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Abstract: Summary of standardisation proposals regarding on-board systems:
At Architecture level, for mobile electronic data interchange, for interfaces in on-board data processing and vehicle data links.

Keyword list: harmonisation, standards, system architecture, EDI, MOBILE EDI, interfaces, vehicle data buses, ITS data bus, protocols.

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EXECUTIVE SUMMARY

The COMETA project was initiated in answer to the growing concern regarding the potential growth in the 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 performed on board functions, allowing for efficient interfacing within an overall 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 close co-operation with the KAREN (Keystone Architecture Required for European Networks) project carried out with the objective of providing Intelligent Transport Systems in Europe within a global System Architecture Framework.

But designing a Systems Architecture was also seen as providing a basis for ensuring more modularity and interoperability through the identification of necessary standards at the interfaces of this SA and as far as possible supporting the on-going standardisation process or starting new ones.

In this document performed are summarised relating to the following matters :

- Mobile EDI, as the need for standardised messages to / from the vehicle becomes stringent. Transport Orders, Tasks and Tasks reports, status reporting, etc. are necessary conditions for the design of a solution based on this Systems Architecture.
- Integration in these messages of information coming from or going to sub-systems and modules other than the Driver Tasks Management Sub-system and going to it, such as tachograph information, driver status, vehicle and equipment condition and operation, cargo information, etc.
- More transparency between mobile data communication networks and fleet management applications (FAP). This can be seen as a complement to data structure and contents standardisation, through messages handling procedures standardisation and a way to solve, on the ground side through application protocol interfacing, the problems raised by the multiplicity of on-board systems and communication solutions. This is commonly seen as “Office Interfacing”.
- More interoperability and integration between sub-systems, control modules (the BUS future).
- Ease of plugging / unplugging of various sub-systems and control modules and physical components in the overall system architecture, whatever the market origin.

COMETA has gathered well-founded justification for standardisation enhancements on one side, has provided interested standardisation bodies with working tools on the other side, but the field for a unified standardisation process is just opening up as some possible solutions can be seen as complementary, alternatives or competing.

INTRODUCTION

COMETA approach towards harmonisation and standardisation proposals.

COMETA Deliverable 6.2 presented its detailed results on possible Harmonisation and standardisation addressing On-board Commercial Vehicle System(s) Integrated Architecture specifications and taking into account an European Architecture Framework provided by KAREN (Keystone Architecture Required for European Networks) Project.

After a reminder of what the COMETA project is, one will find in this document a summary of main considerations addressing harmonisation and standardisation matters after COMETA's last phase which resulted in the design of systems architecture in the above mentioned Deliverable and the drafting of related recommendations, the whole being presented and discussed in a standardisation workshop in Paris on 13th April 2000.

The slides on harmonisation and standardisation used during this workshop, after those presenting the KAREN and COMETA results, those presenting the point of view of a fleet manager, a vehicle manufacturer and a solution provider, can be found in an annex to this document.

The convening of this workshop confirms that the design of an «on-board» System(s) Architecture, was to be seen as only a first step in the process of facilitating the integration of the commercial vehicle and its driver, within an overall transport information system relying on ITS - "Intelligent Transport Systems" - developments and implementations.

Facilitating, means itself making it efficient, but also, easier, cheaper, more user friendly for drivers and fleet managers and even for vehicle manufacturers, solutions providers, authorities and principals (fleet managers customers).

Beyond the Architecture itself, which will only be briefly mentioned in this document, COMETA's purpose is the development of the aspects of this System(s) Architecture, systems and sub systems interfaces, requiring further harmonisation and/or new standardisation proposals, and/or harmonisation of conflicting or not fully interoperable existing standards.

In other words, it is to identify any harmonisation or standardisation enhancements to be favoured or new proposals to be submitted to appropriate standardisation bodies, so as to speed up and widen the use of "intelligence" in European road freight transport, or, at least, identify possible obstacles to be bypassed, when trying to implement this System(s) Architecture (SA).

So this summary document will review first what can be translated into standardisation requirements starting from user needs identified by COMETA. Then it will address system architecture as such and map standardisation requirements with identified functions and physical and communication levels. Two standardisation areas are to be considered more specifically; they concern external and internal communication, mobile data exchanges and on-board systems and vehicle data links.

1 WHAT IS COMETA?

About the COMETA project

In the coming years, drivers' and dispatchers tasks profile will be directly impacted by the introduction of new information technologies thanks to «on-board» systems. The risk of introducing new systems mainly concerns problems of interoperability and the ergonomics of «on-board» systems on trucks and the multiplication of costs. The COMETA project has been initiated to reply to these concerns by defining and designing modular associations of various functions performed «on-board» so as to allow for their interface within an overall transport telematics system. This has resulted in “on-board” information systems architecture.

The main objectives

The objective is *to achieve an open system architecture for onboard freight, fleet and cargo management systems with standardised interfaces for Europe-wide applications.* Having explored and identified the possibility of integrating all on-board elements related to the driver/operator function through an open data interchange system, COMETA also has taken into account other relevant projects like KAREN (overall system architecture), FLEETMAP (standardising the communication between home-base and vehicle) and national projects concerning mobile EDI.

Methodology of the Project

The COMETA project has lasted two years (1998-2000).

The methodology is shown in figure 1.

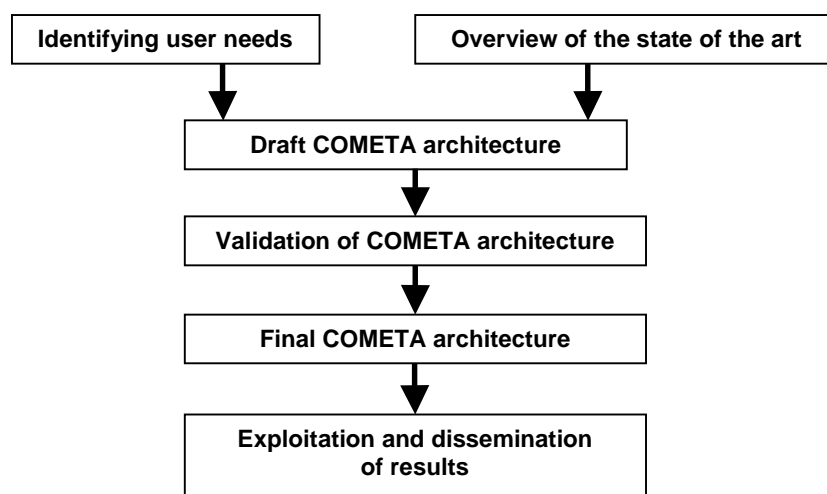


Figure 1 : Methodology of the COMETA project

As Figure 1 shows, the following activities have been carried out by the consortium:

- Precisely identifying the needs of the users through audits and questionnaires;
- Review of existing tools and solutions and their integration potential;

- Designing a COMETA draft architecture and describing main trends in HMI, software, costs and architecture;
- Building national pilots to validate the COMETA draft architecture;
- Producing a final COMETA architecture and giving guidelines and recommendations to transport companies, truck manufacturers and solution providers and making proposals for standardisation;
- Exploiting and disseminating the key results of the project, being the COMETA final architecture, an extensive list of user needs and an overview of the state of the art.

Roadmap to COMETA results

The COMETA project has produced a series of results. These results are available through a number of 'products', varying from a general brochure to very detailed deliverables. A roadmap to the COMETA results is shown in Figure 2.

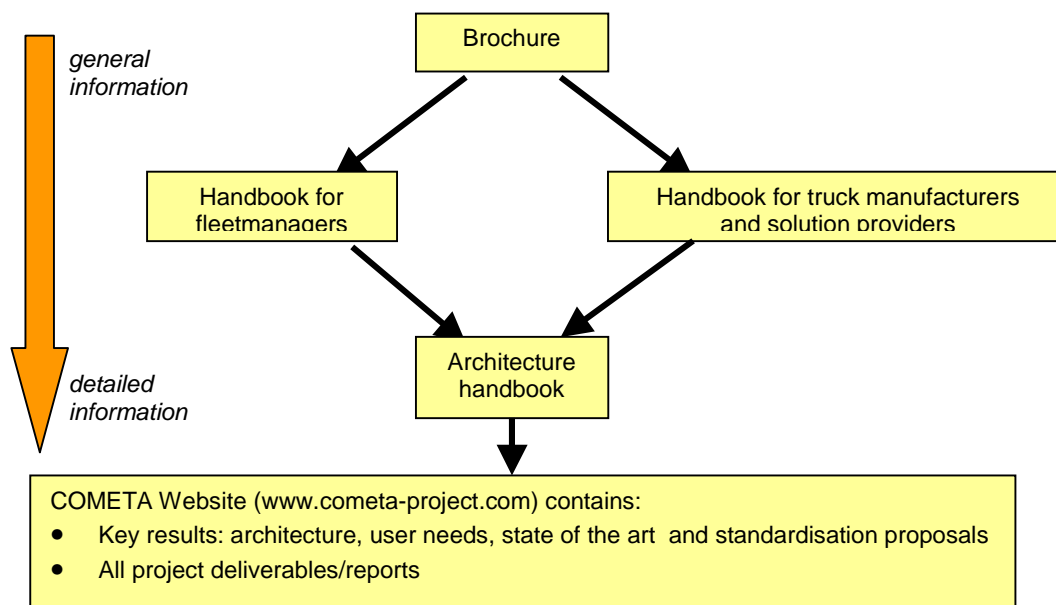


Figure 2 : Roadmap to COMETA results

2 SYNTHESIS OF COMETA STANDARDISATION ISSUES AND STANDARDISATION PROCESS TO BE NOW CONSIDERED

2.1 Synthesis of COMETA standardisation issues

Mobile EDI messages in general.

As already forecasted by CEN TC 278 WG2 (see § 2.2), the need for standardised messages is becoming stringent.

Tasks and Task reports, Status reporting, Transport Orders, are necessary conditions for the design of a solution based on this Systems Architecture.

New structured information into Mobile EDI messages, so as to reduce the importance of non processable 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 which could be seen as “miscellaneous information” for the time being.

Integration of information coming from or going to sub-systems and modules other than the 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.

On the other hand, that is to say mostly the home base, more transparency between mobile data communications networks and fleet management applications.

This can be seen as a complement to data structure and contents standardisation, through messages handling procedures standardisation and a way to solve, on the ground side through application protocol interfacing, the problems raised by the multiplicity of on-board systems and communication solutions. This is commonly seen as “Office Interfacing”.

More interoperability and integration between sub-systems, control modules.

It is clear that any progress in that direction will make the whole “System” more user friendly and, also, more cost efficient and cheaper. It is clear, too, that it will make it safer to operate.

Ease of plugging / unplugging of various sub-systems and control modules and physical components in the overall system architecture, whatever the market origin...

This issue could be considered as redundant to the above-mentioned. But it needs to be considered as such during a “transitory” period that could still last many years...

More harmonisation, if not standards, between support devices, for HMI aspects.

If it seems difficult to imagine standardised HMI, whatever the truck manufacturer or solution provider, as a result of the fact that the fleet will often remain heterogeneous and that the “couple Driver / Vehicle” will be more frequently dissociated in the future, efforts should be made towards HMI harmonisation.

2.2 Standardisation process now to be considered

Standardisation bodies for the examination of these possible proposals are CEN TC 278, the European Technical Committee for standardisation in Road Traffic and Transport Telematics (and more specifically its Working Group 2 on Freight and Fleet Management) and ISO TC 22 for Road Vehicles. These examinations should be made through liaison with EDI / EDIFACT standardisation bodies. Additionally, CEN TC 224 and 225 addressing smart card applications and bar coding will be in touch with the corresponding bodies of ISO.

In fact, COMETA investigations and outputs were deliberately closely related to CEN TC 278 WG2 scope, justifications and identified Work Items.

Review of WG2 official Work Items remaining in its programme of work at the beginning of the year 2000 (this WG has been “dormant” for more than two years) and first comments on COMETA potential inputs:

- **2.1.1 (CEN/CS 00278094) Freight and Fleet management systems reference architecture and terminology. Part 1: High level architecture and terms.**

According to the fact that now KAREN should be used as a reference, it means that the document produced within this WI is now obsolete and should be withdrawn and replaced by one based on the common KAREN/COMETA output which has identified and has now finalised the development of a SA through three High Level Functions (Manage Freight, Manage Fleet, Manage Vehicle/Driver/Cargo/Equipment).

- **2.2.1 Freight and Fleet management systems reference architecture and terminology. Part 2: extended object oriented architecture.**

Needs to be reconsidered according to what has been explained above.

- **2.2.4 Freight and Fleet management systems: Mobile electronic data interchange.**

Can restart with a set of 4 new messages proposal (Transport Order, Tasks Order, Tasks Report, etc.) to be considered in parallel within UN CEFAC and the consideration of a “Fleet Application Protocol” (FAP) representing the “ground side” of data exchange integration.

- **2.3.2 Freight and Fleet management systems: Interfaces for on-board data processing and vehicle data links.**

This WI was passed to ISO/TC 22/SC3 but CEN got no answer and could decide to reconsider this matter based on requirements identified within COMETA.

This means that the consideration of FAP, MOBILE EDI, MDTP, DIS and BUS matters (see further on) justifies WG2 reactivating in the coming months.

3 COMETA USER NEEDS AND STANDARDISATION

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:

- 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 and given a hierarchy according to common objectives:

- 1 social regulations enforcement and observance by drivers through the use of an electronic tachograph,
- 2 operational and commercial management during trip, missions management,
- 3 ensuring and support of safety and security,
- 4 vehicle mechanics monitoring and control,
- 4 automatic identification and tracking and tracing,
- 6 positioning, navigation and route optimisation,
- 7 communication management and solutions optimisation,
- 8 cargo management,
- 9 document management,
- 10 driver comfort.

3.1 Reasons for grouping and hierarchy

These groups, and their hierarchy, are the result of the combination of operational point of views, commercial point of views of data processing and exchanges related to the driver, the vehicle, the cargo, the trips, the tasks and orders to be executed and monitored.

They are the result of the confluence of management requirements, functional requirements and supporting technical requirements.

As far as the electronic tachograph has been the triggering event for COMETA, it is not surprising to find this listed first within a broader view.

Secondly comes the requirement related to the performance of his tasks by the driver, which can be seen as a strategic requirement for transport operators.

Just after this, various requirements addressing safety and security from different points of views have been deliberately grouped, this means that fleet managers are willing to benefit from potential new opportunities, but simultaneously that they are also willing to avoid any new type of additional risk.

Next, two quite different types of requirements are to be found: vehicle mechanics monitoring and control, Automatic identification and tracking and tracing which gather a combination of important functional requirements and requirements addressing technologies to support them. Both can be seen as direct supporting technologies to strategic task performance.

Various requirements addressing supports for positioning, navigation and route optimisation present a particular case. Positioning is seen as a rather important (and even priority) area, but navigation a less important one. So, considering the first aspect, this group should be ranked higher, considering the second one, ranked lower.

Then more technical requirements are to be found in the area of communication management and its optimisation, dedicated requirements for the physical handling and monitoring of cargo to be carried, and when being carried, as well as electronic documents management and exchanges.

Last, users have nevertheless thought of driver comfort that could or should be improved.

In the remainder of this chapter, these groups will be described in more detail and, beyond a generic requirement for modularity and interoperability expressed regarding the architecture to be designed, some standardisation requirements will be tabled already.

3.2 (rank 1) Social regulations enforcement and observance by drivers, through the use of an electronic tachograph.

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

Beyond this, 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 the risk of regulation infringement. In this case also principals and/or freight forwarders are also interested.

Standardisation needs :

Two quite different ones. One is related to the efficient integration of this device within the physical and communication architecture (2 interfaces are required by the electronic tachograph technical annex adopted in March 2000), the other one is related to the structure of the information.

3.3 (rank 2) Operational and commercial management during trip, tasks management.

Here conditions can be found addressing the provision and processing of all necessary information to allow a driver to execute required tasks through real-time exchanges with the appropriate partners (fleet manager, but also commercial partners), also addressing the processing 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 driver 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.

Standardisation needs :

It is obvious that open scenarios of road transport management will require more standardised exchanges of information to / from the “mobile production unit” to be compared to the developments between principals and transport operators “on the ground”.

3.4 (rank 3) Ensuring and support of safety and security.

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, data recording and transmission, and possibly the support of telematic service providers.

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

Standardisation needs :

Beyond HMI aspects to be harmonised as far as possible, requirements address possible standardisation in remote emergency support applications.

3.5 (rank 4 ex æquo) Vehicle mechanics monitoring and control.

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 malfunction, 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.

Standardisation needs :

The needs here address interface transparency between on-board capture of data and their remote use and possible retroaction on them. They also address transparency and efficient interfacing between them and their usage at an upper level (see above) as supports to tasks management.

3.6 (rank 4 ex æquo) Automatic identification and tracking and tracing.

Here too, solutions providers will be asked to allow for 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 at terminals, for fee collection (without stopping the vehicle for these three possible applications), etc.

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

Standardisation needs :

This is a privileged field for standards either for identifiers whatever the technology (bar coding, radio tags, smart cards) and its use as a possible parallel data flow support, or for the implementation of networking of related information between various partners of the logistic and transport chain.

3.7 (rank 6) Positioning, navigation and route optimisation.

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 trip conditions and at more reactivity and anticipation for drivers, by themselves or through dialogues with commercial partners or third parties.

Standardisation needs :

Required standards (GIS, Georeferencing) in this area are already being addressed by the appropriate bodies, it should nevertheless be checked that there will be no “missing links”.

3.8 (rank 7) Communication management and solutions optimisation.

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

The offers should allow voice and data communication (from free text to EDI/EDIFACT, via macro messages) 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 either 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).

Standardisation needs :

Here the provision of more and more sophisticated (and high rate) solutions does not prevent addressing the issue of maximum interoperability between these solutions.

3.9 (rank 8) Cargo management.

This User Need can consist of one or more of the following functions: weighing 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 the 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.

Standardisation needs :

Standards here will address the structuring of data either to allow for remote monitoring or the transmission of possible bay plans.

3.10 (rank 9) Document management.

These User Needs, beyond the regulatory aspects that are required by Authorities' demand for "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 the processing and printing of these documents, when considering the protection of data, or on the other hand, the possibility of modifying some of them, when considering the securing of proofs of delivery and electronic signatures.

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

Standardisation needs :

In this area, legal specifications of documents should stand for standards, but it is possible that some technical aspects could require further consideration.

3.11 (rank 10) Driver Comfort.

Comfort is here to be 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.

Standardisation needs :

Standards could play a support role here so as to enhance a trend towards universal HMI in this area.

The case of one-man companies or chartered drivers (Negotiate transport orders, Administrate business transactions)

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

Standardisation needs :*The same as for tasks management (§3.3).*

4 HARMONISATION AND STANDARDISATION REGARDING SYSTEM ARCHITECTURE

When CEN TC 278 WG 2 started work, “reference architecture modelling” for Freight Fleet Management Systems was seen as a necessary first step to be made so as to identify where standards were required at the interfaces of, yet to be identified subsystems and/or functions within these subsystems.

Starting material came from European Advanced Transport Telematics Projects in DRIVE 1 and DRIVE 2 R&D, FLEET then IFMS (“Integrated Freight and Fleet Management Systems”, leading to the design of an “Open System Architecture for Computer Assisted Integrated Transport”...), “translated” in (ERTICO) CORD “RECOMMENDED DEFINITIONS OF ATT SUBFUNCTIONS, FUNCTIONS and AREAS (A8 FFM)” and in CORD SATIN task force results “ATT System Architecture Developments: the Freight and Fleet Management and Hazardous Goods Monitoring (FFM and HGM) Areas”.

A “high level system architecture” was then adopted by CEN TC 278 WG2.

So COMETA’s first result is a new design, with KAREN, of a Reference detailed System Architecture for Freight and Fleet Management.

This System Architecture is presented in Del 6.1. It will be forwarded (with KAREN) to CEN TC 278 WG2, so as to restart and enhance former developments and allow for possible identification of new standards requirements with other WGs or TCs.

But , before that, the “merging” of both Projects SA needs to be successfully achieved so as to have only one reference architecture for freight and fleet management in WG2.

4.1 Mapping standardisation requirements to functions and physical architecture

4.1.1 COMETA Hierarchy of Functions

1 Manage business transactions	1.1 Negotiate transport orders (Karen 8.2.1.1)	
	1.2 Administrate business transactions (Karen 8.2.1.2)	
2 Prepare vehicle, driver, equipment and cargo	2.1 Prepare resources	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 equipment
		2.1.6 Prepare accessories
		2.1.7 Prepare other transport mode
	2.2 Prepare trips, routes and load plans (Karen 8.2.2.1.1)	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
	3.3 Provide advanced driver assistance (from KAREN)	3.3.1 Provide vision support (Karen 5.1)
		3.3.2 Provide longitudinal control (Karen 5.3)
		3.3.3 Provide lateral control (Karen 5.4)
		3.3.4 Provide automated driving support (Karen 5.2)
		3.3.5 Miscellaneous telematics functions (Karen 5.8)
	3.4 Provide access to comfort services	
	3.5 Manage traffic and route guidance information (Karen 6.2.5)	
	3.6 Support payment operations	3.6.1 Perform EFC transactions(Karen 5.8.9) 3.6.2 Support billing services
	3.7 Monitor vehicle	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
	3.12 Manage emergency	

Table 1 : COMETA Hierarchy of Functions

4.1.2 COMETA Physical Architecture.

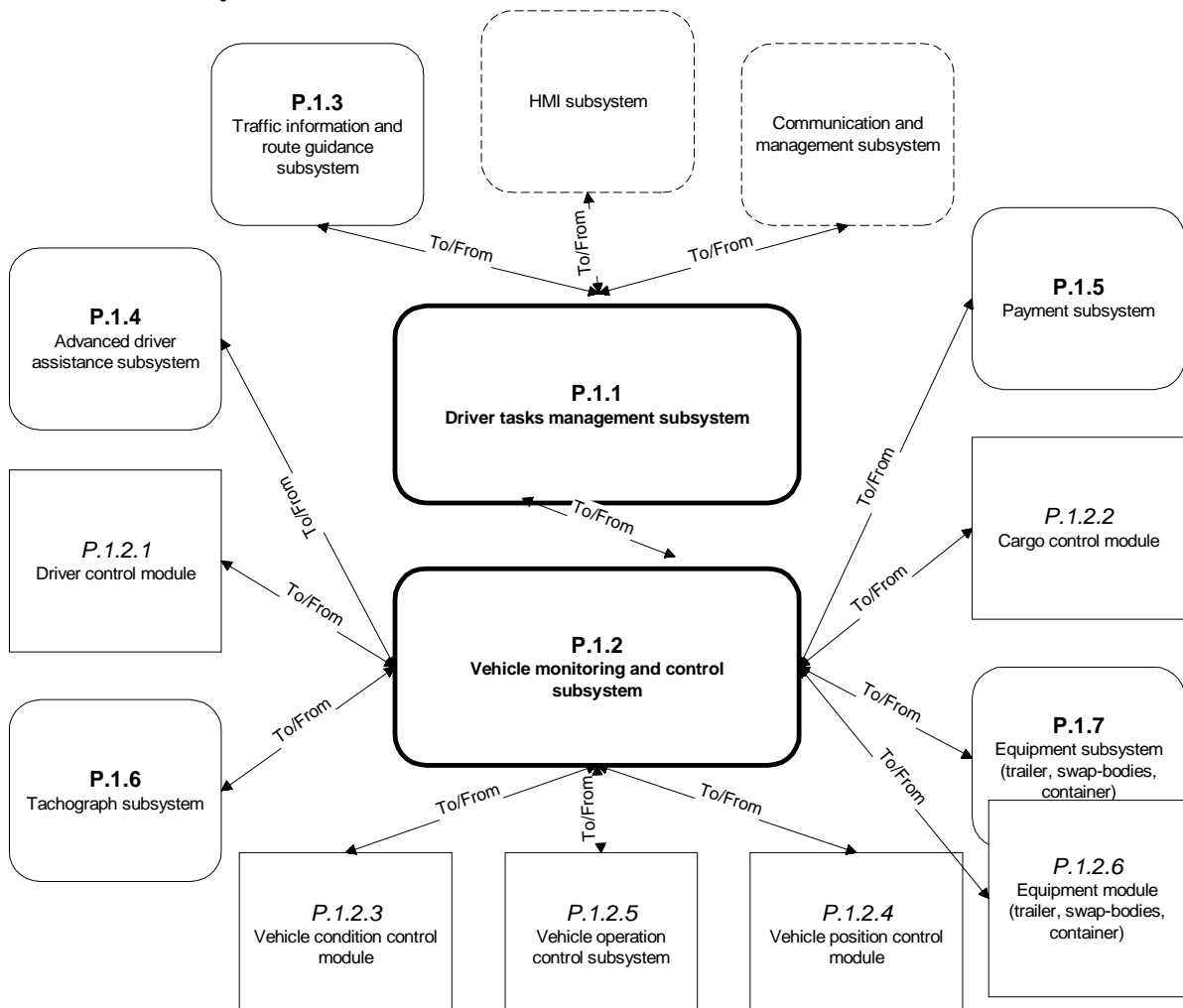


Figure 3 : COMETA Freight Fleet Vehicle, Driver, Cargo, Equipment System

This figure only represents the Sub-systems, with two main ones, “Driver Tasks Management Sub-system” and “Vehicle Monitoring and Control Sub-system” and, for the latter, its related Modules (square boxes). The detailed exchanges with terminators and between Sub-systems and Modules should be found in Del 6.1

The contents of Table 1 (COMETA Hierarchy of Functions), describing the Functional level of COMETA SA and its translation into Physical Architecture as summarised in the above figure (Freight Fleet Vehicle, Driver, Cargo, Equipment System), will be briefly reviewed in this paragraph as regards standards.

4.1.3 Functions 1 Manage business transactions,

Negotiate transport orders (1.1) and Administrate business transactions (1.2).

These functions will be performed between principals (mainly freight forwarders) and independent or chartered drivers. For easy and open partnerships at any moment, they require standardised exchanges of data.

MOBILE EDI messages, which are presented in Chapter 5, already allow for the transmission of transport orders.

This scenario would require other standardised messages, from transport opportunity presentation to invoices.

It could be favoured, in the future, by the spread of MOBILE INTERNET.

Beyond this, all other functions triggered by these exchanges, will be translated into “Tasks” to be compared to those ordered to fleet drivers (see below) and processed at the Physical level by the “Driver Tasks Management Sub-system” requiring appropriate information from the other Sub-systems and / or Modules exactly like a fleet driver.

4.1.4 Functions 2 Prepare Vehicle, Driver, Equipment and Cargo.

Prepare resources (2.1).

These functions will require standardised electronic documents (“paperless transport”) if these Function “prepare documents” (2.1.1) is not to mean the checking of the presence of paper documents.

They will require, as far as possible, standardised sensors and data to be captured and exchanged within the vehicle network (through the Physical “Vehicle Monitoring and Control Sub-system”), so as to check the availability of the vehicle (2.1.2), the equipment (2.1.5), accessories (2.1.6), cargo space (2.1.4), if these checks are beyond or are supporting the human processes.

In particular, it will require standardised access to the content of the tachograph to check driver availability (2.1.3).

It will require automatic integration of the results in a possible report message sent to the home base or even the possibility by the home base to trigger this kind of check without driver intervention.

If not inserted in other messages, it could require the design of ad hoc ones, as for the check (2.1.7) on the availability of other transport modes (train on schedule for combined transport).

Prepare trips, routes, and load plans (2.2).

It will mainly require the standardised structures and contents of “Tasks Order” messages and requests to be exchanged between fleet managers and their drivers, although they could be in an open scenario, and feeding some more or less permanent data bases (2.2.1 / 2.2.2 / 2.2.3).

It will require Standardised digital maps (or a corresponding database to be queried) indicating trip constraints for heavy vehicles (2.2.4 / 2.2.5).

4.1.5 Functions 3 Perform and Control Vehicle, Driver, Cargo, and Equipment operations.

Manage Tasks and Transport orders (3.1).

These functions will require the same standard messages as above, standardised automatic identification of Equipment and / or Cargo (reading or writing), which is happily already rather advanced even if some efforts are still necessary (bar codes, radio tags) and the matching of both (3.1.1 / 3.1.2 / 3.1.3).

Comply with regulations (3.2).

A regulation stipulates the content of the tachograph (3.2.1), but the transfer of this content should be standardised (see MDTP and DIS in Chapter 5), in the same way as the checking of the presence of electronic documents or status of organs involved in safety or environmental requirements could be favoured by appropriate standards (3.2.2).

Provide Advanced Driver Assistance (3.3) These Functions are described in KAREN.

Provide access to comfort services (3.4).

To be examined on a case by case basis.

Manage Traffic and Route Guidance information (3.5).

Much has already been done within CEN TC 278 within that domain (RDS / TMC – DAB – ALERT Messages, etc....).

Support payment operations (3.6).

A standard is available for DSRC electronic toll collection, but interoperability within Europe is still to be achieved (In France in July 2000 between all highway operators). Blue card is a universal mode of payment for other charges (not in motion), but the interface within the On-board System(s) Architecture still needs to be addressed for both (see Payment Sub-system in Physical Architecture – 3.6.1 / 3.6.2).

Monitor Vehicle (3.7).

If vehicle positioning does not seem to raise great difficulties (3.7.1) and seems easily associated to outgoing messages automatically, the provision (3.7.2) of static or dynamic information from the whole vehicle (see appropriate Modules at Physical level) will be highly favoured by the standardisation of data capture, structure and content and circulation within the vehicle (data bus), followed by integration into report messages.

COMETA allowed for the identification of a particular justification for this kind of standardisation and its results should be used to enhance the implementation of remote diagnosis and, also, remote breakdown remedy support, even if only to facilitate and make the physical intervention of a chosen service provider on a given highway (or elsewhere) more efficient.

Monitor Driver (3.8).

For social regulations status (3.8.1), the considerations are the same as for the above (data and messages), for physical status (3.8.2) the COMETA investigation did not go far enough to make any statement here.

Driver expenses (3.8.3) and driver driving behaviour (3.8.4) are addressed in payment matters for the first and in vehicle monitoring for the second.

Monitor Cargo (3.9).

A matter of automatic identification and/or sensors for status monitoring (temperature, stowage, etc....).

Monitor Equipment (3.10).

Same as for Vehicle (3.10.1 / 3.10.2).

Monitor Progress of task (3.11).

These functions can be seen as symmetrical to 1.1 / 1.2 and 2.2 / 3.1, as far as here the driver has to send reports on the execution of required tasks or transport orders. This means standardised messages (or electronic document representing the transport order and receiving an electronic signature – 3.11.2) and, in some occurrences, the integration of technical information automatically captured by sensors (3.11.1).

Manage emergency (3.12). Same as for 3.8.2.

5 MOBILE DATA EXCHANGE

Mobile data exchange means considering application interface protocols (FAP), Message structure and contents (MOBILE EDI), existing proposals for file transfers (MDTP / DIS), to be harmonised or even combined so as to ease data exchange scenarios.

5.1 Fleetmap and FAP

At API level (Application Programming Interface), the FLEETMAP Project (started in March 1998 and supposed to be finished in May 2000, in which the AFT is participating and which is co-ordinated by another COMETA member, PTV) and FAP (Fleet Application Protocol) aims to allow for a standardised interface between in-house applications and a concept of “Fleet protocol Server”, facilitating, in such a way, increased integration through:

- Encapsulation of data which needs to be transferred between the vehicles (or the service provider) and the in house fleet applications (in both directions) by means of the in house communication link,
- Attribution of out going messages to the appropriate “external” protocol,
- Generation of messages which are proprietary to the “external” protocol used or to the in-house protocol server, or in other words, translation between the “external” and the in-house format (in both directions),
- Scheduling communication tasks that are carried out periodically (asynchronously) on the protocol server.

It is based on the assumption that the market for mobile fleet telematics services is characterised by rapidly and dynamically changing technologies, services, communication means and transfer protocols. On the one hand, these developments are determined mostly by dedicated solutions for big individual users, on the other hand strong service providers are currently defining and customising their own service portfolio.

Nearly all fleet telematics applications are constrained in one, and one only, technology: in most cases, only one dedicated combination (package solution) of «on-board» equipment, communication protocol, central application software and fleet service is offered.

A first FAP version was available when COMETA started, it has been up dated in parallel, and also, both Projects came to the conclusion that this protocol should be extended from its present range of services, that is to say,

- Location,
- Messaging,
- Dynamic Pools,
- Call for assistance,
- Traffic information.

Some of them have already been useful for the performance of COMETA (and more, KAREN) Functions.

The extension should for example cover :

- Tasks (e.g. Tour) and Transport Order management,
- Social management,
- Data from sensors (Cargo or Vehicle related; e.g. temperatures),
- Intermodal transport information,

being more directly related to the performance of key COMETA Functions.

5.2 Mobile EDI

This matter has been considered in parallel to FAP, as tackling with the same type of problem but from a different angle, at a different level.

5.2.1 Present situation

Even before the beginning of the COMETA Project, the AFT and “PILOTS” within the French cluster, were involved in the development of standardised EDI using EDIFACT in Transport Messages.

They came, at a given moment, to the conclusion that the standardised information chain between principals (consignor/consignee, freight forwarder) and road transport operators / fleet managers, should include the mobile part of this chain, that is to say driver / vehicle and equipment (defined as “transport unit unable to move by itself”, e.g. trailer, container, swap body, etc.).

COMETA gave to the AFT and to these PILOTS an opportunity to consider this extension of EDI standards within the conceptual framework of a System Architecture provided by KAREN and COMETA.

During the lifetime of COMETA, continuous consideration of on going standardisation investigation into “MOBILE EDI” has been managed, with feedback from COMETA’s first draft of a pre design of System Architecture and from the results of the validation phase of this pre-design, up to the final design of the SA as it can be seen in Del 6.1.

COMETA decided to support and forward this proposal at a European level, with the agreement of French EDITRANSPORT.

As it can be seen in Del 6.1, mainly in Information Level Architecture and in Physical Architecture, with the “Driver Tasks Management Sub-system” the Concept of “TASKS” has been adopted by COMETA. It is the central entity within the management of freight fleet vehicle, driver, cargo and equipment. “Tasks order” is seen as the key operational information provider, with its corresponding “Task report”. Its relationships with the “Transport order” (commercial information) have been clarified according to the EDITRANSPORT definition. So, COMETA supports the finalisation of these three messages, which is expected from EDITRANSPORT.

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

- Wait for a new tasks order,
- Loading,
- Unloading,
- Loading shift,
- Unloading shift,
- Go to a given precise place,
- Move in a given direction,
- Go through ... (e.g. Ferry, etc....),
- Take a given accessory,
- Check availability of a given accessory,
- Check the status of a given vehicle organ,

- Take documents,
- Leave documents,
- Change tractor,
- Park tractor at a given place,
- Have tractor and / or trailer / tank washed,
- Refuel at a given place,
- Go to Workshop,
- Leave (reusable) equipment
- Take back (reusable) equipment,
- Change driver status in tachograph,
- Special action.

This codification activity is an important matter, EDIFACT lacking of course this kind of information, but also being quite unsatisfactory regarding some useful code lists for MOBILE EDI: code lists for types of means of transport and equipment to be required, types of goods, etc....

Free text zones should be limited and translated, as far as possible, but to a reasonable extent, into processable information.

5.2.2 Other Messages to be developed.

- The main present remark that COMETA will forward to EDITRANSPORT (and hopefully a corresponding European level), is that, first, present messages are only truck load and less than truckload oriented and that other activities should be addressed like pick up and delivery (tour order and report) and intermodal transport.
- Secondly, the present scenario could be made more complete by the inclusion of a transport offer sent by a freight forwarder, a transport opportunity by an independent or chartered driver (with perhaps the equivalent as a task request by a fleet driver), or a transport invoice.
- Thirdly, the last type of message: **questions / information from the base to the mobile unit and questions / answers / information flow from the mobile unit to the base**, is rather, for the time being, some kind of “miscellaneous” message. It needs to be more structured (and perhaps split) and allow for more automated processes, the requirement and provision of information related to driver monitoring (social regulation, driving behaviour, physical status) and vehicle / equipment monitoring (various data capture, describing vehicle condition and vehicle operation).

COMETA, during its parallel investigations with FLEETMAP, regarding possible solutions regarding available standardisation of format of data to be extracted from the tachograph and other data capture and exchanges in the vehicle, found two industrial initiatives (MDTP and DIS) for a common standard.

MDTP is led by a French software company developing tools for social regulations data analysis, which includes for the time being: AEROPRODUCTS, DIRLAND, MANNESMANN KIENZLE, LOXANE, MICROPROSS, THOMSON, VOLVO.

A first presentation of COMETA results allowed for the identification of another proposal to be compared to MDTP: DIS Interface (for Data Interchange System) from a company named “Delta Industrie Service”).

These proposals are described hereafter and are now being considered both by EDITRANSPORT and FLEETMAP / FAP.

- Fourth, structured messages coming from other sources than Principal or Fleet Managers (we think here mainly of Service Providers) should be considered too, such as traffic info, route guidance (request and provision), maintenance support, etc...

Even exchanges with Authorities should be investigated.

5.3 MDTP

"MicroPross data transfer protocol" proposes a flat file structure using ASCII codes.

**The MDTP format is made up of a header record, data records, and the end record.
The header record supplies the identification information.**

- The first field indicates the type of file used. It is composed of four MDTP characters. An application simply has to read the first four bytes of the file in order to check that it is in the expected MDTP format.
- The second indicates the number of the version of the specifications of the file format used.
- The third identifies the manufacturer of the data source (e.g. VOLVO, KIENZLE, etc....).

The data records indicate the events. They must indicate the event that has occurred, the driver and the vehicle, and be dated. They also include an indication of the source of the data, and a variable number of values.

- The first field is a numerical field, coding the event that has occurred.
- The second field indicates the date and time when the event occurred, expressed in universal time.
- The third field identifies the driver.
- The fourth field identifies the vehicle.
- The fifth field, numerical, identifies the source of the data (1).
- The following fields indicate the values transmitted with the record. Each value is indicated in two fields: the first is a code indicating the type of value passed (parameter), the second being the value itself.
- The record is finished by a field at 0, indicating the end of the parameters.

The end of the file is indicated by an event code of 0. Therefore, no values will be passed with this record.

Checksum: each record ends with the character * (ASCII code: 0x2A) followed by a checksum expressed in two characters hexadecimal (8 bits). By using a single divider, record checks can be made without having to analyse the fields. The checksum is equal to the complement to 1 of the sum of all the characters making up the record, up to and including the character *.

(1) Identified data sources for the time being:

Code	Source
0001	Tachograph chart
0002	Localisation system
0003	On-board computer
0004	Tachograph
0005	Smart card
0006	Solid importation

It is clear that this kind of approach can be embedded within a message and handled by a fleet application protocol.

5.4 DIS

This “standard” from "Delta Industrie Service" is intended to be used by the following solution providers : Data et Mobiles, Transics, Volvo, Thomson, Veeder Root, Loxane, Techno Sud Industries, ICS, etc. ... so as to manage an interface for their products with Delta Industrie Service software, Scan4 and Visio-Truck.

This “standard” contains the description of the format and content of a text file to be used to import and export information related to a type of activity between two applications.

These activities are, for the time being, mainly related also (if compared with MDTP) to the content of the tachograph.

They concern driving time, working time, resting time, kilometres driven, etc. But also drivers expenses, refueling, tour information, images transfer, etc.

It is clear, too, that this kind of approach can be embedded within a message and handled by a fleet application protocol.

6 ON-BOARD SYSTEMS AND VEHICLE DATA LINKS

It has been said in the introduction that this work item has been left, for the time being by CEN TC 278 WG2, to ISO TC 22, waiting for the expression of new requirements resulting from management functions to be performed on-board the commercial vehicle, or it could be said, waiting for COMETA results.

The following figure from CEN TC 278 WG2 summarises the Interface scheme for on-board data processing and vehicle data links.

It gives, also, some examples of existing physical and data standards to be used at these interfaces (this point have been already considered with MDTP and DIS in 5.3 / 5.4):

- Traffic information interface,
- Positioning interface,
- Between On-board computer and Communication Command unit,
- Air communication interface,
- Peripheral units interface,
- Vehicle bus interface

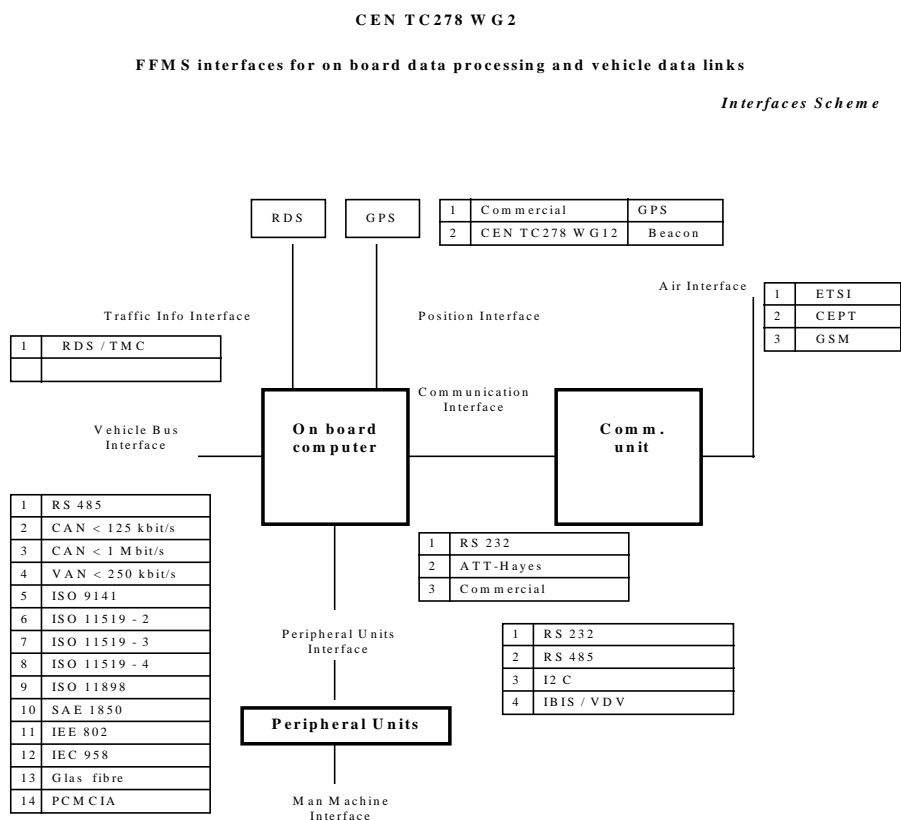


Figure 4: FFMS interfaces for on-board data processing and vehicle data links

COMETA was intended to enhance the investigation in that domain.

As seen, COMETA resulted in the identification of strong requirements for standardisation and integration in this domain, whatever the solution could be, but no proposal as such could be drafted, even if some considerations have been developed in the chapter addressing Physical Architecture in Del 6.1.

Three main types of requirements have been expressed:

- Optimal and easy integration of the Tachograph in the On-board System(s) Architecture, avoiding redundancy of functionality and facilitating the provision of standardised information, beyond the enforcement of social regulation aspects, to on-board and home based management software.
- Optimal and easy integration of all components and devices of the On-board System(s) through one or two (or more if justified) efficiently and transparently interfaced data buses.
- Optimal and easy physical plugging / unplugging of these components or devices in the On-board System(s) Architecture, whatever the market origin, truck manufacturers or solution providers.

6.1.1 Electronic tachograph

Beyond the information that there will be two interfaces (one with CAN bus and another one), it is necessary to consider the content of the recently adopted “Technical Annex” of the new regulation (March 2000) addressing the electronic tachograph, not only to start the countdown of the future introduction date of this tachograph (autumn 2002 ?), but also, and most importantly here, to analyse the possible consequences for the On-board System(s) Architecture and possible standardisation requirements beyond the regulatory stipulations.

6.1.2 Buses

From the present situation to a high integration scenario, through a transitory phase.

But the most important development in the domain of “Interfaces for on-board data processing and vehicle data links”, could now be expected from the AMIC initiative (gathering all car and truck manufacturers) and the ITS Data Bus FORUM, a private industrial initiative (mainly from the USA), of which we know very little up to now, or from MOST which gathers some of the same and some others.

During a presentation in Toronto at the 6th ITS World Congress, where one could understand that this development was just starting (and was to last some two years) and that “Special Interest Groups” would be convened, a COMETA representative asked if one could be convened for truck applications and received a positive answer. But no news followed.

Nevertheless one should remember that it is forecast that the networking¹ of on-board systems will mean a minimum of two interfaced Data Buses as described in Del 6.1, from which we have extracted the following figure and paragraphs, which means that enhancement is also expected on CAN bus or from WORLDFIP, a standard proposed by CEN TC 278 WG3 for public transport vehicles.

¹ we shall not here go into radio based limited area solutions such as BLUE TOOTH, about which COMETA has gathered little information

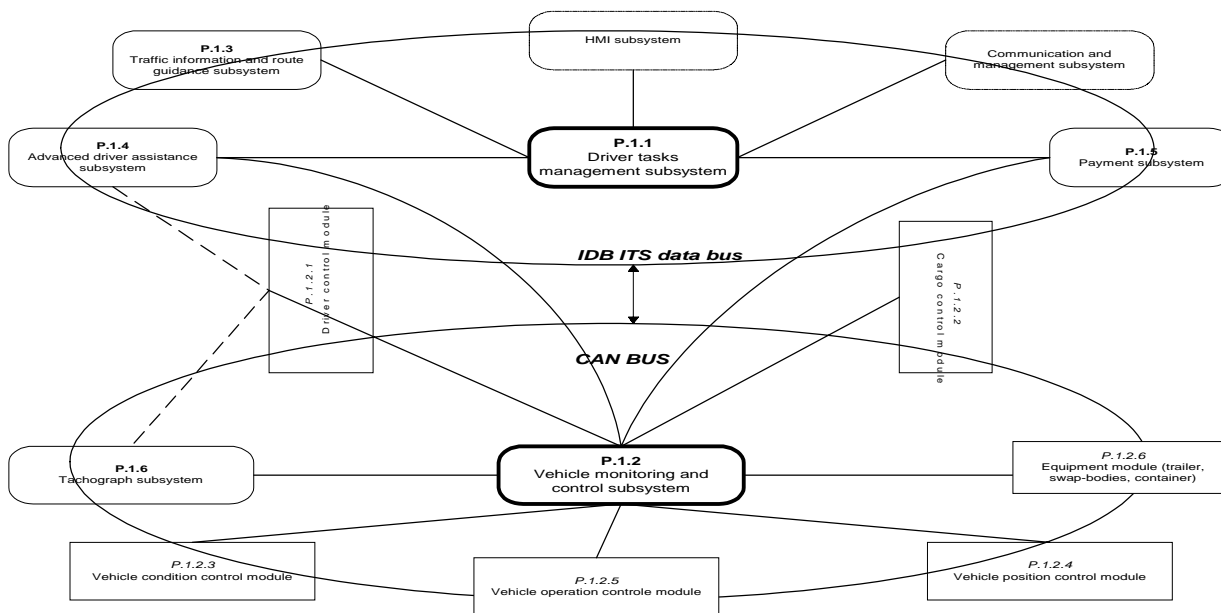


Figure 5 :The “transitory phase”.

If we consider this “transitory phase”, there will be two on-board networks for the interconnection of the different functionalities.

The first network will be related to the telematic functions (i.e. 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 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 into two or more lines to assure safety critical operations.

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 is efficient interfacing between the two networks, which could make discussions upon their “borders” rather irrelevant, it could be imagined that the most “communicative” Sub-systems or Modules, will belong to the IDB.

This would be the case even if advanced driver assistance Sub-system and the Driver control Module become further integrated, or if the Cargo control Module becomes more and more “autonomously communicative” (images, Automatic Identification, “Messages” on the unit itself through high density bar codes or radio tags).

The High integration scenario :

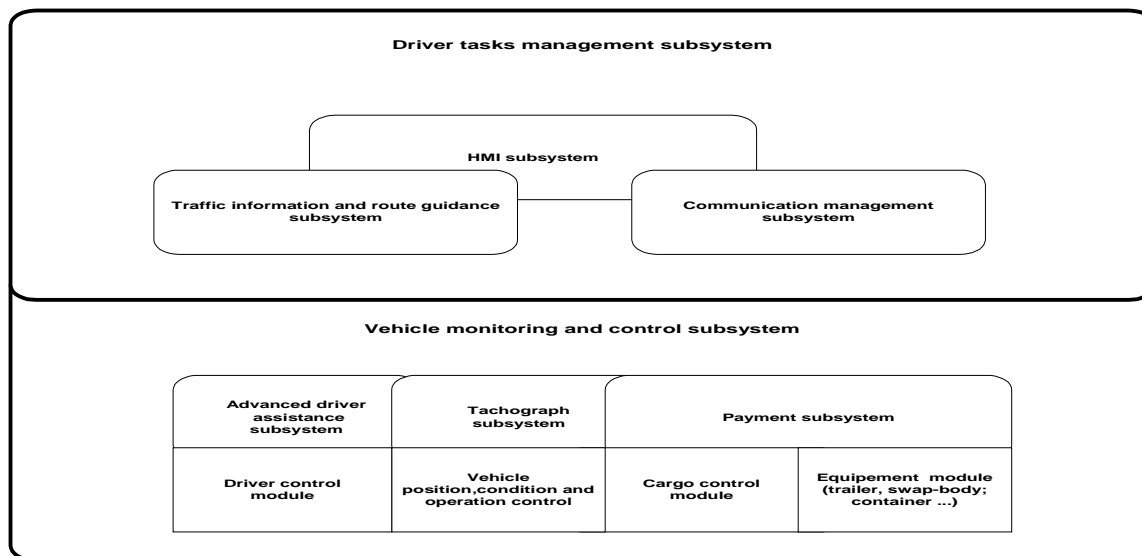


Figure 6 : the High integration scenario

If we consider the high integration scenario represented by the above figure and to be expected between the years 2005 and 2010, we are entering a deeper twilight zone. What the figure means is that, compared to the present situation and even the transitory phase, beyond a possible stage where one could find only one data bus (as at present in air planes), Sub-systems and Modules will become less and less physically distinguished, and more and more interpenetrated. This will occur, even if a major functional distinction will still be made between “driver tasks management sub-system” and “vehicle monitoring and control sub-system”.

Described data flows will remain relevant, but will be input/output from software modules within much more integrated overall 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.

Lastly, this high integration scenario does not give borders to the respective “roles” of an on-board implemented computer and an interfaced handheld or removable one that could be attached to the driver according to given transport activities (e.g. Pick up and delivery as shown presently by UPS or FEDEX).

6.1.3 Optimal and easy physical plugging / unplugging of components.

This requirement appeared to be a very important one from COMETA PILOTS.

For the time being, the plugging in of a new component is often a complex operation, requiring a rather long immobilisation of the vehicle and sometimes even not technically possible or only with important additional investments.

This is particularly the case for the unplugging of given components on a given vehicle of a given type (and given manufacturer) to be plugged into another vehicle of another type (from another manufacturer).

The COMETA conclusion is here to ask ISO TC 22 to address that matter with CEN TC 278 WG2.