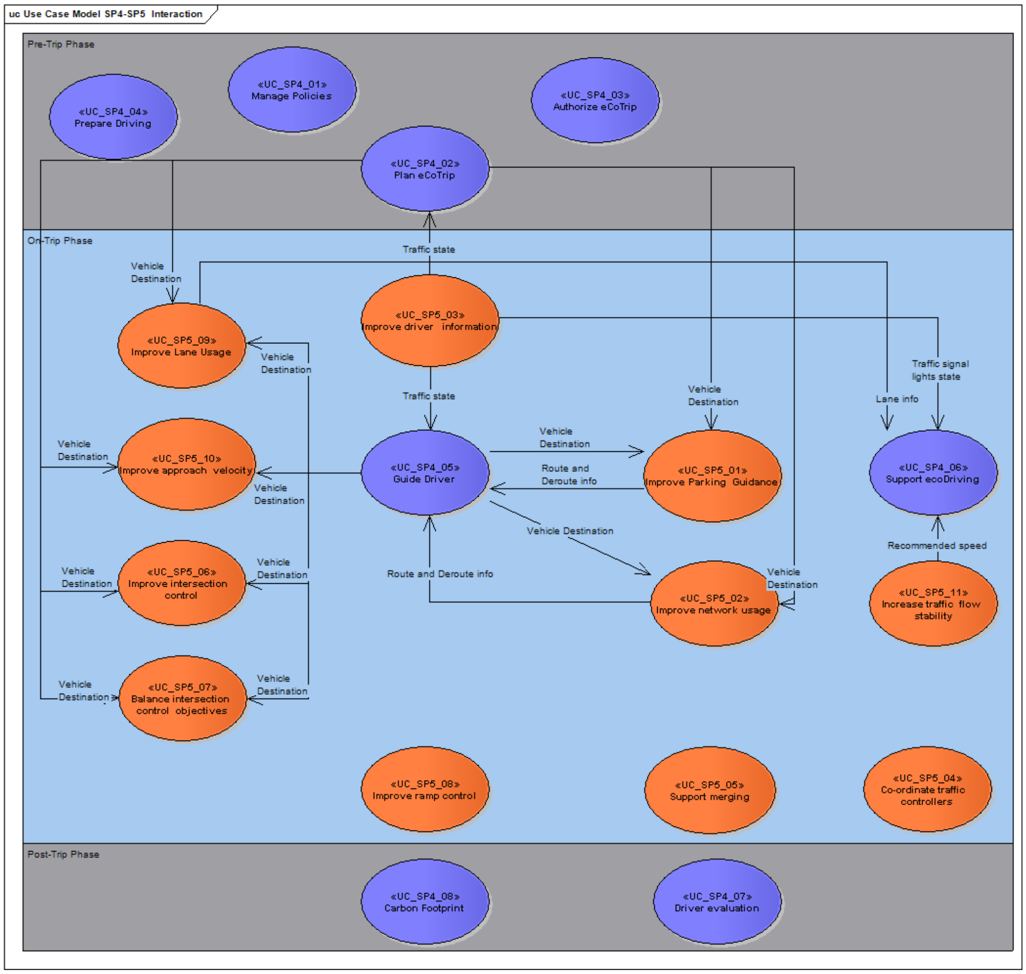


Figure 19: eCoMove use case interaction between SP4 and SP5

Table 3 below summaries how eCoMove use cases are related and what information is involved in the interaction. Each entry in the table means that that is a relation. All use cases which have no relation have been omitted for readability. The table should be read as UC (row) receives from UC (column) the following (type of) information:

- VD: vehicle destination,
- RI: Route info,
- RS: recommended speed,
- LI: lane information,
- TS: traffic state, TSLS-traffic signal light state.

Table 3: Use cases interactions

	UC Short Name	Planning ecoTrip	Dynamic ecoNavigation	Dynamic ecoGuidance	Plan ecoTrip	Guide driver	Improve parking guidance	Improve network usage	Improve driver information	Improve lane usage	Improve approach velocity	Improve traffic flow stability
UC Short Name	UC No.	UC_SP3_02	UC_SP3_04	UC_SP3_05	UC_SP4_02	UC_SP4_05	UC_SP5_01	UC_SP5_02	UC_SP5_03	UC_SP5_09	UC_SP5_10	UC_SP5_11
Planning ecoTrip	UC_SP3_02	-							TS			
Dynamic ecoNavigation	UC_SP3_04		-				RI		TS	LI	RS	
Dynamic ecoGuidance	UC_SP3_05			-			RI	RI	TS LS	LI	RS	
Support ecoDriving	UC_SP3_06								TS LS		RS	RS
Plan ecoTrip	UC_SP4_02				-				TS			
Guide driver	UC_SP4_05					-	RI	RI	TS			
Support ecoDriving	UC_SP4_06								TS LS	LI	RS	RS
Improve parking guidance	UC_SP5_01	VD	VD	VD	VD	VD	-					
Improve network usage	UC_SP5_02	VD		VD	VD	VD		-				
Improve intersection control	UC_SP5_06	VD	VD	VD	VD	VD						
Balance intersection control objectives	UC_SP5_07	VD	VD	VD	VD	VD						
Improve lane usage	UC_SP5_09	VD	VD	VD	VD	VD				-		
Improve approach velocity	UC_SP5_10	VD	VD	VD	VD	VD					-	

6.5. Use Cases and eCoMove inefficiencies

A comprehensible overview of which of the identified eCoMove inefficiencies, see Chapter 4, are addressed by the different use cases is given in Table 4. Obviously, a single use case may deal with multiple inefficiencies.
From this overview it again becomes visible that there is a strong need for cooperativeness when looking at the on-trip inefficiencies (INEF05-INEF13). These are targeted by all SPs by more than one use case.

Table 4: Use cases and inefficiencies

UC Short Name	UC No. (UC_xx)	INEF01 Inefficient Vehicle Condition (pre-trip)	INEF02 Inefficient route choice	INEF03 Inefficient travel timing	INEF04 Inefficient payload	INEF05 Inefficient usage of energy consumers	INEF06 Inefficiency due to vehicle condition (on-trip)	INEF07 Inefficient routing (on-trip)	INEF08 Inefficient acceleration	INEF09 Inefficient deceleration	INEF10 Inefficient (unnecessary) idling	INEF11 Inefficient speed	INEF12 Inefficient gear (RPM)	INEF13 Unnecessary stops
SP3 Use Cases														
Checking Vehicle Condition	SP3_01	X												
Planning ecoTrip	SP3_02		X	X				X						
EcoUse of Vehicle Systems	SP3_03					X	X							
Dynamic ecoNavigation	SP3_04							X						
Dynamic ecoGuidance	SP3_05							X						
Support ecoDriving	SP3_06								X	X	X	X	X	
In-Vehicle ecoTripFeedback	SP3_07			X		X	X	X	X	X	X	X	X	
Off-Board ecoTripFeedback	SP3_08		X	X		X	X	X	X	X	X	X	X	
SP4 Use Cases														
Manage Policies	SP4_01													
Plan ecoTrip	SP4_02		X	X	X									
Authorize ecoTrip	SP4_03													
Prepare driving	SP4_04	X												
Guide driver	SP4_05							X						
Support ecoDriving	SP4_06					X	X		X	X	X	X	X	
Driver evaluation	SP4_07					X	X		X	X	X	X	X	
Carbon footprint calculation	SP4_08		X	X	X									
SP5 Use Cases														
Improve parking guidance	SP5_01							X						

		INEF01	INEF02	INEF03	INEF04	INEF05	INEF06	INEF07	INEF08	INEF09	INEF10	INEF11	INEF12	INEF13
Improve network usage	SP5_02							X						
Improve driver information	SP5_03							X				X		
Coordinate traffic controllers	SP5_04								X	X				X
Support merging	SP5_05								X	X		X		X
Improve intersection control	SP5_06								X	X		X		X
Balance intersection control objectives	SP5_07								X	X		X		X
Improve ramp control	SP5_08								X	X		X		X
Improve lane usage	SP5_09							X						X
Improve approach velocity	SP5_10								X	X		X		X
Improve traffic flow stability	SP5_11								X	X		X		X

7. The eCoMove system concept

This chapter describes the outlines for the total eCoMove system concept, integrating all application SPs. For a detailed description of the subsystems ecoSmartDriving, ecoFreight & Logistics and ecoTraffic Management & Control, please check D3.1, D4.1 and D5.1 [2]-[4].

The overall eCoMove system is composed of three domains, which are mirrored in the corresponding eCoMove Subprojects:

- **SP3 ecoSmartDriving**, which is focused on the passenger car and its driver to plan a trip in the most energy efficient way and, while being on trip, to drive the route with least amount of fuel, and to drive on that route in the most fuel efficient manner. Information from road side units, traffic management centre, ecoMaps and also from other vehicles are used to determine the best route and the most efficient driving strategy. Once the driver has arrived at his / her destination, ecoSmartDriving helps the driver to analyse and understand how the driving behaviour has influenced fuel consumption of the vehicle.

- **SP4 ecoFreight & Logistics** is focused on companies that are transporting goods on the road by means of heavy commercial vehicles. Here, means will be developed to allow the transport planner to determine the most fuel-efficient daily (or weekly) ecoTours of all his vehicles based on a given set of transport orders. Further, for *Truck ecoNavigation*, the route to the next destination is calculated and the driver is guided there. For that purpose, configuration / status of the vehicle and relevant traffic status information are considered to determine the most fuel-efficient route. The *ecoDriver Coaching System* finally supports the driver to drive on the calculated route in the most fuel efficient manner. Drivers can later on see their progress on the back-office application. Fleet managers can derive fleet trends and adapt consequently incentive and training strategies to ensure sustainable fuel efficient driving among their fleet. Information from road side units, traffic management centre, and from the Transport Planning Office is used.

- **SP5 ecoTraffic Management and Control** will evaluate information from both vehicles and infrastructure to formulate strategies to reduce the total fuel consumption in a network or on a specific corridor. Further, the systems make use of management and control systems that are available in the network (e.g. variable message signs, traffic signals, ramp metering) in order to realise those strategies. In addition to that, the systems will generate information (e.g. route or speed advice) that is sent to vehicles and back offices via road side units or mobile or broadcast media to inform SP3 and SP4 systems of the best ways to minimise fuel consumption with respect to route choice and driving manner.

7.1. Operation environment

The overall operation environment, including high level entities involved in the eCoMove System, is shown in Figure 20. As compared to Figure 7, the additional entities treated in eCoMove become obvious:

- ecoFVD and Route Data
- Traffic Situations
- Maneuver & Traffic Data (ecoTSD)
- Request for Green, Remaining Red/Green Time
- (eco) Traffic Messages
- Pre/Post-trip Data
- eco(Cooperative)Horizon
- Road Side Units

All these entities are means employed to realise the eCoMove subprojects objectives outlined and which are specified in D3.1 through D5.1 [2]-[4].

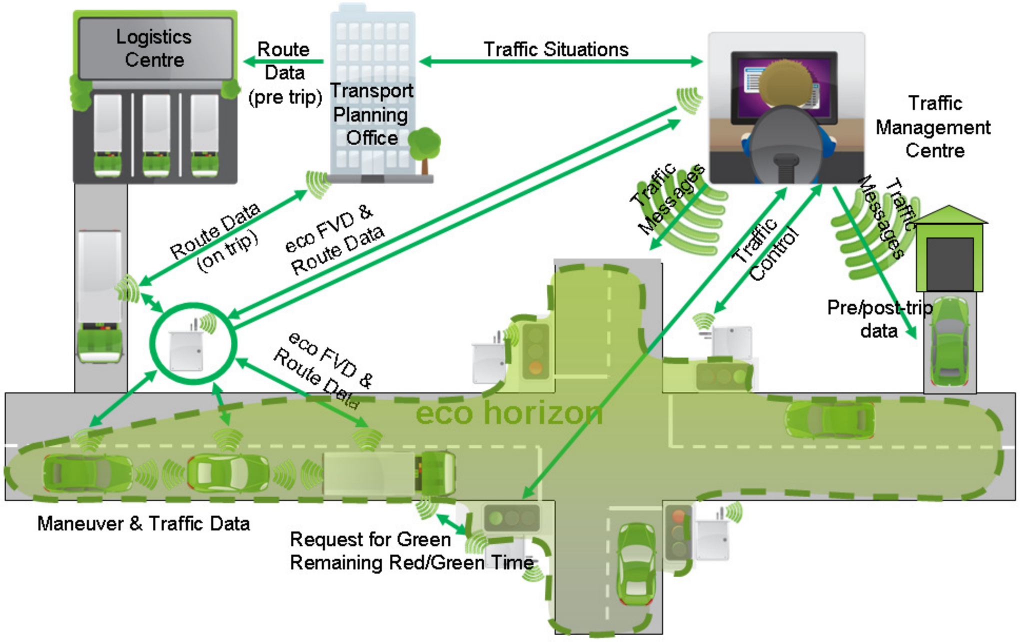


Figure 20: Overall system concept

7.1.1. Organisational entities

Within the overall system concept it is important to identify the organisational entities that have a purpose and responsibility within the system and interact with the system.

- Road operators: in this category the following types can be discerned:
  - Traffic Manager – The Traffic Manager's role within the ecoTraffic Management & Control subsystem is to translate the policy objectives of all the stakeholders of the traffic system, starting with the stated policy objectives of the road administration then to road user to derive a workable and balanced set of objectives to fulfill by the ecoTraffic Management & Control subsystem.
  - Traffic Engineer – The Traffic Engineer's role within the ecoTraffic Management & Control subsystem is to translate the objectives into control

instructions for the different traffic management measures that are available, in a timely and efficient manner.

- Transport planning: the information on what is transported from where to where is coming from the transport planner. Based on the available transport orders his role is to create a tour planning for a given number of vehicles and drivers. Thereby maximum transport efficiency – ton * km per litre – and a minimum duration of each tour are his main objectives. And of course there are drivers who run their own business. Then the truck driver and the transport planner could be regarded as different roles that are assigned to the same person in practice.

- Local authorities: they must be able to put constraints on the eCoMove system (i.e. regulations) which allows them to achieve also other goals than economic efficiency. Examples of regulations are access rules for trucks in specific parts of the city possibly even depending on the time of day.

- Other road users that are not direct users of the eCoMove systems should, to some extend, also be taken into account since they put restrictions or other requirements on the eCoMove systems:
  - Emergency vehicles should always be prioritised and eCoMove may never restrict their movements in the road network;
  - Public transport as such is not included in the eCoMove project, but priority rules that are posed by road operators should be taken into account by the eCoMove system;
  - Weak traffic participants: Any changes the ecoTraffic Management & Control system wishes makes to current traffic management and control practice should be guaranteed not to impinge on the safety of these road user groups.

7.2. eCoMove test site deployment

Within the scope of the eCoMove project it will clearly not be possible to deploy a system like eCoMove with all its application on full-scale. Within the project there will be in total 4 passenger vehicles and 2 trucks and depending on the test site a smaller or larger number of road side units that enable the demonstration of the eCoMove applications. At the current time several test sites in several European countries (Germany, Netherlands, France) are foreseen that will be used for various validation tests. A more detailed plan is being developed in SP6.

7.3. Description of the eCoMove System Concept

7.3.1. Description of subsystems and shared components

In the figure below the entities that are included in the eCoMove system concept definition (see Figure 23) are shown.

The eCoMove system consists of three application subsystems:

- **ecoSmartDriving system**: the sub-system that contains all passenger car applications;

- **ecoFreight & Logistics system**: the sub-system that contains all truck-applications;
- **Traffic Management & Control system**: the sub-system that contains all roadside and traffic management centre applications.

These application subsystems are described in more detail in the deliverables D3.1, D4.1 and D5.1 [2]-[4].

The next important entity is the **eCoMove communication platform system**: this system contains all components, applications and databases that enable the cooperation between the three parallel sub-systems – this is a shared subsystem.
The eCoMove communication platform consists of:

- **in-vehicle communication platforms (or Vehicle ITS Station)** that are located inside the vehicle and enable communication with other vehicles and with road side units and central stations through various communication channels. Specific hardware and software will be determined inside the tasks in WP4 of SP2 in close cooperation with SP3 and SP4.
- **roadside unit communication platforms (or Roadside ITS Station)** that are located inside road side units and enable communication with vehicles and central stations. Specific hardware and software will be determined inside the tasks in WP4 of SP2 in close cooperation with SP5.
- **eCoMove communication support centre** that coordinates all communication from and to vehicles and road side units.

Figure 21 describes which entities should be able to receive / transmit data from which other entity. If this communication is centralised or decentralised is still open in this picture. Very probable most information exchange will be centralised through the eCoMove communication support center (see also Figure 23).

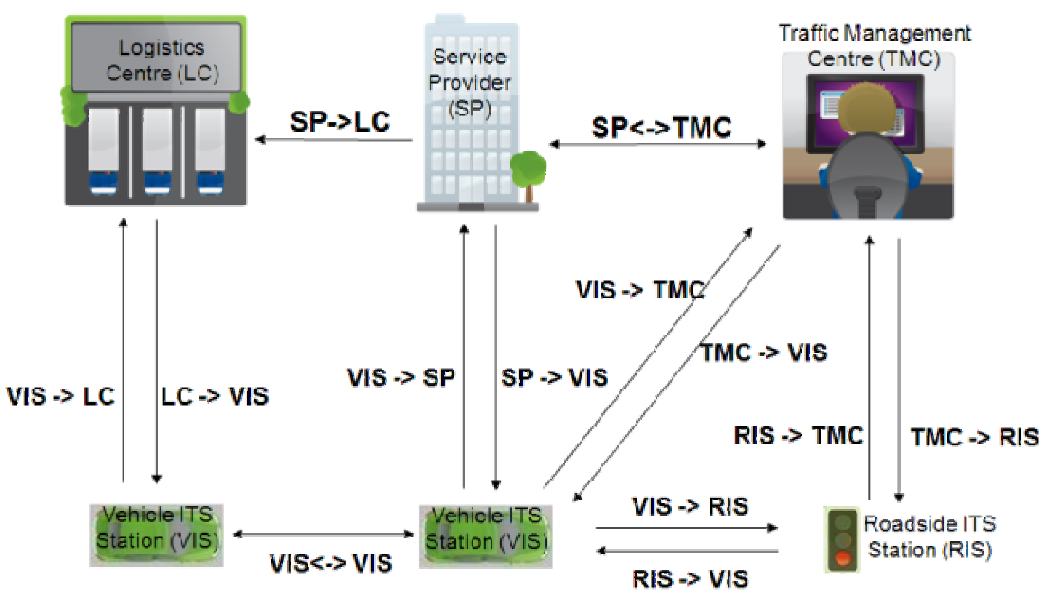


Figure 21: Communication directions within eCoMove (organisational) entities

The ITS stations defined in this overview should preferably be based on the reference architecture as defined within ETSI TC ITS [19] as shown in Figure 22. Within this reference architecture document several deployment scenarios are described which need to be further analysed to determine the best scenario for eCoMove. This should be done within Work Package 4 op the subproject 2 Core Technology Integration.

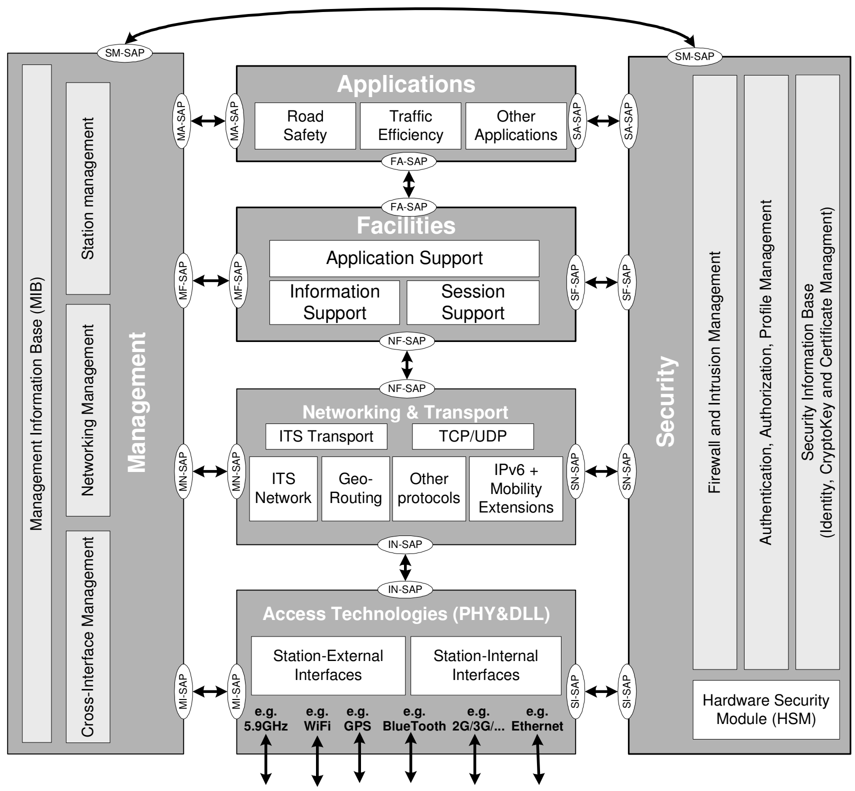


Figure 22: ITS Station Reference Architecture [19]

In other EU-projects or regional projects like CVIS or SIM-TD also already much work has been done on the selection and implementation of relevant communication channels. The communication channels that are used in communication platforms developed in these projects include e.g. GPS, UMTS (3G), 802.11b/g WLAN, 802.11p automotive WLAN, blue tooth, ITS G5, Ethernet. Within eCoMove the requirements from the applications will determine what channels are needed and therefore need to be implemented within eCoMove. Existing (research) platforms can therefore be used as a basis for the communication platform.

The eCoMove communication platform uses **eCoMove messages**. The eCoMove messages will be defined for information exchanges amongst vehicles (V2V), between vehicles and the traffic system (V2I) and between vehicles and data processing and provision services (V2I); these standard messages include an **ecoFVD** message to describe a vehicle's progress, its fuel consumption and its destination, as well as an **ecoTSD** traffic situation data message sent from the traffic system to vehicles; the communication is coordinated through the eCoMove communication support centre. Here all messages from the vehicles, road side units and traffic

management centre are collected and distributed again to the relevant vehicles and road side units.
These eCoMove messages will be based, wherever possible, on already existing standards like the message for exchanging data between vehicles, the Cooperative Awareness Message or CAM (ETSI TS 102 637-2) [21], and the message for broadcasting useful information on road traffic conditions, the so called Decentralised Environmental Notification Message or DENM (ETSI TS 102 637-3) [22] are used as a basis for the cooperative applications in the eCoMove project.
It is already quite clear that these messages currently do not contain all types of information that is needed by the various eCoMove applications, but they do provide a very useful basis. The other way around, the outcomes of the eCoMove project can feedback the findings into the standards on its turn.

In the highest level eCoMove System overview the shared components are:

- **ecoSituational model:** this model has the task to describe the current driving situation and to provide the relevant information with regard to fuel consumption such as speed limit, inclination etc. Additionally the ecoSituational model predicts how the situation will evolve in different time horizons (100m, 500m, 1000 m etc.). The purpose of this model is to provide all relevant information to SP3 and SP4, which is necessary to determine the optimal driving strategy taking into account the current driving and traffic situation and how this will change in the time scope, which is still in the reaction horizon of the driver.
- **ecoStrategic model:** The ecoStrategic model is needed as a basis for the traffic management and control strategies in SP5. Where the ecoSituational model works on the microscopic level, the ecoStrategic model translates the knowledge (included in the situational level) about what causes fuel consumption to be high or low to the macroscopic level (a route or a network). The ecoStrategic model will thus provide information about hot spot events that have a major impact on fuel consumption. These events can be related to the topography/topology of the network (such as steep inclines, areas with many traffic lights in a row etc.) or to the traffic and driving conditions (e.g. stop & go traffic, inefficient merging, etc.).

On eCoMove system level, the **ecoMap** entity is a database entity. The ecoMap entity on its turn contains a static and a dynamic variant. The ecoMap comprises a digital map database enhanced with additional attributes needed for eco-driving support, such as slope, historical speed profile and energy consumption data.

When mapping these entities on the ITS reference architecture, then both the ecoSituational and ecoStrategic model as well as the ecoMap are located in the Facilities layer.

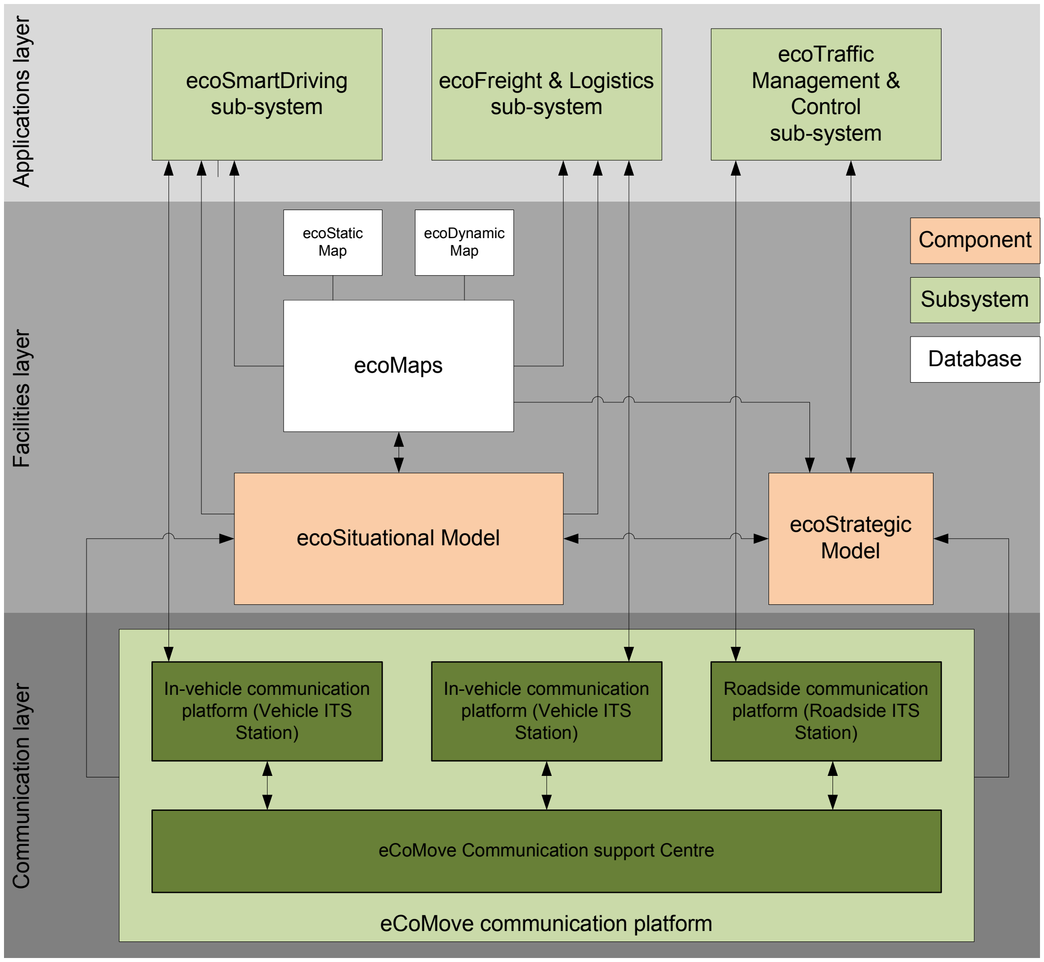


Figure 23: Relations between subsystems and shared component within the eCoMove system

7.3.2. Relation between use cases and applications

In the deliverables of the application subprojects, D3.1, D4.1 and D5.1, a detailed description is given of the applications that are going to be developed in these subprojects and how they reflect the use cases [2]-[4].
In the table below (Table 5) a summary is given of the use cases and how they are covered by the applications.

Table 5: Relation between Use Cases and Applications

		SP3 applications					*SP4 applications*			*SP5 Applications*						
UC Short Name	UC No. (UC_xx)	ecoTRipplanning	ecoInformation	ecoNavigation	ecoDrivingSupport	ecoPosttrip	ecoDriver Coaching System	Truck ecoNavigation	ecoTour Planning	ecoRoute Advice	ecoGreen Wave	ecoBalanced Priority	ecoRamp Metering and Merging	ecoSpeed and Headway Management	ecoTruck Parking	ecoTolling
SP3 Use cases																
Checking Vehicle Condition	SP3_01		X													
Planning ecoTrip	SP3_02	X														
EcoUse of Vehicle Systems	SP3_03		X													
Dynamic ecoNavigation	SP3_04			X												
Dynamic ecoGuidance	SP3_05			X												
Support ecoDriving	SP3_06				X											
In-Vehicle ecoTripFeedback	SP3_07					X										
Off-Board ecoTripFeedback	SP3_08					X										
SP4 Use cases																
Manage Policies	SP4_01								X							
Plan eCoTrip	SP4_02								X							
Authorize eCoTrip	SP4_03								X							
Prepare driving	SP4_04						X	X								
Guide driver	SP4_05							X								
Support ecoDriving	SP4_06						X									
Driver evaluation	SP4_07						X									
Carbon footprint calculation	SP4_08						X		X							
SP5 Use Cases																
Improve parking guidance	SP5_01									X					X	
Improve network usage	SP5_02									X	X	X	X	X		
Improve driver information	SP5_03									X	X	X	X	X	X	X

		SP3 applications					***SP4 applications***			***SP5 Applications***						
UC Short Name	UC No. (UC_xx)	ecoTRipplanning	ecoInformation	ecoNavigation	ecoDrivingSupport	ecoPosttrip	ecoDriver Coaching System	Truck ecoNavigation	ecoTour Planning	ecoRoute Advice	ecoGreen Wave	ecoBalanced Priority	ecoRamp Metering and Merging	ecoSpeed and Headway Management	ecoTruck Parking	ecoTolling
Coordinate traffic controllers	SP5_04									X	X	X				
Support merging	SP5_05												X	X		
Improve intersection control	SP5_06									X	X	X				
Balance intersection control objectives	SP5_07									X	X	X				
Improve ramp control	SP5_08											X	X	X		
Improve lane usage	SP5_09									X	X	X	X			
Improve approach velocity	SP5_10										X	X	X	X		
Improve traffic flow stability	SP5_11												X	X		

7.3.3. Interfaces between subsystems and components

In Figure 23 a scheme is drawn how the different subsystems and shared components are linked to each other.
This model shows that communication between vehicles (both trucks and passenger cars) among each other and with road side units is routed via the eCoMove communication support centre. Here the ecoFVD and ecoTSD data come together and are sent out again to the vehicles and road side units for which the information is relevant.

The ecoSituational Model provides input to the ecoSmartDriving and ecoFreight & Logistics subsystem and also to the dynamic part of the ecoMaps. This model also provides input to the ecoStrategic model that is the main input for the Traffic Management and Control subsystem.
Both models are fed with data from the vehicles and the road side units (ecoFVD and ecoTSD).

Interface relations of subsystems, components and database are summed up in the table below (Table 6). This table concentrates on the interfaces between the shared components, subsystems and databases and the application subsystems. The detailing of the data exchange will be done during the architecture phase, where also will be specified which components are involved in the data exchange. For requirements imposed on the interfaces see Chapter 8.

Table 6: Data exchange between eCoMove system entities

IF side A	Transmit data types A to B →	Receives data types A from B ←	IF side B
ecoSituational Model		Tbd	eCoMove communication platform
	Tbd	Tbd	ecoMaps
	Tbd		ecoSmartDriving
	Tbd		ecoFreight&Logistics
	Tbd	Tbd	ecoStrategic Model
ecoStrategic Model		Tbd	eCoMove communication platform
	Tbd	Tbd	Traffic Mgmt. & Control
		Tbd	ecoMaps
ecoMaps	Tbd		ecoSmartDriving
	Tbd		ecoFreight&Logistics
	Tbd		ecoStrategic Model
	Tbd	Tbd	ecoSituational Model
ecoSmartDriving	ecoFVD	ecoFVD/ecoTSD	eCoMove communication platform
		Tbd	ecoMaps
	Tbd		ecoSituational Model
ecoFreight&Logistics	ecoFVD	ecoFVD/ecoTSD	eCoMove communication platform
		Tbd	ecoMaps
	Tbd		ecoSituational Model
EcoTraffic Management.& Control	ecoTSD	ecoFVD	eCoMove communication platform
	Tbd	Tbd	ecoStrategic Model

7.4. Performance characteristics of the eCoMove system

In Figure 24 an overview is given of possible data items within the eCoMove system and the validity of these items. The validity of these items is a measure that provides input to performance requirements such as update frequencies, update times, accuracy, etc. These are still to be discussed and will be addressed in the functional requirements and further specified in the WP4-phase.

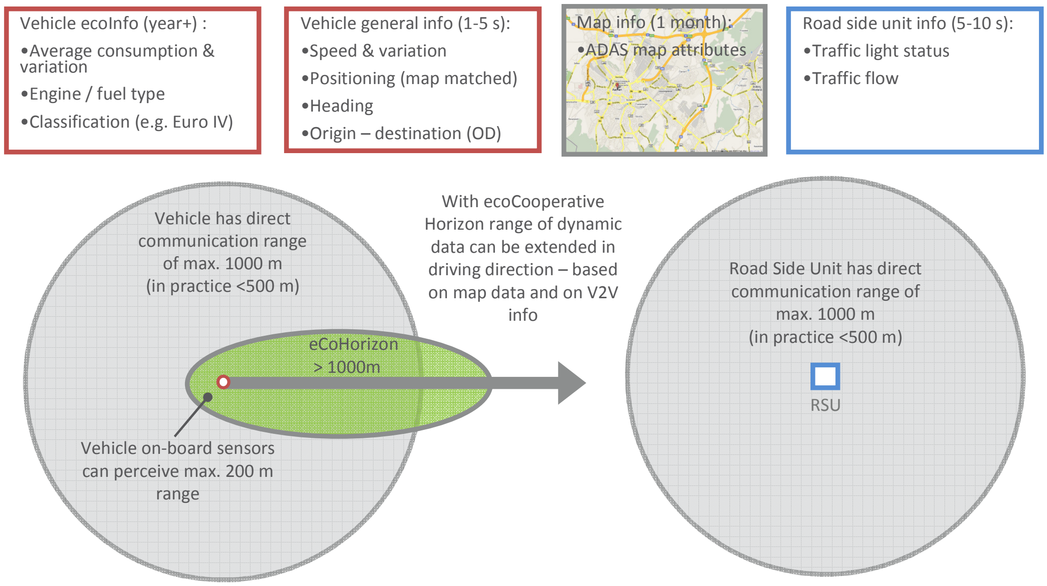


Figure 24: Overview of data items within the eCoMove system

In general, the amount of data to be treated by the eCoMove system is (apart from the static map content) estimated to be at most a few (one digit) Megabyte per ride, which should be able to be exchanged within a few seconds via WLAN or 3G/4G connections. Specific details need to be checked in the next phases of the project and will be subject for the sub project 2 on Core Technologies.

In the next phases of the project, performance requirements on eco messages transmitted are imposed on

- actuality
- spatial resolution
- accuracy
- reliability
- availability
- coverage (area)
- consistency

The same is also the case for ecoMap data regarding:

- actuality
- spatial resolution
- accuracy
- reliability

Another potential performance bottleneck results from cases when the driver unintentionally or intentionally leaves the calculated route. In this case new instructions for the driver should be ready after a few seconds if possible, which imposes requirements on processing power.

7.5. Provisions for safety and security

Safety aspects are touched by eCoMove with respect to

- attention distraction caused by HMI
- changing behaviour of the user and/or vehicle in traffic environment

The first item will be addressed in the design of the ecoHMI within eCoMove, but will not be a primary goal of the development. Based on previous HMI related research findings e.g. in the AIDE project appropriate means are provided to build a safe HMI also for future applications.
The second item is to be considered in every single on-trip use case since reduced safety is in the overall scale always equivalent to a loss of power efficiency.

Privacy issues are touched if relevant information leaves the vehicle. Measures are intended to be provided in the ecoMonitoring application (to be developed in SP3) where all data export matters from individual vehicles are bundled.

Security and privacy are also tangible by intrusion of unauthorized messages into the ecoSmartDriving subsystem. This issue is left for further treatment.

Another issue for privacy and security is the City Logistics component collecting parameters describing a goods distribution trip in the considered urban area and the result of the authorization process. In order to face these issues, the system should use suitable protection mechanisms about user identification, communication protocols and information storage. The ecoFleet Business and the ecoTour Planning applications collect also sensitive information which must be secured.

8. Requirements

This chapter summarises the highest level requirements for the eCoMove project. For the requirements on the applications that are being developed in the applications SPs on ecoSmartDriving, ecoFreight&Logistics and ecoTrafficManagement&Control, please check the deliverables D3.1, D4.1 and D5.1 [2]-[4].

8.1. High level eCoMove requirements

High-level system requirements are requirements on the overall functionality of the eCoMove system. They shall apply to the entire eCoMove system, to every component, service, feature and application that are part of the eCoMove world. The target of these requirements is to ensure that the overall functionality of the eCoMove system fulfils certain criteria. A good example is Security. It needs to be considered throughout the entire eCoMove system. The saying "a chain is as strong as its weakest link" is very illustrative for the Security implementation. Having a number of secure components does not help the overall security of the system if one of the components is non-secure.

It is important to mention that the requirements listed in this chapter have a full-scale deployment scenario as a basis. However, within the eCoMove project it will not be possible to meet all these full-scale deployment requirements. In relevant cases this will be clearly indicated during the following phases of the project.

8.2. Relation of eCoMove requirements to other ITS-project requirements

The requirements in this chapter have been elaborated based on the KAREN/FRAME User Needs and have been cross-checked with COOPERS, CVIS, SAFESPOT and the European ITS Communication Architecture elaborated by COMeSafety.

The User Needs from KAREN/FRAME are categorised into the following groups:

1. General
2. Infrastructure Planning and Maintenance
3. Law Enforcement
4. Financial Transactions
5. Emergency Services
6. Travel Information and Guidance
7. Traffic, Incident and Demand Management
8. Intelligent Vehicle Systems
9. Freight and Fleet Management
10. Public Transport Management

Only the General requirements are considered here. They can be divided into following categories:

1. Architecture properties
2. Data Exchange
3. Adaptability
4. Constraints
5. Continuity

6. Cost/benefits
7. Expandability
8. Maintainability
9. Quality of Data Content
10. Robustness
11. Safety
12. Security
13. User Friendliness

8.2.1. Structure of the requirements tables

The requirement number in column 1 provides a unique ID which enables tracking of the requirements throughout the project. Therefore it is also possible that numbers are missing since requirements have been removed. To ensure reasons for removing are not lost, the requirements are also kept in an excel-file where all removed requirements are also listed including the reason for removal. In this table it is also possible to track changes of requirements.

Column 2 gives the description of the actual requirement.

The owner of the requirement is stated in the column 3 (in the tables below the 'owner' has not yet been defined, this will be done in the following phases). Column 4 is reserved for comments.

Column 3 Owner
These are typically one or more eCoMove SPs or WPs

8.3. High Level system requirements

This Group contains the properties that either the Framework Architecture should possess, or that systems built in conformance to the Framework Architecture should possess.

The list of requirements starts with the ones tackling the goal of the eCoMove project reduction of fuel consumption and CO_2-emission reduction by the development of efficiency applications.

8.3.1. Efficiency applications

REQ NR.	Description	Owner	Comment
ECOM-RQ-IP-0090	The eCoMove System developed should be able to demonstrate the ability to reduce fuel consumption and CO_2 reductions in comparision to the existing system being used.	TBD	
ECOM-RQ-IP-0091	The eCoMove System should provide a co-operative system that helps in reducing the fuel consumption and CO_2 reductions.	TBD	
ECOM-RQ-IP-0092	The eCoMove System developed should support/ coach the driver to drive more fuel efficient.	TBD	

REQ NR.	Description	Owner	Comment
ECOM -RQ-IP-0093	The eCoMove System developed should support the driver with information that helps in reducing the fuel consumption by better tuning and use of vehicle settings (e.g. use of electrical energy consumers).	TBD	
ECOM -RQ-IP-0094	The eCoMove System developed should support the driver / fleet manager to choose the route with lowest fuel consumption.	TBD	
ECOM -RQ-IP-0095	The eCoMove System developed should support the traffic management to optimise system energy efficiency.	TBD	

8.3.2. Architecture Properties

REQ NR.	Description	Owner	Comment
ECOM -RQ-IP-0001	The eCoMove System Architecture description shall include functional, information, physical and communication perspectives.	TBD	
ECOM -RQ-IP-0002	The eCoMove System Architecture description shall include a number of reference models to describe the relationships between the services needed within the traffic and transport system..	TBD	
ECOM -RQ-IP-0003	The eCoMove System Architecture description shall include a glossary to explain all the main concepts described in the architecture.	TBD	
ECOM -RQ-IP-0004	The eCoMove System Architecture shall be provided in a form which enables it to be up-dated after delivery.	TBD	
ECOM -RQ-IP-0005	The eCoMove System Architecture shall be technology independent.	TBD	
ECOM -RQ-IP-0006	The eCoMove System Architecture shall facilitate the creation of modular and flexible designs, so that manufacturers can produce their own versions of equipment.	TBD	
ECOM -RQ-IP-0007	The eCoMove System Architecture shall allow equipment performing the same service to be provided by various suppliers.	TBD	
ECOM -RQ-IP-0008	The eCoMove System Architecture shall allow the same service to be provided by various service providers.	TBD	
ECOM -RQ-IP-0009	The eCoMove System Architecture shall allow the user to select from one of a number of suppliers of the same service.	TBD	
ECOM -RQ-IP-0010	The eCoMove System Architecture shall support interaction between services provided by private and public bodies.	TBD	
ECOM -RQ-IP-0011	The eCoMove System Architecture shall allow current organisational responsibilities and legal liabilities to be retained.	TBD	
ECOM -RQ-IP-0014	The eCoMove System Architecture shall support the integration of Traffic Information Centres and Traffic Control Centres into national and international networks.	TBD	

REQ NR.	Description	Owner	Comment
ECOM -RQ-IP-0016	The eCoMove System Architecture shall require all systems developed from it to use software that is designed according to the most appropriate of the current software design methodologies.	TBD	

8.3.3. Data Exchange

REQ NR.	Description	Owner	Comment
ECOM -RQ-IP-0017	The eCoMove System Architecture shall provide a high level description of the message sets and data communication protocols to be used in data transfers.	TBD	
ECOM -RQ-IP-0018	The eCoMove System Architecture shall provide a high level description of data stores and data flows, and shall have a single data dictionary.	TBD	
ECOM -RQ-IP-0019	Systems that conform to The eCoMove System Architecture shall exchange information in a manner that permits a given geographic location to be understood by all parties.	TBD	
ECOM -RQ-IP-0020	Systems that conform to The eCoMove System Architecture shall exchange information in a manner that permits road and traffic conditions to be understood by all parties.	TBD	
ECOM -RQ-IP-0021	The eCoMove System Architecture shall provide a high level description of the message sets used to exchange data with external interfaces.	TBD	
ECOM -RQ-IP-0022	The eCoMove System Architecture shall support the use of seamless communications. This shall mean that the use of different communication networks is transparent i.e. switches are made without the intervention of the final user.	TBD	
ECOM -RQ-IP-0023	The eCoMove System Architecture shall require systems developed from it to use a communication mechanism that allows flexible routing of messages.	TBD	
ECOM -RQ-IP-0024	The eCoMove System Architecture shall require systems developed from it to be able to send and receive information with a pre-defined position accuracy regardless of where the origin and/or destination are located, e.g. in tunnels, urban areas with building, mountains	TBD	
ECOM -RQ-IP-0025	The eCoMove System Architecture shall require systems developed from it to use V2V and V2I communications standards that will ensure interoperability across Europe.	TBD	
ECOM -RQ-IP-0026	The eCoMove System Architecture shall require systems developed from it to make us of communications (V2V and V2I) that is minimal and adaptable to future applications.	TBD	

8.3.4. Adaptability

REQ NR.	Description	Owner	Comment
ECOM -RQ-IP-0027	Systems that conform to The eCoMove System Architecture shall be able to provide facilities that accommodate the needs of disabled and elderly persons, when relevant.	TBD	
ECOM -RQ-IP-0028	Systems that conform to The eCoMove System Architecture which store data about the travel network (e.g. road network, RSU locations, Green Zones) shall allow that data to be entered and updated	TBD	
ECOM	The eCoMove System Architecture shall not constrain its	TBD	

REQ NR.	Description	Owner	Comment
-RQ-IP-0029	functionality to be implemented in a single topographical domain, be it urban, inter-urban or rural.		
ECOM-RQ-IP-0030	The eCoMove System Architecture shall not constrain its functionality to be implemented by specific local organisations.	TBD	
ECOM-RQ-IP-0031	The eCoMove System Architecture shall not constrain user interfaces to be of a particular type, or from a particular manufacturer.	TBD	
ECOM-RQ-IP-0032	The eCoMove System Architecture shall not require that each of its user interfaces must operate on a specific item of equipment, unless it is for safety reasons.	TBD	

8.3.5. Constraints

REQ NR.	Description	Owner	Comment
ECOM-RQ-IP-0034	The eCoMove System Architecture shall require all systems developed from it to comply with current European and National laws concerning data security, user anonymity and the protection of individual privacy.	TBD	
ECOM-RQ-IP-0035	The eCoMove System Architecture shall require all systems developed from it to comply with the traffic laws and regulations that apply in Europe.	TBD	

8.3.6. Continuity

REQ NR.	Description	Owner	Comment
ECOM-RQ-IP-0036	The eCoMove System Architecture shall provide functionality that enables checking if quality of information content is continuous and consistent, both in time and space (i.e. as the traveller moves).	TBD	
ECOM-RQ-IP-0037	The eCoMove System Architecture shall take into account in the design environmental stress and infrastructure failures.	TBD	

8.3.7. Cost/benefit

REQ NR.	Description	Owner	Comment
ECOM-RQ-IP-0038	Whenever possible and practical, the eCoMove System Architecture shall use the same data as input to several parts of its functionality.	TBD	
ECOM-RQ-IP-0039	The eCoMove System Architecture shall aim to use the same data as input to several parts of its functionality where possible and practical.	TBD	
ECOM-RQ-IP-0040	The eCoMove System Architecture shall aim to have all systems developed from it to be able to use the most cost-effective means of communication available.	TBD	
ECOM-RQ-	The eCoMove System Architecture shall aim that all systems developed from it enable operating costs to be reduced whenever	TBD	

REQ NR.	Description	Owner	Comment
IP-0041	possible, when compared with the systems that they replace.		

8.3.8. Expandability

REQ NR.	Description	Owner	Comment
ECOM-RQ-IP-0042	The eCoMove System Architecture shall allow systems developed from it to have an evolutionary development strategy that enables their continuous upgrading.	TBD	
ECOM-RQ-IP-0043	The eCoMove System Architecture shall provide services that are not constrained to operate in a particular geographic region.	TBD	

8.3.9. Maintainability

REQ NR.	Description	Owner	Comment
ECOM-RQ-IP-0044	The eCoMove System Architecture shall require all systems developed from it to be capable of being repaired.	TBD	
ECOM-RQ-IP-0045	The eCoMove System Architecture shall require all systems developed from it to be easily maintainable with minimum disturbance.	TBD	

8.3.10. Quality of Data Content

REQ NR.	Description	Owner	Comment
ECOM-RQ-IP-0046	The eCoMove System Architecture shall enable all information systems developed from it to provide data with a stated accuracy, either as additional information or as part of the documentation, at all times.	TBD	
ECOM-RQ-IP-0047	The eCoMove System Architecture shall require all systems developed from it to check all input data for validity, whenever possible, and to report failures.	TBD	
ECOM-RQ-IP-0048	The eCoMove System Architecture shall enable all systems developed from it to check data values by comparing different sources, when available, so as to ensure high-accuracy and completeness.	TBD	
ECOM-RQ-IP-0049	The eCoMove System Architecture shall require all systems developed from it to use a databases structure that is compatible on local/regional/national level (i.e. data from local/regional and national databases can be exchanged)	TBD	
ECOM-RQ-IP-0050	The eCoMove System Architecture shall require all systems developed from it to reject all data communicated to it that fails any validity checks.	TBD	
ECOM-RQ-IP-0051	The eCoMove System Architecture shall require all systems developed from it to be able to adjust the speed with which data is accessed according to the need for that data to accurately reflect the current situation.	TBD	
ECOM-RQ-IP-	The eCoMove System Architecture shall require all systems developed from it to support priority, quality and reliability concepts for dynamic content handling and data fusion algorithms.	TBD	

REQ NR.	Description	Owner	Comment
0052			
ECOM -RQ- IP- 0053	The eCoMove System Architecture shall require all systems developed from it to support digital rights management for all data that it uses, particularly where this data is obtained from other systems, e.g. map data.	TBD	

8.3.11. Robustness

REQ NR.	Description	Owner	Comment
ECOM -RQ- IP- 0054	The eCoMove System Architecture shall allow all systems developed from it to be able to detect errors in operation, when higher integrity is required, e.g. for financial, security or safety reasons.	TBD	
ECOM -RQ- IP- 0055	Systems that conform to the eCoMove System Architecture shall be able to monitor each safety-related component (including software), warn the user in case of problems, and disable it, or reduce it to a safe state.	TBD	
ECOM -RQ- IP- 0056	The eCoMove System Architecture shall require all safety-related systems developed from it to be fault tolerant.	TBD	
ECOM -RQ- IP- 0057	The eCoMove System Architecture shall require all systems developed from it to be reliable with respect to the legal and/or quality requirements necessary for each application.	TBD	
ECOM -RQ- IP- 0058	The eCoMove System Architecture should aim that all systems developed from it are able to operate in all potential climatic and traffic conditions.	TBD	
ECOM -RQ- IP- 0059	The eCoMove System Architecture shall require all systems developed from it to be able to provide the required levels of security and data integrity protection and counter measures without having a permanent link to a control or certification centre.	TBD	
ECOM -RQ- IP- 0060	The eCoMove System Architecture shall require all systems developed from it to provide redundancy in operation where the manipulation of data and output of commands and/or information to the driver is safety critical.	TBD	

8.3.12. Safety

REQ NR.	Description	Owner	Comment
ECOM -RQ- IP- 0061	The eCoMove System Architecture shall provide functionality that operates in a manner that does not generate a safety hazard for its users.	TBD	
ECOM -RQ- IP- 0062	The eCoMove System Architecture shall provide functionality that operates in a manner that does not encourage unsafe behaviour.	TBD	
ECOM -RQ- IP- 0063	The eCoMove System Architecture shall provide functionality that operates in a safe manner during degraded modes of operation.	TBD	
ECOM -RQ- IP- 0064	The eCoMove System Architecture shall provide functionality that is ultimately under the control of the human operator.	TBD	
ECOM -RQ- IP- 0065	The probability to provide the user with a corrupted or false information shall be lower than x %	TBD	

8.3.13. Security

REQ NR.	Description	Owner	Comment
ECOM-RQ-IP-0066	The eCoMove System Architecture shall require that systems developed from it are capable of surviving accidental and intentional attacks on their integrity.	TBD	
ECOM-RQ-IP-0067	The eCoMove System Architecture shall require systems developed from it to provide protection against unauthorised access.	TBD	
ECOM-RQ-IP-0068	The eCoMove System Architecture shall require systems developed from it to include mechanisms that require users to be authorised before they can gain access to any of the services that it provides.	TBD	
ECOM-RQ-IP-0069	The eCoMove Systems developed should ensure anonymity against unauthorized parties	TBD	
ECOM-RQ-IP-0070	The eCoMove Systems developed should preserve resolvable pseudonymity for security reason	TBD	
ECOM-RQ-IP-0071	The eCoMove Systems developed should enable accountability and non-repudiation	TBD	
ECOM-RQ-IP-0073	The security overhead shall not use more than (tbd) % of the computing cycles because the system or nodes need to deal with abundant message processing for communication.	TBD	
ECOM-RQ-IP-0074	ITS Stations have to process security functions (integrity check of a message, decryption etc.) for every received message.	TBD	
ECOM-RQ-IP-0075	The security functionality is mandatory for every ITS Vehicle Station.	TBD	
ECOM-RQ-IP-0077	The ITS Station has to employ the service securely even with intermittent ITS Operation Support connectivity.	TBD	
ECOM-RQ-IP-0078	Fleet Operator privacy: Fleet information (position, cargo, destination, etc) must not be spread to people or systems not needing the information. Unauthorised access to information shall not be possible.	TBD	

8.3.14. User Friendliness

REQ NR.	Description	Owner	Comment
ECOM-RQ-IP-0080	The eCoMove System Architecture shall require all systems developed from it to be simple and efficient for the end users, and easy to understand.	TBD	
ECOM-RQ-IP-0081	The eCoMove System Architecture shall require all interactive systems developed from it to have a user interface syntax that is easy to learn and to remember (especially for users with specific needs).	TBD	
ECOM-RQ-IP-0082	Systems developed from the eCoMove System Architecture shall produce their output within a time that is sufficient to be useful, and within normal expectations.	TBD	
ECOM-RQ-	The eCoMove System Architecture shall require all systems developed from it to provide facilities that enable their users to	TBD	

REQ NR.	Description	Owner	Comment
IP-0083	control the speed and frequency of information presentation.		
ECOM-RQ-IP-0084	The eCoMove System Architecture shall ensure that the safety and security of systems developed from it are not compromised by their ease of use.	TBD	
ECOM-RQ-IP-0085	The eCoMove System Architecture shall require all systems developed from it to use a harmonized and standardized set of driving recommendations, icons and messages.	TBD	

8.4. Additional Requirements

In addition to the KAREN/FRAME system requirements, the eCoMove IP has in its Core Architecture Requirements deliverable described some general requirements on the integration of eco traffic management centers.

8.4.1. Integration of eco traffic management centres

REQ NR.	Description	Owner	Comment
ECOM-RQ-IP-0088	The eCoMove System shall be able to integrate environmental, traffic control and traffic information information from a traffic management center to improve vehicle applications dealing e.g. with the reduction of fuel consumption	TBD	
ECOM-RQ-IP-0089	The eCoMove System shall be able to provide additional information from the vehicles to the traffic management center to support the traffic management to optimise system energy efficiency	TBD	

8.5. Core technology requirements

8.5.1. Communication platform

REQ NR.	Description	Owner	Comment
ECOM-RQ-SP2-0001	The eCoMove System developed should be platform Independent	TBD	
ECOM-RQ-SP2-0002	the eCoMove platform should be CVIS compatible	TBD	
ECOM-RQ-SP2-0003	the eCoMove platform should be MOOVE compatible	TBD	
ECOM-RQ-SP2-0004	eCoMove platforms should be interoperable	TBD	
ECOM-RQ-SP2-0005	SP2 should provide harmonised communication interfaces for every eCoMove platform	TBD	
ECOM-RQ-SP2-0006	Characteristic distance of V-I communication: The RSU is expected to communicate with vehicles in 300m range	TBD	

REQ NR.	Description	Owner	Comment
ECOM-RQ-SP2-0007	The ecoFVD and eco TSD message must be delivered to destination node within the range of (tbd) millisec (single hop API – to – API timing)	TBD	
ECOM-RQ-SP2-0008	The eCoMove platform should support information exchange between center ITS stations and vehicle or roadside ITS stations using 3G communication	TBD	

8.5.2. Communication system

REQ NR.	Description	Owner	Comment
ECOM-RQ-SP2-0009	The eCoMove System shall support two-way roadside-to vehicle communication (point-to-point).	TBD	
ECOM-RQ-SP2-0010	The eCoMove System shall support two-way vehicle-to vehicle communication (point-to-point)	TBD	
ECOM-RQ-SP2-0011	The eCoMove System shall support one-way roadside-to vehicle communication (point-to-multi-point) by broadcasting to a specific area (geo-broadcast)	TBD	
ECOM-RQ-SP2-0012	The eCoMove System shall support one-way vehicle-to-vehicle communication (point-to-multi-point) by broadcasting to a specific area (geo-broadcast)	TBD	
ECOM-RQ-SP2-0013	The eCoMove System shall be able to transport a message into a specific area (geo-cast)	TBD	
ECOM-RQ-SP2-0014	The eCoMove System shall support communication between RSUs	TBD	

8.5.3. ecoSituational model

REQ NR.	Description	Owner	Comment
ECOM-RQ-SP2-0015	The ecoSituational model should describe, forecast and integrate for a vehicle the current driving situation and the dynamics of nearby vehicles and the traffic control system	TBD	
ECOM-RQ-SP2-0016	The ecoSituational model has to supply all applications (such as the strategic model (T2.4.4.1), the ecoNetwork Prediction (T5.4.2.1) and the ecoEmission (T5.4.2.2)) with situational data and predicted vehicle velocity profiles in the resolution as required by the applications (tbd).	TBD	The ecoSituational model has to supply all applications (such as the strategic model (T2.4.4.1), the ecoNetwork Prediction (T5.4.2.1) and the ecoEmission (T5.4.2.2)) with all necessary information in the demanded resolution, which is constrained by the performance of the communication platform.
ECOM-RQ-SP2-0017	The ecoSituational model should use all available sensors of the vehicle and should be able to work with different sensor combinations. It should check the signals and derives information with the highest accuracy.	TBD	

REQ NR.	Description	Owner	Comment
ECOM -RQ-SP2-0018	The ecoSituational model should observe the behaviour of the driver (on-trip) in specific situations and improves the predictions based on this.	TBD	
ECOM -RQ-SP2-0019	The ecoSituational model should be applicable for hybrid vehicles (trucks and cars) as well as for vehicles (trucks and cars) with an ordinary drivetrain concept.	TBD	

8.5.4. ecoMessage

REQ NR.	Description	Owner	Comment
ECOM -RQ-SP2-0020	The eCoMove messages should provide information on vehicle's progress, its fuel consumption and its destination	TBD	
ECOM -RQ-SP2-0021	The eCoMove messages should provide information on traffic situation data to be sent to vehicles in the vicinity	TBD	
ECOM -RQ-SP2-0022	The eCoMove Messages should use a common standard that could help in easy processing of messages by the required applications	TBD	
ECOM -RQ-SP2-0023	Vehicle to Vehicle (V2V) and Vehicle to Infrastructure (V2I) messages should make use of the existing standard (e.g. TS 102 637-2 CAM, Cooperative Awareness Message)	TBD	
ECOM -RQ-SP2-0024	ecoMessages are map independend referenced (TBD)	TBD	

8.5.5. ecoMap

REQ NR.	Description	Owner	Comment
ECOM -RQ-SP2-0025	The ecoMap should provide a digital map database enhanced with additional attributes needed for ecodriving support, such as slope, historical speed profile and energy consumption data	TBD	
ECOM -RQ-SP2-0026	ecoMap (TBD) information should be accessible by every eCoMove application	TBD	
ECOM -RQ-SP2-0027	SP2 should provide harmonised interfaces for ecoMap access	TBD	
ECOM -RQ-SP2-0028	Map database shall contain information about number of lanes	TBD	
ECOM -RQ-SP2-0029	Map database shall contain information about bus lane presence	TBD	
ECOM -RQ-SP2-0030	Map database shall include details about infrastructure elements (e.g. Road Side Unit) including type and location	TBD	
ECOM	Map database shall include information about area restricted to heavy	TBD	

REQ NR.	Description	Owner	Comment
-RQ-SP2-0031	vehicle access		
ECOM-RQ-SP2-0032	Map database shall contain information about Parking Zones	TBD	
ECOM-RQ-SP2-0033	Map database shall make allowance for enhanced geometry representation for specific areas (e.g. complex and dangerous intersections)	TBD	
ECOM-RQ-SP2-0034	Local map database (urban intersection) shall include details about traffic control infrastructure elements (e.g. detectors, traffic lights) including type and location	TBD	
ECOM-RQ-SP2-0035	Local map database (interurban) shall include speed limits (category specific)	TBD	
ECOM-RQ-SP2-0037	Local map database shall include details (TBD) about vehicles including (host vehicle)	TBD	
ECOM-RQ-SP2-0038	The supply positioning feature shall provide the best positioning data considering TBD various measurements	TBD	

8.6. Interface requirements

To support the definition of the eCoMove system architecture it was one main task of WP2 to identify and name the interfaces especially between the SPs. A sound system architecture and the smooth development of applications can only realised if there is already a common understanding of the future interfaces between the functional entities available.

In the following the interface requirements between SP3, SP4 and SP5 are listed. Requirements towards SP2 are already handled in the previous chapter.

8.6.1. SP3 – SPX interfaces

REQ NR.	Description	Owner	Comment
ECOM-RQ-SP3-0001	The ecoTripPlanning application should be able to access TrafficStatePredictions (SP5) to enable the system to check the relevant traffic data for optimal planning of the trip (incl. ecoRoute).	TBD	
ECOM-RQ-SP3-0011	Given requirement SP3 0001, the ecoTripPlanning application should access TrafficStatePredictions (SP5) at the following times: a. One day or more before the trip: based on historic traffic profiles – check should be done daily b. Day of the trip	TBD	
ECOM-RQ-SP3-0002	Dynamic ecoNavigation must access the static ecoMap, the interface is TBD.	TBD	
ECOM-RQ-SP3-	Dynamic ecoNavigation should access dynamic traffic information.	TBD	

REQ NR.	Description	Owner	Comment
0003			
ECOM-RQ-SP3-0004	Dynamic ecoNavigation should access situational data from Road-Side Units and floating car data from other vehicles via the dynamic ecoMap.	TBD	
ECOM-RQ-SP3-0005	Dynamic ecoNavigation should access MPP from ecoHorizon.	TBD	
ECOM-RQ-SP3-0006	Dynamic ecoNavigation should receive route advice from traffic centre.	TBD	
ECOM-RQ-SP3-0007	The ecoMonitoring application should be able to provide the ecoFVD message (incl. destination information) to the communication platform	TBD	
ECOM-RQ-SP3-0008	The control centre should define some specific TBD parameters to be received by the ecoMonitoring system for any trip of the vehicle. [The parameters could be: vehicle parameters: speed, rpm, brake pedal status, fuel level, cruise control if available, clutch status, stop&start if available, external temperature, fuel consumption, gas pedal, acceleration longitudinal/lateral. trip parameters: starting and ending position, travelling time, travelling distance, roads slope.]	TBD	
ECOM-RQ-SP3-0009	Traffic lights controller should transmit to each eCoMove vehicle within reach: • Location reference of traffic lights • Residual red display times for each driving direction	TBD	

8.6.2. SP4 – SPX interfaces

REQ NR.	Description	Owner	Comment
ECOM-RQ-SP4-0001	ecoTour Planning requires mid and long-term traffic state predictions from SP5	TBD	
ECOM-RQ-SP4-0002	Truck ecoNavigation requires from SP5 the: • Actual traffic state • Short term traffic state predictions • Network optimal routes	TBD	
ECOM-RQ-SP4-0003	The ecoDriver Coach requires from SP5: • Traffic signal states • Local advices that are relevant for the current driving situation.	TBD	

8.6.3. SP5 – SPX interfaces

REQ NR.	Description	Owner	Comment
ECOM-RQ-SP5-0003	SP5 should provides traffic state and forecast information to the vehicles and other service provider		Format TBD (e.g. TPEG-TFP)
ECOM-RQ-SP5-0004	SP5 should provides traffic event and strategy information to the vehicles and other service provider		Format TBD (e.g. TPEG-TEC); including route advices and restrictions

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