# Cooperative Mobility Systems and Services for Energy Efficiency

| D3.3 | Functional architecture and specifications for ecoMonitoring & ecoPostTrip |
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| **SubProject No.** | **3** | **SubProject Title** | **ecoSmartDriving** |
| **Workpackage No.** | **3.3** | **Workpackage Title** | **Architecture & System Specifications** |
| **Task No.** | **3.3.2** | **Task Title** | **Application and functional architecture and specification: ecoMonitoring & ecoPostTrip** |
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| **Abstract** | The SP3 - ecoSmartDriving sub project is focused on helping the driver of a passenger car to plan a trip in the most energy efficient way and to drive on the planned route in the most fuel efficient way. At the end of the trip, the ecoSmartDriving helps the driver to analyze how the driving behaviour influences fuel consumption of the vehicle.<br><br>This document, together with the companion D3.2, defines the architecture of the ecoSmartDriving applications, which is the result of the work package 3 of SP3 sub project.<br><br>It has been organized in cooperation with the work package 3 of the sub project 2, which had the role of coordinating all the other sub projects to provide architectures for all applications of vehicles, fleets and road side units interfacing among each other correctly.<br><br>The starting points of the architecture design were the use cases & requirements defined in the previous work package 2.<br><br>The architecture of the applications was then designed sequentially, from the system level design to the architectural design. The first designs each application as a set of black boxes interacting and interfacing among them and with other black boxes provided by external applications (present on road side units and traffic control centers).<br>The second layer of design inspected the single black boxes to show how they will be expanded in multiple functions to be then implemented in the next work package 4.<br><br>The applications have been split in the two deliverables of the work package 3: this deliverable D3.3 includes the applications of the post trip phase: ecoMonitoring and ecoPostTrip.<br>During the design of the applications, the ecoMonitoring resulted to be useful for the onTrip phase also, so it was designed for both phases, and left in this deliverable.<br><br>Additionally, it includes also the first temptative of definition of the Trip Data Set, which stores the information related to the vehicle, the driver, the trip performed and the previous ones, the comparisons among trips, and all the other data to be used during all the phases of the trip. |
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# Control sheet

| Version history | | | |
|---|---|---|---|
| **Version** | **Date** | **Main author** | **Summary of changes** |
| 0.1 | 16-11-2010 | M. De Gennaro (Magneti Marelli) | Initial template from the common template of D2.2 |
| 0.2 | 01-12-2010 | J. Tran (Continental) | First draft for D3 .3 deliverable based on D3.2 template proposal. |
| 0.3 | 15-12-2010 | J. Tran (Continental) | Including finalized Business Layer diagrams, Requirements traceability matrix |
| 0.4 | 05-01-2011 | M. De Gennaro (Magneti Marelli) | Revision of the entire deliverable. |
| 0.5 | 18-01-2011 | M. De Gennaro (Magneti Marelli) | Update of the ecoMonitoring application BL AL TL and traceability matrix. |
| 0.6 | 21-01-2011 | M. De Gennaro (Magneti Marelli) | Update of the ecoPostTrip application, BL, AL, TL and traceability matrix. |
| 0.7 | 25-01-2011 | F. Tosetto (Magneti Marelli) | Update of the ecoMonitoring diagram of BL, AL and ecoPostTrip and ecoMonitoring traceability matrix. |
| 0.8 | 28-01-2011 | F. Tosetto (Magneti Marelli) | Added the ecoHMI traceability matrix. |
| 0.9 | 01-02-2011 | F. Tosetto (Magneti Marelli) | Added paragraph 3.3 Use Case covered by Applications. |
| 0.10 | 01-02-2011 | F. Tosetto (Magneti Marelli) | Update tripDataSet traceability matrix. |
| 0.11 | 02-02-2011 | M. De Gennaro (Magneti Marelli) | Update of the last version of ecoPostTrip, added the chapter with the general diagrams BL and TL. |
| 0.12 | 04-02-2011 | J. Subbian (FFA) | Update of the descriptions of ecoPostTrip, added comments. |
| 0.13 | 07-02-2011 | M. De Gennaro, F. Tosetto | Inserted appendices with general diagrams and tables |

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|---|---|---|---|
| | | (Magneti Marelli) | of interfaces of ecoMonitoring and ecoPostTrip with other SP3 applications. |
| 0.14 | 09-02-2011 | S. Damiani (CRF) | Added the TripDataSet description |
| 0.15 | 10-02-2011 | M. De Gennaro (Magneti Marelli) | Update of the TripDataSet description |
| 0.16 | 10-02-2011 | S. Damiani (CRF) | Update of the ecoPostTrip description and reviews some diagrams |
| 0.17 | 11-02-2011 | M. De Gennaro (Magneti Marelli) | Added the SP3 requirements table in the annex. |
| 0.18 | 16-02-2011 | M. De Gennaro (Magneti Marelli) | Update of the table of Terms and definitions |
| 0.19 | 16-02-2011 | J. Subbian (FFA) | Review of the deliverable and updates in some chapters. Added the abstract. |
| 1.0 | 11-03-2011 | M. De Gennaro (Magneti Marelli) | Update of the deliverable after the peer review process. |
| 2.0 | 02-09-2011 | C. Jankowiak (Continental) | Upgraded with answers to the Commission Reviewer's comments |

| | **Name** | **Date** |
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| Prepared | M. De Gennaro (Magneti Marelli) | 11-03-2011 |
| Reviewed | J-Ch. Pandazis (ERTICO) | 14-03-2011 |
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***Terms and definitions***

| Term | Abbreviation. | Definition |
|---|---|---|
| Application Layer | AL | Diagram used to design an application as collection of interacting functions. |
| Business Layer | BL | Diagram used to design an application at high layer, defining the users, the events, the processes and the services involved in the application. |
| Configuration Item | CI | a collective term used for referring to both software configuration items (a group of software treated as a single entity: operating systems, drivers, system software layers, databases, applications) and hardware configuration items (a set of hardware treated as a single entity: processors, storage devices, network cards, radio antennas, GPS receivers). |
| database | DB | an organized collection of data for one or more uses |
| developer | | one who programs or designs the system to match the requirements of the project |
| eCoMove Modeling Language | eML | Modeling language used to design the architecture of the applications |
| eco Floating Vehicle Data | ecoFVD | Eco Data about individual vehicles, to be transmitted by V2X communications |
| ecoCooperativeHorizon | | logical view of the road ahead of the vehicle, addresses both service and data object |
| ecoRecommendations | | Output provided by ecoTripPlanning, ecoDrivingSupport, and ecoInformation applications |
| ecoRoute | | Route provided by ecoNavigation application |
| ecoSituationalModel | | Service to supply different applications with information on current and predicted vehicle and traffic states. |
| interface | | a point of interaction between two systems |
| In Vehicle Data | | A subset of vehicle data stored in temporary memory for two main purposes: temporary (trip) data history; exchange within applications or services |
| Most Probable Path | MPP | Sequence of the most likely successor links to current position |
| OEM Gateway | | Component used for access to vehicle data |
| Out of Car Data | | A set of data related to the trip planning out of the car. |
| Route advice | | recommendations which parts of the road network to use or not to use, provided by |

| | | |
|---|---|---|
| | | TCC/TMC |
| service | | a set of related software functionalities, together with the policies that should control its usage |
| situational data | | Short-range data describing the local traffic situation. Current data and/or predictions for a short time scale (seconds to minutes). Received by V2I communications from roadside units, or computed locally by the ecoSituationalModel from ecoFVD. |
| system | | a set of interacting or interdependent entities forming an integrated whole |
| Technology Layer | TL | Diagram used to design an application at lowest level as software bundle with several modules. |
| Traffic Control Center/ Traffic Management Center | TCC/TMC | Provider of long-range data describing flow |
| Traffic information | | long-range data describing flow patterns and traffic events. Can be current data or predictions for a medium time scale (in the order of hours), provided by TCC/TMC |
| Trip Data Set | | a subset of In Vehicle data or data obtained from them. The driver characteristic are also part of this data set. The purpose of these data is mainly related to a long term memory for different purposes (i.e. maintenance, ecoPoint collections, list of previous destination, other to be defined). |
| Vehicle data | | Data obtained mainly via OEM gateway |
| Vehicle parameters | | set of data used to describe the main vehicle characteristic that have relevance for the ecoMove applications. |

# 1. Scope

## 1.1. Identification

This deliverable D3.3, together with the companion D3.2, describes the architecture of the eCoMove SP3 applications.

In D3.3 the focus will be on the postTrip applications, which work after that the trip is ended: the applications are ecoPostTrip and ecoMonitoring.

In the D3.2. the focus will be on the applications related to the preTrip and onTrip phases.

The set of applications described in the present deliverable is shown in the upper layer of Figure 1, where the applications themselves are colored in dark green. The representation refers to the identical view in D3.1 [1]**Erreur ! Source du renvoi introuvable.**.

The current deliverable includes also the description of the TripDataSet, which is a common collector of data used by the ecoSmartDriving applications, in the three phases of the trip.

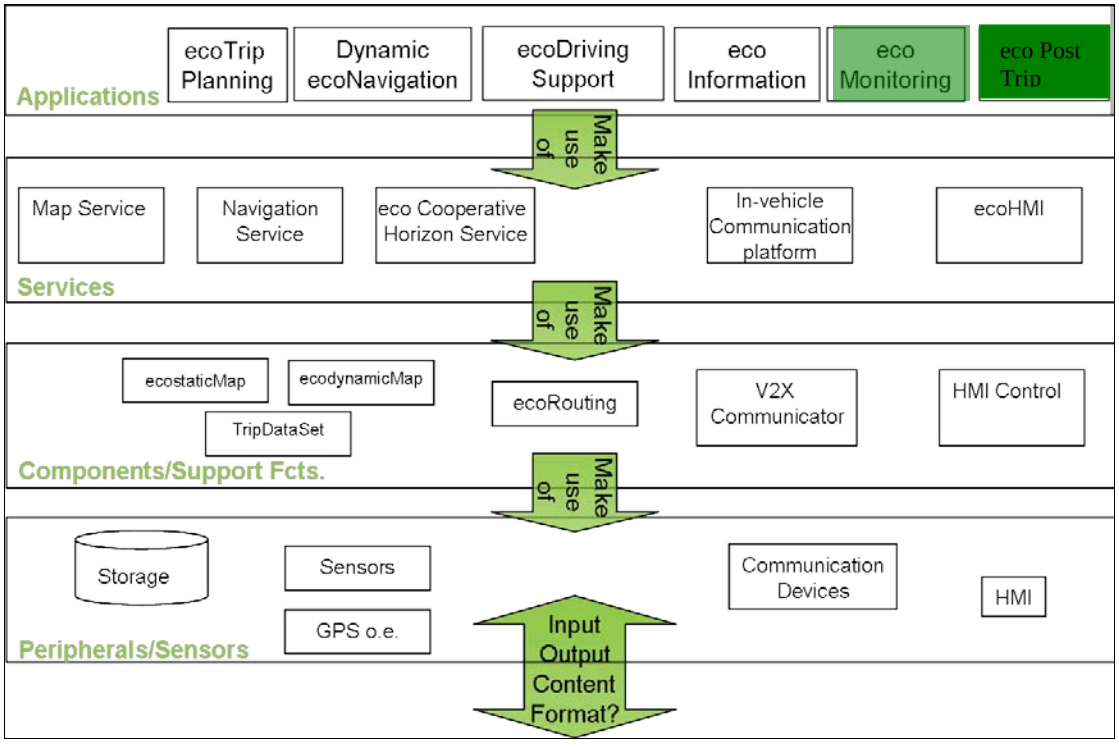



***Figure 1**: SP3 applications and components*

The deliverable D3.3 addresses the concepts and solutions of the architecture and the specifications as represented in the V - Diagram of overall eCoMove process in Figure 2, as far as used for the ecoPostTrip &

ecoMonitoring applications. Further, this document complements the system concept description given in D3.1.

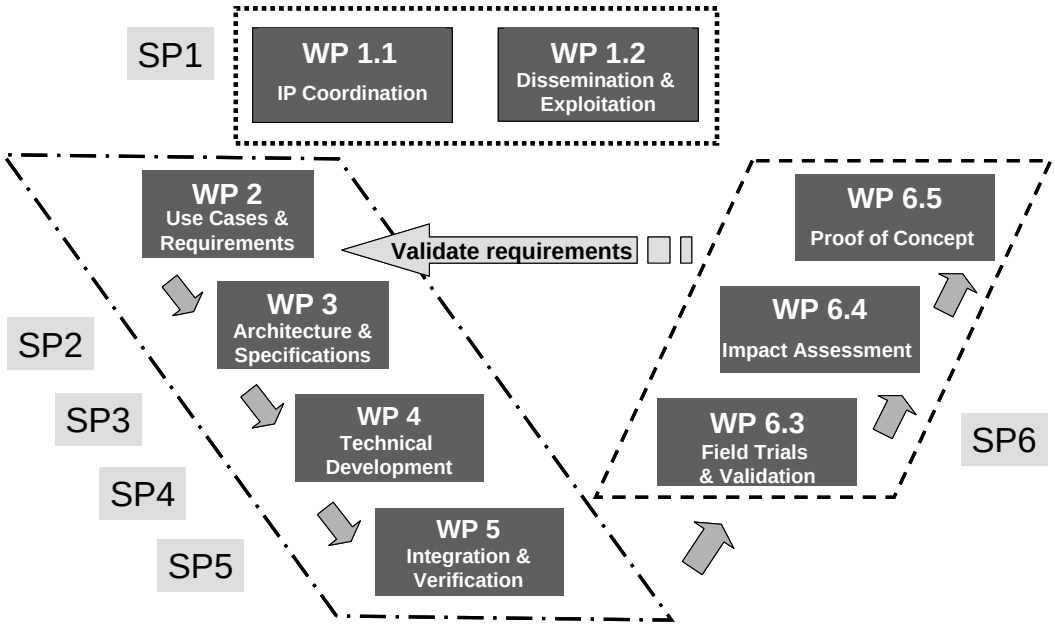



*Figure 2: V-Diagram of overall eCoMove process*

## 1.2. System overview

The SP3 applications described within this deliverable are ecoMonitoring and ecoPostTrip.

The **ecoMonitoring** application is active in the onTrip and postTrip phase. It is the basis for the eco Floating Vehicle Data - ecoFVD, and derives relevant information from the TripDataSet that is also used for the ecoPostTrip application and distributes it to the Traffic Control Centre in a fully anonymous way to protect drivers' privacy. The ecoFVD information will also be available while the vehicle is driving on the road.

The **ecoPostTrip** application is based on the drivers TripDataSet that is an essential component of the whole chain of eco applications as it will be the key to understand how the driver is driving. The information derived will be used to optimize the eco driving parameters and the provision of dedicated information to the driver; this application is foreseen to be available on-board of the vehicle, but in a more extensive version also off-board. The ecoPostTrip application will be made available either immediately after driving (providing feedbacks on how ecologically the driver has been driving) or/and be made available for subsequent downloading for a detailed analysis of driving behavior.

## 1.3. Document overview

### 1.3.1. Intended Audience

This document will address concepts and solutions for the development of the architecture and the specifications that will be used for the ecoMonitoring & ecoPostTrip applications. As such it addresses the developer for whom it provides information about the entities to be developed.

### 1.3.2. Document Structure

Chapter 2 lists the referenced documents.

Chapter 3 - System-wide design decisions, gives high level representations of the ecoMonitoring and ecoPostTrip applications, using the Business Layer diagrams. The purpose is to give a general but complete representation in terms of roles, services, processes and objects necessary to provide the intended functionalities of the applications. From this view interfaces to other applications also from other subprojects are identified (and specified below in this document).

Chapter 4 - System Architectural Design, gives a more interior view for each application. Application internal services and processes are represented with more details in the Application Layer diagrams and broken down to components in the Technology Layer diagrams.

Chapter 5 - Interface Design, gives an overview over the objects to be handled among applications from different sub-projects.

Chapter 6 – Trip Data Set description, gives an overview of the data shared among all applications of SP3 during the different steps of the trip (pre trip, on trip and post trip).

Chapter 7 - Requirements traceability, gives references of use cases and requirements identified in the previous deliverable to the applications as described above. This serves to make sure of requirements coverage.

Then, three Appendices have been placed to represent the interaction of the SP3 applications. Appendix A - List of General Object Exchange Tables, shows for each SP3 application described in the present deliverable, the set of used inputs and provided outputs. Appendix B - Diagrams including all applications, shows two general diagrams including all SP3 applications and their relations. Appendix C – SP3 requirements, summarizes the requirements for the applications of SP3, which come from [1].

# 2. Referenced documents

[1] Eikelenberg, N. e.a., D3.1 Use cases and requirements for ecoSmartDriving (SP3), eCoMove-project deliverable, October 2010. https://service.projectplace.com/pp/pp.cgi/d536525587/100927-DEL-D3.1-ecoSmartDriving-Use-cases-and-System-Requirements-v08.pdf?save_as=1

[2] Schmits, T, Traceability Matrix (SP2), available at: https://service.projectplace.com/pp/pp.cgi/d551990917/101213-DOC-Traceability_Matrix_template-TS.xls?save_as=1 (internal Project document)

[3] Schmits T, D2.2 High Level Architecture, in submission.

[4] Zhang W. e.a., D2.5 – Preliminary definition of ecoMessages, - in preparation.

# 3. System-wide design decisions

The System-wide design has the objective to define the functional architecture of the SP3 applications in terms of configuration items which will be connected to each other, exchanging some useful data related to the vehicle itself, and eventually to other vehicles, infrastructures, traffic information, and so on. This first design thus helps to highlight the possible connection between the vehicle applications and the applications coming from external sources. The interactions will be exploited then in Chapter 5.

The description of the single applications has been done using a common instrument for design, which is eML (eCoMove Modeling Language). The eML tool allows showing for each function, who are the involved actors, which processes are executed with their own inputs/outputs, and how these processes are implemented using functions and finally components.

All technical SubProjects of eCoMove use eML to model their applications, thus it has been defined a color coding to represent the objects of the single subprojects.

The complete description of eML is present in [2], while in the next Figures are reported the concepts used to model the applications at all layers, Business, Application, Technology and to represent the interfaces.

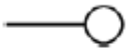
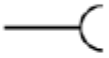
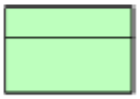
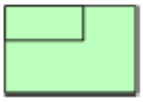
| Concept | Description | Notation |
|---|---|---|
| Business process | A unit of internal behavior or collection of causally related units of internal behavior intended to produce a defined set of products and services. |  |
| Business event | Something that happens (internally or externally) and influences behavior. |  |
| Business actor | An organizational entity that is capable of performing behavior. |  |
| Business role | A named specific behavior of a business actor participating in a particular context. |  |
| Business service | An externally visible unit of functionality, which is meaningful to the environment and is provided by a business role. |  |
| Business Interface, Provided | Declares how a business role can connect with its environment: provides the interface |  |
| Business Interface, Required | Declares how a business role can connect with its environment: requires a provided interface |  |
| Business object | A unit of information that has relevance from a business perspective. |  |
| Product | A coherent collection of services, accompanied by a contract/set of agreements, which is offered as a whole to (internal or external) customers. |  |

*Figure 3: eML Business Layer quick reference.*

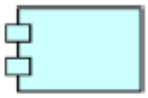
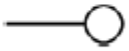
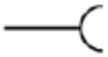
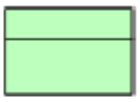
| Concept | Description | Notation |
|---|---|---|
| Application Component | A modular, deployable, and replaceable part of a system that encapsulates its contents and exposes its functionality through a set of interfaces. |  |
| Application Interface, Provided | An application interface declares how a component can connect with its environment: provides the interface |  |
| Application Interface, Required | An application interface declares how a component can connect with its environment: requires a provided interface |  |
| Data Object | A coherent, self-contained piece of information suitable for automated processing. |  |
| Application Function | A coherent group of internal behavior of a component. |  |
| Application Service | A unit of behavior jointly performed by two or more collaborating components. |  |

*Figure 4: eML Application Layer quick reference.*

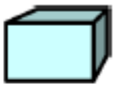
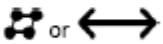
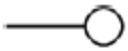
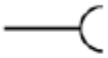
| Concept | Description | Notation |
|---|---|---|
| Node | A computational resource upon which artifacts may be deployed for execution. |  |
| Device | A physical computational resource upon which artifacts may be deployed for execution. |  |
| Network | A physical communication medium between two or more devices. |  |
| Communication path | A link between two or more nodes, through which these nodes can exchange information. |  |
| Infrastructure Interface, Provided | A point of access where the functionality offered by a node can be accessed by other nodes and application components: provides the interface |  |
| Infrastructure Interface, Required | A point of access where the functionality offered by a node can be accessed by other nodes and application components: requires a provided interface |  |
| System software | A software environment for specific types of components and objects that are deployed on it in the form of artifacts. |  |
| Infrastructure Service | An externally visible unit of functionality, provided by one or more nodes, exposed through well-defined interfaces, and meaningful to the environment. |  |
| Artifact | A physical piece of information that is used or produced in a software development process, or by deployment and operation of a system. |  |

*Figure 5: eML Techology Layer quick reference.*

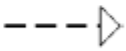
| Structural Relationships | | Notation |
|---|---|---|
| Association | Association models a relationship between objects that is not covered by another, more specific relationship. |  |
| Access | The access relationship models the access of behavioral concepts to business or data objects. |  |
| Used by | The used by relationship models the use of services by processes, functions, or interactions and the access to interfaces by roles, components, or collaborations. |  |
| Realization | The realization relationship links a logical entity with a more concrete entity that realizes it. |  |
| Assignment | The assignment relationship links units of behavior with active elements (e.g., roles, components) that perform them, or roles with actors that fulfill them. |  |
| Aggregation | The aggregation relationship indicates that an object groups a number of other objects. |  |
| Composition | The composition relationship indicates that an object consists of a number of other objects. |  |
| **Dynamic Relationships** | | **Notation** |
| Flow | The flow relationship describes the exchange/transfer of, for example, information or value between processes, function, interactions, and events. |  |
| Triggering | The triggering relationship describes the temporal or causal relations between processes, functions, interactions, and events. |  |
| **Other Relationships** | | **Notation** |
| Junction | A junction is used to connect relationships of the same type. |  |
| Specialization | The specialization relationship indicates that an object is a specialization of another object. |  |

*Figure 6: eML Interfaces quick reference.*

| Src. | RGB Value | Example |
|---|---|---|
| Internal ('own' SP) | original RGB | |
| SP3 | R255 G255 B102 | |
| SP4 | R248 G181 B126 | |
| SP5 | R175 G194 B218 | |

| Src. | RGB Value | Example |
|---|---|---|
| SP2 | R218 G151 B146 | |
| 3rd Party (optional) | R000 G176 B080 | |
| Unknown SP | orig. RGB + red border | |
| Complete Unknown (int/ext) | R217 G217 B217 + red border | |

*Figure 7: Color coding for eCoMove SubProjects.*

In the following the two applications of ecoMonitoring and ecoPostTrip will be described.

### 3.1. eCoMonitoring

The ecoMonitoring application provides the ecoFVD (eco Floating Vehicle Data) to the Traffic Control Centre and to the other vehicles. It distributes it to the Traffic Control Centre and other vehicles in a fully anonymous [1] way to protect drivers' privacy. The definition of ecoFVD and its content is part of the subproject SP2, in particular it is part of the ecoMessages [4].
The Business Layer Diagram representing the ecoMonitoring application is shown in Figure 8.
The ecoFVD information is available both during the onTrip phase, when driver moves, and during the postTrip, when the trip was ended and the driver waits to receive updates about his/her driving style from the ecoPostTrip application.

[1] eCoMove builds on results from previous projects and adapts and extends the communication system for energy efficiency applications. In particular, features like privacy protection and information security are considered as provided by other projects results or standardization efforts.
Regarding privacy protection, projects like Network on Wheels, SEVECOM, GeoNET, CVIS, PRECIOSA and PRESERVE have dealt with privacy protection in cooperative systems and suggested the usage of pseudonyms. The approach is currently being standardized by ETSI TC ITS WG5. The eCoMove communication platform is compatible with this approach, therefore the expected level of privacy protection when using eCoMove applications is the same as that in those projects. Further, developing new privacy protection schemes is outside the scope of eCoMove.

When vehicle is in the onTrip phase the *ecoMonitoring* process collects the VehicleParameters, the VehicleData, the ecoRoute, the current position and the path related traffic information present in to *ecoCooperativeHorizon* and prepares the ecoFVD; the ecoFVD are sent to *ecoFVD transmission* service from the *Send ecoFVD Data* process of the Communication Platform of SP2. The ecoFVD are thus sent to the Traffic Control Centre and to the other vehicles.

When the vehicle is in the postTrip phase, the *ecoMonitoring* process collects the VehicleParameters, the DriverProfile, the TripAnalysisReport, the TripData and the StoredPlannedRoute and prepares the ecoFVD data, which are then transferred as during the onTrip phase. The parameters will be collected depending on the addressee of the message to be sent out, to satisfy the privacy requirements of the application itself.

The objects VehicleParameters and VehicleData, used by ecoMonitoring, are filled in by the product named OEM Gateway, which is OEM dependent because it retrieves the vehicle data from automotive CAN bus and translates it into the eCoMove standard format.

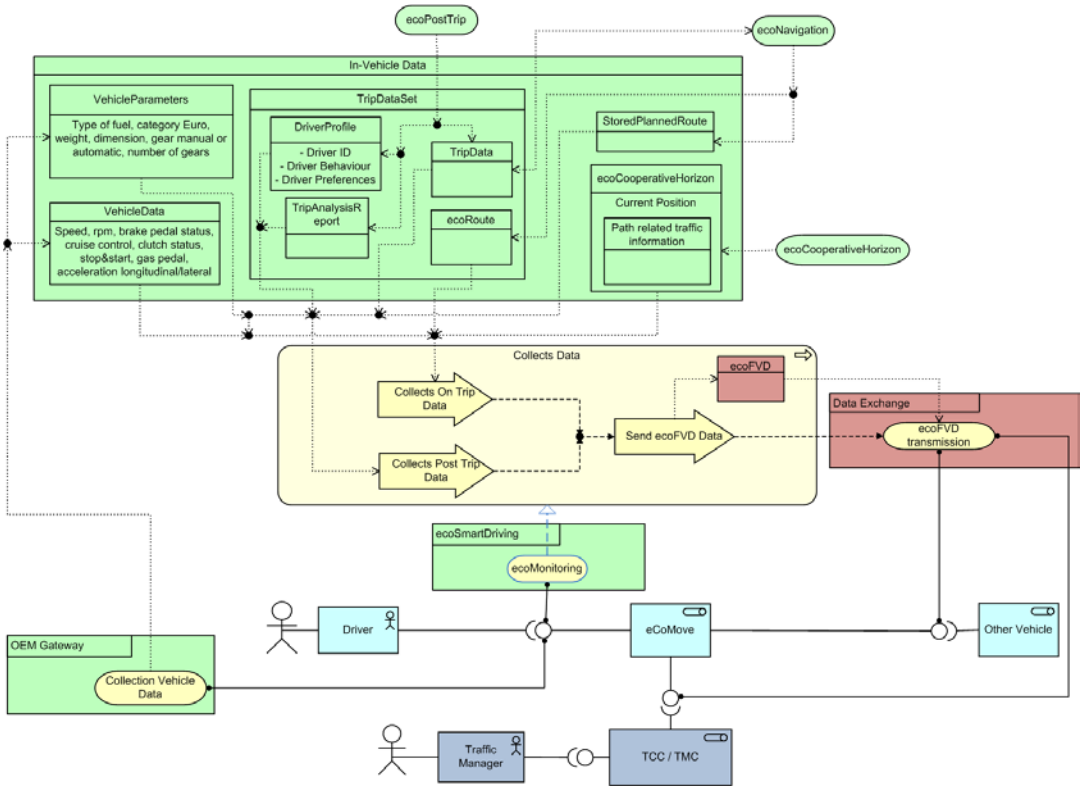



***Figure 8: Business Layer diagram of ecoMonitoring***

## 3.2. ecoPostTrip

The ecoPostTrip application analyses various data such as TripData, vehicle data (like speed, accelerator pedal position, brake pedal position, selected gear, etc …), map data, route data from the ecoRoute, driver preferences and driver behaviour. The focus of the analysis is on how the driver has been driving compared to optimal eco driving, taking into account the driving situation the driver was in, and gives related feedbacks to the driver. It also provides recommendation to the driver on improving his/her eco driving for future trips.

The ecoPostTrip business layer diagram provided in Figure 9 can be divided into two phases. The first phase deals with confirming the driver profile at the end of the trip and storing the relevant trip data. Also if the driver takes a break and continues his/her trip, this is also identified and trip data is stored accordingly. The second phase deals with providing the actual ecoPostTrip services. [2]

**First Phase:**

By the event *ignition off & key-out*, the process *confirm Driver ID* is triggered. Once the Driver ID is confirmed it triggers the process *storing of TripData* and relevant TripData is stored in the TripDataSet to that driver profile. In case the driver takes a break and comes back within one hour and turns the ignition on, the particular event occurs and triggers the process - in which it is confirmed with the driver if he wants to continue with his/her previous trip and also his/her Driver ID. Now there are three possible scenarios:

1) Driver wants to continue his/her previous trip and has the same Driver ID as the previous trip – in this case the storing of the trip data continues as it was and the trip analysis and recommendation provided earlier are overwritten at the end of the trip.

2) Driver wants to continue his/her previous trip and has a different Driver ID than the previous trip – in this case the previous trip is concluded as ended and a new trip is stored for the new driver.

3) Driver wants to start a new trip – in this case the previous stored TripData remains the same and a new trip is started.

In case the Driver does not confirm the ID or change it, the application does not save the TripData.

[2] EcoMove being a research project, it is crucial that trip data are stored and can be compared for each driver and each trip to prepare for the ecoMove Validation and Impact Assessment phases. Entering and confirming Driver ID data processes are enforced to secure the trip data storage and to allow for trip data comparison. The ecoMove team is conscious of the potential impact on user acceptance. Specific studies are performed via simulations by the HMI Task Force and recommendations will be generated.

**Data Objects used:**

**TripData:** All data that is relevant for the analysis of fuel consumption during that particular trip is stored as TripData in the TripDataSet database.
**Driver Profile:** The Driver Profile consists of the driver ID, Driver Preferences and Driver Behaviour. The Driver ID could be made available during the On-Trip phase. If there was a break in the trip, then this information has to be confirmed again. The Driver Preferences and Driver Behaviour are always linked to a specific Driver ID. The Driver Profile is important since all data, including preferences and behaviour are stored in relation to this profile, to ensure that if a different person drives in the same vehicle, the trip data can be saved in relation to that specific other person and not become mixed up with the primary driver.

**Second phase:**
In the second phase, the ecoPostTrip application provides the following services

**Trip Analysis report**:
After the trip is ended and TripData is stored, the event "Trip analyse state" occurs. This event triggers the *Analyse Trip* process which triggers on its turn the *Provide trip analysis report* process and then the *Trip Analysis report* is produced and stored in the TripDataSet component.
This service requires the following data objects as input: Driver Profile - consisting of driver ID, driver preferences and driver behaviour- (provided by ecoDrivingSupport application), TripData, ecoRoute (provided by ecoNavigation), and it provides the Trip Analysis report as output.

**Recommendations for improving fuel efficiency:**

Based on the Trip Analysis report, certain recommendations are created for the particular driver to improve his / her driving style and ultimately improve the fuel efficiency through the *create recommendations for improving fuel efficiency* process.

This service uses the Trip Analysis report and Driver Behaviour as the input and provides the Recommendations for improving fuel efficiency as output.

**Offline analysis of trip:**
In the event of *driver requesting export of trip data* for offline analysis, the process *export trip data for offline access* is triggered and the trip data is retrieved from the TripDataSet and exported to the relevant storage medium.

The data that could be exported is Exported TripDataSet. This Exported TripDataSet is a copy of the TripDataSet that is stored in the vehicle. The in-vehicle storage is expected to be limited, but off-board the database could be much bigger, so after a while the oldest trip data in vehicle will be overwritten once the storage is full (see also note hereafter).

**Comparison of trips:**
If the driver request to compare his/her previous trips, then the corresponding event occurs and triggers the process *compare trips and produce report* and produces the comparison report.

The comparison basically could be done in three ways:
1. Compare the just finished trip with (averaged) previous trips – this is available both off-board and on-board
2. Compare the just finished trip with the best trip (this also requires that the best trip is stored, so it is available only off-board).
3. Compare trips among each other – this option is available only off-board

**Note:** For storing the TripData, recommendations and reports - there could be some restrictions based on the availability of the storage space. Storage capacity management mechanism will be defined and requirements will be generated. The data management mechanism may also be complemented by additional mechanisms such as older data sub-sampling in order to avoid the loss of old trips. When the memory is full despite the above mentioned measures, the driver will be advised early enough to download all data on an external device and maybe keep only the last/best trip as a reference. This last case might be difficult to verify within ecoMove due the limitation over time of a research project.

Obviously it is also possible to think to a remote data transfer. All these cases were considered but not approached with the intention to identify a unique solution because the solution cover in some way a precious aspect that is related to the OEM and his customer relation. For this reason, no definitive solution has been selected and more effort has been spent on the eco recommendation policy.

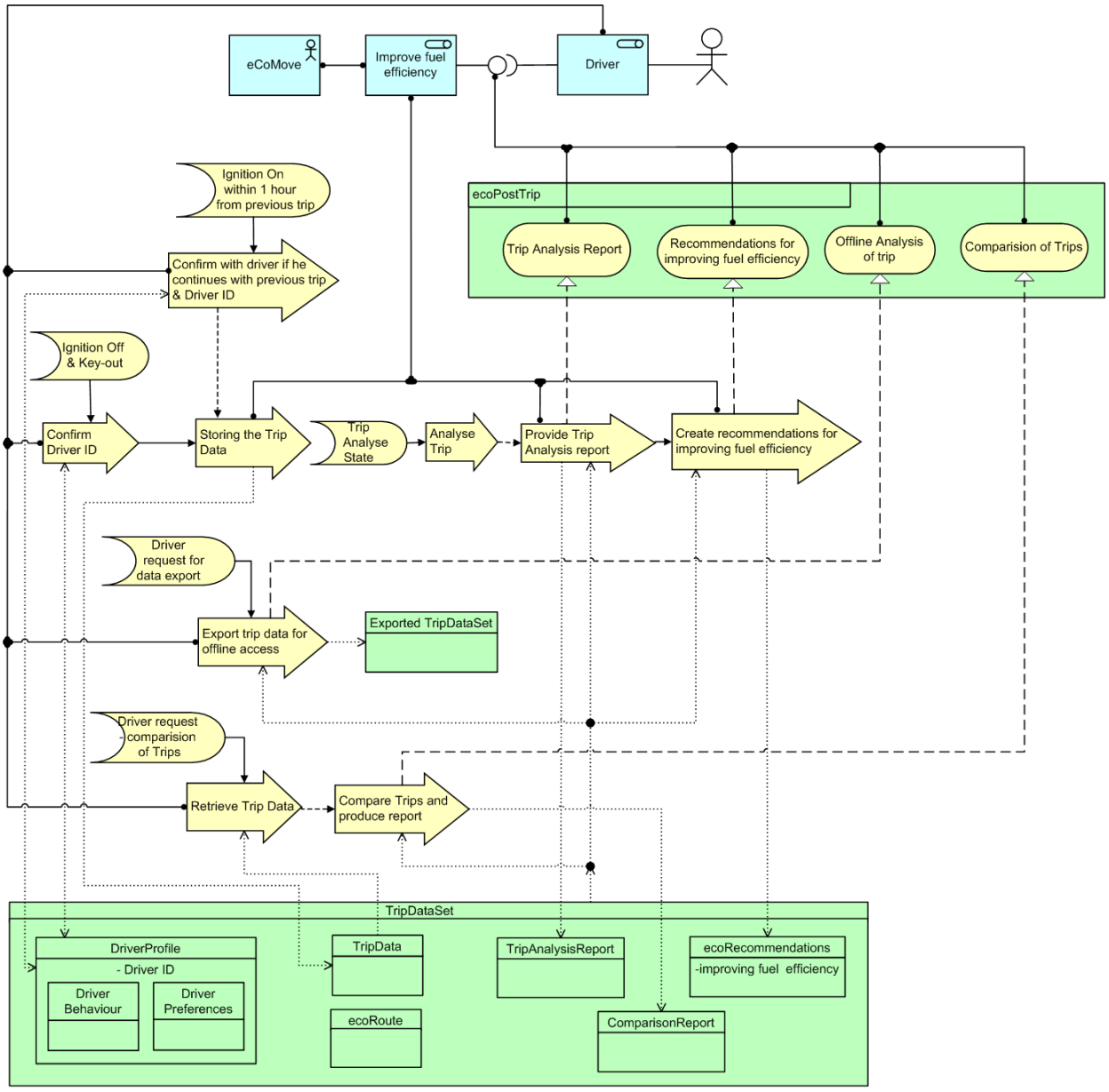



*Figure 9: Business Layer diagram of ecoPostTrip.*

## 3.3. Use Case covered by Applications

The following table shows the relationship between Use Cases of SP3, defined in [1], and the Applications designed within this deliverable

*Table 1. Use Cases covered by Applications.*

| | UC_SP3_01: Checking Vehicle Condition (pre-trip) | UC_SP3_02: Planning ecoTrip | UC_SP3_03: EcoUse of Vehicle Systems | UC_SP3_04: Dynamic ecoNavigation | UC_SP3_05: Dynamic ecoGuidance | UC_SP3_06: Support ecoDriving | UC_SP3_07: In-vehicle ecoTripFeedback | UC_SP3_08: Off board ecoTripFeedback |
|---|---|---|---|---|---|---|---|---|
| ecoMonitoring | | | | | | | | |
| ecoPostTrip | | | | | | | **x** | **x** |

The ecoMonitoring application does not have a direct relation with one of the use cases, but it supports all the other applications of SP3, as well as the applications of other SPs, since it provides the visibility of the vehicle outside of it with the ecoFVD messages.
The use cases from UC_SP3_01 to UC_SP3_06 are covered by pre trip and on trip applications treated in deliverable D3.2:

# 4. System architectural design

The system architectural design analyses in a deeper way the design of the applications.

Starting from the BL diagrams shown in Chapter 3, the single processes are expanded in multiple functionalities which are software modules to be implemented during the next phase of the project, the WP4. The software modules for the single application are shown in the Application Layer diagrams of eML.

The Technology diagrams are a further step of design, where all the software modules for the single application are placed in the hardware where the application will run: in vehicles, on mobile devices, on external laptops or ground station.

## 4.1. ecoMonitoring

### 4.1.1. Application Layer

The Application layer diagram of the ecoMonitoring application shows how the ecoMonitoring service is split in two components: Data Collector and Format Data as ecoFVD.
The Data Collector is implemented by two functions: onTrip and PostTrip data collection. They respectively get data from the In-Vehicle Data object, and provide them to the other component.
The onTrip data collector gets data from VehicleParameters, VehicleData, ecoRoute, and ecoCooperativeHorizon. The PostTrip data collector gets data from VehicleParameters, DriverProfile, TripAnalysisReport, TripData and StoredPlannedRoute.
The Format Data as ecoFVD component is implemented by the Send ecoFVD data function, which retrieves data from the Data Collector component, and formats them using standard messages as defined in [4], which will be sent out to other vehicles and TCC/TMC by the use of the ecoFVD transmission service of the communication platform prepared by SP2. The ecoFVD is thus received from the other vehicles and from the TCC/TMC through the communication system.

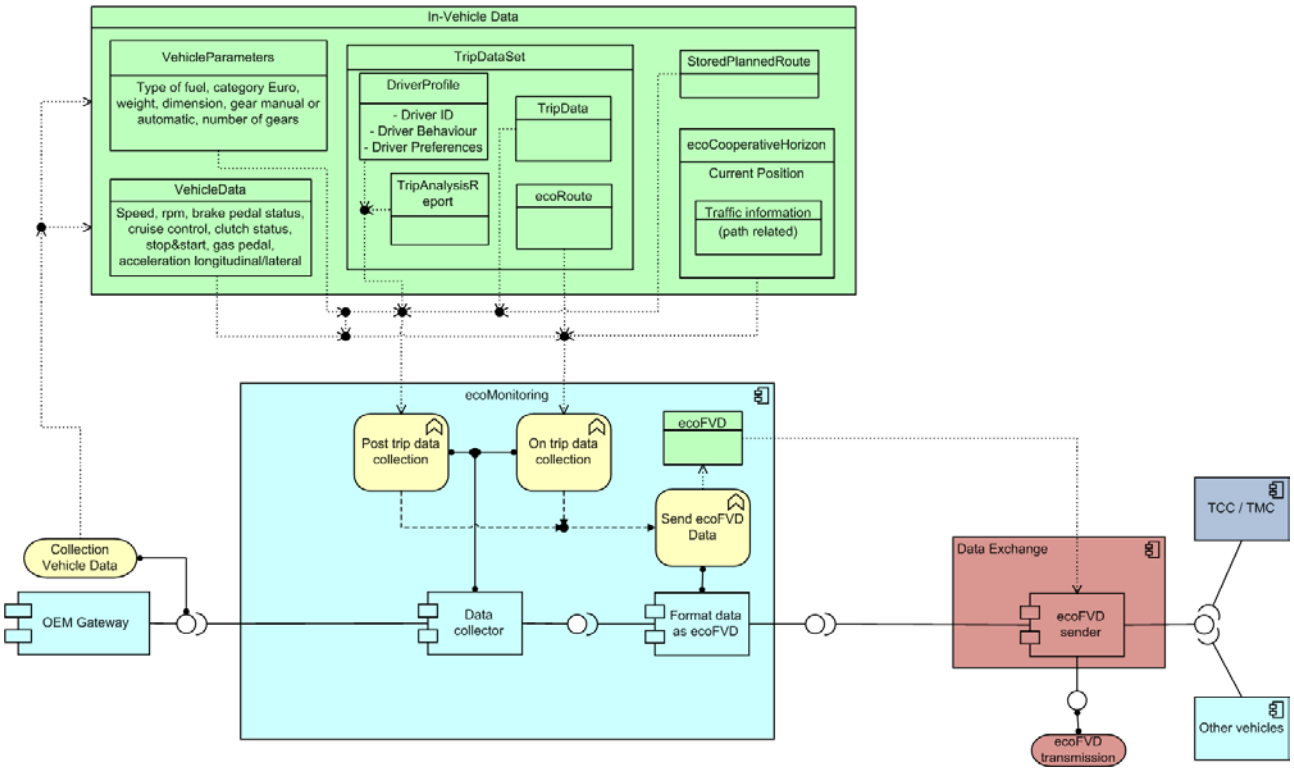



*Figure 10: Application Layer diagram for ecoMonitoring.*

### 4.1.2. Technology Layer

The technology diagram of ecoMonitoring shows where the service is implemented.
In the Vehicle ITS Station, in the Software Execution Platform, there will be the two components of ecoMonitoring, the Data Collector and Format data as ecoFVD. The service makes also use of data coming from the OEM gateway, which is thus shown in the Software Execution Platform.
The communication of the ecoFVD message is directed to other Vehicles and to the Central ITS station.

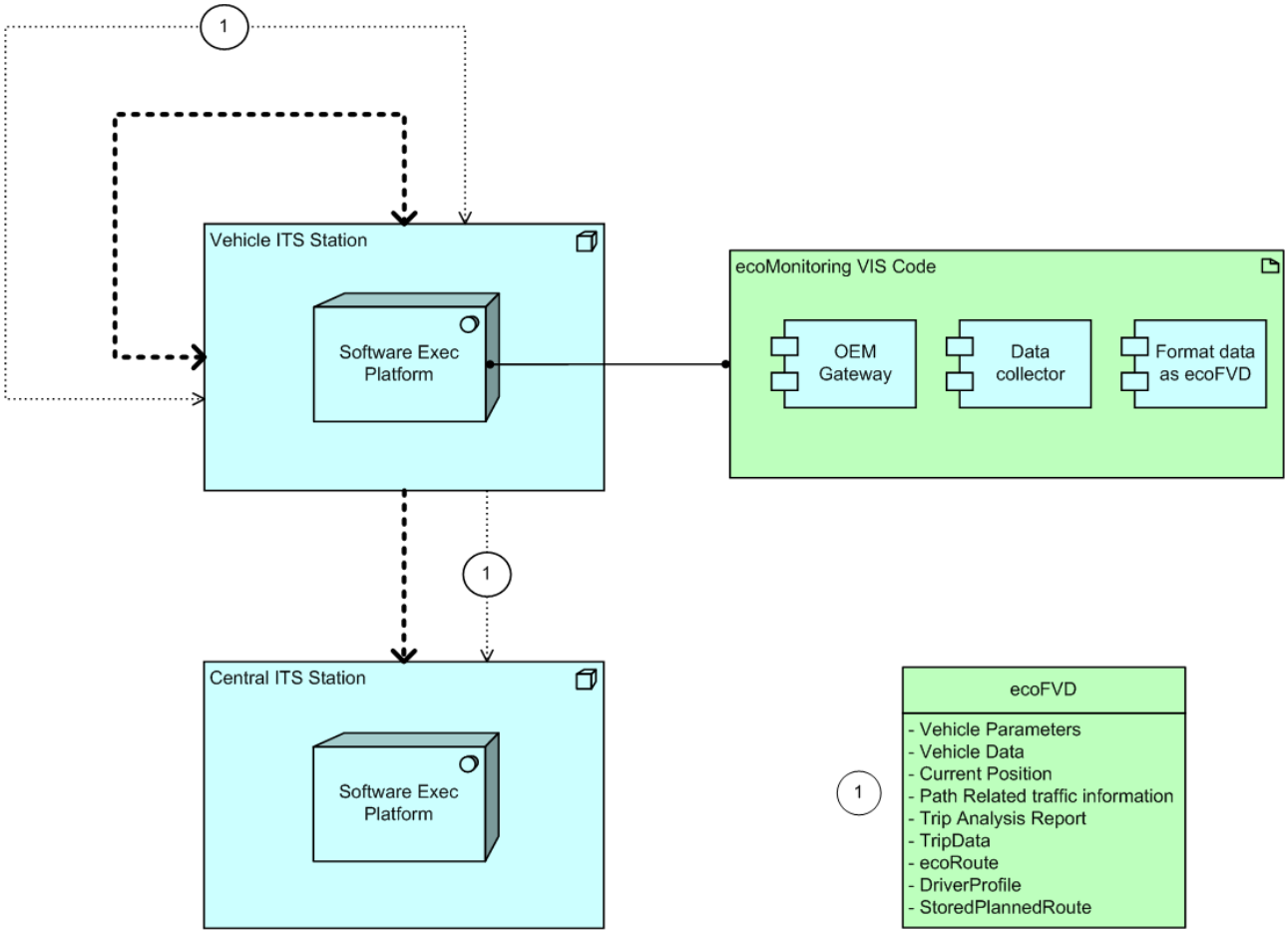



*Figure 11: Technology Layer diagram for ecoMonitoring.*

## 4.2. ecoPostTrip

### 4.2.1. Application Layer

The application layer of the ecoPostTrip application helps in realising the business process mentioned in the business layer diagram through a set of application service and functions.

The ecoPostTrip application shown in Figure 12 provides services both on-board and off-board. The on-board ecoPostTrip services are supplemented by TripDataSet stored in a database. Similarly for the off-board ecoPostTrip services, selected TripDataSet is exported to the local storage space for further access. Both these services could be accessed by the driver through the ecoHMI component.

**ecoPostTrip on Board:**
The ecoPostTrip services on board are implemented by the ecoPostTrip – on Board component. This component could be accessed by ecoPostTrip – on Board service. It consists of sub-functions to identify the driver and end of trip (as explained in the Business layer description). To identify the driver, it uses the Driver profile data object from TripDataSet which was previously updated by on-Trip applications.

This ecoPostTrip – on Board component also has two sub-components they are:

**TripDataManager:** This component can be accessed by TripData service and it has three sub-functions.

- Store TripData: Once the end of the trip is identified then Store-Trip Data functions stores all the relevant trip data in the TripDataSet.
- Retrieve TripData: The stored trip data can also be retrieved from the TripDataSet in the database through the retrieve trip data sub-function.
- Export TripData: In order to provide the data for offline access, the trip data can be exported through the export TripData function.

**Trip Analyser:** This component can be accessed by Trip analyser service and it has three sub-functions.

- Analyse Trip function: analyses the current trip data to evaluate how much eco was the trip.
- Provide Trip Analysis Report function: it provides the trip analysis report to the driver.
- Create recommendation function: creates recommendation for improving fuel efficiency based on the trip analysis report.

After the analysis is done and recommendations created, the function "store recommendations and comparison report" stores all the produced reports.

Note: Some data objects with the name "Event" have been added before some functions, these objects basically act as a trigger to that particular function. It helps the implementer to identify when this function has to be called.

**ecoPostTrip off Board:**
The ecoPostTrip services off board are implemented by the ecoPostTrip – off Board component, which can be accessed by the ecoPostTrip off-board service. Similar to the on-board, the analysis and comparison services are also provided by ecoPostTrip-off Board. The only difference being the data used as input is taken from the local storage space and the output is also stored in local storage space. These services are implemented by off board **TripDataManager** and **Trip Analyser** component.

The **Off-board TripDataManager** contains the Import trip data function to import the trip data from ecoPostTrip on-board component and store the TripData in the local storage space. The Select Trip and Retrieve Trip Data function provides the input data necessary for the analysis and compare function.

The Off- board **Trip Analyser** component includes also the function of:

- Compare trip and produce report: it compares the different trip data as requested by the user and produces the comparison report. This report will generally not be stored in the database, unless a best trip of a particular driver has to be stored (if required only). Then each time when a trip analysis report is produced it has to be compared with previous best trip and the best among them has to be stored.

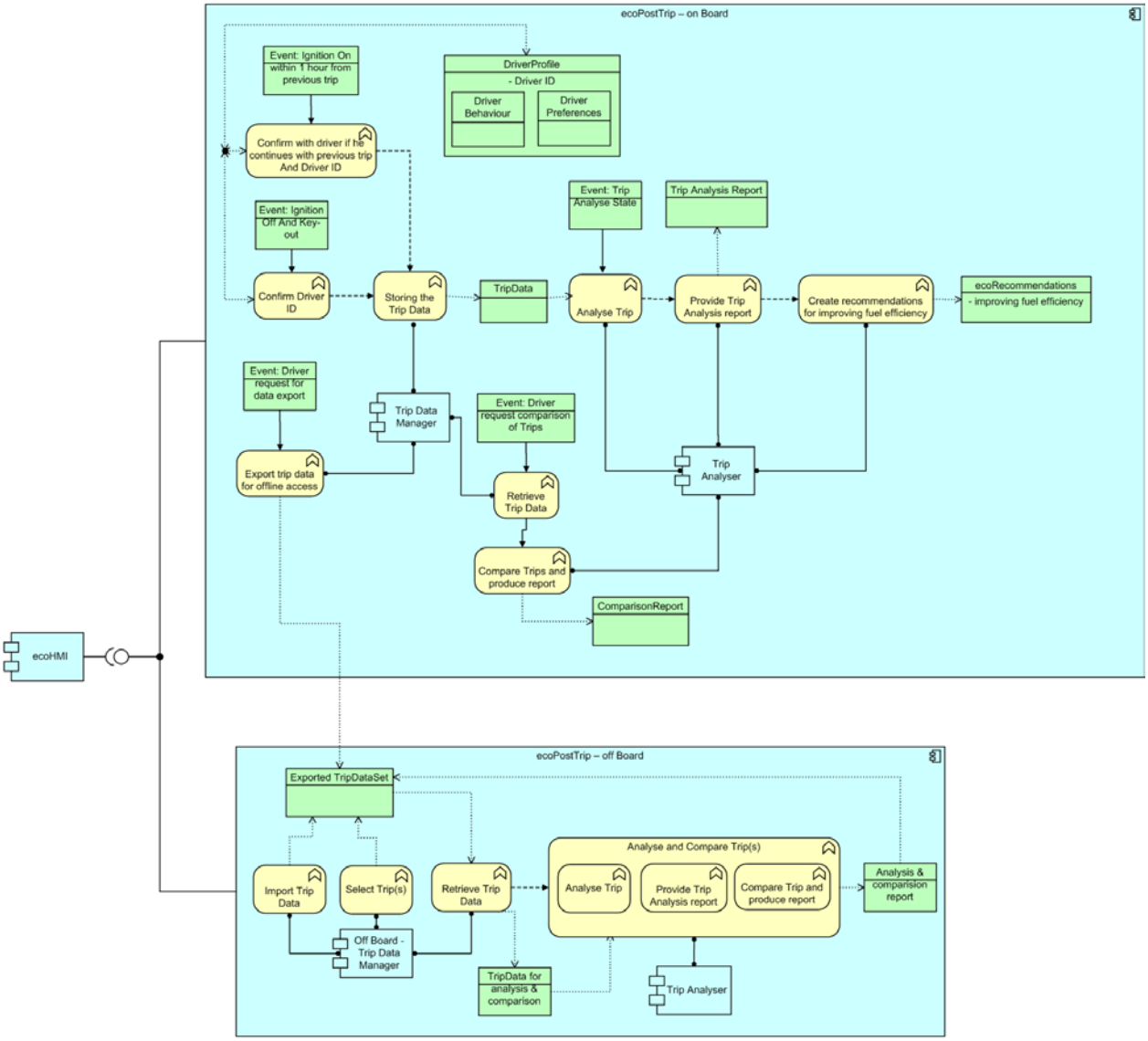



*Figure 12: Application Layer diagram for ecoPostTrip.*

### 4.2.2. Technology Layer

This chapter provides a detailed description about the ecoPostTrip Architecture (Technology layer) diagram, shown in Figure 13.

The overall eCoMove system has three ITS stations, In- Vehicle ITS station, Central ITS station and Road Side Unit ITS station. The In-Vehicle ITS station consist of a software execution platform, which is responsible for running the applications. The ecoPostTrip application runs only on the In-Vehicle ITS station and it has no communication with the other ITS units.

As mentioned in the business layer and application layer descriptions, ecoPostTrip services are provided both on-board and off-board. The on-board

services are available through the application unit present in the In-Vehicle ITS station. This is done by deploying the ecoPostTrip-on Board artifact in the application unit of In-Vehicle ITS station. A database for TripDataSet is also connected to the Application unit for storing the TripDataSet information.

The ecoPostTrip off-Board services are made available by deploying the ecoPostTrip-off Board artefact in the following devices:

- Mobile Handset /PDA
- Home PC/ Laptop

Both the above device could exchange data (Exported TripDataSet) with the on-Board application unit through one of the following methods

- Via Bluetooth
- Via Wifi Modem
- Via USB cable (the format for data export is yet TBD)
- Via a central server on the internet.
- By transferring the TripDataSet to and external memory disk (card) and then copying it to their respective devices (the format for data export is yet in definition).

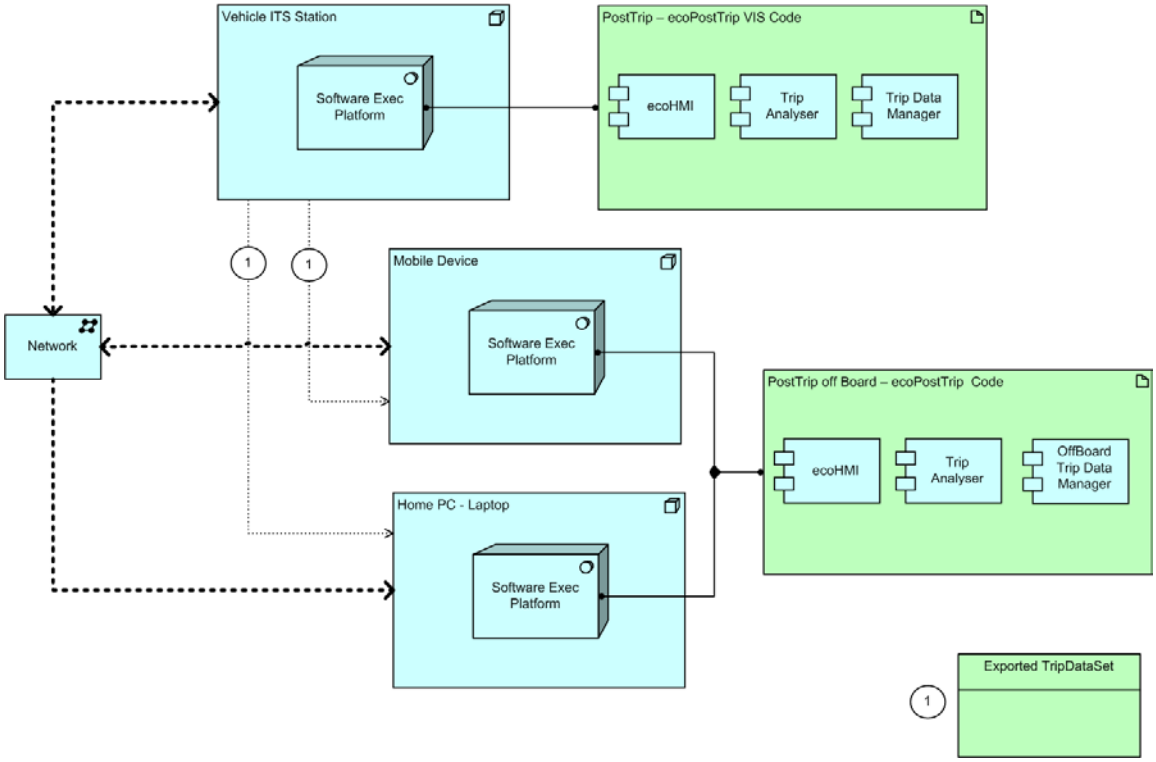



*Figure 13: Technology Layer diagram for ecoPostTrip.*

# 5. Interface Design

The interfaces between the SP3 applications and the other applications from SP2, SP4 and SP5 are represented in the following tables. They will be used to check with partners of the other SPs that the contents required from SP3 applications will be really available from the other SPs, and vice versa.

In addition, for each application an overall table of objects handled (also internally) has been produced which contains references to

- BL-diagrams
- Author
- Role
- Product
- Service
- Process(es)
- Event
- Data content

References to these General Object Exchange Tables are given in the Appendix A - List of General Object Exchange Tables in portrait format.

## 5.1. ecoMonitoring

The ecoMonitoring retrieves data only from internal computations on the vehicle, so it does not require anything from external SPs. The output of the ecoMonitoring, which is the ecoFVD, is sent to TCC/TMC of SP5 and to other vehicles (of SP3), through the communication system, which is an SP2 component. For this reason, just SP2 is involved in the table shown below.

*Table 2. Interfaces of ecoMonitoring provided to other SPs*

| PRODUCES | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **SP** | **Diagram** | **Author** | **Produces** | **Object** | **Delivered To** | **SP** | **Reference Diagram** | **Contact** |
| SP3 | ecoMonitoring | Tosetto Fabio, De Gennaro Marilina | ecoFVD | ecoFVD | Data Exchange | SP2 | Communication system | |

## 5.2. ecoPostTrip

The ecoPostTrip application does not exchange data with external entities (TCC/TMC or fleets), and it does not use data provided by other components of SP2, thus there are not interfaces with other SPs.

# 6. TripDataSet

The TripDataSet has been analysed from the applications groups of SP3, in order to understand how the objects coming out from the design as inputs / outputs of the single applications will be developed, provided and exchanged among applications in the next phase of the project (Work Package 4).

The TripDataSet is a complex aggregation of data coming from or requested by different applications.
Data have been organized in terms of family (i.e. vehicle data, route data etc.) to create some groups coming from the same source, or related to the same component or application.

The first division for the data can be done using the concept of persistency: some data are *persistent*, which means that they are updated at low frequency. Other data, not persistent, are called *operational* and are updated at high frequency.

Table 3 shows a preliminary distinction in persistent and operational data collected in some reference tables.

***Table 3. Groups of data from TripDataSet.***

| Persistent Data | Operational Data |
|---|---|
| Vehicle_characteristic | Route_data |
| Last_Trip_minimal_data | Vehicle_history_RD |
| Maintenance | From_to_HMI_module |
| Vehicle_driver | Planned_Route_summary |
| TripAnalysisReport | Planned_Route_detailed |
| Stored_Planned_Route_data_summary | |

The difference between persistent and operational data is a topic which is under discussion also with the other subprojects of eCoMove, and will be a starting point for the next activities of the Work Package 4, where the conceptual idea will be transformed probably in two separate implementations.

The persistent data are described in the following, at least for their meaning:

- Vehicle characteristics: information about the vehicle (like vehicle dimensions, automatic or manual gear, etc.).
- Last_Trip_minimal_data: traveled kilometers, elapsed time, average consumption.
- Maintenance: status of pressure tires, filters, oil, exterior lights.
- Vehicle_driver: driver ID, settings (sport, comfort, normal), navigation preferences.
- TripAnalysisReport: information related to one trip occurred at a specific date and hour, with a specified driver, consumptions and eco points.

- Stored_Planned_Route_data_summary: list of points to be sequentially reached, as saved after the route search during the ecoTripPlanning.

The operational data are:

- Route_data: data related to the current route, with starting position, current position, destination, etc.
- Vehicle_history_RD: information about number of persons in the vehicle, number of key on and off, and other information related to the last trip.
- From_to_HMI_module: ecoInformation, inefficiencies recommendations, eco instructions, guidance instructions to the HMI and then visualized to the driver.
- Planned_Route_summary: information about the route planned from the ecoTripPlanning: starting and ending position, navigation preferences set, fuel/ time trade/off.
- Planned_Route_detailed: other information related to the planned route, more specific.

Independently from the future implementation aspects, the TripDataSet will be accessed by two services, *storeTripData* and *retrieve TripData*,.
The first service basically stores the various trip data along with other necessary information that would be required for the analysis of trips such as vehicle data, driver profile etc.
The various application components such as ecoDrivingSupport, ecoTripPlanning and ecoNavigation store their output data in the TripDataSet.
These stored TripDataSet data could be accessed by the ecoPostTrip component using the retrieve service, and by the ecoMonitoring which will use the data to forward them outside as ecoFVD.

# 7. Requirements traceability

The requirements traceability is important to verify that all requirements defined in the previous steps of the eCoMove project, within SP3, have been covered by the architecture design. The requirements were previously collected in [1] and reported in the Appendix C – SP3 requirements for reference.

The requirements are here summarized and related to the applications using a traceability matrix, whose template is referenced in 12[2]. The matrix collects the requirements defined for each application, and shows which item of the application architecture covers the requirement itself.

In this deliverable the requirements related to the postTrip applications are collected, together with the requirements of the ecoHMI and TripDataSet.

*Table 4. Requirements traceability*

| Requirement | Design | | | Test Status | Note |
|---|---|---|---|---|---|
| | Application (Diagram) | (optional) eML Concept | BL\|AL\|TL | | |
| **ecoPostTrip** | | | | | |
| **SP3-5-0001** | ecoPostTrip | TripDataManager component | AL | | |
| **SP3-5-0002** | ecoPostTrip | TripAnalyzer component | AL | | |
| **SP3-5-0003** | ecoPostTrip | TripAnalyzer component | AL | | |
| **SP3-5-0004** | ecoPostTrip | TripDataManager component | AL | | |
| **SP3-5-0005** | ecoPostTrip | TripAnalyzer component | AL | | |
| **SP3-5-0006** | ecoPostTrip | tripDataSet object | BL,AL | | |
| **SP3-5-0007** | ecoPostTrip | TripDataManager component | AL | | |
| **SP3-5-0008** | ecoPostTrip | Confirm Driver ID process | BL,AL | | |
| **SP3-5-0009** | ecoPostTrip | TripAnalyzer component | AL | | |

| | | | | | |
|---|---|---|---|---|---|
| **SP3-5-0010** | ecoPostTrip | Off Board - TripDataManager and Trip Analyzer component | AL | | |
| **SP3-5-0011** | ecoPostTrip | | TL | | |
| **SP3-5-0012** | ecoPostTrip | TripDataManager component | AL | | |
| **SP3-5-0013** | ecoPostTrip | TripDataManager and Off Board - TripDataManager component | AL | | |
| **SP3-5-0014** | ecoPostTrip | Export trip data for offline access process | BL,AL | | |
| **SP3-5-0015** | ecoPostTrip | | BL | | This requirement will be covered in WP4: see D3.9 |
| **SP3-5-0016** | ecoPostTrip | | BL | | This requirement will be covered in WP4: see D3.9 |
| **ecoMonitoring** | | | | | |
| **SP3-6-0001** | ecoMonitoring | VehicleParameters, VehicleData, TripData, ecoRoute,TripAnalysisReport, DriverProfile | BL, AL | | |
| **SP3-6-0002** | ecoMonitoring | TripAnalysisReport, DriverProfile | BL, AL | | |
| **SP3-6-0003** | ecoMonitoring | | BL | | |
| **SP3-6-0004** | ecoMonitoring | VehicleParameters, VehicleData, ecoCoperativeHorizon, TripData,StoredPlannedRoute | BL, AL | | |
| **SP3-6-0005** | ecoMonitoring | VehicleParameters, VehicleData, TripData, TripAnalysisReport | BL, AL | | |
| **SP3-6-0006** | ecoMonitoring | TripDataSet | BL, AL | | |
| **SP3-6-0007** | ecoMonitoring | | BL, AL | | |
| **SP3-6-0008** | | | | | Covered by SP2 Core Tecnology |
| **SP3-6-0009** | ecoMonitoring | | BL | | |
| **SP3-6-0010** | ecoMonitoring | | BL | | |
| **SP3-6-0011** | ecoMonitoring | | BL | | |

| | | | | | |
|---|---|---|---|---|---|
| **SP3-6-0012** | ecoMonitoring | | BL | | |
| **ecoHMI** | | | | | |
| **SP3-7-0001** | | | | | This requirement will be covered in WP4: see D3.6 ecoHMI |
| **SP3-7-0002** | | | | | This requirement will be covered in WP4: see D3.6 ecoHMI |
| **SP3-7-0003** | | | | | This requirement will be covered in WP4: see D3.6 ecoHMI |
| **SP3-7-0004** | ecoDrivingSupport | | BL, AL | | |
| **SP3-7-0005** | | | | | This requirement will be covered in WP4: see D3.6 ecoHMI |
| **SP3-7-0006** | ecoInformation<br>ecoDrivingSupport<br>ecoNavigation | | BL, AL | | |
| **SP3-7-0007** | ecoDrivingSupport | | BL, AL | | The ecoCooperativeHorizon gives indications of such obstacles |
| **SP3-7-0008** | ecoDrivingSupport | | BL, AL | | |
| **SP3-7-0009** | ecoDrivingSupport | | BL, AL | | |
| **SP3-7-0010** | ecoDrivingSupport | | BL, AL | | |
| **SP3-7-0011** | ecoInformation | | AL | | |
| **SP3-7-0012** | ecoNavigation | | BL, AL | | |
| **SP3-7-0013** | ecoPostTrip | | AL | | |
| **SP3-7-0014** | | | | | This requirement will be covered in WP4: see D3.6 ecoHMI |
| **SP3-7-0015** | | | | | This requirement will be covered in WP4: see D3.6 ecoHMI |
| **SP3-7-0016** | | | | | This requirement will be covered in WP4: see D3.6 ecoHMI |
| **SP3-7-0017** | | | | | This requirement will be covered in WP4: see D3.6 ecoHMI |

| | | | | | |
|---|---|---|---|---|---|
| **SP3-7-0018** | | | | | This requirement will be covered in WP4: see D3.6 ecoHMI |
| **SP3-7-0019** | | | | | This requirement will be covered in WP4: see D3.6 ecoHMI |
| **SP3-7-0018** | | | | | This requirement will be covered in WP4: see D3.6 ecoHMI |
| **SP3-7-0019** | | | | | This requirement will be covered in WP4: see D3.6 ecoHMI |
| **SP3-7-0020** | | | | | This requirement will be covered in WP4: see D3.6 ecoHMI |
| **SP3-7-0021** | | | | | This requirement will be covered in WP4: see D3.6 ecoHMI |
| **SP3-7-0022** | | | | | This requirement will be covered in WP4: see D3.6 ecoHMI |
| **SP3-7-0023** | | | | | This requirement will be covered in WP4: see D3.6 ecoHMI |
| **SP3-7-0024** | | | | | This requirement will be covered in WP4: see D3.6 ecoHMI |
| **SP3-7-0025** | | | | | This requirement will be covered in WP4: see D3.6 ecoHMI |
| **SP3-7-0026** | | | | | This requirement will be covered in WP4: see D3.6 ecoHMI |
| **SP3-7-0027** | | | | | This requirement will be covered in WP4: see D3.6 ecoHMI |
| **SP3-7-0028** | | | | | This requirement will be covered in WP4: see D3.6 ecoHMI |
| **SP3-7-0029** | | | | | This requirement will be covered in WP4: see D3.6 ecoHMI |
| **SP3-7-0030** | | | | | This requirement will be covered in WP4: see D3.6 ecoHMI |
| **TripDataSet** | | | | | |

| | | | | | |
|---|---|---|---|---|---|
| **SP3-9-0001** | ecoNavigation | | BL, AL | | |
| **SP3-9-0002** | ecoPostTrip<br>ecoDrivingSupport<br>ecoTripPlanning | | BL, AL | | |
| **SP3-9-0003** | ecoPostTrip<br>ecoNavigation<br>ecoDrivingSupport<br>ecoTripPlanning<br>ecoInformation | | BL, AL | | |
| **SP3-9-0004** | ecoNavigation<br>ecoTripPlanning<br>ecoPostTrip<br>ecoDrivingSupport | | BL, AL | | |
| **SP3-9-0005** | ecoPostTrip<br>ecoNavigation<br>ecoDrivingSupport<br>ecoMonitoring<br>ecoInformation<br>ecoTripPlanning | TripDataSet object | BL, AL | | |
| **SP3-9-0006** | ecoPostTrip | | BL, AL | | |

# Appendix A - List of General Object Exchange Tables

Tables of objects required from and provided for other SPs are given and explained per application in Chapter 5. In addition, for each application an overall table of objects handled (also internally) has been produced which contains references to

- BL-diagrams
- Author
- Role
- Product
- Service
- Process(es)
- Event
- Data content

*Table 5. ecoMonitoring table of Inputs/Outputs*

| SP | Diagram | Author | Role | Product | Service | Main Process | Process (P) / Event (E) | Input Objects | Input Data | Output Objects | Output Data |
|---|---|---|---|---|---|---|---|---|---|---|---|
| SP3 | ecoMonitoring | Tosetto Fabio, Marilina De Gennaro | eCoMove | ecoSmartDriving | ecoMonitoring | Collects Data | P: Collects On Trip Data | In - Vehicle Data / VehicleParameters | Type of Fuel | - | - |
| | | | | | | | | | Category Euro | | |
| | | | | | | | | | Weight | | |
| | | | | | | | | | Dimension width | | |
| | | | | | | | | | Dimension length | | |
| | | | | | | | | | Dimension height | | |
| | | | | | | | | | Gear Manual or Automatic | | |
| | | | | | | | | | Number of Gear | | |
| | | | | | | | | In - Vehicle Data / VehicleData | Speed | | |
| | | | | | | | | | RPM | | |
| | | | | | | | | | Brake Pedal Status | | |
| | | | | | | | | | Cruise Control | | |
| | | | | | | | | | Clutch status | | |
| | | | | | | | | | Stop & Start function | | |
| | | | | | | | | | Gas Pedal | | |
| | | | | | | | | | Acceleration longitudinal | | |
| | | | | | | | | | Acceleration lateral | | |
| | | | | | | | | TripDataSet | ecoRoute | | |
| | | | | | | | | In - Vehicle Data / ecoCooperativeHorizon | Traffic Information (path related) | | |
| | | | | | | | | | Current Position | | |
| | | | | | | | P: Collects Post Trip Data | In - Vehicle Data /VehicleParameters | Type of Fuel | | |
| | | | | | | | | | Category Euro | | |
| | | | | | | | | | Weight | | |
| | | | | | | | | | Dimension width | | |
| | | | | | | | | | Dimension length | | |
| | | | | | | | | | Dimension height | | |
| | | | | | | | | | Gear Manual or Automatic | | |
| | | | | | | | | | Number of Gear | | |
| | | | | | | | | Driver Profile | Driver ID | | |
| | | | | | | | | | Driver Behaviour | | |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | Driver Preferences | | | |
| | | | | | | | | TripDataSet | TripAnalysisReport | | | |
| | | | | | | | | TripDataSet | TripData | | | |
| | | | | | | | | In - Vehicle Data | StoredPlannedRoute | | | |
| | | | | | | | P: Send ecoFVD Data | - | - | ecoFVD | - | |

| SP | Diagram | Author | Role | Product | Service | Main Process | Process (P) / Event (E) | Input Objects | Input Data | Output Objects | Output Data |
|---|---|---|---|---|---|---|---|---|---|---|---|
| SP3 | ecoMonitoring | Tosetto Fabio, Marilina De Gennaro | eCoMove | OEM Gateway | Collection Vehicle Data | - | - | - | - | In - Vehicle Data / VehicleParameters | Type of Fuel |
| | | | | | | | | | | | Category Euro |
| | | | | | | | | | | | Weight |
| | | | | | | | | | | | Dimension width |
| | | | | | | | | | | | Dimension length |
| | | | | | | | | | | | Dimension height |
| | | | | | | | | | | | Gear Manual or Automatic |
| | | | | | | | | | | | Number of Gear |
| | | | | | | | - | - | - | In - Vehicle Data / VehicleData | Speed |
| | | | | | | | | | | | RPM |
| | | | | | | | | | | | Brake Pedal Status |
| | | | | | | | | | | | Cruise Control |
| | | | | | | | | | | | Clutch status |
| | | | | | | | | | | | Stop & Start function |
| | | | | | | | | | | | Gas Pedal |
| | | | | | | | | | | | Acceleration longitudinal |
| | | | | | | | | | | | Acceleration lateral |
| | | | | Data Exchange | ecoFVD Transmission | - | - | ecoFVD | - | - | - |

*Table 6. ecoPostTrip table of Inputs/Outputs*

| SP | Diagram | Author | Role | Product | Service | Main Process | Process (P) / Event (E) | Input Objects | Input Data | Output Objects | Output Data |
|---|---|---|---|---|---|---|---|---|---|---|---|
| SP3 | ecoPostTrip | Jean-Marie Tran | Driver | ecoPostTrip | Trip Analysis Report | - | E: Ignition On within 1 hour from previus trip | - | - | - | - |
| | | | | | | | P: confirm with driver if he continues with previous trip & Driver ID | DriverProfile | DriverID | DriverProfile | DriverID |
| | | | | | | | | | Driver Behaviour | | Driver Behaviour |
| | | | | | | | | | Driver Preferences | | Driver Preferences |
| | | | | | | | | Trip Data | | Trip Data | |
| | | | | | | | E: Ignition Off & Key-out | - | - | - | - |
| | | | | | | | P: Confirm Driver ID | DriverProfile | DriverID | DriverProfile | DriverID |
| | | | | | | | | | Driver Behaviour | | Driver Behaviour |
| | | | | | | | | | Driver Preferences | | Driver Preferences |
| | | | | | | | P: Storing Trip Data | - | - | TripData | - |
| | | | | | | | E: Trip analyse State | - | - | - | - |
| | | | | | | | P: Analyse Trip | Trip Data | - | - | - |
| | | | | | | | P: Provide Trip Analysis Report | TripDataSet | ecoRoute | TripAnalysisReport | - |
| | | | | | | | | | Driver Behaviour | | |
| | | | | | | | | | Driver Preferences | | |
| | | | | | Recommendations for improving fuel efficiency | - | P: Create recommendations for improving fuel effienciency | TripDataSet | ecoRoute | ecoRecommendations | Improving fuelefficiency |
| | | | | | | | | | Driver Behaviour | | |
| | | | | | | | | | Driver Preferences | | |
| | | | | | Off line Analysis Of trip | - | E: Driver request for data export | - | - | - | - |
| | | | | | | | P: Export trip data for offline access | TripDataSet | ecoRoute | Exported TripDataSet | ecoRoute |
| | | | | | | | | | Driver Behaviour | | Driver Profile |
| | | | | | | | | | Driver Profile | | TripData |
| | | | | | | | | | Trip Data | | TripAnalysisReport |
| | | | | | | | | | Comparison Report | | Comparision Report |
| | | | | | | | | | ecoRecommendations | | ecoRecommendation |
| | | | | | Comparison of Trips | - | E: Driver request comparison of trips | - | - | - | - |
| | | | | | | | P: Retrieve Trip Data | TripData | - | - | - |
| | | | | | | | P: Compare Trips and produce report | TripDataSet | ecoRoute | ComparisonReport | - |
| | | | | | | | | | Driver Profile | | |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | Trip Data<br>Trip Analysis Report<br>ecoRecommendation | | | |

# Appendix B - Diagrams including all applications

This Appendix is composed by two diagrams which represent the connections among all applications.

The BL diagram shows the inputs/outputs sequence for all applications, showing how they are connected each other.

The TL diagram, in a more generic meaning with respect to the single diagrams for the single applications, shows how a generic vehicle should be equipped to be an ecoMove vehicle.

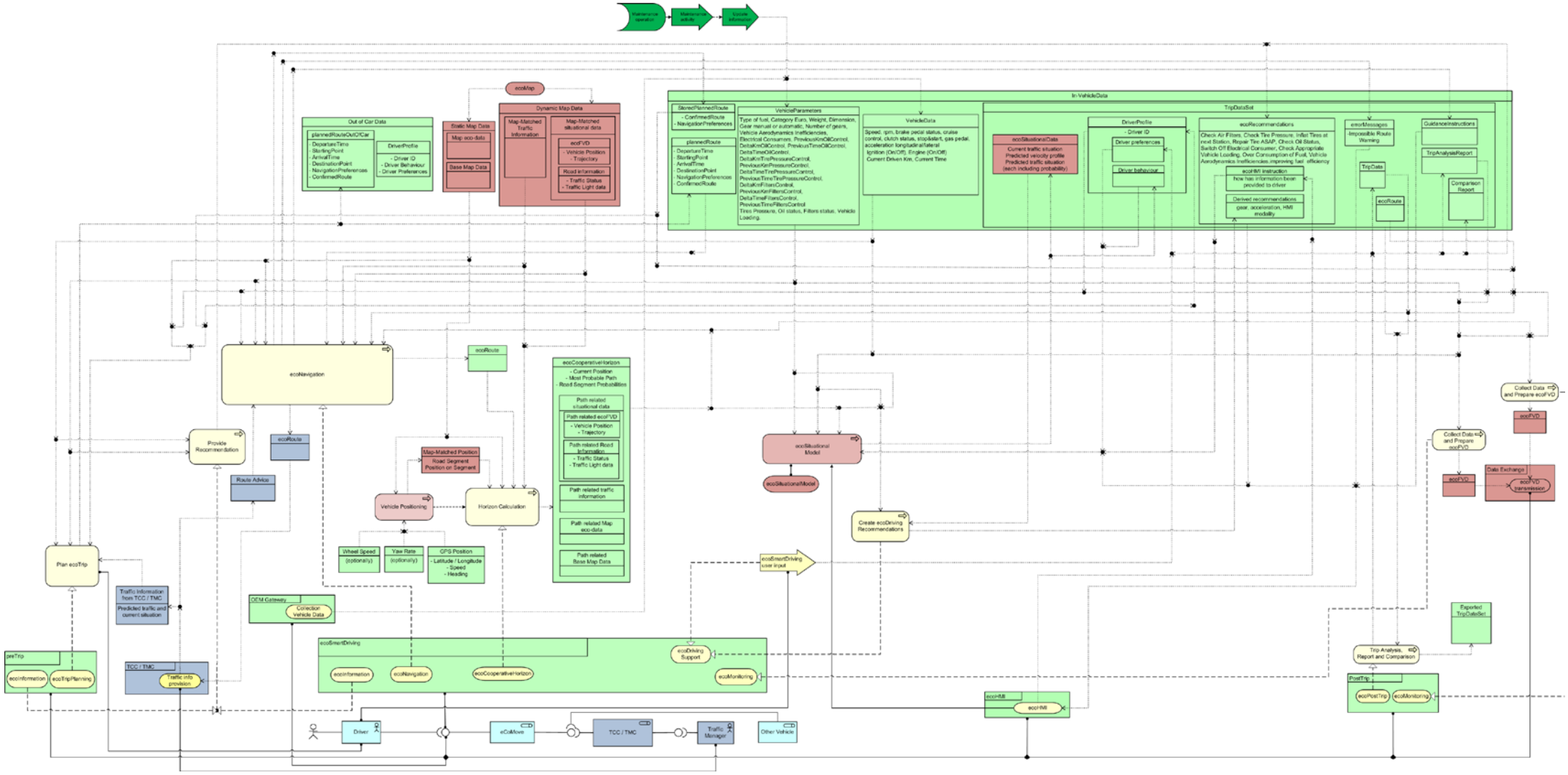



*Figure 14: Business Layer diagram of all SP3 applications*

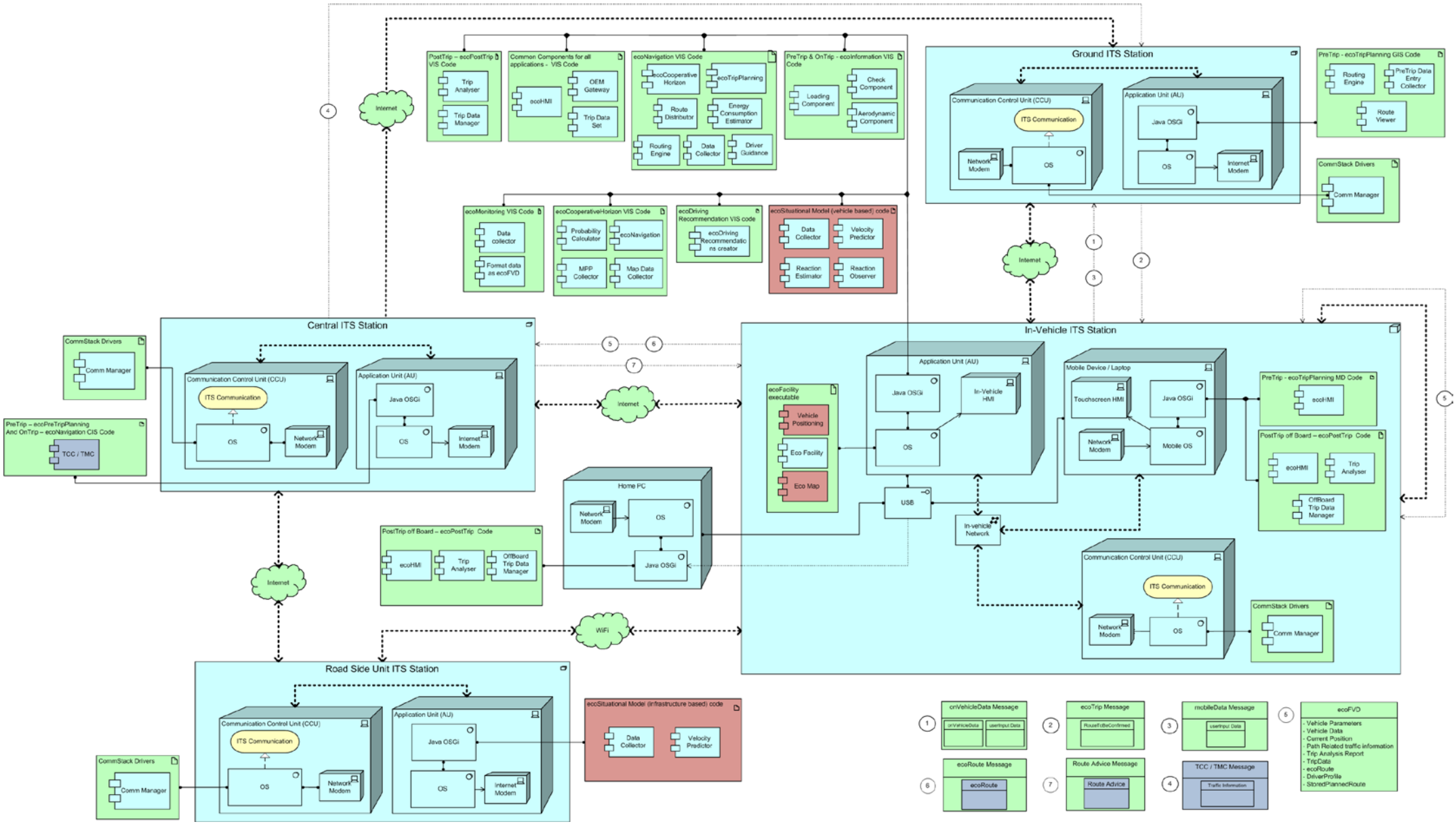



*Figure 15: Technology Layer diagram of all SP3 applications.*

# Appendix C – SP3 requirements

The requirements table comes from [1] and it has been reported here for reference for the traceability matrix.
The first column consist of a requirement number of the format **SP3** - **X** - **XXXXx**

*SP3* – stands for ecoSmartDriving subproject
*X* – the number for the application/ component
***Applications:*** *1 – ecoTripPlanning, 2 – ecoInformation, 3 - dynamic ecoNavigation, 4 - ecoDriving Support, 5 – ecoPostTrip application, 6 – ecoMonitoring*
***Components:*** *7 – ecoHMI, 8 – ecoCooperativeHorizon, 9 - TripDataSet*
*XXXX*– is the actual number of the requirement
In case several requirements are closely related then they have the same sequential number indexed by a trailing alphabet (e.g. XXXXx - 0001a)

The second column in the Table 7 consists of the type of the requirement. The possible types are shown in the Table below.

| Type | Abbreviation |
|---|---|
| Cultural & Political | CP |
| Functional | F |
| Legal | L |
| Maintainability & Support | MS |
| Performance | P |
| Usability & Humanity | UH |
| Look & Feel | LF |
| Operational & Environmental | OE |
| Security | S |

The third column of Table 7 has the first row, Description, which explains the intention of the requirement, and the second row, Rationale, which explains the fundamental reason of why such a requirement is needed.

*Table 7. SP3 Requirement table.*

| Requirement number | Type | Description |
|---|---|---|
| **SP3-1-0001** | F | **Description**:<br>The system needs to collect from the user and/or from the vehicle the necessary information in order to determine an optimal route.<br>The necessary data are the following:<br>• Vehicle type (in case it is a vehicle that is not enabled to drive through certain areas)<br>• From (start location)<br>• To (location destination)<br>• When (date and time of the trip) |
| | | **Rationale**:<br>Building block for ecoTripPlanning |
| **SP3-1-0002** | F | **Description**:<br>The system needs enhanced maps data to determine the ecoRoute.<br>To determine the ecoRoute the system needs additional data from digital maps (e.g. road slope) |
| | | **Rationale**:<br>Building block for ecoTripPlanning |
| **SP3-1-0003** | F | **Description**:<br>Availability of additional information to increase the function performance.<br>The preTrip function will be able to perform better route computing if historical traffic data will be available for each road segment. These data potentially are provided by external service / function. |
| | | **Rationale**:<br>Building block for ecoTripPlanning |
| **SP3-1-0004** | F | **Description**:<br>The functions should be able to take care of local traffic restrictions.<br>Municipality frequently proposes temporary traffic restriction. The ability to consider them makes the result more useful.<br>These data potentially are provided by external service / function. |
| | | **Rationale**:<br>Building block for ecoTripPlanning |

| Requirement number | Type | Description |
|---|---|---|
| **SP3-1-0005** | F | **Description**:<br>A link to external services is necessary to provide the system with data which are not locally available.<br>Data as historical data, traffic limitation etc. are available from external services. |
| | | **Rationale**:<br>Building block for ecoTripPlanning |
| **SP3-1-0006** | F | **Description**:<br>In case the departure / arrival time entry of the user is not specified, the ccoTripPlanning application should enable trip timing optimisation (departure/arrival time) based on TrafficStatePrediction if fuel consumption can be reduced with an alternative timing. |
| | | **Rationale**:<br>Building block for ecoTripPlanning |
| **SP3-1-0007** | F | **Description**:<br>In case the arrival time is fixed the ecoTripPlanning application should be able to warn the driver if the travel time changes before the trip has started. |
| | | **Rationale**:<br>Building block for ecoTripPlanning |
| **SP3-1-0008** | OE | **Description**:<br>The ecoTripPlanning application should use the ecoRouting component to determine the least fuel consuming route based on one or more of the following entries from the user:<br>a. Origin<br>b. Destination<br>c. Intermediate destination<br>d. Arrival time<br>e. Departure time<br>f. Vehicle ID |
| | | **Rationale**:<br>In order to calculate the optimal route. |

| Requirement number | Type | Description |
|---|---|---|
| **SP3-1-0009** | OE | **Description**:<br>The ecoTripPlanning application should be available off board and on-board of the vehicle<br>a. Off-board availability should be enabled via a mobile device or via PC<br>b. On-board access via TBD device |
| | | **Rationale**:<br>In order to help the user plan ahead of the trip and indpendent of the car. |
| **SP3-1-0010** | OE | **Description**:<br>The ecoTripPlanning application should be able to access TrafficStatePredictions (SP5) to enable the user to perform the following check:<br>a. One day or more before the trip: based on historic traffic profiles – check should be done daily<br>b. Day of the trip: prediction of traffic state based on actual traffic situation – check should be done each hour |
| | | **Rationale**:<br>For providing optimal suggestions |
| **SP3-1-0011** | UH | **Description**:<br>Acceptance for ecoTripPlanning application: the function should represent an opportunity for the user |
| | | **Rationale**: |
| **SP3-1-0012** | UH | **Description**:<br>Usability of data input: the interface should be easy to use |
| | | **Rationale**: |
| **SP3-1-0013** | UH | **Description**:<br>Usability of data output: the result should be easy to be used |
| | | **Rationale**: |
| **SP3-1-0014** | UH | **Description**:<br>Usability the ecoTripPlanning application: the system should be easy, effective and safe to interact with |
| | | **Rationale**: |
| **SP3-2-0001** | F | **Description**:<br>The driver is informed on the tires pressure status, and receives a recommendation when necessary, encouraging to inflat tires to an optimized pressure value to reduce the rolling resistance, and thus reduce the fuel consumption. |

| Requirement number | Type | Description |
|---|---|---|
| | | **Rationale**:<br>Reducing the rolling resistance by over-flatted tires (+10%) |
| **SP3-2-0002** | F | **Description**:<br>The driver is informed on the best practices related to aerodynamics influence: encouraging to dismount unused luggage racks in order to reduce the aerodynamic resistance. |
| | | **Rationale**:<br>Reducing the aerodynamic resistance by mounting (spoiler for truck) or dismounting accessory (luggage rack,..) . |
| **SP3-2-0003** | F | **Description**:<br>The driver is informed on the best practices related to weight influence, encouraging to remove unused weights on passenger car or unused trailers on trucks in order to reduce significantly weight. |
| | | **Rationale**:<br>Reducing the extra-weight on trip |
| **SP3-2-0004** | F | **Description**:<br>The driver is informed and encouraged when necessary to deactivated (manually) some electrical consumers (AC, electrical heater systems, radio/video, auxiliaries plugged on "car cigar-jack",...) in order to reduce the torque resistance from alternator, and thus reducing fuel consumption and/or saving battery energy during trip. |
| | | **Rationale**:<br>Reducing the torque resistance and saving battery energy. |
| **SP3-2-0005** | OE | **Description**:<br>Outputs to:<br>SP4 : ecoHMI interface - PreTrip<br>ecoInformation encouraging to mount a spoiler for cockpit roof on trucks in order to reduce the aerodynamic resistance. |
| | | **Rationale**:<br>Interface required |
| **SP3-2-0006** | OE | **Description**:<br>Outputs to :<br>SP4 : ecoHMI interface - OnTrip<br>ecoInformation displaying in real time the current lost of fuel in order to induce the mounting of the spoiler.. |

| Requirement number | Type | Description |
|---|---|---|
| | | **Rationale**:<br>Interface required |
| **SP3-2-0007** | OE | **Description**:<br>Outputs to :<br>SP4 : ecoHMI interface - PostTrip<br>ecoInformation displaying in real time the total lost of fuel in order to induce the mounting of the spoiler.. |
| | | **Rationale**:<br>Interface required |
| **SP3-2-0008** | OE | **Description**:<br>Outputs to:<br>SP3 : ecoHMI interface - PreTrip<br>ecoInformation encouraging to dismount luggeage track from the roof in order to reduce the aerodynamic resistance. |
| | | **Rationale**:<br>Interface required |
| **SP3-2-0009** | OE | **Description**:<br>Outputs to :<br>SP3 : ecoHMI interface - ON Trip<br>ecoInformation :displaying in real time the current over-consumption of fuel due to aerodynamic lost. |
| | | **Rationale**:<br>Interface required |
| **SP3-2-0010** | OE | **Description**:<br>Outputs to :<br>SP3 : ecoHMI interface - PostTrip<br>ecoInformation displaying in real time the total over-consumption of fuel |
| | | **Rationale**:<br>Interface required |

| Requirement number | Type | Description |
|---|---|---|
| **SP3-2-0011** | OE | **Description**:<br>Inputs from :<br>SP3 : ecoDriving - PreTrip/ OnTrip/ PostTrip<br>Engine variables (torque, consumption, engine speed, AC switch, State of charge, engine temp...), TireGuard system variables, Vehicle sensor variables (contacts) |
| | | **Rationale**:<br>Interface required |
| **SP3-2-0012** | P | **Description**:<br>The ecoInformation related to the tire guard function must have 3 levels of pressure.<br>ecoLevel = Comfort Level + 10 %<br>Comfort Level= Pressure advised by manufacturer.<br>Safety Level = Comfort.<br>The precision of the pressure acquisition must have an appropriate tolerance. The recurrency of the acquisition is at least every 10 secondes. |
| | | **Rationale**:<br>Precision and Measurement recurrency |
| **SP3-2-0013** | P | **Description**:<br>The ecoInformation system related to the optimizing electrical consumers should able to measure electrical data from power net ( power, current, voltage) with the precision (10% power of the smallest consumption). The measure is done before any regulation by the alternator or other regulator. |
| | | **Rationale**:<br>Precision and Measurement recurrency |
| **SP3-2-0014** | UH | **Description**:<br>ecoInformation can display the tires pressure status, encouraging to inflat tires to an optimized pressure value to reduce the rolling resistance, and thus reduce the fuel consumption.<br>ecoInformation can include information on potential consumption loss, money or range gain if tires are not correctly inflated.<br>ecoInformation can inform on the nearest station for inflating tires. |

| Requirement number | Type | Description |
|---|---|---|
| | | **Rationale**:<br>Reducing the rolling resistance by over-flatted tires (+10% standart pressure) |
| **SP3-2-0015** | UH | **Description**:<br>ecoInformation can inform on the best practices related to aerodynamics influence, encouraging to dismount unused luggage racks and/or to mount a spoiler for cockpit roof on trucks in order to reduce the aerodynamic resistance.<br>ecoInformation can include information on potential consumption loss, money or range gain during pre-trip, trip and post-trip.. |
| | | **Rationale**:<br>Reducing the aerodynamic resistance by mounting (spoiler for truck) or dismounting accessory (luggage rack,..) . |
| **SP3-2-0016** | UH | **Description**:<br>ecoInformation can inform on the best practices related to weight influence, encouraging to remove unused weights on passenger car or unused trailers on trucks in order to reduce significantly weight.<br>ecoInformation can include information on potential consumption loss, money or range gain during pre-trip, trip and post-trip. |
| | | **Rationale**:<br>Reducing the extra-weight on trip<br>Informing the fuel saving / CO2-emission reduction estimated up to xx%. |
| **SP3-2-0017** | UH | **Description**:<br>ecoInformation can inform and encourage when necessary to deactivated (manually) some electrical consumers (AC, electrical heater systems, radio/video, auxiliaries plugged on "car cigar-jack",...) in order to reduce the torque resistance from alternator, and thus reducing fuel consumption and/or saving battery energy during trip.<br>ecoInformation can include information on potential consumption (money and range) loss, if non necessary loads are activated.<br>ecoInformation can provide information in Pre-trip phase, during Trip, and on Post-trip phases as well, with different priorities and contents depending on driving conditions |
| | | **Rationale**:<br>Reducing the torque resistance and saving battery energy.<br>Best fuel saving reduction in extreme conditions (AC on traffic jam in summer…) for passenger car (incl. hybrid) and trucks. |
| **SP3-3-0001** | F | **Description**:<br>User must be able to select destination. |

| Requirement number | Type | Description |
|---|---|---|
| | | **Rationale**:<br>Routing requires a destination to route to. |
| **SP3-3-0002** | F | **Description**:<br>dynamic ecoNavigation must generate a route to the destination. |
| | | **Rationale**:<br>This is the very purpose of routing. |
| **SP3-3-0003** | F | **Description**:<br>dynamic ecoNavigation must check alternatives to MPP when no destination is known. |
| | | **Rationale**:<br>Even without a final destination, it's possible to find more fuel-efficient alternatives to the road ahead of the vehicle. |
| **SP3-3-0004** | F | **Description**:<br>dynamic ecoNavigation should warn of impossible routes. |
| | | **Rationale**:<br>The system shouldn't guide the driver through illegal maneuvers without at least informing the driver. |
| **SP3-3-0005** | F | **Description**:<br>Green route must be fuel-efficient. |
| | | **Rationale**:<br>This is what makes the route a green route.<br>Unfortunately, there is no way to set a requirement on the actual fuel savings (compared to what?) in advance; and since routing needs some heuristics for performance reasons, it's not feasible to require the route to be the very optimum route – one at most can require a good enough route. |
| **SP3-3-0006** | F | **Description**:<br>dynamic ecoNavigation should make use of vehicle parameters. |
| | | **Rationale**:<br>The least fuel consuming route might depend in some cases on vehicle data like mass, cw (aerodynamic drag coefficient), cross section, or motor properties. |
| **SP3-3-0007** | F | **Description**:<br>dynamic ecoNavigation should make use of historic traffic patterns. |

| Requirement number | Type | Description |
|---|---|---|
| | | **Rationale**:<br>The least fuel consuming route depends on the possible speeds along the route which can be estimated from collected data. |
| **SP3-3-0008** | F | **Description**:<br>dynamic ecoNavigation should make use of dynamic traffic information and situational data. |
| | | **Rationale**:<br>The least fuel consuming route depends on the possible speeds along the route; this information can be collected and distributed centrally. Also incidents need to be taken into account.<br>Roadside units can distribute situational information about local traffic and near-future events like traffic light phases. |
| **SP3-3-0009** | F | **Description**:<br>dynamic ecoNavigation should make use of floating vehicle data from other vehicles. |
| | | **Rationale**:<br>Information from other vehicles might allow conclusions on where it's currently possible to drive in a fuel efficient way. |
| **SP3-3-0010** | F | **Description**:<br>dynamic ecoNavigation should make use of route advice from a traffic centre. |
| | | **Rationale**:<br>A traffic centre might have route advice that takes into account on the one hand planned measured like future traffic light control settings, on the other hand the effects of one vehicle on the total fuel consumption of the vehicles in the area. |
| **SP3-3-0011** | F | **Description**:<br>When new floating vehicle data or dynamic traffic information is available, the route is recalculated. If the newly calculated route shows a significant fuel saving compared to the previous one, it replaces the previous route for further guidance. |
| | | **Rationale**:<br>New dynamic traffic information orV2V information (or even the ego vehicle moving with a different speed than assumed, for the time dependency of traffic pattern data) might outdate a route. |
| **SP3-3-0012** | F | **Description**:<br>When the vehicle leaves the route, the route is recalculated. |
| | | **Rationale**:<br>When the driver misses some manoeuvre, new guidance is needed within a short time. |

| Requirement number | Type | Description |
|---|---|---|
| **SP3-3-0013** | F | **Description**:<br>dynamic ecoNavigation guides the driver along the route and informs about impending manoeuvres. |
| | | **Rationale**:<br>Just having a route is not enough; it needs to be used to guide the driver. |
| **SP3-3-0014** | F | **Description**:<br>dynamic ecoNavigation gives lane information to the driver. |
| | | **Rationale**:<br>Lane information enables early lane choice which improves traffic flow and thus reduces fuel consumption. |
| **SP3-3-0015** | F | **Description**:<br>Optionally, the route can be optimized for a configurable combination of fuel consumption and travel time. |
| | | **Rationale**:<br>In real life, drivers wouldn't use a green route if that means unreasonably high travel times, so there's a trade-off between the two that should be reflected in the application. |
| **SP3-3-0016** | OE | **Description**:<br>dynamic ecoNavigation must access the static ecoMap, the interface is TBD. |
| | | **Rationale**:<br>The map is the very base for routing. Details of the interface will be defined in task 2.4.3.1. |
| **SP3-3-0017** | OE | **Description**:<br>dynamic ecoNavigation should access dynamic traffic information. |
| | | **Rationale**:<br>Dynamic traffic information helps avoiding traffic incidents and delivers information on possible speeds which are important for fuel consumption estimation. |
| **SP3-3-0018** | OE | **Description**:<br>dynamic ecoNavigation should access situational data from Road-Side Units and floating car data from other vehicles via the dynamic ecoMap. |
| | | **Rationale**:<br>Situational data helps locally optimizing the route. |

| Requirement number | Type | Description |
|---|---|---|
| **SP3-3-0019** | OE | **Description**:<br>dynamic ecoNavigation should access MPP from ecoHorizon. |
| | | **Rationale**:<br>Without a planned route, dynamic ecoNavigation still can propose better alternatives to the MPP. |
| **SP3-3-0020** | OE | **Description**:<br>dynamic ecoNavigation should receive route advice from traffic centre. |
| | | **Rationale**:<br>This is the counterpart to SP5 route advice. |
| **SP3-3-0021** | OE | **Description**:<br>dynamic ecoNavigation should use driver profiles created by TripDataSet. |
| | | **Rationale**:<br>Driver behaviour has a large influence on fuel consumption, and this influence can vary much depending on the road properties, so the most fuel-efficient route may be different for different drivers. |
| **SP3-3-0022** | OE | **Description**:<br>ecoNavigation should be available as a component to applications; interfaces are yet TBD. |
| | | **Rationale**:<br>dynamic ecoNavigation will be used by both pre-trip planning and on-board navigation; as a modular component, it shouldn't need knowledge about the applications that use it. |
| **SP3-3-0023** | P | **Description**:<br>A route calculation should take at most one minute for a route up to 500 km. |
| | | **Rationale**:<br>We cannot keep the user waiting too long for a route. On the other hand, dynamic ecoNavigation algorithms may be considerably more complex than the fastest/shortest route calculation in commercial navigation systems (which usually are highly optimized), so we have to allow (at least in this research project) considerably longer computing times. |
| **SP3-3-0024** | P | **Description**:<br>A route recalculation due to new/updated information should take at most one minute for a route up to 500 km. |
| | | **Rationale**:<br>Dynamic traffic information and V2V information needs to be processed in a timely fashion to be useful. |

| Requirement number | Type | Description |
|---|---|---|
| **SP3-3-0025** | P | **Description**:<br>A route recalculation after leaving the route should take at most 10 seconds. |
| | | **Rationale**:<br>When the driver has left the route, new guidance is required almost immediately; in this case, time is more important than route quality. Usually, just a way back to the previous route is calculated. |
| **SP3-4-0001** | F | **Description**:<br>The system has to consider the driving safety in the determination of the driving strategies |
| | | **Rationale**:<br>The system has to determine a driving strategy that considers driving safety. Although hard braking maneuvers are inefficient these should be recommended when the vehicles is driven above the legal speed maximum. Also too close distances to front vehicles have to be avoided in any situation. |
| **SP3-4-0002** | F | **Description**:<br>The system optimizes the velocity profile of the vehicle for the trip (driving strategy) dynamically. Therefore the following variables are affected: travel time, fuel consumption, driver acceptance, (electrical) power supply for different energy consumers |
| | | **Rationale**:<br>To determine an optimal driving strategy the system should consider the following information:<br>• Velocity (current and future maximum velocity limitations)<br>• Inclination (current and future)<br>• Constant vehicle parameters such as engine and transmission map<br>• Estimated inconstant vehicle parameters such as mass, rolling or aerodynamic resistant |
| **SP3-4-0003** | F | **Description**:<br>The recommended green driving strategy considers the type of driver to reach a maximum driver acceptance. → connected to the ecoHMI. |
| | | **Rationale**:<br>The system has to assess the standard driving style of a specific driver (e.g. sporty or highly efficient driving style). Depending on this driving style recommendations for a more fuel efficient driving style have to be proceeded. |
| **SP3-4-0004** | F | **Description**:<br>The system shold consider a holistic use function of the driver including travel time as well as fuel consumption. |

| Requirement number | Type | Description |
|---|---|---|
| | | **Rationale**:<br>The green driving strategies should be tunable to consider the benefits of a driver to move as well as the cost arising from fuel consumption. A faster arriving at the target destination and a lower usage of fuel is beneficial for the driver. A higher velocitiy is nearly in all situations accompanied by higher fuel consumption. Thus the driver decides on his driving behaviour in a trade off between driving time and fuel consumption. This trade off is driver specific and has to be estimated by the system to ensure optimal results. |
| **SP3-4-0005** | F | **Description**:<br>The driving strategies consider information about the driving style of front vehicle to improve the prediction of future driving situations and thereby improve the calculation of green driving strategies. |
| | | **Rationale**:<br>The front vehicle affects the driving strategy of the following vehicle. A probable behavior of the front vehicle can be assessed taking a standard driver into account. The system should also be able to assess the driving style of the front driver using several sensor informations. If the front vehicle is equipped with a eCoMove system it should determine and predict the driving style of its driver. This information should be transmitted to the following vehicle to increase the predicion accuracy and thus the effectiveness of driving strategies. |
| **SP3-4-0006** | F | **Description**:<br>Determination and prediction of the effectiveness of different driving strategies |
| | | **Rationale**:<br>The system has to assess the effectiveness of different driving strategies (e.g. coasting, deceleration with engine in trailing throttle mode or braking) and communicate their probable effectiveness (this is the energy consumption) to the driver. This comparison enables the driver to see the benefits of a predictive driving style. |
| **SP3-4-0007** | F | **Description**:<br>The system considers both fuel economy and the potential trade-off with travel time while optimizing the trip and the driving strategies for a specific traffic stituation. |
| | | **Rationale**:<br>driver acceptance can only be ensured, if besides fuel consumption als other relevant parameters such as travel time and acceleration profile are considered. The holistic use function has to be adjustable by the driver |
| **SP3-4-0008** | F | **Description**:<br>The system dynamically determines the optimal driving strategy and communicates it to the driver. |

| Requirement number | Type | Description |
|---|---|---|
| | | **Rationale**:<br>The ecoDriver Coaching system is aware about the vehicle status (e.g. load) and the route to be driven. Furthermore it considers the environmental conditions of the vehicle (e.g. other vehicles, infrastructure, weather, legal restrictions) to adjust driving behavior to the current driving situation. Based on all this information it supports the driver in using the vehicle in the most fuel efficient way. |
| **SP3-4-0009** | F | **Description**:<br>System does not recommend something which is against any legal restriction (such as maximum speed) |
| | | **Rationale**:<br>The driving strategy must come up with optimization results that do not exceed the legal maximum speed. |
| **SP3-4-0010** | F | **Description**:<br>The performance of the chosen driving strategy is analyzed and stored for further evaluation. |
| | | **Rationale**:<br>To educate the driver to a more eco friendly driving style feedback of how he performed on the trip has to be provided. |
| **SP3-4-0011** | OE | **Description**:<br>The system estimates the travel time for the journey based on calculations considering different driving strategies. The driving strategies system thus should be equipped with an interface to support this. |
| | | **Rationale**:<br>To inform the driver about the estimated travel time this value has to be calculated dynamically. The estimated travel time of the journey also affects the behavior of the driver. For example he is willed to drive more eco friendly if he knows that he will arrive in time. |
| **SP3-4-0012** | OE | **Description**:<br>The system stores relevant data during the trip and analyses the driving behavior/ the driving strategy of the driver to allow a post trip feedback to the driver. Therefore an interface of the driving strategies should be implemented if necessary. |
| | | **Rationale**:<br>The post trip analysis and feedback to the driver requires stored data derived from the evaluation of driving strategies. Therefore relevant data has to be stored depending on the specific hardware specificaions. For example the total amount of fuel that could have been saved driving optimally can be derived and stored. |
| **SP3-4-0013** | OE | **Description**:<br>The on-board navigation guides the driver along the planned ecoTrip containing the application of green driving strategies. |

| Requirement number | Type | Description |
|---|---|---|
| | | **Rationale**:<br>The system is guiding the driver how to drive energy efficiently following the planned ecoTrip. |
| **SP3-5-0001** | F | **Description**:<br>At the end of the trip - the application must be able to store the trip details based on the defined parameters (TBD) for a defined period of time(TBD) |
| | | **Rationale**:<br>The trip data should be stored for future analysis and reporting |
| **SP3-5-0002** | F | **Description**:<br>At the end of the trip - the application must be able to provide a detailed analysis report of the trip (onboard) with TBD parameters such as<br>a. Gear change behaviour<br>b. Acceleration behaviour<br>c. Deceleration behaviour<br>d. Constant speed<br>e. Anticipative driving<br>f. Distance keeping (if possible based on vehicle sensors)<br>g. Engine idling<br>h. Drive style related to road geometry |
| | | **Rationale**:<br>Inform the driver how fuel efficient he / she has driven and which aspects of the drive contributed to this |
| **SP3-5-0003** | F | **Description**:<br>The application must be able to analyze certain parameters (TBD) of the trip details and provide an advice on improving the fuel efficiency |
| | | **Rationale**:<br>To make the driver aware of the ways to save fuel |
| **SP3-5-0004** | F | **Description**:<br>The stored trip data should be exportable to PDAs and PCs |

| Requirement number | Type | Description |
|---|---|---|
| | | **Rationale**:<br>For offline analysis of the data |
| **SP3-5-0005** | F | **Description**:<br>The application should be able to compare the current trip data with the previous trip data of the same driver and provide a comparison report |
| | | **Rationale**:<br>To motivate the driver to improve from his current best |
| **SP3-5-0006** | F | **Description**:<br>The application should be able to share the specific parameters (TBD) of the trip data to TBD-application in order to improve the green routing |
| | | **Rationale**:<br>To improve the accuracy of the fuel consumption prediction on a particular route |
| **SP3-5-0007** | | **Description**:<br>The application should enable identification of single trips |
| | | **Rationale**:<br>To compare each single trip with other trips made |
| **SP3-5-0008** | | **Description**:<br>The application should be able to identify the driver- when there is more than one driver using the same vehicle |
| | | **Rationale**:<br>to avoid ambiguities |
| **SP3-5-0009** | | **Description**:<br>the application should be able to determine the remaining saving potential of trip |
| | | **Rationale**:<br>as an awareness for the user |

| Requirement number | Type | Description |
|---|---|---|
| **SP3-5-0010** | | **Description**:<br>The ecoPostTrip application that is available off-board should enable a detailed analysis of a trip on fuel consumption related behaviour like for example:<br>a. Gear change behaviour<br>b. Acceleration behaviour<br>c. Deceleration behaviour<br>d. Constant speed<br>e. Anticipative driving<br>f. Distance keeping (if possible based on vehicle sensors)<br>g. Engine idling<br>h. Drive style related to road geometry |
| | | **Rationale**:<br>For offline analysis of the data |
| **SP3-5-0011** | OE | **Description**:<br>The application should enable downlaod of trip data onto a USB-stick or other devices such as PDAs and PCs |
| | | **Rationale**:<br>For offline analysis of the data |
| **SP3-5-0012** | OE | **Description**:<br>The ecoPostTrip application should be able to provide input to the ecoHMI on the trip evaluation including a selection of the following parameters:<br>a. fuel saved by following system recommendations<br>b. evaluation of selected drive style parameters (e.g. gear shift, anticipative driving or a driver preference)<br>c. tips for better driving |
| | | **Rationale**: |
| **SP3-5-0013** | OE | **Description**:<br>The ecoPostTrip application should be able to store and retrieve trip data from the TripDataSet component |
| | | **Rationale**:<br>As a storage database |

| Requirement number | Type | Description |
|---|---|---|
| **SP3-5-0014** | UH | **Description**:<br>the readability of the report should be more clear also when it is exported to an external devices |
| | | **Rationale**:<br>to be able to analyze offboard |
| **SP3-5-0015** | S | **Description**:<br>the report should be secure enough and should not be editable by unauthorized persons |
| | | **Rationale**:<br>to maintain privacy and secure the data |
| **SP3-5-0016** | L | **Description**:<br>Sharing of the report to others should be authorized by the user |
| | | **Rationale**:<br>to identify the willingness of the user to share his data |
| **SP3-6-0001** | F | **Description**:<br>The ecoMonitoring system sends to the control centre (and to external vehicles if required from them to refine their pre – trip algorithms) some TBD parameters related to the last executed trip, after the post trip application.<br>[The parameters could be:<br>- 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.<br>- trip parameters: starting and ending position, travelling time, travelling distance, roads slope.] |
| | | **Rationale**:<br>Send to other vehicles and to the control centre the data related to the last executed trip. |
| **SP3-6-0002** | F | **Description**:<br>The ecoMonitoring system sends to the control centre (and to external vehicles if required from their pre-trip applications) the results of the post trip application. |
| | | **Rationale**:<br>Inform the control centre and the other cars of eventual results of the post trip application. |

| Requirement number | Type | Description |
|---|---|---|
| **SP3-6-0003** | F | **Description**:<br>The data sent from the ecoMonitoring to the control centre must be standardized. All OEM must make available to the ecoMonitoring the same data with the same TBD format. The ecoMonitoring can work on all the OEM vehicles in the same way. |
| | | **Rationale**:<br>The control centre must receive the data required from all the vehicles with the same standard format, independently of the OEM. |
| **SP3-6-0004** | F | **Description**:<br>The ecoMonitoring system sends to the control centre and to external vehicles as floating car data, some TBD parameters related to the vehicle itself and to the current trip: [The parameters could be: vehicle parameters: GPS position, speed, rpm, brake pedal status, cruise control if available, clutch status, stop&start if available, gas pedal, acceleration longitudinal/lateral.<br>- trip parameters: destination of the trip, road slope.] |
| | | **Rationale**:<br>Send to other vehicles and to the control centre the real time data related to the current trip of the vehicle. |
| **SP3-6-0005** | F | **Description**:<br>The ecoMonitoring system sends to the insurance company the raw paratemers related to the vehicle and to the trip.<br>[The parameters could be:<br>- vehicle parameters: GPS position, speed, rpm, brake pedal status, fuel level, fuel consumption<br>- trip parameters: initial position and destination of the trip.] |
| | | **Rationale**:<br>Send to insurance company data related to the trip in order to receive benefits for ecoDriving |
| **SP3-6-0006** | OE | **Description**:<br>The ecoMonitoring application should be able to retrieve trip data from the TripDataSet. |
| | | **Rationale**:<br>Retreive the information about the vehicle (also the trip?) from the TripDataSet. |
| **SP3-6-0007** | OE | **Description**:<br>The ecoMonitoring application should be able to provide the ecoFVD message (incl. destination information) to the communication platform |

| Requirement number | Type | Description |
|---|---|---|
| | | **Rationale**:<br>The ecoMonitoring should send to the communication platform the set of data to be sent out to vehicles and traffic management centre. |
| **SP3-6-0008** | OE | **Description**:<br>The control centre defines some specific TBD parameters to be received by the ecoMonitoring system for any trip of the vehicle.<br>[The parameters could be:<br>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.<br>trip parameters: starting and ending position, travelling time, travelling distance, roads slope.] |
| | | **Rationale**:<br>The control centre discriminates among all data related to a generic trip, and selects a limited set of parameters to be sent from the ecoMonitoring system. |
| **SP3-6-0009** | P | **Description**:<br>Define an update rate for each post trip parameter to be sent to the control centre. |
| | | **Rationale**:<br>The ecoMonitoring system has to send to the control centre some data related to the post trip, but any parameter has its own update rate (ex. speed, acceleration, fuel consumption), and not all updates can be sent to the control centre, otherwise there is |
| **SP3-6-0010** | P | **Description**:<br>The ecoMonitoring system has to collect data with a TBD precision, which is dependent from the particular parameter to be collected (as an example, the precision on speed could be at level of 0.01 m/sec, while for acceleration it could be at level of 0.01 m/sec2). |
| | | **Rationale**:<br>Set the precision of each parameter to be monitored. |
| **SP3-6-0011** | S | **Description**:<br>Privacy requirement. The data saved by the ecoMonitoring system should contain information about the last trip performed, without any information about the car and the driver sending the data. |

| Requirement number | Type | Description |
|---|---|---|
| | | **Rationale**:<br>Transmit data without information about the source vehicle.<br>Yes: speed, acceleration lateral/longitudinal, fuel type, displacement, type of vehicle (hybrid/not), windows open/closed, driving style, and similar data.<br>No: numberplate, chassis, brand, vehi |
| **SP3-6-0012** | S | **Description**:<br>Immunity requirement: the data sent from the ecoMonitoring should be not accessible from external programs that could modify the contents. The data format should be encrypted to be read only from an eCoMove system. |
| | | **Rationale**:<br>Immunity requirement from external illegal access. |
| **SP3-7-0001** | F | **Description**:<br>The ecoSmartDriving HMI should provide on-board training sessions. These should be complimentary to post-trip information. |
| | | **Rationale**:<br>To ensure that the driver will use the system in the intended way, the system HMI should support the driver by offering introduction and learning sessions inside the car in standstill (e.g. "How to use“, "Learn more about your system“). |
| **SP3-7-0002** | F | **Description**:<br>ecoSmartDriving HMI should provide a help function |
| | | **Rationale**:<br>A context specific help function will give the driver the opportunity to get more information about the indicated elements of the current ecoSmartDriving HMI view and driver’s options to operate the system, e.g. how to navigate in the menu or to change modes. |
| **SP3-7-0003** | F | **Description**:<br>The ecoSmartDriving HMI should indicate a possible Availability or non-availability of the system. Also the indication should be given if the system is switched to on or off. |
| | | **Rationale**:<br>If the system function is not available for a certain reason, it should be indicated to the driver. In case of a system failure the driver should be informed by issuing an appropriate message. |
| **SP3-7-0004** | F | **Description**:<br>System switches silent if there are no driver reactions |

| Requirement number | Type | Description |
|---|---|---|
| | | **Rationale**:<br>If the driver does not want to use the system or is in a specific situation (e.g. emergency) the system should not produce too many warnings and recommendations. This would just distract the driver. |
| **SP3-7-0005** | F | **Description**:<br>It should be possible to configure or even to shut down the ecoHMI by the user |
| | | **Rationale**:<br>It must be taken into account, that every user has his personal preferences and wants to decide whether he wants to use a system or in which cases he wants to use it. |
| **SP3-7-0006** | F | **Description**:<br>The ecoHMI should motivate the user to change the behaviour to a more efficient driving |
| | | **Rationale**:<br>guiding the driver how to drive energy efficiently |
| **SP3-7-0007** | F | **Description**:<br>The ecoHMI should assist at obstacles by recommending an energy efficient driving. |
| | | **Rationale**:<br>The HMI has to inform the driver about obstacles (e.g. road works, congestion, speed limits, roundabouts etc.) and how fast he should drive and when he should start to coast. |
| **SP3-7-0008** | F | **Description**:<br>The ecoHMI should help the driver to approach a slower vehicle in an energy efficient way |
| | | **Rationale**:<br>The driver is approaching a slower vehicle. He has to adopt the speed of the slower front vehicle |
| **SP3-7-0009** | F | **Description**:<br>The ecoHMI should tell the driver to turn off the car if it is stopped for traffic reasons |
| | | **Rationale**:<br>The vehicle is stopped for traffic reasons. If the motor is running then it consumes fuel |
| **SP3-7-0010** | OE | **Description**:<br>The ecoHMI should provide an interface to the information identified in the ecoDrivingSupport that has to be indicated to the driver |

| Requirement number | Type | Description |
|---|---|---|
| | | **Rationale**:<br>the interface is required |
| **SP3-7-0011** | OE | **Description**:<br>The ecoHMI should provide an interface to the information identified in the ecoInformation application that has to be indicated to the driver |
| | | **Rationale**:<br>the interface is required |
| **SP3-7-0012** | OE | **Description**:<br>The ecoHMI should provide an interface to the information identified in the Dynamic ecoNavigation application that has to be indicated to the driver |
| | | **Rationale**:<br>the interface is required |
| **SP3-7-0013** | OE | **Description**:<br>The ecoHMI should provide an interface to the ecoPostTrip application. To indicate the analysis report |
| | | **Rationale**:<br>the interface is required |
| **SP3-7-0014** | UH | **Description**:<br>The ecoSmartDriving HMI should indicate the driver with feedback about short term and long term efficiency performance (e.g. the indication of fuel consumption rate etc ) |
| | | **Rationale**:<br>The driver's motivation and excitement to use the system regularly will work on the basis of comparing efficiency performance values. Long term efficiency performance should also be the basis for rewarding the driver, e.g. with incentives. |
| **SP3-7-0015** | UH | **Description**:<br>The ecoSmartDriving HMI should provide consistent system reactions |
| | | **Rationale**:<br>As a basis for intuitiveness and comprehensibility of the ecoSmartDriving system the HMI should provide consistent system reactions to driver inputs, road conditions, traffic conditions and environmental conditions. |

| Requirement number | Type | Description |
|---|---|---|
| **SP3-7-0016** | UH | **Description**:<br>The ecoSmartDriving HMI should provide information and warnings which are easy to understand by the user |
| | | **Rationale**:<br>Beside an easy-to-use menu navigation it is important to provide all information and warnings in the way that they are easy to recognize, to differentiate and easy to remember |
| **SP3-7-0017** | UH | **Description**:<br>To support efficient deceleration the ecoSmartDriving HMI should communicate to the driver HOW to decelerate (Applying the brake pedal, Engine in trailing throttle mode or Coasting) and also WHEN to start decelerating. If applicable, the reason for decele |
| | | **Rationale**: |
| **SP3-7-0018** | UH | **Description**:<br>To support efficient acceleration the ecoSmartDriving HMI should communicate to the driver how to accelerate more energy efficient. If applicable, the reason for acceleration (e.g. to cross the traffic light, change in speed limit) should be provided |
| | | **Rationale**: |
| **SP3-7-0019** | UH | **Description**:<br>To avoid unnecessary stops at traffic lights the ecoSmartDriving HMI should communicate to the driver the currently appropriate target speed for passing the traffic light at green and /or the timeframe until the lights will change. |
| | | **Rationale**: |
| **SP3-7-0020** | UH | **Description**:<br>To support efficient driving in dense traffic the ecoSmartDriving HMI should communicate to the driver the currently appropriate target speed. |
| | | **Rationale**: |
| **SP3-7-0021** | UH | **Description**:<br>The ecoSmartDriving HMI should be providing visual, auditive and/or tactile information as system feedback based on the settings |
| | | **Rationale**:<br>Mapping appropriate feedback to driver input enhances the transparency and comprehensibility of the system. The frequency of erroneous driver inputs decreases. |
| **SP3-7-0022** | UH | **Description**:<br>While navigating in the system menu the ecoSmartDriving HMI should always be showing where the user currently is. |

| Requirement number | Type | Description |
|---|---|---|
| | | **Rationale**:<br>Enhances the transparency and comprehensibility of the system. The frequency of erroneous driver inputs decreases. |
| **SP3-7-0023** | UH | **Description**:<br>The ecoSmartDriving HMI should prevent the user from selecting incorrect options, avoiding unintended activation possibilities. |
| | | **Rationale**:<br>Enhances the transparency and comprehensibility of the system. The frequency of erroneous driver inputs decreases. |
| **SP3-7-0024** | UH | **Description**:<br>The ecoSmartDriving HMI should make the possible choices menu (settings) visible for the user |
| | | **Rationale**:<br>Enhances the transparency and comprehensibility of the system. The frequency of erroneous driver inputs decreases. |
| **SP3-7-0025** | UH | **Description**:<br>The ecoSmartDriving HMI should permit easy reversal of actions |
| | | **Rationale**:<br>Enhances the transparency and comprehensibility of the system. The frequency of erroneous driver inputs decreases. |
| **SP3-7-0026** | L | **Description**:<br>The ecoSmartDriving HMI should be in compliance to the following standards & regulations<br>- Commission Recommendation of 26/V/2008 on safe and efficient in-vehicle information and communication systems: Update of the European Statement of Principles on Hum |
| | | **Rationale**: |
| **SP3-7-0027** | UH | **Description**:<br>The ecoSmartDriving HMI should minimize distraction from the primary driving task. Thus the system should fulfill the following needs:<br>- Visual feedback should be in the primary field of view<br>- Visual / cognitive demand should be minimized<br>- Visual inform |
| | | **Rationale**:<br>Enhances the transparency and comprehensibility of the system. The frequency and duration of glances to the driver display should be minimised. |

| Requirement number | Type | Description |
|---|---|---|
| **SP3-7-0028** | UH | **Description**:<br>The ecoHMI should encourage the user to use the system |
| | | **Rationale**:<br>An ecoHMI must be accepted by the driver. If not the driver will not use (shut off) the system |
| **SP3-7-0029** | UH | **Description**:<br>The ecoHMI should show only the most important information in the specific situation, respectively not too much information |
| | | **Rationale**:<br>The driver will possibly get much information. There has to be a solution that the driver will not get too much information. |
| **SP3-7-0030** | UH | **Description**:<br>Easy to understand green driving strategy in energy relevant situations |
| | | **Rationale**:<br>The driver should be able to directly understand the messages of the system aiminig to realize green driving. All parts of the strategy such as coasting while approaching a STOP sign should be communicated clearly. |
| **SP3-8-0001** | F | **Description**:<br>Information about the vehicle's own<br>• location incl. lane information<br>• speed<br>• heading<br>in the road network is available. |
| | | **Rationale**:<br>Building block for detailed information on vehicle environment |
| **SP3-8-0002** | F | **Description**:<br>Vehicle's most probable path ahead in the road network is available.<br>content of MPP for further description |
| | | **Rationale**:<br>Building block for detailed information on vehicle environment |

| Requirement number | Type | Description |
|---|---|---|
| **SP3-8-0003** | F | **Description**:<br>The vehicle system has information about<br>• number and usage of lanes (is it a bus lane, turning lane etc.)<br>• overtake prohibits<br>• speed limits<br>• geometrical properties<br>• eco properties<br>• traffic state<br>of the most probable path MPP in the road network |
| | | **Rationale**:<br>Building block for detailed information on vehicle environment |
| **SP3-8-0004** | F | **Description**:<br>The system has information about vehicle specific data such as fuel consumption depending on slopes, speed, gear, and load condition.<br>Other information may be necessary and will be defined during the project. |
| | | **Rationale**:<br>Building block for detailed information on vehicle environment |
| **SP3-8-0005** | F | **Description**:<br>Vehicle system has information about calculated route |
| | | **Rationale**:<br>Building block for cooperative routing |
| **SP3-8-0006** | F | **Description**:<br>The ecoMap available in the system contains precise (accuracy tbd.) information about the slopes of the streets including altitudes, curves as well as driving attributes such as speed limits, number of lanes etc. (the precise list of needed attributes is tbd). |
| | | **Rationale**:<br>Building block for ecoDriving and ecoRouting. |

| Requirement number | Type | Description |
|---|---|---|
| **SP3-8-0007** | F | **Description**:<br>The system is able to calculate a slope going out of a path (MPP) and precise geometry information |
| | | **Rationale**:<br>Building block for ecoDriving and ecoRouting. In Case slope is not available from ecoMap |
| **SP3-8-0008** | F | **Description**:<br>The ecoMap available in the system contains precise (accuracy tbd.) information about the curvatures of the streets including altitude, slopes, as well as driving attributes such as speed limits, number of lanes etc. (the precise list of needed attributes is tbd). |
| | | **Rationale**:<br>Building block for ecoDriving and ecoRouting. |
| **SP3-8-0009** | F | **Description**:<br>The system is able to calculate a curve radius going out of a path (MPP) and precise geometry information |
| | | **Rationale**:<br>Building block for ecoDriving and ecoRouting. In case curves not available from ecoMap |
| **SP3-8-0010** | F | **Description**:<br>The ecoMap available in the system contains precise (accuracy tbd.) information about the geometry of the streets including altitude slopes, curves as well as driving attributes such as speed limits, number of lanes etc. (the precise list of needed attributes is tbd). |
| | | **Rationale**:<br>Building block for ecoDriving and ecoRouting. |
| **SP3-8-0011** | F | **Description**:<br>The system is able to receive and process information via the V2V communication unit.<br>This information include:<br>- MPP of the sending vehicle<br>- Next maneuver attempted by the sending vehicle<br>- Distance to the next maneuver<br>- Current speed and position of the sending vehicle |

| Requirement number | Type | Description |
|---|---|---|
| **SP3-8-0012** | OE | **Description**:<br>The ecoCooperativeHorizon should provide the Most Probable Path to the:<br>a. ecoDrivingSupport application;<br>b. dynamic ecoNavigation application; |
| | | **Rationale**:<br>This information is required by other application |
| **SP3-8-0013** | OE | **Description**:<br>The system is able to communicate with other vehicles |
| | | **Rationale**:<br>Building block for detailed information on vehicle environment |
| **SP3-8-0014** | OE | **Description**:<br>The system is able to communicate with oncoming vehicles |
| | | **Rationale**:<br>Building block for detailed information on vehicle environment |
| **SP3-8-0015** | OE | **Description**:<br>V2V communication transmits and receives<br>• Position (WGS84) incl. lane info<br>• Speed (km/h)<br>• Heading (degree against north)<br>• MPP (e.g. location reference following AGORA-C)<br>of each communication participant within reach. |
| | | **Rationale**:<br>Building block for detailed information on vehicle environment |
| **SP3-8-0016** | OE | **Description**:<br>The system is able to communicate with other vehicles on ist calculated route |
| | | **Rationale**:<br>Building block for detailed information on vehicle environment |

| Requirement number | Type | Description |
|---|---|---|
| **SP3-8-0017** | OE | **Description**:<br>V2V communication transmits and receives<br>• Position (WGS84) incl. lane info<br>• Speed (km/h)<br>• Heading (degree against north)<br>• MPP (location reference following AGORA-C)<br>of each communication participant on ist calculated route. |
| | | **Rationale**:<br>Building block for detailed information on vehicle environment |
| **SP3-8-0018** | OE | **Description**:<br>The system is able to communicate with other vehicles queing |
| | | **Rationale**:<br>Building block for detailed information on vehicle environment |
| **SP3-8-0019** | OE | **Description**:<br>The system is able to communicate with traffic lights controller |
| | | **Rationale**:<br>Building block for detailed information on vehicle environment |
| **SP3-8-0020** | OE | **Description**:<br>V2V communication transmits and receives<br>• Position (WGS84) incl. lane info<br>• Speed (km/h)<br>• Heading (degree against north)<br>• MPP (e.g. location reference following AGORA-C)<br>of each communication participant queing. |
| | | **Rationale**:<br>Building block for detailed information on vehicle environment |

| Requirement number | Type | Description |
|---|---|---|
| **SP3-8-0021** | OE | **Description**:<br>The system is able to communicate with other vehicles on ist MPP. |
| | | **Rationale**:<br>Building block for ecoDriving. |
| **SP3-8-0022** | OE | **Description**:<br>The system is able to communicate with slower vehicles ahead |
| | | **Rationale**:<br>Building block for ecoDriving: To avoid unnecessary braking and acceleration. |
| **SP3-8-0023** | OE | **Description**:<br>Traffic lights controller transmits<br>• Location reference of traffic lights<br>• Residual red display times for each driving direction<br>to each eCoMove vehicle within reach. |
| | | **Rationale**:<br>Building block for ecoDriving: To avoid unnecessary braking and acceleration. |
| **SP3-8-0024** | OE | **Description**:<br>V2V communication transmits and receives<br>• Position (WGS84) incl. lane info<br>• Speed (km/h)<br>• Heading (degree against north)<br>• MPP (e.g. ocation reference following AGORA-C)<br>of each communication participant slower ahead. |
| | | **Rationale**:<br>Building block for ecoDriving: To avoid unnecessary braking and acceleration. |

| Requirement number | Type | Description |
|---|---|---|
| **SP3-8-0025** | P | **Description**:<br>The accuracy of both<br>• the measurement of position, speed and heading and<br>• the stored map data<br>allows the system to calculate the accurate distance to the slope (in real time). |
| | | **Rationale**:<br>General requirement on precision of the map and the position calculation and on the system performance |
| **SP3-8-0026** | P | **Description**:<br>The location reference transmitted by the V2V communication partners is described unambiguously (e.g. AGORA-C) |
| | | **Rationale**:<br>General requirement on precision of location referencing |
| **SP3-8-0027** | P | **Description**:<br>The Location reference transmitted by the traffic light controllers and by the vehicles at the queue is described unambiguously (e.g. AGORA-C) |
| | | **Rationale**:<br>General requirement on precision of location referencing |
| **SP3-8-0028** | P | **Description**:<br>The Location reference is described unambiguously (e.g. AGORA-C) |
| | | **Rationale**:<br>General requirement on precision of location referencing |
| **SP3-9-0001** | F | **Description**:<br>the application must be able to store the destination |
| | | **Rationale**:<br>To be made available for analysis |
| **SP3-9-0002** | F | **Description**:<br>the application must be able to store the different driver profile, using the same vehicle |
| | | **Rationale**:<br>Need for the analysis |

| Requirement number | Type | Description |
|---|---|---|
| **SP3-9-0003** | F | **Description**:<br>the application must be able to store the vehicle information |
| | | **Rationale**:<br>Need for the analysis |
| **SP3-9-0004** | F | **Description**:<br>The TripDataSet should store trip data of each trip containing the TBD information for example<br>a. Driver ID (in case more than one driver is using the vehicle)<br>b. Date & time of trip<br>c. Speed profile (incl. accelerations & decelerations)<br>d. Gear choice<br>e. Engine RPM<br>f. Engine on/off at stop<br>g. Road segment parameters (speed limit, slope, road signs/traffic signals, tbd., ) – the exact position where the driver has been? Or only the road characteristics?<br>h. Fuel consumption (CAN) |
| **SP3-9-0005** | OE | **Description**:<br>The TripDataSet should be accessible for the following applications / components:<br>a. PostTrip analysis – on board<br>b. PostTrip analysis – off board<br>c. ecoMonitoring<br>d. ecoDrivingSupport<br>e. ecoRouting |
| **SP3-9-0006** | P | **Description**:<br>The TripDataSet should be able to store at least TBD km of trips |
| | | **Rationale**:<br>Need for the analysis |