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**Abstract:** This document contains the design of an on board system(s) Architecture for commercial vehicles, reminding the context for future on board systems for freight and fleet management, developing functional, information, physical and communication levels of this Architecture as well as a risks analysis and implementation hypothesis.

**Keyword list:** Systems Architecture, Functional Architecture, Information Architecture, Physical Architecture, communication Architecture, Data Flows, Data Stores, Sub-Systems, Modules, Freight Fleet Vehicle, Driver, Cargo, Equipment Management.

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## **Executive summary**

This document contains the final COMETA system architecture consisting of:

- functional and control architecture,
- information and management architecture,
- physical and communication architecture.

It is the core deliverable produced in work package 6 of the project.

The following steps were followed to arrive to these architectures:

- an extensive examination of user needs was undertaken in work package 2,
- an overview of state of the art technologies was established in work package 3,
- provisional architectures were prepared in work package 4, based on the outcome of work packages 2 and 3,
- pilots in France, Germany, Italy, The Netherlands and Sweden were used to validate the proposed architectures in work package 5.

Apart from the results of the previous work packages in COMETA, the deliverable also benefited from close links and cooperation with the KAREN and INTACT projects. Particular efforts have been made to ensure full consistency of the COMETA system architecture with the overall framework architecture for ITS applications that is being developed by the KAREN project.

The document starts with a description of the context in which the COMETA system architecture was developed. The most important characteristics of the road freight transport environment, the key user needs that had to be incorporated in the COMETA system architectures and the technologies which are coming onto the market, allowing to build systems that will respond to these needs. Next, the different views of the COMETA system architectures are presented and discussed, also showing where truck of the future is likely to look like, not only from the viewpoint of the technical contribution to the vehicle, but also from the viewpoint of how this will affect drivers and goods transport.

As such, this deliverable contains all the necessary material to serve as the basis for the three other deliverables that are the additional outcome of WP 6:

- standardisation recommendations (D6.2),
- recommendations to fleet managers (D6.3),
- recommendations to truck manufacturers and solution providers (D6.4).

## 1 INTRODUCTION

### 1.1 OVERALL DESCRIPTION OF THE COMETA PROJECT

The COMETA project was initiated to answer the strong concern regarding the potentially growing proliferation of on board systems for commercial vehicles. Some of these systems are offered by the market and some are imposed by authorities. The objective of COMETA was therefore to define and design modular associations of various on board performed functions, allowing for efficient interfacing within a global transport telematics system. This has resulted in an on board information and communication systems architecture that is modular, flexible and (as it is based on a middle and long term broad vision) subject to evolution.

This architecture has been designed through a close cooperation with KAREN (Keystone Architecture Required for European Networks) project carried in parallel with the objective to provide Intelligent Transport Systems in Europe with a global System Architecture Framework.

An evaluation of COMETA consistency with KAREN is presented in an annex to this document.

### 1.2 THE FINAL ARCHITECTURE WORK PACKAGE

The objective of the work-package is to finalise the different provisional architectures that were designed in work package 4, exploiting the outcome of the validation through pilots conducted in WP 5. This document contains the final COMETA system architectures:

- functional and control architecture
- information and management architecture
- physical and communication architecture.

It is the basis for different sets of recommendations that are the subject of three related deliverables:

- standardisation recommendations (D6.2)
- recommendations to fleet managers (D6.3)
- recommendations to truck manufacturers and solution providers (D6.4).

Because of its close relationship with KAREN, the COMETA project has followed the KAREN methodology its functional<sup>1</sup> and physical<sup>2</sup> architectures. This process-oriented methodology is described in greater detail in the corresponding KAREN deliverables (refer to footnote).

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<sup>1</sup> Karen (TR4108), Keystone Architecture Required for European Networks, D3.1 “Functional architecture”, June 1999, pp 8-11.

<sup>2</sup> Karen (TR4108), Keystone Architecture Required for European Networks, D3.2 “Physical architecture”, October 1999, pp 5-7

### **1.3 STRUCTURE OF THE REPORT**

Chapter 2 describes the context in which the COMETA architectures have been developed:

- the most important characteristics of the road freight sector
- key user needs
- the promoting technologies.

Chapter 3 presents the COMETA functional and control architecture.

Chapter 4 presents the COMETA information and management architecture.

Chapter 5 presents the COMETA physical and communication architecture.

Conclusions are drawn in Chapter 7.

A number of important supporting documents are contained in the Annexes:

- Annex 1: Glossary
- Annex 2: Tabular list of user needs.
- Annex 3: Consistency with KAREN
- Annex 4: Influence of the pilots on the COMETA system architecture
- Annex 5 : TRACAR system architecture example

## **2 CONTEXT FOR FUTURE ON BOARD SYSTEMS FOR FREIGHT AND FLEET MANAGEMENT**

The consolidated “Handbook of basic freight, fleet and vehicle management operational functions potentially optimisable through the use of on-board computers and how to achieve their optimisation” has been the basis for the development of the COMETA system architectures, combining the functional view of daily procedures to the users expectations, to be satisfied with the help of available technologies.

The objective here is first to address some key issues in freight and fleet management that need to be explored further to be correctly interpreted in the different views of the COMETA system architectures(for simplicity reasons we will speak of different architectures). As such, the goal of this chapter is to establish a common view and terminology within COMETA on issues that affect the various architectures, that is to say definition of physical operations and documents possibly related to them. The illustration of how this S.A could be operated will be described within the physical architecture level in chapter 5, from a combined user and system perspective. The system perspective includes the subsystem processing, communications and equipment required to implement the management of the Driver/Vehicle/Cargo/Equipment. The user perspective identifies the user interactions with the system.

The objective is then to remind and update the users expectations regarding the system architecture and to support technologies as identified during the validation phase of the project. The objectives is, last, to give hints on the state of the art of these “supporting technologies”.

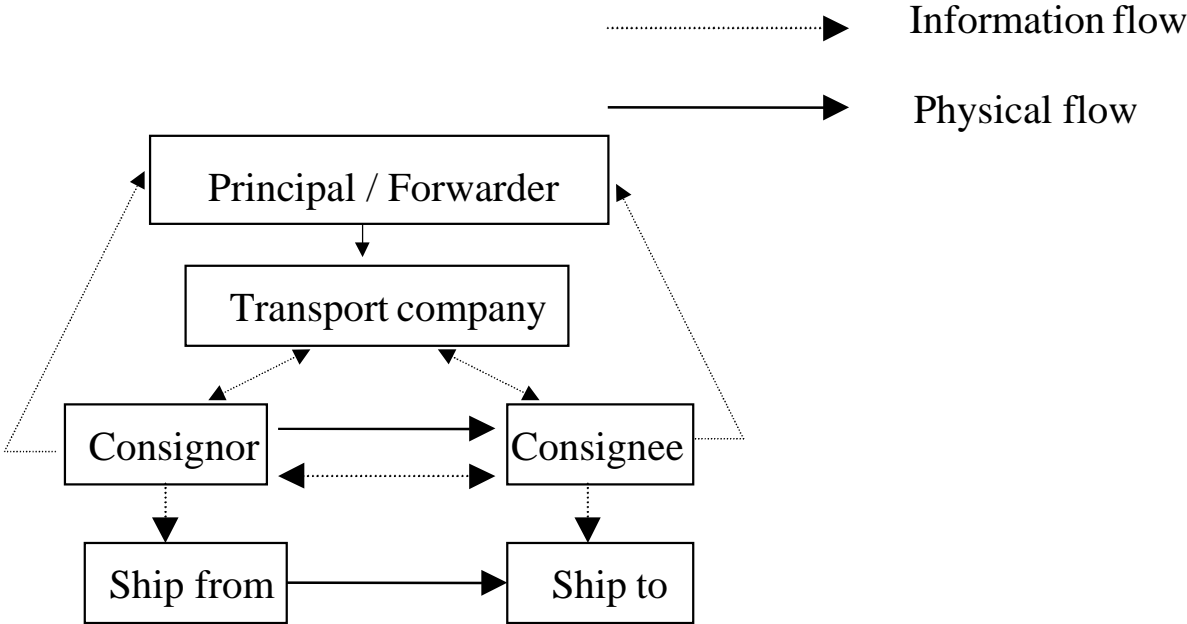
### **2.1 KEY ISSUES IN ROAD FREIGHT TRANSPORT CHARACTERISTICS**

#### **2.1.1 The actors involved**

There are many users of on board computers for freight and fleet management. The most important categories are:

- transport companies
- commercial partners
- ◇ consignor (contractual)
- ◇ consignee (“ “)
- ◇ principal (“ “)
- ◇ forwarder (“ “)
- ◇ ship from (operational)
- ◇ ship to (“ “)
- drivers
- public authorities and road operators
- intermodal transport operators
- service providers
- manufacturers of OBC
- truck manufacturers.

The figure below illustrates the relationships between a transport company and its main commercial partners.



**Figure : 1. Relationship between transport company and main commercial partners**

The “principal” is the party (independently from whether it plays the role of a forwarder, consignor, consignee, or third party) requiring transport, issuing the order.

The consignor is the party responsible for the shipment / loading operation, which can even take place at the premises of another physical entity (ship from).

The consignee is the party responsible for the unloading / reception operation, which can even take place at the premises of another physical entity (ship to) identified as such in the transport order.

COMETA considered various functionality which the system architecture has to respond and satisfy. Beyond the field relating strictly to the management of the transport operations (tasks and transport orders), in which we are interested here, and the means allowing to facilitate them and/or to improve comfort of their execution, we mean the functionality relating to the vehicle as a physical entity, as well as those relating to the security (in the broad meaning).

At the first degree of the realisation of the transport operations, three actors are directly involved :

- the driver (and vehicle) which is in the heart of the approach,
- the one (or those) which give him orders,
- the one (or those) to which legally reports must be forwarded.

Some other actors are not directly involved, but take part :

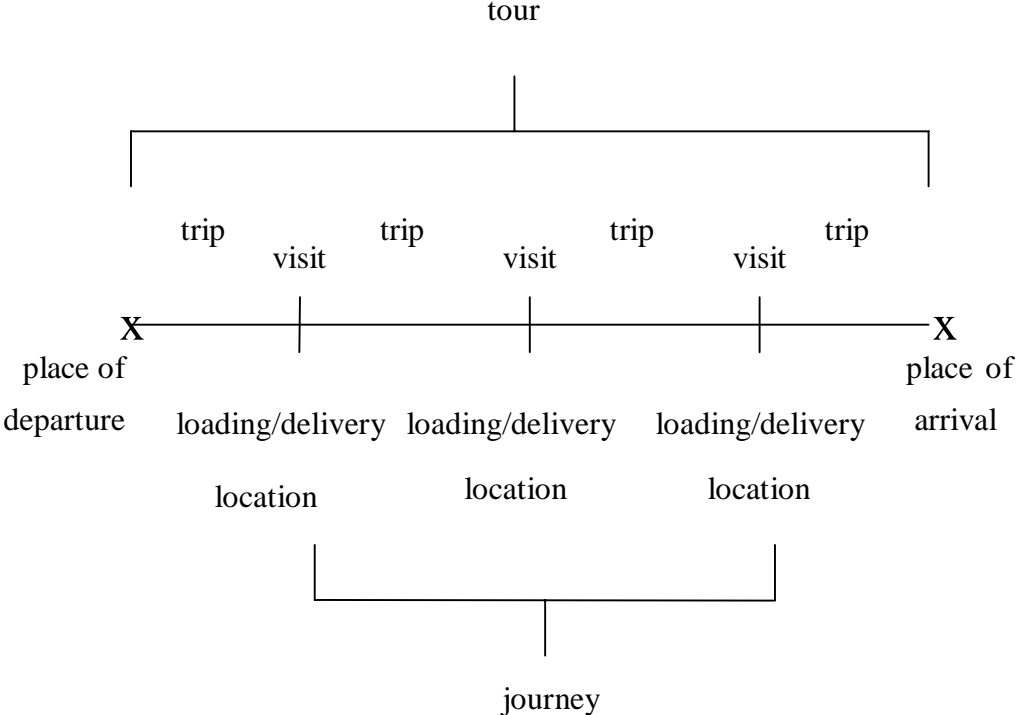
- either because of their function (Authority : control) ;
- or because they send information to the driver (and to the vehicle) and/or give access to some tools which enable the driver to optimise his tasks and procedures (service provider) ;
- or those who use data processed or produced on board : Home base for non operational application, freight centres operators, combined transport operators, traffic information servers.

### **2.1.2 Overview of transport operations supported by COMETA SA.**

To better understand to what the COMETA system architecture refers, the most basic terms are explained below, based on the work of CEN TC 278 WG2 :

- Transport order: Instruction with a specific reference, including the information required to carry out the commercial act of transport, technically divided into unit loads / item numbers. in COMETA it is considered as being “commercial information”.
- Tasks order (which is used with the meaning of an assignment to the driver, and as a translation of the French “ordre de mission = “mission order”): Instructions, possibly linked to a transport order, sent to a driver and justified by all the characteristics of a mission likely to be fulfilled by the driver motor vehicle pair, formed at a given moment, until such time as the pair is separated.  
Several assignments may be given during the driver-motor vehicle ”a pairing” period, involving, to an even greater extent, several tasks (for example coupling/uncoupling of different trailers). A task is a sequence of assignments corresponding to a basic operation for the driver–vehicle pair. It may be linked to one or several transport orders.  
Examples: Loading a transport order (unit load / item number), uncoupling a trailer, etc. In COMETA it is considered as “operational information”.
- To each task of the “tasks order” the driver will report through a task report on completion of the task.
- Trip: “a planned execution of one or more transport orders or tasks, from (a visit at) a loading location to (a visit at) an unloading location or to another loading location”
- Journey: “the movement of a particular consignment from the consignor to the consignee”
- Tour: “the totality of trips to be made by a vehicle in one assignment, normally ending at the point of departure”.

Note that a transport order is defined too as “a shipping (consignment) instruction or the task definition given by a dispatcher to a driver”, while a consignment is defined as “a goods item or collection of goods items (to be) transported from one or many despatch locations to one or many delivery locations for one consignor to one consignee under the terms of one contract of carriage”. Last a route plan refers to “the path to be taken to get from a starting point to a point of destination or to supplement a trip plan”.

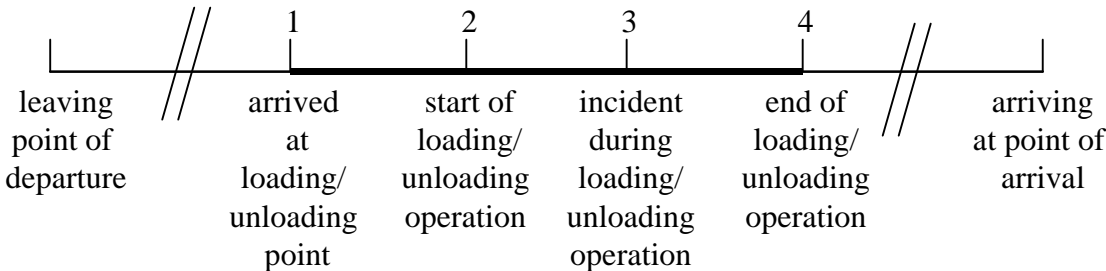


**Ordering**

Concerning the realisation of the transport operations, whatever the sector of activity is, the basic operational scenarios are similar if we consider the exchanges of information on board the vehicle :

- Transmission of an order or of successive orders, which includes commercial data, all the mandatory elements which must appear in a transport order and operational data, tasks linked or not to transport order, whose conditions for execution and optimal sequence of operations is usually determined by the home base (taking into account the requirements expressed by the customer). In the case of an independent or chartered driver, the transport order received from the principal, will be translated into necessary tasks to be performed.
- Transmission of task execution and/or incident report (and status reports concerning : transport, goods, driver, vehicle, equipment), which can be subdivided more finely into task reports and transport order status.

A vehicle can essentially be in driving mode or in loading/unloading mode. In driving mode, an order is either proceeding according to schedule or a driving incident has taken place. In loading/unloading mode (shown in the figure above) a number of incidents can take place:



- arrived at loading/unloading point,
- start of loading/unloading operation,
- (optional) positioned at loading/unloading dock,
- incident during loading/unloading operation,
- end of loading/unloading operation.

The driver (vehicle) receives (its) orders from the home base , the orders are sent directly from a principal or a forwarder in case of an independent or chartered driver, and reports to them.

The sender transmits to the driver, all the elements relating to the transport order and to the goods:

- Commercial data: addresses of the consignor/consignee, type and/or nature of goods, type and number of units, weight (and/or obstruction, volumes), complementary request for services, requirement of announcement of arrival, cashing ).

and all order data, the one to be determined by the consignor / consignee (constraints) and/or by the sender :

- Time of appointment, routes (possibly segmented, with precision of working time and rest), journey times, estimated time of arrival on the sites.

as well as known data, relating to the sites, that the driver must manage :

- Time ranges of pick up/delivery or opening hours, particular conditions of access and/or loading or unloading, identity of the persons in charge (e.g. of quay, of reception).

But it has to be kept in mind that it consists in heterogeneous structure of data because at the same time, the transport, the mission or the task order is segmented in several chronological tasks.

When there is no on-board equipment, these instructions (with the relevant commercial and statutory documents), are either handed over in paper form at the home base before vehicle departure, or transmitted by phone in case of non-planned operations, changing orders or additional operations. The documents stored on-board are in filled manually by driver. In case of onboard equipment, these orders could be downloaded before departure (through a cradle or smart card) and new orders or modifications will be transmitted by mobile communication (including the relevant commercial and statutory documents).

## **Reporting**

Once the tasks order is "accepted" - i.e. that the driver must confirm by a message «tasks received and accepted», progressive sending of reports linked to tasks status or to the transport order status (non-conformity or incidents during the various phases of the transport operation ... and during the loading/unloading of cargo) will take place.

These reports contain commercial data as well as operational data. According to the request expressed by the customer, and/or the geographical field of activity, and/or to the sector of activity (and the nature of the goods), they are transmitted :

- either in real time (for each or key phase performed),
- or in differed time (during the trip or downloaded at the end).

As far as possible, the data included in the reports will be generated automatically (positioning, automatic identification).

In terms of report procedures of all performed phases, even the conformity to the planning during the trip, or the identification of all route changes has to be transmitted during the operations.

The conformity of execution relating to commercial data (transport order status) must be recorded including the contradictory signature of driver and consignor/consignee at the pick-up/delivery phases and including the time (of arrival on site, of beginning and end of operations and thus the time of loading/unloading, of departure) - and memorised on handling board, in case of equipped vehicle , transmitted to the home base and/or directly to whom concerned ( dispatcher, principal, forwarder and consignor).

The home base, the principal and the forwarder must receive in real-time a report of all incidents relating to the loading/unloading at the pick-up/delivery phases (non-conformity of cargo in weight or number, abnormal waiting time and/or delay).

Concerning of processing and information exchanges, all the elements relating to the commercial and operational data as transmitted in the task and transport order must be stored on-board, and it must be confirmed at each phase that the realisation of tasks and the goods loaded are in accordance with the instructions.

The assessment of the conformity can be done using several techniques of automatic identification: bar code reader, radio tags, by contact (hooking/unhooking of trailer and/or swap body), automatic weighting, acquired electronic signatures, which will be automatically integrated in the documents stored on board and/or in a relevant message.

The report is transmitted to the home base to be processed in the different applications which monitor Trip and/or Freight and/or Cargo management and up date the statute of available means (Vehicle management & Fleet management) update as to allow the communication of information to :

- final users (principal or forwarder, consignor, if relating to consignment),
- some other users (consignee) or intermodal operator, which looks for further information (or confirmation) of booking, as an advice of arrival and information giving characteristics of the goods (e.g. volume and weight, nature). The information «departure time», associated with loading conformity (N° of swap body or container), will allow, with the position of the vehicle during the transmission of the report the intermodal operator (or more generally the consignee), in order to establish a first approximation of

the probable time of arrival, which can be of first importance regarding to the departure of a train.

- internal services in the company : invoicing services, after-sales and quality services, follow-up and control of costs and performances.

Concerning the independent or chartered driver, these reports/ratios are transmitted in real time to the forwarder or to the principal.

In parallel to these reports (which update the status of transport and goods) the feedback coming from the digital tachograph brings up-to date the driver status and thus take part in the updating of the status of the means (Driver management), at the same time as they will feed the applications related to preparation of wages

Some of the stored and/or produced on-board data must be accessible to authorities:

- regulatory documents,
- data allowing to control the respect of regulatory constraints ruling driver driving and working times (digital tachograph data).

These data could be consulted (and/or printed) on board, on screen, and/or extracted for reading on a portable device, either with smart card, or via a DSRC medium.

## Optimising

The information which allows the driver to optimise his tasks performance consist primarily of all the data relating to positioning. They can be integrated in map application, which can be in optimal prospect enriched by data relating to traffic information.

- **The basic configuration** consists in establishing the optimal route thanks to the positioning of the vehicle on a map until his destination and to estimate the trip time in under normal traffic conditions.
- **The optimal configuration** will allow, with the integration of data concerning the driver status (e.g. working time) and traffic information, to estimate more precisely the arrival time on the site and to draw a best route to reach the objectives.

Various scenarios are conceivable :

- The map and applications may be located on board the vehicle, the processing of data is also performed on board,
- The processing as well as the applications and maps are managed at the home bas,;
- The processing is performed by the service provider and then transmitted to the vehicle using several mediums.

Depending from the needs, cost of systems and mobile units, it can be even considered that certain components of these configurations can be imported when needed, then deleted after use.

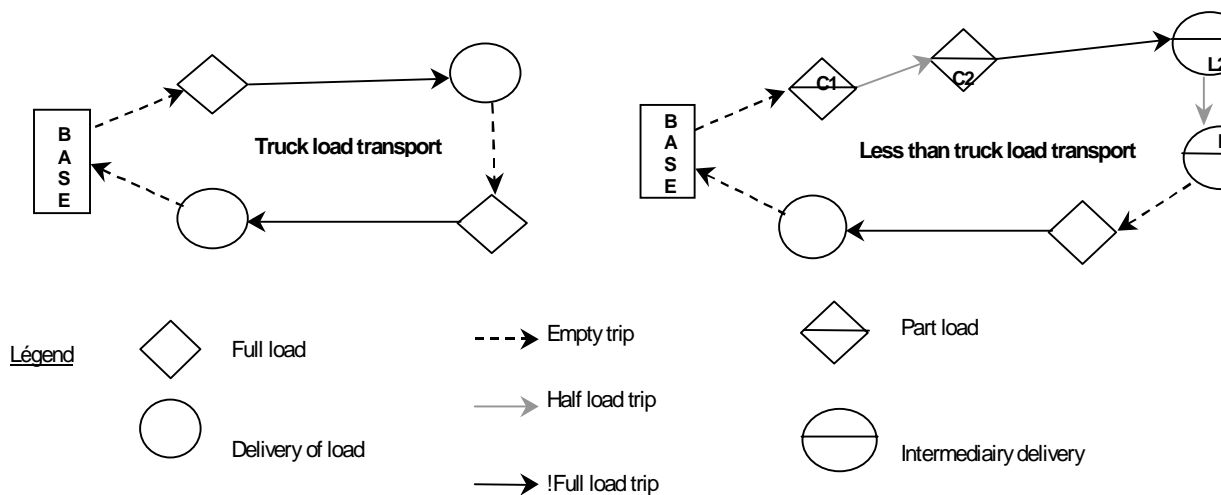
In addition to the functions directly related to the transport operations and those which aim to facilitate their realisation, it is convenient to keep in mind that the system architecture also covers aspects relating to the vehicle itself, considered as physical entity, and deals with security aspects. These functionalities allow processing and data exchanges without any difference due to different activities and size of the companies.

### 2.1.3 Details per transport activity :

The following will illustrate the main features of the two basic dimensions of road freight transport, whatever its other specificities based on the nature of goods or geographic coverage of the activity could be. It should allow to have a more operational view of what “intelligence”, distributed on board the vehicle and at the home base, will have to support.

#### 2.1.3.1 *Truck load and less than truck load transport*

The idea is to link loading and delivery operations whilst limiting the number of empty trips as far as possible and additionally optimising the loading rate. At local or regional level, two or three operations can be linked before returning to the base. At national or European level the trip from the loading point to the delivery point can take one day or more, which means that the driver can perform two or three operations a week before returning to his base.



Many constraints can be encountered during the performance of transport operations, they consist principally on :

- Non observance of appointment times by the shipper or the consignee,
- Delays linked to road traffic,
- Imponderables linked to the business hours of customer sites,
- Constraints linked to rest, driving, service and work time,
- Management of service and rest time for medium and long-distance transport
- Incidents linked to loading and/or unloading operation,

Part and additional loads face a specific constraint with the LIFO principle (last in, first out) but add, too, the possibility of using excess capacity to transport an additional part load, thereby achieving enhanced profitability. This additional transport can be performed only if two conditions are met :

- the transport must not involve excessive detours,
- it must not put a strain on driver service and driving/rest times.

These constraints could be partly reduced thanks to the enhancement of haulier organisation (in order to meet customers requirements), to the upstream planning of transport orders assignments, to the optimisation of fleet management by real time tracking,...etc.

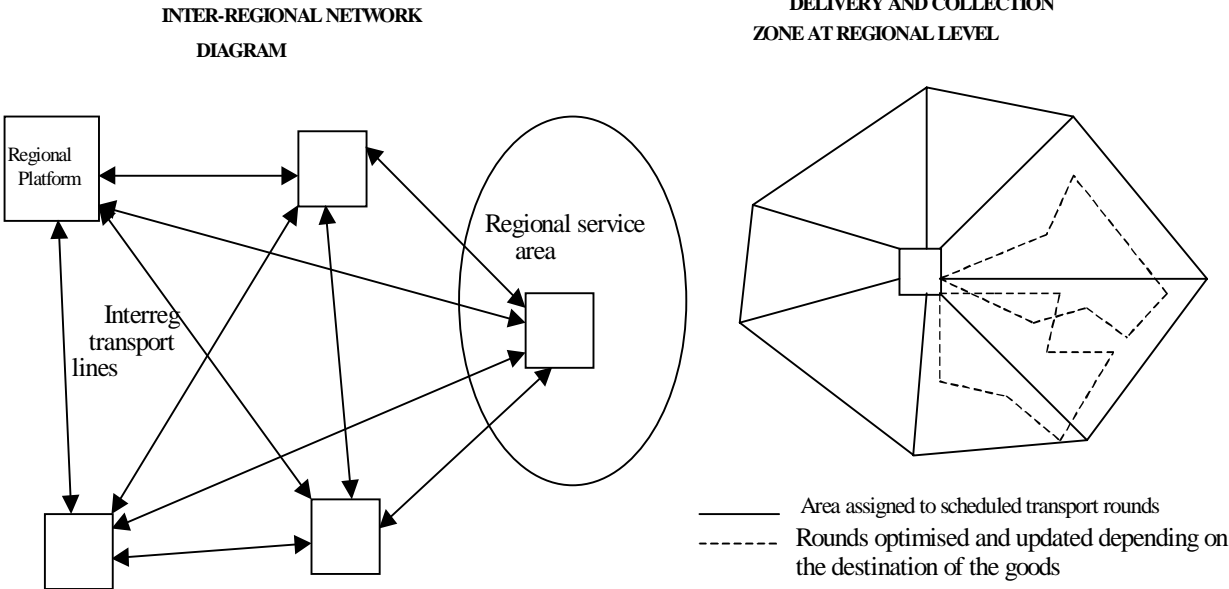
### **2.1.3.2 Parcel Service Transport**

With two transshipments (consolidation/de-consolidation) of each shipment and transport performed by three vehicles managed by two traffic management bases, this is a genuine operational chain, each links representing obligations in terms of continuous monitoring.

The main feature of parcel service is the connection of heterogeneous operations performed by vehicles of varying tonnage. Parcel service involves collecting, carrying and delivering small packages (from 1 to 3,000 kilos). It can be broken down into two levels:

- *Regional delivery and collection tours*: performed by vehicles with small or medium tonnage for the delivery of packages in the morning (tours sometimes involving 50 items or more) and for the collection of packages during the afternoon (involving 20 or 30 operations). This level can be spread over four geographic areas or more depending on the density of the industrial or urban environment. As a general rule, each platform generates between 10 and 30 tours a day.

- *Transport between platforms and regional consolidation/de-consolidation platforms:* performed by high tonnage vehicles which transport all the packages from a collection platform and carry them (overnight in most cases) to a destination platform where the packages will be unloaded, sorted and consolidated for regional distribution.



Unlike full load transport, parcel service is characterised by:

- longer packages loading/unloading times compared to driving time, resulting in a significant volume of information exchange (feedback) and monitoring operations (e.g. bar-code reading) for each tour, or even for each customer site if several orders are delivered or collected,
- commercial constraints expressed by customers, most of whom want delivery to take place early in the morning and collection late in the afternoon,
- not knowing customer requirements sufficiently in advance in terms of number/weight and load volume meaning that sometimes vehicle capacity is insufficient,
- not knowing the volume, weight and quantity of goods collected, meaning that it is not possible to optimise scheduling of inter-regional transport beforehand.

In absence of tours optimisation applications, package distribution and collection tours use regular pre-established routes, corresponding to a given geographical area. Optimisation involves implementing such applications, based on precise knowledge of locations, volume and weight (and type) of goods to be carried, in order to

- plan delivery and collection circuits on a case by case basis, depending on the quantity, weight and volume of the goods and on the collection/delivery locations, thereby reducing the distance to be covered and even the number of vehicles used, which presupposes,
  - information from platform/delivery managers on the volume and weight for each final destination, in order to plan the optimal means for inter-regional transport
  - information from collection/platform managers on the volume and weight for each final destination, in order to plan optimal distribution rounds

One last point concerning parcel service must be mentioned, namely the risk of delivery incidents, which include refusal of the package because of non-compliance or delayed delivery, absence of the consignee, reservations concerning the condition of packaging. The number of incidents of this type can be quite high for each tour and increase further due to payment incidents (carriage collect, C.O.D.). The management base must be informed of these incidents as soon as possible, so that it can take the necessary corrective actions to ensure that service quality is maintained

#### **2.1.4 Identification of possibly related documents :**

Beyond internal operational documents, two main types of documents are supposed to be on board a professional vehicle, some pertaining to the enforcement of regulations (statutory documents), some pertaining to commercial services required by the carrier's partners (commercial documents).

#### **2.1.4.1 Statutory documents**

Various documents required by different authorities should be on board the vehicle.

They can be related to general transport regulations, to the vehicle, to the driver, to the freight, to the equipment (in the meaning of “transport unit unable to move by itself”), to the trip.

- **Transport documents :**

- Registration certificate, a document which entitles the company to perform professional transport, according to national specifications.
- Transport license, a document which entitles the company to use a vehicle to perform a certain type of transport, Regional, National, International, according to national or international specifications.

- **Vehicle**

- Vehicle registration card, identifying the vehicle (license plate), its main characteristics and its owner.
- Insurance certificate, a receipt proving that the vehicle insurance have been paid for.
- Tax receipt, according to the size of the vehicle and the country, a document proving that the vehicle has paid a one year fee to use infrastructures.
- Type approval certificate, for adapted vehicles.
- Vehicle inspection certificate, a compulsory document proving that the vehicle has been checked OK by the appropriate technical body, in due time (every x years...).

- **Driver**

- Driving license, a document delivered and renewed after given periods, proving that the driver have successfully went through an ad hoc examination.
- Qualification certificate, a document proving that the driver is qualified for certain transport operations. (i. e. dangerous goods).
- Logbook, or Mission Order (i.e. in France, description of tasks to be performed according to given transport order (s)), a document describing and storing driver activity.

- **Freight**

- Public Health certificate, given to certain goods such as meat or fish.
- Dangerous goods declaration, to be made by the principal and given to the carrier.

- TREMCARD, safety instructions for a given type of dangerous goods category.
- Customs documents, such as bonded warehouse, transit permit, clearing certificate.
- Other clearance certificates, such as alcohols, etc.
- **Equipment**
  - Equipment features document, e.g. trailers, containers or swap bodies.
- **Trip**
  - Motorway payment certificate,
  - Ecopoints, or similar proofs of payment for transiting in a given country.

#### **2.1.4.2 Commercial documents**

- **Ordering documents**
  - Road waybill (i.e. CMR for international transport). This is a generic term to identify the document which covers the transport contract and may differ according to the country and/or the type of contract (i.e. full load, pick up and delivery, etc. ...).
  - Bill of lading, a private document asking a carrier to load a given consignment.
  - Packing list, a private document describing and identifying the totality of “packages”, units to be loaded for a given consignment.
  - Notice of dispatch, or goods pick up/delivery receipts, documents sent by the principal to the consignee (buyer) as the proof of execution of an order and that the carrier / driver is asked to carry to this consignee so as to be acknowledged.

- **Invoicing**

Before final invoicing (often made at every month's end) and so as to facilitate mutual checking, a pre-invoice is generated when accepting the order.

This pre-invoice can still be modified at two moments

- at the pick-up of goods
- at the delivery of goods

and in three ways:

- number and nature of goods is different,
  - longer waiting time than foreseen (no modifications are made in the case of shorter waiting times),
  - extra services.
- **Pick-up and delivery reports, notices and proofs as documents resulting from a transport status transition.**

In relation to the important transaction of picking-up or delivering a consignment, different terms are used and therefore clarified here. First, the term “report” (pick-up or loading report, respectively delivery or unloading report) is used for the document typically sent from vehicle to carrier as it contains a *detailed* description of all goods picked-up or delivered (and/or of any irregularities). Second, the term “notice” (respectively notice of dispatch notice of delivery – also referred to respectively as consignment pick-up, consignment delivery) is used for the document sent from carrier to forwarder and forwarder to client to inform him of the correct pick-up or delivery (and/or of any irregularities). Last, the term “proof” (proof of pick-up, proof of delivery) refers to a signed document that has a legal status and that confirms the correct pick-up or delivery (and/or any irregularities) – currently, this proof is hand-delivered by driver to carrier and forwarded by mail to forwarder and client. In the future, the proof of pick-up and delivery will be integrated within the reports and notices through the use of electronic signatures.

## 2.2 SUMMARY OF COMETA USER NEEDS

Beyond above described main transport activities features, the COMETA project has carried out an extensive user needs analysis and validated it through “Pilots”, in order to find out what functionality support the users expect from the COMETA system architecture, or what kind of generic requirement they expressed. In this context various types of “direct” users can be distinguished as seen in 2.1:

- transport companies
- commercial partners
  - consignor (contractual)
  - consignee
  - principal
  - forwarder
  - ship from (operational)
  - ship to
- drivers
- public authorities
- road operator
- intermodal transport operator
- service provider

The COMETA user needs have been related to:

1. Commercial Consumers such as fleet managers, one man companies or drivers being chartered by other road transport operators either through time based contracts or for spot operations.
2. Local Authorities or High Level Ministries, Companies providing, using ITS, Operators applying the ITS, Companies developing and producing ITS.

All these users have various needs, depending upon their role in the transport chain, the products transported, the region in which the transport is carried out, etc. In order to present the user needs in an orderly way, these user needs have been grouped according to common objectives:

- social regulations enforcement and observance by drivers through the use of an electronic tachograph,
- positioning, navigation and route optimisation,
- operational and commercial management during trip, missions management,
- documents management,
- cargo management,
- communication management and solutions optimisation,
- automatic identification and tracking and tracing,
- vehicle mechanics monitoring and control,
- ensure and support safety and security,
- provide driver comfort.

In the remainder of this section these groups will be described in detail. The relationship between a group of user needs and the functional architecture (see 3) is given by the numbers of the COMETA functions in brackets (the numbers indicate which COMETA functions are mainly related to that specific group of user needs).

### **Social regulations enforcement and observance by drivers, through the use of an electronic tachograph (2.1.3, 3.2.1, 3.2.2, 3.8.1, 3.11.1)**

What is required here is of course that appropriate information should be permanently recorded and made available to Authorities without any possible questioning upon its relevance and integrity, at any moment and even without stopping the vehicle.

Beyond, this information should be made available to the Driver and Fleet manager whenever appropriate or necessary, matched with other relevant information such as vehicle position, supported by means which facilitates and optimise its provision when relevant.

Nearly all users are interested here, though mainly fleet operators, drivers and authorities. Since there is a trend to consider principal and/or freight forwarder responsibility in transport, it might be that orders cannot be executed without risk of regulation infringement. In this case also principals and/or freight forwarders are interested.

**Positioning, navigation and route optimisation (2.1.2, 2.2.3, 2.2.4, 3.5, 3.7.1, 3.10.1, 3.11.1)**

From a minimal positioning requirement up to highly sophisticated possible navigation systems, using digital maps and interfaced with traffic, weather and infrastructure real time information, these User Needs are aiming at the provision of best or alternative trips conditions and at more reactivity and anticipation for Drivers, by themselves or through dialogues with commercial partners or third parties.

**Operational and commercial management during trip, tasks management (2.1.2, 2.1.3, 2.1.4, 2.1.5, 2.1.7, 2.2.1, 2.2.2, 2.2.3, 2.2.5, 3.1.1, 3.3.5, 3.4, 3.7.1, 3.7.2, 3.8.1, 3.10.1, 3.11.1, 3.11.2)**

Here can be found conditions addressing the provision and process of all necessary information to allow a driver to execute required tasks through real-time exchanges with appropriate partners (fleet manager, but also commercial partners), also addressing the process and transmission of any kind of status report to the same partners, either automatically or with human intervention, so as to facilitate, anticipate and speed up freight, fleet and drivers management on the ground side.

Fleet drivers or chartered drivers will perform this in different ways, but it will require appropriate on-board software, communication channels and protocols from solutions providers.

**Documents management (2.1.1, 3.1.1, 3.1.2, 3.2.2, 3.11.2)**

These User Needs, beyond the regulatory aspects that is required by Authorities' demand for a "paperless transport" and/or checks without stopping the vehicle, address more specific legal and formal dimensions of formatted document exchanges, storage, modification, printing, electronic signature "on" them or on a substitute.

Solution providers are concerned when considering processing and printing these documents, when considering the protection of data, or opposed, the possibility to modify some of them, when considering the securing of proofs of delivery and electronic signature.

These kind of solutions are of course welcomed, if not eagerly requested, by the "clients" involved (and responsible) at a given moment in document management.

**The case of one man companies or chartered drivers (1.1, 1.2)**

This category could be more demanding for appropriate software, hardware and communication solutions related to the two above mentioned requirements. The concept of Mobile Office for this category is made still more stringent when considering that it requires too a support for the management of tenders, offers, quotations, tariffs calculation and invoicing...

### **Cargo management (2.1.4, 2.2.5, 3.1.2, 3.7.2, 3.9, 3.10.2)**

This User Need can consist of one or more of the following functions: weighting the goods to be carried (directly or through the variation of the vehicle weight), the exchange and management of bay plans (so as to optimise loading/unloading and evaluation of remaining capacity), the acquisition and memorisation of cargo characteristics (so as for instance to avoid incompatibilities), and the continuous monitoring of these characteristics and stowage and transport conditions.

It can imply the triggering of alarms, automatic messaging or even remote corrective actions.

Industry is of course expected, by all kind of transport operators, to provide appropriate solutions, which should require minimum intervention from the driver.

Authorities are required to facilitate their inspections through the implementation of weight in motion systems.

### **Communication management and solutions optimisation (1.1, 1.2, 2.1.7, 3.4, 3.5, 3.6.1, 3.10, 3.11)**

Solutions providers (network operators and related software providers, telematics servers) are here strongly appealed.

The offers should allow voice and data (from free text to EDI/EDIFACT, via macros messages) communication associated with automatic identification, positioning, authentication, content protection, openness or flexible access from/to various parties, including other vehicles or equipment, roadside, etc.

They should allow from short range to worldwide communication, with rather "generic" tools (radio, phone, fax) or more dedicated ones (beacons, transponders, radio tags).

They should allow for "on line" applications or downloading of software. The involvement of "clients" varies, according to the degree of integration of the physical movement of goods within their complete supply or delivery chain management (e.g. just in time).

### **Automatic identification and tracking and tracing (3.1.2, 3.1.3, 3.6.1, 3.6.2, 3.7.1, 3.9, 3.10.1, 3.11.1)**

Here too, solutions providers will be asked to allow identification at all levels (e.g. cargo, documents, vehicle, driver, equipment) and appropriate linkages when and where required: loading, unloading, trailers shifting, during trips, during gate in/gate out procedures on terminals, for fee collection (without stopping the vehicle for these three possible applications), etc.

Automatic transmission should be facilitated and creation and allocation of new Ids by the driver should be supported.

### **Vehicle mechanics monitoring and control (2.1.2, 2.1.5, 2.1.6, 3.7.2, 3.10.2, 3.12)**

These are requirements that aim to ensure that vehicles have been and will be properly maintained. Between two maintenance operations, first the driver, then if necessary the fleet manager and/or any remote support, will be warned and/or in case of any dysfunction, can access, more or less automatically, continuously stored parameters.

These User Needs are of course expressed by all drivers and fleet managers, but will be satisfied by vehicle manufacturers, solution providers and telematic service providers.

Authorities could, in the future, implement road checks for this kind of information.

### **Ensure and support Safety and security (3.3, 3.4, 3.7, 3.8.2, 3.10, 3.12)**

These requirements can take two forms:

1. Intrinsic passive safety specifications, to be followed by on board system designers in order to avoid driver disturbance or use that could endanger him.
2. Active safety ones, providing assistance to the driver.

This assistance will cover quite different expectations such as driving assistance (vehicle operation control), driver physical condition evaluation, emergency situation management support, etc.

It will also cover e.g. anti theft assistance, alarm management, and vehicle immobilisation.

These requirements imply appropriate sensors and data recording and transmission, and possibly support of telematic service providers.

Authorities could, in the future, implement road checks for this kind of information or even a dedicated global system.

### **Provide Driver Comfort (3.3.5, 3.4)**

Comfort is here understood in a very broad way, as far as it addresses HMI requirements related to matters like the provision of visual or acoustic information (and multilingual information), to the automatic customisation of the driver environment, his access to entertainment services.

## **2.3 AVAILABLE TOOLS**

If 2.1 reminds the key characteristics of the road freight transport sector to which COMETA SA applies, if 2.2 summarises users expectations regarding this SA, 2.3 is here to remind briefly (beyond the on board computer itself, which may be a dedicated limited one or a market laptop / hand held using windows CE or EPOC) physical potential other components of a solution supporting this SA, that users could have in mind when expressing their needs, or that COMETA SA designers had in mind when addressing physical and communication architecture (see 5).

## **2.3.1 Communication technologies**

### **2.3.1.1 Protocols standards and visions**

#### **WAP**

The Wireless Application Protocol (WAP) is an open, global specification that empowers mobile users with wireless devices to easily access and interact with information and services instantly. It is an initiative started by Unwired Planet, Motorola, Nokia and Ericsson to develop a standard for wireless content delivery on the next generation of mobile communicators.

#### **IMT2000 and the UMTS concept**

The ITU (International Telecommunication Union) has defined in the frame of the IMT2000 (International Mobile Telecommunication and its predecessor the FPLMTS (Future Public Land and Mobile System) the requirements for the 3<sup>rd</sup> generation mobile systems. IMT2000 will provide wireless access to the global high rate telecommunication through both satellite and terrestrial systems.

#### **FAP**

The FAP (Fleet Application Protocol) is an open interface for home-based fleet related applications, supporting provider independent, modular, interoperable and extendable solutions for fleet managers. The FAP was originally specified by MANNESMANN AUTOCOM and PTV.

#### **Mobile EDI**

This proposal is a second attempt in the design and submission of an appropriate standard devoted to cover the «mobile» part of the road freight transport information chain, already using EDIFACT messages between partners (see 4.4).

### **2.3.1.2 Traffic information services**

#### **DAB**

DAB (Digital Audio Broadcast) is a technology that was developed within the EUREKA 147 project. Originally it was planned as an audio-broadcast system, but as a multimedia tool it is more and more used for data-broadcast purposes. According to the European political plans, it is going to replace the traditional VHF radio broadcast in a few years.

#### **RDS/TMC**

RDS-TMC (the “Radio Data System - Traffic Message Channel”) is a system of collection, collation and broadcasting of traffic-related data according to a uniform European standard.

### **2.3.1.3 Short-range wired connectivity**

#### **USB**

This communication interface represents a new connection standard agreed by different prominent industry players like Microsoft, Intel and Compaq. The USB (Universal Serial Bus) will functionally replace the parallel and the standard serial interface (RS232).

#### **FireWire (IEEE 1394)**

The FireWire is Apple Computer's version of a new standard, IEEE 1394 High Performance Serial Bus, to connect devices to a personal computer.

IEEE 1394 implementations are expected to replace and consolidate the standard serial and parallel interfaces, including Centronic parallel, RS232-C and SCSI.

#### **CardBus (PCMCIA)**

The Personal Computer Memory Card International Association (PCMCIA) was established in 1991 to standardise a particular form of add-in cards for mobile computers. Since then the PCMCIA has grown to include more than 400 member companies, which produce a wide range of add-in functions (PC cards) for mobile computers. The most advanced of these functions are being implemented using the CardBus technology.

#### **RS232**

RS is supposed to stand for Recommended Standards for serial communications. Nevertheless the RS232 is more an industry default than a standard. Fortunately, this standard (as the RS485) has been widely used for the implementations, to have become fairly consistent. Even though it is not a standard like IEEE-1394, it is good enough to allow for reliable implementation.

### **2.3.1.4 Medium and long-ranged wired connectivity**

#### **CAN**

CAN stands for Controller Area Network and was originally developed by BOSCH for applications in the automotive industry. Because of the large availability of CAN controllers from several manufacturers, CAN is more and more used in other industrial applications.

#### **RS485**

RS is supposed to stand for Recommended Standards for serial communications. Nevertheless the RS485 is more an industry default than a standard. Fortunately, this standard (as the RS232) has been widely used for the implementations, to have become fairly consistent. Even though it is not a standard like IEEE-1394, it is good enough to allow for reliable implementation.

### **J1708**

In-vehicle computer networks are used to transfer information over a serial link, between control modules, sensors and the outside world.

In The USA the trucking industry uses only the J 1708 standard defining those parameters of the serial link that primarily relate to hardware and basic software compatibility such as interface requirements, system protocol and message format. The serial data link is based on the EIA RS 485 standard.

### **J1587**

This standard precisely defines all messages and parameters ranged 128 to 255 in the J1708.

## **2.3.1.5 Short-range wireless connectivity**

### **IrDA**

The Infrared Data Associations is an international organisation that was founded 1993 to create and promote interoperable, low cost infrared data interconnection standards that support a point-to-point user model. The standards support a broad range of appliances, computing and communications devices. IrDA has over 150 members drawn from major hardware, systems, software, peripherals, component, and communications manufacturers, cable and telephone companies, automobile and service providers.

### **BLUETOOTH**

The Bluetooth technology is a result of a co-operation between the leaders in the telecommunications and computer industries. It is a proposed radio frequency (RF) specification for short-range, point to multiple point voice and data transfer. It is based on a low-cost, short-range radio link and facilitates ad hoc connections for stationary and mobile communication environments.

### **DSRC**

Dedicated Short Range Communication provide a means of communicating between vehicles and road beacons. This technology which has been developed to support the Electronic Fee Collection is today stabilised at the normative level, and its deployment is already ensured in France by the nearest introduction of TIS “Télépéage Inter Sociétés”.

## **2.3.1.6 Medium and long-ranged wireless connectivity**

### **2.3.1.6.1 Satellite**

#### **INMARSAT**

Founded in 1979 to support the maritime industry by means of satellite communications, INMARSAT (INternational MARitime SATellite organisation) began service in 1982. Currently INMARSAT has since expanded into land, mobile and aeronautical communications its functions which operate a global satellite system used by independent service providers to offer an extensive range of voice and multimedia communications.

### **ORBCOMM**

The ORBCOMM system offers global wireless data and messaging communications services. The system is based on the LEO satellites (LEO: Low Earth Orbiting) constellation to provide world-wide geographic coverage.

### **IRIDIUM**

The IRIDIUM system is a satellite-based wireless personal communications network based on a constellation of 66 interconnected LEO (Low Earth Orbit) satellites. The system allow for voice, paging, fax or data communications.

#### **2.3.1.6.2 Terrestrial**

### **GSM**

GSM (Global System for Mobile communications), a digital cellular phone technology based on TDMA that is widely deployed in Europe and throughout the world.

### **Mobitex**

Mobitex is intended for data communication from, to and between mobile units. The network is a nation-wide network of independent components such as base radio stations and area exchanges.

Mobitex wireless network technology is more and more recognised as an international data communication standard although it is operational in a limited number of countries. In the following European countries a network is available: Belgium, Finland, The Netherlands, Norway, Poland, Sweden and the United Kingdom.

Mobitex was developed in 1984 by Eritel for the Swedish Telecommunication Administration. Today, Mobitex is managed by the Mobitex Operators Association (MOA), which controls its specifications. The network infrastructure is manufactured by Ericsson Mobile Data Design AB.

### **Trunked radio**

Among the manufacturers of trunked radio systems are renowned companies such as Alcatel, Bosch/Ascom, Ericsson, Motorola, Nokia, Kenwood and Philips. The providers of these systems are manifold; many telecom companies provide trunked radio services.

Trunked radio is a concept that involves both (digital) speech and data transmission.

### **TETRA**

Trans European Trunked RAdio (TETRA) is a European standard for digital trunked radio that is primarily designed to meet the requirements of the emergency services.

Developed by ETSI, the European Telecommunications Standards Institute, TETRA is the result of a massive co-operative effort between major manufacturers, regulators, operators and user groups.

### **2.3.2 Positioning systems**

#### **NAVSTAR GPS**

The NAVSTAR Global Positioning System (GPS) is a whole of twenty-four satellites which orbit around the earth. Launched and maintained by the US Department of Defence (DoD) these satellites send continuous signals to the surface enabling a receiver to determine its position.

#### **GLONASS**

GLONASS (GLObal Orbiting NAVigation Satellite System) is a Russian constellation of 24 satellites placed in three orbital planes at an altitude of about 25000 km.

#### **GNSS**

There is strong support within the European community for a precision source of world-wide navigation and timing that is not under the sole control of the U.S. government. This concept is the Global Navigation Satellite System (GNSS).

This system uses NAVSTAR and GLONASS and other geo-stationary satellites to provide positioning, along with other components to improve accuracy and provide fast warning of problems.

#### **EUTELTRACS**

Launched in Europe in 1992 by EUTELSAT (the network operator of EUTELTRACS in Europe) and ALCATEL QUALCOMM (the joint venture between QUALCOMM, the American system developer and ALCATEL, the European manufacturer of telecommunication systems), EUTELTRACS, the system itself is the leading two way mobile communications and vehicle positioning system via satellite dedicated to the transportation business and specially to enhancing the productivity of fleet management.

### **2.3.3 Portable storage media**

#### **PCMCIA PC-cards**

PC-Cards are small, credit card sized storage devices. They are used in many portable devices.

#### **Ibuttons**

Ibuttons is a 16-mm computer chip, which is Java powered. This can be used for storage of identification information and other storage needing less information.

#### **Sony's memory stick**

Memory Stick: 16MB Storage Capacity Ultra-Small, Thin Design Erasure Prevention Switch 10 Pin Connector for High Reliability. It has 20MHz Clock Speed, 1.5MB/sec Write Speed and 2.45MB/sec Read Speed.

#### **IBM micro drive**

This is a very small hard drive with a capacity of either 340 Mb or 170 Mb.

## **2.3.4 Other**

### **Electronic signature processing**

Several methods can be used to sign documents electronically from simple ones (scanned images of a handwritten signatures in a word processing documents) to advanced ones (digital signatures using public-key cryptography).

Although currently there is no agreed definition for it, an electronic signature may be defined as the electronic equivalent to a manual signature placed over an electronic document.

Electronic signatures allow people receiving data via the Net:

To determine the origin of the data (identity the sender);

To check if the data was modified during the transmission (integrity of the data).

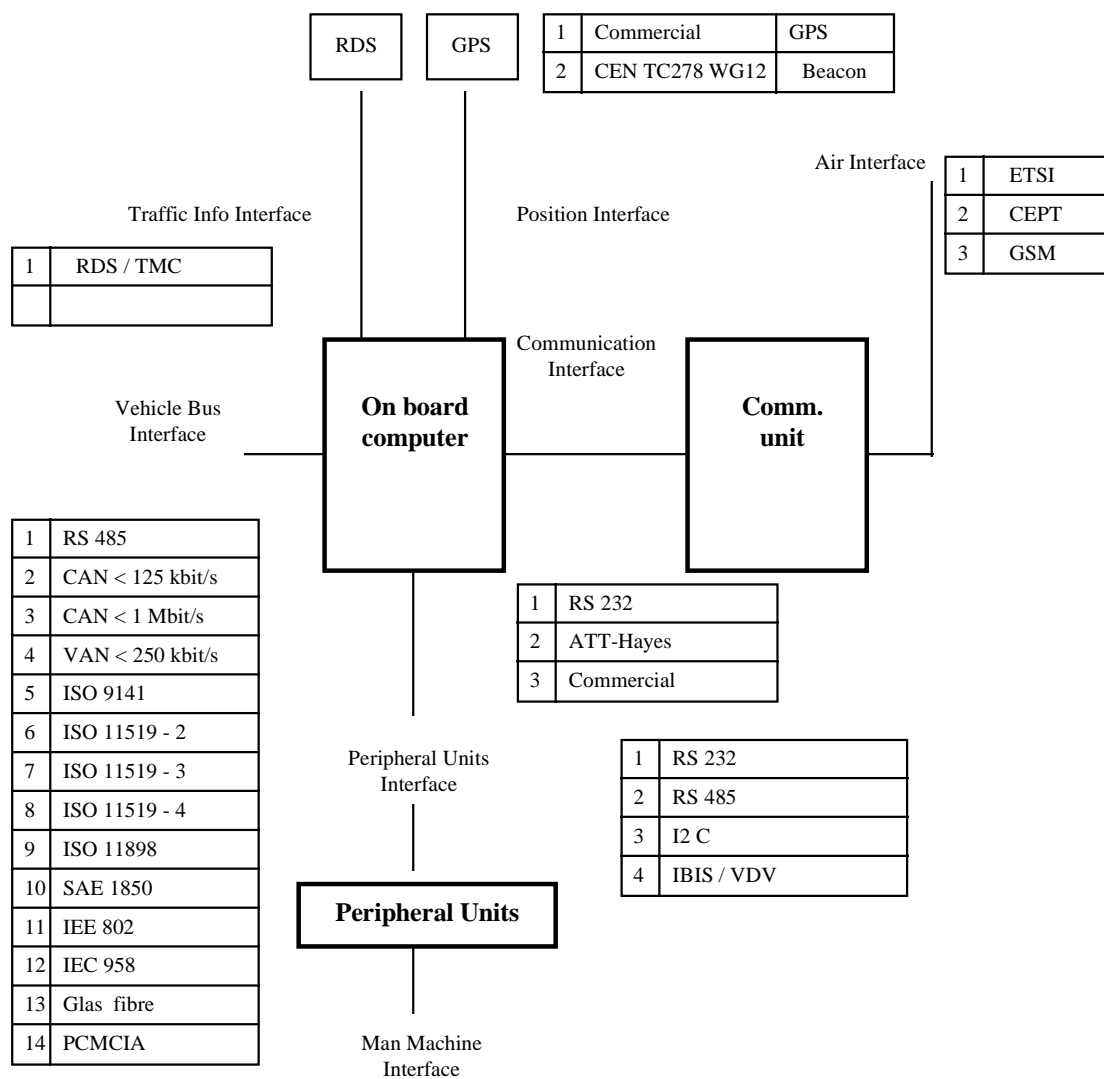
The transmitted data is accompanied by a certificate, issued by the provider of service of certification which make it possible to the recipient to be ensured of the identity of the signatory.

### 2.3.5 Mapping of technology to interface

#### CEN TC278 WG2

#### FFMS interfaces for on board data processing and vehicle data links

#### Interfaces Scheme



	PERIPHERAL INTERFACE	VEHICLE BUS INTERFACE	POSITION INTERFACE	TRAFFIC INFORMATION INTERFACE	AIR INTERFACE
RDS/TMC				✓	
DAB				✓	
RS232	✓				
USB	✓	✓			
Firewire (IEEE 1394)	✓	✓			
CardBus (PCMCIA)	✓				
CAN		✓			
J1708		✓			
RS485	✓	✓			
IrDA	✓				✓
Bluetooth	✓				✓
Euteltracs			✓		✓
INMARSAT					✓
ORBCOMM					✓
IRIDIUM					✓
GSM (GPRS, EDGE)			✓		✓
UMTS					✓
TETRA					✓
Mobitex					✓
Trunked radio					✓
GPS			✓		
GLONASS			✓		
GNSS			✓		
DSRC					✓

## 3 FUNCTIONAL AND CONTROL ARCHITECTURE

### 3.1 FUNCTIONAL HIERARCHY

Below, the functionality developed in the COMETA functional architecture is shown. In this functional hierarchy, the functionality that is also described by KAREN is indicated in bold.

This functionality has been developed and organised to support two key physical and communication scenarios : an “independent (or chartered) driver scenario” (relying on high level functions 1, 2 and 3) and a “fleet driver scenario” (relying on high level function 3 mainly, but, as it will be seen, also function 2).

Clearly, any other physical and communication scenario can be developed making any combination of the functionality that is described below. Examples of such scenarios are extended fleet driver scenarios such as (1) a version in which high level functions 1 and 2 are combined (allowing the fleet driver to prepare resources as well as to prepare trips, routes and load plans) and (2) a version in which high level functions 1, 2 and 3 are combined (allowing the driver to sometimes act as a member of a fleet and sometimes as an independent or chartered driver).

Considering High level Function 3 “Perform and control vehicle, driver, cargo and equipment operations”, COMETA Project is aware that having 12 intermediate Functions under this High Level Function is conflicting with the rule that there should not be more than 5 or 6 Functions / Sub functions at the same level.

Nevertheless, COMETA considering the balance between homogeneity of Functions and their adequacy to a meaningful degree of description precision (e.g. considering all monitoring functions), came to the conclusion that keeping only 3 levels for its Systems Architecture should make it simpler and more legible, and so understandable and translatable into Physical Architecture, without any loss of meaning and efficiency.

The decomposition of high level Function 3 could be seen as hiding in fact 5 intermediate level Functions which can be easily tracked within the present structure:

- 3.1 as it is now, “manage tasks and transport order”,
- 3.2 as it is now, “comply with regulations”,
- a new possible 3.3 “Provide Driver Support”, containing,
  - 3.3.1 Provide Advanced Driver Assistance (present 3.3),
    - 3.3.1.1 Provide vision support,
    - 3.3.1.2 Provide longitudinal control,
    - 3.3.1.3 Provide lateral control,
    - 3.3.1.4 Provide automated driving support,
    - 3.3.1.5 Miscellaneous telematics functions,
  - 3.3.2 Provide Access to Comfort Services (present 3.4),
  - 3.3.3 Manage Traffic and route Guidance Information (present 3.5),

- 3.3.4 Support payment operations (present 3.6).
- a new 3.4 “Monitor Operations”, containing,
  - 3.4.1 Monitor Vehicle,
    - 3.4.1.1 Monitor Vehicle Position,
    - 3.4.1.2 Monitor Vehicle Status and operation
  - 3.4.2 Monitor Driver,
    - 3.4.2.1 Monitor Social Regulations Status,
    - 3.4.2.2 Monitor Physical Status,
    - 3.4.2.3 Monitor Driver Expenses,
    - 3.4.2.4 Monitor Driving Behaviour.
  - 3.4.3 Monitor Cargo,
  - 3.4.4 Monitor Equipment,
    - 3.4.4.1 Monitor Equipment position,
    - 3.4.4.2 Monitor Equipment Status.
  - 3.4.5 Monitor Progress of Tasks.
    - 3.4.5.1 Monitor and report on Operational Tasks,
    - 3.4.5.2 Monitor and prove Transport Order Execution.
- 3.5 as it is now in 3.12 “Manage Emergency”.

It should be made clear that having 3 or 4 levels here would not change external and internal data flows exchanges, triggering of low level functions, functional data flows, data stores read or write and contents.

**IMPORTANT : notice that three Functions names will be changed :**

- **3.11.1 Monitor and Report on Operational Tasks,**
- **3.11.2 Monitor and Prove Transport Order Execution,**
- **3.12 Manage Emergency.**

<b>1 Manage business transactions</b>	<b>1.1 Negotiate transport orders (Karen 8.2.1.1)</b>	
	<b>1.2 Administrative business transactions (Karen 8.2.1.2)</b>	
<b>2 Prepare vehicle, driver, equipment and cargo</b>	<b>2.1 Prepare resources</b>	2.1.1 Prepare documents (Karen 8.2.2.1.2)
		2.1.2 Prepare vehicle
		2.1.3 Prepare driver
		2.1.4 Prepare cargo space
		2.1.5 Prepare of equipment
		2.1.6 Prepare accessories
		2.1.7 Prepare other transport mode

	<b>2.2 Prepare trips, routes and load plans (Karen 8.2.2.1.1)</b>	2.2.1 Ask for a new task order 2.2.2 Process and read a new task order 2.2.3 Check client profile and constraints 2.2.4 Prepare trip/routes 2.2.5 Prepare load plan
3 Perform and control vehicle, driver, cargo and equipment operations	3.1 Manage tasks and transport orders	3.1.1 Manage tasks and transport order contents and modifications 3.1.2 Check whether cargo and or equipment conforms to transport order 3.1.3 Create a new transport Unit
	3.2 Comply with regulations	3.2.1 Comply with social regulations
		3.2.2 Comply with other regulations
	<b>3.3 Provide advanced driver assistance (from KAREN)</b>	<b>3.3.1 Provide vision support (Karen 5.1)</b>
		<b>3.3.2 Provide longitudinal control (Karen 5.3)</b>
		<b>3.3.3 Provide lateral control (Karen 5.4)</b>
		<b>3.3.4 Provide automated driving support (Karen 5.2)</b>
		<b>3.3.5 Miscellaneous telematics functions (Karen 5.8)</b>
	3.4 Provide access to comfort services	
	<b>3.5 Manage traffic and route guidance information (Karen 6.2.5)</b>	
	<b>3.6 Support payment operations</b>	3.6.1 Perform EFC transactions(Karen 5.8.9)
		3.6.2 Support billing services
	<b>3.7 Monitor vehicle</b>	3.7.1 Monitor vehicle position (Karen 7.3)

		3.7.2 Monitor vehicle status and operation
	3.8 Monitor driver	3.8.1 Monitor social regulations status
		3.8.2 Monitor physical status (Karen 5.5)
		3.8.3 Monitor driver expenses
		3.8.4 Monitor driving behaviour
	3.9 Monitor cargo	
	3.10 Monitor equipment	3.10.1 Monitor equipment position
		3.10.2 Monitor equipment status
	3.11 Monitor progress of tasks	3.11.1 Monitor and report on operational task 3.11.2 Monitor and prove transport order execution
	<b>3.12 Manage emergency</b>	

### 3.1.1 “Generic” functionality not explicitly developed in the functional architecture

In order not to “overload” the diagrams and descriptions of functions below, some important “generic” functionality (that would have to be repeated in almost any diagram and description of functions) is described below. The most important examples of generic functionality are:

#### (1) Confirmation of incoming and outgoing messages

Incoming and outgoing messages will be stored until they are deleted by the driver. For any incoming and outgoing message, the following types of confirmation can be set: :

- confirmation of reception of messages
- confirmation that messages have been successfully processed by the on board application
- confirmation that messages have been read
- confirmation that messages were understood and have been accepted (to be carried out as such).

#### (2) Access to, downloading and uploading of driver, vehicle, cargo and equipment data store (by the fleet manager)

The fleet manager can at any time access and modify (read, write) any part of the vehicle, driver, equipment and cargo data store.

(3) Access to data store by driver

The driver can at any time access and modify (read, write) any part of the vehicle, driver, equipment and cargo data store.

(4) Templates for documents stored in database

The vehicle, driver, equipment and cargo data store shall contain templates allowing preformatted data entry or consultation for any relevant subset of data contained in the data store.

(5) Updating of software modules

On board applications and the management of peripherals can be updated at any moment by the fleet manager or a service provider.

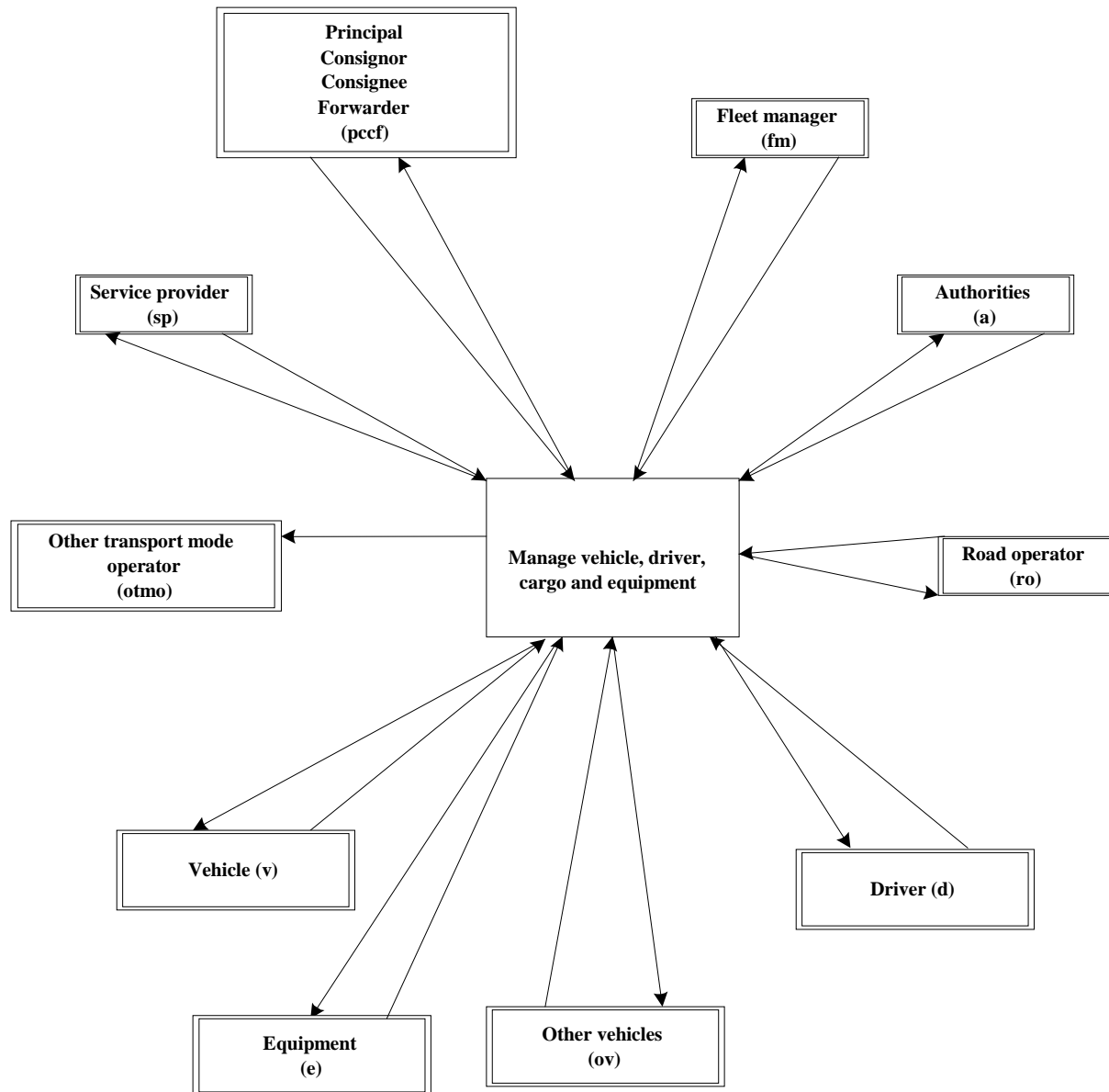
### **3.1.2 Control Architecture**

Following the KAREN methodology, Control Architecture has been embedded within the Functional Architecture by the indication of trigger flows when describing low level function (see 3.5).

### **3.1.3 Specific case of function 3.3 “provide advanced driver assistance”.**

The functional hierarchy reminds that a functionality described too by KAREN is indicated in bold characters. All, except 3.3, have been jointly developed 3.3, which refers to any kind of vehicle, has been imported as such by COMETA from KAREN and presented in a simplified way.

### 3.2 FUNCTIONAL DIAGRAMS



**Figure : 2. Context Diagram with terminators (see3.3)**

In the following diagrams “f” will mean “from”, “t” will mean “to”.

- Examples :
- fd = from driver
  - td = to driver
  - ffm = from fleet manager
  - ta = to authorities
  - totmo = to other transport modes.

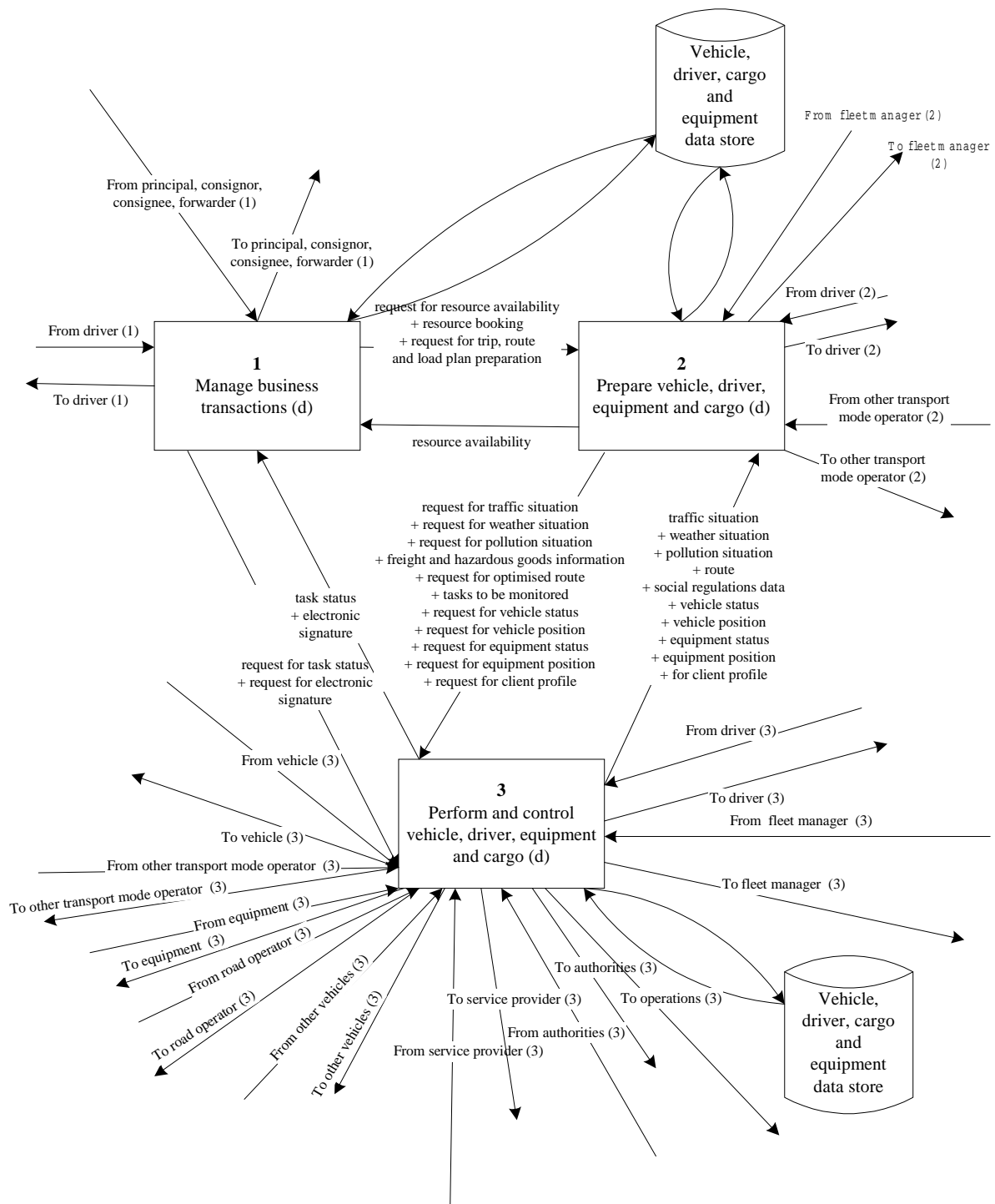
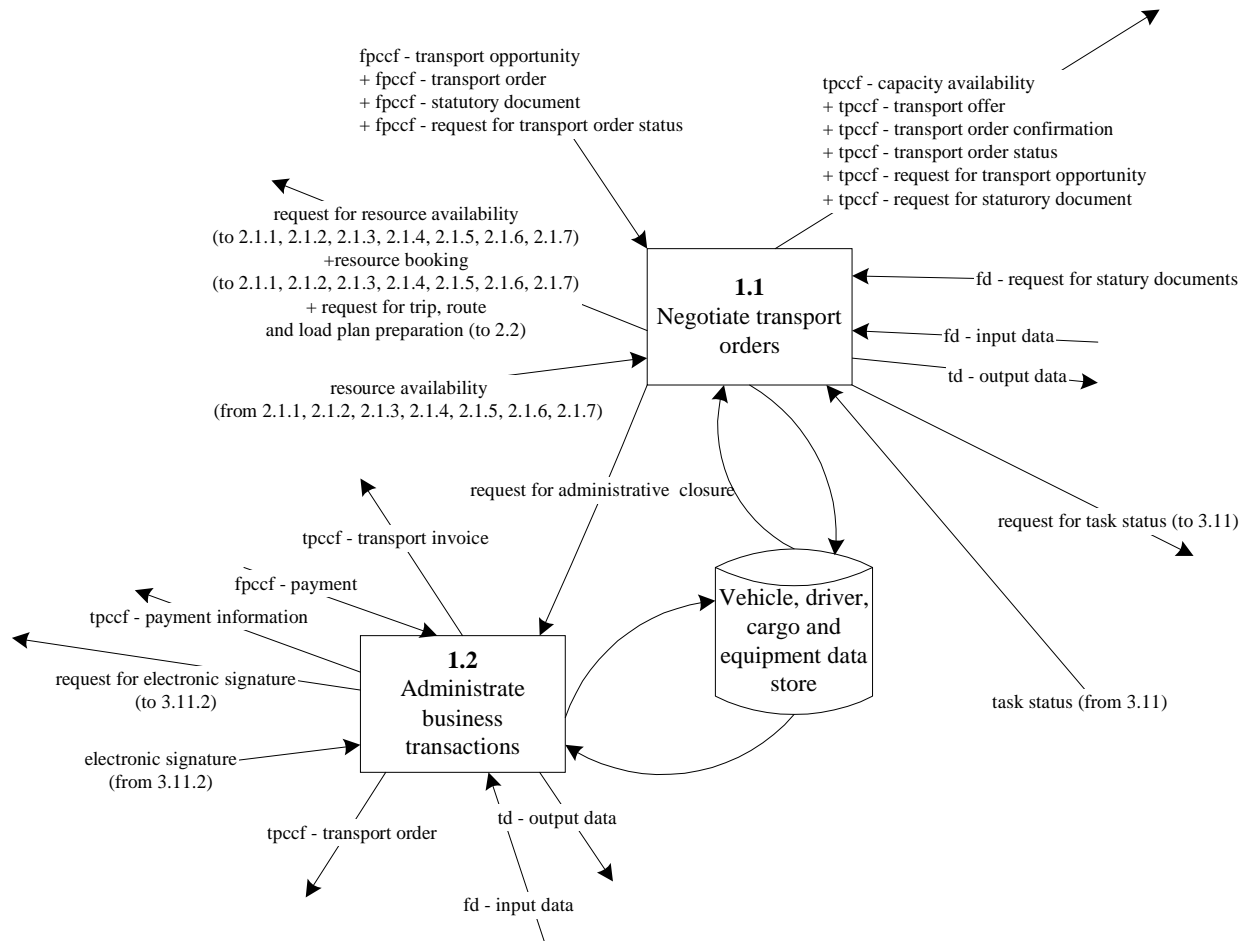
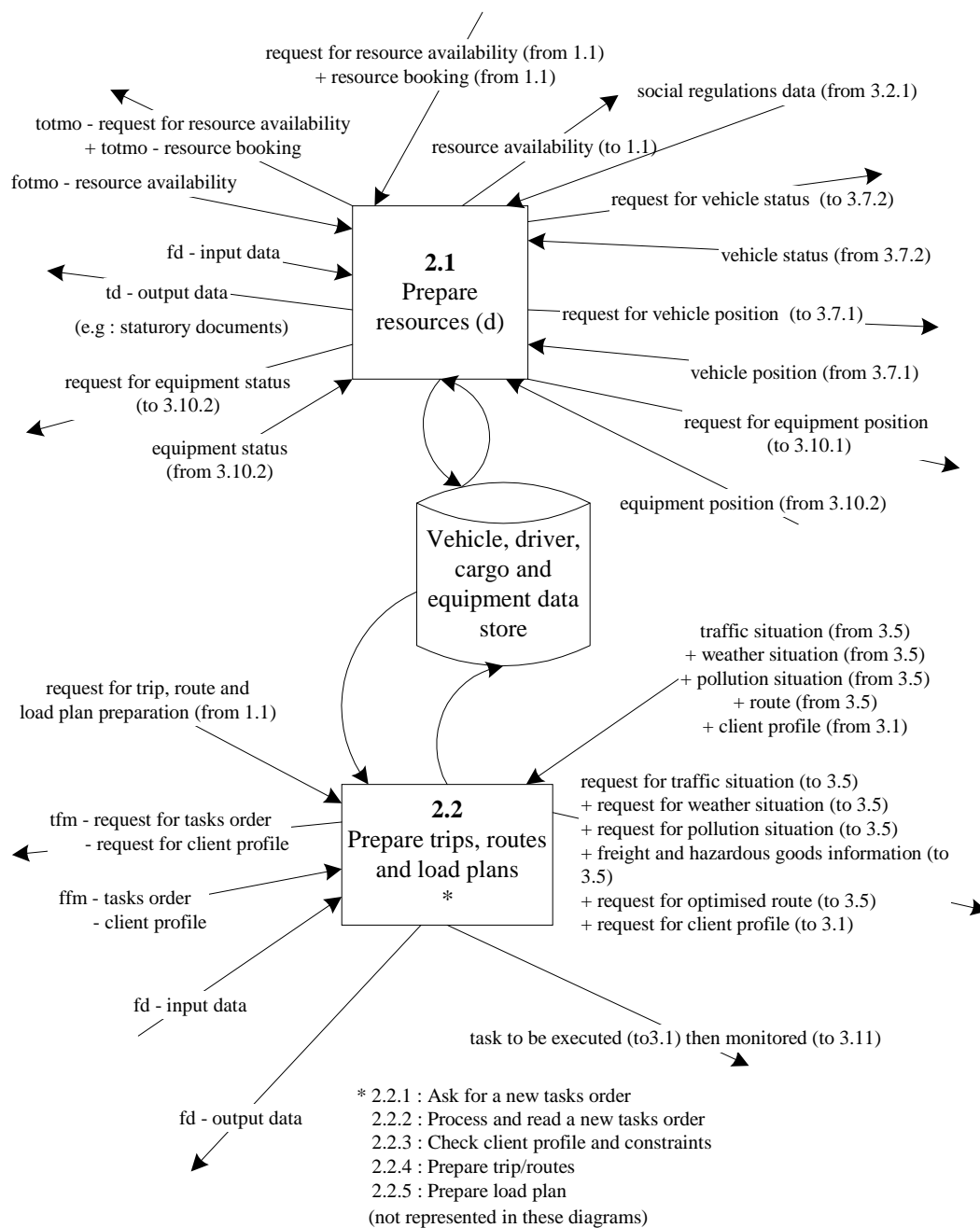


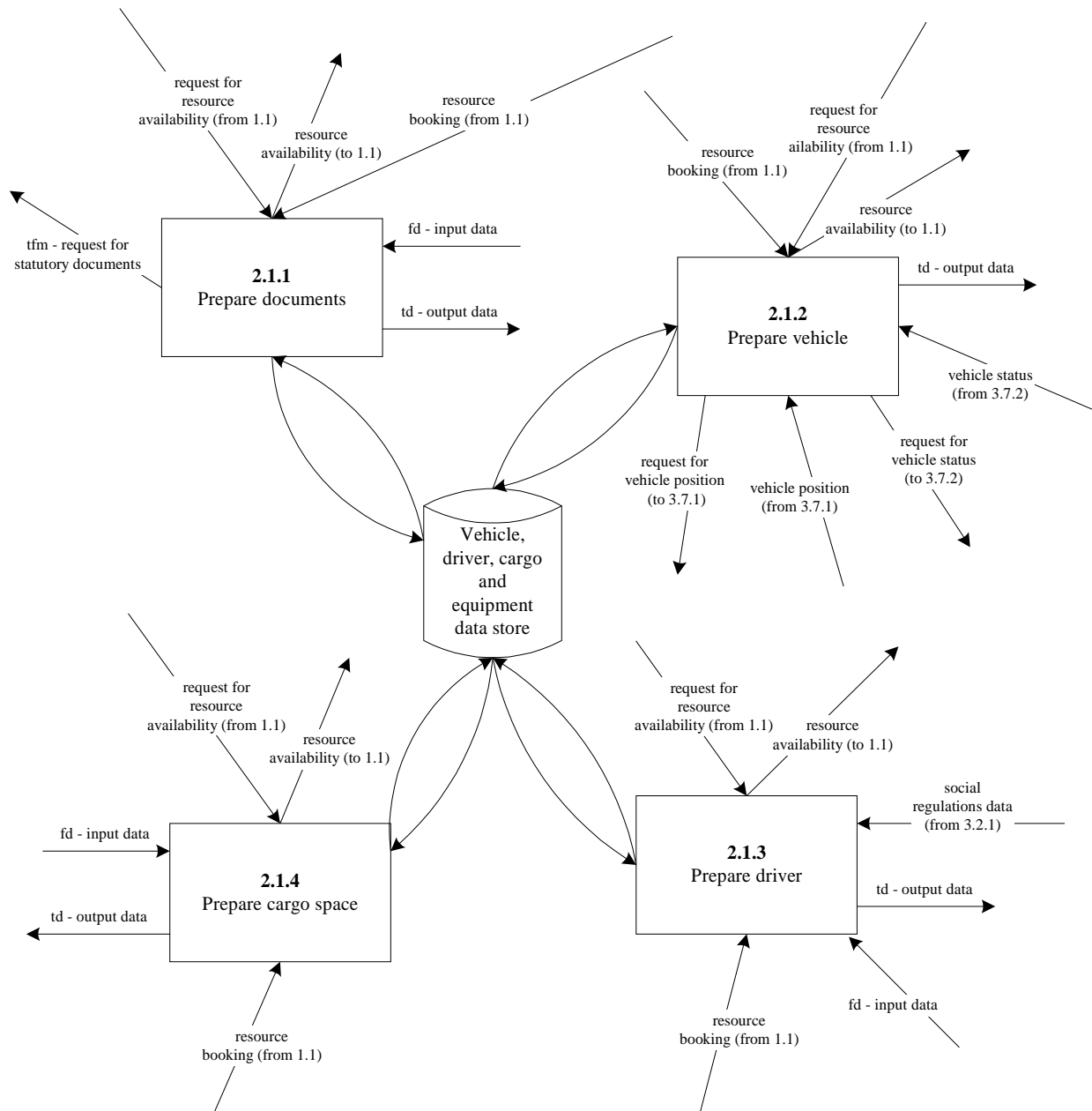
Figure : 3. Decomposition of COMETA architecture



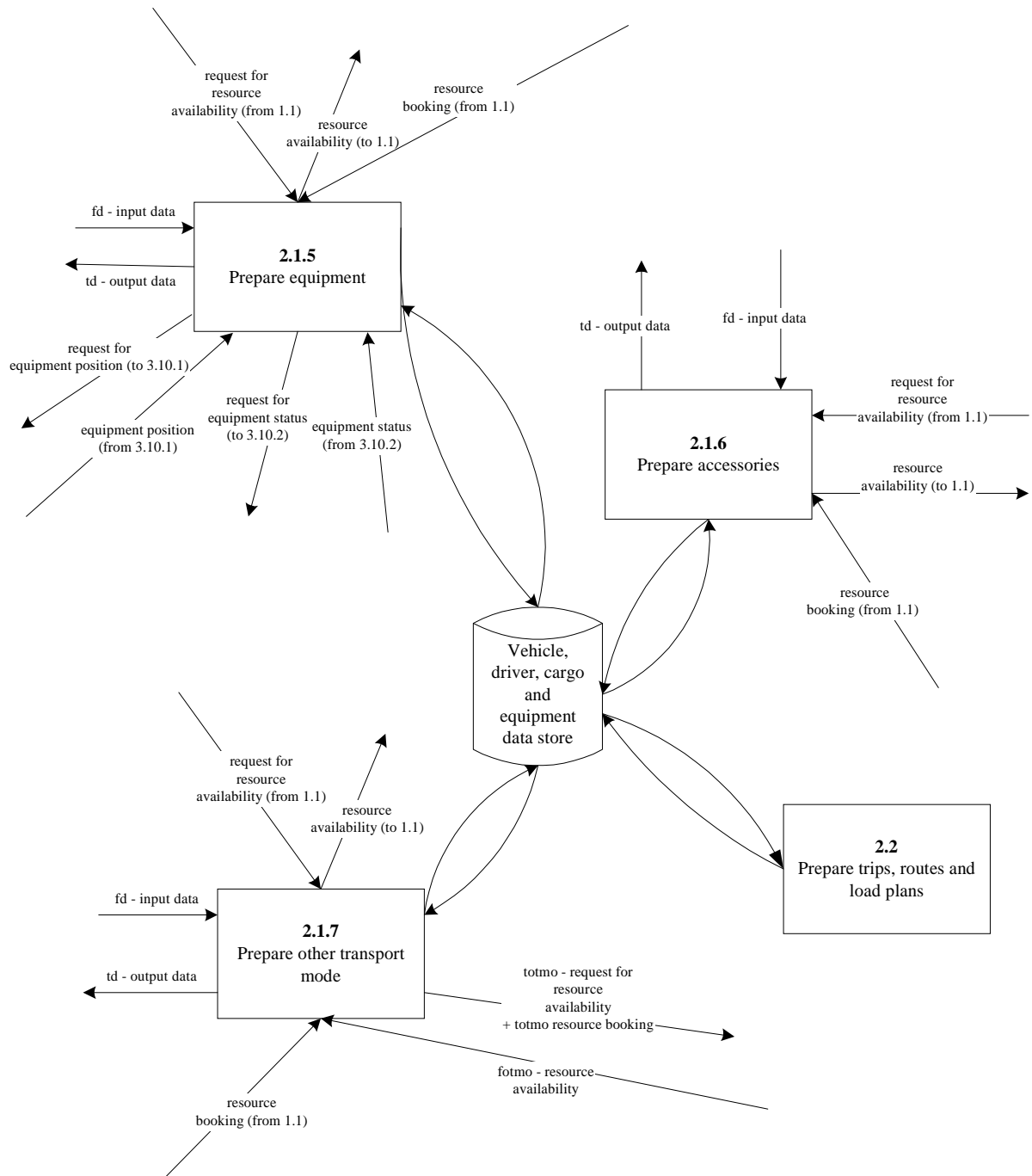
**Figure : 4. Decomposition of 1 Manage business transactions**



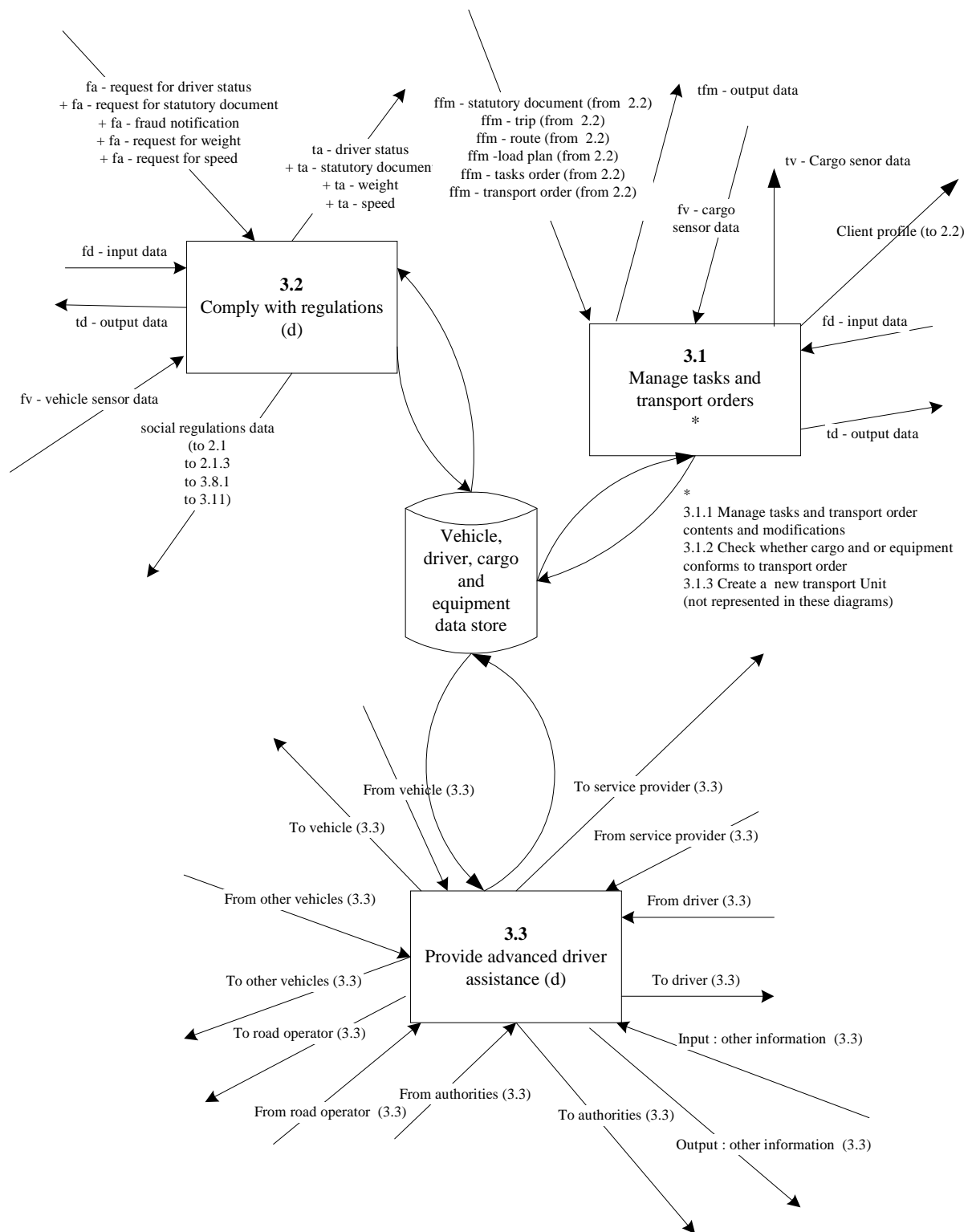
**Figure : 5. Decomposition of 2 prepare vehicle, driver, equipment and cargo**



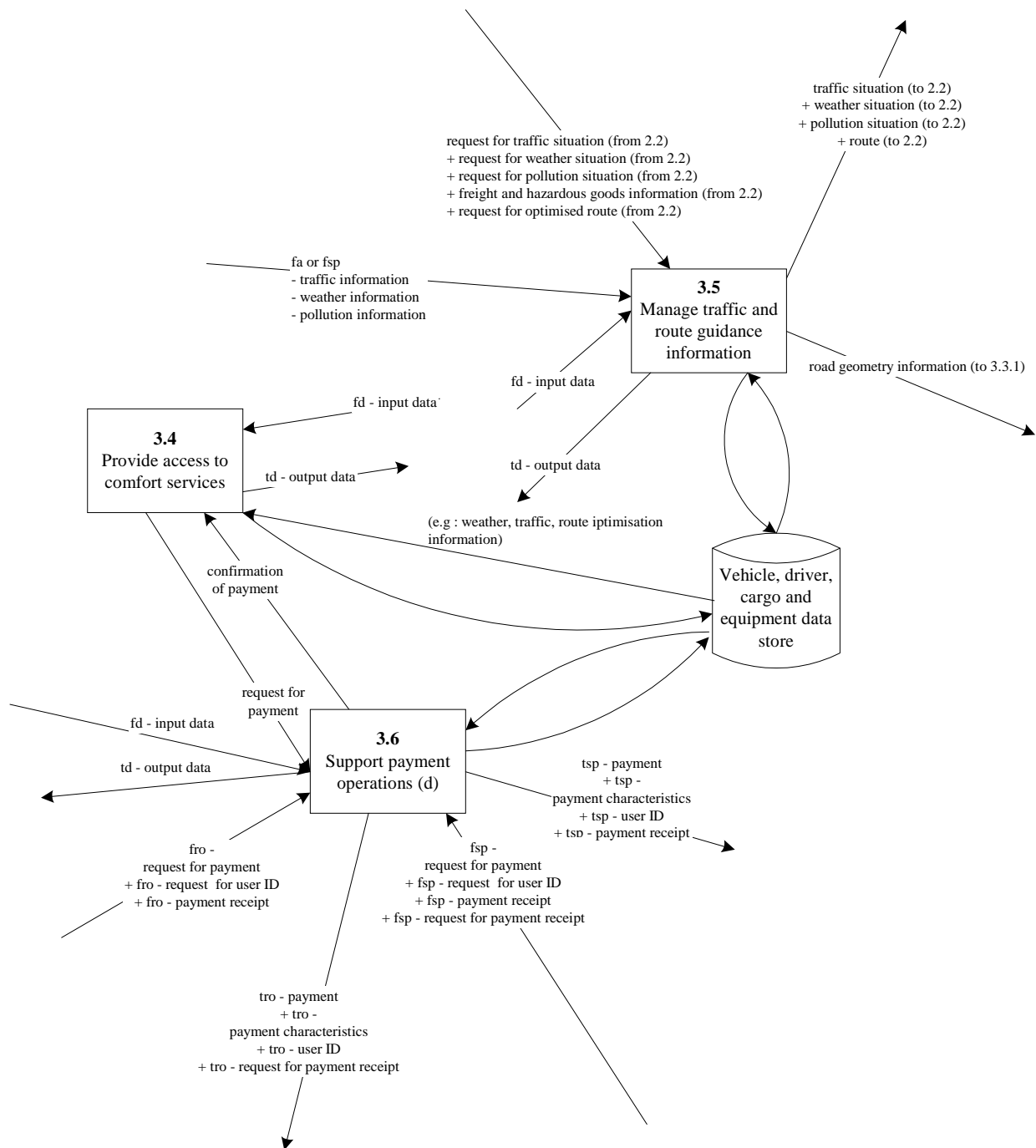
**Figure : 6. Decomposition of 2.1 check availability of resources (part 1)**



**Figure : 7. Decomposition of 2.1 Check availability of resources (part2)**



**Figure : 8. Decomposition of 3 perform and control vehicle, driver, cargo and equipment operations (part 1)**



**Figure : 9. Decomposition of 3 perform and control vehicle, driver, cargo and equipment operations (part 2)**

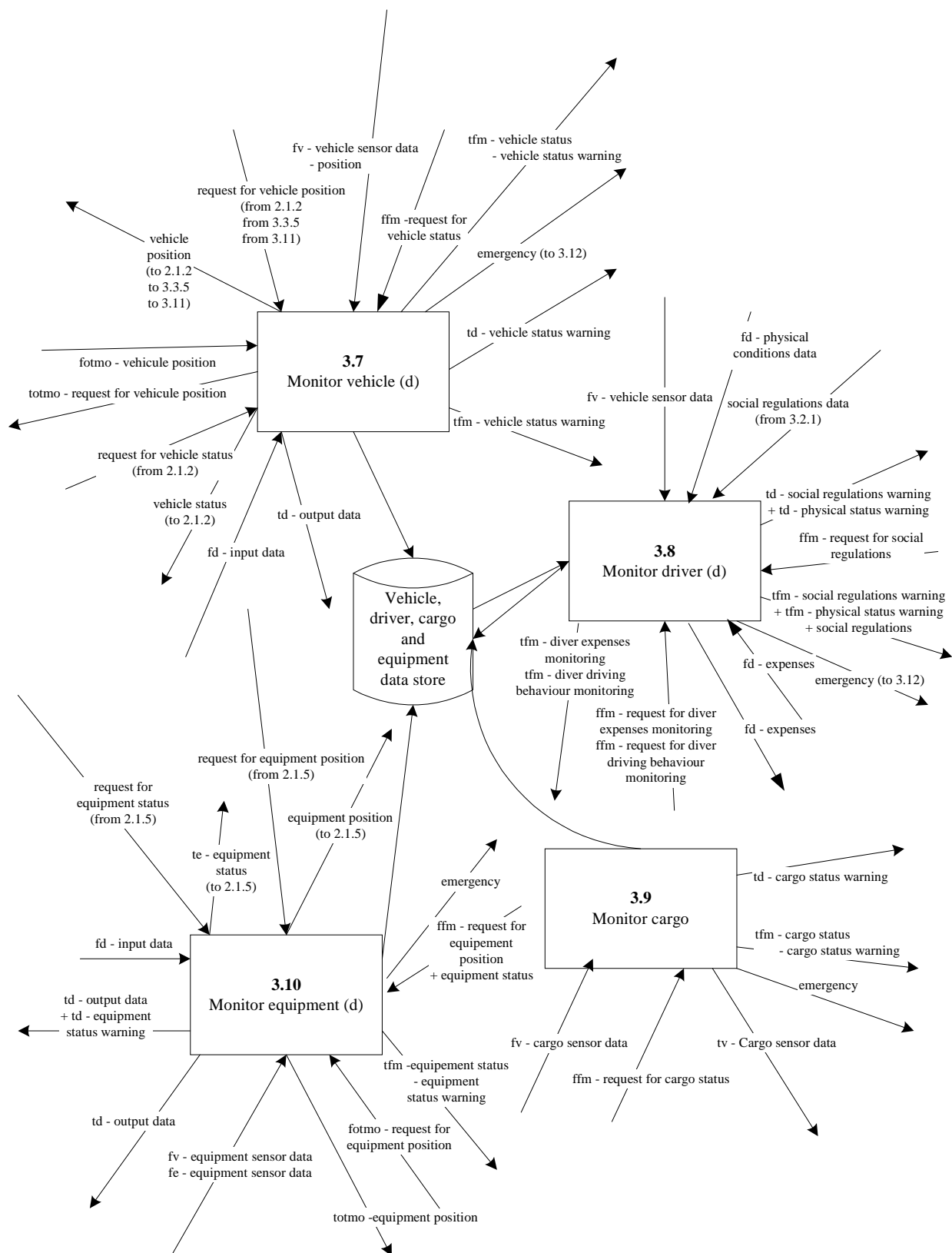
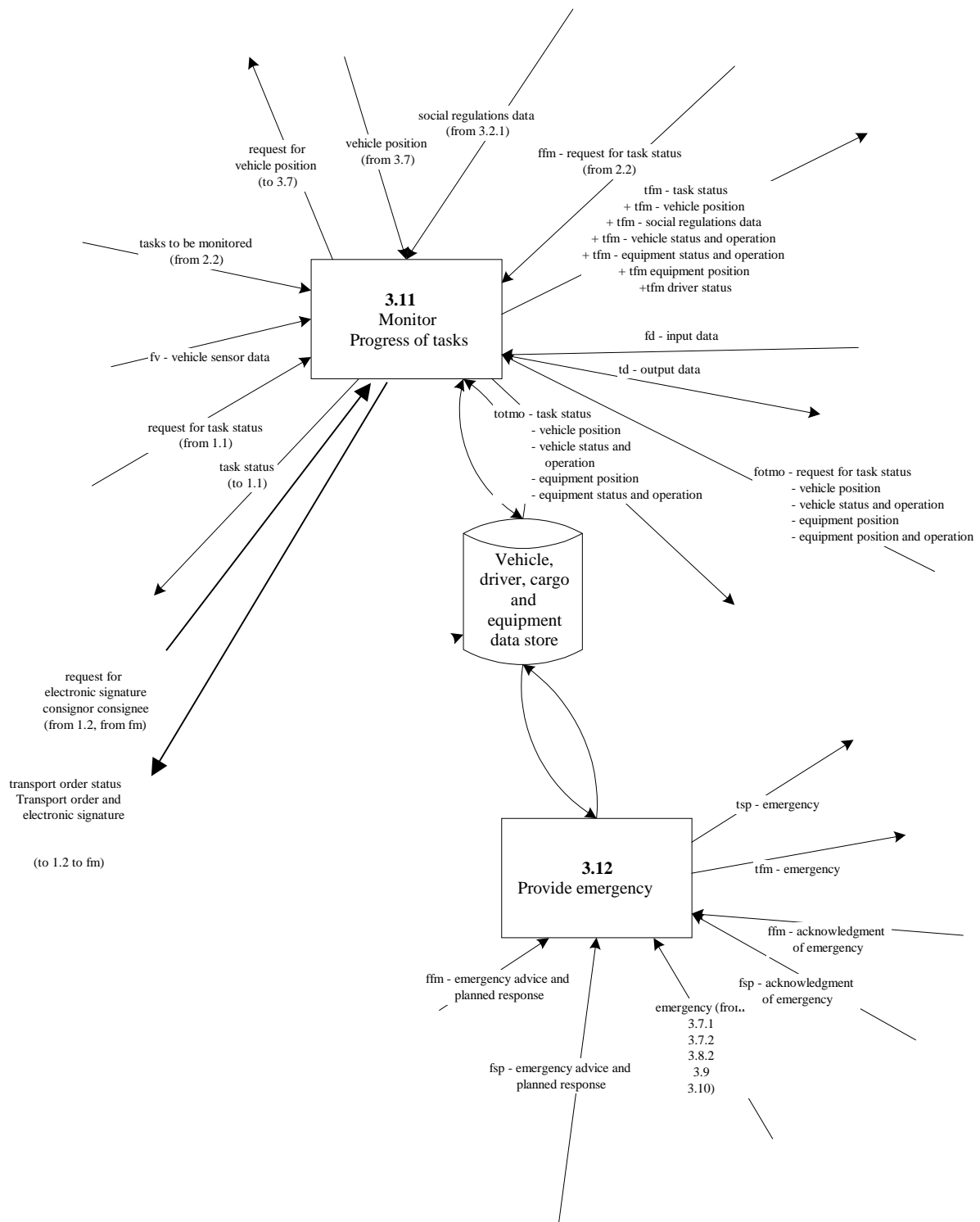
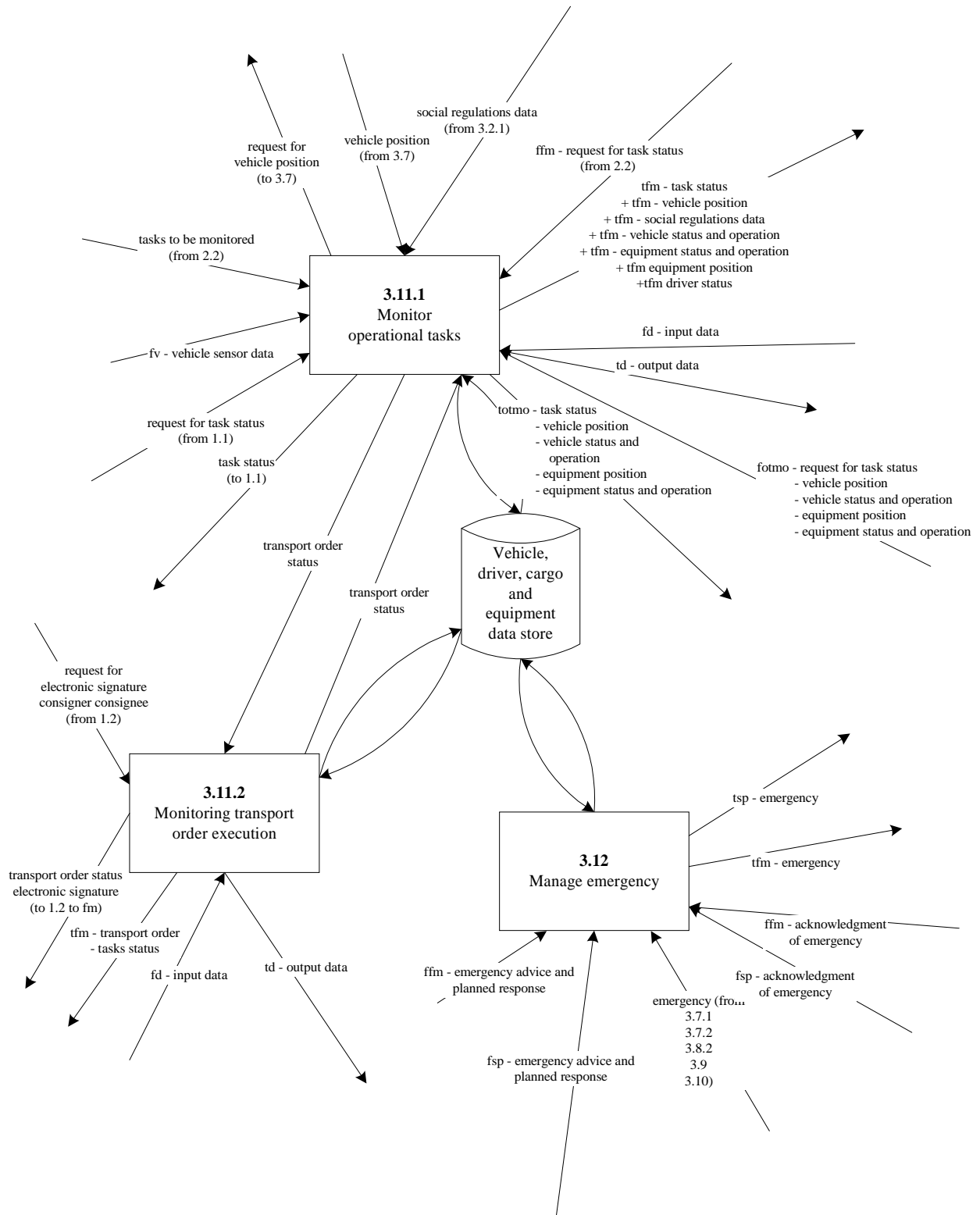


Figure : 10. Decomposition of 3 perform and control vehicle, driver, cargo and equipment operations (part 3)



**Figure : 11. Decomposition of 3 perform and control vehicle, driver, cargo and equipment operations (part 4)**



**Figure : 12. Decomposition of 3 perform and control vehicle, driver, cargo and equipment operations (part 5)**

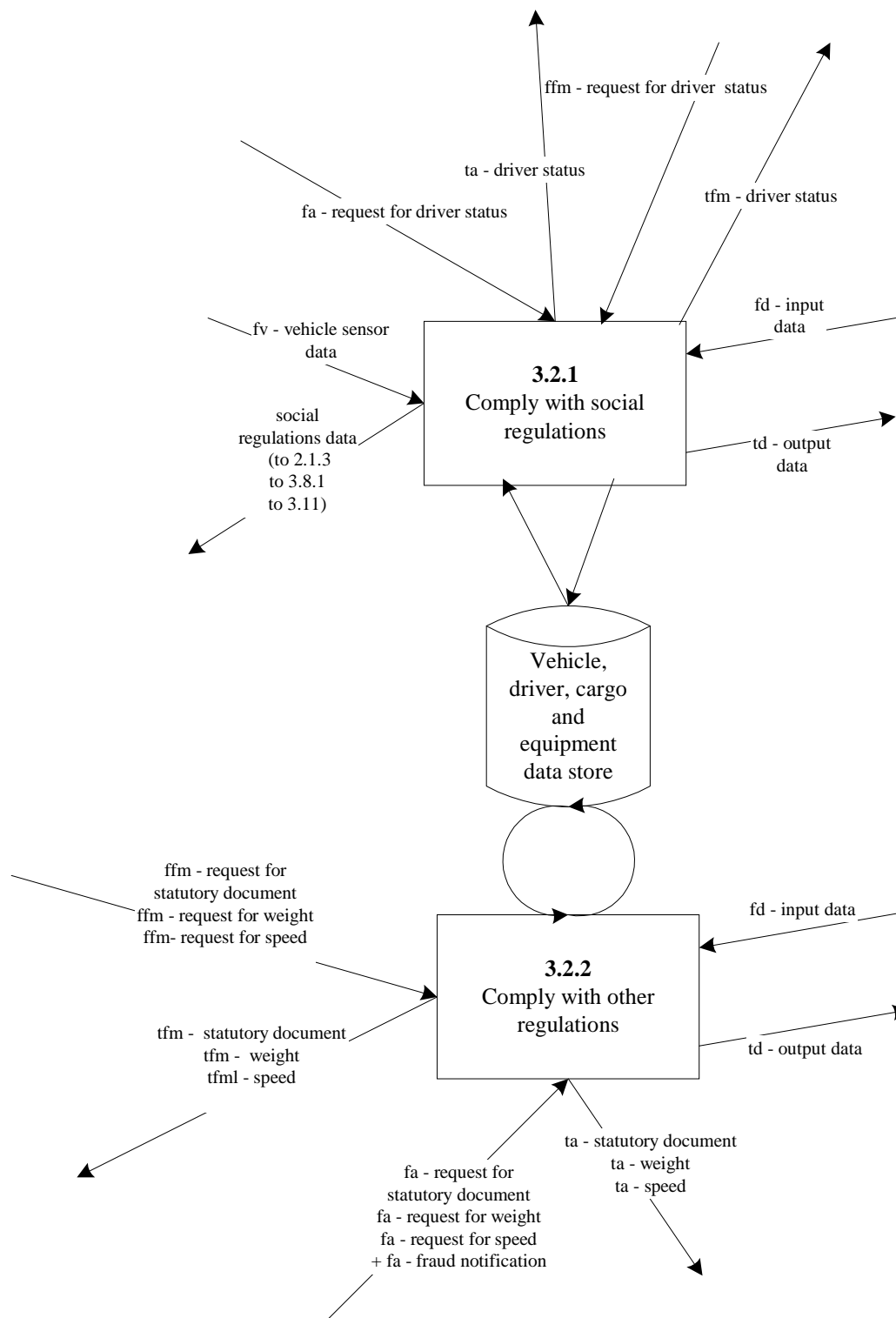


Figure : 13. Decomposition of 3.2 comply with regulations

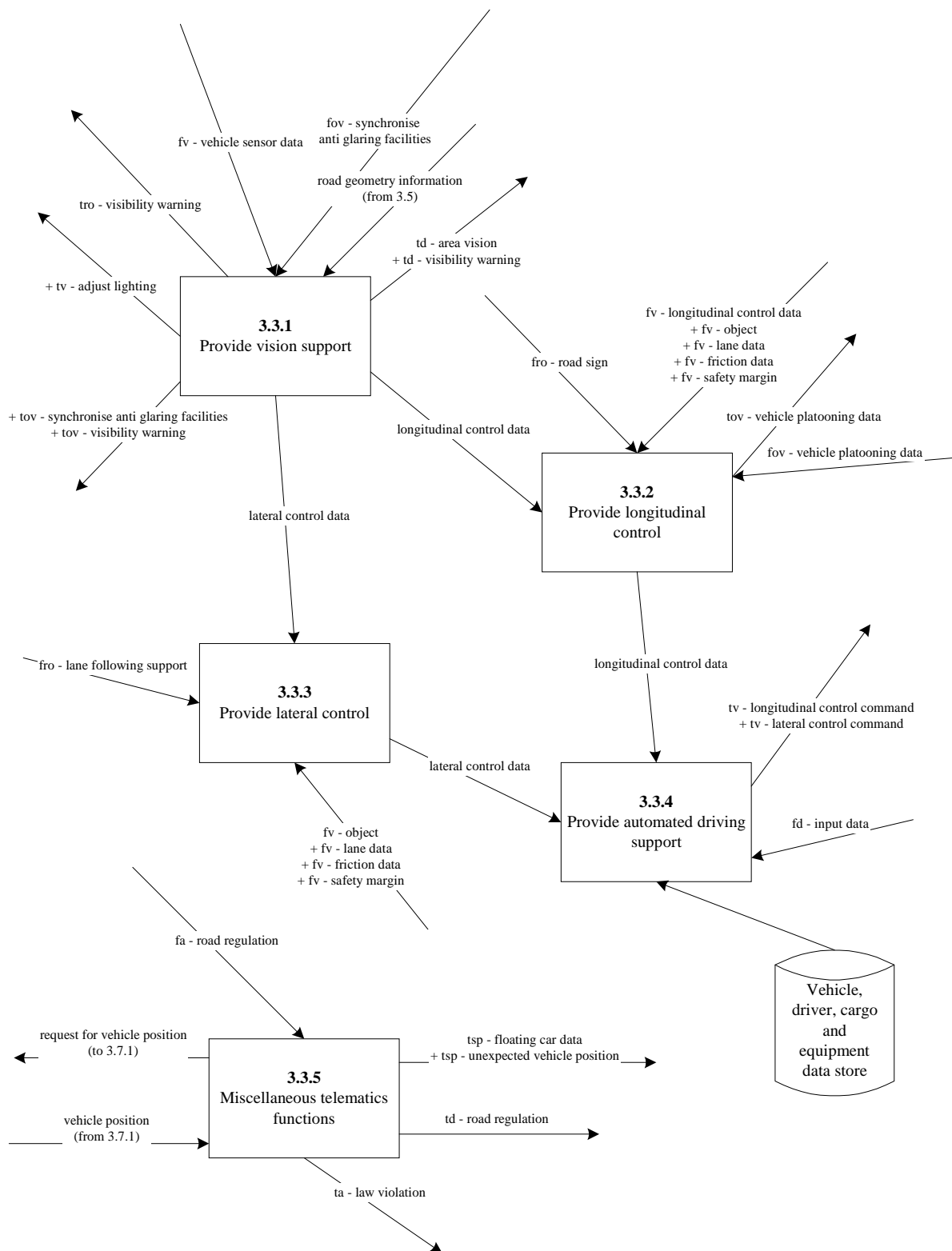
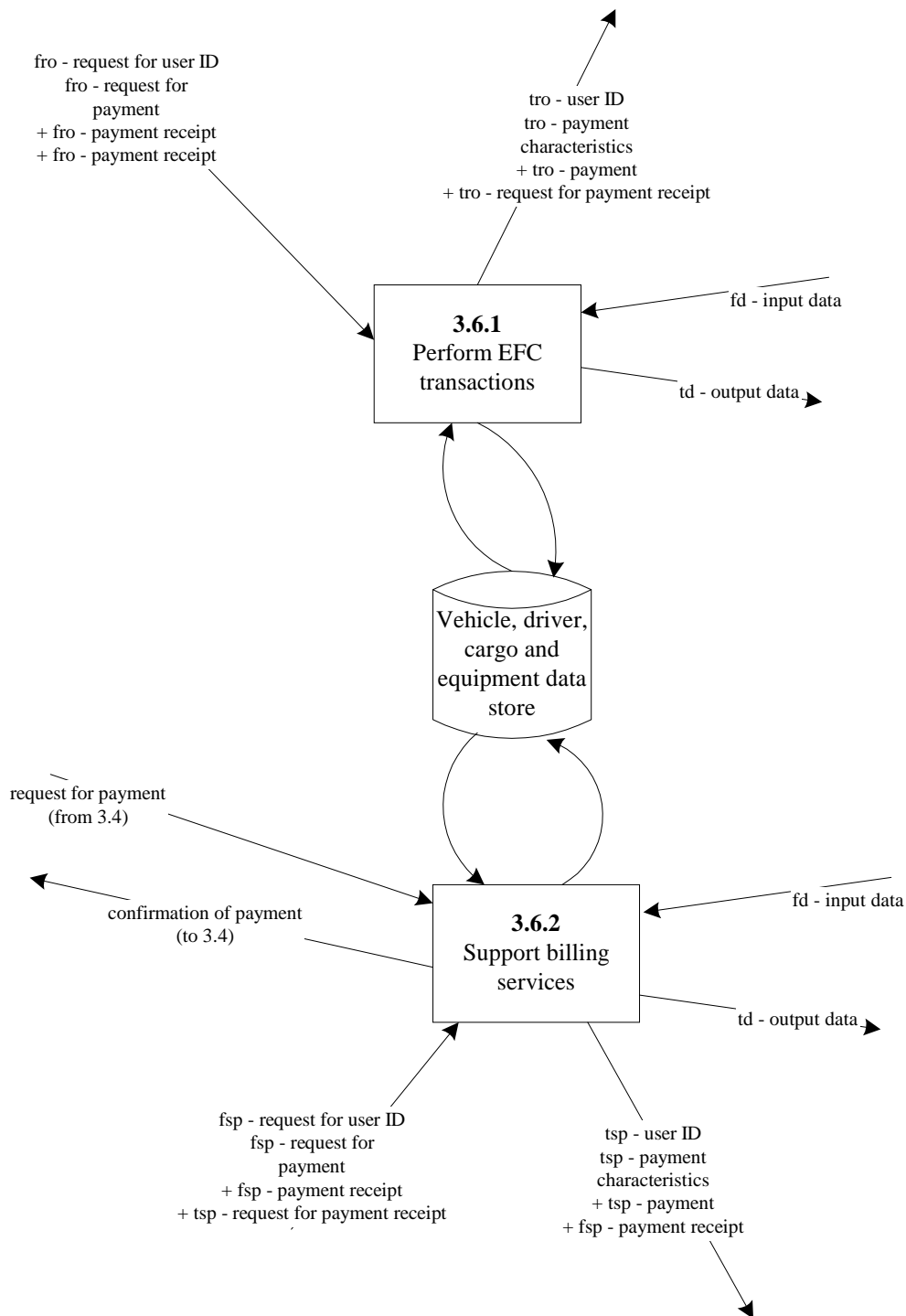
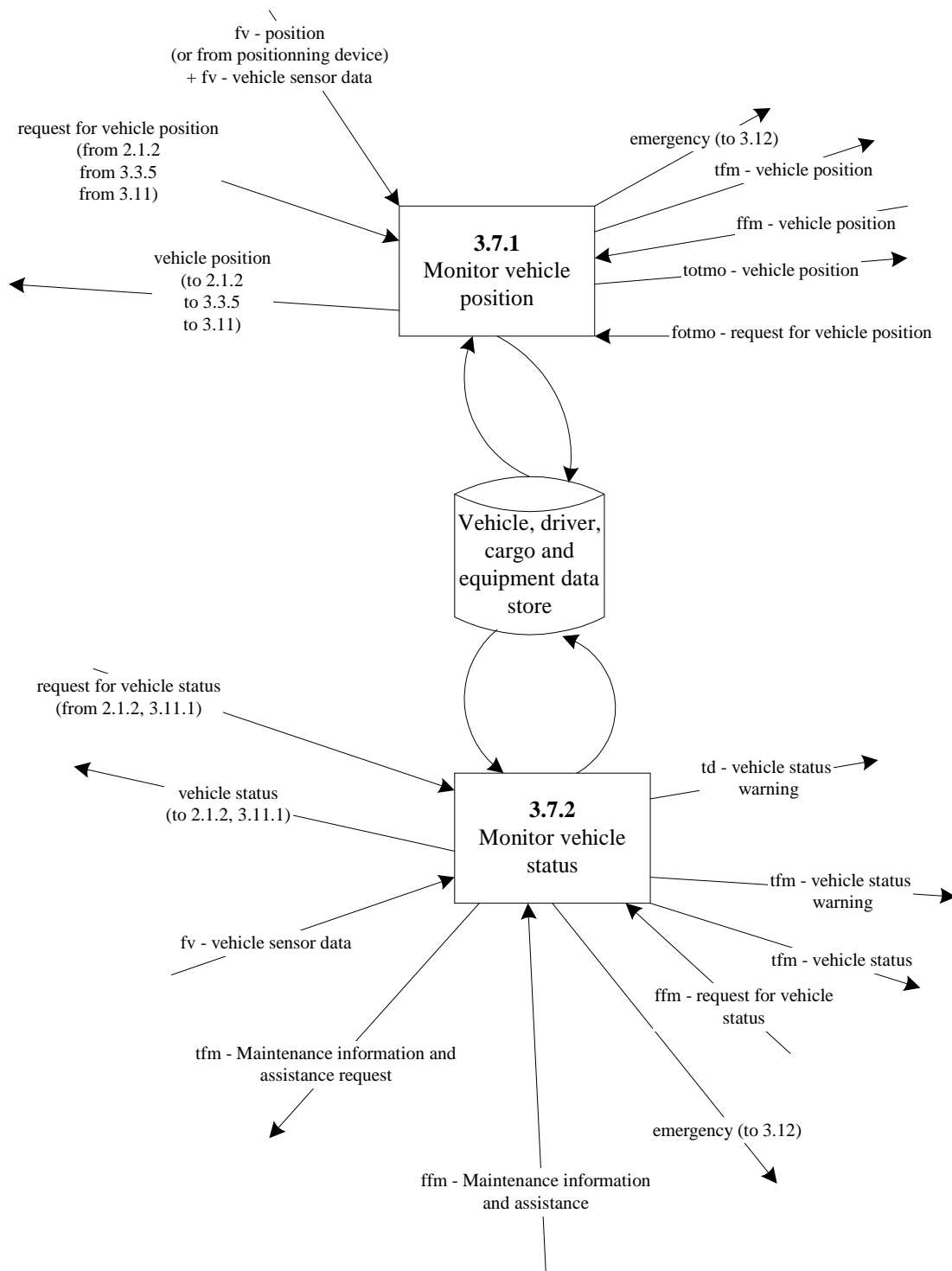


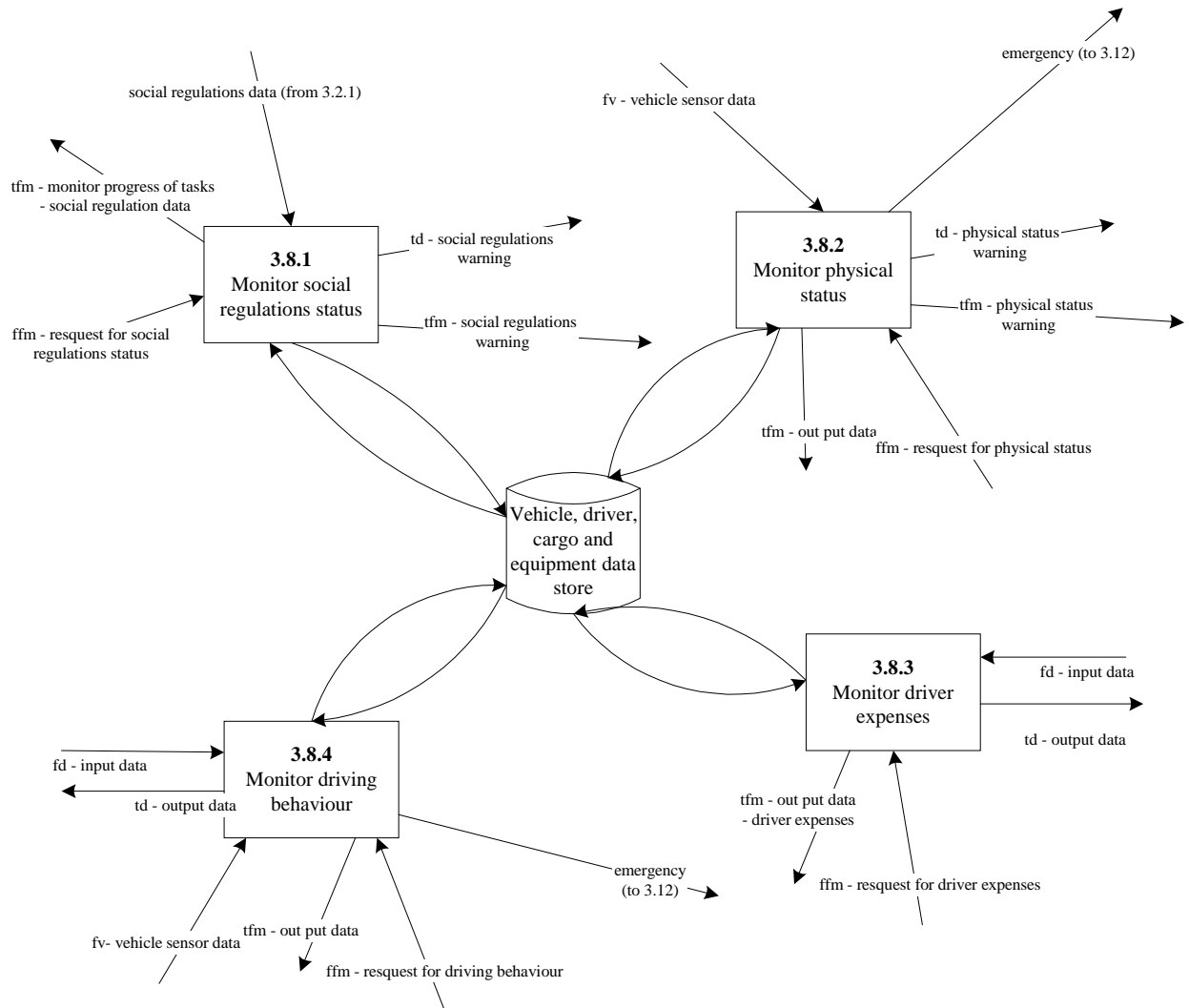
Figure : 14. Decomposition of 3.3 provide advanced driver assistance



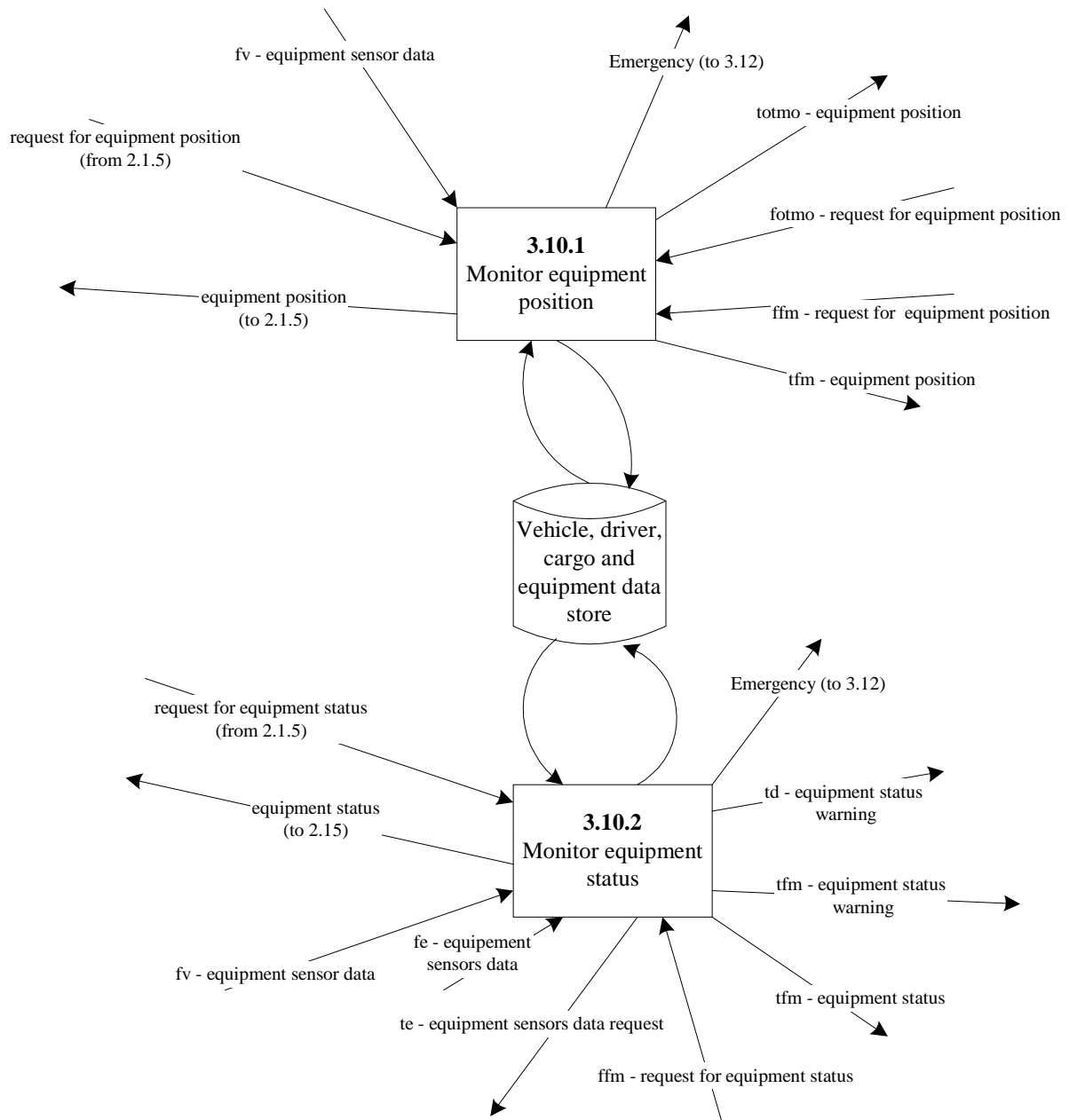
**Figure : 15. Decomposition of 3.6 support payment operations**



**Figure : 16. Decomposition of 3.7 monitor vehicle**



**Figure : 17. Decomposition of 3.8 monitor driver**



**Figure : 18. Decomposition of 3.10 Monitor equipment**

### **3.3 DESCRIPTIONS OF TERMINATORS**

A terminator is an external entity to COMETA System(s) Architecture, with which this system(s) Architecture will have to exchange information and that will trigger the performance of functions, or will be asked to as the result of the performance of one given function.

These terminators have been selected from KAREN list, except a new one the “equipment” as defined here. Besides, COMETA came to the conclusion that “infrastructures” (that is to say, road or highway as such, with a given profile and characteristics) could be seen too as a terminator providing “de facto” information for driving assistance.

#### Authorities (a)

Authorities are public bodies, high level ministries and local authorities involved with or related to the transport process, often in a law enforcement role. Examples are:

- Police,
- Customs agency,
- Social regulations authority.

#### Driver (d)

The driver is the person that drives the truck and operates the on board freight and fleet management system. Messages are received from and sent to a driver through peripheral equipment such as:

- Display,
- Printer,
- Keyboard,
- barcode scanner and,
- other peripheral equipment.

#### Equipment (e):

This term has been imported from the EDI/EDIFACT area where, in transport messages, it means “a transport unit unable to move by itself” but possibly autonomous : trailer, semi-trailer, swap body, pallet...

#### Fleet manager (fm)

The fleet manager is the main interlocutor for drivers who are working as a part of a transport fleet. The fleet manager is responsible for generating sufficient transport orders and ensuring optimal use of fleet resources when executing these orders. To do so, he will communicate in various ways with all relevant parties including drivers.

#### Other vehicles (ov)

Other vehicles are vehicles that are travelling within a relevant range (in the same area or on the same stretch of road) of the vehicle concerned by the COMETA architecture either

because they are likely to physically cross or because they are an interesting source or target of information exchange for instance supporting cooperative driving.

#### Other transport mode operator (otmo)

Operators of other transport modes are responsible for performing freight transports on modes different from roads. Examples are rail, inland waterways and sea transport.

#### Principal, consignor, consignee, forwarder (pccf)

Principal, consignor, consignee and forwarder have been grouped into a single terminator within COMETA as all are possible interlocutors for independent (or chartered) drivers. Precise definitions are as follows:

- principal: an individual or organisation that requests a transport order to be performed (by a contractor) against a relevant form of remuneration, when relevant stipulated in a contract (it is a generic term for the entity that orders a transport; examples are the consignor, consignee, freight forwarder or any third party),
- consignor or shipper: an individual or organisation that prepares a bill of lading by which a carrier is directed to transport goods from one location to another (based on ELA),
- consignee: the party such as mentioned in the transport document by whom the goods, cargo or containers are to be received and accepted (based on ELA),
- forwarder: the party arranging the carriage of goods including connected services and/or associated formalities on behalf of a shipper or consignee (ELA); the forwarder is often contracted by the principal, the consignor or the consignee, depending on which terms of contract apply in the business relation between them.

#### Road operator (ro)

Road operators are responsible for the provision of safe roads on which vehicles can travel efficiently. Increasingly, road operators are levying tolls for the use of their infrastructure either to recover road construction and maintenance costs (for instance in build, operate and transfer or BOT arrangements) or to better manage demand (also known as road pricing).

#### Service provider (sp)

Nowadays there are a number of service providers offering different kinds of services and this number will increase in the near future. Examples are:

- traffic information service providers (using e.g. RDS/TMC or DAB as a communication medium),
- freight information service providers (using e.g. the WWW as a communication medium),
- automatic billing service providers.

### Vehicle (v)

The vehicle terminator is foremost a collection of relevant sensors. These sensors are used to capture measurements for:

- temperature,
- pressure,
- speed,
- tiredness,
- anti-theft,
- etc.

## **3.4 DESCRIPTIONS OF HIGH LEVEL FUNCTIONS**

COMETA covers two main scenarios : one for what can be called Independent Driver (« one man company”) or Chartered Drivers, that may belong to small companies, but even to bigger ones when these companies are chartered by another one, which plays then a freight forwarder role; one for what will be called “Fleet Drivers” receiving their orders from their fleet manager and reporting to them, even if they can be allowed to have contact with other parties during given circumstances.

As it has been indicated under the title “Functional Hierarchy”, Independent Driver or Chartered Driver scenario will rely on the three High Level Functions, where the Fleet Driver’s will rely on Functions 2 and 3.

On Function 2, through the accomplishment of a “dialogue” between this Driver and his Fleet Manager, according to the degree of sophistication of the on board system and its data capture and memorisation abilities (refer to COMETA Physical Architecture) and according to the degree of decision autonomy left to that Driver.

### **1 Manage business transactions**

#### Overview

This is a high level function that groups the low level functions “Negotiate transport orders” and “Administrate business transactions”. The most important functional elements are:

- to acquire transport orders by preparing transport offers in response to transport opportunities or by indicating the availability of excess capacity,
- to provide the client with status information as agreed in the transport order or in response to a specific request,
- to handle all administrative aspects of the order vis a vis the client in the form of invoices and payment.

#### Component functions

1.1 Negotiate transport orders

1.2 Administrate business transactions

### Covered user needs

46, 47, 48, 60, 61, 76,

## **2 Prepare vehicle, driver, equipment and cargo**

### Overview

This is a high level function that groups two high level functions “prepare resources” and “Prepare trips, routes and load plans”. The function will essentially prepare resources by checking the availability and status of the vehicle, driver, equipment, cargo, the client profile and, in case of intermodal transport, if the expected to be used other transport mode is on Schedule.

Upon reception of the transport order, for the Independent or Chartered Driver, the function will also be triggered to transform the order into specific tasks, including the detailed trip(s) to be made for executing the order as well as the route and the load plan to be followed. The Fleet Driver will receive Mission and Tasks orders to be performed as such, or related to a Transport Order. The function will then also reserve the resources that are required for executing the transport order.

Beyond its role for an Independent or Chartered Driver, this high level function represents the dialogue between the driver and the fleet manager which consolidates information related to drivers, vehicles, cargoes and equipment to perform the management of these units, within a global FLEET management.

For that, he relies more or less, according to a given situation or configuration of drivers / cargoes / equipment / state of the vehicles etc. ...and according to the degree of sophistication of the on board systems mentioned here above, on information automatically captured by the on board systems or provided by the driver. Besides, a driver is asked to perform more or less detailed checks and allowed more or less autonomy by this fleet manager, so as to decide upon the execution of the order, for instance, where he will have rest times, lunches, which route he will choose, etc. ...

In this preparation phase, the content of the “Tasks order” asked and received by the Driver and the ability of the on board software to process its content are of prior importance.

This function is triggered by a tasks order received by (or simply the requirement of a new one) by the on board computer, containing operational information for the driver and possibly a related transport order containing commercial information needed for checks and control with consignor / consignee / authorities.

According to an identified trend, these information (more specifically the transport order) could be sent directly in the future to an “intelligent” equipment (trailer, swap body or even container...) that a given couple driver / tractor have been or will be required to fetch. Communication between both units being performed through wired links, DSRC or even wider network.

As a consequence, functions “ prepare resources”, “Prepare trips routes and load plans” and flows between them are performed in fact in parallel with dependencies from each other.

## Component functions

2.1 Prepare resources

2.2 Prepare trips, routes and load plans

## Covered user needs

4, 5, 6, 7, 8, 9, 10, 11,12, 12, 14, 15, 16, 19, 22, 23, 26, 31, 36, 37, 38, 39, 40, 44, 49, 50, 51, 62, 70, 92, 95

## **2.1 Prepare resources**

### Overview

This is a high level function that groups the low level functions “Prepare documents”, “Prepare vehicle”, “Prepare driver”, “Prepare equipment”, “Prepare cargo space availability”, “Prepare accessories“ and “Prepare other transport mode”.

This function groups all necessary functionality to ensure a independent (or chartered) driver by himself, or the Fleet Driver through dialogue with his Fleet manager that, his vehicle, driver, equipment, cargo and accessories and other transport mode, are ready to help perform a task or a transport order. The most important elements are that:

- the necessary statutory, commercial and operational documents are available on board the vehicle,
- the vehicle’s maintenance situation and the driver’s driving time records as well as the cargo, equipment and accessories availability and status allow to perform the task,
- liaison with any other transport mode needed to perform the task.

The functions include early reservations for resources to avoid that conflicting tasks or transport orders are unconsciously accepted at a later stage.

## Component functions

2.1.1 Prepare documents

2.1.2 Prepare vehicle

2.1.3 Prepare driver

2.1.4 Prepare cargo space

2.1.5 Prepare equipment

2.1.6 Prepare accessories

2.1.7 Prepare other transport mode

## Covered user needs

4, 5, 6, 7, 8, 24, 31, 37, 38, 39, 40, 44, 49, 50, 51, 62, 92, 95,

## **2.2 Prepare trips, routes and load plan.**

### Overview

This is a high level function that groups the lower level functions “Ask for a new task order”, “Process and read a new task order”, “Check client profile and constraints”, “Prepare trips/routes”, “Prepare load plan”. It covers all necessary functionality so as :

- to ensure that the driver will get or has got appropriate information to start his tasks,
- to ensure that, in conjunction with the checking of resources, he will take appropriate decisions and be able to achieve them in the most efficient conditions,
- to ensure that, in the case the tasks and related transport order means a multiple pick up and / or delivery, it allows the driver to plan pick ups and deliveries accordingly.

### Component functions

2.2.1 Ask for a new task order

2.2.2 Process and read a new task order

2.2.3 Check client profile and constraints

2.2.4 Prepare trip/routes

2.2.5 Prepare load plan

### Covered user needs

7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 19, 22, 23, 26, 31, 36, 49, 70

## **3. Perform and control vehicle, driver, cargo and equipment operations**

### Overview

This is a high level function that groups the high and low level level functions “Manage tasks and transport orders”, “Comply with regulations”, “Provide advanced driver assistance”, “Provide access to comfort services”, “Manage traffic and route guidance information”, “Support payment operations”, “Monitor vehicle”, “Monitor driver”, “Monitor cargo status”, “Monitor equipment”, “Monitor progress of tasks”, “Manage emergency”. The most important elements helping to perform operations are:

- support to check whether loaded or unloaded cargo and / or equipment (trailer / swap body, container...) corresponds to the transport order and possibly create a new Transport Unit,
- support to comply with regulations, the provision of driver assistance functions and access to comfort services and support for payment operations.

The most important elements helping to monitor operations triggered by the start of vehicle and switched off at the end of vehicle / driver / equipment association, this including driver shift or equipment shift for a given vehicle, are:

- the monitoring and positioning of any relevant vehicle, driver, cargo and equipment parameters including storage of relevant parameter values for future use,
- the function will warn the driver if the value of any monitored parameter exceeds a threshold and it will also support the driver by informing the fleet manager or any other relevant party if the same or other thresholds are exceeded or it can be triggered by a request from the Fleet Manager,

- support for monitoring the progress of transport orders and other accepted tasks.

### Component functions

- 3.1 Manage tasks and transport order
- 3.2 Comply with regulations
- 3.3 Provide advanced driver assistance
- 3.4 Provide access to comfort services
- 3.5 Manage traffic and route guidance information
- 3.6 Support payment operations
- 3.7 Monitor vehicle
- 3.8 Monitor driver
- 3.9 Monitor cargo status
- 3.10 Monitor equipment
- 3.11 Monitor progress of tasks
- 3.12 Manage emergency

### Covered user needs

1, 2, 4, 5, 6, 7, 8, 9, 10, 12, 14, 15, 16, 17, 18, 20, 21, 24, 25, 26, 27, 28, 29, 30, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 50, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 68, 69, 71, 72, 73, 74, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 91, 93, 94, 95, 101, 102, 103, 104, 105, 106, 107, 108, 109, 110, 112, 113, 114, 115, 116, 117, 119,

## **3.1 Manage Tasks and Transport Order**

### Overview

This is a high level function that groups the low level functions “Manage Tasks and Transport Order contents and modifications”, “Check whether cargo and or Equipment conforms to transport order”, “create a new transport unit”.

The function gives rules to the driver so as to execute the allocated task or tasks described in the Tasks Order, after the preparation phase and to report and react accordingly, particularly in case of modifications felt as necessary or decided by the Fleet manager. In the case where the Tasks order is associated to the execution of a starting part or a complete transport order, these reaction may be to warn about discrepancy, or, if permitted, to accept an additional transport unit after its identification.

### Component functions

- 3.1.1 Manage Tasks and transport order contents and modifications
- 3.1.2 Check whether cargo and or Equipment conforms to transport order
- 3.1.3 Create a new transport unit

### Covered user needs

26, 27, 33, 36, 42, 44, 50, 52, 81, 83, 91,

### **3.2 Comply with regulations**

#### Overview

This is a high level function that groups the low level functions “Comply with social regulations”, “Comply with other regulations”. These functions typically allow the authorities to check the compliance of the driver with the European Union’s social regulations as well as the availability on board of statutory documents required for executing the transport order, as well as compliance with road regulations (e.g. speed limits, forbidden lanes / roads to heavy vehicles, weight limits - “Weigh in Motion” – etc. ...)

#### Component functions

3.2.1 Comply with social regulations

3.2.2 Comply with other regulations

#### Covered user needs

12, 37, 38, 39, 40, 41, 43, 45, 56, 62, 73, 84, 102

### **3.3 Provide advanced driver assistance**

#### Overview

This is a high level function that groups the following low level functions: “Provide vision support”, “Provide longitudinal control”, “Provide lateral control”, “Provide automated driving support” and other “Miscellaneous telematics functions”. The main functionality is:

- the monitoring of visibility conditions for the driver (darkness and glaring)
- longitudinal dynamic control such as for supporting parking, intelligent speed adaptation, adaptive cruise control, stop & go and anti-collision emergency braking, speed enforcement and vehicle platooning,
- lateral dynamic control such as for supporting parking, lane and road keeping, lane change, reserved lanes I/O, overtaking and stop & go,
- automated driving,
- miscellaneous functions such as the provision of road regulations, the provision of floating car data, support for tracking stolen vehicles and the detection of law violations.

#### Component functions

3.3.1 Provide vision support

3.3.2 Provide longitudinal control

3.3.3 Provide lateral control

3.3.4 Provide automated driving support

3.3.5 Miscellaneous telematics functions

### Covered user needs

25, 57, 64, 65, 105, 106, 109, 114, 115

## **3.6 Support payment operations**

### Overview

This is a high level function that groups the low level functions “Perform EFC transactions” and “Support billing services”. The function provides support for road based or area based tolling as well as for any service that requires payment support.

### Component functions

3.6.1 Perform EFC transactions

3.6.2 Support billing services

### Covered user needs

62, 66, 73, 85, 86

## **3.7 Monitor vehicle**

### Overview

This is a high level function that groups the low level functions “Monitor vehicle position” and “Monitor vehicle status”. The first function supports a wide range of other functions that request the current vehicle position from it, whilst the second function essentially collects and stores engine and maintenance related data.

### Component functions

3.7.1 Monitor vehicle position

3.7.2 Monitor vehicle status

### Covered user needs

4, 7, 8, 10, 17, 21, 24, 53, 54, 58, 62, 62, 82, 84, 89, 93, 94, 95, 102, 103, 106, 117

### **3.8 Monitor driver**

#### Overview

This is a high level function that groups the low level functions “Monitor social regulations status”, “Monitor physical status”, “Monitor driver expenses” and “Monitor driving behaviour”. The first function receives the social regulations data collected by function 3.2.1 “Comply with social regulations” and supports warnings to the driver as well as (if relevant) to the fleet manager. The second function monitors the physical status of the driver such as driver fatigue. The third function monitors and stores all expenses made by the driver either collected through 3.6.1 or other means (automatic payments for refuelling, washing, having lunches or hôtel accommodations, etc. ...). The fourth function supports the permanent recording of relevant driving parameters associated to a given driver, to allow for future analysis by the fleet manager and driver, then advising or training to safe and economical driving.

#### Component functions

3.8.1 Monitor social regulations status

3.8.2 Monitor physical status

3.8.3 Monitor driver expenses

3.8.4 Monitor driving behaviour

#### Covered user needs

1, 2, 4, 5, 6, 21, 24, 63, 82, 93, 94, 95, 104, 108, 110

### **3.10 Monitor equipment**

#### Overview

This is a high level function that groups the low level functions “Monitor equipment position” and “Monitor equipment status”. The first function supports requests from other functions to provide the current position of the equipment. The second function responds to requests from other functions on the current status of the equipment, for instance on its availability and status (driven kilometres, registered temperatures, maintenance record, etc.).

#### Component functions

3.10.1 Monitor equipment position

3.10.2 Monitor equipment status

#### Covered user needs

7, 8, 24, 53, 54, 55, 62, 63, 68, 82, 84, 87, 88, 89, 93, 94, 95, 106

### **3.11 Monitor progress of tasks**

#### Overview

This high level function helps to ensure that the driver will comply with tasks instructions and possibly related transport order execution, including the necessary feedback and reporting. Tasks are, of course, such actions as start loading, start trip, but, too, have vehicle washed or examined, take another vehicle, manage equipment, from trailer shift to exchange of reusable pallets, etc. ...The function will maintain a queue of on going and foreseen tasks and support the driver by providing early warnings for requested feedback.

The driver will be required to send report or will report, but he will, too, be proactive, for instance advice his arrival to another transport mode operator, indicate route modification, be involved in gate in / gate out procedures.

#### Component functions

3.11.1 Monitor and report on operational tasks

3.11.2 Monitor and prove Transport order execution

#### Covered user needs

6, 7, 9, 10, 15, 16, 20, 24, 28; 29, 30, 32; 33, 34, 35, 36, 38, 39, 42, 43, 44, 45, 58, 59, 60, 61, 62, 77, 78, 80, 81, 82, 87, 88, 89

## **3.5 DESCRIPTIONS OF LOW LEVEL FUNCTIONS**

### **1.1 Negotiate transport orders**

#### Overview

This function is responsible for the commercial interface between an independent (or chartered) driver and a (potentially) contracting party (consignor, consignee, principal or forwarder). The function also looks over the order book and sends - when needed - transport capacity availability advices or transport opportunity requests to potential customers. As such it basically handles transport orders. The function delegates the necessary preparation of resources (checking of availability and early reservations) such as documents, vehicle, driver, equipment, cargo, accessories and other transport modes to functions 2.1.1-2.1.7. It will also rely on these functions to book the resources when a transport order has finally been received. Once the commercial negotiation is finalised, the function hands over further activity to the functions in charge of performing and controlling the vehicle, driver, cargo and equipment operations. The closure of the order from an administrative point of view plus invoicing and payments are also handled by a separate function.

Input data flows (trigger data flows are in italics)

read vehicle, driver, cargo and equipment data store

*fd – input data*

*fd – statutory document*

*fpccf – transport opportunity*

*fpccf – transport order*

*fpccf – statutory document*

*fpccf – request for transport order status*

*resource availability*

*task status*

Output data flows (trigger data flows are in italics)

load vehicle, driver, cargo and equipment data store

*request for administrative closure*

*td – output data*

*tpccf – capacity availability*

*tpccf – transport offer*

*tpccf – transport order confirmation*

*tpccf – transport order status*

*tpccf – request for transport opportunity*

*pccf – transport order*

*request for trip, route and load plan preparation*

*request for resource availability*

*request for task status*

*resource booking*

Functional requirements

- (a) keep watching over the completeness of the order book
- (b) if there is a low level occupancy rate, start corrective actions: send transport capacity availability advices as well as requests for transport opportunities to potential customers
- (c) receive a transport opportunity from a potential customer
- (d) request for a check of compliance of the need with the current status of resources
- (e) send a transport offer to the potential customer
- (f) receive a transport order from a potential customer
- (g) send a confirmation of the order to the customer
- (h) save all relevant information in the vehicle, driver, cargo and equipment data store
- (i) receive transport order status requests, process them and send requested operational information to customers
- (j) request administrative closure of contract when transport order has been delivered

Covered user needs

46, 60, 61, 76

## **1.2 Administrate business transactions**

### Overview

This function is responsible for the administrative operations of an independent (or chartered) driver. As such it prepares and sends invoices to customers and waits for payment.

### Input data flows (trigger data flows are in italics)

read vehicle, driver, cargo and equipment data store

*fd – input data*

*fpccf – payment*

*request for administrative closure*

*electronic signature*

### Output data flows (trigger data flows are in italics)

load vehicle, driver, cargo and equipment data store

*td – output data*

*tpccf – transport invoice*

*tpccf – payment information*

*request for electronic signature*

### Functional requirements

- (a) wait for administrative closure request
- (b) prepare and send invoice to the customer and wait for payment
- (c) save all operational information in the vehicle, driver, cargo and equipment data store

### Covered user needs

47, 48, 60, 61

## **2.1.1 Prepare documents**

### Overview

This function helps to ensure that all documents<sup>3</sup> needed by the driver to complete a task (related to a transport order or any other accepted task) are available on board the vehicle. The function is either triggered by incoming tasks instructions or a request or it can be accessed directly by the driver. To support the function, tasks (including transport orders) are associated with a list of required documents that can either be textual descriptions of these documents if these are only available in paper format or references to the documents if these are available in electronic format. Both options are supported as virtually all documents are

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<sup>3</sup> Note that the term “documents” groups all items that are currently still provided to the driver in paper format, e.g. : statutory documents, commercial documents or operational documents. These terms are fully described in 2.1.

still available in paper format only and migration to a paperless environment will take several years. The function will also inform the driver of any missing documents which may result in the rejection of a task.

#### Input data flows (trigger data flows are in italics)

read vehicle, driver, cargo and equipment data store  
*fd – input data*  
*request for resource availability*  
*resource booking*

#### Output data flows (trigger data flows are in italics)

Load vehicle, driver, cargo and equipment data store  
*td – output data*  
*resource availability*

#### Functional requirements

- (a) wait until a request for availability or a direct request from the driver arrives for a specific task
- (b) check what documents are necessary for the task
- (c) report whether these documents are available.

#### Covered user needs

37, 38, 39, 40, 44

### **2.1.2 Prepare vehicle**

#### Overview

This function helps to ensure that the vehicle is ready for the driver to complete a task (related to a transport order or to any other accepted task). The function is either triggered by a request or it can be accessed directly by the driver. To support the function, tasks (including transport orders) are associated with an implied mileage that will allow to check whether it is possible to complete the task before maintenance is due. The function will also inform the driver if this is the case, possibly subject to trespassing a maintenance threshold, which may result in the rejection of a task. A second type of support to the driver is to check whether the requested maintenance has been completed. Maintenance requests are either created when certain sensor thresholds are exceeded or entered manually by the driver. The function also includes early reservations for vehicle resources to avoid that conflicting tasks or transport orders are unconsciously accepted at a later stage.

Input data flows (trigger data flows are in italics)

read vehicle, driver, cargo and equipment data store  
*request for resource availability*  
*vehicle status*  
*vehicle position*  
*resource booking*

Output data flows (trigger data flows are in italics)

Load vehicle, driver, cargo and equipment data store  
*td – output data*  
*resource availability*  
*request for vehicle status*  
*request for vehicle position*

Functional requirements

- (a) wait until a request for availability or a direct request from the driver arrives for a specific task
- (b) check what mileage is associated with the task
- (c) report whether this mileage can be carried out before maintenance is due.

Covered user needs

7, 8, 24, 92, 95

**2.1.3 Prepare driver**

Overview

This function helps to ensure that the driver is ready to complete a task (related to a transport order or to any other accepted task). The function is either triggered by a request or it can be accessed directly by the driver. To support the function, tasks (including transport orders) are associated with an implied driving time and arrival time that will allow to check whether the driver can complete the task. The function will also inform the driver if this is not the case, which may result in the rejection of a task. The function also includes early reservations for driver resources to avoid that conflicting tasks or transport orders are unconsciously accepted at a later stage.

Input data flows (trigger data flows are in italics)

read vehicle, driver, cargo and equipment data store  
*request for resource availability*  
*resource booking*  
social regulations data

Output data flows (trigger data flows are in italics)

load vehicle, driver, cargo and equipment data store  
*td – output data*  
*resource availability*

Functional requirements

- (a) wait until a request for availability or a direct request from the driver arrives for a specific task
- (b) check what driving times are necessary for the task
- (c) report whether these driving times can be performed with respect to EU social regulations.

Covered user needs

4, 5, 6, 24

**2.1.4 Prepare cargo space**

Overview

This function helps to ensure that the necessary cargo space for completing a task (related to a transport order or any other accepted task) is available. The function is either triggered by a request or it can be accessed directly by the driver. To support the function, tasks (including transport orders) are associated with a description of the required volume and weight and this data will be compared with the load plan. The function will also inform the driver of any missing or faulty equipment which may result in the rejection of a task. The function also includes early reservations for cargo space resources to avoid that conflicting tasks or transport orders are unconsciously accepted at a later stage.

Input data flows (trigger data flows are in italics)

read vehicle, driver, cargo and equipment data store  
*fd – input data*  
*request for resource availability*  
*resource booking*

Output data flows (trigger data flows are in italics)

load vehicle, driver, cargo and equipment data store  
*td – output data*  
*resource availability*

Functional requirements

- (a) wait until a request for availability or a direct request from the driver arrives for a specific task
- (b) check what capacity is necessary for the task
- (c) report whether this capacity is available.

### Covered user needs

24, 49, 50, 51

### **2.1.5 Prepare equipment**

#### Overview

This function helps to ensure that the necessary equipment (for instance a trailer, swap body or container) for completing a task (related to a transport order or any other accepted task) is available, the required one, and ready. The function is either triggered by a request or it can be accessed directly by the driver. To support the function, tasks (including transport orders) are associated with a list (including the identification) of required equipment that can either be coded or textual descriptions of the equipment if no sensors are available, to detect its presence and status or references to the equipment if sensors are available. Both options should be supported as it is likely that not all equipment will be connected to sensors. The function will also inform the driver of any missing or faulty equipment which may result in the rejection of a task. The function also includes early reservations for equipment resources to avoid that conflicting tasks or transport orders are unconsciously accepted at a later stage.

#### Input data flows (trigger data flows are in italics)

read vehicle, driver, cargo and equipment data store

*fd – input data*

*request for resource availability*

*equipment position*

*equipment status*

*resource booking*

#### Output data flows (trigger data flows are in italics)

load vehicle, driver, cargo and equipment data store

*td – output data*

*resource availability*

*request for equipment position*

*request for equipment status*

#### Functional requirements

- (a) wait until a request for availability or a direct request from the driver arrives for a specific task
- (b) check the required equipment for the task
- (c) report whether this equipment is available, the required one and ready.

### Covered user needs

24, 92

### **2.1.6 Prepare accessories**

#### Overview

This function helps to ensure that the necessary accessories for completing a task (related to a transport order or any other accepted task) is available. The function is either triggered by a request or it can be accessed directly by the driver. To support the function, tasks (including transport orders) are associated with a description of the required accessories. The function will also inform the driver of any missing accessories which may result in the rejection of a task. The function also includes early reservations for accessories to avoid that conflicting tasks or transport orders are unconsciously accepted at a later stage.

#### Input data flows (trigger data flows are in italics)

read vehicle, driver, cargo and equipment data store  
*fd – input data*  
*request for resource availability*  
*resource booking*

#### Output data flows (trigger data flows are in italics)

load vehicle, driver, cargo and equipment data store  
*td – output data*  
*resource availability*

#### Functional requirements

- (a) wait until a request for availability or a direct request from the driver arrives for a specific task
- (b) check what accessories are necessary for the task
- (c) report whether these accessories are available.

#### Covered user needs

31, 49, 92

### **2.1.7 Prepare other transport mode**

#### Overview

This function helps to ensure that the other transport mode required for completing a task (related to a transport order or any other accepted task) will be available on time. The function is either triggered by incoming task instructions or a request or it can be accessed directly by the driver. To support the function, tasks (including transport orders) are associated with a description of the required transport mode. The function will also inform the driver of any problem (delay, breakdown, cancellation, ...) which may result in the rejection of a task.

Input data flows (trigger data flows are in italics)

read vehicle, driver, cargo and equipment data store

*fd – input data*

*request for resource availability*

*resource booking*

fotmo – resource availability

Output data flows (trigger data flows are in italics)

load vehicle, driver, cargo and equipment data store

*td – output data*

*resource availability*

*totmo – request for resource availability*

*totmo – resource booking*

Functional requirements

- (a) wait until a request for availability or a direct request from the driver arrives for a specific task
- (b) check which other transport mode is required for the task
- (c) report whether this transport mode is available and report any problem.

Covered user needs

31, 62

**2.2.1 Ask for a new Task order**

Overview

This function allows the driver to ask for a new Task order if no one has been sent to him.

Input data flows (trigger data flows are in italics)

*fd – input data*

read vehicle, driver, cargo and equipment data store

Output data flows (trigger data flows are in italics)

Request for Task order

Functional requirements

Ask and wait for a new task and task order.

Covered user needs

26, 36,

### **2.2.2 Process and read a new task order**

#### Overview

This function allows the on board application to process the new Task order, the driver to read it and to trigger both types of acknowledgements.

#### Input data flows (trigger data flows are in italics)

Task order

*fd – input data*

load vehicle, driver, cargo and equipment data store

#### Output data flows (trigger data flows are in italics)

Task order acknowledgement

Check availability of resources

*td – output data*

read vehicle, driver, cargo and equipment data store

#### Functional requirements

Process new tasks order, read it, acknowledge it, ask for additional information if necessary and, if ok, initiate other functional requirements.

#### Covered user needs

26, 31, 36, 70

### **2.2.3 Check client profile and constraints**

#### Overview

This function allows the driver to check in the on board data base (and, if necessary, to update it later) or from the incoming information, any Consignor or Consignee specificity that may impact the tasks performance (time slots, scheduling, physical presentation of the vehicle for loading / unloading).

#### Input data flows (trigger data flows are in italics)

*mission and tasks order and possibly associated transport order*

*answer on client profile and constraints*

*fd – input data*

load vehicle, driver, cargo and equipment data store

Output data flows (trigger data flows are in italics)

*request for client profile and constraints*

*td – output data*

read vehicle, driver, cargo and equipment data store

Functional requirement

Check and consider any Client specificity as parameters for trip preparation and tasks performance.

Covered user needs

9, 19, 23, 31

**2.2.4 Prepare trip / routes**

Overview

This function obtains route information and information on environmental conditions, such as traffic, weather, pollution, clients profile and constraints, etc. from a supporting function.

The function shall obtain the information through communication with the route information providing function.

Input data flows (trigger data flows are in italics)

*answer on traffic situation*

*answer on weather situation*

*answer on pollution situation*

*route*

*fd – input data*

read vehicle, driver, cargo and equipment data store

Output data flows (trigger data flows are in italics)

*request on pollution situation*

*request on traffic situation*

*request on weather situation*

*route optimisation request*

load vehicle, driver, cargo and equipment data store

Functional requirements

(a) elaborate the route request providing relevant freight and hazardous goods information and including requests on pollution, traffic and weather information, clients profiles and constraints

(b) determine the trip, route

(c) store all relevant data in the vehicle, driver, cargo and equipment data store

### Covered user needs

7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 19, 26

### **2.2.5 Prepare load plan**

#### Overview

This function prepares the load plan for a confirmed task or transport order by the driver himself or through a dialogue with his interlocutor (Fleet Manager or Principal for an Independent or Chartered Driver), according to trips scheduling or cargo characteristics.

#### Input data flows (trigger data flows are in italics)

*mission and tasks order and possibly associated transport order  
answer on client profile and constraints*

*fd – input data*

load vehicle, driver, cargo and equipment data store

#### Output data flows (trigger data flows are in italics)

*td – output data*

read vehicle, driver, cargo and equipment data store

#### Functional requirement

Check and consider any Cargo specificity as parameters for trip preparation and tasks performance.

### Covered user needs

22, 49

### **3.1.1 Manage Tasks and Transport Order contents and modification**

#### Overview

This function supports the starting of the execution phase of a given Task and possibly related transport order, after achievement of all necessary operations during the preparation phase. It indicates, programs and triggers the types of monitoring of tasks progress required from the on board application and / or the driver.

It supports too, any modification required or felt necessary, during an on going Mission or task.

#### Input data flows (trigger data flows are in italics)

Mission and tasks order and possibly related transport order modification

*fd – input data*

load vehicle, driver, cargo and equipment data store

Output data flows (trigger data flows are in italics)

*td – output data*

Start monitoring progress of task  
read vehicle, driver, cargo and equipment data store

Functional requirements

Start execution of Mission and tasks order and possibly related transport order, fulfil starting of tasks requirements.

Covered user needs

26, 27, 36

**3.1.2 Check whether cargo and or equipment conforms to transport order**

Overview

This function helps to ensure that the loaded goods or hooked equipment (trailer / swap body / container...) to be handled at a given place, correspond to the goods / equipment that are described in the corresponding transport order. The function is triggered by the driver at the start of loading (hooking) operation. The function will ensure that there is a match between the unique identifiers that are marked on the loaded (but see 3.1.3) goods or hooked equipment, other features, such as weight, nature of goods (compatibility between them or with already loaded other goods etc. ...) and those that are stored in the corresponding driver instructions. If this is not the case, this will be stored in the vehicle, driver, cargo and equipment data store so as to feed an appropriate report, asking possibly for new instructions.

Input data flows (trigger data flows are in italics)

*fd – input data*

*fv – cargo sensor data*

*fe \_ equipment sensor data*

read vehicle, driver, cargo and equipment data store

Output data flows (trigger data flows are in italics)

load vehicle, driver, cargo and equipment data store

*td – output data*

Functional requirements

wait for function initialisation by the driver  
verify whether goods / equipment corresponds to transport order  
report any discrepancies

### Covered user needs

33, 44, 50, 52, 81, 83, 91

### **3.1.3 Create a new transport unit**

#### Overview

This function allows a driver to accept a proposed new transport load unit (logistic unit), either in addition to those listed in the order or for a back haul from a consignee, when the transport contract is said “open” and on time basis. If the consignor/shipper is not supposed or able to do so, the driver will allocate an identifier to the unit or ask for one to its fleet manager, create a barcoded label and a transport order or modify the existing one through exchanges with his fleet manager or forwarder or principal.

#### Input data flows (trigger data flows are in italics)

*fd – input data*

*fv – cargo sensor data*

read vehicle, driver, cargo and equipment data store

#### Output data flows (trigger data flows are in italics)

*td – output data*

*tv – cargo sensor data*

monitor transport order execution

load vehicle, driver, cargo and equipment data store

#### Functional requirements

wait for function initialisation by the driver

verify whether goods corresponds to transport order

allocate a new ID through bar coding if possible and relevant

advise Fleet manager or principal through a task progress report

### Covered user needs

33, 42, 91

### **3.2.1 Comply with social regulations**

#### Overview

This function supports the verification by authorities and by the Fleet Manager, that the driver complies with EU social regulations. The function is triggered by the start of any driver or vehicle activity or by the request of an authority / Fleet Manager to verify compliance with the social regulations. As such, the function will record all relevant data as requested by the EU social regulations and support the authorities to verify compliance of the recorded data with the social regulations.

Input data flows (trigger data flows are in italics)

read vehicle, driver, cargo and equipment data store

*fd – input data*

*fa – request for driver status*

*ffm – request for driver status*

*fv – vehicle sensor data*

Output data flows (trigger data flows are in italics)

load vehicle, driver, cargo and equipment data store

*td – output data*

ta - driver status

tfm – driver status

social regulations data

Functional requirements

(a) wait for start of vehicle, driver activity to record relevant driver status data

(b) respond to requests from authorities or fleet manager.

Covered user needs

12, 62, 73, 102

**3.2.2 Comply with other regulations**

Overview

This function helps to ensure that the driver complies with any other regulations. The function is triggered by the request of an authority and by the fleet manager to verify compliance with any relevant regulations. It will allow authorities and fleet manager to verify if the necessary statutory documents are on board the vehicle and that any other prevailing regulation, such as on speed and weight limits, has not been infringed.

Input data flows (trigger data flows are in italics)

read vehicle, driver, cargo and equipment data store

*fd – input data*

*fa/ffm – request for statutory document*

*fa/ffm – request for weight*

*fa/ffm – request for speed*

*fa – fraud notation*

Output data flows (trigger data flows are in italics)

*td – output data*

ta/ffm– statutory document

ta/ffm – weighth

ta/ffm – speed

load vehicle, driver, cargo and equipment data store.

Functional requirements

(a) respond to requests from authorities or fleet manager.

Covered user needs

12, 37, 38, 39, 40, 41, 43, 45, 56, 62, 73, 84, 102

**3.3.1 Provide vision support**

Overview

This function is responsible for monitoring visibility conditions for the driver (darkness and glaring) as well as for providing the necessary support to help overcome visibility problems. This may involve the provision of warnings and enhanced vision images to the driver as well as the activation of increased lighting or of anti-glaring facilities.

Input data flows (trigger data flows are in italics)

*fv – vehicle sensor data*

*fov – synchronise anti glaring facilities*

*road geometry information*

Output data flows (trigger data flows are in italics)

*tov – synchronise anti glaring facilities*

*tov – visibility warning*

td – area vision

*td – visibility warning*

*tv – adjust lighting*

*lateral control*

*longitudinal control*

Functional requirements

- (a) constantly monitor the visibility of the driver with respect to darkness and glaring
- (b) warn the driver of any reductions in visibility as well as other involved vehicles in the case of glaring and activate corrective measures if visibility values fall below given thresholds. These include the increased lighting and the activation of anti-glaring facilities.

#### Covered user needs

105

### **3.3.2 Provide longitudinal control**

#### Overview

This function collects longitudinal control data from the vehicle to provide longitudinal dynamic control of the vehicle supporting parking, intelligent speed adaptation, adaptive cruise control, stop & go and anti-collision emergency braking, speed enforcement and vehicle platooning.

#### Input data flows (trigger data flows are in italics)

*fv - longitudinal control data*  
*fv – object*  
*fv – lane data*  
*fv – friction data*  
*fv – safety margin*  
*fro – road sign*  
*tov – vehicle platooning data*  
*longitudinal control data*

#### Output data flows (trigger data flows are in italics)

*longitudinal control data*  
*tov – vehicle platooning data*

#### Functional requirements

- (a) constantly collect and monitor longitudinal control data
- (b) support parking, intelligent speed adaptation, adaptive cruise control, stop & go and anti-collision emergency braking, speed enforcement and vehicle platooning initiating if necessary corrective longitudinal control commands

#### Covered user needs

105

### **3.3.3 Provide lateral control**

#### Overview

This function collects lateral control data from the vehicle to provide lateral dynamic control of the vehicle supporting parking, lane and road keeping, lane change, reserved lanes I/O, overtaking and stop & go.

Input data flows (trigger data flows are in italics)

*fv – object*  
*fv – lane data*  
*fv – friction data*  
*fv – safety margin*  
*fro – lane following support*  
*lateral control data*

Output data flows (trigger data flows are in italics)

*lateral control data*

Functional requirements

- (a) constantly collect and monitor lateral control data
- (b) support parking, lane and road keeping, lane change, reserved lanes I/O, overtaking and stop & go initiating if necessary corrective lateral control commands.

Covered user needs

105

**3.3.4. Provide automated driving support**

Overview

This function is responsible for providing automated driving through longitudinal control by manipulating the accelerator and brakes of the vehicle as well as through lateral control by manipulating the steering mechanism. To do so, the function employs the longitudinal and lateral control data that are generated by the corresponding functions. The function also supports interaction with the driver allowing him to release and take over control.

Input data flows (trigger data flows are in italics)

*longitudinal control data*  
*lateral control data*  
*fd – input data*

Output data flows (trigger data flows are in italics)

load vehicle, driver, cargo and equipment data store  
*tv – longitudinal control commands*  
*tv – lateral control commands*

### Functional requirements

- (a) allow the driver to seize or release control
- (b) if control is released, use longitudinal and lateral control data and initiate the necessary corrective longitudinal and lateral control commands to provide automated driving.

### Covered user needs

105

## **3.3.5. – Miscellaneous telematics functions**

### Overview

This function combines miscellaneous telematics functionality including the provision of road regulations, the provision of floating car data, support for tracking stolen vehicles and the detection of law violations.

### Input data flows (trigger data flows are in italics)

fa – road regulation  
vehicle position

### Output data flows (trigger data flows are in italics)

request for vehicle position  
tsp – floating car data  
tsp – unexpected vehicle position  
*td – road regulation*  
*ta – law violation*

### Functional requirements

- (a) receive incoming road regulations messages
- (b) inform the driver of current road regulations and warn driver of any law violations
- (c) collect floating car data and send them to the relevant service provider(s)
- (d) provide the vehicle position to a service provider following his request

### Covered user needs

25, 57, 64, 65, 106, 109, 114, 115

## **3.4 Provide access to comfort services**

### Overview

This function provides driver comfort through telephony services as well as access to on board or telematics information and entertainment services. The function is triggered by a request of the driver.

Input data flows (trigger data flows are in italics)

read vehicle, driver, cargo and equipment data store  
*fd – input data*  
*confirmation of payment*

Output data flows (trigger data flows are in italics)

load vehicle, driver, cargo and equipment data store  
*td – output data*  
*request for payment*

Functional requirements

- (a) wait for input from the driver
- (b) provide access to information and entertainment services
- (c) handle payments for paid services

Covered user needs

25, 64, 65, 66, 69, 71, 74, 79, 101, 107, 112, 113, 114, 115, 116, 117, 119

**3.5 Manage traffic and route guidance information**

Overview

This function supports the driver in providing traffic, weather and pollution information as well as in finding the shortest, quickest or cheapest route from any origin to any destination taking into account any of this information. The function is either triggered by a request from another function or directly by the driver. This function can be performed on permanent basis using a navigation on board support, or only on punctual basis through a request to an external service, or mixing both.

The driver / vehicle may be themselves a source for traffic information.

Input data flows (trigger data flows are in italics)

read vehicle, driver, cargo and equipment data store  
*fd – input data*  
*request for traffic situation*  
*request for weather situation*  
*request for pollution situation*  
*freight and hazardous goods information*  
*request for optimised route*  
*fa /fcp - traffic situation*  
*weather situation*  
*pollution situation*

Output data flows (trigger data flows are in italics)

load vehicle, driver, cargo and equipment data store

*td – output data*

*road geometry information*

*traffic situation*

*weather situation*

*pollution situation*

*route*

Functional requirements

- (a) wait for a request for traffic, weather or pollution information or for a request for an optimised route by the driver or from another function
- (b) provide traffic, weather or pollution information or an optimised route to the driver or to another function

Covered user needs

14, 15, 16, 18, 72, 79

**3.6.1 Perform EFC transactions**

Overview

This function supports the execution of an EFC transaction (such as for the use of motorways, bridges and tunnels, or to support any other fee collection system such as Ecopoints). The function is either triggered when the vehicle enters a road or when it enters an area that is subject to EFC payments.

Input data flows (trigger data flows are in italics)

read vehicle, driver, cargo and equipment data store

*fd – input data*

*fro – request for payment*

*fro – request for user ID*

*fro – payment receipt*

*fro – request fro payment receipt*

Output data flows (trigger data flows are in italics)

load vehicle, driver, cargo and equipment data store

*td – output data*

*tro – payment characteristics*

*tro – user ID*

*tro – payment receipt*

*tro - payment*

### Functional requirements

- (a) detect the need to initiate payment
- (b) provide contractual payment characteristics to the concerned service provider
- (c) receive a specific request for payment from the service provider
- (d) provide payment

### Covered user needs

62, 66, 73, 85, 86

## **3.6.2 Support billing services**

### Overview

This function supports the execution of a billing transaction. The function is triggered by a request of the service that requires payment.

### Input data flows (trigger data flows are in italics)

read vehicle, driver, cargo and equipment data store

*fd – input data*

*fsp – request for payment*

*fsp – request for user ID*

fsp – payment receipt

*fsp – request for payment receipt*

request for payment

### Output data flows (trigger data flows are in italics)

load vehicle, driver, cargo and equipment data store

*td – output data*

*tsp – payment characteristics*

*tsp – user ID*

*tsp – payment receipt*

*tsp – payment*

payment

### Functional requirements

- (e) receive a request from another function or detect the need to initiate payment
- (f) provide contractual payment characteristics to the concerned service provider
- (g) receive a specific request for payment from the service provider
- (h) provide payment
- (i) confirm, if necessary, payment to the requesting function

### Covered user needs

62, 66, 85, 86

### **3.7.1 Monitor vehicle position**

#### Overview

This function monitors and stores vehicle position data. It will receive requests for the vehicle position from other functions and reply to them.

#### Input data flows (trigger data flows are in italics)

read vehicle, driver, cargo and equipment data store  
*fv – vehicle sensor data*  
*ffm/fv/fotmo - request for vehicle position*

#### Output data flows (trigger data flows are in italics)

load vehicle, driver, cargo and equipment data store  
*emergency*  
*tv/tfm/totmo - vehicle position*

#### Functional requirements

- (a) monitor and store current vehicle position
- (b) receive requests from other functions for the vehicle position and reply

#### Covered user needs

4, 7, 8, 10, 17, 58, 103, 106

### **3.7.2 Monitor vehicle status**

#### Overview

This function monitors and stores engine and maintenance related data. It provides warnings to the driver and to the fleet manager – if relevant – and also answers to requests for the vehicle status to other functions.

#### Input data flows (trigger data flows are in italics)

read vehicle, driver, cargo and equipment data store  
*request for vehicle status*  
*fv – vehicle sensor data*  
*ffm – maintenance information and assistance*  
*ffm – request for vehicle status*

Output data flows (trigger data flows are in italics)

load vehicle, driver, cargo and equipment data store

*td – vehicle status warning*

*tfn – vehicle status warning*

*tfn – vehicle status*

*emergency*

*vehicle status*

*tfn – maintenance information and assistance request*

Functional requirements

- (a) respond to requests for the vehicle status from other functions
- (b) wait for the start of the vehicle to monitor and store vehicle status data
- (c) stop monitoring and storing vehicle status data when the vehicle is stopped
- (d) warn the driver and – if relevant – the fleet manager of any abnormal status

Covered user needs

21, 24, 53, 54, 62, 63, 82, 84, 89, 93, 94, 95, 102, 103, 106, 117

**3.8.1 Monitor social regulations status**

Overview

This function will receive social regulations data from function 3.1.2.1 “Comply with social regulations” and it will warn the driver and, if relevant, the fleet manager, for non compliance with the EU social regulations.

Input data flows (trigger data flows are in italics)

Read vehicle, driver, cargo and equipment data store

social regulations data

*tfm – request for social regulation data*

Output data flows (trigger data flows are in italics)

*td – social regulations warning*

*tfn – social regulations warning*

*tfn – social regulation data*

Monitor progress of tasks

Load vehicle, driver, cargo and equipment data store

Functional requirements

- (a) receive social regulations data
- (b) warn driver and, if relevant, fleet manager, for non compliance

### Covered user needs

1, 2, 4, 5, 6, 24, 63

### **3.8.2 Monitor physical status**

#### Overview

This function will monitor the presence and psycho-physiological condition of the driver (in particular driver fatigue and drowsiness) and warn him and, if relevant, the fleet manager if any dangerous situation arises.

#### Input data flows (trigger data flows are in italics)

Read vehicle, driver, cargo and equipment data store

*fv – vehicle sensor data*

*ffm – request for physical status*

#### Output data flows (trigger data flows are in italics)

Load vehicle, driver, cargo and equipment data store

*td – physical status warning*

*tfm – physical status warning*

*tfn – physical status*

*emergency*

#### Functional requirements

- (a) monitor and store driver physical status data
- (b) warn driver and, if relevant, fleet manager if any thresholds are exceeded

### Covered user needs

63, 82, 104

### **3.8.3 Monitor driver expenses**

#### Overview

This function allows the storage of driver expenses on a permanent basis as well as the consolidation and allocation of expenses to any period, task or transport order.

#### Input data flows (trigger data flows are in italics)

read vehicle, driver, cargo and equipment data store

*fd – input data*

*ffm – request for driver expenses*

Output data flows (trigger data flows are in italics)

load vehicle, driver, cargo and equipment data store

*td – output data*

*tfn – out put data*

*tfn – driver expenses*

load vehicle, driver, cargo and equipment data store

Functional requirements

(a) record driver expenses

Covered user needs

21

**3.8.4 Monitor driving behaviour**

Overview

This function supports the permanent recording and access to parameters that characterises a driving style at a given moment or during a given period, such as the use of the gearbox, brakes, revolution per hour values, speed, mileage and fuel consumption.

The function allows for real time access of results to the driver and, usually, for differed time analysis by Fleet manager and driver as an evaluation and or training to safe and economical driving.

Input data flows (trigger data flows are in italics)

read vehicle, driver, cargo and equipment data store

*fd – input data*

*fv - vehicle sensor data*

*ffm – request for driving behaviour*

Output data flows (trigger data flows are in italics)

load vehicle, driver, cargo and equipment data store

*td – output data*

*tfn – output data*

*emergency*

Functional requirements

(a) monitor and record driving behaviour to improve it and / or understand engine or other part tear and wear...

Covered user needs

93, 94, 95, 108, 110

### **3.9 Monitor cargo**

#### Overview

This function will monitor and store the status of the cargo and warn the driver and, if relevant, the fleet manager if any dangerous situation arises.

#### Input data flows (trigger data flows are in italics)

fv – cargo sensor data  
*ffm – request for cargo status*

#### Output data flows (trigger data flows are in italics)

*td – cargo status warning*  
*tjm – cargo status warning*  
*tv – cargo sensor data*  
*tjm – cargo status*  
*emergency*

#### Functional requirements

- (b) monitor and store cargo status data
- (c) warn driver and, if relevant, fleet manager if any thresholds are exceeded

#### Covered user needs

7, 8, 50, 51, 52, 53, 54, 63, 80, 81, 82, 83, 88

### **3.10.1 Monitor equipment position**

#### Overview

This function monitors and stores equipment position data (examples of equipment are trailer, swap body, container and pallets). It will receive requests for the equipment position from other functions and reply to them.

The consequences of having to manage a more or less “intelligent and autonomous” equipment (with even its own communicating OBC ...) are managed at the Physical and communication level of COMETA architecture.

#### Input data flows (trigger data flows are in italics)

read vehicle, driver, cargo and equipment data store  
*fv – equipment sensor data*  
*fotmo/ffm – request for equipment position*  
*request for equipment position*

Output data flows (trigger data flows are in italics)

load vehicle, driver, cargo and equipment data store  
*totmo/tfm – equipment position*  
*equipment position*  
*emergency*

Functional requirements

- (a) receive and store current equipment position
- (b) receive requests from other functions for the equipment position and reply

Covered user needs

7, 8, 24, 68, 87, 106

**3.10.2 Monitor equipment status**

Overview

This function monitors and stores equipment status data. Examples are that a swap body was left in a combined transport terminal, the number of kilometres driven by a given trailer, the temperature of an equipment or the exchange of reusable pallets. It provides warnings to the driver and to the fleet manager, if relevant, and also answers to requests on the status of equipment to other functions.

Input data flows (trigger data flows are in italics)

read vehicle, driver, cargo and equipment data store  
*fv/fe – equipment sensor data*  
*ffm - request for equipment status*  
request for equipment status

Output data flows (trigger data flows are in italics)

load vehicle, driver, cargo and equipment data store  
*equipment status*  
*td - equipment status warning*  
*tfm – equipment status warning*  
*te – equipment sensor data*  
*tfm – equipment status*  
*emergency*

Functional requirements

- (a) respond to requests on the equipment status from other functions
- (b) wait for the start of the operation of equipment to monitor and store equipment status data
- (c) stop monitoring and storing equipment status data when the operation of the equipment is stopped
- (d) warn the driver and, if relevant, the fleet manager of any abnormal status

### Covered user needs

24, 53, 54, 55, 62, 63, 68, 82, 84, 87, 88, 89, 93, 94, 95, 106

### **3.11.1 Monitoring and report on operational tasks**

#### Overview

This function requires from the driver and helps him to report, on a time basis, or according to given tasks phases or associated events and locations, or passing threshold points (this includes, for instance, the management of gate in / gate out procedures for intermodal transport terminals). This function can automatically trigger task reports or require driver to add relevant information, or reports may be emitted on driver initiative.

#### Input data flows (trigger data flows are in italics)

read vehicle, driver, cargo and equipment data store

*fd – input data*

*vehicle position*

*social regulation data*

*tasks to be monitored*

*request for task status*

*fv – vehicle sensor data*

*ffm – task*

*ffm – request for task status*

*ffm – transport order*

*fotmo \_ request for vehicle position*

*fotmo \_ request for vehicle status and operation*

*fotmo \_ request for equipment position*

*fotmo \_ request for equipment status and operation*

*fotmo – request for tasks status*

### Output data flows (trigger data flows are in italics)

load vehicle, driver, cargo and equipment data store

*td – output data*

*tfn – task status*

*task status*

*tfn – vehicle position*

*tfn \_ Vehicle status and operation*

*request for vehicle position*

*Vehicle status and operation*

*tfn – social regulations data*

*driver status*

*tfn \_ Equipment position*

*tfn \_ Equipment status and operation*

*totmo \_ vehicle position*

*totmo \_ vehicle status and operation*

*transport order status*

### Functional requirements

- (a) receive tasks to be monitored
- (b) maintain a queue of tasks under execution
- (c) respond task status requests including the current vehicle position and latest social regulations data, vehicle data, equipment data, etc. ...

### Covered user needs

6, 7, 9, 10, 15, 16, 20, 24, 29, 30, 33, 34, 36, 45, 58, 59, 60, 61, 62, 80, 81, 82, 87, 88, 89

## **3.11.2 Monitor and prove Transport Order execution**

### Overview

This function requires from the driver and helps him to report, on a time basis, or according to given Transport order phases or associated events and locations, identified through tasks management. This function can automatically trigger task reports (electronic signature of the road waybill or consignment note...) or require driver to add relevant information, or reports may be emitted on driver initiative.

Most important occurrences of this function are the possible pick up report (if modifications to the transport order are induced, see 3.1.2 and 3.1.3) and the proof of delivery (or a delivery difficulty, or even refusal ...).

#### Input data flows (trigger data flows are in italics)

read vehicle, driver, cargo and equipment data store

*fd – input data*

*request for task status*

*tasks to be monitored*

*fv – vehicle sensor data*

*ffm – task*

*ffm – request for task status*

*ffm – transport order*

*fpccf – request for electronic signature consignor/consignee*

*transport order status*

#### Output data flows (trigger data flows are in italics)

load vehicle, driver, cargo and equipment data store

*td – output data*

*tfm – task status*

*tfm – transport order*

*task status*

*transport order status*

*electronic signature*

#### Functional requirements

- (d) receive tasks and related transport order to be monitored
- (e) maintain a queue of transport orders under execution
- (f) get necessary signatures at pick up, and, most, at delivery (POD). And / or get client reservations.
- (g) respond task and related transport order status requests . . .

#### Covered user needs

28, 29, 30, 32, 33, 35, 36, 38, 39, 42, 43, 44, 77, 78

### **3.12 Manage emergency**

#### Overview

This function initiates alarms and emergency calls (related to driver, vehicle and equipment, cargo intrinsic conditions and/or attack, theft, ...) to any relevant party and follows up the emergency by waiting for an acknowledgement of the call as well as for advice and a description of planned support actions.

Input data flows (trigger data flows are in italics)

*emergency*

*ffm – acknowledgment of emergency*

*ffm – emergency advice and planned response*

*fsp – acknowledgment of emergency*

*fsp – emergency advice and planned response*

Output data flows (trigger data flows are in italics)

*tfm – emergency*

*tsp - emergency*

Functional requirements

- (a) emergency occurrence
- (b) send out emergency call to relevant parties
- (c) receive acknowledgment
- (d) receive emergency advice and overview of planned response

Covered user needs

93, 94, 95, 103, 104, 106, 109

### 3.6 DESCRIPTIONS OF EXTERNAL DATA FLOWS

**fa – fraud notification**

This data flow notifies the driver that a fraudulent action has been detected.

**fa – request for driver status**

This data flow contains a request from the relevant authorities to obtain all legally required social status information about the driver and the use of his vehicle.

**fa – request for speed**

This data flow requests the current speed of the vehicle.

**fa – request for statutory document**

This data flow contains a request from the relevant authorities to obtain all legally required statutory document, pertaining to the driver, the vehicle, the equipment or the cargo.

**fa – request for weight**

This data flow requests the current weight of the vehicle.

**fa – road regulations**

This data flow contains a provision of appropriate or a new regulation by authorities

**fd - expenses**

This data flow contains a provision of appropriate or a new regulation by authorities

**fd – input data**

This data flow contains any telematics input from the driver (from keyboard or communication system).

**fd – physical conditions data**

This data flow contains information captured automatically by various devices ( camera, actuators ) and describing the actual physical driving condition

**fd – request for statutory documents**

This data flow contains a request from the driver to obtain all legally required statutory document, pertaining to the driver, the vehicle or the cargo.

**fd – request for weather, traffic, route optimisation information**

This data flow contains a request from the driver to obtain an appropriate information on weather, etc...

**fe \_ equipment sensors data**

This data flow carries information (availability, status, operation...) captured by the sensors that are present on a given type of equipment (trailer, swap body, container, pallet...).

**ffm – acknowledgment of emergency**

This data flow acknowledges receipt of an emergency call.

**ffm – client profile**

This data flow contains , any Consignor or Consignee specificity that may impact the tasks performance (time slots, scheduling, physical presentation of the vehicle for loading / unloading), if not in the vehicle data base.

**ffm – emergency advice and planned response**

This data flow responds to an emergency call by giving emergency advice as well as a description of the planned response.

**ffm – load plan**

This data flow contains a description of the place within the vehicle where loaded goods have to be placed or off-loaded goods have to be removed.

**ffm – maintenance information and assistance**

This data flow contains the provision of maintenance information and assistance formerly requested by the fleet manager.

**ffm – request for cargo status**

This data flow contains the request from the fleet manager for information related to the cargo status .

**ffm – request for driving behaviour**

This data flow contains a request from the fleet manager for information allowing the description and the understanding of driving behaviour for a given period.

**ffm – request for driver expenses**

This data flow contains a request from the fleet manager for information allowing the description and the amount of driver expenses for a given period or related to a given task.

**ffm – request for driver physical status**

This data flow contains a request from the fleet manager for information

**ffm – request for equipment position**

This data flow contains the request from the fleet manager of equipment position.

**ffm – request for equipment status**

This data flow contains the request from the fleet manager for information allowing to describe and understand equipment status.

**ffm – request for social regulations status**

This data flow contains the request from the fleet manager for the content of the tachograph related to a task or a period

**ffm – request for speed**

This data flow requests the current speed of the vehicle.

**ffm– request for statutory document**

This data flow contains a request from the relevant authorities to obtain all legally required statutory document, pertaining to the driver, the vehicle, the equipment or the cargo.

**ffm – request for task status**

This data flow requests information on the current status of a task. Examples of task statuses are described in 2.1.

**ffm – request for vehicle position**

This data flow contains the request from the fleet manager of vehicle position.

**ffm – request for vehicle status**

This data flow contains the request from the fleet manager for information allowing to describe and understand vehicle status

**ffm – request for weight**

This data flow requests the current weight of the vehicle.

**ffm - route**

This data flow contains a description of the roads to follow to travel to the next destination.

**ffm – statutory document**

This data flow contains official documents such as customs and hazardous goods declarations. A more detailed description is given in 2.1

**ffm – tasks order**

This data flow contains information on elementary operations that are to be carried out by the driver. Examples of tasks are described in 2.1.

**ffm – transport order**

This data flow carries characteristics about the freight operation that will be performed. The data flow includes the transport order ID, the customer's name and address, origin/destination conditions, departure/arrival dates conditions, cargo/freight characteristics;

**ffm - trip**

This data flow contains a description of the next destination including the time (window) of arrival.

**fotmo - request for task status**

This data flow requests information on the current status of a task. Examples of task statuses are described in Chapter 2.1.

**fotmo – request for vehicle position**

This data flow contains the request from fotmo of vehicle position.

**fotmo – request for equipment position**

This data flow contains the request from of equipment position.

**fotmo – resource availability**

This data flow contains information from an other transport mode about availability of a mean of transport.

**fov – synchronise antiglaring facilities**

This data flow allows for the synchronisation of anti-glaring facilities between two vehicles.

**fov – vehicle platooning data**

This data flow contains information received from other vehicles within the same driving area to support vehicle platooning.

**fpccf – payment**

This data flow carries all necessary data to ensure that a payment will be placed by the customer on the bank account of the company or organisation that has provided an agreed service. The data flow includes the transaction ID, the selected mode of payment, the account number, the date of payment and an electronic signature.

**fpccf – request for transport order status**

This data flow carries the information that the status of a transport order is requested. The data flow includes the transport order ID.

**fpccf – statutory document**

see ffm – statutory document

**fpccf – transport opportunity**

This data flow carries characteristics about the freight operation that needs to be performed. The data flow includes the potential customer's name and address, transaction ID, the chartered driver's name and address, origin/destination conditions, departure/arrival dates and cargo/freight characteristics.

**fpcf – transport order**

This data flow carries characteristics about the freight operation that will be performed. The data flow includes the transport order ID, the transport offer ID, the customer's name and address, the chartered driver's name and address, origin/destination conditions, departure/arrival dates conditions, cargo/freight characteristics, the agreed price and an electronic signature.

**fro – lane following support**

This data flow is sent by the road operator (infrastructure) to support lane following.

**fro – payment receipt**

This data flow contains a proof that a payment has been received. Examples of data elements include: service ID, definition of service, amount, mode of payment and electronic signature.

**fro – request for user ID**

This data flow carries the information that the ID of a user of a service is requested.

**fro – request for payment**

This data flow contains the request for the electronic toll collection by a road operator.

**fro – road signs**

This data flow contains information on road signs and signals including their position with respect to the vehicle.

**fsp – acknowledgment of emergency**

see ffm – acknowledgment of emergency

**fsp – emergency advice and planned response**

see ffm – emergency advice and planned response

**fsp – payment receipt**

see fro – payment receipt

**fsp – request for payment**

This data flow carries the request for the payment of a service that has been delivered or that will be delivered. Examples of data elements include: service ID, description of the service, mode of payment, account number and amount.

**fsp – request for payment receipt**

see fro – request for payment receipt

**sp – request for user ID**

see fro – request for user ID

**fv – cargo sensor data**

This data flow carries information captured by the cargo sensors (temperature, weight, stowing, ...) that are present.

**fv – friction data**

This data flow carries information on the current road – tire friction.

**fv – lane data**

This data flow contains information on the lateral and longitudinal (actual and predicted) position of lane borders with respect to the vehicle's position.

**fv - object**

This data flow contains information on objects within the driving range of the vehicle. These objects can be static or dynamic and can be at any side of the vehicle including the rear (for instance in the case of overtaking vehicles).

**fv – position**

This data flow contains information resulting the calculation, by the vehicle, of its position.

**fv – safety margin**

This data flow contains information on the current safety margins, for instance on the limits of possible manoeuvres given the vehicle dynamics and the available space for manoeuvres.

**fv – equipment sensors data**

This data flow contains all relevant data collected by sensors installed in the vehicle such as : temperature door opening , automatic identification...etc

**fv – vehicle sensor data**

This data flow contains all relevant data collected by sensors installed in the vehicle, such as:

- sensors capturing the image of the driving scenario allowing visibility enhancement (eg infrared camera)
- tachograph data as a consolidation of different sensors providing operational data for the vehicle
- sensors evaluating fuel or oil consumption (including sudden increases), vehicle and parts temperatures and wear.

**ta – driver status**

This data flow contains information on the current social regulations status of the driver (mainly (1) periods of driving time, (2) other periods of work and availability and (3) breaks from work and daily rest periods.

**ta – law violations**

This data flow contains information supporting law enforcement.

**ta - speed**

This data flow carries the speed of the vehicle.

**ta – statutory document**

This data flow carries statutory documents; typically these are related to the vehicle, the driver or the cargo. Examples of the most important statutory documents are given in 2.1.

**ta – weight**

This data flow carries the weight of the vehicle.

**td – area vision**

This data flow contains the processed image of the driving scenario based on sensor information allowing to enhance the driver's visibility of the driving area.

**td – cargo status warning**

This data flow contains a warning that certain thresholds of the cargo status have been exceeded.

**td – equipment status warning**

This data flow carries warnings to the driver upon equipment status if certain thresholds are exceeded or if problems occur.

**td – output data**

This data flow contains any telematics output to the driver (from keyboard or communication system).

**td – physical status warning**

This data flow contains a warning that certain thresholds of the physical status of the driver have been exceeded.

**td – road regulations**

This data flow carries information on the road regulations that apply to the particular road (or area) on which the vehicle is travelling.

**Td – social regulations**

This data flow contains information on the current social regulations status of the driver (mainly (1) periods of driving time, (2) other periods of work and availability and (3) breaks from work and daily rest periods.

**td – social regulations warning**

This data flow contains a warning that the constraints imposed by the European union's social regulations, for instance on driving time, have been violated or are about to be violated.

**td – vehicle status warning**

This data flow contains a warning that certain thresholds of the vehicle status have been exceeded.

**td – visibility warning**

This data flow is sent to other vehicles in the same area or on the same stretch of road to inform them of poor visibility conditions.

**te – equipment sensors data request**

This data flow is sent to equipment sensors so as to collect any relevant captured data.

**tfm – cargo status**

This data flow contains information about the status of the cargo such as temperature, stowage conditions, etc. ...

**tfm – cargo status warning**

see td – cargo status warning

**tfm – driver driving behaviour**

This data flow contains the description of the driving behaviour during the performance of a given task, for a given period.

**tfm – driver expenses**

This data flow contains the description and amount of expenses related to a task or a period.

**tfm – driver physical status warning**

see td – physical status warning

**tfm – emergency**

This data flow describes a dangerous or potentially dangerous situation for which an urgent emergency response is necessary.

**tfm – equipment status**

This data flow contains the description of the equipment status

**tfm – equipment position**

This data flow contains information about equipment position.

**tfm – equipment status warning**

This data flow contains information about equipment status warning.

**tfm – maintenance information and assistance request**

This data flow contains a request for assistance or maintenance support.

**tfm – out put data**

This data flow contains various non structured information for the fleet manager.

**tfm – request for tasks order**

This data flow contains a request from the driver to the fleet manager for a new task order.

**tfm – request for client profile**

This data flow contains a request from the driver to the fleet manager of any Consignor or Consignee specificity that may impact the tasks performance (time slots, scheduling, physical presentation of the vehicle for loading / unloading) if not in the vehicle data base.

**tfm – request for statutory documents**

This data flow contains a request from the driver to the fleet manager for the provision of missing or necessary statutory documents.

**tfm – social regulations data**

This data flow contains information on the current social regulations status of the driver (mainly (1) periods of driving time, (2) other periods of work and availability and (3) breaks from work and daily rest periods.

**tfm – social regulations warning**

see td – social regulations warning

**tfm – task status**

This data flow contains information on the status of a task that is being executed. Examples of the most important task statuses are given in 2.1.

**tfm – transport order**

This data flow contains the executed and signed (by the consignee) transport order

**tfm – vehicle position**

This data flow contains information on the geographic vehicle location.

**tfm – vehicle status**

This data flow contains the provision of vehicle status information to the fleet manager.

**tfm – vehicle status warning**

see td – vehicle status warning

**totmo – equipment position**

This data flow contains the provision of equipment position to other transport mode operator.

**totmo – request for resource availability**

This data flow contains a request to other transport mode operator to check the availability of a mean of transport.

**totmo – task status**

see tfm – task status

**totmo – vehicle position**

This data flow contains the provision of vehicle position to other transport mode operator.

**totmo – resource booking**

This data flow carries the request to book a specific resource.

**tov – vehicle platooning data**

This data flow contains information sent to other vehicles within the same driving area to support vehicle platooning.

**tov – visibility warning**

see td – visibility warning

**tov – synchronise anti glaring facilities**

This data flow contains information useful for cooperative antiglaring and is sent to crossing vehicles (e.g. to switch between high and low beams or to synchronise pulsed lights/beams).

**tpccf – capacity availability**

This data flow indicates to the customer that the independent or chartered driver is available to carry freight implying a request to study transport opportunities. The data flow includes the driver's name and ID, start time of availability, end time of availability as well as a description of the available capacity during the availability period.

**tpccf – payment information**

This data flow contains information to be added to the transport contract or modifying it, so as to allow the payment of appropriate amount by the principal.

**tpccf – request for statutory documents**

This data flow contains a request from the driver to the principal, or consignor, or freight forwarder, for the provision of missing or necessary statutory documents.

**tpccf – request for transport opportunity**

This data flow is a request from the independent or chartered driver to customer to get information about current freight opportunities. The data flow includes the driver's name and ID, criteria for transport opportunity selection: start time, end time, start location, end location, and cargo type.

**tpccf – transport invoice**

This data flow is the formal invoice from the chartered driver to the customer. The data flow includes the transport order ID, price and electronic signature.

**tpccf – transport offer**

This data flow carries characteristics about the conditions under which the freight operation could be performed. The data flow includes the transport offer ID, the independent or chartered driver's name and ID, proposed departure and arrival dates, proposed price and electronic signature.

**tpccf – transport order confirmation**

This data flow carries characteristics about the conditions under which the freight operation will be performed. It is the contract established between the customer and the independent or chartered driver. The data flow includes the transport order ID, the chartered driver's name and address, origin/destination conditions, departure/arrival dates, agreed price and electronic signature.

**tpccf – transport order status**

This data flow carries all transport order status information that is provided by the chartered independent or driver to the customer for the performed freight transport. The data flow includes the transport order ID, the chartered driver's name and ID, origin/destination conditions, departure/arrival dates, proof of delivery, delay and penalties.

**tro - payment**

This data flow contains the payment of the toll collection operation.

**tro – payment characteristics**

This data flow contains information about driver identification and subscriptions conditions related to toll collection.

**tro – request for payment receipt**

This data flow contains a request to send a payment receipt as proof that payment for a service has been made.

**tro – user ID**

This data flow carries the unique identification of a user.

**tro – visibility warning**

see td – visibility warning

**tsp - emergency**

see tfm - emergency

**tsp – floating car data**

This data flow contains information on the time that a vehicle is present at a certain place as well as on the speed and direction in which the vehicle is travelling.

**tsp – payment**

see fpccf – payment

**tsp – payment characteristics**

This data flow contains information about driver identification and subscriptions conditions related to toll collection related to service.

**sp – unexpected vehicle position**

This data flow carries information on the geographic location of a vehicle if this deviates from a planned route or itinerary.

**tsp – user ID**

see tro – user ID

**tv – adjust lighting**

This data flow contains all necessary information to activate and /or control the intelligent lighting system (beam shaping, beam orientation, ...).

**tv – cargo sensors data**

This data flow contains corrective actions on the cargo or its automatic identification process.

**tv – lateral control commands**

This data flow contains control data to handle the vehicle's required lateral dynamics (steering angle, steering rate).

**tv – longitudinal control commands**

This data flow contains control data to handle the vehicle's required longitudinal dynamics (braking, accelerating).

### **3.7 DESCRIPTIONS OF INTERNAL DATA FLOWS**

#### **Client profile**

This data flow contains , any Consignor or Consignee specificity that may impact the tasks performance (time slots, scheduling, physical presentation of the vehicle for loading / unloading), if not already in the vehicle data base.

#### **confirmation of payment**

This data flow contains a confirmation that payment has been made.

#### **emergency**

This data flow carries information describing the nature and key characteristics of an emergency.

#### **electronic signature**

This data flow carries the electronic signature of the person from whom an electronic signature was requested.

#### **equipment position**

This data flow contains information on the geographic equipment position.

#### **equipment status**

This data flow carries information on the status of the equipment that is currently available.

#### **freight and hazardous goods information**

This data flow contains the origin/destination points, departure/arrival time constraints and in case of hazardous goods transport the vehicle and cargo characteristics - all information required to determine the route.

- + origin/destination points
- + departure/arrival time constraints
- + vehicle and cargo characteristics.

#### **lateral control data**

This data flow is sent to the vehicle controls allowing automatic longitudinal interventions (braking or accelerating). This is for instance done in poor visibility conditions.

#### **load vehicle, driver, cargo and equipment data store**

This data flow carries all information to be loaded from the vehicle, driver, cargo and equipment data store.

#### **longitudinal control data**

This data flow is sent to the vehicle controls allowing automatic longitudinal interventions (braking or accelerating). This is for instance done in poor visibility conditions.

#### **payment receipt**

see fsp – payment receipt

**Pollution situation**

This data flow contains the response to a previous request for information about the current pollution situation.

**read vehicle, driver, cargo and equipment data store**

This data flow carries all information to be stored into the vehicle, driver, cargo and equipment data store.

**request for administrative closure**

This data flow carries the information that the administrative closure - invoice as well as the preparation and sending of payment - must start. The data flow includes the transport order ID.

**Request for client profile**

This data flow carries the request upon information about any Consignor or Consignee specificity that may impact the tasks performance (time slots, scheduling, physical presentation of the vehicle for loading / unloading), if not already in the vehicle data base.

**request for electronic signature**

This data flow carries the request for an electronic signature.

**request for equipment position**

This data flow contains a request to be informed of the equipment position.

**request for equipment status**

This data flow contains a request to be informed of the equipment status.

**request for optimised route**

This data flow contains a request for all criteria that are useful for route optimisation for a trip. It includes start time and location, end time and location as well as intermediate locations and times.

**request for payment**

see fsp – request for payment

**request for pollution situation**

This data flow contains a request for information about the current pollution situation. The request includes information on the area or roads concerned.

**request for resource availability**

This data flow carries the information that an analysis must be made to determine whether the resources to carry out a transport order are available.

**request for task status**

This data flow requests information on the current status of a task. Examples of relevant statuses can be found in Chapter 2.1.

**request for traffic situation**

This data flow contains a request for information about the current traffic situation.

**request for trip, route and load plan preparation**

This data flow carries the information that a new freight operation has been contractually accepted by the independent or chartered driver and that this operation must start its preparation process. This preparation typically involves the preparation of the trip, the route and the load plan. The data flow includes the transport order ID.

**request for vehicle position**

This data flow requests information on the current position of a vehicle.

**request for vehicle status**

This data flow requests information on the current status of a vehicle.

**request for weather situation**

This data flow contains a request for information about the current weather situation.

**resource availability**

This data flow indicates whether all necessary resources to execute a task are available (on board). 5 different types of resources are concerned: driver, vehicle, equipment, accessories and other transport mode for intermodal transport.

**resource booking**

This data flow carries the request to book a specific resource.

**road geometry information**

This data flow contains detailed information on the geometry of the road ahead, for instance allowing to direct the lighting of the vehicle in a curve.

**route**

This data flow describes the route to be taken, ie the detailed street by street instructions to be followed to go from the origin to the destination. No route can be provided in case of unauthorised hazardous goods transport.

**social regulations data**

This data flow contains information on the current social regulations status of the driver (mainly (1) periods of driving time, (2) other periods of work and availability and (3) breaks from work and daily rest periods.

**task status**

For a chartered or independent driver, this data flow contains information on the status of a task that is being executed. Examples of the most important task statuses are given in Chapter 2.1.

**tasks to be executed then monitored**

This data flow request the function monitoring task progress to add an accepted task to the monitoring queue.

**Transport order status**

This data informs that a foreseen event or unforeseen event (incident) has happened before the start of a trip, during or after a trip, (from pick up to delivery e.g. POD) that may need processing at commercial level. It contains trip ID, event (among a pre-defined list of relevant events).

**traffic situation**

This data flow contains the response to a previous request for information about the current traffic situation.

**vehicle position**

see tfm – vehicle position

**vehicle status**

This data flow carries information about the current status of the vehicle.

**weather situation**

This data flow contains the response to a previous request for information about the current weather situation.

### **3.8 DESCRIPTION OF DATA STORE**

#### **1. vehicle, driver, cargo and equipment data store**

This data store contains all recorded information for freight operations. The data categories that are stored are the following :

- + commercial information
  - transport opportunity
  - transport order
  - transport order confirmation
  - invoice
  - payment (proof)
  - transport order status information contractually foreseen or requested by the commercial partners, proof of execution
- + statutory document
  - driver
  - equipment
  - vehicle
  - cargo
  - transport
- + operational task order
  - trip, route and load plan
  - transport order status information (used for operational purposes)
  - other task instruction status information
  - driver data
  - vehicle data
  - cargo data
  - equipment data

The contents of these data categories may greatly differ between road transport activities. Nevertheless, Cometa have made one additional step through a generic approach, so as to identify main data tables and, within these tables and, within these tables, main data.

These data represent the basic materiel for messages to be built and exchanged.

So, from a logical point of view, Cometa has developed, in the following chapter, the information level of its architecture.

## 4 INFORMATION AND MANAGEMENT ARCHITECTURE

In preceding chapter 3, functional data flows to and from terminators and within functions and sub-functions have been described, with, as a result, a list description of the on board data store categories.

In this chapter, an attempt to make one step further is made so as to detail and structure this on board data base considering the information level of COMETA System(s) Architecture.

Nevertheless, according to the potential variety of road freight transport activities, this attempt should still be seen as a simplified illustration (even if this information approach allows for a more clear view of the nature and amount of data to be managed) of the main entities, their relationships, the data gathered into tables.

What should be kept in mind is :

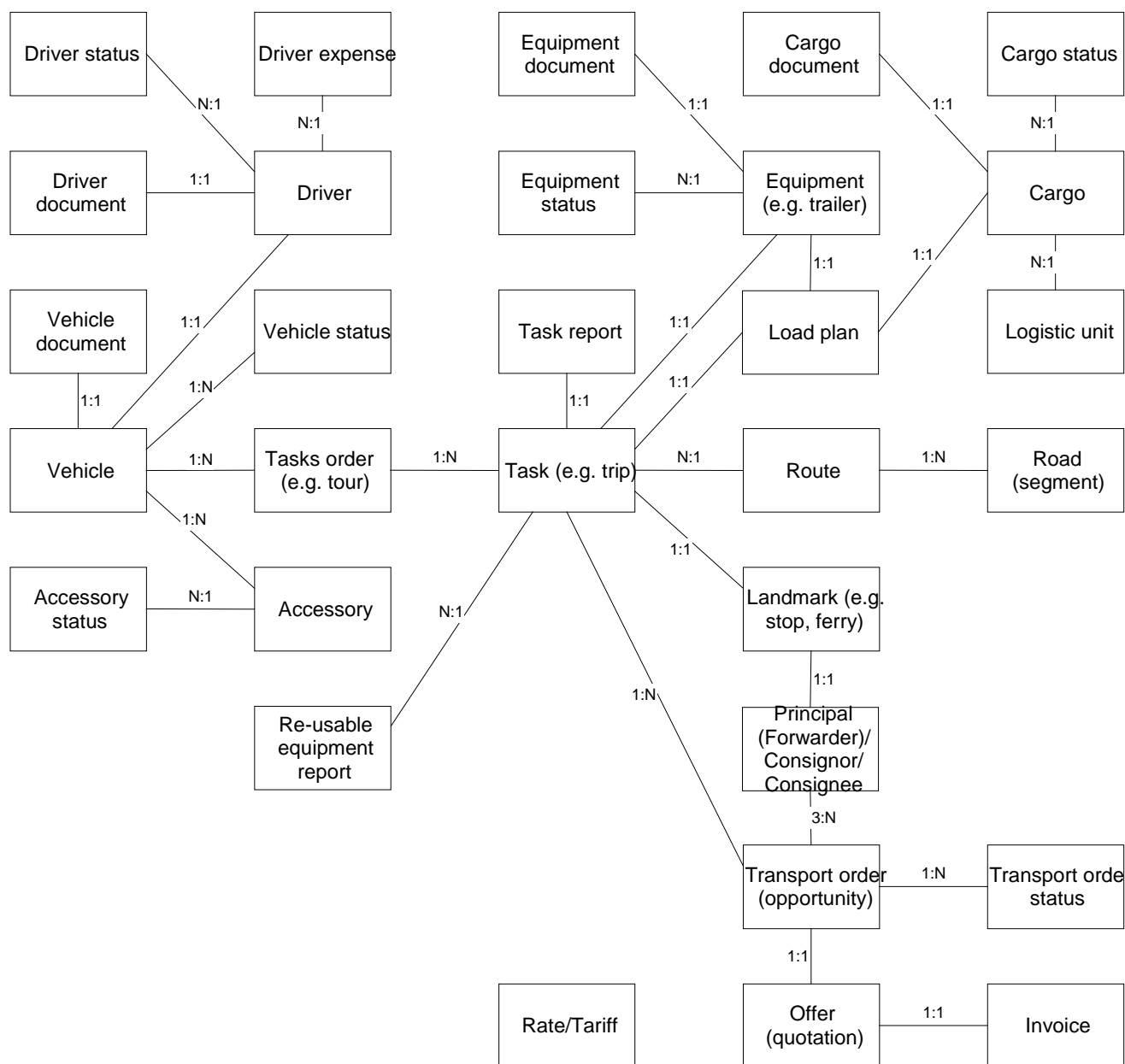
- on one side that the task to be performed by the vehicle – driver pair (doing nothing is even a task...) is the very central entity around which the rest of the information is structured,
- on the other side that information managed within and by COMETA System(s) Architecture can be divided into :
  - commercial information,
  - statutory information,
  - operational information,leaving aside accident / emergency information.

To this static description, is added a dynamic one, with the illustration of some messages exchange logical scenarios, even if it has not been tried to have a one to one relation between present tables and the way they will be used during these logical scenarios.

As an additional example that the formalisation (we could even say the harmonisation and even standardisation) of this information level being now developed by Cometa French pilots, is still an on going process, can be found too some hints on “Mobile EDI messages”, a matter which presented with more details in Del 6.2 addressing standardisation matters.

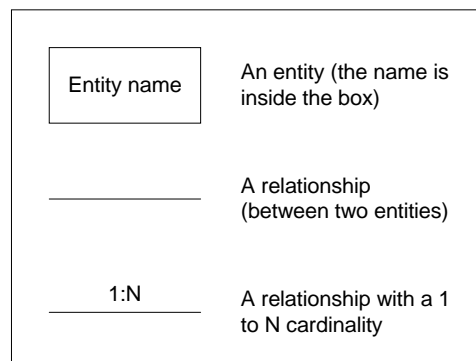
### 4.1 ENTITY RELATIONSHIP DIAGRAM

The following entity relationship diagram visualises the entities that are present in the on-board data-base and the cardinality of the relationships between them.



**Figure : 19. Extended entity relationship diagram of the onboard database**

The entity relationship diagram showed in figure 18 visualises the entities that are present in the on-board data-base and the cardinality of the relationships between them. Please refer to the following figure for an explanation of the symbols used in it. As a general rule the cardinality of a relationship between two entities has to be read from left to right and/or from up to down.



### **Symbols used in entity relationship diagrams**

NOTE: The eventuality that the driver may carry the onboard computer with him (when exchanging vehicles with another driver) is not taken into consideration by this data model.

NOTE: The 'social management' related information is not explicitly stored in the database, but in the memory of the digital tachograph; it is directly read out from there when needed.

The 1:1 relationship between the Location and the Principal (Forwarder)/Consignor/Consignee has to be considered as being an optional relationship. A 'Tour' is a 'Tasks order' containing only trips. A 'Trip' is a special kind of task, where a destination is given. The relationship between 'Task' and 'Route' exists only if the task to be carried out is the driving of a trip.

#### 4.1.1 Data dictionary

ENTITY	DESCRIPTION
Driver	<i>The human resource for carrying out a task.</i>
Driver status	<i>The actual status of the driver.</i>
Driver document	<i>Driving license or qualification certificate.</i>
Driver expense	<i>Amount of money spent by the driver on the fulfilment of a task and which will be paid back by the fleet-manager.</i>
Vehicle	<i>The commercial transportation means.</i>
Vehicle status	<i>The actual status of the vehicle.</i>
Vehicle document	<i>Vehicle registration card, insurance certificate, tax receipt, type approval certificate (for adapted vehicles) or vehicle inspection certificate.</i>
Accessory	<i>A small crane, a pump, a suction engine (for liquids), etc.</i>
Accessory status	<i>The actual status of the accessory.</i>
Equipment	<i>Trailer, container or swap-body.</i>
Equipment status	<i>The actual status of the equipment.</i>
Equipment document	<i>Equipment features document.</i>
Cargo	<i>Goods transported or to be transported.</i>
Cargo status	<i>The actual status of the cargo (e.g. temperature, humidity).</i>
Cargo document	<i>Public health certificate, dangerous goods declaration, TREMCARD (safety instructions for a given type of dangerous goods category), customs documents or other clearance certificates (e.g. for alcohol).</i>
Logistic unit	<i>Smallest identifiable unit being part of the cargo (transport unit).</i>
Tasks order	<i>Description of tasks to be performed according to given transport order(s) or as such. A tour is a special type of tasks order.</i>
Task	<i>Instructions, possibly linked to a transport order, sent to a driver and justified by all the characteristics of a mission likely to be fulfilled by the driver/vehicle pair formed at a given moment T, until such time when the pair is separated. A trip is a special type of task.</i>
Task report	<i>A message which is either sent to the fleet-manager and/or stored in the database upon fulfilment of the respective task.</i>

Route	<i>The path to be taken to get from a starting point to a point of destination or to supplement a trip plan.</i>
Road segment	<i>A geometrically defined segment of a road.</i>
Landmark	<i>An explicitly defined (geo-coded) point of interest, which may be a hotel, a sea-port, the location of a consignor, the location of a consignee, etc.</i>
Re-usable equipment report	<i>A (sent and/or stored) report on re-usable equipment (e.g. boxes, pallets) which was picked at a point A and brought to a point B.</i>
Principal (Forwarder) / Consignor / Consignee	<i>The entity publishing the transport order, the entity sending the goods and the entity receiving the goods.</i>
Transport order (opportunity)	<i>Instruction with a specific reference, including the information required to carry out the commercial act of a transport, technically divided into logistic units/item numbers of which the cargo may be composed.</i>
Transport order status	<i>The actual status of a transport order, including proof of delivery and of pick-up.</i>
Offer (quotation)	<i>A calculation on the amount of money that the driver (transport company) is requesting for his services.</i>
Invoice	<i>The document sent by the driver (transport company) to his customer after fulfilment of a transport order, in which he asks for remuneration.</i>
Rate/tariff	<i>Standard rates and tariffs for different types of orders and services.</i>
Load plan	<i>A description of the order in which logistic units are loaded or unloaded.</i>

#### 4.1.2 Informational clusters

Depending on the functionality implemented in the onboard computer system a number of entities (database tables) may be either merged with each other, or may be completely absent in a possible implementation.

The data entities modelled in the entity relationship diagram may be sub-divided into the following informational ad-hoc clusters and sub clusters, which could be regarded as being modular components of the database:

=> **Management of commercial information**

Principal (Forwarder)/Consignor/Consignee, Transport order (opportunity), Transport order status (includes Proof/notice of pick-up/delivery), Offer (quotation), Invoice, Rate/Tariff, Cargo, Logistic unit.

=> **Management of statutory information and other electronic documents**

Driver document, Vehicle document, Equipment document, Cargo document, Transport order.

=> **Management of operational information**

=> **Monitoring of operational statuses**

Driver status, Vehicle status, Cargo status, Equipment status, Accessory status.

=> **Management of loading/unloading information**

Vehicle, Equipment (trailer), Load plan, Cargo, Logistic (transport) unit.

=> **Management of tasks order**

Tasks order, Task report, Landmark.

=> **Management of road information**

Landmark, Route, Road (segment).

=> **Management of resource information**

Driver, Vehicle, Equipment (e.g. trailer), Accessory

=> **Management of additional information**

Re-usable equipment report, Driver expense.

As can be seen from this sub-division, certain entities may belong to different clusters like e.g. 'Landmark' which belongs to 'Management of tasks order' and to 'Management of road information'. This means that certain fields out of a landmark-record are relevant for the first sub cluster, while others are relevant for the second.

Another example is the 'Transport order' which is both, commercial information and (with a look to the future) an electronic document; for this reason it belongs to the cluster 'Management of commercial information' and to 'Management of statutory information and other electronic documents'.

### 4.1.3 Data access mobilities

The following table visualises which tables (or records) are accessed by each of the functions making up the functional architecture. A difference is made between a reading access (R) and a writing access (W). Please keep in mind that a writing access is not only used to update, but also to create one or more records.

LOW LEVEL FUNCTION	RECORD/TABLE																														
	DRIVER	DRIVER STATUS	DRIVER DOCUMENT	DRIVER EXPENSE	VEHICLE	VEHICLE STATUS	VEHICLE DOCUMENT	ACCESSORY	ACCESSORY STATUS	EQUIPMENT	EQUIPMENT STATUS	EQUIPMENT DOCUMENT	CARGO	CARGO STATUS	CARGO DOCUMENT	LOGISTIC UNIT	TASKS ORDER	TASK	TASK REPORT	ROUTE	ROAD SEGMENT	LANDMARK	RE-USABLE EQUIPMENT REPORT	PRINCIPAL/CONSIGNOR/CONSIGNEE	TRANSPORT ORDER (OPPORTUNITY)	TRANSPORT ORDER STATUS	OFFER (QUOTATION)	INVOICE	RATE/TARIFF	LOAD PLAN	
1.1 Negotiate transport orders	R	R			R	R		R	R	R	R				W									R W	W R	R	W		R		
1.2 Administrate business transactions																										R	R	W R			
2.1.1 Prepare documents	R		R		R		R			R		R	R		R		R	R	W							R					
2.1.2 Prepare vehicle					R W	R W											R	R	W							R					
2.1.3 Prepare driver	R W	R W															R	R	W							R					
2.1.4 Prepare cargo space					R	R W				R	R		R			R W	R	R	W							R					R W
2.1.5 Prepare equipment										R W	R W						R	R	W							R					
2.1.6 Prepare accessories								R W	R W								R	R	W							R					
2.1.7 Prepare other transport mode																	R	R	W							R					

LOW LEVEL FUNCTION	RECORD/TABLE																															
	DRIVER	DRIVER STATUS	DRIVER DOCUMENT	DRIVER EXPENSE	VEHICLE	VEHICLE STATUS	VEHICLE DOCUMENT	ACCESSORY	ACCESSORY STATUS	EQUIPMENT	EQUIPMENT STATUS	EQUIPMENT DOCUMENT	CARGO	CARGO STATUS	CARGO DOCUMENT	LOGISTIC UNIT	TASKS ORDER	TASK	TASK REPORT	ROUTE	ROAD SEGMENT	LANDMARK	RE-USABLE EQUIPMENT REPORT	PRINCIPAL/CONSIGNOR/CONSIGNEE	TRANSPORT ORDER (OPPORTUNITY)	TRANSPORT ORDER STATUS	OFFER (QUOTATION)	INVOICE	RATE/TARIFF	LOAD PLAN		
2.2.1 Ask for new task order																	W	W								W						
2.2.2 Process and read new task order								W	W	W	W	W	W	W	W	W	R	R								R						
2.2.3 Check client profile and constraints																							W		R	R						
2.2.4 Prepare trip/route																	R	R	W		W	R	W		R	R						
2.2.5 Prepare load plan					R	R								W	R		R	R								R						W
3.1.1 Manage tasks and transport order content and modifications																	R	R	W							R	W					
3.1.2 Check whether cargo and/or equipment conforms to transport order														R	R		R									R						
3.1.3 Create a new transport unit											W	W		W	W		W															R
3.2.1 Comply with social regulations	R	R			R	R																										

LOW LEVEL FUNCTION	DRIVER	DRIVER STATUS	DRIVER DOCUMENT	DRIVER EXPENSE	VEHICLE	VEHICLE STATUS	VEHICLE DOCUMENT	ACCESSORY	ACCESSORY STATUS	EQUIPMENT	EQUIPMENT STATUS	EQUIPMENT DOCUMENT	CARGO	CARGO STATUS	CARGO DOCUMENT	LOGISTIC UNIT	TASKS ORDER	TASK	TASK REPORT	ROUTE	ROAD SEGMENT	LANDMARK	RE-USABLE EQUIPMENT REPORT	PRINCIPAL/CONSIGNOR/CONSIGNEE	TRANSPORT ORDER (OPPORTUNITY)	TRANSPORT ORDER STATUS	OFFER (QUOTATION)	INVOICE	RATE/TARIFF	LOAD PLAN	
3.2.2 Comply with other regulations			R		R	R	R						R	R	R	R															
3.3.1 Provide vision support						R	W																								
3.3.2 Provide longitudinal control						R	W																								
3.3.3 Provide lateral control						R	W																								
3.3.4 Provide automated driving support						R	W																								
3.3.5 Miscellaneous telematics functions				W		R																									
3.4 Provide access to comfort services		W																													
3.5 Manage traffic and route guidance information					R	R							R	R			R	R	W		R	R	R	W							
3.6.1 Perform EFC transactions	R			W	R	R															R										
3.6.2 Support billing services	R			W	R																										

LOW LEVEL FUNCTION	RECORD/TABLE																															
	DRIVER	DRIVER STATUS	DRIVER DOCUMENT	DRIVER EXPENSE	VEHICLE	VEHICLE STATUS	VEHICLE DOCUMENT	ACCESSORY	ACCESSORY STATUS	EQUIPMENT	EQUIPMENT STATUS	EQUIPMENT DOCUMENT	CARGO	CARGO STATUS	CARGO DOCUMENT	LOGISTIC UNIT	TASKS ORDER	TASK	TASK REPORT	ROUTE	ROAD SEGMENT	LANDMARK	RE-USABLE EQUIPMENT REPORT	PRINCIPAL/CONSIGNOR/CONSIGNEE	TRANSPORT ORDER (OPPORTUNITY)	TRANSPORT ORDER STATUS	OFFER (QUOTATION)	INVOICE	RATE/TARIFF	LOAD PLAN		
3.7.1 Monitor vehicle position						W																										
3.7.2 Monitor vehicle status and operation						W																										
3.8.1 Monitor social regulations status		W				W																										
3.8.2 Monitor physical status	R	W																														
3.8.3 Monitor driver expenses	R			R																												
3.8.4 Monitor driving behaviour	R	W																														

LOW LEVEL FUNCTION	DRIVER	DRIVER STATUS	DRIVER DOCUMENT	DRIVER EXPENSE	VEHICLE	VEHICLE STATUS	VEHICLE DOCUMENT	ACCESSORY	ACCESSORY STATUS	EQUIPMENT	EQUIPMENT STATUS	EQUIPMENT DOCUMENT	CARGO	CARGO STATUS	CARGO DOCUMENT	LOGISTIC UNIT	TASKS ORDER	TASK	TASK REPORT	ROUTE	ROAD SEGMENT	LANDMARK	RE-USABLE EQUIPMENT REPORT	PRINCIPAL/CONSIGNOR/CONSIGNEE	TRANSPORT ORDER (OPPORTUNITY)	TRANSPORT ORDER STATUS	OFFER (QUOTATION)	INVOICE	RATE/TARIFF	LOAD PLAN	
3.9 Monitor cargo													R	W																	
3.10.1 Monitor equipment position										R	W																				
3.10.2 Monitor equipment status										R	W																				
3.11.1 Monitor and report on operational tasks						R											R	R	W			R									
3.11.2 Monitor and prove transport order execution																	R	R				R			R	W					
3.12 Manage emergency						R																									

#### 4.1.4 Life-cycle of the information

The life-cycle (generation and archiving/deletion) of the single data-records in the database is summarised in the following table

<b>RECORD</b>	<b>TIME OF GENERATION</b>	<b>TIME OF ARCHIVING/DELETION</b>
Driver document	Beginning of first trip	---
Vehicle document	Beginning of first trip	---
Equipment document	As soon as a new equipment (e.g. a trailer) is attached or at the beginning of trip.	End of trip.
Cargo document	As soon as a new trailer is attached or at the beginning of trip.	End of trip
Driver status	During task execution	Immediate archiving Deletion at the completion of mission order (after downloading of data)
Vehicle status	During task execution	Immediate archiving Deletion at the completion of mission order (after downloading of data)
Cargo status	During task execution	Immediate archiving Deletion at the completion of mission order (after downloading of data)
Equipment status	During task execution	Immediate archiving Deletion at the completion of mission order (after downloading of data)
Accessory status	During task execution	Immediate archiving Deletion at the completion of mission order (after downloading of data)
Transport opportunity	On reception of transport opportunity	On reception of final transport order
Transport order	On reception of transport order	On reception of order payment
Offer (quotation)	On reception of transport opportunity	On reception of order payment
Transport order status	On transition of new transport order state (e.g. on pick-up of goods or as soon as the consignor has signed)	On transport fulfilment and order payment

Invoice	On transport fulfilment (Proof/notice of delivery)	On reception of transport payment
Principal (Forwarder)/Consignor/Consignee	New principal/forwarder/consignor/consignee	---
Rate/Tariff	On update of Rates/Tariffs	On update of Rates/Tariffs
Equipment (e.g. trailer)	As soon as a new equipment (e.g. a trailer) is attached or during the planning phase	At the end of trip
Vehicle	As soon as database is updated	---
Load plan	As soon as a new trailer is attached or during the planning phase	At the end of trip
Cargo	As soon as a new trailer is attached or during the planning phase	At the end of trip
Logistic unit	As soon as a new trailer is attached or during the planning phase	At the end of trip
Route	On calculation of route/path by planning software	At the end of trip
Road (segment)	As soon as the card software is updated	---
Tasks order (e.g. tour)	As soon as the tour is planned (with the planning software) or by manual planning of tasks. As soon as a new tasks order is downloaded from the fleet manager.	Archiving on termination of tour. Deletion after downloading of data to the fleet manager.
Task (e.g. trip)	As soon as the trip is planned (with the planning software) or by manual planning. As soon as a new task is transmitted by the fleet manager.	Archiving on termination of trip. Deletion after downloading of data to the fleet manager.
Landmark	As soon as the trip is planned (with the planning software) or by manual planning. As soon as a new landmark is transmitted with a new task.	Archiving on termination of trip. Deletion after downloading of data to the fleet manager.

Task report	As soon as the destination of the trip is reached (a copy may be sent to the home-base)	Immediate archiving. Deletion at the end of mission order (after downloading of data).
Re-usable equipment report	After unloading the goods with the re-usable equipment	Immediate archiving. Deletion after downloading of data to the fleet manager.
Driver expense	As soon as a payment by the driver occurs	Immediate archiving. Deletion after downloading of data to the fleet manager.
Accessory	As soon as a new accessory is used	Immediate archiving. Manual deletion.
Driver	Before a new driver is attributed to the vehicle for a mission (transmission from the fleet manager). Alternatively: manual input of information.	Immediate archiving. Manual deletion.

#### 4.1.5 Physical considerations

Generally we differentiate between the driver doing acquisition of transport orders and administration himself (independent driver) and a driver who is directly employed by the transport company and “only” takes care about the driving (fleet driver).

A minimum database consists of the tables ‘tasks order’, ‘Landmark’ and ‘Principal (Forwarder)/Consignor/Consignee’ (with minimum information about the contact person). To reduce the number of database tables (e.g. if a copy of the principal (forwarder)/consignor/consignee table cannot or does not need to be stored onboard) ‘Landmark’ and ‘Principal (Forwarder)/ Consignor/ Consignee’ may be merged into a single, simple table.

The ‘Equipment’ table stores the characteristics of the equipment (if e.g. a new trailer is attached to the traction engine); these characteristics include the dimensions of the loading space; the same applies for the ‘Vehicle’ table (for the vehicle). Theoretically the traction engine (vehicle) may transport a trailer from point A to point B, a second trailer from point B to point C etc. Each of these trailers may require an own loading plan for the logistic units; if no trailer is meant, then the loading plan refers to the loading space of the vehicle.

A load plan is determined before the trip (if the ‘Logistic unit’ information is available). The ‘Load plan’ contains the information about the order of the logistic units to be loaded/unloaded.

The fully extended ‘Principal (Forwarder)/ Consignor/ Consignee’ table together with ‘Transport order’, ‘Transport order status’, ‘Offer (quotation)’, ‘Invoice’ are present only in the case of an independent driver who manages the commercial information himself.

#### 4.1.6 Additional remarks

A trip is a journey from point A to point B. For simplicity reasons the starting point is either the home-base or the last point B, so each ‘Trip’ references only one ‘Landmark’, which may be any kind of stop (e.g. pick-up, delivery, ferry, border). Logically a new trip starts as soon as the ‘Tour’ (mission order) with all the ‘Trips’ (tasks) information is downloaded to the onboard computer system or as soon as a ‘Trip’ (task) is accomplished. A ‘Tour’ (mission order) is accomplished as soon as its last ‘Trip’ (task) is accomplished.

The so called ‘Path’ or ‘Route’ cannot be reflected directly by an entity, but is the result of a database query (a so called view) and is described by a list of links. The resulting vector of the database query “*determine the path/route for trip1*” or more specifically “*determine all road segments to be driven for trip 1 and order the list by the sequence number*” could look like the following

$$Path / Route = \begin{pmatrix} trip1 & segment22 & 1 \\ trip1 & segment30 & 2 \\ trip1 & segment35 & 3 \end{pmatrix}$$

meaning that first a road segment identified by the ID 22 has to be driven, then a road segment with the ID 30 and last road segment 35.

## 4.2 TABLE DESCRIPTIONS

### 4.2.1 Management of commercial information

Table	Transport Order
Contents	<p>NOTE: See the discussion on basic differences between full-load transport and pick-up and delivery transport in the chapter “Theory of Operations”.</p> <p><u>Full-load transport</u></p> <p>Transport order ID</p> <p>Principal ID or forwarder ID</p> <p>Consignor ID                      Telephone number, fax number, e-mail address                      Name of person in charge</p> <p>Consignee ID                      Telephone number, fax number, e-mail address                      Name of person in charge</p> <p>Departure/arrival date and hour conditions                      (Window) departure date                      (Window) departure time                      (Window) arrival date                      (Window) arrival time</p> <p>OPTIONAL: loading/unloading conditions                      Materials to bring for loading/unloading (e.g. palette-carrier)                      Order in which to load/unload goods                      Loading/unloading done by driver                      OPTIONAL: transport conditions                      Minimum/maximum temperature during transport                      Itinerary to follow</p> <p>OPTIONAL: transport order status reporting conditions</p> <p>OPTIONAL: pick-up and delivery reporting conditions</p> <p>OPTIONAL: foreseen penalties (EURO / hour)                      For late arrival at loading point                      For late start of loading                      For late arrival at unloading point                      For late start of unloading</p> <p>Cargo/freight characteristics                      Nature (e.g. vegetables, fragile)                      Total weight                      Total volume (in cubic metres, OPTIONAL: ground surface occupied, OPTIONAL: length)                      Number of units                      Characteristics of units (e.g. palettes, cartons)                      ADR class                      OPTIONAL: payment conditions (30 days / end of the month)</p>

Contents (continued)	Pick-up and delivery transport  Generally, there will be less information in the transport order: Transport order ID Principal ID – this can be any company or individual  Origin/destination conditions Name and address of consignor Name and address of consignee  Departure/arrival date and hour conditions (Window) departure date (Window) departure time (Window) arrival date (Window) arrival time  OPTIONAL: transport order status reporting conditions (see earlier but now number of stages is limited: Collected parcel and given ID. / bar code, specific destination address, payment conditions, signature Arrival in origin consolidation/distribution centre Sent to destination consolidation/distribution centre (mostly at night) Arrival in origin consolidation/distribution centre Delivered parcel at destination address  OPTIONAL: delivery and pick-up reporting conditions (see earlier) Parcel characteristics Nature (eg vegetables, hardware) Total weight Total volume (in cubic metres, OPTIONAL: ground surface occupied, OPTIONAL: length) Number of units Characteristics of units (eg palletes, cartons)  OPTIONAL: payment conditions (30 days / end of the month)
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<b>Table</b>	<b>Transport Opportunity</b>
Contents	= Transport order, with the following modifications  Name and address of consignor and consignee are normally not included in the transport opportunity as they will be added at the time the order is issued; instead, there will be: origin/destination conditions origin commune and postal code (NUTS3) destination commune and postal code (NUTS3)  Normally no signature is added (only the principal's or forwarder's ID.) as transport opportunities have no contractual value  Request for offer/quotation

<b>Table</b>	<b>Transport Offer (Quotation)</b>
Contents	= Transport opportunity. Note that transport offers do normally not contain a signature.  Additional attributes are: Transport offer ID. (replaces transport opportunity ID.) Quotation/offer

<b>Table</b>	<b>Notice/Proof of Pick-up or Delivery (see too transport order status)</b>
Contents	<p>The pick-up and delivery notice/proof is a record that can be forwarded to the home base or to clients (notice) or proof (in which case it contains a signature) of the pick-up or delivery of goods in the context of a transport order. It also contains all relevant remarks related to the loaded and unloaded goods including any unforeseen service carried out at loading or unloading point in as well as any incidents or unforeseen waiting times that may have an effect on the transport invoice.</p> <p>Pick-up/delivery notice/proof ID                      Pick-up or delivery                      Transport order ID                      Remarks for date and time window at loading/unloading point                      Remarks services requested at loading/unloading point                      Remarks waiting time at loading/unloading point                      Remarks goods loaded/unloaded</p> <p>The number of entries in this data store depends on the number of pick-ups and deliveries that must be stored until the corresponding order is finalised (paid or uploaded to the home base).</p>

<b>Table</b>	<b>Principal/Consignor/Consignee/Forwarder</b>
Contents	<p>Customer/contact ID</p> <p>Name                      Contact person                      Address                      Telephone number                      Fax number                      E-mail address                      Creditworthiness and payment record                      Special preferences                      Specific access conditions</p> <p style="padding-left: 40px;">Opening hours                      Dates closed                      Access constraints (e.g. bridge with weight limit, tunnel with height limit)</p>

Table	Transport Order Status (see notice/proof of pickup or delivery)
Contents	<p>Transport order ID</p> <p>Possible principal own reference.</p> <p>Transport order status</p> <p>OPTIONAL (and if not sent before) list of all previous transport order statuses</p> <p><i>Possible statuses are:</i></p> <p><i>Order executed according to schedule</i></p> <p><i>Position</i></p> <p style="padding-left: 40px;"><i>Driving incident</i></p> <p><i>Position</i></p> <p><i>List of incidents (delay due to traffic or weather conditions or accidents)</i></p> <p style="padding-left: 40px;"><i>Arrived at loading point</i></p> <p style="padding-left: 80px;"><i>Loading point ID</i></p> <p style="padding-left: 80px;"><i>Arrived at loading point</i></p> <p style="padding-left: 80px;"><i>Date, hour, minutes of arrival</i></p> <p style="padding-left: 80px;"><i>Minutes before schedule / on time / minutes behind schedule</i></p> <p style="padding-left: 80px;"><i>Expected waiting time before loading</i></p> <p style="padding-left: 40px;"><i>OPTIONAL: positioned at loading dock</i></p> <p><i>Loading point ID</i></p> <p><i>Positioned at loading dock</i></p> <p><i>Date, hour, minutes</i></p> <p><i>Expected waiting time before loading</i></p> <p style="padding-left: 40px;"><i>Start of loading operation</i></p> <p><i>Loading point ID</i></p> <p><i>Start of loading operation</i></p> <p><i>Date, hour, minutes</i></p> <p><i>Expected waiting time before end of loading</i></p> <p style="padding-left: 40px;"><i>Incident during loading operation</i></p> <p><i>Type of incidents</i></p> <p><i>Expected waiting time until recovery</i></p> <p><i>End of loading operation</i></p> <p><i>Loading point ID</i></p> <p style="padding-left: 40px;"><i>End of loading operation</i></p> <p><i>Date, hour, minutes</i></p> <p><i>Description of any anomaly or discrepancy detected at pick-up or delivery, of any reservation or refusal, made by the consignor / consignee (coded lists of status events and status reasons).</i></p> <p><i>Confirmation of correct loading / loading incident</i></p> <p><i>Expected departure time</i></p> <p><i>Expected arrival date and time at next client</i></p>

<b>Table</b>	<b>Invoice</b>
Contents	Invoice ID  Transport order ID  Payment conditions  Extra services at pick-up and delivery point  Extra waiting times at pick-up point and delivery point  <i>Normally an invoice can only be sent when proof of delivery has been received (but this can be negotiated).</i>

<b>Table</b>	<b>Rate/Tariff</b>
Contents	Standard rates and tariffs for different types of orders and services

<b>Table</b>	<b>Cargo</b>
Contents	Cargo ID Cargo text Cargo weight Cargo quantity Cargo number of parcels

<b>Table</b>	<b>Logistic Unit</b>
Contents	Logistic unit ID Dimensions Weight Other characteristics

#### 4.2.2 Management of electronic documents

Table	Statutory Document
Contents	<p><b>Statutory documents</b></p> <p><i>Transport documents</i></p> <ul style="list-style-type: none"> <li>- Registration certificate</li> <li>- Transport Licence</li> <li>- Road waybill (i.e. CMR for international transport)</li> </ul> <p><i>Vehicle</i></p> <ul style="list-style-type: none"> <li>Vehicle registration card,</li> <li>Insurance certificate</li> <li>Tax receipt</li> <li>Type approval certificate</li> <li>Vehicle inspection certificate</li> </ul> <p><i>Driver</i></p> <ul style="list-style-type: none"> <li>Driving license</li> <li>Qualification certificate</li> <li>Logbook, or Mission Order</li> </ul> <p><i>Freight (cargo)</i></p> <ul style="list-style-type: none"> <li>Public Health Certificate</li> <li>Dangerous goods declaration</li> <li>TREMCARD</li> <li>Customs documents</li> <li>Other clearance certificates, such as alcohol, etc...</li> </ul> <p><i>Equipment</i></p> <ul style="list-style-type: none"> <li>Equipment features document</li> </ul> <p><i>Trip</i></p> <ul style="list-style-type: none"> <li>Motorway payment certificate</li> <li>Ecopoints</li> </ul>

Table	Transport Order
Contents	See description under 'Management of commercial information '

## 4.2.3 Monitoring of operational information

### 4.2.3.1 Monitoring of operational statuses

Table	Driver Status
Contents	<p>This data store contains very detailed information on the driver’s activities and his behaviour. Some of this information overlaps with the content of other data stores, namely “pick-up and delivery report/notice/proof” and “transport order status”. The data store mainly contains two types of information:</p> <p><u>The log book of the driver</u> that consists of recording the chronology of activities performed by the driver. Items between brackets mean that the action can be automatically detected by sensor activation:</p> <p>Time/date                      Action :</p> <ul style="list-style-type: none"> <li><i>(Trailer coupling)</i></li> <li><i>(Trailer uncoupling)</i></li> <li><i>(Load body)</i></li> <li><i>(Unload body)</i></li> <li><i>Start loading</i></li> <li><i>End loading</i></li> <li><i>Start unloading</i></li> <li><i>End unloading</i></li> <li><i>Forecasted extra activities</i></li> <li><i>Non-forecasted extra activities</i></li> <li><i>Customs clearance operation</i></li> <li><i>Authorities inspection</i></li> <li><i>Weighting</i></li> <li><i>stowage</i></li> <li><i>Waiting for being ahead of schedule</i></li> <li><i>Abnormal waiting time</i></li> <li><i>Road incident</i></li> <li><i>Modal shift(train, ferry)</i></li> <li><i>(Road accident)</i></li> <li><i>(Driving)</i></li> <li><i>(Rest)</i></li> </ul> <p><u>Other driver operational data</u></p> <ul style="list-style-type: none"> <li>Driver ID</li> <li>Vehicle ID</li> <li>Trailer ID</li> <li>Odometer</li> <li>Vehicle position</li> <li>Performance data such as                             <ul style="list-style-type: none"> <li><i>Distance covered</i></li> <li><i>Fuel consumption</i></li> <li><i>Maximum speed</i></li> <li><i>Maximum engine rotation speed</i></li> <li><i>Average speed</i></li> <li><i>Etc..</i></li> </ul> </li> </ul>

<b>Table</b>	<b>Vehicle Status</b>
Contents	This data store contains all information relating to the vehicle usage such as: Vehicle operational data ID (e.g. time of sampling) Odometer first use Odometer end Distance covered Accumulated engine revolutions Engine speed profile Speed profile Idle duration Operating duration Speed violation duration Rpm violations occurrences and duration Maximum rpm Maximum speed Total fuel used Average fuel consumption Etc.

<b>Table</b>	<b>Cargo Status</b>
Contents	Sampling over time of: <i>Temperature</i> <i>Humidity</i> <i>Pressure</i>

<b>Table</b>	<b>Equipment Status</b>
Contents	Operational data of equipment used to carry out a transport, ordered by time

<b>Table</b>	<b>Accessory Status</b>
Contents	Operational data of an accessory used to carry out a transport, ordered by time

#### 4.2.3.2 Management of loading/unloading information

<b>Table</b>	<b>Load Plan</b>
Contents	Load plan ID Load plan text Vehicle/trailer ID Order of loading (unloading) list ( <i>the following block repeated for each good</i> ) Logistic unit ID Position (lowest x- and y-position) Space left

<b>Table</b>	<b>Logistic Unit</b>
Contents	Logistic unit ID Dimensions Weight Other characteristics

<b>Table</b>	<b>Cargo</b>
Contents	Please refer to the description given under ‘Management of commercial information’

<b>Table</b>	<b>Vehicle or Trailer</b>
Contents	Field specifying if vehicle or trailer is concerned  <b>Vehicle</b> Vehicle ID Registration ID Type of vehicle (e.g. for refrigerated or hazardous goods) Technical data (for maintenance and operation) Dimensions of loading space  <b>Trailer</b> Trailer ID Registration ID Type Technical data Dimensions of loading space

### 4.2.3.3 Management of tasks order

Table	Tasks order
Contents	<p>Date/time. Date/time of creation by the operator/driver = manual validation by the latter, likely to differ more or less from the time of sending.</p> <p>The date/time of reading by the addressee is likely to be added to the record kept at the base.</p> <p>Report classes (reading, processing, error).</p> <p>Type of processing (process triggered by the message in the on-board computer, screen types).</p> <p>Driver code and towing vehicle code, and any general remarks ...</p> <p>Sequencing and dates.</p> <p>Possible links with an item / transport order.</p> <p>Information on customs clearance and the hazardous nature of the contents of the "equipment".</p> <p>Information concerning the "equipment" (see transport order).</p> <p>Description of the tasks coded and additional clear text</p>

Table	Task
Contents	<p>Description of the task :</p> <p>Wait for a new tasks order, Loading, Unloading, Loading shift, Unloading shift, Go to such precise place, Move in a given direction, Go through ...(e.g. Ferry, etc. ...), Take such accessory, Check availability of such accessory, Check the state of a given vehicle organ, Take documents, Change tractor, Park tractor at such a place, Have tractor and / or trailer washed, Refuel at such a place, Go to Workshop, Take back reusable equipment, Special action.</p> <p>One should indicate the "type of report process" required to the driver, as well as the "format type":</p> <p>The "format type" can in fact be understood as an "(alphanumeric?) macro number" and must be linked to the case scenarios (start / end of task / discrepancy).</p> <p>Attributes of the task (places and dates/times)</p> <p>Remarks or comments</p>

Table	Task Report
Contents	<p>Date/time. Date/time of creation by the operator/driver = manual validation by the latter, likely to differ more or less from the time of sending.</p> <p>The date/time of reading by the addressee is likely to be added to the record kept at the base.</p> <p>Report classes (reading, processing, error).</p> <p>Type of processing (process triggered by the message in the on-board computer, screen types).</p> <p>Principal description and contract number (optional), "qualified" client reference.</p> <p>Information on the assignment (and any possible assignment/item links) and the vehicle/equipment concerned, dates/times, remarks...</p> <p>On non compliance, place, goods, quantities, etc. ...</p>

<b>Table</b>	<b>Landmark</b>
Contents	Landmark ID Consignor/Consignee ID or NULL Type (consignor, consignee, ferry, stop, etc.) Position (co-ordinates)

#### **4.2.3.4 Management of additional information**

<b>Table</b>	<b>Driver Expense</b>
Contents	Detailed accounts of driver expenses

<b>Table</b>	<b>Re-usable equipment</b>
Contents	Re-usable equipment ID Trip ID Date, time Quantity Type of package Type of logistic address code Logistic address Quality code Status code

#### **4.2.4 Management of road information**

<b>Table</b>	<b>Route (Link)</b>
Contents	Link ID Trip (task) ID Road segment ID Sequence number

<b>Table</b>	<b>Road Segment</b>
Contents	Road segment ID Start intersection ID End intersection ID Length Type of road (freeway, primary or secondary street) Allowed speed Toll Dangerous goods prohibited

<b>Table</b>	<b>Landmark</b>
Contents	Landmark ID Consignor/Consignee ID or NULL Type (consignor, consignee, ferry, stop, etc.) Position (co-ordinates)

#### 4.2.5 Management of resource information

<b>Table</b>	<b>Driver</b>
Contents	Driver ID Name Address License Salary, currency Specialisation Preferences

<b>Table</b>	<b>Vehicle</b>
Contents	Vehicle ID Mission order (tour) ID Registration ID Type of vehicle (e.g. for refrigerated or hazardous goods) Technical data (for maintenance and operation)

<b>Table</b>	<b>Equipment (e.g. Trailer)</b>
Contents	Equipment ID Task (trip) ID Registration ID Type Technical data

<b>Table</b>	<b>Accessory</b>
Contents	Accessory ID Vehicle ID Type Technical data

### 4.3 BUSINESS SCENARIOS

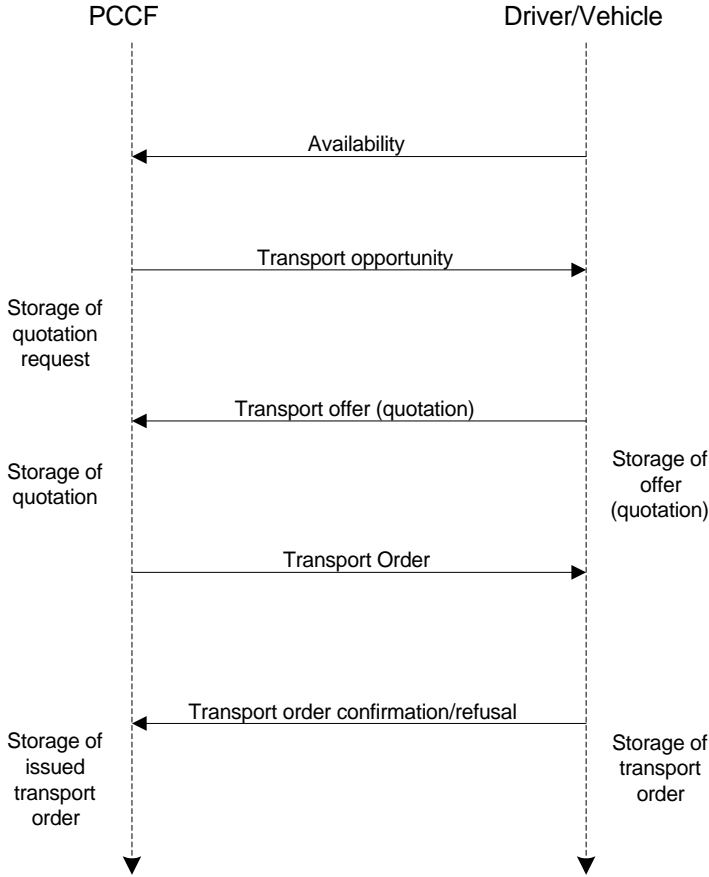
The translation of this information architecture into messages exchanges is illustrated here after by a few examples of business scenarios. One is showing the management of a transport order process by an independent or chartered driver.

The other ones apply to the fleet driver and show :

- Transport order issuing
- Basic scenario,
- Tasks order performance including a transport order execution down to proof of delivery
- Re-optimisation of route
- Monitoring of vehicle
- Control of re-usable equipment
- Monitoring of transport order status

**4.3.1 Transport order issuing (independent or chartered driver)**

The principal (consignor, consignee or forwarder) presents a transport opportunity to one (or more) independent drivers (and/or fleet managers), which have stated their availability, together with a request for quotation; each request is stored in a quotation data-store. All interlocutors (including the displayed driver) reply with a transport offer (quotation), which is stored in the respective transport offer data-store. The principal stores each transport offer, chooses the most suitable (which happens to be the one sent by our driver) and sends the transport order to the driver. The driver checks all further parameters and confirms the transport order. The transport order is stored in the appropriate data-store. The principal receives the transport order confirmation and sets the status of the respective transport order to the state ‘issued’.

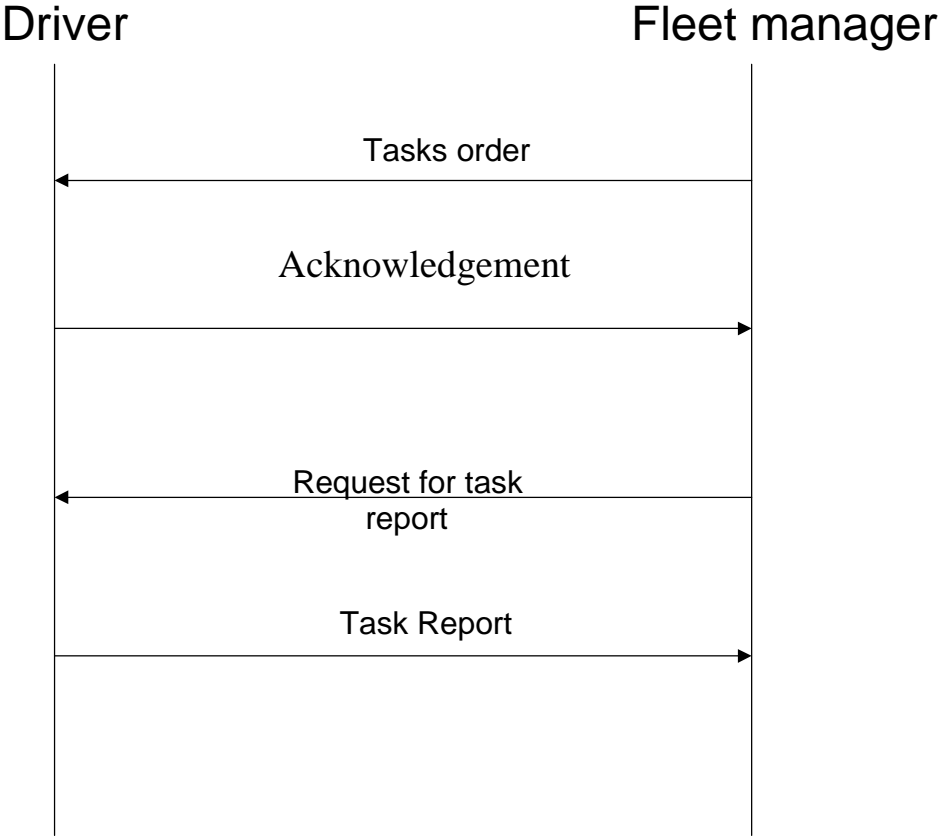


**Figure : 20. Transport order issuing.**

**4.3.2 Basic scenario (fleet driver)**

The fleet manager sends a tasks order to the driver as soon as he knows that this tasks order can be considere by the actual vehicle – driver pair. These tasks are limited tothe immediate horizon for this pair.

The driver acknowledges this tasks order, accepts it or possibly objects to it for reasons yet unknown to the fleet manager. He will report as scheduled in the tasks order for each relevant phase of the task performance ar the fleet manager may decide to request a task report at any moment.



**Figure : 21. Tasks order and report**

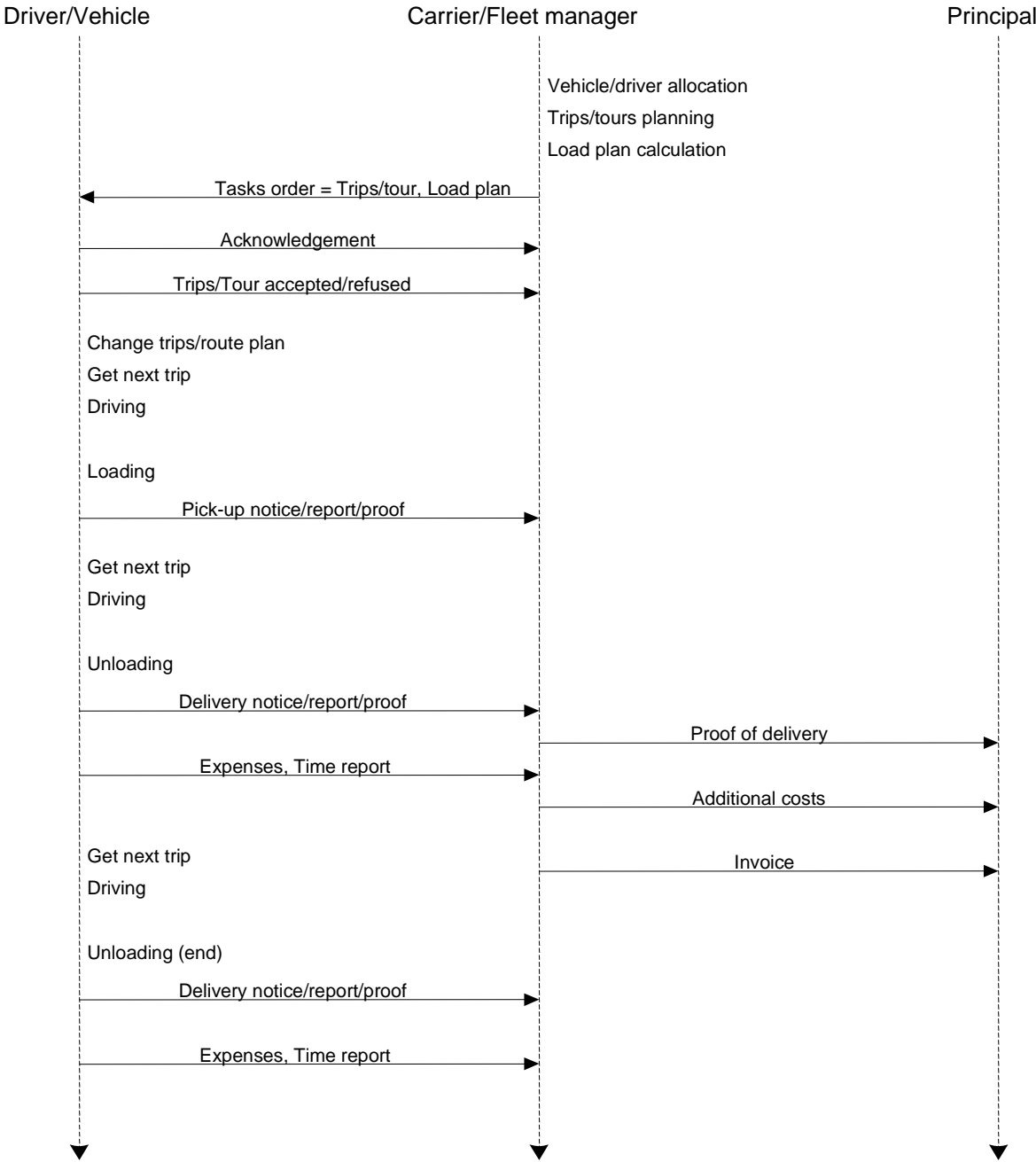
### **4.3.3 Tasks order performance including a transport order execution down to proof of delivery (and invoicing) (fleet driver)**

The fleet management software of the carrier/fleet manager allocates vehicles to drivers using the tasks orders as input, plans trips/tours and calculates the respective load plans. The trips/tours are downloaded to the respective vehicles (drivers) together with the load plans. The onboard system acknowledges the reception of the information.

As soon as the ignition key is activated, the onboard computer asks the driver whether he acknowledge the planned task. On positive answer it changes the task plan according to the newest information. The data concerning the next tasks are read from the data-store and are displayed on the onboard monitor. The driver starts the task. E.g. after each loading procedure a signed (by the driver) pick-up notice/report/proof is sent to the fleet manager.

On completion of a trip, the data for the new trip is loaded from the data-store and displayed on the onboard monitor. A time report and a report of driver expenses is sent to the fleet manager.

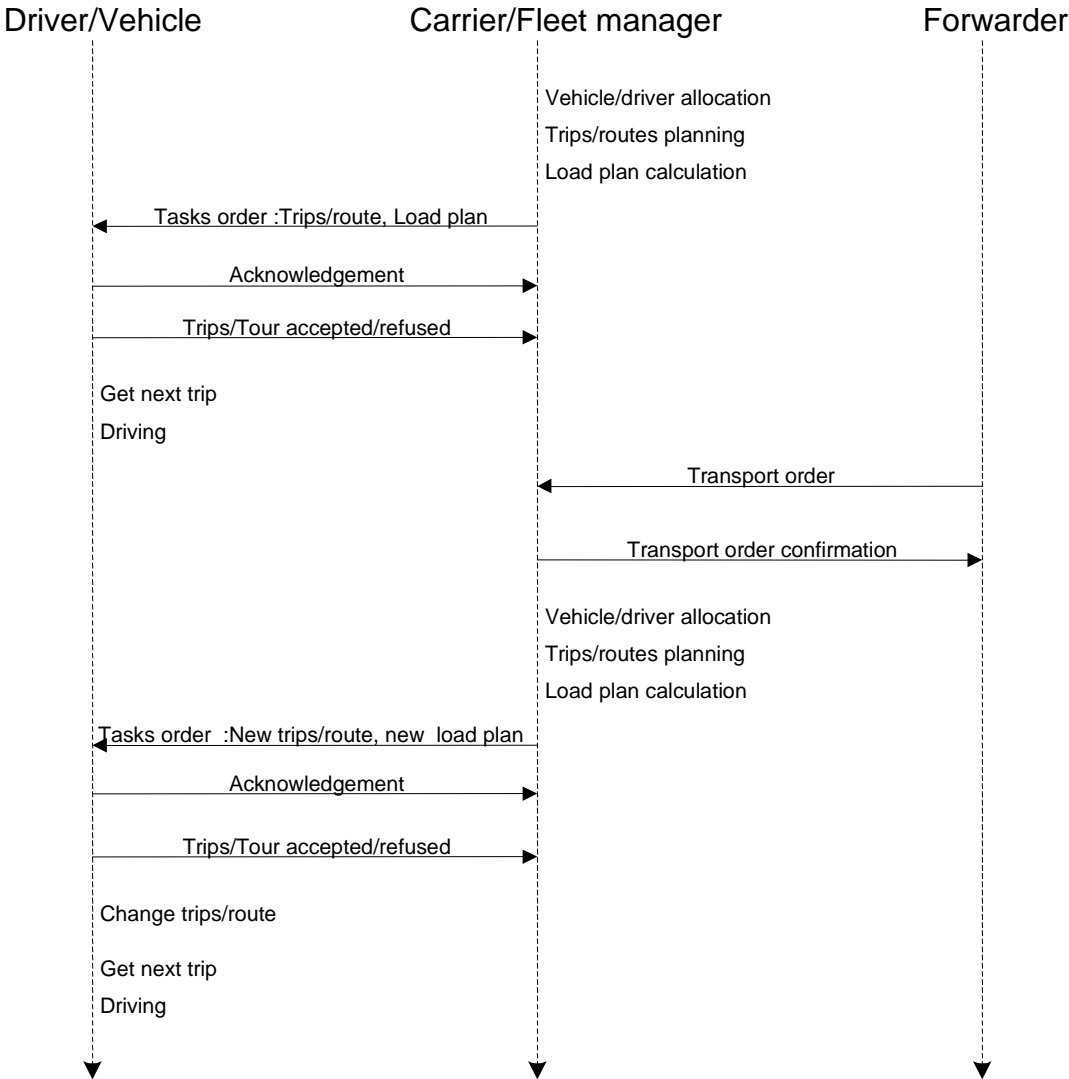
After each unloading procedure, depending on the functionality of the onboard application, a signed (by the consignee) delivery report/proof is sent to the carrier/fleet manager. Alternatively the application may be simply capable of sending delivery notices, without including signatures of the consignees.



**Figure : 22. Tasks order performance including a transport order execution down to proof of delivery (and invoicing) (fleet driver)**

**4.3.4 Re-optimisation of route (fleet driver)**

A new transport order is received by the carrier/fleet manager and a task is immediately attributed to a driver/vehicle already being on a suitable tour. After re-optimisation of the trips/route and of the load plan, the information is downloaded to the concerned vehicle. The onboard application receives the new data, acknowledges the reception and displays the tour modification request to the driver. The driver answers with a tour modification confirmation (refusal is also possible). The onboard application automatically loads the data concerning the next trip and displays it on the onboard monitor. The driver continues his tour according to the new parameters.

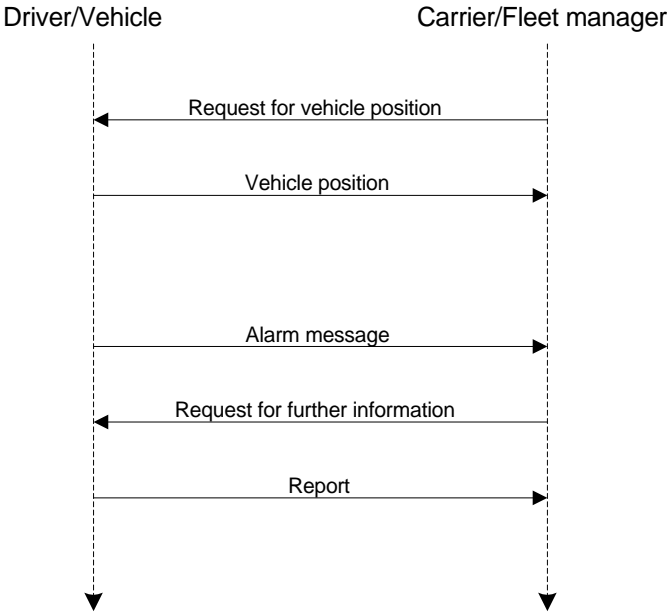


**Figure : 23. Re-optimisation of route.**

### 4.3.5 Monitoring of vehicle (fleet driver)

The fleet manager sends a request for position information to the vehicle. The request is answered promptly.

In case of a serious danger to driver, vehicle, or cargo, an alarm is displayed on the onboard display and an alarm message is sent to the fleet manager. The fleet manager immediately requests further information, either by calling the driver, or by sending an appropriate request message. The request is answered by the driver accordingly.



**Figure : 24. Monitoring of vehicle.**

### 4.3.6 Control of re-usable equipment (fleet driver)

Balance information regards the re-usable equipment (e.g. pallets, boxes) is sent to the fleet manager on each loading/unloading operation, either together with the pick-up/delivery notice/report, or as a separate message.

The entity administrating the balance information is the forwarder. A periodical balance of re-usable equipment is sent once a month from the forwarder to the consignor/consignee.

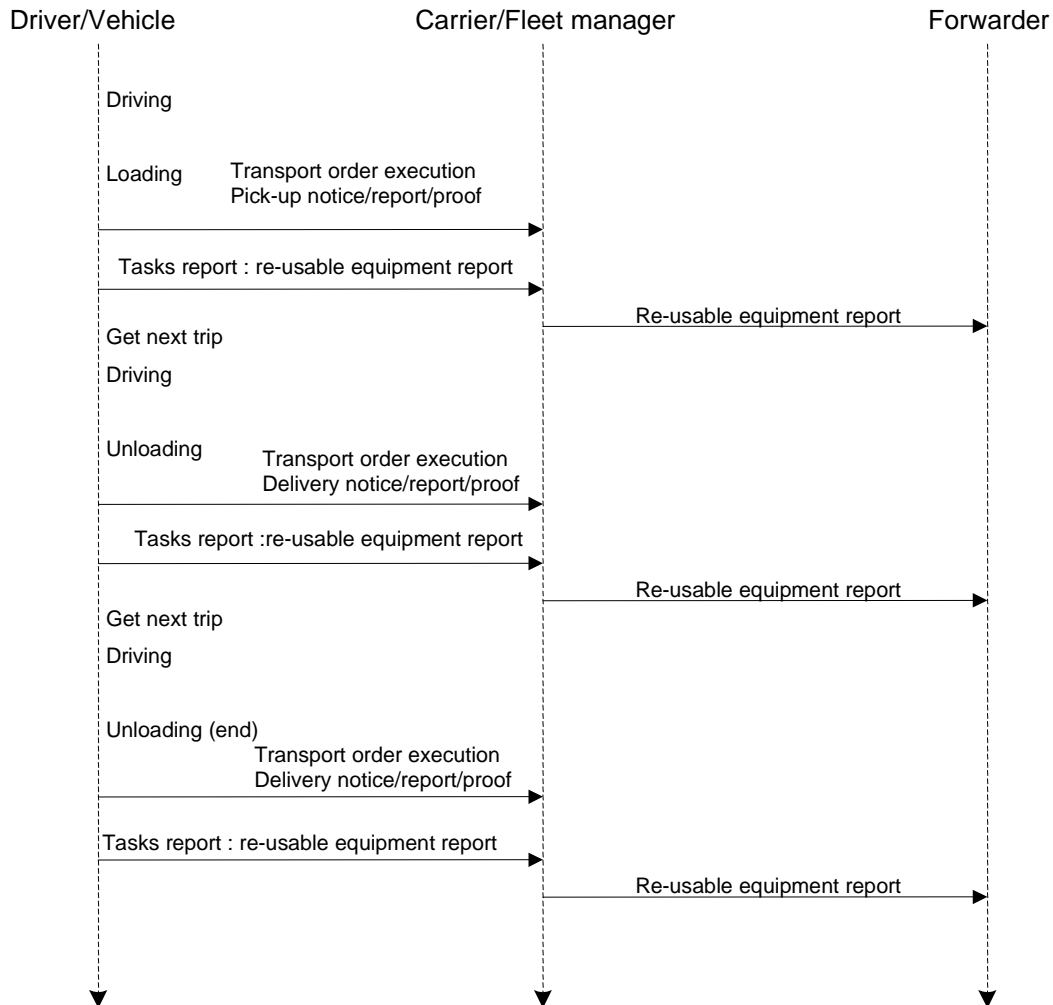
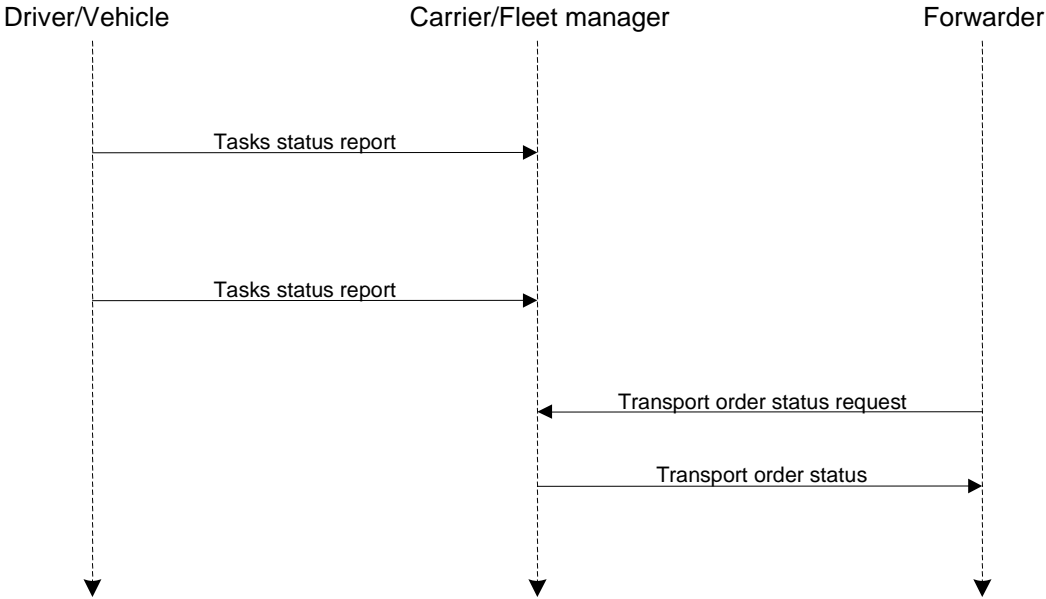


Figure : 25. Control of re-usable equipment.

**4.3.7 Monitoring of transport order status (fleet driver)**

The transport order status is a logical parameter, reflecting the state reached by the driver in a transport operation, on the achievement of his primary objective, the fulfilment of the transport order. It may be of a certain importance for a forwarder, or for a consignor/consignee.

The transport order status may change on each related task event. Transport order events are tasks related to loading/unloading, driving, waiting etc .... Transport order execution phases are covered by notice of pick up, proof of delivery.



**Figure : 26. Monitoring of transport order status.**

**4.4 MOBILE EDI MESSAGES**

To support the “messages” exchanged within these scenarios (information contents have been already addressed in 4.1) a standardisation proposal is being worked out by French EDITRANSPORT, a standardisation body in transport EDI, to which some COMETA PILOTS belong to.

This allowed for a permanent iterative process during Cometa project duration and resulted in a common support of this standardisation process.

This proposal will be detailed in COMETA Deliverable 6.2 addressing standardisation matters.

What can be found below and in the next pages is a list of present messages and the example of a “Tasks Message” using EDIFACT standard.

**A set of 6 Messages is presently worked out and could be extended :**

- 1. Transport (“item” ?) order (detailed content – unit load / item number), with information to be used by the consignee,**
- 2. Assignment and tasks order, providing details on the tasks to be fulfilled within the framework of the assignment,**
- 3. Addresses (insofar as the on-board computer does not have a data base),**
- 4. Report on tasks of all types,**
- 5. Questions / information from the base to the mobile unit,**
- 6. Questions / answers / information flow from the mobile unit to the base.**

In the following pages is given the example of what is called within COMETA a Tasks Order or “Tasks”...

This Message is a work in progress using EDIFACT.

For instance, an updated list of Tasks have been drafted in December 1999 in parallel with COMETA Systems Architecture development :

- Wait for a new tasks order,
- Loading,
- Unloading,
- Loading shift,
- Unloading shift,
- Go to such precise place,
- Move in a given direction,
- Go through ...(e.g. Ferry, etc. ...),
- Take such accessory,
- Check availability of such accessory,
- Check the state of a given vehicle organ,
- Take documents,
- Change tractor,
- Park tractor at such a place,
- Have tractor and / or trailer washed,
- Refuel at such a place,
- Go to Workshop,
- Take back reusable equipment,
- Special action.

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2. Assignment and tasks order							
Base -> Mobile							
Segment	Data elem.	Format	Leng.	Stat.	Description	Code values	Meaning or comments
<b>Out of envelope</b>					<i>Data / time of required emission</i>		<i>Requirement to the network operator</i>
DTM	2005	an	3	op.	Programmed date and time		<i>According to Networl protocol and modalities</i>
DTM	2380	an	35	op.	Date and time	SSAAMMJJHMM	
<b>INTERCHANGE ENVELOPE</b>							
UNB INTERCHANGE HEADER							
	0001	a	4	ma.	Syntax identifier		
	0004	an	35	ma.	Sender identification		
	0010	an	35	ma.	Recipient identification		
	0017	n	8	ma.	Date of preparation		
	0019	n	4	ma.	Time of preparation		
	0020	an	14	ma.	Interchange control reference		<i>Should allow sequencing for each adressed mobile : ref. + potential index N°.</i>
	0022	an	14	op.	Recipient's reference/password		
	0029	a	1	op.	processing priority code	A or nothing	
	0031	n	1	ma.	Acknowledgement request (techn.)	?	No acknowledgement
					....	?	Differed mandatory acknowledgement
					....	?	Immediate mandatory acknowledgement
	0035	n	1	op.	Test indicator		Real
					...	1	Test
<b>MESSAGE ENVELOPE</b>							
UNH							
	0062	an	14	ma.	Message reference number		
	0065	an	6	ma.	Message type identifier	?	Assignment and tasks order
	0052	an	3	ma.	Message type version number		
	0054	an	3	ma.	Message type release number		
	0051	an	2	ma.	controlling agency		
	0057	an	6	op.	Association assigned code		
					<i>rest of the segment to be defined</i>		<i>Common access reference?</i>
<b>ASSIGNMENT AND TASKS ORDER</b>							
BGM	1004	an	35	ma.	Document/message number		Assignment / Mission N°
BGM	1056	an	9	ma.	Index N°		Sequence N°
BGM	1225	an	3	ma.	Message function, coded	9	Original
					**	1	Cancellation
					**	5	Replace
					**	31	Copy
					**	42	Confirmation via specific means
DTM	2005	an	3	ma	Date/time/period qualifier	?	Date / time of message manual validation
DTM	2380	an	35	ma.	Date/time/period		
DTM	2379	an	3	op.	Date/time/period format qualifier	MMJJHMMSS	
GIS	7365	an	3	ma.	Processing indicator, coded (here : read)	?	"Reading acknowledgement requested" ?
GIS	7187	an	17	ma.	Process type identification	?	No report
GIS					(here : reading acknowledgement)	?	Differed mandatory report
GIS					**	?	Immediate mandatory report
GIS	7365	an	3	ma.	Processing indicator, coded (here : proc.)	?	"Processing acknowledgement requested" ?
GIS	7187	an	17	ma.	Process type identification	?	No report
GIS					(here : processing acknowledgement)	?	Differed mandatory report
GIS					**	?	Immediate mandatory report
GIS	7365	an	3	ma	Processing indicator, coded (here : error)	14	"error message requested"
GIS	7187	an	17	ma	Process type identification	?	No report
GIS					(here : error acknowledgement message)	?	Differed mandatory report
GIS					**	?	Immediate mandatory report
PRC	7191	an	17	ma	Process identification	?	On board computer process identification

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2. Assignment and tasks order (continued)								
Base -> Mobile								
Segment	Data elem.	Format	Leng.	Stat.	Description	Code values	Meaning or comments	
RFF	1053	an	3	ma.	reference qualifier	Up to twice		
RFF	1054	an	35	ma.	Reference number	AGP ou VT	Tractor identification code, by the carrier	
RFF	1054	an	35	op.	Reference number	AGS	Driver identification code, by the carrier	
FTX	4440	an	70	op.	Free text		Message comments	
FTX	4440	an	70	op.	Free text		Message comments	
<b>ASSIGNMENT AND TASKS ORDER (DETAILS OF TASKS)</b>								
STG	9421	n	3	ma.	Stages qualifier		Here driver mission	
STG	6426	n	2	op.	Number of stages		Number of tasks described in the message	
STG	6428	n	2	ma.	Actual stage : <b>Task sequence number</b>		Carrier internal N° of Assign. / task sequence	
DTM	2005	an	3	op.	Date/time/period qualifier	up to twice	Task execution start date / time	
DTM	2380	an	35	op.	Date/time/period		Task execution limit date / time	
DTM	2379	an	3	op.	Date/time/period format qualifier	MMJJHMM		
RFF	1053	an	3	op.	Reference qualifier	ma. if segment is used	CN	Given by carrier
RFF	1054	an	35	op.	<b>Transport order number</b>	X ...	(link)	Referring or not to a client order number
				op.	<b>Item N°</b>	(an 17 + n 8 ?)		(departure-arrival address & goods)
GOR	9353	an	3	op.	Government procedure		5 or 6	Customs clearance management
FTX	4440	an	70	op.	Free text			Comments on Customs clearance
FTX	4440	an	70	op.	Free text			Comments on Customs clearance
DGS	8273	an	3	op.	Dangerous goods regulations, coded			here ADR code
FTX	4440	an	70	op.	Free text			ADR plain text
FTX	4440	an	70	op.	Free text			Comments
EQD	8053	an	3	op.	Equipment qualifier	X ...	CN	Container
EQD	8053	an	3	op.	""		PA	Palett
EQD	8053	an	3	op.	""		PL	Platform
EQD	8260	an	17	op.	Equipment identification number			Carrier's or chartered party Trailer N° code
EQD	8260	an	17	op.	Equipment identification number			Swap body N° 1 code
EQD	8260	an	17	op.	Equipment identification number			Swap body N° 2 code
EQD	8154	an	35	op.	Equipment size and type (description)			(Straps, cable...)
EQN	6350	n	15	op.	Number of units			Number of necessary equipment units
EQN	6353	an	3	op.	Number of units qualifier		?	Management description : to be picked, left...
FTX	4440	an	35	op.	Free text			Loading plan in the trailer
RCS	7293	an	3	ma.	Sector / subject identification qualifier	(codes to be claimed for)	?	"Road haulage driver management" ?
RCS	7295	an	17	ma.	Requirement identification	idem	ex : 1	Task ordered by client
RCS					(here : task originator) identification		ex : 2	Task ordered by carrier
RCS	7294	an	35	op.	Requirement or condition	X ...		Type of Task (clear text)
RCS	1229	an	3	ma.	Action request / notification, coded	(codes to be provided)	ex : C	Loading
RCS					""		D	Unloading
RCS					""		RC	Loading shift
RCS					""		RD	Unloading shift
RCS					""		P	Positioning
RCS					""		VV	Movement towards...
RCS					""		Others	

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2. Assignment and tasks order (continued)							
Base -> Mobile							
Segment	Data elem.	Format	Leng.	Stat.	Description	Code values	Meaning or comments
GIS	7365	an	3	ma.	Processing indicator	?	here : "Task start report" requested
GIS	7187	an	17	ma.	Process type identification	?	No report
GIS	7187	an	17	ma.	(here report class)	?	Differed mandatory report
GIS	7187	an	17	ma.	...	?	Immediate mandatory report
PRC	7191	an	17	ma	Process identification	?	Task start report format in on board computer
GIS	7365	an	3	ma.	Processing indicator	?	here : "Task end report" requested
GIS	7187	an	17	ma.	Process type identification	?	No report
GIS	7187	an	17	ma.	...	?	Differed mandatory report
GIS	7187	an	17	ma.	...	?	Immediate mandatory report
PRC	7191	an	17	ma	Process identification	?	Task end report format in on board computer
GIS	7365	an	3	ma.	Processing indicator	?	here : "deviation report" ?
GIS	7187	an	1	ma.	Process type identification	?	No report
GIS	7187	an	1	ma.	...	?	Differed mandatory report
GIS	7187	an	1	ma.	...	?	Immediate mandatory report
PRC	7191	an	17	ma	Process identification	?	Deviation report format in on board computer
LOC	3227	an	3	op.	Place / location qualifier	If not mentioned in order	(link) Address where the task will be performed
LOC	3225	an	25	op.	Place / location identification	7 , 9 or others...	
DTM	2005	an	3	op.	Date/time/period qualifier	If not mentioned in order	Earliest expected entry
DTM	2380	an	35	op.	Date/time/period		
DTM	2379	an	3	op.	Date/time/period format qualifier	MMJJHHMMSS	
DTM	2005	an	3	op.	Date/time/period qualifier	If not mentioned in order	Latest expected entry
DTM	2380	an	35	op.	Date/time/period		
DTM	2379	an	3	op.	Date/time/period format qualifier	MMJJHHMMSS	
DTM	2005	an	3	op.	Date/time/period qualifier	If not mentioned in order	Earliest expected exit
DTM	2380	an	35	op.	Date/time/period		
DTM	2379	an	3	op.	Date/time/period format qualifier	MMJJHHMMSS	
DTM	2005	an	3	op.	Date/time/period qualifier	If not mentioned in order	Latest expected exit
DTM	2380	an	35	op.	Date/time/period		
DTM	2379	an	3	op.	Date/time/period format qualifier	MMJJHHMMSS	
DTM	2005	an	3	op.	Date/time/period qualifier	If not mentioned in order	Commercial waiting time agreed upon... duration
DTM	2380	an	35	op.	Date/time/period		
DTM	2379	an	3	op.	Date/time/period format qualifier	HHMMSS	
FTX	4440	an	70	op.	Free text		Tasks comments
FTX	4440	an	70	op.	Free text		Tasks comments
FTX	4440	an	70	op.	Free text		Tasks comments
FTX	4440	an	70	op.	Free text		Tasks comments

## **5 PHYSICAL AND COMMUNICATION ARCHITECTURE : « FREIGHT FLEET VEHICLE, DRIVER, CARGO, EQUIPMENT SYSTEM » WITHIN FREIGHT AND FLEET MANAGEMENT SYSTEMS.**

This Chapter provides a description of the Physical Architecture which forms part of the COMETA System Architecture.

### **Definition of a Physical Architecture from KAREN Project which COMETA refers to.**

A Physical Architecture defines and describes the way in which the constituents of the Functional Architecture can be brought together into groups to form physical entities. The main characteristics of these entities are firstly that they provide one or more services required by the User Needs, and secondly that they can be created. This creation process may involve physical things such as roadside structures and various forms of equipment, non-physical things such as software, or a combination of the two. In the KAREN Physical Architecture these physical entities are called Systems.

### **COMETA**

So, a Physical Architecture will define and describe how the functionality created in the COMETA Functional Architecture (high level and low level functions, data flows to / from / between them and Terminators – **See Chapter 3**) can be grouped to form Systems that can be produced. These Systems will use components that are produced from hardware, software, or a mixture of the two. Through their inclusion of parts of the Functional Architecture, these Systems will of course be able to satisfy some or all of the requirements of the COMETA User Needs.

This Chapter considers the Physical Architecture as a series of “example Systems”.

This approach has been adopted because there are many ways in which a Physical Architecture can be produced from a Functional Architecture. The purpose of these “example Systems” is to illustrate examples of products that could be produced to fulfil some of the COMETA User Needs. The description of each System includes details of the parts of the Functional Architecture (Functions, Data Flows and Data Stores) that it includes, as well as providing information on what the System can provide.

### **5.1 COMETA PHYSICAL HIGHEST LEVEL : FREIGHT FLEET VEHICLE, DRIVER, CARGO, EQUIPMENT SYSTEM.**

This System can be seen as an “example System” for the Physical Architecture of a global “Intelligent Transport System Architecture” for which KAREN Project is providing a Framework.

It will be interfaced with other KAREN “example Systems” such as of course “Freight and Fleet Management Systems” and “Vehicle (not FFM or PTM) Systems”.

It will be described, in fact, through possible different occurrences of this example, according to different business scenarios or technical scenarios.

### **5.1.1 The two basic scenarios.**

Road freight transport is a very heterogeneous activity, it is clear, for instance, that truckload or pickup / delivery and large fleet or one man company, will require different features of the System...

But COMETA, as it can be seen in the Functional Architecture, have considered two major scenarios: one that could be seen as a “maximal” one, corresponding to a concept and hypothesis of “mobile office”, for independent or chartered drivers, one that could be seen as a “minimal” one, corresponding to large fleet drivers behaviour.

### **5.1.2 The Equipment Case...**

An important preliminary remark must be made here : within COMETA, EQUIPMENT means “a transport device unable to move by itself”, which is the definition used in EDI / EDIFACT messages allowing for information flows in parallel with physical freight flows.

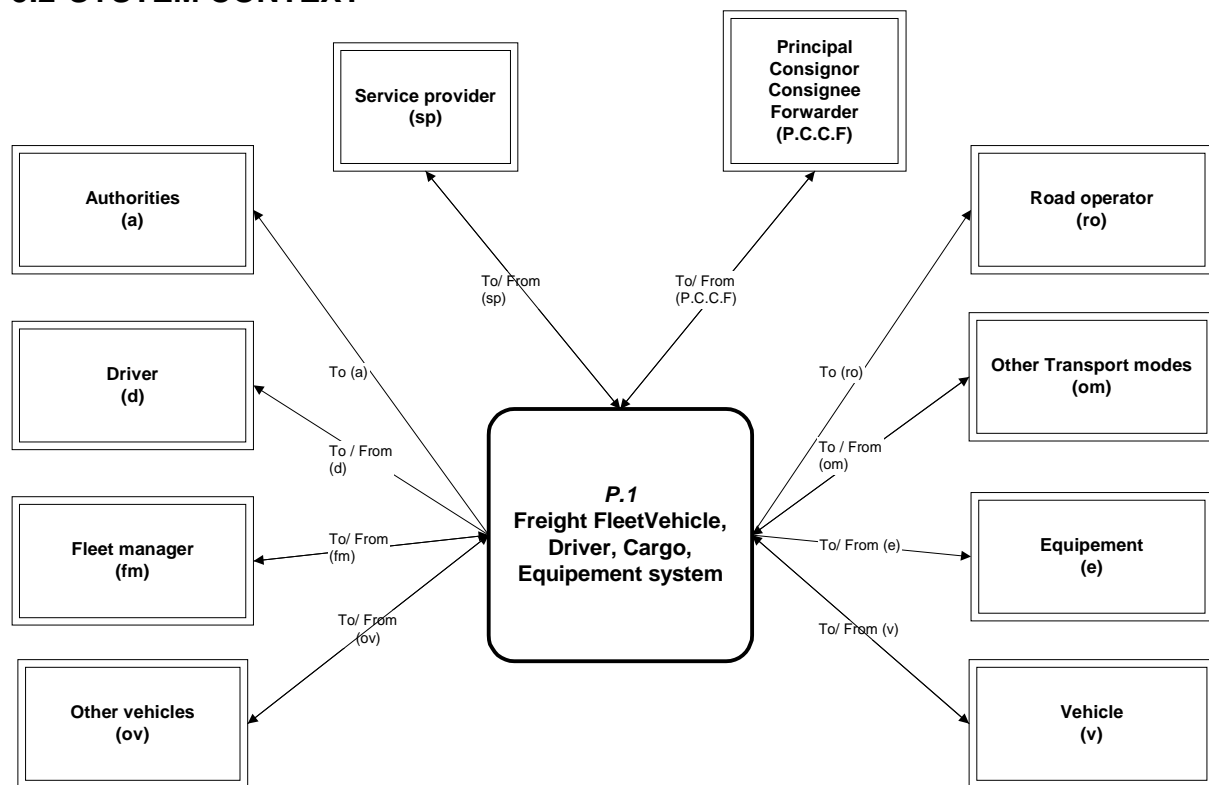
So an EQUIPMENT may be a Trailer, a Swap Body, a Container or even a Pallet (and outside COMETA scope, a wagon ...).

What is important in COMETA Physical Architecture is that these EQUIPMENT can be, regarding information capture, process and exchange, more or less enslaved to a motor vehicle or be completely independent from it at a given moment. It will be tracked and traced as such, will receive, emit information and even process some in the most sophisticated situation.

So it could host a rather multifunctional Subsystem.

This statement drove COMETA Project to add, to its own considerations about EQUIPMENT management representation through a Physical Architecture, as another “example System”, the TRACAR (Traffic and Cargo Supervision System) Project System Architecture (see annex 5).

## 5.2 SYSTEM CONTEXT



**Figure : 27. The context diagram**

As already seen, the first context is KAREN project as such, and as one can read in KAREN Physical Architecture for Distributed Freight Management System:

“It has been created to illustrate how the recommendation of certain standards at the European level could:

1. in the short term improve the efficiency of existing Freight Management systems
2. in the medium term, harmonise the transport of Freight across Europe in a wider sense, after study of the results of KAREN and by evolving European transport policy to further use ITS”.

What COMETA can add to that, is the justification of a more efficient and safer working environment for the professional drivers, this environment implying a new kind of relationships between Authorities and Fleet Managers, sharing and benefiting from common systems.

The “second” one, the usual description of the context of a System Architecture that can be seen in figure 26, comes from KAREN too with one adaptation proposal : “Equipment”.

The System Context describes the framework within which the System exists. It is illustrated using a System Context Diagram, which is shown in the Figure 1. In the Diagram are shown the links that this particular System has with the outside World. The outside World is represented by terminators.

Terminators have been defined by COMETA at the beginning of Chapter 3 addressing Functional and Control Architecture.

What could be added here is that some “Services Providers” could be more explicitly identified, such as “Emergency Systems”, “Maintenance Organisation”, “Weather Systems,” or that automatic “dialogues” with such terminators as “ambient environment,” present in KAREN, or “Infrastructure” (even not present in KAREN, which is rather surprising – only “road pavement” can be found), important for Advanced Driver Assistance.

“Equipment” in the meaning described here above, have been of course introduced and will be proposed to KAREN.

## **5.3 OVERVIEW OF THE APPROACH**

### **5.3.1 COMETA / KAREN**

So as to insure consistency with KAREN Project , COMETA have proceeded to the identification of “Sub-systems” and “modules” within them.

- Fleet management Sub-system, home based, so outside COMETA scope, but to be interfaced with,
- Freight management sub-system, home based or forwarder / principal based, so outside COMETA scope too, but covers some functions performed by “Independent and Chartered Drivers” (sometimes called “Independent Drivers” or “owner drivers” in COMETA).
- Freight Fleet vehicle, driver, cargo, equipment system to be found on board the mobile commercial production unit which is now the “Intelligent” truck and maybe trailer...

#### **KAREN “example System”:**

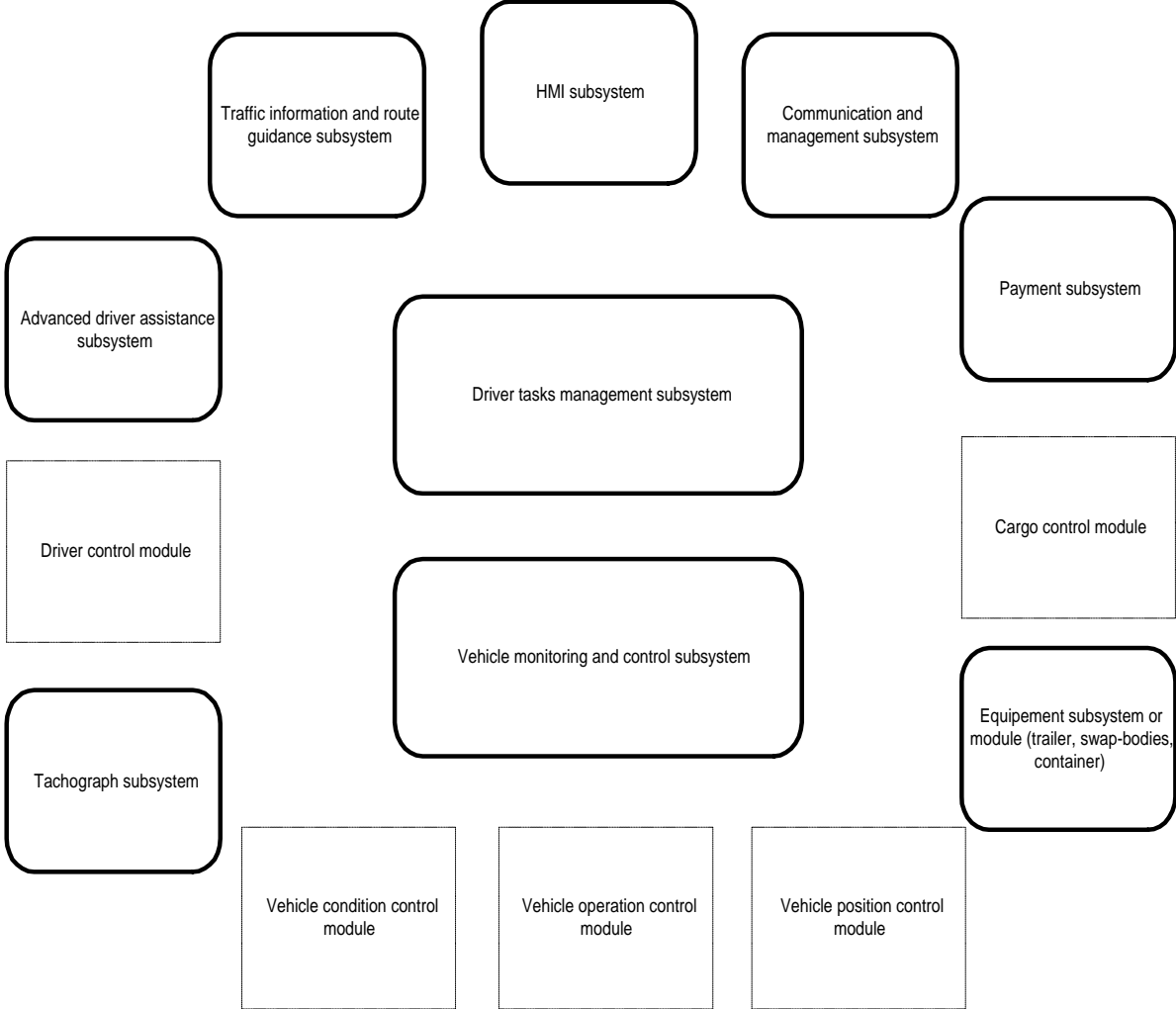
P81 – Distributed Freight Management System (the Vehicle is seen as a terminator)

P81 is subdivided into two Subsystems :

- P81.1 Fleet Management Sub-system (which exchanges with “Vehicle” and “Driver” as terminators)
- P81.2 Freight Management Services Subsystem.
  - P81.1 is subdivided into :
    - P81.1.1 Central Fleet Manager Module (which exchanges with “Driver” and “Vehicle” as terminators, and “multimodal system”),
    - P81.1.1.2 Fleet Maintenance Module (which exchanges with “Vehicle” as a terminator),
  - P81.2 is subdivided into :
    - P81.2.1 Freight Services Module,
    - P81.2.2 Freight to Fleet Co-ordination Module (which exchanges with “multimodal system”).

**5.3.2 Within Cometa direct scope : the concept.**

*Freight, Fleet, Driver/Vehicle/Cargo/Equipement system*  
*The concept*



**Figure : 28. Freight Fleet Vehicle, Driver, Cargo, Equipment system :  
 The Concept**

Figure 27 can be seen as the presentation of the separate “boxes” of intelligence (that is to say functions performance) that can be potentially mounted on board a commercial vehicle, more or less implicitly, used within it.  
 Some of these boxes are in fact already more or less complex systems that will become COMETA SA sub-systems.  
 Some are more dedicated and could be seen as drawers to be inserted in a box. They will become COMETA SA modules of sub-systems.  
 COMETA Physical Architecture should then allow to understand how these sub-systems and modules could be combined so as to support the functional Architecture, nowadays or in possible different futures.

### **5.3.2.1 Static View.**

This COMETA System provides, either for large freight fleet or for independent or chartered drivers (refer to Functional Architecture), a Freight Fleet Vehicle, Driver, Cargo, Equipment System, when these four entities are combined so as to perform operational or commercial road freight transport activities, even involving other transport modes, in a given infrastructures management and public regulatory environment. It does mean that it is limited to on board information management but it means that it aims to the integration of these four entities in a wider intelligent transport system.

The System is physically distributed, consisting in :

- Driver Tasks Management Sub-system,  
Which supports the execution, monitoring, reporting of tasks required from a driver by his Fleet Manager or directly by another “partner” such as Principal, Freight Forwarder, Consignor, Consignee, Infrastructure Managers, Authorities, or the performance of which will be helped by the same, or by dedicated Telematic Services Providers.
- Vehicle Monitoring and Control Sub-system,  
Which provides an internal support to the driver, providing automatically or on request information, so as to prepare, execute, monitor and report on any operation involving the four above mentioned components.
  - This Sub-system gathers the following Modules, which will be detailed hereafter:
    - Driver control,
    - Vehicle operation control,
    - Vehicle condition control,
    - Vehicle position control,
    - Cargo control,
    - Equipment module, when this equipment is enslaved to the motor vehicle.

Equipment Sub-system, in the “Autonomous” scenario, where one will find nearly the equivalent of the “Vehicle Monitoring and Control Sub-system” mentioned here above, without, of course, a driver control module...

- Tachograph Sub-system, which captures, stores and protect information related to driver compliance with social regulation and others related to vehicle operation. This tachograph could be seen as a sensor like others used for data capture, but its legal status and the fact that it allows (beyond appropriate handling by the driver) for direct access from authorities, requires to consider it as a Sub-system as such..
- Advanced Driver Assistance Sub-system, which gathers driving helps which will be found in any “intelligent vehicle”, but with the addition of vehicle platooning functions more dedicated to freight vehicles.
- Payment Sub-system, which allows automatic electronic fee collection for various services (even without stopping the vehicle) and manages related procedures.

- Traffic Information and Route Guidance Sub-system, which provides with the driver another kind of help from simple appropriate information up to a complete automatic navigation system receiving possibly instructions from the infrastructures.
- Communication management Sub-system, which covers a possible wide range of solutions, from voice mobile phone or fax to a multiprotocol, multistandards, multinetworks (from short range to satellite, from infrared to INTERNET and UMTS...) communication platform.
- HMI Sub-system which provides, beyond all what can be already imagined through the above descriptions, interfaces such as display, keyboard, voice recognition and process, printer, bar code and smart card readers / writers, printer...
- Entertainment Sub-system, which will be found too in any “intelligent vehicle”, be it TV or INTERNET or other medium, but which will not be addressed here...

### **5.3.2.2 Dynamic View**

The “concept” means here that the combination of these Sub-systems and modules may vary, of course, according to companies profiles and transport activities specificity, but it means too and most, that, beyond technical evolutions to be expected in the coming years (COMETA Physical Architecture have not been “dated”...) the combination will depend on two major factors :

- Important on board information processing or simple terminal, all what can be remote processed, being processed that way (up to an automatic vehicle concept ? ...) with permanent communication.
- Progress (as far as relevant and cost/efficiency justified) towards a complete integration of these Sub-systems, which can be seen today as a group of separated building blocks, due to state of art, but, too, due to vehicle manufacturers and authorities present requirements.

Beyond the possible evolution of the “Generic Intelligent Vehicle” in the future, which consideration is left to KAREN, these perspectives will be briefly considered, added to the particular point of the “Intelligent Autonomous Equipment” mentioned above and added to the consideration of the impact of emerging possible “virtual fleet managers”, that is to say telematic services provided to drivers by third parties, through standardised applications interfaces.

A focus will be made, nevertheless, on what can be seen as a transitory phase allowed by standardisation of vehicles internal data buses.

Therefore, after a brief reminder of what can be seen as a starting situation, the “concept” will be developed on the basis of shortest term, or even on going, evolution.

**5.4 STARTING SITUATION**

Where one may find, on board a commercial vehicle, the following physical components, with functions they are supposed to serve.

<b>advanced driver assistance system (ADAS)</b>	<b>digital tachograph (DT)</b>	<b>EFC device (EFC)</b>	<b>engine computer (EC)</b>	<b>navigation system (NS)</b>	<b>OBC for FFM (OBC FFM)</b>
3.3.1, 3.3.2, 3.3.3, 3.3.4, 3.3.5	3.2.1	3.6.1	3.7.2	3.5	1.1, 1.2, 2.1, 2.2, 3.1, 3.2.2, 3.4, 3.6.2, 3.7.1, 3.8, 3.9, 3.10, 3.11, 3.12

Even not all these components can be found on board a vehicle and data flows between these components are often “should be” data flows...

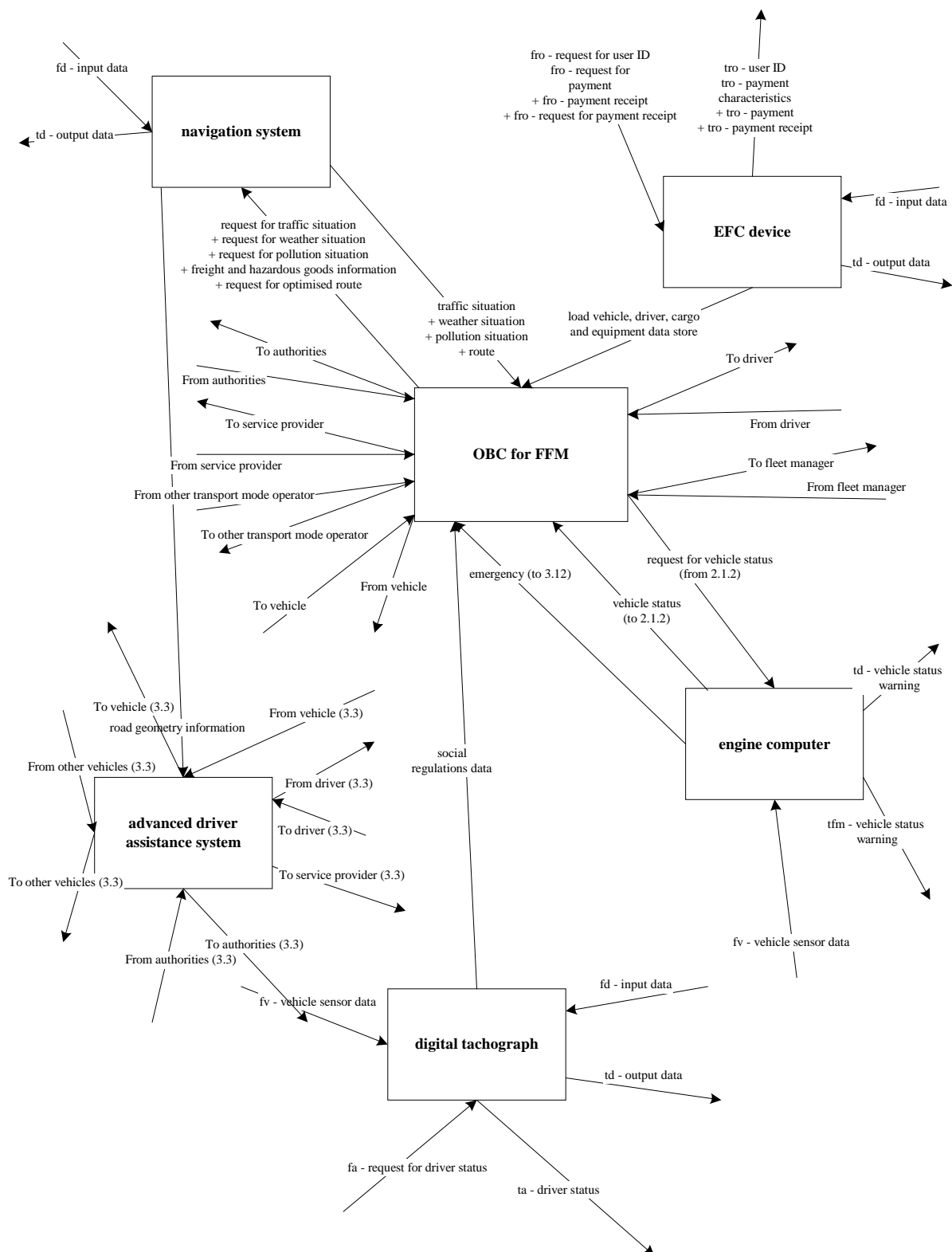


Figure : 29. Starting situation

## **5.5 SHORTEST TERM EVOLUTION**

Beyond the rather trivial presentation in the previous pages of what we have depicted as the “starting situation”, it is obvious that truck manufacturers and solution providers are already designing more “intelligent” architectures and that fleet managers or independent drivers, have in mind more comprehensive on board integrated systems...

So the combination of Sub-systems and modules for the beginning of years 2000 will be described hereafter.

### **5.5.1 Sub-Systems**

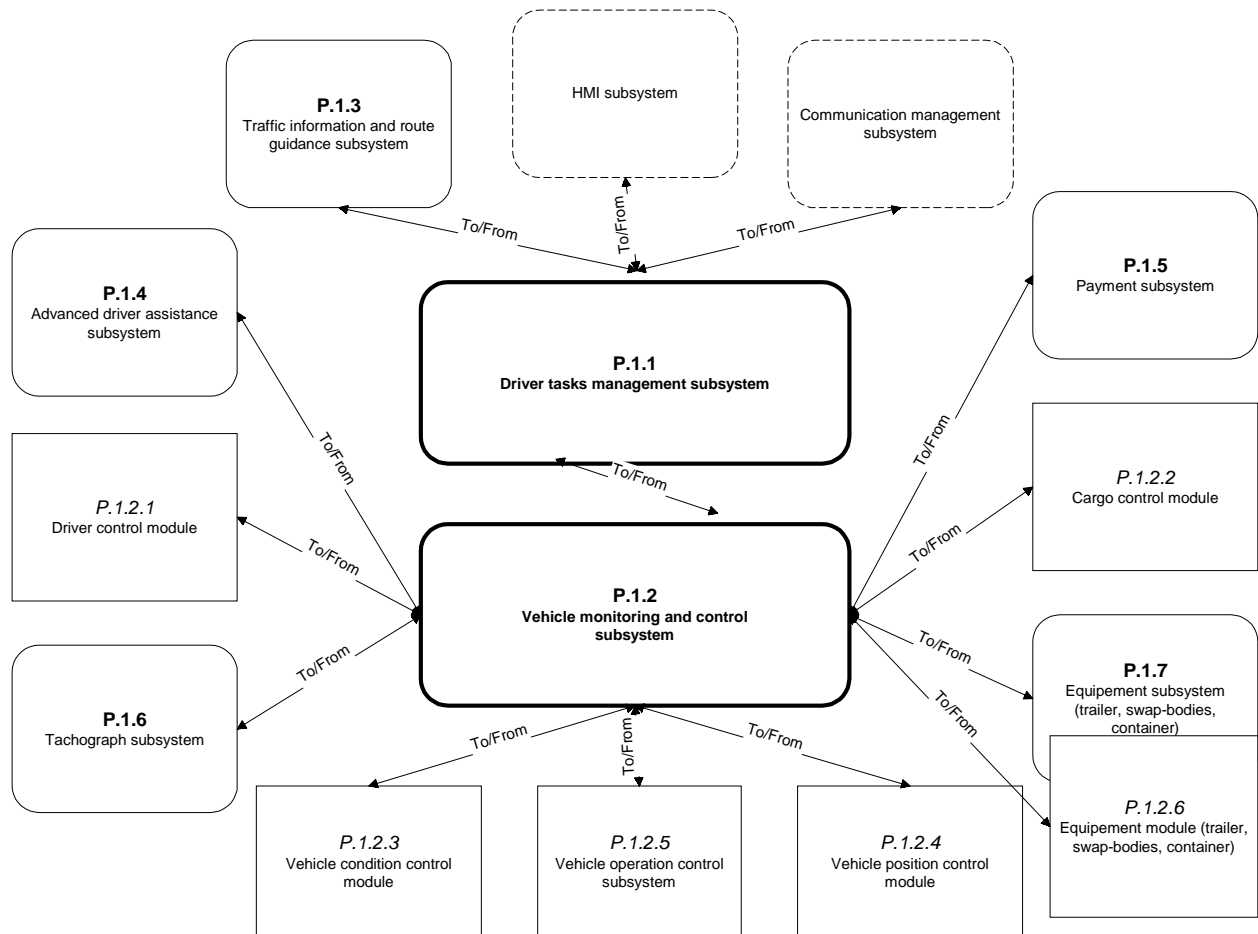
The Freight Fleet Vehicle, Driver, Cargo, Equipment System consists in (possibly, if the Equipment is autonomous...) seven Sub-systems.

They provide a demonstration of the different functionality within the management system, an illustration of how :

- an independent or chartered driver would use this system to be physically close to its customers (and Authorities...), in this case the customers are represented by the “Principal” actor, be it Consignor, Consignee, freight forwarder.
- A fleet driver would use this system to be close to his fleet manager, even if he could be allowed to exchange with other partners, including, too, Authorities...

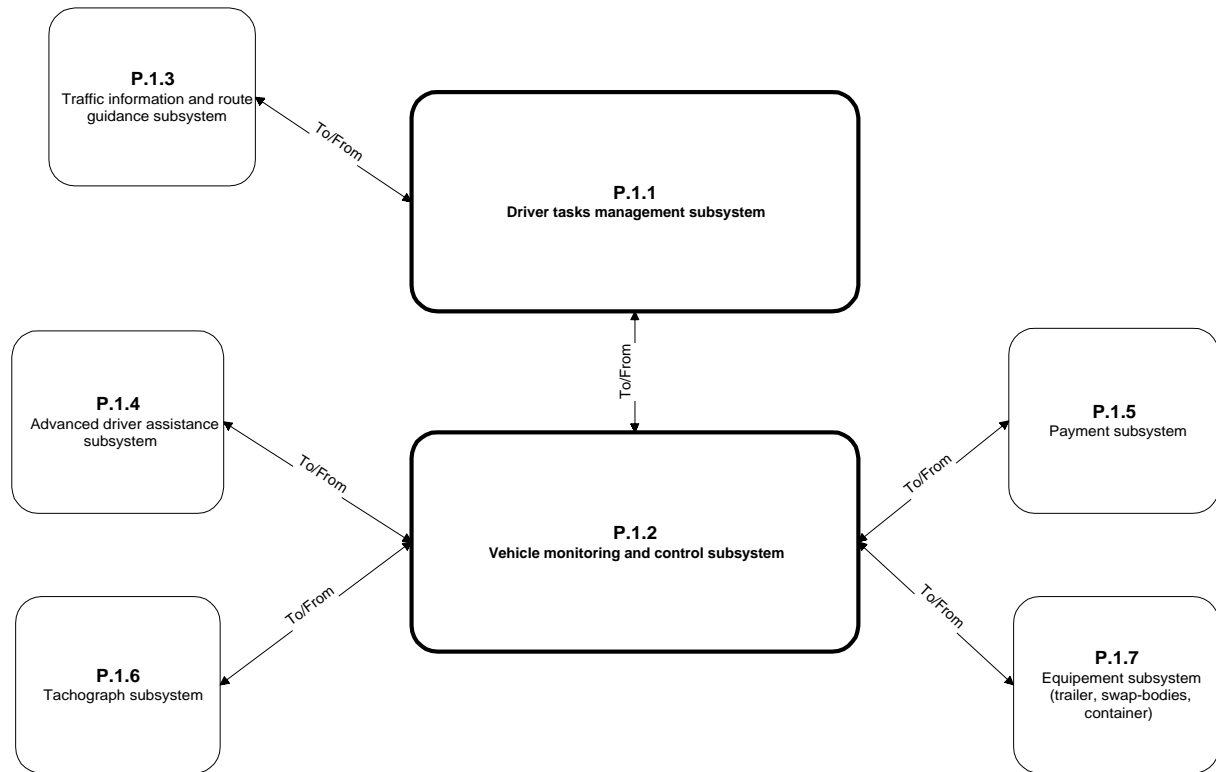
The Subsystems are described hereafter. They are also shown in the Figures on the following pages, together with their relationships to each other and the terminators.

First through a short term global internal view then selected at the sub systems level next, one by one...



**Figure : 30. Freight Fleet Vehicle, Driver, Cargo, Equipment :  
 The short term global internal view**

### 5.5.1.1 The subsystems level



**Figure : 31. Freight Fleet Vehicle, Driver, Cargo, Equipment :  
 The subsystems diagram**

Are represented here the “major” components of the on board systems Physical Architecture.

Driver tasks management Sub-system gathers all hardware (even a removable one...) and software that will be operated by the driver or directly triggered by partners or by the vehicle monitoring and control Sub-system, so as to perform adapt or modify and stop the performance of any kind of task (resting is even one...). It could have been subdivided into more specific modules (leaving aside the HMI and communication aspects) according to the type of support to be provided to tasks preparation and performance. These modules should mainly be software modules and possibly related data bases. These potential modules can be implicitly identified “behind” the data flows.

Nevertheless This subsystem will have a “privileged interlocutor” with a more or less sophisticated traffic information and route guidance Sub-system, able to “operate” on its own...

Vehicle monitoring and control Sub-system is tied to the vehicle and is supposed to play an orchestra leader role in receiving, storing, selecting, processing and emitting all relevant information. It is supposed to be permanently interfaced with 4 other more or less autonomous Sub-systems : Advanced driver assistance Sub-system, Tachograph Sub-system, Payment Sub-system, Equipment Sub-system (in the “autonomous” scenario).

Opposed to the Driver tasks management Sub-system, the specificity of its potential hard and soft components allowed and even required a subdivision in appropriate modules which will be reviewed as such.

**This Sub-systems level (and the underlying Modules) should not be directly mapped to Functions, as far as if some Functions could be easily “followed” within a Sub-system, some, such as, for instance, compliance with regulations other than social ones (which may be related to Driver, Vehicle, Cargo, Equipment...) or provision of emergency call, may be performed in many different ways and involve different Sub-systems and / or Modules.**

**Besides, all physical data flows that appear in the following diagrams are mostly aggregation of functional data flows that are supposed to be received and/or sent by the same given sub-system or module.**

**Opposed to that statement, one will see that the same functional data flow can be implemented through different sub-systems and / or modules.**

### 5.5.1.2 Detailed approach

#### P1.1 Driver Tasks Management Sub-system:

This Sub-system provides all the functionality so as to receive, execute, monitor ,make report, send reports of tasks required from a driver by his Fleet Manager in the fleet driver scenario or manage orders directly with another “partner” such as Principal, Freight Forwarder, Consignor, Consignee, for the independent or chartered driver and “translate” them into the same kind of tasks.

This Sub-system provides for both, functionality for the management of information from/to Infrastructure Managers, Authorities, or from dedicated Telematic Services Providers.

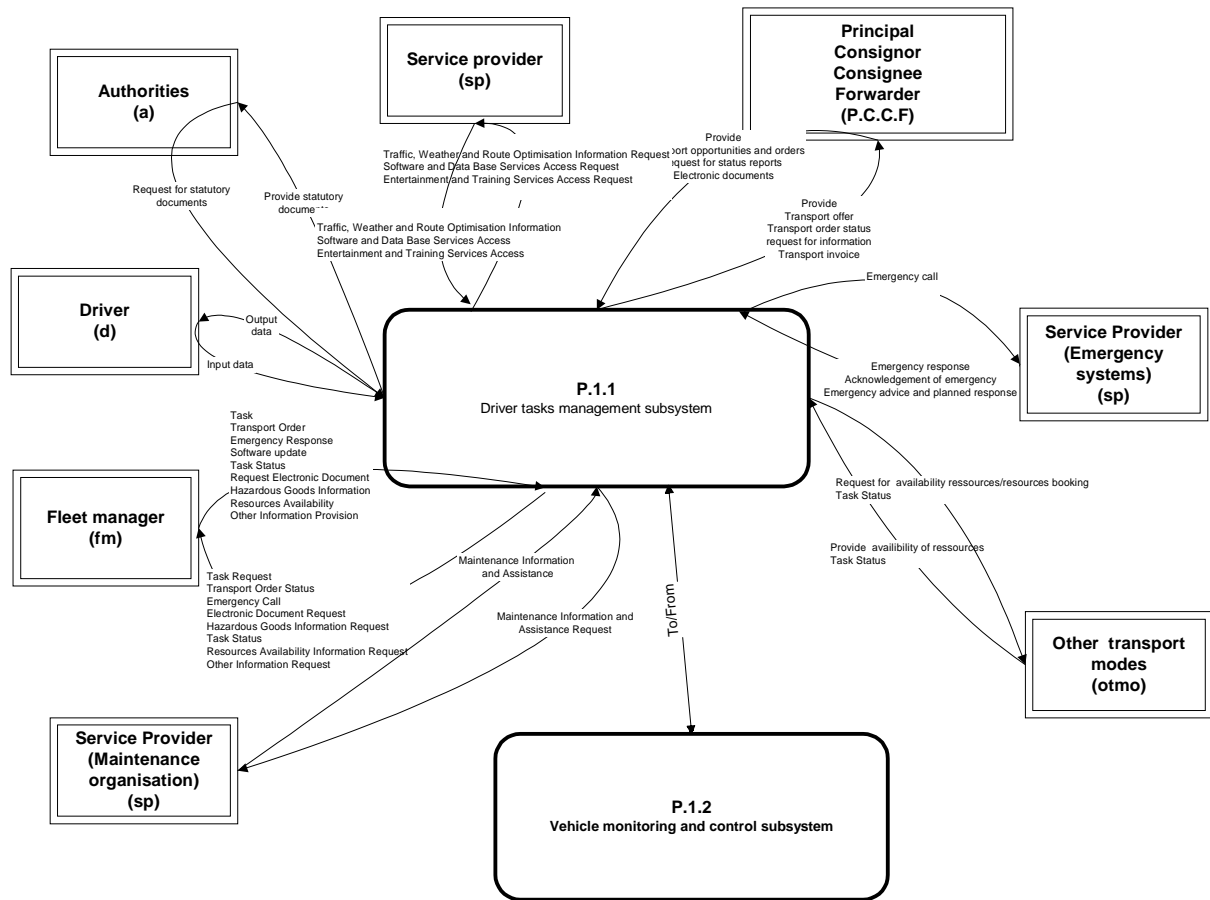
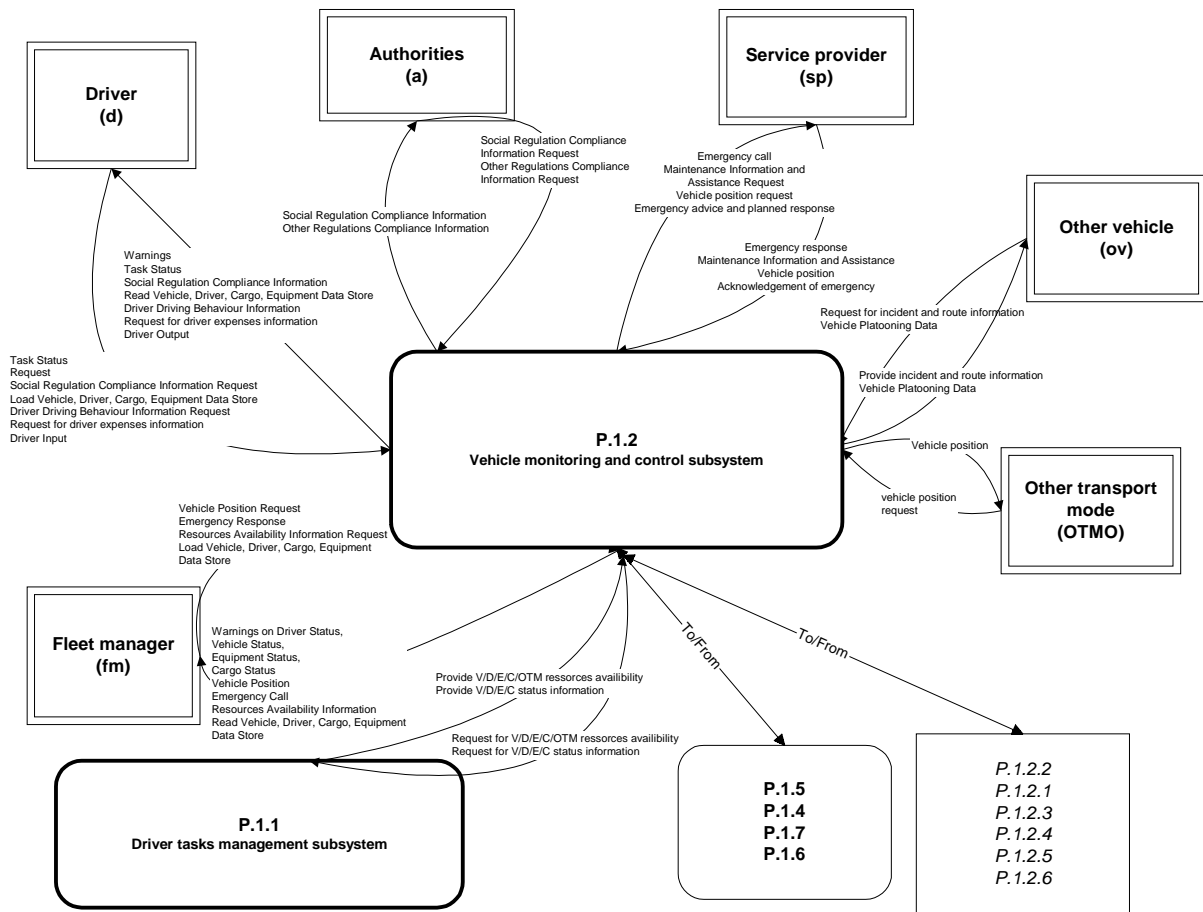


Figure : 32. Driver tasks management subsystem

Physical data flows identified in all figures from 31 to 44, must be seen as aggregations and simplified representations of COMETA Functional data flows from Chapter 3, when they are “translated” at a physical level. Besides, one should remind here the quotation from KAREN saying that “there are many ways in which a Physical Architecture can be produced from a Functional Architecture”...

**P1.2 Vehicle Monitoring and Control Sub-system:**

This Sub-system must be seen as an internal support to the driver (or directly to other terminators such as Fleet Managers, Emergency Services, Maintenance Services, etc. ...) providing automatically, or on request, permanently captured information, so as to prepare, execute, monitor and report on any operation involving, beyond the driver himself, the vehicle, the cargo or the equipment.

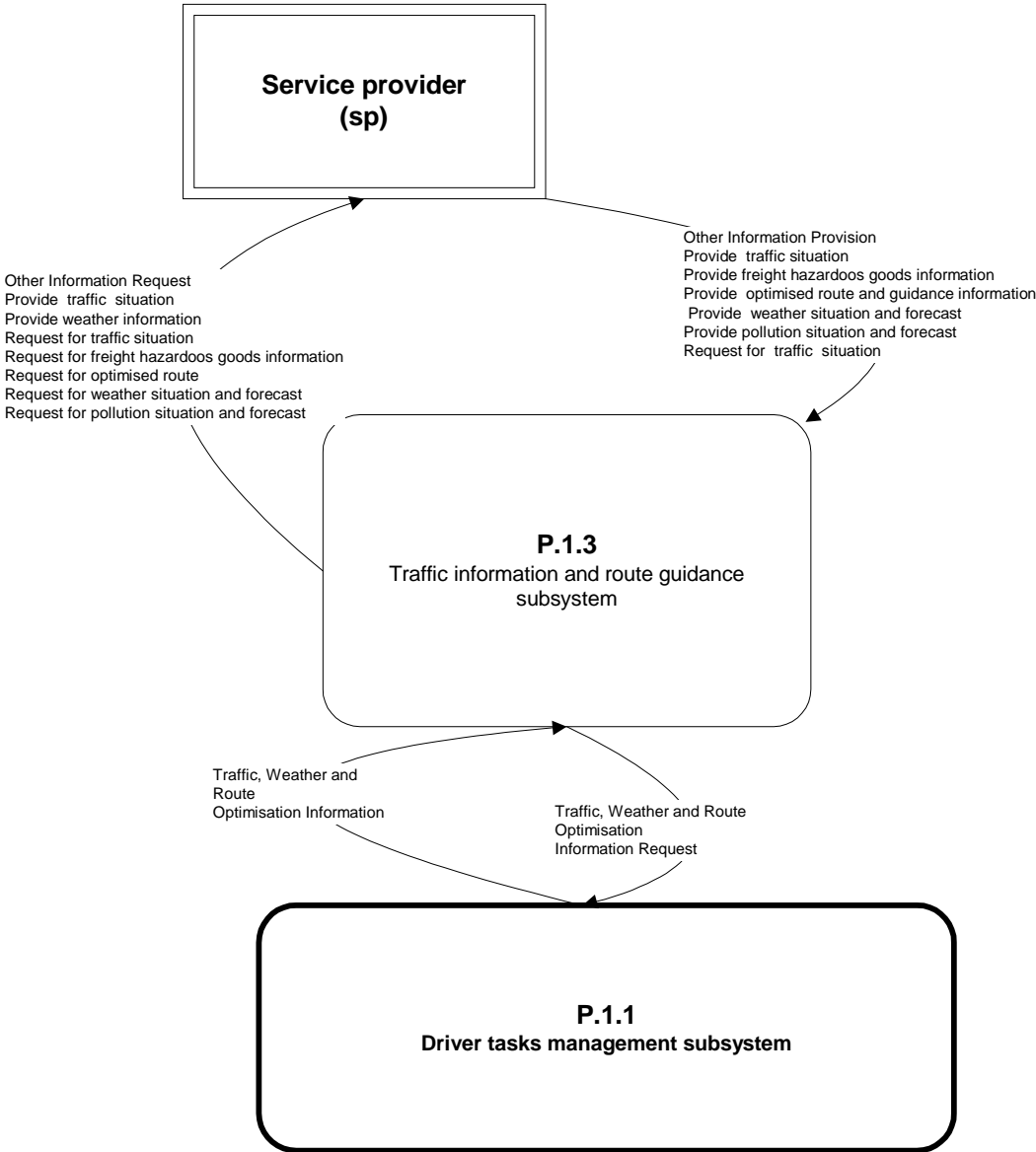


**Figure : 33. Vehicle Monitoring and Control Subsystem**

Representation of Physical data flows between P.1.1 and P.1.2, its “satellites” P.1.5 to P.1.6 and Modules P.1.2.1 to P.1.2.6, have been deliberately simplified, being either detailed further in the following pages or being possibly summarised as Resources availability and statuses requests, then information provision backwards or warnings, to / from Vehicle, Driver, Equipment, Cargo, Other transport mode...

**P1.3 Traffic Information and Route Guidance Sub-system:**

This Sub-system provides and possibly manages, traffic Information and Route Guidance, as an help to the driver, from simple appropriate information up to a complete automatic navigation system receiving possibly instructions from the infrastructure



**Figure : 34. Traffic Information and Route Guidance Subsystem**

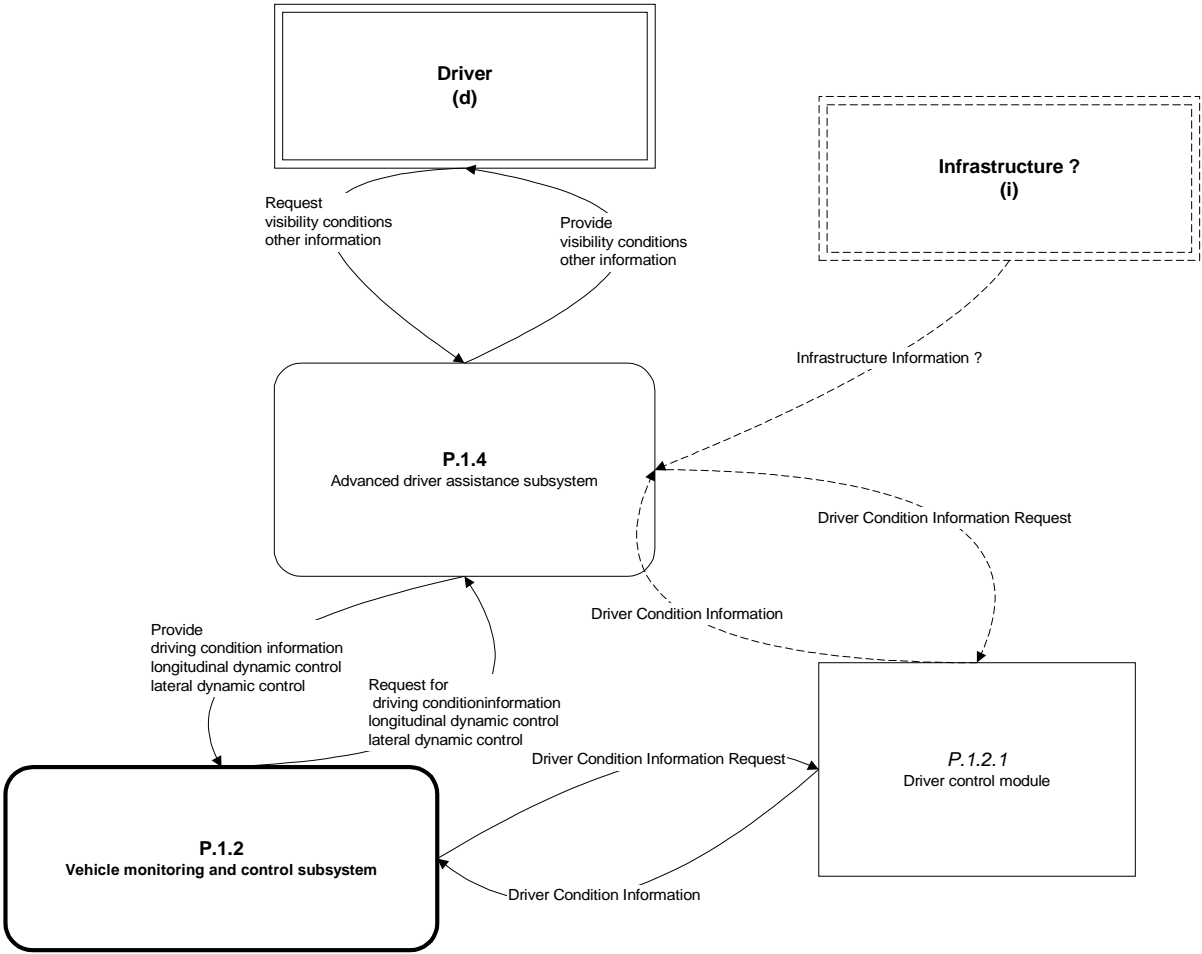
It is clear that very different information could be provided by very different Services Providers (and even, for some of them by Fleet Manager or even Authorities...). It is clear that it could be rather “raw” information or highly processed one...

It is clear, last, that this sub-system could be, in the future more connected to P.1.2 “vehicle monitoring and control sub-system” for some automated route guidance applications.

**P1.4 Advanced Driver Assistance Sub-system:**

From KAREN : “This System provides all kinds of facilities for Advanced Driving Assistance. It is based on similar Systems that exist or are under development in different countries and particularly as part of the European Commission 4<sup>th</sup> Telematics Application Programme (4FP).

In this System both the standard components (like engine, brakes, dash-board, sensors etc.) and the ADAS equipment (like radar, cameras, automatic controls, telematic equipment etc.) are considered as part of the vehicle”.



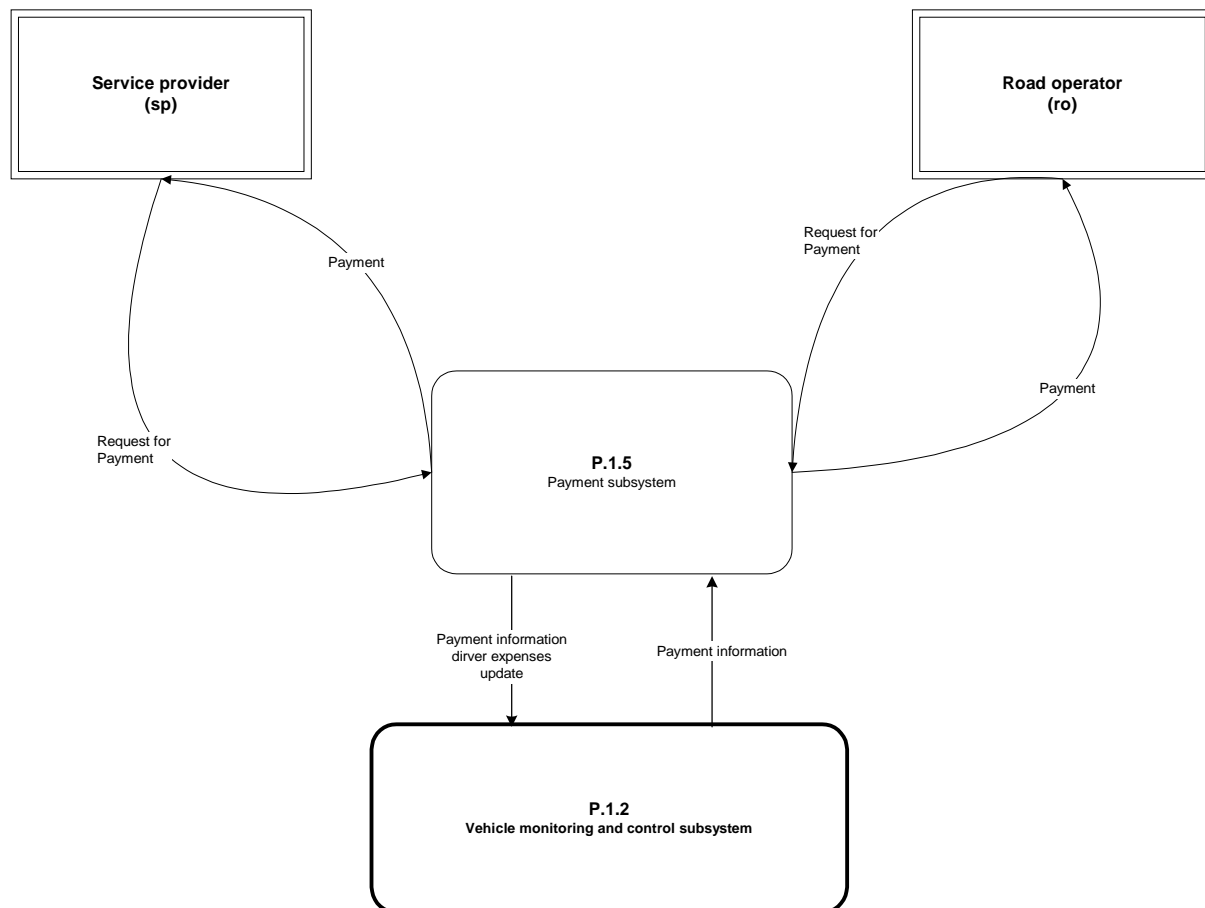
**Figure : 35. Advanced Driver Assistance Sub-system**

Seen by COMETA, this subsystem provides driver with advanced assistance, which gathers driving helps which will be found in any “intelligent vehicle”, but with the addition of vehicle platooning functions more dedicated to freight vehicles.

As seen in chapter addressing terminators description, COMETA considers infrastructure as a passive provider of information (road geometry, gradient, curves, etc...) refer too to comments under figure 39

**P1.5 Payment Sub-system:**

This subsystem is responsible for automatic electronic fee collection payment for various services, even without stopping the vehicle, and manages related procedures.

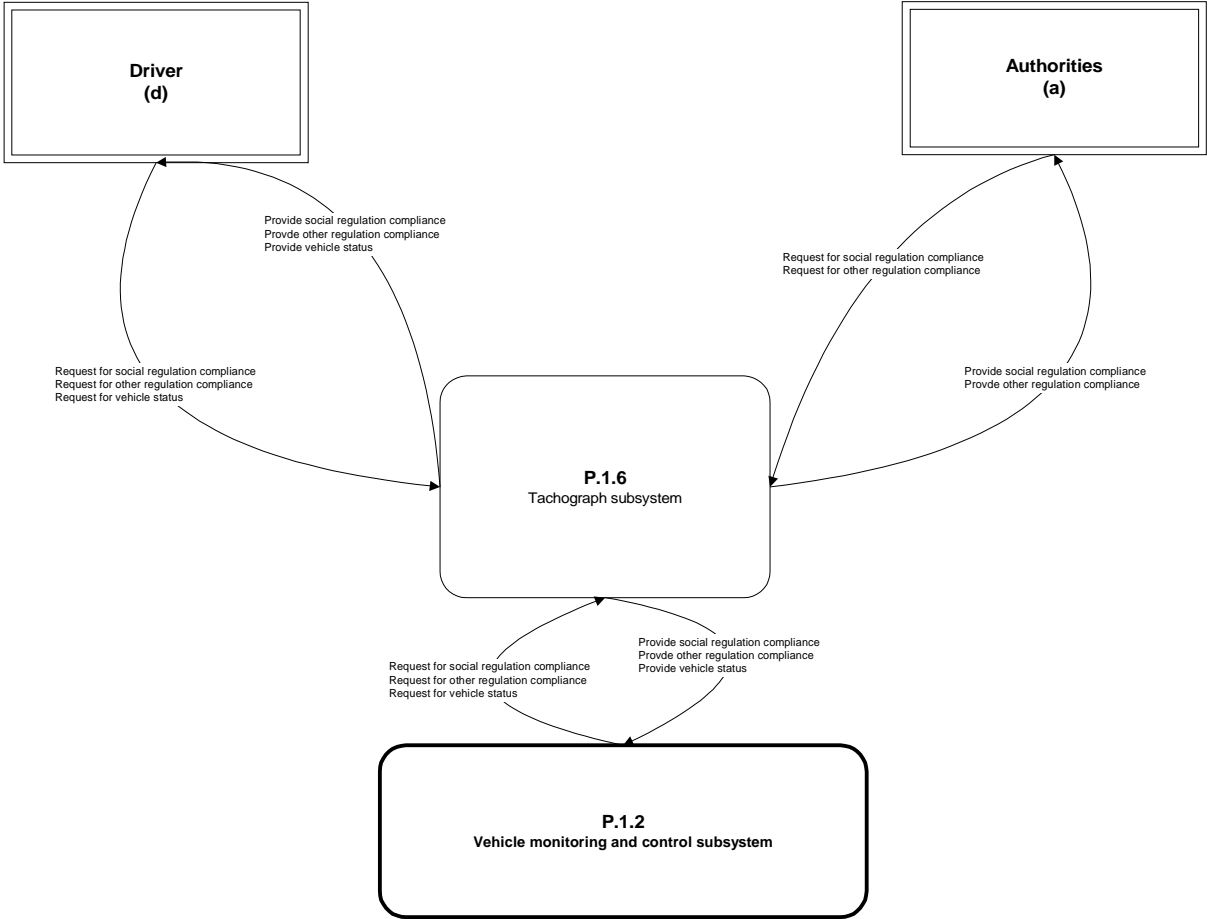


**Figure : 36. Payment Subsystem**

Payment Sub-system is here a very generic approach, as far as it may cover a range of different services, such as Electronic Toll Collection, ECO Points, Road Pricing, Fuel, Hotel, Restaurant, Garage, INTERNET Services...from DSRC to wide range communication, using or not smart cards, electronic purse concept or not ...

**P1.6 Tachograph Sub-system:**

This sub-system captures, stores and protect information related to driver compliance with social regulation and others related to vehicle operation. It receives inputs from the driver (on occurrences) and from vehicle sensors (on a permanent basis). It has its own HMI, for the time being, and its content can be accessed (without any modification possibility) by the Driver, the Fleet Manager and, of course, Authorities.



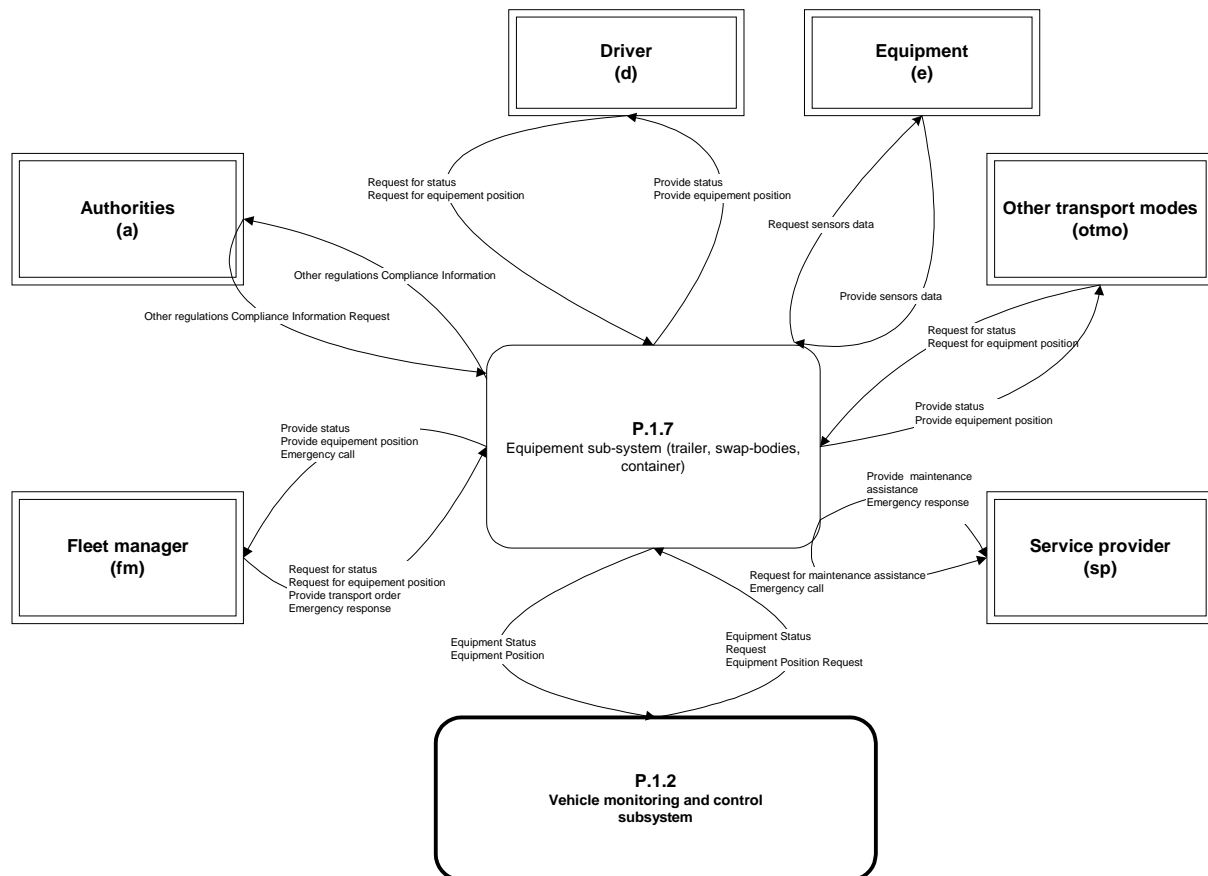
**Figure : 37. Tachograph Subsystem**

The Tachograph Sub-system is of course represented here in its basic configuration, where it is handled by the Driver and accessed by authorities. Value addition is brought to the Systems Architecture, through its use as a data capture tool by the “Vehicle Monitoring and Control Sub-system”, so as to allow for various processes.

We Know that, for the time being the Tachograph Sub-system may be directly interfaced with a Communication solution, so as to provide the Fleet Manager with information without Driver intervention.

**P1.7 Equipment Sub- system:**

This Sub-system, in the “Autonomous” Equipment scenario, provides nearly the equivalent of the “Vehicle Monitoring and Control Sub-system” mentioned here above, without, of course, a driver control module...



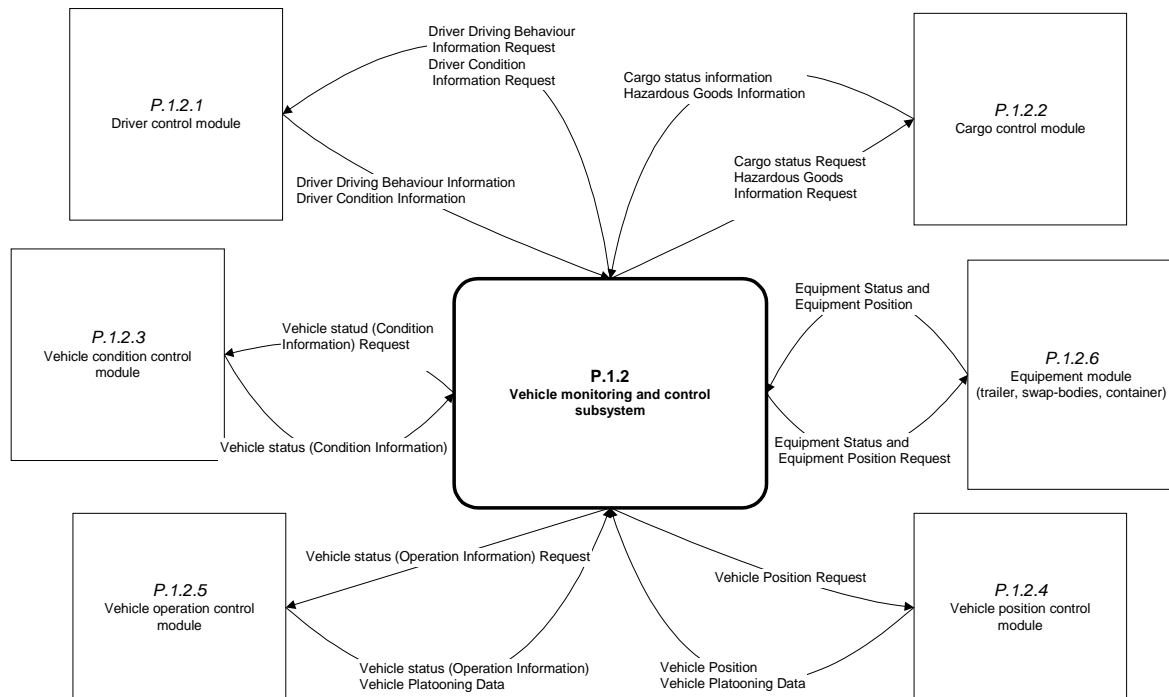
**Figure : 38. Equipment Subsystem**

One can see that “other transport modes” are compared to the “vehicle monitoring and control sub-system”, present too the reason is that the equipment as such can be managed by the intermodal terminal and will be carried alone.

## 5.5.2 Modules

Sub-system P.1.2 “Vehicle Monitoring and Control Subsystem” (for P.1.4 “Advanced Driver Assistance Subsystem” refer to KAREN) can be split up in the following modules:

*Freight, Fleet, Driver/Vehicle/Cargo/Equipment system*  
**The modules**



**Figure : 39. Freight Fleet Vehicle, Driver, Cargo, Equipment:  
 The modules**

The “Vehicle Monitoring and Control Sub-system” has been splitted into what can be seen as its 6 main components.

“Driver Control Module” will monitor in the future the Driver physical and safety conditions, “external” aspects of its driving behaviour.

“Vehicle Condition Control Module” can be seen as a “snapshot” of comprehensive vehicle static features at a given moment (contributing to the description of vehicle status), while “Vehicle Operation Control Module” can be seen as a permanent dynamic registration of various parameters so as to facilitate, for instance, later maintenance and analysis of vehicle organs by the driver. To use a comparison with tracking and tracing, the first Module refers to tracking statuses the second one to tracing the same or other statuses to be explained by combination of parameters.

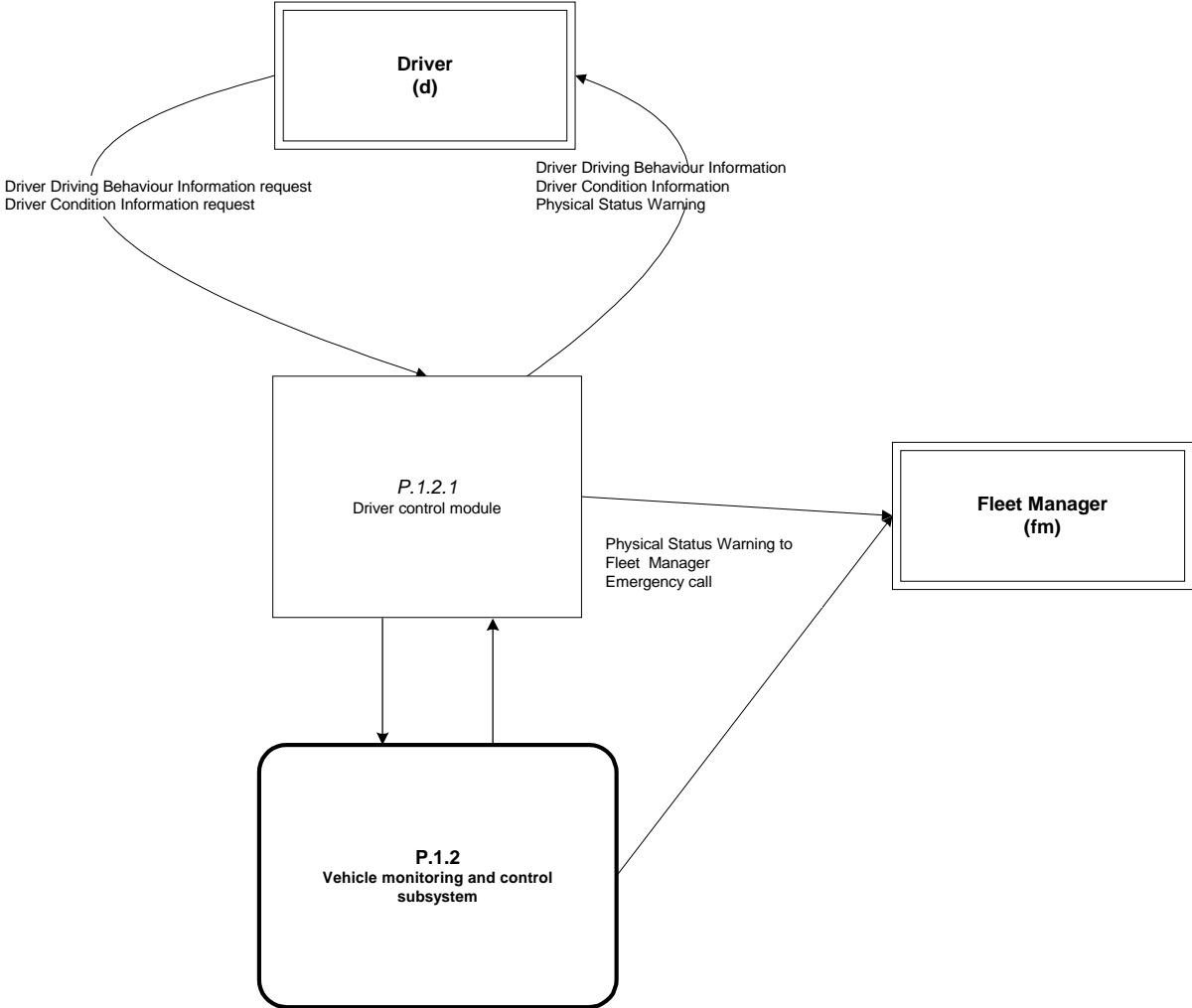
“Cargo Control Module” may be implemented within the vehicle or within the Equipment.

“Vehicle Position Module” is justified if the vehicle is able to calculate (itself) its position and store it.

“Equipment Module” will play here the role of the before described equipment sub-system.

**P.1.2.1 Driver Control Module:**

This module is responsible for the monitoring of Driver physical status (fatigue, drowsyness, etc. ...) if this support is not provided by P.1.4.

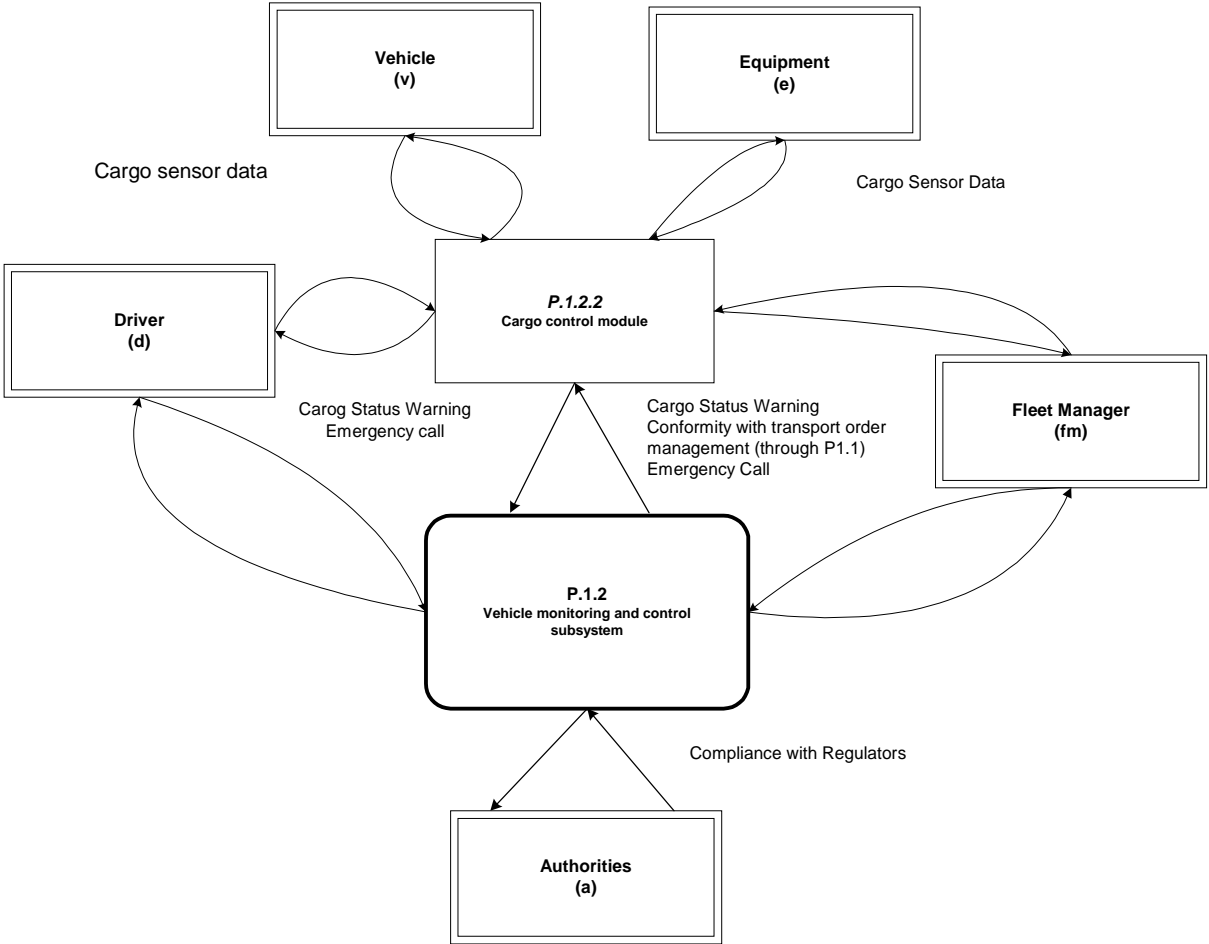


**Figure : 40. Driver Control Module**

This module has very flexible borders as far as it is a very innovative area and as far as control can be achieved very directly on the driver or, opposed, indirectly through the usage of driving HMI or advanced driver assistance sub-system.

**P.1.2.2 Cargo Control Module:**

This module is responsible for the management and monitoring of the cargo. According to the type of road freight transport activity and sophistication of that module, this could mean weight sensors, temperature sensors, stowage sensors, automatic identification devices (read and write), etc. ...Automatic corrections could be provided too e.g. for temperature setting.

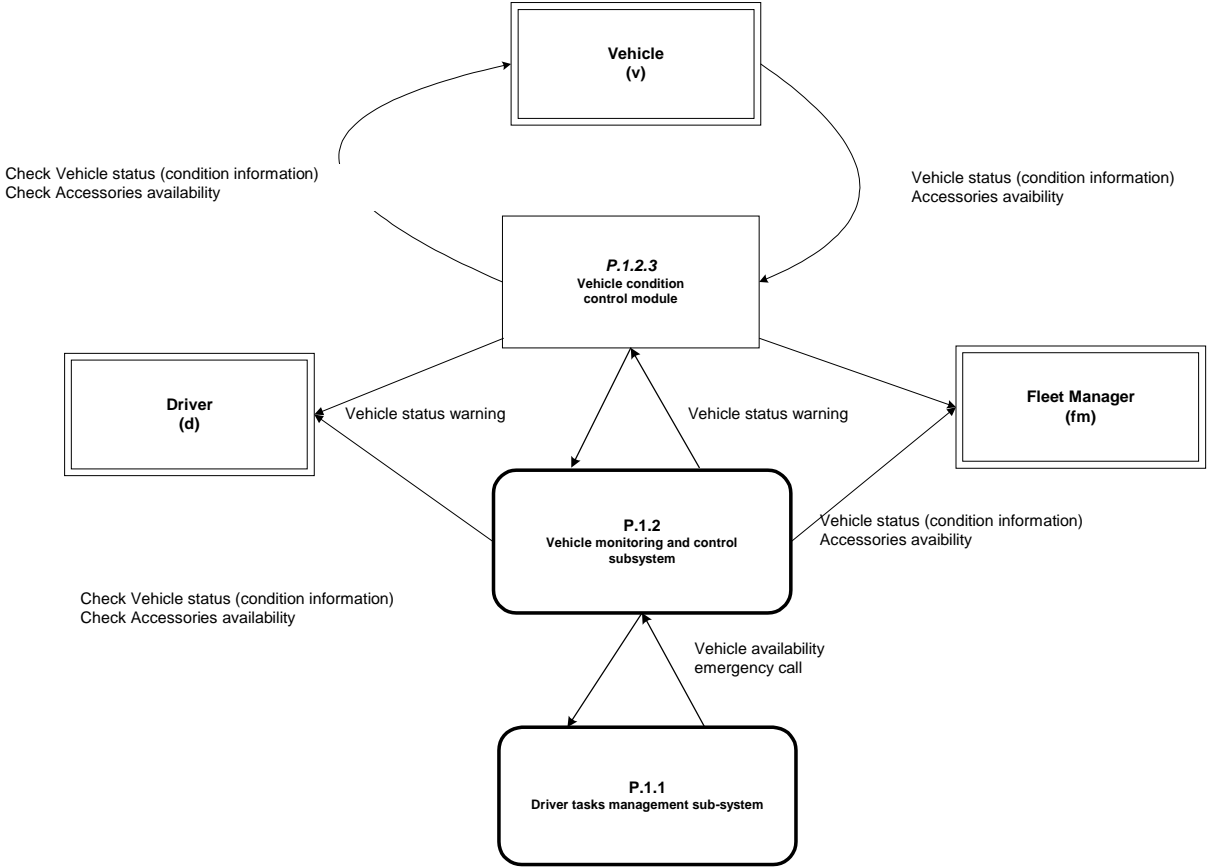


**Figure : 41. Cargo Control Module**

Cargo Control Module is also a very comprehensive one, as far as it should allow for automatic identification (read and write) and support Functions such as conformance with transport order and creation of new transport unit, but also allow for permanent monitoring of Cargo (weight, temperature, etc. ...), warnings and corrective actions...

**P.1.2.3 Vehicle Condition Control Module:**

This module is responsible for evaluation, storage and information provision, of vehicle characteristics and state of organs and various parts, presence of accessories, space availability.



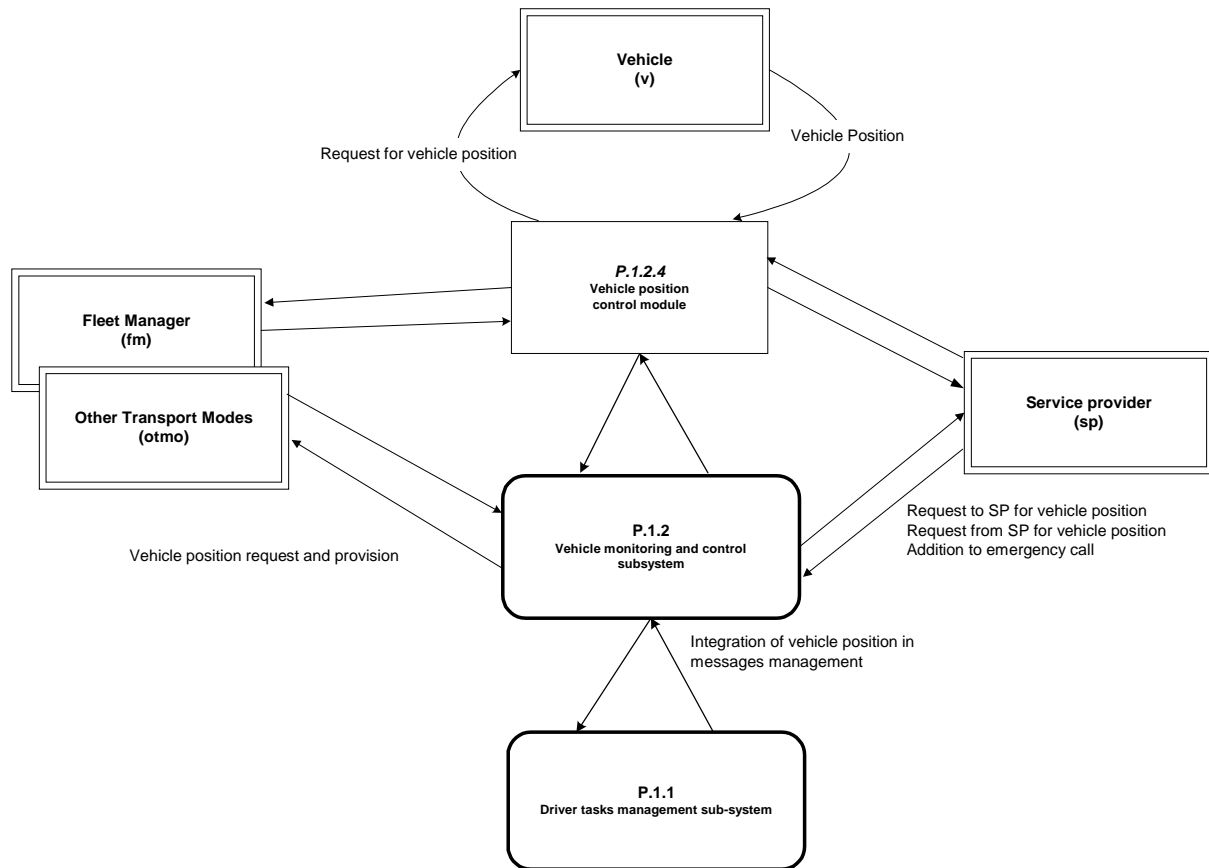
**Figure : 42. Vehicle Condition Control Module**

This module provides information to the function “monitor vehicle status”, as a snapshot either of rather long lasting vehicle characteristics (features) or very changing ones (space availability, or results from (or asked to) vehicle operation control module.

Compared to tracking and tracing functions, this is the tracking function.

**P.1.2.4 Vehicle Position Control Module:**

This module provides information so as to allow for the calculation of the vehicle position or is able to calculate it and make it accessible when required.

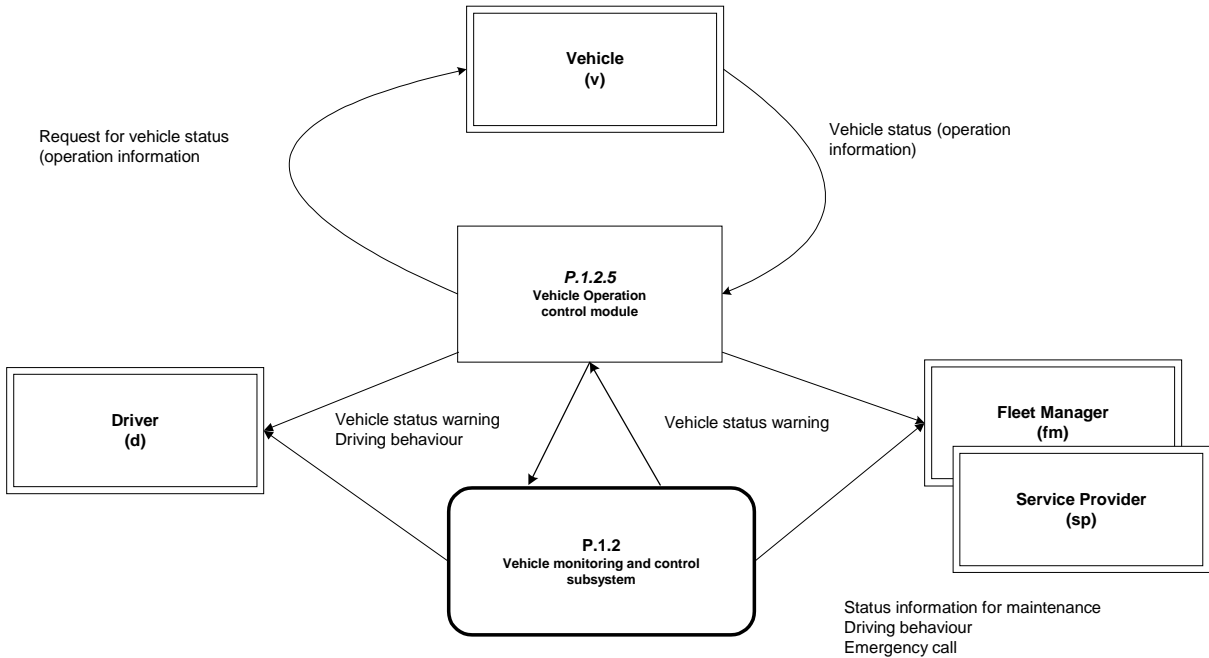


**Figure : 43. Vehicle Position Control Module**

Vehicle position as understood here seems to leave aside the vehicle platooning function, which could be supported in fact by this module if position calculation is extended to other vehicles distance.

**P.1.2.5 Vehicle Operation Control Module:**

This module is responsible for the permanent registration of vehicle parameters while in operation (such as mileage, fuel and oil consumption, etc. ...) but beyond that (some of these parameters being already possibly provided through the tachograph...), this module could allow for programmable corrective actions in a sophisticated configuration.



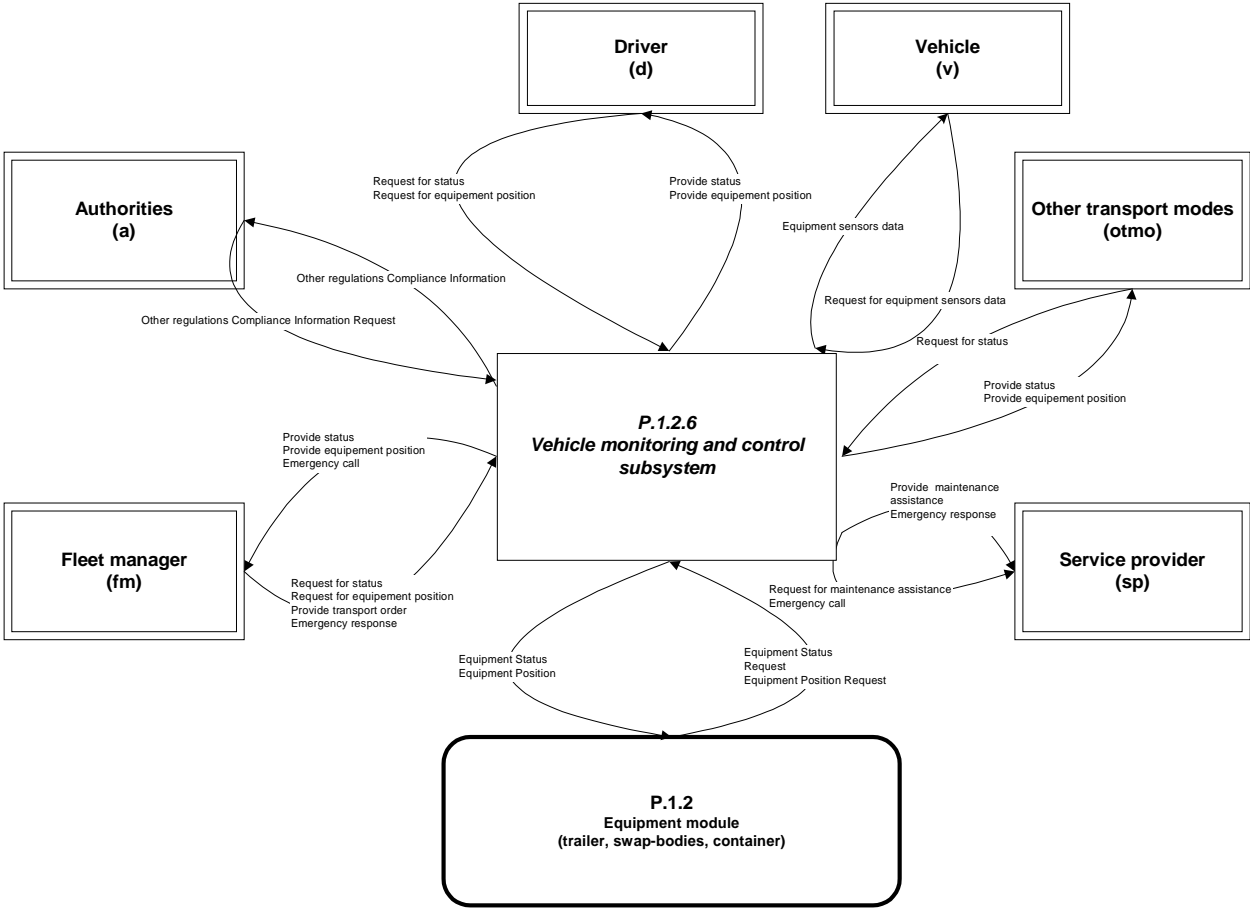
**Figure : 44. Vehicle Operation Control Module**

This module provides too information “monitor vehicle status” either through the results of calculations at a given moment or if this monitoring requires much more information than a snap shot (e.g. for maintenance).

Compared to tracking and tracing functions, this is the tracing function.

**P.1.2.6 Equipment module (“slave” scenario...):**

In this scenario, this module will in fact be responsible for the provision of information or actions that could be compared to P.1.2.3 and 5, as a “mobile” and “temporary” part of the vehicle, but linked to it through the same communication bus and even hosting a Cargo Control Module.



**Figure : 45. Equipment module (“slave” scenario...)**

The potentiality of information provision through that module could be quite different if the equipment is a trailer or a container (with no physical link with the traction unit).

## **5.6 SUB-SYSTEMS, MODULES, FUNCTIONS MATRIX AND THE FLEET DRIVER, INDEPENDENT AND CHARTERED DRIVER, VIRTUAL MANAGER SCENARIOS**

As a kind of traceability matrix, the different levels of the System(s) Architecture should be set through a global perspective with the User needs they refer to.

The 7 Sub-systems and 6 Modules of Sub-system “Vehicle Monitoring and Control Sub-system”, consist of one or more functions identified and described at the Functional Architecture level (refer to Chapter 3), with the identification of user needs they are supposed to answer to. The whole is synthesised in the following table.

For COMETA, this exercise should consider that, at Functional level, two main scenarios have been retained, the Independent or chartered driver scenario and the Fleet driver scenario.

Additionally, it can be seen that some functions are served by different subsystems or modules, this is the case for compliance with regulations.

First, as far as compliance with social regulations can be checked by different terminators (Authorities, Driver, Fleet Manager), at different moments, in different ways, even if the Tachograph sub-system is somewhere involved in the raw capture of data or as direct output of data (it is the reason why it is supposed to have, for the time being, its own card reader/writer, own screen, own printer...). But as European Authorities decided, nevertheless, to apply the “KISS” (“Keep It Simple and Stupid”...) principle to it, some additional analysis and process of the provided information can be made by an on board application.

Second, as far as compliance with “other regulations” cover and may cover in the future quite various requirements, from checking of presence on board and adequacy of mandatory (electronic...) documents associated to the Driver, Vehicle, Equipment, Cargo, to safety checks, through speed checks and weigh in motion, etc. ...They will involve different technical procedures and imply different physical scenarios.

It is the case also for the triggering of emergency call (by driver condition, vehicle condition or operation, cargo status, equipment status).

### **Could a virtual manager scenario be added**

This exercise could consider too, that, coming to the Physical level (as implementation level), one discovers the importance of Services Providers role which could lead some of them, through the addition of assistance services, software and data bases and their appropriate integration, to be in the situation to play a “virtual fleet manager” role (see already 5.3.2.2).

But, if this perspective is very meaningful (and will be more and more through INTERNET mobile access), is it structuring and determining enough to impact on Functions and System / Sub-systems ?

It can be seen, in fact, that if a split has been made between “Independent and Chartered driver”, that none, in spite of the title of this paragraph, has been made for the “Virtual Fleet Manager”.

It is obvious that an “Independent or Chartered Driver” will have (according to the hypothesis of “mobile office” concept...) to manage business transactions directly with partners, so that he is supposed to be the only one interested by Type 1 functions (and possibly related important on board implemented applications and data bases) and that Type 2 functions (preparation) could require from him more data processing and physical checks than for a “Fleet Driver”, which is supposed to receive corresponding instructions from his Fleet Manager (or given instructions should reflect the knowledge of state of preparation of the recipient of these instructions).

**BUT...**

- The consequence of being in the situation of an “Independent or Chartered Driver” (ICD, to make short...) or of a “Fleet Driver” (FD), or, for both, to be simultaneously in the situation to be managed via a “Virtual Fleet Manager” (“VFM”), or simply assisted by him as a third party service provider, cannot be made precise enough through that level of description.
- an “ICD” can subscribe to services from a “VFM”...
- Services from a “VFM” can be more or less extensive (e.g. only route optimisation support, or weather information, up to comprehensive freight management assistance)...
- A driver may act during certain periods as an “ICD” and at others as an “FD” according to the fact if he is operating for his own company or chartered by another one...

So, if the following table shows the particularity of an “ICD” at the Freight Management Level, it just shows that, beyond this level, the System “translates” transport orders into Tasks to be performed like by a “FD” with the operation or assistance of the same Sub-systems or Modules.

It cannot show the respective importance of these Sub-systems and Modules depending on the driver situation, and on the intervention or not, of a third party Service Provider.

It is not even obvious that an “ICD” will require a fully multifunctional on board “big” computer while the “FD” will require only a terminal...

Others parameters will interfere, such as ease and price of mobile data communication, success of INTERNET based solutions, success of standards in exchanges formats and contents and in applications interfaces, wide spreading of “VFM” solutions...

EC DG XIII Telematics Application Programme - Project: COMETA – Contract TR 4005  
 Deliverable D6.1 – Commercial vehicles on board systems integrated architecture(s) specifications, risks analysis and implementation time schedules hypothesis.

Subsystems		Modules		Functions					
				Independent and Chartered Driver			fleet Driver		
No .	Name	No .	Name	No .	Name	User Needs	No.	Name	User Needs
P.1.1	Driver tasks management			1.1	Negotiate Transport Order	46.60.61.76			46.60.61.76
				1.2	Administrate Chartered Driver Business Transaction	47.48.60.61			
				2.1.1	Prepare documents	37.38.39.40.44	2.1.1	Prepare documents	37.38.39.40.44
				2.1.2	Prepare vehicle	7.8.24.92.95	2.1.2	Prepare vehicle	7.8.24.92.95
				2.1.3	Prepare driver	4.5.6.24	2.1.3	Prepare driver	4.5.6.24
				2.1.4	Prepare cargo space	24.49.50.51	2.1.4	Prepare cargo space	24.49.50.51
				2.1.5	Prepare equipment	24.92	2.1.5	Prepare equipment	24.92
				2.1.6	Prepare accessories	31.49.92	2.1.6	Prepare accessories	31.49.92
				2.1.7	Prepare other transport mode.	31.62	2.1.7	Prepare other transport mode.	31.62
			2.2.1	Ask for a new Mission Order	26.36	2.2.1	Ask for a new Mission Order	26.36	

				2.2.2	Process and read a new tasks Order	26.31.36.70	2.2.2	Process and read a new tasks Order	26.31.36.70
				2.2.3	Check client profile and constraints	9.19.23.31	2.2.3	Check client profile and constraints	9.19.23.31
				2.2.4	Prepare trip / routes	7.8.9.10.11.12.13.14. 15.16.19.26	2.2.4	Prepare trip / routes	7.8.9.10.11.12.13.14. 15.16.19.26
				2.2.5	Prepare load plan	22.49	2.2.5	Prepare load plan	22.49
				3.1.1	Manage tasks and Transport Order contents and modifications	26.27.36	3.1.1	Manage tasks and Transport Order contents and modifications	26.27.36
				3.1.2	Check whether cargo and or equipment conforms to Transport order	33.44.50.52.81.83.91	3.1.2	Check whether cargo and or equipment conforms to Transport order	33.44.50.52.81.83.91
				3.1.3	Create a new Transport Unit	33.42.91	3.1.3	Create a new Transport Unit	33.42.91
				3.11.1	Monitoring and report on operational tasks	6.7.9.10.15.16.20.24.29.30.33.34.36.45.58.59.60.61.62.80.81.82.87.88.89	3.11.1	Monitoring and report on operational tasks	6.7.9.10.15.16.20.24.29.30.33.34.36.45.58.59.60.61.62.80.81.82.87.88.89
				3.11.2	Monitor and prove Transport Order execution	28.29.30.32.33.35.36.38.39.42.43.44.77.78	3.11.2	Monitor and prove Transport Order execution	28.29.30.32.33.35.36.38.39.42.43.44.77.78

P.1.2	Vehicle monitoring and control	P.1.2.1	Driver Control Module	3.2.1	Comply with social regulations	12.62.73.102	3.2.1	Comply with social regulations	12.62.73.102
				3.2.2	3.2.2 Comply with other regulations	12.37.38.39.40.4 1.43.45.56.62.73. 84.102	3.2.2	3.2.2 Comply with other regulations	12.37.38.39.40.4 1.43.45.56.62.73. 84.102
				3.8.2	Monitor physical status	63.82.104	3.8.2	Monitor physical status	63.82.104
				3.8.3	Monitor driver expenses	21	3.8.3	Monitor driver expenses	21
				3.8.4	Monitor driver driving behaviour	93.94.95.108.110	3.8.4	Monitor driver driving behaviour	93.94.95.108.110
				3.12	Manage emergency	93.94.95.103.104 .106.109	3.12	Manage emergency	93.94.95.103.104 .106.109
	P.1.2.2	Cargo Control Module	3.2.2	Comply with other regulations	12.37.38.39.40.4 1.43.45.56.62.73. 84.102	3.2.2	Comply with other regulations	12.37.38.39.40.4 1.43.45.56.62.73. 84.102	
			3.9	Monitor cargo status		3.9	Monitor cargo status		
			3.12	Manage emergency	93.94.95.103.104 .106.109	3.12	Manage emergency	93.94.95.103.104 .106.109	

		P.1.2.3	Vehicle Condition Control Module	3.2.2	Comply with other regulations	12.37.38.39.40.4 1.43.45.56.62.73. 84.102	3.2.2	Comply with other regulations	12.37.38.39.40.4 1.43.45.56.62.73. 84.102
				3.7.2	Monitor vehicle status	21.24.53.54.62.6 3.82.84.89.93.94. 95.102.103.106.1 17	3.7.2	Monitor vehicle status	21.24.53.54.62.6 3.82.84.89.93.94. 95.102.103.106.1 17
				3.12	Manage emergency	93.94.95.103.104 .106.109	3.12	Manage emergency	93.94.95.103.104 .106.109
		P.1.2.4	Vehicle Position Control Module	3.7.1	Monitor vehicle position	4.7.8.10.17.58.10 3.106	3.7.1	Monitor vehicle position	4.7.8.10.17.58.10 3.106
				3.12	Manage emergency	93.94.95.103.104 .106.109	3.12	Manage emergency	93.94.95.103.104 .106.109
		P.1.2.5	Vehicle Operation Control Module	3.2.2	Comply with other regulations	12.37.38.39.40.4 1.43.45.56.62.73. 84.102	3.2.2	Comply with other regulations	12.37.38.39.40.4 1.43.45.56.62.73. 84.102
				3.7.2	Monitor vehicle status	21.24.53.54.62.6 3.82.84.89.93.94. 95.102.103.106.1 17	3.7.2	Monitor vehicle status	21.24.53.54.62.6 3.82.84.89.93.94. 95.102.103.106.1 17
				3.12	Manage emergency	93.94.95.103.104 .106.109	3.12	Manage emergency	93.94.95.103.104 .106.109

		P.1.2.6	Equipment module	3.2.2	Comply with other regulations	12.37.38.39.40.4 1.43.45.56.62.73. 84.102	3.2.2	Comply with other regulations	12.37.38.39.40.4 1.43.45.56.62.73. 84.102
				3.10.1	Monitor equipment position	8.7.24.68.87.106	3.10.1	Monitor equipment position	8.7.24.68.87.106
				3.10.2	Monitor equipment status	24.53.54.55.62. 63.68.82.84.87. 88.89.93.94.95. 106	3.10.2	Monitor equipment status	24.53.54.55.62. 63.68.82.84.87. 88.89.93.94.95. 106
				3.12	Manage emergency	93.94.95.103.104 .106.109	3.12	Manage emergency	93.94.95.103.104 .106.109
P.1.3	Traffic information and route guidance			3.5	Manage traffic and route guidance information		3.5	Manage traffic and route guidance information	
P.1.4	Advanced driver assistance		(See KAREN)	3.3.1	Provide vision support	105	3.3.1	Provide vision support	105
				3.3.2	Provide longitudinal control	105	3.3.2	Provide longitudinal control	105
				3.3.3	Provide lateral control	105	3.3.3	Provide lateral control	105

				3.3.4	Provide automated driving support	105	3.3.4	Provide automated driving support	105
				3.3.5	Miscellaneous telematics functions	25.57.64.65.106.109.114.115	3.3.5	Miscellaneous telematics functions	25.57.64.65.106.109.114.115
				3.4	Provide access to comfort services		3.4	Provide access to comfort services	
				3.12	Manage emergency	93.94.95.103.104.106.109	3.12	Manage emergency	93.94.95.103.104.106.109
P.1.5	Payment			3.6.1	Perform EFC transactions	62.66.73.85.86	3.6.1	Perform EFC transactions	62.66.73.85.86
				3.6.2	Support billing services	62.66.85.86	3.6.2	Support billing services	62.66.85.86
P.1.6	Digital tachograph			3.7.2	Monitor vehicle status	21.24.53.54.62.63.82.84.89.93.94.95.102.103.106.117	3.7.2	Monitor vehicle status	21.24.53.54.62.63.82.84.89.93.94.95.102.103.106.117
				3.8.1	Monitor social regulations status	1.2.4.5.6.24.63	3.8.1	Monitor social regulations status	1.2.4.5.6.24.63

P.1.7	Equipment			3.2.2	Comply with other regulations	12.37.38.39.40.4 1.43.45.56.62.73. 84.102	3.2.2	Comply with other regulations	12.37.38.39.40.4 1.43.45.56.62.73. 84.102
				3.10.1	Monitor equipment position	8.7.24.68.87.106	3.10.1	Monitor equipment position	8.7.24.68.87.106
				3.10.2	Monitor equipment status	24.53.54.55.62. 63.68.82.84.87. 88.89.93.94.95. 106	3.10.2	Monitor equipment status	24.53.54.55.62. 63.68.82.84.87. 88.89.93.94.95. 106
				3.12	Manage emergency	93.94.95.103.104 .106.109	3.12	Manage emergency	93.94.95.103.104 .106.109

## 5.7 PHYSICAL DATA FLOWS

As we have seen in the figures, the Sub-systems and Modules in this System are linked together using Physical Data Flows. The term “Physical” is used to distinguish them from Functional Data Flows which are described in Chapter 3.

Physical Data Flows may consist in other Physical Data Flows, but will always consist in one or more Functional Data Flows. The description of the Physical Data Flows used in this System are the following.

(ICD : Independent or chartered driver  
FD : Fleet driver).

### **Cargo Status Information**

This physical data flow is used within the Freight Fleet Vehicle, Driver, Cargo, Equipment System. It can be Gathered from data captured through appropriate captors and sensors according to the type of parameters (identification, weight, volume, temperature, stowage, etc. ...) and sent by the Cargo control Module to the Vehicle Monitoring and Control System or Equipment Subsystem, then to Driver, Fleet Manager, Service Providers or Authorities (Monitoring of dangerous goods, or compliance with other regulations related to Cargo).

This physical data flow can be sent to the Driver Tasks Management Subsystem so as to be used as an input for a Tasks and status report.

It can be triggered automatically by the trespassing of a given threshold point and give a warning message, or be required by the Driver, Fleet Manager, Authorities or Service Provider.

### **Cargo Status Information Request**

This physical data flow is used within the Freight Fleet Vehicle, Driver, Cargo, Equipment System. It is sent by Driver, Fleet Manager, Service Providers or Authorities, so as to Gather data to be captured through appropriate captors and sensors according to the type of parameters (automatic identification, weighting, volume, temperature measure, stowage conditions, etc. ...), to the Vehicle Monitoring and Control System or Equipment Subsystem, to the Cargo control Module.

### **Driver Condition (or status) Information**

This physical data flow is used within the Freight Fleet Vehicle, Driver, Cargo, Equipment System. It can be Gathered from data captured through appropriate captors (camera, recent driver action on vehicle commands, tachograph, etc. ...) and / or fed by the driver. It is sent by the driver (and / or may be consulted by him ...) or automatically by the Vehicle Monitoring and Control System to the Fleet Manager, so as to ensure that the driver is ready to complete a task (or triggered by threshold points trespassing). This flow is either triggered by incoming task instructions or it can be triggered directly by the driver or be “translated” into a warning for different terminators (including the driver and the vehicle monitoring and control subsystem which could react accordingly...). It could be triggered by Authorities or by a third party.

It contains information about driver physical condition, past and / or remaining driving and working time, mandatory resting periods, information on driving style, etc. ...

This physical data flow can be sent to the Driver Tasks Management Subsystem so as to be used as an input for a Tasks and status report.

### **Driver Condition (or status) Information Request**

This physical data flow is used within the Freight Fleet Vehicle, Driver, Cargo, Equipment System. It is sent by the driver, the Fleet Manager, Services Providers, Authorities, to the Task Management Sub- system, or to the Vehicle Monitoring and Control Sub-system, and then to the Driver Control Module and / or Tachograph, according to the type of Information and expected type of response

### **Driver Driving Behaviour Information**

This physical data flow is used within the Freight Fleet Vehicle, Driver, Cargo, Equipment System. It is sent by the Vehicle Monitoring and Control Subsystem, Vehicle Operation Module, and contains extractions of the permanent recording of, main parameters that characterise a driving style at a given moment or for a given period, or for a given trip, such as use of gearbox, brakes, values of rph, speed, mileage, fuel consumption, etc. ...It is sent to Driver, Fleet Manager, and could be sent to Maintenance Organisation, Services Providers (Authorities ? ...That have already some equivalent through the tachograph Sub-system).

For the time being, it is mainly a download process, through a physical support or short range communication, of the on board data base on a periodical basis, to a Fleet and Drivers Management Application.

### **Driver Driving Behaviour Information Request**

This physical data flow is used within the Freight Fleet Vehicle, Driver, Cargo, Equipment System. It is sent to the Vehicle Monitoring and Control Subsystem, Vehicle Operation Module, to trigger extractions of the permanent recording of, main parameters that characterise a driving style at a given moment or for a given period, or for a given trip, such as use of gearbox, brakes, values of rph, speed, mileage, fuel consumption, etc. ...It is sent by Driver, Fleet Manager, and could be sent by Maintenance Organisation, Services Providers (Authorities ? ...That have already some equivalent through the tachograph Sub-system).

For the time being, it is mainly a read process of the on board data base on a periodical basis, from a Fleet and Drivers Management Application.

### **Driver Input**

This physical data flow is used within the Freight Fleet Vehicle, Driver, Cargo, Equipment System. It represents any kind of data keying or dialog box validation, acknowledgement, by the Driver, so as to enter human or manual information in the Sub-systems, fill in preformatted Messages or write free text, trigger various Requests.

### **Driver Output**

This physical data flow is used within the Freight Fleet Vehicle, Driver, Cargo, Equipment System. It represents any kind of information that should necessarily be brought to the attention of the Driver, either as a response to his inputs or as warnings from Sub-systems or Modules, or Messages and Requests sent by Authorities, Fleet Manager, Maintenance Organisation, Services Provider, Road Operator.

### **Electronic Document Request**

This physical data flow is used within the Freight Fleet Vehicle, Driver, Cargo, Equipment System. It is sent by the driver (or the Driver Tasks Management Subsystem) to the Principal or Fleet Manager or emitted by Authorities to the Driver Tasks Management Subsystem.

### **Electronic Document**

This physical data flow is used within the Freight Fleet Vehicle, Driver, Cargo, Equipment System. It provides, from the Principal or Fleet Manager, all documents (Commercial or statutory) needed by the driver to complete a task or execute a transport order, on board the vehicle. These documents may be required by Authorities (Police, Sanitary Authorities, Customs...), or to be (electronically...) signed by Consignors / consignees.

To support this flow, tasks instructions sent to a driver are associated with a list of required documents, that can either be textual descriptions of these documents if these are only available in paper format or references to the documents if these are available in electronic format. Both options are supported as virtually all documents are still available in paper format only and migration to a paperless environment will take several years.

### **Emergency Call**

This physical data flow is used within the Freight Fleet Vehicle, Driver, Cargo, Equipment System. This Physical flow is either sent by the Driver or triggered automatically by the Vehicle Monitoring and Control System (or Equipment subsystem if relevant and appropriate), according to various possible parameters. It is sent to appropriate rescue service, Police, Services Providers and Fleet Manager.

It contains the Vehicle and / or Equipment position and relevant additional information.

### **Emergency Response**

This physical data flow is used within the Freight Fleet Vehicle, Driver, Cargo, Equipment System. It is sent, if still efficient and relevant, by Terminators which have received an Emergency call. It contains any information valuable to manage the emergency.

### **Entertainment and Training Services Access**

This physical data flow is used within the Freight Fleet Vehicle, Driver, Cargo, Equipment System. This Physical Flow contains the entertainment or training programmes sent to the Driver by a Service Provider or Fleet Manager.

### **Entertainment and Training Services Access Request**

This physical data flow is used within the Freight Fleet Vehicle, Driver, Cargo, Equipment System. It is sent, by the Driver, to access to Entertainment or Training Services on an appropriate peripheral, to a Service Provider or Fleet Manager..

### **Equipment Status Information**

This physical data flow is used within the Freight Fleet Vehicle, Driver, Cargo, Equipment System. It is gathered by various equipment sensors or known within the on board (Vehicle or Equipment...) data base. It is sent by the driver or automatically by the Vehicle Monitoring and Control Sub-system and, of course, Equipment Sub- system or Module according to the scenario, so as to ensure that the necessary equipment (e.g. trailer, swap body, container, etc. ...) is available, the required one, ready to complete a task (related to a transport order or to any other accepted task). The flow is either triggered by incoming task instructions, the trespassing of a threshold point, or it can be initiated directly by the driver. It can be triggered too, at any moment, by the Fleet Manager, Maintenance Organisation or Other Transport Mode Operator. It could be triggered by authorities (road side safety inspection).

This physical data flow can be sent to the Driver Tasks Management Subsystem so as to be used as an input for a Tasks and status report.

It can contain equipment characteristics, mileage, instantaneous data on wear and tear of organs and parts, maintenance status, information on space availability (a description of the available volume and / or weight, possibly compared with the load plan), information on present accessories.

#### **Equipment Status Information Request**

This physical data flow is used within the Freight Fleet Vehicle, Driver, Cargo, Equipment System. It is sent by the Driver, Fleet Manager, Other Transport Mode Operator, Authorities, or by the Driver Tasks Management Sub-system to the Vehicle Monitoring and Control Subsystem (and or Equipment Sub-system or Control Module...) to check that the necessary equipment (e.g. trailer, swap body, container, etc. ...) for completing a task (related to a transport order or any other accepted task) is available, the required one, and ready.

It may contain a description or identification of required equipment that can either be coded or textual descriptions of the equipment if no sensors and / or transponders are available to detect its presence and status or references to the equipment if sensors are available. Both options should be supported as it is likely that not all equipment will be connected to sensors / transponders.

#### **Equipment Position**

This physical data flow is used within the Freight Fleet Vehicle, Driver, Cargo, Equipment System. It contains equipment positioning data associated to the motor Vehicle or as such. It can be sent to the Driver, Fleet Manager, Services Providers, Maintenance Organisation, Road Operators, Other Transport Mode Operator, Authorities.

#### **Equipment Position Request**

This physical data flow is used within the Freight Fleet Vehicle, Driver, Cargo, Equipment System. It is sent by the Driver, Fleet Manager, Services Providers, Maintenance Organisation, Road Operators, Other Transport Mode Operator, Authorities, to the Equipment Sub-system or Vehicle Monitoring and Control Module, to request for the equipment positioning data.

#### **Hazardous Goods Information**

This physical data flow is used within the Freight Fleet Vehicle, Driver, Cargo, Equipment System. It contains all relevant and necessary data pertaining to a classified Cargo as “Hazardous Goods” according to ADR regulation. It may or must be sent by the Principal to an “ICD” and by the Fleet Manager to a “FD” with transport Order Information, To the Cargo Control Module and the On Board Data Base. It can be sent by the driver to other Terminators, such as Authorities for regulations compliance and rescue services, to Services Providers.

#### **Hazardous Goods Information Request**

This physical data flow should be used within the Freight Fleet Vehicle, Driver, Cargo, Equipment System. IT can be sent to the Vehicle Monitoring and Control Sub-system , Equipment Sub-system, Cargo Control Module, by Authorities (for regulation Compliance or accident management and rescue conditions), or Road or Infrastructure Operator (tunnels...), or Services Operators, to check if the Cargo is a classified one.

### **Infrastructure Information ?**

This physical data flow is used within the Freight Fleet Vehicle, Driver, Cargo, Equipment System. It should be sent by the Infrastructure to the Vehicle Monitoring and Control System, Advanced Driver Assistance Sub-system and contains information pertaining to road geometry, surface, lanes marking, bridges heights, etc. ...

### **Invoice Information**

This physical data flow is used within the Freight Fleet Vehicle, Driver, Cargo, Equipment System. It supports the administrative operations of a independent or chartered driver. As such it contains Invoices to customers and triggers for payment by these customers (here the “Principal”) it is managed out by the “ICD” Driver Tasks Management Sub-system.

### **Load Vehicle, Driver, Cargo, Equipment Data Store**

This physical data flow is used within the Freight Fleet Vehicle, Driver, Cargo, Equipment System. It covers the permanent provision of any data to the on board data base, resulting from the monitoring and positioning of any relevant vehicle, driver, cargo and equipment parameters, by the various Sub-system and Modules and possibly by Terminators (e.g. electronic document from a Principal, tasks order from a Fleet Manager etc. ...), including storage of relevant parameter values for future use. (e.g. Driver driving behaviour, Driver expenses...).

It covers, so, internal flows to Sub-systems or Modules, triggered by their processes.

### **Maintenance Information and Assistance**

This physical data flow is used within the Freight Fleet Vehicle, Driver, Cargo, Equipment System. It is sent by the Maintenance Organisation or Fleet Manager or any other Services Provider to the Driver and Vehicle Monitoring and Control Sub-system. It contains maintenance data and assistance data asked by a Driver / Vehicle request and / or downloaded in the Vehicle data base on a periodical basis.

It is sent too by the Vehicle Monitoring and Control Sub-system (from extraction of the on board data base) to the Driver Tasks Management Sub-system, so as to check for Vehicle availability.

### **Maintenance Information and Assistance Request**

This physical data flow is used within the Freight Fleet Vehicle, Driver, Cargo, Equipment System. It can be sent by the driver, the Vehicle Monitoring and Control system (or Equipment), to check whether it is possible to complete a task before maintenance is due or to check whether the formerly requested maintenance has been completed. It can be triggered, too, by the trespassing of a maintenance threshold point. It can be automatically triggered by a dysfunction or incident detection; it is sent, then, to the Fleet Manager, the Maintenance Organisation or a Services Provider.

This physical data flow can be sent to the Driver Tasks Management Subsystem so as to be used as an input for a Tasks and status report.

### **Other Information Provision**

This physical data flow is used within the Freight Fleet Vehicle, Driver, Cargo, Equipment System. It is sent from various terminators to the Driver Tasks Management Subsystem or the Vehicle Monitoring and Control system (e.g. Traffic Information and Route Guidance Sub-system, from Ambient Environment Terminator) and contains miscellaneous data not yet

inserted in structured standard “Messages” (e.g. from Principal or Fleet Manager, information not pertaining directly to a Transport Order or A Task). Replies of the same kind can be sent backwards. It can fill in or be extracted from the on board data base.

#### **Other Information Request**

This physical data flow is used within the Freight Fleet Vehicle, Driver, Cargo, Equipment System. It can circulate to and from various Terminators, to and from the Driver Tasks Management Subsystem or the Vehicle Monitoring and Control system, so as to ask for information not yet inserted in structured standard “Messages”.

#### **Payment Information**

This physical data flow is used within the Freight Fleet Vehicle, Driver, Cargo, Equipment System.

It is sent between the Principal and the “ICD”, Driver Tasks Management Subsystem, and contains possible additional information related to the payment of a Transport Order.

It is sent by any Terminator requiring payment from the Driver (e.g. EFC, refueling, telematics services, hotel, restaurant, etc. ...and contains at least the user ID) so as to trigger and manage payment by the Vehicle Monitoring and Control Sub-system and receive receipts.

It loads the on board data base (e.g. so as to consolidate Driver expenses file...).

#### **Payment Information Request**

This physical data flow is used within the Freight Fleet Vehicle, Driver, Cargo, Equipment System. It is sent from a principal to an “ICD” so as to require additional information for payment of a Transport Order.

It is sent to any Terminator requiring payment from the Driver (e.g. EFC, refueling, telematics services, hotel, restaurant, etc. ...) so as to receive information allowing payment management by the (Vehicle Monitoring and Control Sub-system) payment subsystem.

It reads the on board data base.

#### **Read Vehicle, Driver, Cargo, Equipment Data Store**

This physical data flow is used within the Freight Fleet Vehicle, Driver, Cargo, Equipment System. It covers all flows triggered by the requirement of any Terminator (from Authorities to Services Providers...), processed by appropriate Sub-system or Module, delivering stored information related to the Driver, Vehicle (position, condition, operation), Equipment, Cargo...

It covers, too, internal flows to Sub-systems or Modules, triggered by their own processes.

#### **Regulations Compliance Information**

This physical data flow is used within the Freight Fleet Vehicle, Driver, Cargo, Equipment System. It is sent to Authorities and possibly to Fleet Manager, to check that the driver complies with any other regulations than Social Regulations, and that Vehicle, Equipment, Cargo complies with appropriate regulations. It contains such information as the evidence that necessary statutory documents are on board the vehicle, or that a given regulation, such as Speed limits, overweight (checked through weigh in motion system...), Hazardous Goods, etc. ...is or has not been infringed.

### **Regulations Compliance notification**

This physical data flow is used within the Freight Fleet Vehicle, Driver, Cargo, Equipment System. It is sent from Authorities to inform about regulations and / or to send the result of compliance check.

### **Regulations Compliance Information Request**

This physical data flow is used within the Freight Fleet Vehicle, Driver, Cargo, Equipment System. It is sent from Authorities and possibly from Fleet Manager, to check that the driver complies with any other regulations than Social Regulations, and that Vehicle, Equipment, Cargo complies with appropriate regulations.

In the case of roadside inspection, this request is sent to the appropriate Terminator (the Vehicle itself for speed limits and overweight infringement), but to appropriate Sub-systems or Modules to obtain additional information such as auto ID and other data from the on board data base.

### **Resources Availability Information**

This physical data flow is used within the Freight Fleet Vehicle, Driver, Cargo, Equipment System. This physical flow gathers all necessary information to ensure an “ICD”, by himself (from Vehicle Monitoring and Control Sub-system), or the “FD” through dialogue with his Fleet Manager (so as to ensure his Fleet Manager, too, if necessary) and from the same Sub-system, that him, his vehicle, equipment, accessories and other transport mode, are ready to help perform a Task or a transport order.

It may be sent (to the Driver Tasks Management Sub-system) by Other Transport Mode Operator, so as to inform that the transport mean scheduled for completing a task (related to a transport order or any other accepted task) is, or will be available on due time. It will then contain an identification or description of the required transport mean, information on any problem (delay, breakdown, cancellation etc...).

### **Resources Availability Information Request**

This physical data flow is used within the Freight Fleet Vehicle, Driver, Cargo, Equipment System. It is sent by the Driver, the Fleet Manager, the Driver Task Management Sub-system to the Vehicle Monitoring and Control System, and, if necessary, by the first Sub-system to an Other transport Mode Operator, so as to check that all necessary resources to perform a task are or will be available. It may contain appropriate identifiers (Driver, Vehicle, Equipment, Other Transport Mean, etc. ...) and related information for these checks.

### **Social Regulation Compliance Information**

This physical data flow is used within the Freight Fleet Vehicle, Driver, Cargo, Equipment System.

This flow necessarily starts from the tachograph Sub-system, so as to support the verification by Authorities and of course by the Fleet Manager that the driver complies with EU social regulations. The function is triggered by the start of any driver or vehicle activity and the flow by the request of an Authority / Fleet Manager, to verify compliance with the social regulations.

As such, this flow will contain all raw relevant data as requested by the EU social regulations. This physical data flow can be sent to the Driver Tasks Management Subsystem so as to be used as an input for a Tasks and status report; it can be sent, too, as driver availability information.

The Vehicle Monitoring and Control Subsystem may process and enrich this flow so as to output a more structured, consolidated and readable information, to allow for Driver decision support.

#### **Social Regulation Compliance Information Request**

This physical data flow is used within the Freight Fleet Vehicle, Driver, Cargo, Equipment System. Sent directly to the Tachograph Sub-system by Authorities or Fleet Managers or through the Vehicle Monitoring and Control Subsystem by the Fleet Manager or Driver, to trigger the provision of Social Regulation Compliance Information.

#### **Software and Data Base Services Access**

This physical data flow is used within the Freight Fleet Vehicle, Driver, Cargo, Equipment System. This flow provides the Driver and Sub-systems / Modules, with various kind of inputs from Telematics Services Providers (Digital maps, route optimisation software, hazardous goods regulations, road and transport regulations, etc. ...).

#### **Software and Data Base Services Access Request**

This physical data flow is used within the Freight Fleet Vehicle, Driver, Cargo, Equipment System. It is sent by the Driver, or Interested Sub-system, to a Service Provider, to satisfy a punctual need or to be assisted during a given period (e.g. Route Guidance), or even permanently (concept of “Virtual Fleet Manager”).

#### **Software update**

This physical data flow is used within the Freight Fleet Vehicle, Driver, Cargo, Equipment System. It is sent by the Fleet Manager or a Service Provider to the Interested Sub-system or Module, so as to remotely and automatically update the version of the implemented software, or implement a new one.

#### **Tasks**

This physical data flow is used within the Freight Fleet Vehicle, Driver, Cargo, Equipment System. It is sent by the Fleet Manager to the “FD” Driver Tasks Management Sub-system.

For the “ICD” it is the internal translation of a Transport Order within this Sub-system.

It contains all necessary information to start and achieve a Sequence of an assignment corresponding to a basic operation for the driver / vehicle pair at a given moment (trip, route, load plan, etc. ...).

It may or may not be linked to one or several transport orders execution.

Examples: move to a given position, Load the cargo corresponding to a transport order, uncouple a trailer, have maintenance operation, have the vehicle washed, etc. ...

It may be a Task modification to be processed by the Sub-system and Driver.

#### **Tasks Request**

This physical data flow is used within the Freight Fleet Vehicle, Driver, Cargo, Equipment System. This physical flow is triggered by the driver or by the Driver Tasks Management Sub-system, to contain the requirement of a new tasks order from the Fleet Manager, if no one has been sent to them. It may be associated with Vehicle Position and Resources Availability Information.

### **Task Status request**

This physical data flow is used within the Freight Fleet Vehicle, Driver, Cargo, Equipment System. This flow, sent from the Driver Tasks Management Sub-system to the Fleet Manager or Other Transport Mode Operator, contains first the result (according to Tasks Message requirements) of on board application process of a new tasks order, the result of driver reading it, both types of acknowledgements.

It contains then all relevant information about an ordered task, after achievement or during its performance.

This “Message” is built, beyond immediate status of the Task (OK, delayed, Pbs ...) with possibly, if justified, relevant and / or required, other associated “building blocks”:

- Driver status regarding social regulations or other parameters,
- Vehicle and / or Equipment status,
- Related Transport order Status (for the “FD”...),
- Maintenance request or information,
- Etc. ...

The Driver / Driver Tasks Management Subsystem may be proactive, for instance send advice of arrival to another transport mode operator (as a booking confirmation), indicate route modification, be involved in gate in / gate out procedures.

### **Task Status**

This physical data flow is used within the Freight Fleet Vehicle, Driver, Cargo, Equipment System. It is sent by the Fleet Manager to the Driver Management Sub-system (if not programmed and scheduled in the Task description itself) to check that the driver have complied with task instructions (Task ID) and possibly related transport order execution (Transport Order ID), including the necessary feedback and reporting. Tasks are, of course, such actions as start loading, start trip, but, too, have vehicle washed or examined, take another vehicle, manage equipment (from trailer shift to exchange of reusable pallets), etc...

Other Transport Mode Operator may send this physical data flow to get informed about the execution of a Task in which he is, has been, will be involved.

### **Traffic, Weather and Route Optimisation Information**

This physical data flow is used within the Freight Fleet Vehicle, Driver, Cargo, Equipment System. This physical flow, sent to the Sub-system Traffic Information and Route Guidance Sub-system, by various possible Terminators, contains route information (possibly maps) and information on environmental conditions, such as traffic, weather, pollution, clients profile and constraints, etc. ...

### **Traffic, Weather and Route Optimisation Information Request**

This physical data flow is used within the Freight Fleet Vehicle, Driver, Cargo, Equipment System. It is sent by the Traffic Information and Route Guidance Sub-system to various possible Terminators. It can contain information on the position and status of Driver, Vehicle, Equipment, Clients, Cargo, load plan, other transport means.

### **Transport Opportunity**

This physical data flow is used within the Freight Fleet Vehicle, Driver, Cargo, Equipment System. It is sent by the Principal to the Independent and Chartered Driver / Driver Management Sub-system. It contains all necessary data to evaluate the feasibility and interest

of the possible transport Order (ID, Consignor/Consignee info, weight, volume, packaging, pick up conditions, delivery conditions, freight rate, etc. ...).

### **Transport Offer**

This physical data flow is used within the Freight Fleet Vehicle, Driver, Cargo, Equipment System. It is sent to the Principal by an “ICD” and contains relevant information so as to trigger a transport opportunity or order by the former: Vehicle position, Cargo space availability, possible next route, etc. ...

### **Transport Order**

This physical data flow is used within the Freight Fleet Vehicle, Driver, Cargo, Equipment System. It is sent either by the Principal or a Fleet Manager to the Driver / Driver Management Sub-system. For both, it contains an instruction, with a specific reference, including the information required to carry out the commercial act of a transport contract, technically divided up into unit loads / item numbers of which it may be composed.

For the “FD” it needs to be associated to one or several Tasks instructions (the same Transport Order may be executed by several successive Drivers), for the “ICD” it will be translated into Tasks.

IT may be “sent” to Consignor and Consignee for signature or reservations.

### **Transport Order Status**

This physical data flow is used within the Freight Fleet Vehicle, Driver, Cargo, Equipment System. It is sent either to the Principal or a Fleet Manager by the Driver / Driver Management Sub-system. For both, it contains a report, with a specific reference.

For the “FD” it needs to be associated to one or several Tasks status reports (the same Transport Order may be executed by several successive Drivers), for the “ICD” it will be only a Transport Order Status Report.

It will be sent by the Driver / Driver Management Sub-system, with Consignor and, most, Consignee (Proof of delivery) signature and or reservations or ...refusal...

### **Transport Order Status Request**

This physical data flow is used within the Freight Fleet Vehicle, Driver, Cargo, Equipment System. It is sent by the Principal or Fleet Manager to the Driver / Driver Management Sub-system so as to have it report on the Transport Order execution (ID) if this has not been programmed and scheduled when contracting (“ICD”) or Tasks description (“FD”).

### **Vehicle Condition Information**

This physical data flow is used within the Freight Fleet Vehicle, Driver, Cargo, Equipment System. It is gathered by various vehicle sensors or known within the on board data base. It is sent by the driver or automatically by on board application (within Vehicle Monitoring and Control Sub-system), so as to ensure that the vehicle is ready to complete a task (related to a transport order or to any other accepted task). The flow is either triggered by incoming task instructions, the trespassing of a threshold point, or it can be initiated directly by the driver. It can be triggered too, at any moment, by the Fleet Manager, Maintenance Organisation or Other Transport mode Operator. It could be triggered by authorities (road side safety inspection).

It can contain vehicle characteristics, mileage, instantaneous data on wear and tear of organs and parts, maintenance status, information on space availability (a description of the available volume and / or weight, possibly compared with the load plan), information on present

accessories. Other identical type of information to be gathered from a separable equipment will be provided by the equipment Sub-system or module according to the scenario.

#### **Vehicle Condition Information Request**

This physical data flow is used within the Freight Fleet Vehicle, Driver, Cargo, Equipment System. It is sent to the Vehicle Monitoring and Control Subsystem (and Vehicle Condition Control Module), by the Driver, the Fleet Manager, Authorities, Maintenance Organisation, Other Transport Mode Operator, or by the Driver Tasks Management Sub-system so as to trigger Vehicle Condition Information Provision.

It may contain (beyond the Vehicle ID, the identification of specific items to be checked, or, e.g. cargo volume and / or weight to check for space availability).

#### **Vehicle Operation Information**

This physical data flow is used within the Freight Fleet Vehicle, Driver, Cargo, Equipment System. It is sent to the Vehicle Monitoring and Control Subsystem by various captors and sensors, so as to improve the vehicle real time operation: area vision, friction data, lane data, objects on the road, safety margins, etc. ... It is sent to the Driver, Fleet Manager, Maintenance Organisation, Service Provider (e.g. floating car data), by the Vehicle Monitoring and Control Sub-system. It contains extracts of the on board data base permanently fed by captors and sensors managed by the Vehicle Operation Control Module from the Vehicle Organs (usage duration and parameters of usage).

#### **Vehicle Operation Information Request**

This physical data flow is used within the Freight Fleet Vehicle, Driver, Cargo, Equipment System. It is sent by the Driver, Fleet Manager, Maintenance Organisation, Service Provider, to the Vehicle Monitoring and Control Sub-system / Vehicle Operation Control Module.

It can contain details about information to be gathered.

#### **Vehicle Platooning Data**

This physical data flow is used within the Freight Fleet, Vehicle, Driver, Cargo, Equipment System. It is sent from / received by, the Vehicle Monitoring and Control Sub-system, to / from other Vehicles. It contains information so as to allow a safe platooning of vehicles.

#### **Vehicle Position**

This physical data flow is used within the Freight Fleet Vehicle, Driver, Cargo, Equipment System. It contains the co ordinates of a vehicle at a given moment. It can be emitted by the vehicle (positioning module), if this one is equipped with an autonomous calculating system. It can be sent to it or directly to the requiring party if it is calculated by an external positioning device. It can be automatically added to outgoing messages by the “Vehicle Monitoring and Control Sub system” or the “Driver Tasks Management Sub system”.

#### **Vehicle Position Request**

This physical data flow is used within the Freight Fleet Vehicle, Driver, Cargo, Equipment System. It is sent by the vehicle (positioning module) or by any other interested terminator, to an external positioning device and / or to the Vehicle appropriate Sub system or Module.

### **Warnings on Driver Status, Vehicle Status and Operation, Equipment Status and Operation, Cargo Status**

This physical data flow is used within the Freight Fleet Vehicle, Driver, Cargo, Equipment System. It is emitted by Sub-systems or Modules to warn the driver if the value of any monitored parameter exceeds a threshold and it will also support the driver by informing the Fleet Manager, or any other relevant party, if the same or other thresholds are exceeded or it can be triggered by a request from the Fleet Manager or any other relevant party.

## **5.8 BASIC TECHNICAL CONSIDERATIONS AND OPTIONS**

This chapter describes, as a more trivial approach, possible input/output devices required to satisfy the needs identified within the previous steps of the project and translated here, after the Functional Architecture, into a Physical Architecture, sub-systems and modules.

It describes, too, what should be required from these devices so as to be able to support efficiently this system(s) Architecture and to allow for its integration.

The following diagram (figure 45) shows a basic example of a physical architecture implementation of the On board system, based on the today's constraints such as the European regulation that requires the digital tachograph, the features of which cannot be shared very easily with other systems.

This diagram combine the hypothesis of having an hand held computer (dotted white boxes) added to the on board one (we think here of pick up and delivery activities), the scenarios of "slave" equipment (dotted grey boxes) and "autonomous" equipment (grey boxes).

Whatever the physical architecture, economic criteria as well as the availability of certain technologies but also the requirements of each type of transport activity must be taken into account in the design of the system from both the hardware and the software levels.

Therefore it is recommended to consider the physical layer where the hardware input/output features have to be defined especially at the sensor level. For all other kinds of input/output the hardware is using very well known standards that are currently available on most systems.

Then the logical layer, provides data for all generic or specific functions executed by the system. This capability should allow software companies to develop application software by considering the logical layer only, since it is anticipated to acquire most information throughout a CAN and no longer by using specific sensor inputs.

The "system" (in its EDP meaning) functions are basically the functions performed by the BIOS in the PC environment. Without the operating system that support any type of applications, it is still (and mandatory) possible to operate the system at a very low level where the I/O can be configured, the peripherals can be identified and finally the operating system can be loaded.

**This step is of key importance since it must allow to definitely split the hardware level from the software one as apparently requested by truck manufacturers.**

The other main advantages will be the flexibility, the capability of hardware and software upgrades and more important, the end users will be able to select application software independently of OBC's manufacturers, which is almost impossible today.

Finally an entire application and the associated environment can be loaded so that the system can operate according to the customer needs. An overview of a general concept is described in this document to show how the functions defined in the functional architecture are handled by such a system.

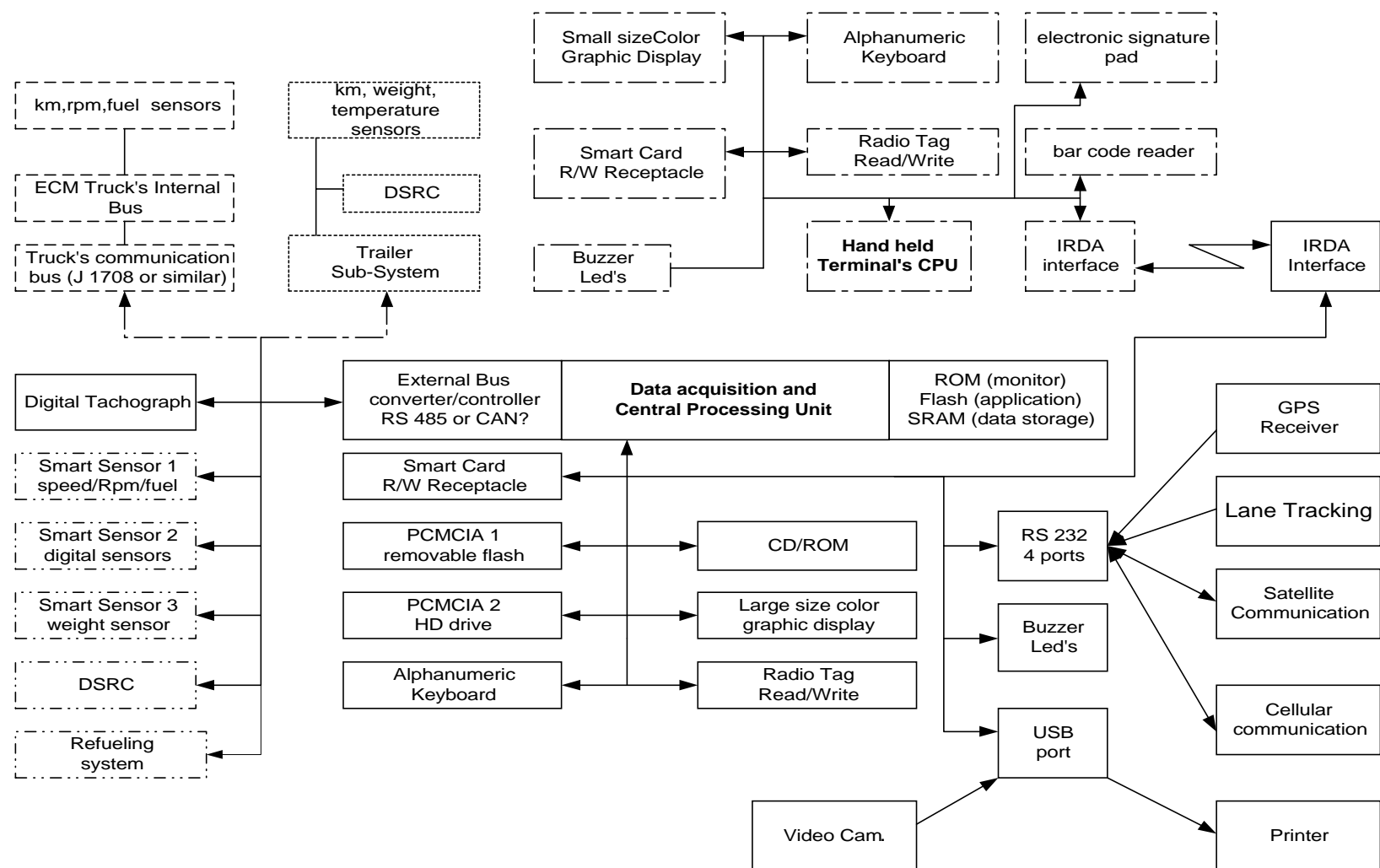


Figure : 46. : Basic example of a physical architecture emplementation

## **5.8.1 On Board Systems general description**

### **5.8.1.1 The Central Processing Unit**

The OBC is the kernel of the On Board Systems that include a central processing unit built around a 133 or 166 Mhz Pentium. This module controls and manages all I/O such as the keyboard, the graphic display, the internal memory and all the external peripherals. Such Micro-motherboards are available on the market and fully support Windows 95, CE or NT. Therefore all kinds of standard fax, E-mail, invoicing and fleet management applications developed under these environments become easily operational.

### **5.8.1.2 The internal memory**

The global controller of the system has to be stored in a ROM. The setting and all configuration permanent parameters as well as certain I/O drivers are stored in a flash EPROM. This means that the flash eprom must have a total capacity of few megabytes. Temporary data as well as transmission and reception buffers require a RAM space that can be expanded in case of implementation of new features.

### **5.8.1.3 The external data storage**

A first PCMCIA slot of recording can be used to store the vehicle, driver, trip, equipment and cargo data during the process. Based upon the duration of the recording period, few megabytes may be necessary and the Flash memory card could be a good data transfer support. If not too large, the application software could also be loaded on the flash card which might make easier any software upgrade since it can be done while a data download at the home base. However under extreme operating conditions, this PCMCIA could be replaced by a contact less high capacity memory card ( 4 to 48 MB and higher if necessary).

### **5.8.1.4 The hard disk drive**

In the case of the “chartered driver” scenario that relies on high level functions 1, 2 and 3, a second PCMCIA slot might be necessary to plug either a hard disk drive or a high capacity flash memory for the application software itself.

### **5.8.1.5 The keyboard**

An alphanumeric keyboard is necessary to enter free messages or to fill up all preformatted messages. In addition in order to quickly and easily access pre-programmed functions, the keyboard shall include functions keys so that drivers can directly access to the most used functions such as E-mail, the mapping system, log In/Out.

#### **5.8.1.6 The display**

A 8 to 10 inches active matrix colour screen (TFT) is necessary to display on line menus, alarms, messages received or transmitted. In the case of the “chartered driver” scenario the display become more important since fleet and freight management functions must be carried out on board the vehicle.

For safety reasons the brightness of the back light must be automatically adjusted according to the ambient light. Due to the lack of space it might be useful to combine both the keyboard and the display features into a unique peripheral using a “touch screen” technology. This might also result in a better flexibility since the keyboard becomes completely customisable.

#### **5.8.1.7 The CD-ROM drive**

Depending on the level of services and functions to be implemented on board the vehicle the CD-ROM is a good way to store a huge quantity of data assuming that the mapping feature is necessary in real time, most of the landscape databases are available on CD's. Ultimately the CD drive can be a DVD player for entertainment or self training purposes.

#### **5.8.1.8 A smart card receptacle**

It allows all “read” and “write” instructions using cryptographic algorithms for secured data exchange. This receptacle must accept various types of smart card complying with the ISO standards 7816-1 to 4. The smart card can be used for many purposes including loading of a Tasks order into the On board system, customer identification, goods identification electronic documents related to vehicle, regulation, invoicing information, etc...

For some transport activities not requiring the installation of a tachograph such as city buses or vehicles weighting less than 3.5 T the smart card becomes very useful for driver identification. The storage capacity available as well as the integration of programming platforms on smart cards, may allow using it as a data storage support for those applications where the data download is done on a daily basis.

#### **5.8.1.9 The IRDA interface**

Located in a cradle it allows the plugging of a handheld terminal that should be considered as an option to be probably widely used for the pickup and delivery activities.

#### **5.8.1.10 The serial communication ports**

Most computers operating under a Windows environment normally support four RS 232 C serial ports. Today GPS receivers, Lane tracking systems, CDPD modems and cellular phones support a RS 232 as a standard I/O interface. Therefore and unless otherwise, our On Board system has to manage 4 serial ports, the setting parameters of which must be fully programmable. Some of them will have to operate with a high priority interruption. The line

dedicated to the reception of message should have a higher priority than the one dedicated to the GPS receiver.

- The first port should be dedicated to a multi protocol communication platform,
- One port is dedicated to the GPS receiver,
- One port is dedicated to the lane tracking system,
- One port is dedicated to the Data Short Range Communication system.

#### **5.8.1.11 The USB port.**

More and more peripherals support the USB port. In our configuration, the USB port can manage the printer and a video camera in case of transport of passengers or waste removal

#### **5.8.1.12 The RS 485**

It is dedicated to the acquisition of vehicle/trailer/equipment data. At this time this is the most unknown part. Progresses must be done in the definition of a standard vehicle communication network in order to precisely determine what will be the most appropriate solution to interface all other peripherals and smart sensors mandatory for an efficient management system. It must be reminded at this time that the future higher level of integration is mainly dependant on this interface. The last section of the document shows the consequences on the physical architecture introduced by the full implementation of a bus as defined in the J 1708 and J1587 standards.

### **5.8.2 The external peripheral devices**

#### **5.8.2.1 The digital tachograph:**

A serial port interface has been defined to transmit data stored in the vehicle unit towards an Intelligent Dedicated Equipment (IDE). These IDE could suitably be a PC or laptop because data can be directly processed. For this reason the RS 232 is the most compatible. However a further analysis of the protocol highlights that the download is allowed in very restricted conditions that avoid our system of using this interface. Therefore a CAN appears to be the best suitable solution but messages need to be defined to request data from the digital tachograph. The following data are the minimum required to feed our applications:

- Driver ID and Co-Driver ID including Name, first name, card number, insertion date&time
- Activity code (Dr/Wk/Av/Re)
- Distance covered and current speed

### **5.8.2.2 The GPS receiver:**

At this low level of integration the GPS receiver is connected through a serial port and will provide the On Board system with the main following data:

- Latitude, longitude, altitude
- heading, speed and time.

The two first parameters are important to locate the vehicle on a map. The time info could be useful for internal checking of the On Board system Real Time clock.

### **5.8.2.3 GSM/SMS**

Every standard unit includes one RS 232 port for data transmission or reception.

### **5.8.2.4 The lane tracking system**

This communicates through an RS 232 port and provides upon request the following data:

- Vehicle yaw rate: indicates how driver his behaving on his lane in deg/sec
- Driver's alertness Index in percentage (0=bad 99=perfect)
- Ambient light level (0= very dark) this may be used for the automatic adjustment of the screen brightness.

### **5.8.2.5 The smart sensors:**

Assuming that no bus is available, a smart sensor must acquire data from various actuators located on the vehicle. The most useful parameters needed for vehicle and driver management are:

- Speed/distance, Engine rotation speed, fuel consumption, dual or tri axis acceleration,
- foot brake activation, clutch depressed, delay usage, turn signals, reverse engaged, power take off, wipers usage, low-beam, high-beam,
- Trailer or swap body Id.

All These parameters require today specific inputs that also make the installation more difficult. On ground of flexibility, some "smart sensors" should be made available to interface the current actuators with the system. The smart sensor is then sending a message upon the request of the On Board system. A similar smart sensor can be developed to interface the weighting system.

### **5.8.2.6 The DSRC module**

It is used for EFC application or for any type of data exchange while vehicle is at the home base and for data exchange with the law enforcement authorities.

### 5.8.3 The logical layer

This section explains how input/output are organised so that the processor can manipulate information whatever the physical acquiring method. This means that links have to be defined between the hardware I/O and the corresponding internal registers.

Various families of inputs should be considered in such a system. One can summarise them as follows:

- **Digital information:** information that can only take on “0” and “1” logic status. In most cases a such a data is provided by a switch actuated either by an operator or by another physical magnitude managed by threshold (pressure contact, thermo-contact, etc.)
- **Analogue information:** information that can take on any positive or negative value representing a quantity such as speed, engine revs, fuel flow, battery voltage, weight, temperature, etc...
- **Messages:** information provided in a chain of characters such as, transport order N°, task order N°, client Id, client phone number, description of goods, etc...

### 5.8.4 The “digital data”.

On grounds of flexibility, a sensor library should be established that can change progressively with new requirements. In addition it is of key importance to dissociate the logic part of the system ( software) from the physical one (hardware connection). The logical data can have several sources and might require specific process depending on the source that it is coming from. The following table summarise the features of the logical data.

Family	Definition & Source	Process needed	Examples
External Logic sensor (ELS)	“On/Off” signals supplied by External sensors	Software filtered Hysteresis cycle Activation level	Power take off, wiper, foot brake, head lights, reverse gear, Engine on, etc.
Internal Logic sensors (ILS)	“On/Off” statuses resulting of internal system registers analysis. No connection required.	Internal register analysis	New message IN, new hour, new day, new driver, new trip, vehicle idling, vehicle moving, driver smart card IN, etc

The ELS may have a limitation of number according to the hardware capabilities of the system. Looking at the specifications of the J1587 it is clear that most ELS will disappear in the future by hooking up the system to the vehicle communication network. Therefore the ILS will have to be considered only, since all “On/Off” sensors such as foot brake, engine delaying, power take off, turn light signals will be managed by the vehicle communication system that will result in a messages chain.

### COMETA’s example for suggestion of LOGICAL SENSORS

Data source	Sensor activated	Comments
F1 to F12 Keys	ILS_1 to ILS_12	Indicates that the corresponding key is pressed
New Message IN	ILS_13 to ILS_18	Each time a new message is being received from the corresponding communication support (satellite, CDPD, DSRC,..) the associated sensor is set at the logical level “1”
Status request	ILS_19 to ILS_31	Each time a status is requested (either vehicle position, transport order, driver status,...) the associated sensor is set at the logical level “1”
Internal system status	ILS_32 to ILS_256	These sensors will be associated to information that can be provided by the system itself. As example one sensor can be set to the logical level “1” each time a new driver is detected, or each time the hand held terminal is inserted into its cradle, each time a new transport order is received or each time a change has occurred in the status of the driver (driving, resting, working, etc..).
Vehicle sensors	ELS_1 to ELS_32	Each time a vehicle sensor (PTO, reverse gear, foot brake ) is actuated, the associated ELS is set at the logical level “1”.

## 5.9 CONSIDERATION UPON THE EQUIPMENT AND THE TRACAR SCENARIO

As it could be seen at several stages of COMETA System Architecture description, one important hypothesis to be managed is that the “equipment”, such as trailer, swap body and even carried or to be carried container (and to a lesser extent, the pallet...), could be more or less “intelligent” by themselves, more or less autonomous from the motor vehicle.

As a part of a freight vehicle they will only be requested to provide information from appropriate sensors according to the type of activity, through the vehicle data bus.

As an autonomous unit, they could even be seen as the kernel of a data capture and process, communicating and positioning system, possibly even moved by a “stupid” tractor or locomotive...

Between these two extremes, many intermediate solutions are possible.

Intermodal transport offers a relevant opportunity to justify intermediate scenarios.

It is the reason why, with the permission of the Project responsible, we decided to illustrate this kind of scenario of System Architecture with an input from TRACAR (Traffic & Cargo Supervision System) Project which is still running (TRACAR 2) in parallel to COMETA.

“ The aim of the TRACAR Project is to develop and provide a system, which can track, monitor and manage vehicles, containers/swap bodies and their contents during transport operations in European Multimodal Traffic.

The expected result is to set a new standard for supervision and management of combined freight transport, and a minute data logging of the total journey, including relevant data that always follows the goods and gives the possibility to change the conditions of the goods during the transportation, for instance the possibility of thaw up frozen meat under very controlled conditions, so that the meat is ready for manufacturing as soon as it arrives to the receiver”

As an example of System Architecture design, beyond the interest of the presentation of an “intermediate scenario” between slave or autonomous Equipment, TRACAR offers another justification as it illustrates the integration of on board systems within a global Tracking and tracing (and even “reactive” application, e.g. for temperature setting) System Architecture.

A description can be found in annex 5.

This System Architecture has been developed before the start of KAREN and COMETA projects, so it presents another kind of justification : the proof that harmonised description of System Architecture will facilitate comparisons and cross fertilisation of Systems supposed to be implemented in common areas.

## **5.10 LOW INTEGRATION AND HIGH INTEGRATION SCENARIOS**

Beyond what we have presented as the short term scenario, main trends of possible evolutions can be already identified.

- One that could be presented as a transitory phase, focusing on internal data buses through AMIC, the “Automotive Manufacturers Initiative Consortium”, which gathers all main cars manufacturers, and within this initiative, the IDB Forum which has started in mid 1999 an investigation on an ITS Data Bus.
- One that could be presented as the future “high integration scenario”, where the networking problem (be it physical like CAN / IDB or radio like Blue tooth), could be translated into operating system and software modules solutions, within a multipurpose, multifunction chip.

### **The “transitory phase”.**

If we consider the “transitory phase” There will be two on-board networks for the interconnection of the different functionality.

The first network will be related to the telematic functions ( it is a kind of multimedia bus ) and its main aim is to circulate, to all the on-board modules, the information coming from (or going to) outside the vehicle (via the communication media like RDS, GSM, DAB, DSRC etc.). This bus has provisions to check the integrity of the data and to avoid misuse.

The second network is a kind of vehicle control bus that, depending on the required function, guarantees a suitable level of dependability. In real applications it can be split in two or more lines to assure safety critical operations.

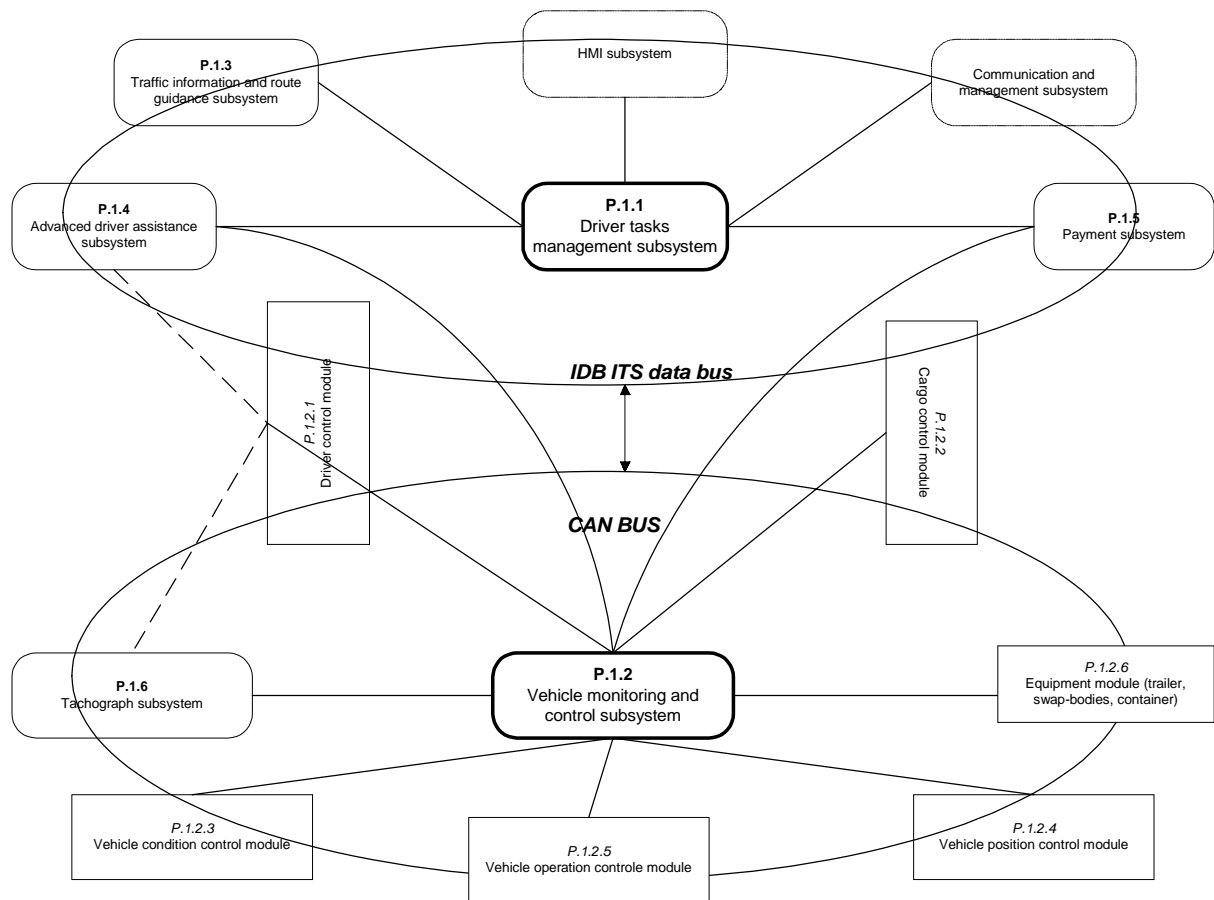
This is illustrated by Figure 46 in the next page.

The distribution of Sub-systems and Modules between the two data buses is built on the assumption that some will be more external communication and telematics oriented and other will remain more internal communication oriented.

It means that, if, of course, there will be efficient interfacing between the two networks, which could make discussions upon their “borders” rather irrelevant, it can be imagined that the most “communicating” Sub-systems or Modules, will belong to the IDB.

Even if Advanced driver assistance Sub-system and Driver control Module will get more integrated.

Even if Cargo control Module will become more and more “autonomously communicating” (images, Automatic Identification, “Messages” on the unit itself through high density bar codes or radio tags).



**Figure : 47. Freight Fleet Vehicle, Driver, Cargo, Equipment system :  
 The transitory phase**

### **High integration scenario.**

If we consider the high integration scenario represented by figure 47 and to be expected (?) between years 2005 and 2010, we are entering a more twilight zone...

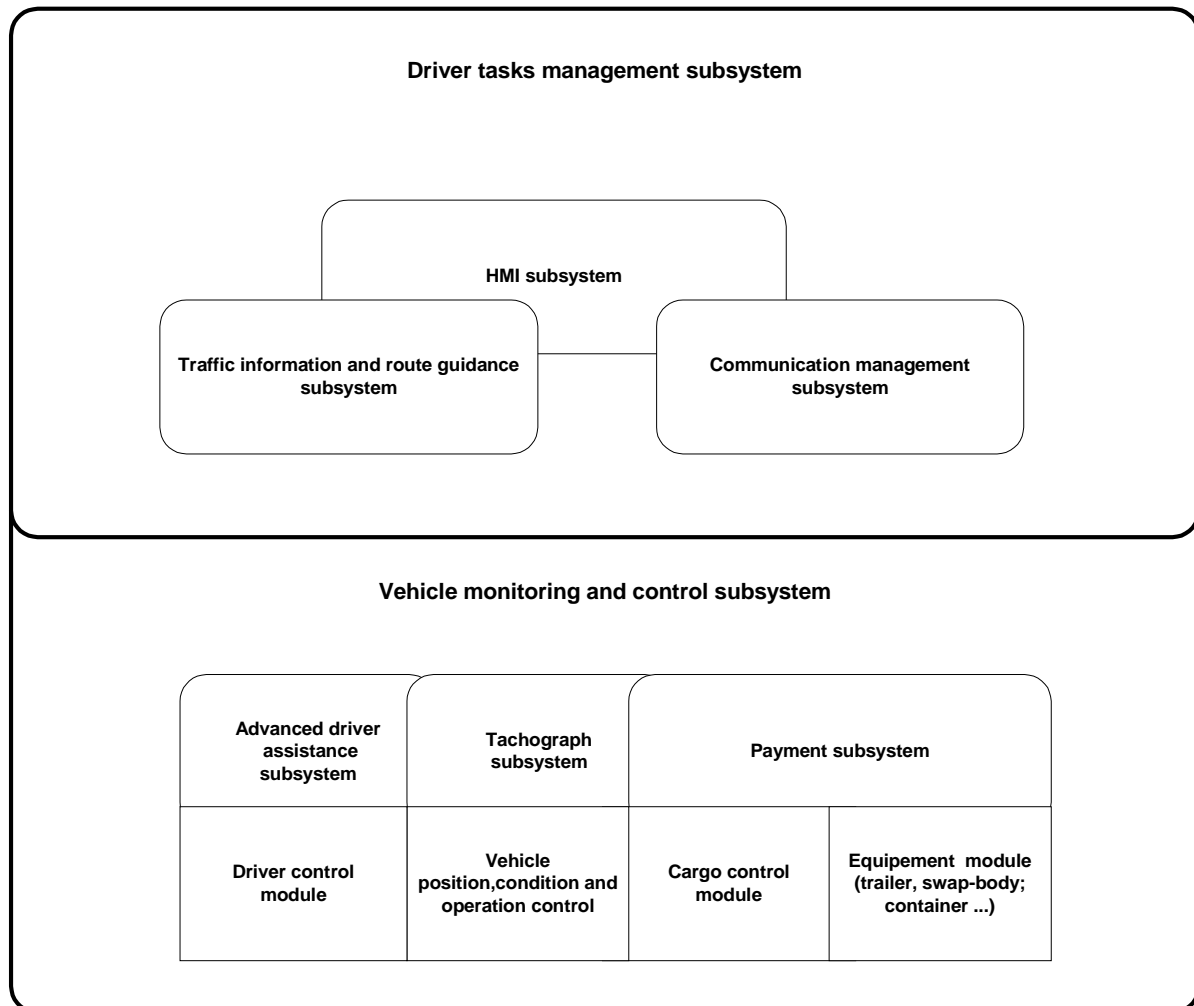
What the figure means is that, compared to the starting situation and even the transitory phase, Sub-systems and Modules will become less and less physically distinguished, more and more interpenetrated, even if a major Functional distinction will still be made between “Driver tasks management sub-system” and “Vehicle monitoring and control sub-system”.

Above described physical data flows will remain relevant, but will be input / output from software modules within a much more integrated global data processing.

What can be pushed forwards as a key example of integration justification, is the tachograph case : it is clear that software solutions will replace the present hardware ones used to protect the integrity of social regulations data.

Reasons for having a separate sub-system will become irrelevant.

Besides, it may be expected that social regulations enforcement will become only a part of a more global safety / security inspection by authorities.



**Figure : 48. The high integration scenario**

### 5.11 HOW IT ALL WORKS ...

Whatever the degree of integration, the unrolling of operations could be summarised hereafter, even if the way they could be performed will be impacted by the “quantity of intelligence” mounted on board, and by the quality and quantity of communication with the outside world.

The following chapter brings additional views of the global Systems Architecture through the Communication level.

### 5.11.1 Preparation of transport :

1. The PCCF ( Principal/Consignor/Consignee/Forwarder) terminator sends a request for quotation to freight transport services physically represented by the P1 system ( Freight Fleet Vehicle, Driver, Cargo, Equipment).  
In case of fleet driver, the request for quotation will be sent from the PCCF terminator to the FM ( Fleet manager) terminator which will be in charge to response him thanks to the information gathered when interrogating the P.1 system.  
This interrogation process will, in fact, rather be replaced by a permanent updating of the fleet management operational data base, through the process of tasks reports received from the drivers.
2. The P.1 system passes the inquiry to the p.1.1 subsystem (Driver tasks management subsystem) which gather all the necessary information to prepare offer as Vehicle/Driver/Cargo/Equipment and Other transport mode resources availability from the P.1.2 subsystem ( Vehicle monitoring and control subsystem ) considered as an internal support to the driver (or directly to other terminators such as Fleet manager, Driver, Authorities, Service providers and other vehicles.).

These information are gathered thanks to the modules and subsystems the P.1.2 subsystem is linked with, such as :

- P.1.7 or P.1.2.6 (Equipment subsystem or module ) to check the equipment availability and status ;
  - P.1.2.4 ( Vehicle position control module ) which allow the calculation of the vehicle position;
  - P.1.2.3 ( Vehicle condition control module) for all the information related to the vehicle characteristics and state ;
  - P.1.6 ( Digital tachograph subsystem) for all the information dealing with social regulations.
3. Once all these information are gathered by the P.1.2 subsystem, a transport offer (including the price calculation performed thanks to software modules for the ICD) is either transmitted directly to the PCCF in case of the independent and chartered driver scenario or to the fleet management services in case of the fleet driver scenario to choose the better offer or the optimal offer ( taking into account previous transport orders constraints) before transmitted to the PCCF terminator.
  4. The PCCF either refuses, negotiates, or agrees the offer, thereby a transport order contract is established.

### 5.11.2 Transport operation:

The transport order accepted will be then performed directly under the control of P.1.1 subsystem in the independent and chartered driver scenario or indirectly through the fleet management application which permanently allocates tasks to the driver, these tasks being directly related to a transport order or resulting from a global fleet operational management in the fleet driver scenario , it will consist on:

1. Thanks to software modules, a load plan is dedicated to the transport order,
2. The P.1.3 (Traffic information and route guidance subsystem) provide the P.1.1 with information related to traffic, weather and route optimisation subsystem through the links managed with various service providers such as :
  - Weather and pollution service providers;
  - Traffic information and route guidance traffic information service providers which in optimal configuration take into account the freight hazardous goods and cargo standard information before planning any route (updated databases are required). The P.1.3 information should be permanently updated regarding to any changes occurring during the trip.
3. During the execution of the trip, and thanks to the information from the infrastructure terminator, the P.1.4 (Advanced driver assistance subsystem) provide information to the driver on request or automatically concerning the visibility condition and other driving condition information.
4. Another kind of information dealing with the driver physical status (fatigue, drowsiness) could be provided in a warning matter to both the driver and the fleet manager (fleet driver scenario) by the P.1.2.1 (Driver control module) through the P.1.2.
5. During the trip execution, the P.1.1 subsystem reports automatically or on request the Driver/Vehicle/Equipment/cargo status (totally or partially depending on the nature of information requested –operational or commercial) principally to the PCCF or to the fleet manager through tasks reports (depending on the scenario involved), to authorities terminator (for social regulation compliance information) and to service providers thanks to the information gathered from the P.1.2 subsystem, such as:
  - P.1.6 (tachograph subsystem) for vehicle status, social regulation and other regulation information,
  - P.1.5 (payment subsystem) which is in charge to perform automatic electronic fee collection for different services regarding vehicle expenses (toll collection, road pricing, fuel...etc.) and driver ones (hotel, restaurant ..etc.).
  - P.1.2.4 ( Vehicle position control module ), providing automatically when any information is requested or exchanged, the vehicle position;
  - P.1.2.5 (Vehicle operation control module) which is in charge to control and register all the vehicle parameters while in operation. In a basic configuration this module send an alarm message to the driver, fleet manager or to service provider (maintenance organisation if any incident), in a sophisticated one, it can proceed to corrective action (e.g. temperature setting);

- P.1.2.2 (cargo control module) which allow in a sophisticated configuration to check whether the cargo conforms to transport order, the permanent control and monitoring of the cargo (e.g. temperature, weight), perform corrective actions (creating new transport unit).

### **5.11.3 Transport conclusion**

Finally once the transport order has been carried out, the fleet manager (task report) or the PCCF is informed, Proof of delivery is sent allowing for invoicing.

## **5.12 COMMUNICATION ARCHITECTURE**

### **5.12.1 Terminology and methodology**

So as to insure consistency with the global European ITS Approach managed through KAREN Project, some terminology and basic methodological elements will be first reminded.

#### **Definition of Communication Architecture adapted from KAREN Project :**

A Communication Architecture defines and describes the means which support the exchange of information between different parts of the system. In the COMETA context, this Communication Architecture defines and describes the means to support physical data flows. Physical data flows of the most representative examples of the Freight Fleet Vehicle, Driver, Cargo, Equipment system are described in the Physical Architecture (Chapter 5 1 to 5.7). This in turn refers to the Functional Architecture (Chapter 3) as the source of the functionality in each System.

In fact, describing and defining the means to support physical data flows concerns two complementary issues. The first issue is to provide the means that enable data to be transported from one point to another and that the way this data is transported is suitable for the System in terms of cost, alteration and delay. In other words, the issue is to describe and define the needed pipelines to transport the information. The second issue is to make sure that the information sent at one end of the pipe is interpreted without deviation at the other receiving end of the pipe.

These two issues are addressed by the Communication Architecture. The first one requires an analysis which leads to the definition and description of the communication links at the main interfaces of the System. The second one reflects the needs for private or standard protocols. As part of the Communication Architecture, this leads to the description of existing standards and possible new requirements to be developed in COMETA Deliverable 6.2.

**Adapted from KAREN too :**

Like the other components of the COMETA Architecture, the Communication Architecture must remain as much technologically independent as possible. Hence, the issue will be examined here from a generic point of view. To achieve this, the methodology proposed here is that the most representative ITS physical data flows are characterised and analysed to derive most representative telecommunication needs at different interfaces of the System.

Describing these typical telecommunication links is the first achievement of the Communications Architecture. Telecommunication technologies are changing so fast that it is not possible to provide a technology driven Architecture valid in the long-term. However the generic description of typical links, like the one proposed here, remain valid as long as the picture of the most representative Systems in ITS does not change too much. Hence, this will provide solid ground for analysing issues related to telecommunication in ITS.

Together with the telecommunication issue, a second issue is also paramount as far as communication is concerned. The issue is to make sure that the information sent at one end of the pipe is not only understood but also interpreted without deviation at the other, receiving end of the pipe.

At first sight, it is just a matter of standards that must be agreed upon so that different parts of the System may exchange data in the most efficient way. But in fact, the ability of a System to provide services completely depends on the data it is processing. Hence, at stake is not only which kind of data is to be processed but also what level of detail is used to describe analysed objects. Other technical questions, such as where data is stored and which part of the System is processing which part of the data, must not be omitted. They often lead to very different kinds of exchanges and, thus, to very different kinds of message standards.

Moreover, it is clear that the way data is exchanged between different parts of the System is a crucial matter within a System, and that it triggers its capacity to provide one service or another. Since ITS has emerged from the development of many different manufacturers with different objectives, the emergence of common standards is a long and difficult process which will need strong support if interoperability is to be achieved.

**Methodological hints.**

On terminators :

Only physical terminator links to non-human entities are analysed in the Communications Architecture. This is because the links to human entities are concerned with non-electronic communications issues such as ease of access, presentation etc.

On communication links :

A communication link is the communication means that support Physical Data Flows. In this document, they can be found between two sub-systems or between a sub-system and a terminator.

On location, source, and sink :

Situated at each end of a communication link, locations are the places where physical data flows originate (sources) or are received (sinks). Communication ends are the entity which can be found at the each ends of communication links. A communication link may link one or several instances of a sink to one or several instances of sources. Locations are defined in the physical architecture.

On physical interface :

Physical interfaces are the part of the System through which communication links must be established. They can be found between two sub-systems or between a sub-system and a Terminator.

Physical interfaces are defined by the location of their communication ends.

### **5.12.2 Basic considerations on Freight Fleet Vehicle, Driver, Cargo, Equipment system Communication Architecture.**

In this paragraph shall be briefly reviewed the Communication aspects of the System.

**It cannot be seen as an analysis of the detailed technical requirements, as far as the quite numerous communication links between numerous Sub-systems / Modules and Terminators, quite numerous media to be possibly used as such or as alternatives, quite numerous different road transport activities justifying communication, should have necessitated investigations that exceeded the Project Frame.**

Nevertheless one will find hereafter some basic considerations which should be completed by reading the following :

- In 2.2 and ANNEX 2, description of User Needs addressing communication,
- In 2.3.1, description of communication technologies,
- In 4.3 and 4.4, Business scenarios and Mobile EDI messages (logical level of communication),
- In 5.7, description of Physical Data Flows,
- In 5.8, on-board systems general description.

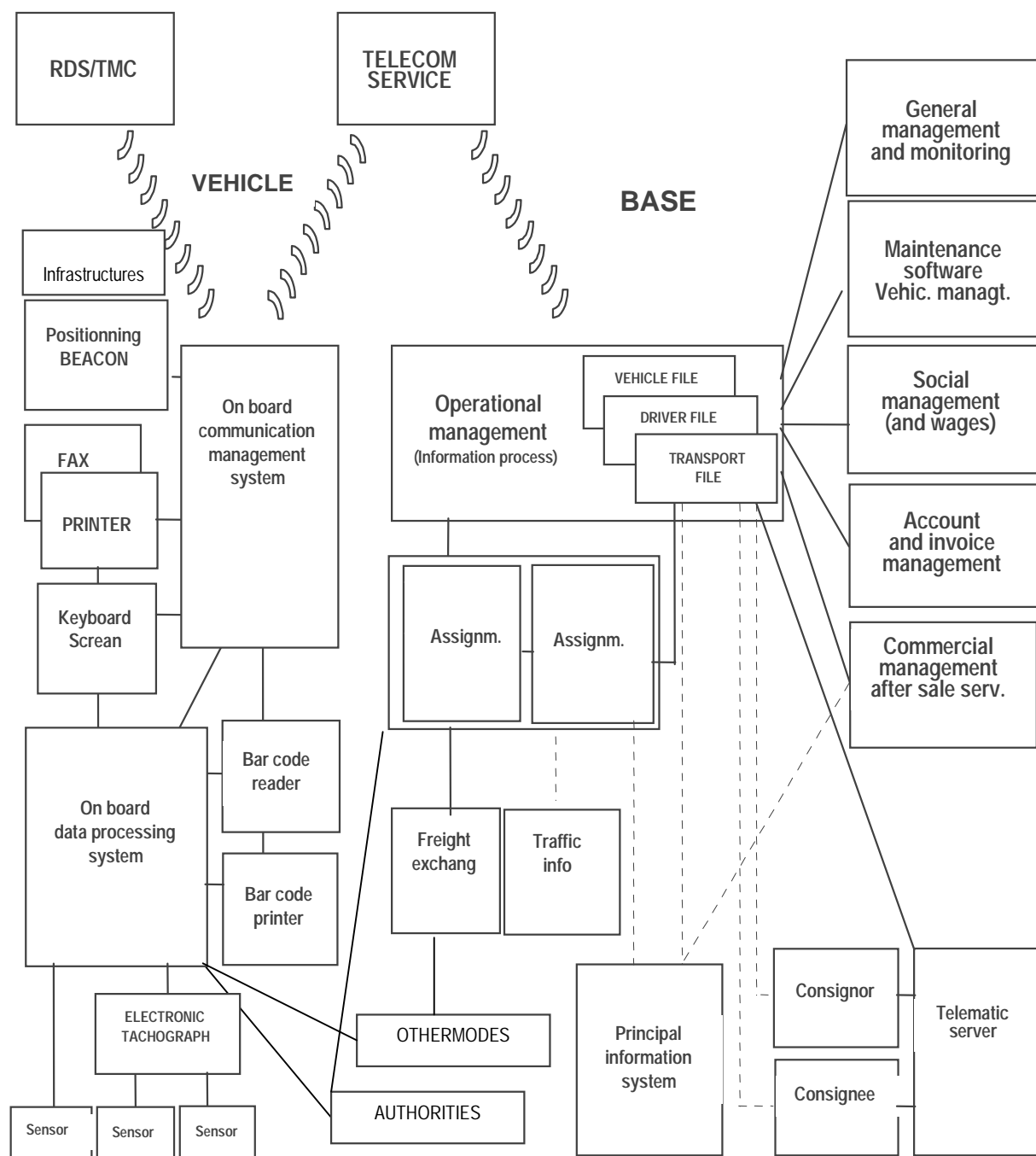
The Freight Fleet Vehicle, Driver, Cargo, Equipment management, described through its related system in the physical architecture requires external and internal communication. In COMETA, internal communication means communication between Sub-systems / Modules within the vehicle.

As it has been stressed on, the “Equipment” (trailer, swap body, container, etc. ...) can be as such a more or less autonomous communicating unit, within the internal communication links, but, too, directly through external links.

### 5.12.2.1 EXTERNAL COMMUNICATION

Figure 48 reminds COMETA objective which is to have Driver / Vehicle inserted in a Global Information System.

**Figure : 49. Driver vehicle positioning in global Information System**



The following table is the translation of “Freight Fleet Vehicle, Driver, Cargo, Equipment system” Diagram into a more readable representation allowing to identify communication links between Sub-systems / Modules and Terminators.

**Figure : 50. Communication links between subsystems-modules and terminators**

	Authorities (a)	Service provider (sp)	Principal Consignor Consignee Forwarder (pcff)	Driver (d)	Other transport mode (otmo)	Other vehicles (ov)	Fleet manager (fm)	Road operator (ro)	Equipment (e)	Vehicle (v)
<b>P.1.1</b> Driver task management subsystem	<b>x</b>	<b>x</b>	<b>x</b>	<b>x</b>	<b>x</b>		<b>x</b>			
<b>P.1.2</b> Vehicle monitoring and control subsystem	<b>x</b>	<b>x</b>		<b>x</b>		<b>x</b>	<b>x</b>			
<b>P.1.3</b> Traffic information and route guidance subsystem		<b>x</b>								
<b>P.1.4</b> Advanced driver assistance subsystem				<b>x</b>						
<b>P.1.5</b> Payment subsystem		<b>x</b>						<b>x</b>		
<b>P.1.6</b> Tachograph subsystem	<b>x</b>			<b>x</b>						
<i>P.1.2.1</i> Driver control module				<b>x</b>			<b>x</b>			
<i>P.1.2.2</i> Cargo control module	<b>x</b>			<b>x</b>			<b>x</b>		<b>x</b>	<b>x</b>
<i>P.1.2.3</i> Vehicle condition control module				<b>x</b>			<b>x</b>		<b>x</b>	<b>x</b>
<i>P.1.2.4</i> Vehicle position control module		<b>x</b>			<b>x</b>		<b>x</b>		<b>x</b>	<b>x</b>
<i>P.1.2.5</i> Vehicle operation control module		<b>x</b>		<b>x</b>			<b>x</b>		<b>x</b>	<b>x</b>
<i>P.1.2.6</i> Equipment module	<b>x</b>	<b>x</b>		<b>x</b>	<b>x</b>		<b>x</b>			<b>x</b>

Communication media to be possibly used range from DSRC to satellite and include physical devices :

- DSRC and high frequency radio (possibly through TAGS),
- Cellular phone (GSM / TETRA / etc. up to UMTS),
- Satellite communication (including GPS),
- Radio broadcast,
- Inductive loops,
- Infrared,
- Smart cards,
- Bar codes,
- Portable terminal.

The following chart sums up the communication modes to be adopted according to the needs of the different parties involved in the transport chain. They depend on the type of communication and/or its contents :

- voice and/or data
- real time
- differed time
- covered area
- necessary output

<b>Mode</b>	<b>Contacted parties</b>
Cellular phone	Authorities Home base Principal Consignor/Consignees, Forwarders Maintenance network Emergency services Freight database Other vehicles
Satellite	Home base Authorities Principal Consignor/Consignees, Forwarders Maintenance network Emergency services Freight database Other vehicles
HF Radio (DSRC)	Home base Authorities Dynamic weighting stations Gas stations (motor-fuel and washing) Tolls
FM	Radio stations Traffic information dispatch center

Microwaves	Authorities Dynamic weighting stations Gas stations (motor-fuel and washing) Tolls
Inductive loop	Gas stations Home base
Infrared links	Home base
Smart card	Authorities Service suppliers Training centres Principal Consignor/Consignees Forwarders
Bar codes	Home base Principal Consignor/Consignees Forwarders
Portable terminal	Home base Principal Consignor/Consignees Forwarders

**Example of use :**

*Planning phase*

A Tasks order or a transport order has to be sent to the vehicle that shall include all the necessary information to allow their efficient execution an corresponding reports to be sent back.

The cellular with its vocal and data transmission capabilities will certainly be the most flexible media to use. As to concerns the large fleets, satellite communication will be the appropriate media for data transmission only. Nevertheless, when the vehicles are sitting at their park, less costly means such as smart cards, infrared link, portable terminal, inductive loop and microwave transmission, to name a few, will easily fit in.

*Execution phase*

The vehicle/driver association must be handled in real time. Cellular phone and satellite links will prove to be the most flexible ones. Microwave transmission will be essential for the on-road and tolls dynamic inspections.

COMETA Pilot surveys and installations have recently proven that the inductive loop was very interesting thanks to its low cost and good performances in the case of re-filling at the service stations as well as for all other applications where a credit card would be utilised with the introduction of complementary identification parameter (vehicle plate , mileage, etc.). Taking advantage of the presence of a vehicle on a site such as a service station, the loop may then act as a relay between the vehicle and the telecommunication network to transfer and receive data at low cost.

The portable terminal offers multiple advantages for managing the consignments; Pick up and delivery designed systems are a perfect illustration of these advantages.

At last, the smart card may be preferred in the case of drivers evaluation and follow-up.

#### *Control phase*

All data generated during the tasks execution must be collected for analysis purpose as well as for reaching useful conclusions on both the technical and economical grounds. The quantity of information may be very important and the selected transmission mode must be cost-effective. Here again, the cellular phone in “data” mode will certainly be performing. The memory card, the inductive loop relayed by the telecommunication network, the smart card, the microwave link and the portable terminal will also find their room and the selection of the solution will greatly depend on the company’s size and activity field.

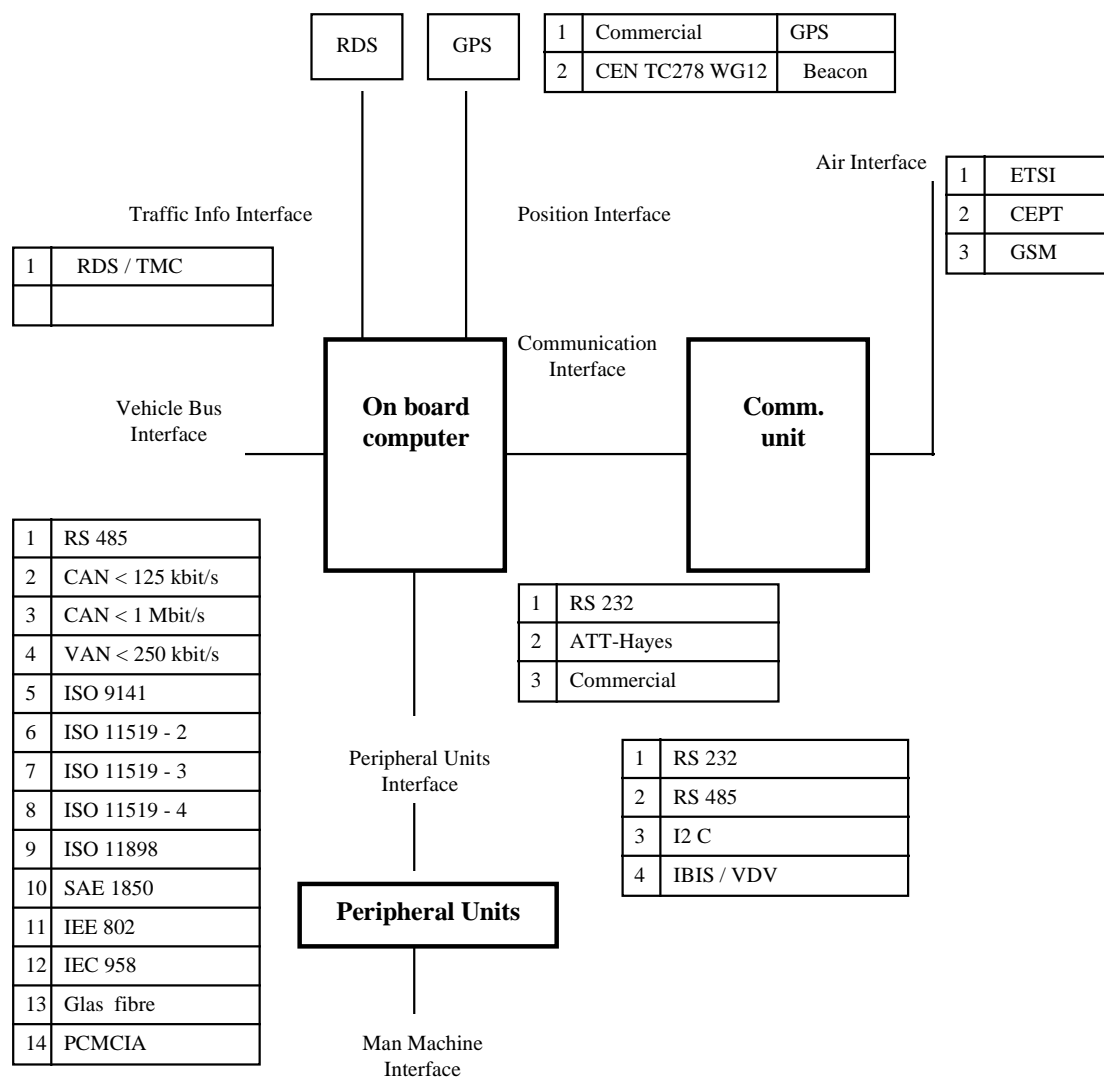
#### **5.12.2.2 INTERNAL COMMUNICATION**

Figure 50 reminds interfaces for on board data processing and vehicle data links.

CEN TC278 WG2

FFMS interfaces for on board data processing and vehicle data links

Interfaces Scheme



**Figure : 51. FFMS interfaces for on board data processing and vehicle data links**

The following table is the translation of “Freight Fleet Vehicle, Driver, Cargo, Equipment system” potential Diagram into a more readable representation allowing to identify communication links between Sub-systems / Modules.

The above presented figure and table (including diagram used in 5.10 to illustrate the “transitory phase” in connection evolution of these Sub-systems and Modules) are there to summarise the main challenge that the On Board System(s) Architecture will have to face so as to achieve an efficient integration.

Communication solutions, as seen in former chapters, will rely on new wired or optical fibre links such as CAN bus and multimedia bus (IDB or others), or on radio solutions (such as BLUETOOTH or others).

These points are addressed in Deliverable 6.2.

### Communication links between subsystems and modules

	P.1.1	P.1.2	P.1.3	P.1.4	P.1.5	P.1.6	P.1.2.1	P.1.2.2	P.1.2.3	P.1.2.4	P.1.2.5	P.1.2.6
<b>P.1.1</b> Driver task management subsystem		<b>X</b>	<b>X</b>		<b>O</b>	<b>O</b>	<b>O</b>	<b>O</b>	<b>O</b>	<b>O</b>	<b>O</b>	<b>O</b>
<b>P.1.2</b> Vehicle monitoring and control subsystem	<b>X</b>			<b>X</b>	<b>X</b>	<b>X</b>	<b>X</b>	<b>X</b>	<b>X</b>	<b>X</b>	<b>X</b>	<b>X</b>
<b>P.1.3</b> Traffic information and route guidance subsystem	<b>X</b>											
<b>P.1.4</b> Advanced driver assistance subsystem		<b>X</b>										
<b>P.1.5</b> Payment subsystem	<b>O</b>	<b>X</b>										
<b>P.1.6</b> Tachograph subsystem	<b>O</b>	<b>X</b>										
<i>P.1.2.1</i> Driver control module	<b>O</b>	<b>X</b>										
<i>P.1.2.2</i> Cargo control module	<b>O</b>	<b>X</b>										
<i>P.1.2.3</i> Vehicle condition control module	<b>O</b>	<b>X</b>										
<i>P.1.2.4</i> Vehicle position control module	<b>O</b>	<b>X</b>										
<i>P.1.2.5</i> Vehicle operation control module	<b>O</b>	<b>X</b>										
<i>P.1.2.6</i> Equipment module (trailer, swap bodies, container)	<b>O</b>	<b>X</b>										

**X:** Direct links

**O:** Links through P.1.2

### **5.12.2.3 Hints on some communication issues**

We have seen in 5.12.2 introduction that the communication architecture could not be carried down to detailed technical requirements, such as, for each function, number of connections per period, frequency, amount of bits and their speed exchange, etc...

Some points may be whatever addressed.

It is clear that internal communication will require a high rate network, with a very keen management of information flows priorities.

For external communication the requirements will range from rates of just a few bits, to allow for positioning, to the downloading of a digital map, or the emission of numerous vehicle operation parameters. Frequency requirements will range from 1 / 2 messages per day for tasks ordering and reporting, to / from a vehicle, for truck load long distance international transport, up to more than 100 messages per day for pickup and delivery activities (just compare with a taxi).

Both types should require the addition of positioning when emitted from the vehicle.

For this kind of functions it is obvious that it should be required from the network to send again and / or store messages as long as they have not been acknowledged by the on board system.

Considering the issue of correct interpretation of the received information mentioned by KAREN, one could see, in a former chapter, that MOBILE EDI messages standardisation requires 4 types of acknowledgements from the on-board system :

- the message has been delivered,
- the message has been processed by the on-board application,
- an error has been detected by the on-board application,
- the message has been read by the driver.

## **5.13 KEY ISSUES**

Key issues identified through the achievement of this System(s) Architecture and to be addressed to facilitate and speed up the design of implementations are summarised hereafter. Most of them are directly or indirectly related to standardisation matters. So they will be developed more in depth in COMETA D6.2.

### **Mobile EDI messages in general...**

As seen above (and to be developed in COMETA Del 6.2), when coming to Physical and Communication Architecture, the need for standardised messages becomes stringent.

Tasks and Tasks reports, status reporting, Transport Orders (to which transport opportunity and offer could be added, among others ...), are necessary conditions for the design of a solution based on this Systems Architecture.

**New structured information into messages, so as to reduce the importance of “other information” flows...**

Beyond the above statement, automated dialogues between home based applications and on board ones, requires the creation of “ad hoc” messages standing for present free text zones in existing messages and or messages 5 and 6 in the present EDITRANSPORT list (see 4.4), which could be seen as “miscellaneous” for the time being...

Integration of information coming from other sub-systems and modules than “driver tasks management sub-system” and going to it such as tachograph information, driver status, vehicle and equipment condition and operation, cargo information, etc...

This can be seen as precise cases or alternatives to above mentioned issues.

The “System” should allow for automatic addition of various kind of more technical information within operational messages. This aspect is already addressed in standardisation area, considering a first proposal called “MDTP” (“Microprocess Data Transfer Protocol), this point, too, will be developed in COMETA Del 6.2.

**More interoperability and integration between sub-systems, control modules...**

This point has been illustrated by the low level, transitory and high level scenarios.

It is clear that any progress in that direction will make the whole “System” more user friendly and, most, cost efficient and cheaper...

It is clear, too, that it will make it safer to operate.

**More harmonisation (if not standards...) between support devices, for HMI aspects.**

It seems difficult to imagine standardised HMI, whatever the truck manufacturer or solution provider...

Nevertheless, according to the fact that fleet will remain often heterogeneous and that the “couple Driver Vehicle” will be more and more dissociated in the future, efforts should be made towards HMI harmonisation.

Happily, one may think that these efforts could be facilitated by a general trend in information processing tools.

**Ease of plugging / unplugging of various sub-systems and control modules and physical components in the global system architecture, whatever the market origin...**

This issue could be considered as a redundant one to the above mentioned. But it needs to be considered as such during a “transitory” period that could still last many years...

**Importance of the evolution of hard and soft dissociation...**

Up to now, on board systems were sold with their “proprietary” software...already, the wide spreading of Windows CE, EPOC or JAVA, INTERNET based solutions etc.... show a way that should not allow any return.

### **Importance of the evolution of communication solutions...**

For external communications, high rate solutions such as GPRS and UMTS are expected in the coming years, it is obvious that this will encourage real time transmission of important amount of information and could simultaneously encourage opposed perspective : the mobile office with many communicating applications as well as the simple terminal.

For internal communication, much is expected from on going work addressing either wired networks (IDB / CAN) or radio ones (Blue tooth).

### **Importance of the global integration approach, through the role of integrators and telematic services providers...**

The concept of virtual fleet manager, which has been presented here, is already entering the market either from communication providers (WEBRASKA from ALCATEL ...) or from car manufacturers (diagnosis and remedy support, emergency support...), the wide spreading and increased comprehensiveness of these offers will wipe off the borders between the types of usage of on board systems by SME s and large fleet.

### **Possible impact of new public / private relationships...**

The introduction of the electronic tachograph, possibly followed by developments in other regulations enforcement and in the field of safety checks, could provide the basis for a new common usage (and implementation acceleration) of on board systems and of an equivalent of the American CVISN (Commercial Vehicle Information System Network).

### **Consideration of longer term hypothesis : the automatic vehicle and automatic highways and the autonomous intelligent equipment...**

Beyond the “immediate” (!...) perspective of vehicle platooning, investigation should be started, so as to be prepared to maximise the benefits of having vehicles and equipment managed as industrial production units more and more automated. This will mean, of course, adapted “intelligent” infrastructures.

## **6 CONCLUSIONS – RISK ANALYSIS AND THE COMETA VIEW ON THE INTELLIGENT TRUCK OF THE FUTURE**

The main COMETA conclusion to be brought in this deliverable is the System(s) Architecture itself.

Nevertheless, beyond considerations that have been already developed in Chapter 5 upon expectable evolutions, threats to the implementation of this System(s) Architecture should be reviewed and, as a consolidated result of both, possible future should be pictured.

For that purpose a brief risk analysis will be presented here and an implementation time schedule hypothesis will be drafted in parallel.

### **6.1 RISK ANALYSIS**

For a System Architecture, a risk analysis objective is to identify the obstacles or constraints that might prevent the successful and fast deployment of this Architecture. A risk being the possibility of an adverse outcome and uncertainty over the occurrence, timing, or magnitude of that adverse outcome.

As far as COMETA is seen as a part of the deployment of an Intelligent Transport System (ITS) the risks have been evaluated in that context, regarding :

- COMETA Framework Architecture,
- Communication,
- Cost and benefit,
- Deployment and operation,
- Funding provision,
- Politics,
- Privacy,
- Safety,
- Stakeholder acceptance,
- Standardisation.

#### **Framework architecture**

A risk belongs to this category, when it describes an Intelligent Transport System (ITS) issue, that is not expected to be covered by the COMETA system architecture.

<b>Risk</b>	<b>Rating</b>
1) Regulation	High
2) Extendibility	High
3) Embedded interfaces	High
4) Multiple protocol communication and shared software server	Medium
5) Supporting information	Medium

- ⇒ The COMETA SA shows Authorities as a terminator, but their potential more active role in the future does not seem to have been considered far enough (Social Regulations, Safety checks, Paperless Transport, etc. ... See US ITS CVO...) and this could be a limit of this framework, only addressing private management.
- ⇒ A general feeling is that embedded computer technology may not be fast enough in development to follow the fast development in networking and telecommunications.
- ⇒ Common servers, on a shared services basis, could help considerably the operation of this SA, in the context of a global FFM ITS, so this SA should help to identify where and when they will play a facilitation role to SMEs (nevertheless see the “virtual Fleet Manager” scenario in chapter 5)
- ⇒ The COMETA SA could be seen as not precise enough so as to help designers for some functions and to understand how they are performed and with which tools.

### **Communication**

A risk belongs to this category, when it describes a data exchange mechanism not widely accepted or deployed.

1) Saturation of mobile network	High
2) Lack of information on future communication systems	High
3) TETRA (TransEuropean Trunked RAdio) – ETSI standard	Medium

- ⇒ The most important risk is on the saturation of the mobile data networks, as the mobile phone network, due to new services which will need more and more capacity and perhaps will overwhelm users with too much information.
- ⇒ We hear of future Communication Protocols (TETRA, GPRS, UMTS, etc.), which should allow for big amounts of data exchange at higher and higher speed, but when, at which cost and will it oblige to change often communication devices ?

### **Cost and benefit**

A risk belongs to this category when it describes a situation that may affect the COMETA system architecture, such as development, implementation or deployment, that does not provide a sufficient return on investment.

1) Technology evolution	High
2) Training of users (drivers)	High
3) Evolution of the transport sector	High
4) The product does not belong to a mass market	High
5) Uncertainty related to system components costs evolution	High
6) Uncertainty related to development costs necessary to insure a sound integration within companies.	High
7) Uncertainty related to usage costs	Medium
8) Complexity of the system architecture	Medium

- ⇒ The main concern relates to the potential series of investments and then on the fact that investments could only even be a minor part of the global cost to be faced by transport operators using ITS: information system reengineering, subscriptions, training of employees, etc. “Wait and see” could be a justified behaviour.
- ⇒ The price of the systems has to be adapted to this potential evolution: that is to say that the return on investment has to be short.

### Deployment and operation

A risk belongs to this category, when it describes a situation that will negatively affect deployment and operation of the COMETA system architecture.

1) One man company	High
2) Differences in legislation between countries	High
3) Employees reluctance to changes (drivers preferring voice transmission, dispatchers fearing a rivalry to their know-how).	High
4) User information (e.g. transport companies, system/truck manufacturers)	High
5) User training (drivers)	Medium
6) Uncertainty related to mobile INTERNET availability	Medium
7) Different priorities for incoming messages	Medium
8) Promotional campaigns	Medium
9) Dispatchers fear all day long working time	Low

- ⇒ The risk is that the COMETA system architecture, which is supposed to meet the one man company requirements, cannot be afforded by these latter.
- ⇒ As any too new thing, the actual operation of COMETA SA could be hampered by employees reluctant to change their habits, fearing to loose their job or as a minimum

fearing that it will become a less “human” one. As a first step, for instance, 24h/24h operations (e.g. alarms) will require available people during nights.

- ⇒ “WEB enabled vehicles” and INTERNET wide spreading should speed up implementation, but this will only be true if services providers offer easy access, flows and operation such as:
- software downloading and up-dating,
  - connection to home base (INTRANET),
  - connection to shared servers.

### Funding provision

A risk belongs to this category when it describes a situation that results in a lack of funding in order to support the deployment of the COMETA system architecture.

1) Lack of financial benefits in transport specially for the one man company	High
2) Long term investments	High
3) Complexity of the system architecture	High

- ⇒ The transport business is generally made up of small companies which realise small profits. It is therefore difficult for them to invest in a non-perennial onboard system.
- ⇒ For big companies, usage costs are raising more problems, as far as usage scenarios are not yet known with their consequences on frequency and importance of exchanges and processes.

### Politics

A risk belongs to this category, when it describes a situation related to politics, having an influence on the COMETA system architecture deployment.

1) “Big brother syndrome”	High
2) Insecure situation regarding subsidies	High
3) Protection of national industries	High

- ⇒ Ecological policies will encourage this SA expected to result in less empty trips/kms and so less trucks necessary to carry more goods. As far as COMETA SA will encourage or allow efficient combined transport, this should be a positive element too but these very “positive” aspects are counterbalanced by a potential “big brother syndrome” for users.
- ⇒ The other risks are considered by truck manufactures and solutions providers.

## Privacy

A risk belongs to this category, when it describes a situation which affects individual privacy.

1) Social risks	High
2) Control of communication	High
3) Control of movement	High

- ⇒ The system will permit to control the activity of the drivers. It is important to explain to the drivers the positive effects of the usage of these systems, in order to avoid strikes and social conflicts.
- ⇒ The same risks apply as for any other standard information network. It is considered more a problem of industrial culture and of legal status than of technical possibilities.

## Safety

A risk belongs to this category when it describes services which do not provide an appropriate safety level.

1) Driving safety	High
-------------------	------

- ⇒ It is important that these system should not threaten driving safety; for example:
  - Drivers must not read information displayed on the screen while driving. Information on the screen or printed messages must be read in a stopped vehicle.
  - Editing of messages by the driver while driving must be strictly prohibited.
- ⇒ Audible signalling of incoming messages must be encouraged.

## Stakeholder acceptance

A risk belongs to this category when it describes a situation not compliant with a stakeholder interest.

1) Benefits and costs may be attributed to different stakeholders	High
---	------

- ⇒ Risks related to such SA could mean in fact the fear to have to take too often strategic decisions in a fast moving environment.

## Standardisation

A risk belongs to this category, when it describes a situation related to the missing or not used standard.

1) Standardisation of mobile messages and mobile EDI	High
2) Standardisation of manufacturers interfaces and embedded solutions	High

- ⇒ A multiple protocol, cheap and user friendly, with easy updating process and EDI translator, should be developed. It should not only be a technical traducer, but also a language translator to allow a transport operator to widen its potential partnerships.
- ⇒ Mobile EDI is not a standard yet and it is arguable whether transport companies all over Europe would like to extend the usage of EDIFACT to the mobile part of the information chain.
- ⇒ COMETA needs to dedicate some work to take into consideration existing standards. Standards should be the basis of the COMETA system architecture; without standards the mass market cannot be reached.

As a global conclusion here, one should say that beyond intrinsic insufficiencies of COMETA System(s) Architecture to be used as an implementation tool (that it is not), risks are very common, and, as usual, related to the role of authorities, to uncertainty of technological evolution, to cost / benefits aspects, to lack of standardisation.

## 6.2 IMPLEMENTATION TIME SCHEDULE HYPOTHESIS

One of the main COMETA's objectives is to define the architecture of the system that is intended to equip the to-morrow's commercial vehicles with the purpose to fully and automatically integrate them in the transport process. Transport may be compared to any industrial process of which the key elements are :

- the command (or order) consists in defining the work that has to be performed and how.
- the comparator will transmit the original order to the executant and then adapts the new orders depending on how the process is progressing.
- the executant, that in this case is the driver with his working tool i.e. his vehicle, will follow the orders transmitted to him in the most possible dependable way.
- the measuring system will perform the collection of the data that will allow to evaluate the result of the given order. The comparison between the original order and the observed result of its execution allows to modify the orders sent to the executant so as that the work may be accomplished in the best possible conditions.

In the general context, the measure of the result as well as the comparison with the original order are performed in real time so that to avoid any drift, and this must also apply to the transport, bearing in mind that the drifts we want to avoid are mainly :

- the non-compliance to the commitments given to the orders originator,
- the non-compliance to the European legislation with respects to the driving and break-resting times, etc,
- the alteration of the economical results by lack of co-ordination,
- not even considering that in this type of situation many decisions are made to the detriment of the safety.

In the logistic chain, the transport execution is likely one of the most difficult links to control, as, unlikely to a standard industrial process, installed at a fix location, the driver and his vehicle are totally mobile.

This implies to equip the driver and his vehicle with a system allowing to achieve the necessary feedback information in order to enhance their use and profitability, whilst complying with the enforced rules and improving the driver's safety as well as the other road-users'.

## **6.2.1 View on vehicle and internal link for medium and long term implementations**

### **6.2.1.1 *The present situation***

The surveys carried out in the frame of COMETA Work Package 2 are clearly highlighting the requirements that will have to be fulfilled. These requirements correspond to the following aspects :

- identify the orders that will have to be transmitted to the driver via the system installed on his vehicle,
- identify the necessary data to be followed during the transport progress,
- thoroughly identify all the factors, both internal or external, that may have an effect upon the normal transport progress.

All these information are summarised in the Deliverable 2.

Simultaneously, a survey has been carried out in the frame of the Work Package 3 to inventory the available solutions and most importantly evaluate their integration and compliance levels versus the requirements. The conclusions of the Report relating to this Work Package (Deliverable 3) are reflecting a very low integration level of the existing systems, even if their individual performances are often of very high quality.

### **6.2.1.2 *What tomorrow will bring***

The integration of a recording system, of data processing and transferring on-board a vehicle should first of all require the development of new specific sensors and of a “communication bus” fitted to the vehicle, allowing the linking up of all the systems necessary to the management of the driver and his vehicle (see the “transitory phase” in chapter 5).

#### **With regard to the vehicle**

At the sensors level, all the parameters related to the vehicle are already available in a great number and only their availability on a bus would represent an appreciable advantage. However, and on a more general ground, the vehicle must become an element of the logistic chain, and be remotely automatically identifiable. In a same conceptual manner a system allowing the automatic vehicles fuel refilling should be envisioned in order to simplify this

task and more importantly protect the transactions by eliminating all risks of frauds. The same principle could be applied to the highway tolls and to all other services requiring the vehicle or driver identification.

With regards to the articulated vehicles it is key important to maintain the data acquisition function at the equipment level for its identification purpose as well as the processing of all the necessary information.

#### **With regard to the smart sensor concept**

For as powerful as may be the envisioned systems (as more probably built around portable computers), their main functions are however to process, store and exchange data. The data acquisition in its primary meaning is a function that can be integrated in the communication function perfectly well supported by the PC, under the condition that the data are in a compatible format. As an example, neither the signal collected from a temperature sensor, nor the pulses delivered by the moving sensor can be routed on to a RS232 port. This will be the role of “smart” sensors or of systems such as the Electronic Control Module (ECM) developed by trucks and cars makers. These units will act as concentrators collecting the data supplied by the various sensors and making these data available on a connector often used nowadays in diagnostic operations. To-date, the majority of the recording systems indexed in COMETA deliverable 3 play a concentrator role that make their installation difficult and ultimately allows a very limited data acquisition.

#### **With regard to internal data bus communication system**

With the CAN (Controlled Area Network) concept, the sensors are becoming “smart”. Alike the interconnection of all these sensors, as it has already been made by the American truck makers, our European vehicles must be fitted with a similar system providing the on-board computer manufacturers with a connector which hardware and software characteristics will comply with a unique standard.

#### **With regard to external communication**

Efficient solutions are already available and it seems that evolution of new offers will go quite faster than the readiness and common willingness and ability to use them to / from a commercial vehicle.

#### **With regard to the driver**

Europe is noteworthy from the USA and other continents, with a legislation that enforces a recording unit the technology of which has just been recently modified. All the data relating to the driver’s identification and of a possible team-mate are now available (or will be within very short term) on a “smart card”. It is to be noted that the digital tachograph, such as presently defined, will not avoid certain voluntary or involuntary “errors”, and that more accurate identification systems will have to be made available as soon as possible. For example, a dual purpose moving camera might be used to both identify the driver and holding his state of alertness in check, which will diminish the number of accidents caused by falling asleep while driving. Considering that the identified driver is the one on the driving seat, all

the necessary information will be available concerning his status with respects to his potential driving time.

### **With regard to the cargo**

The monitoring of the transported goods, in different context than parcels delivery carriers such as FEDEX and UPS already using very sophisticated systems where the weight measuring is an important information. In this domain also, in the USA, some systems are in use that allow to know the overall weight of a mobile running at 60Km/H and where it is rapidly possible to deduct the transported load. North America is very advanced in this domain and numerous weighting and automatic inspection stations are in use; only the vehicles with observed anomalies will be stopped for further investigations, since they drive through these stations on a specific lane.

### **With regard to the ergonomics and human-machine interface**

Safety must remain paramount. The vehicle control instruments use more and more digital technology and widely use attractive display techniques with many information that might divert the driver's attention. In Europe the trend is to use several on-board systems since the legislation prescribes the use of a digital tachograph with its own display screen, and the integration concern of the vehicle in the logistic chain will require very sophisticated processing tools compulsorily including a screen and voice synthesiser equipment, that are as many factors to divert the driver's attention. The to-morrow's cabin will have to comprise these necessary items but their use will have to be closely controlled; as an example, transmission of messages to the driver will have to contain a priority criteria allowing the on-board system to automatically select the restitution more, that is to say :

- restitution and vocal acknowledgement if “urgent” and “vehicle moving”
- restitution and screen/keyboard acknowledgement if “urgent” and “vehicle at stop”
- memorisation and postponed restitution if “non urgent” and “driver at rest”.

### **With regard to possible longer term implementations**

These implementations most probably pertain to sensors that will allow to link the vehicle with road infrastructures or when, if already the case, automating some of the vehicle's reactions to particular events. Just like it is now possible to slow down or even bring to complete stop a train that is entering a busy railway track, the to-morrow's vehicle should be capable to stop or at least reduce its speed as necessity occurs.

At the functional level the integration of the driver and the vehicle in the logistics chain requires to create links allowing the exchange of data between the process that monitors the transport, driver and vehicle, and the other links of the chain.

## **6.3 Overall conclusions**

Tomorrow's vehicle will have to be equipped with high technology equipment together with several state-of-the-art communication means allowing it to fit in its environment. Short term should see the materialisation and the availability of built-in communication bus that will

facilitate the implementation of the on board management tool. Simultaneously, the booming of portable telecommunication market trend should result in giving birth to a broad number of solutions. COMETA must full fill their objective by now defining the rules that will make all these systems articulate and communicate together.

At this prospective stage, it is important to note that ITS America has put together a training program that makes comprehensive what the “Intelligent Transportation System” is all about, as the implementation of such a concept will only be reachable if granted the contribution of all the operators directly or indirectly involved.

As a conclusion, the following could be seen as a roadmap for evolutions that COMETA foresees in the area of on-board computers for freight and fleet management.

First, and as a general trend, on-board computers will gradually become more open, including the possibility to download new software modules (leading to more modular software designs) as well as friendly environments to add hardware (plug and play environment).

More specifically, the following are the different phases in the development of on-board computers for freight and fleet management that can be foreseen; (numbers in bracket show when these different generations of on-board computers should become available on the market):

- On-board computers supporting drivers without external communications (0 - already available on the market)
- On-board computers optimising the functioning of "fleet drivers"(0-3 years)
- On-board computers optimising the functioning of "independent or chartered drivers" (3-5 years)
- On-board computers optimising the interaction with applications of public authorities (5--10 years)
- On-board computers fully integrated in the wider transport environment: intelligent vehicles communicating with intelligent infrastructure as well as with other vehicles (10-20 years)

Obviously, the time scales that are mentioned will heavily depend on developments in other leading markets, such as the car (integration of the mobile office in the car), telecom market (WAP, UMTS, ...), intelligent infrastructures equipment.