Establishing an open in-vehicle platform for heavy vehicles

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Abstract

An open in-vehicle platform seems indispensable to ensure interoperability of ITS services. This paper discusses steps towards establishing an open in-vehicle platform architecture for the provision of ITS services in heavy vehicles. It is based on a study[1] for Specific Action 4.1 of the ITS Action Plan commissioned by the European Commission. The core idea of an open in-vehicle platform is to create an environment where service providers can access resources existing in the vehicle and plug into them in order to provide a wide range of freight and fleet management related services. Due to their legal requirements regulatory applications (e.g. European Electronic Tolling Service, Digital Tachograph, On-Board Weighing) can well define the core applications of an open in-vehicle platform architecture. This paper proposes several recommendations for concrete actions that the European Commission should undertake to facilitate the realisation of an open in-vehicle platform for heavy vehicles and support open and competitive markets for ITS services. The recommendations stress, among others, actions to create open access to in-vehicle resources, clarify ownership of vehicle data and ensure the absence of hindrance for coexisting applications.

Keywords: open in-vehicle platform, heavy vehicle, open access to vehicle data

Motivation

In the context of the European transport policy, several road transport telematics applications are being **regulated** or imposed on vehicles, mainly heavy duty vehicles and coaches, for the sake of road safety and enforcement of certain policies. Such in-vehicle services and applications typically build on a **limited set of ITS components** to cover for transport management needs or to fulfil the requirements stipulated in (existing or planned) legal acts. So far, implementation of most of these acts and agreements has been tackled in perfect **isolation** and has evolved independently of each other, resulting in **limited synergies** (e.g. technical, organisational, commercial) even when requirements or needs are quite similar.

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[1] Rapp Trans (2013). *ITS Action Plan – Specific Action 4.1: Open in-vehicle platform concepts for the provision of ITS services and applications in heavy vehicles – Final Report*, Framework Service Contract: TREN/G4/FV-2008/4575/01

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Within the framework of Specific Action 4.1 of the ITS Action Plan, the European Commission (EC) commissioned a study on analysis and **actions towards establishing an open in-vehicle platform** architecture for heavy vehicles and coaches (hereafter referred to as "heavy vehicles").

Scope of this study

This second study[2] into an open in-vehicle platform architecture focuses on the following selection of **key regulatory ITS applications**:

- European Electronic Toll Service (EETS): Directive 2004/52/EC and Decision 2009/750/EC introduce the set-up of EETS, based on the concept of one contract and one on-board equipment (OBE). EETS Providers may want to use the EETS OBE functionalities (e.g. GNSS, GSM-GPRS, DSRC) to provide value-added services.
- Digital Tachograph (DT): Regulation (EU) No 165/2014 introduces a "Smart Tachograph" with following enhancements: GNSS functionality, DSRC functionality, an optional interface to other ITS applications and an upgrade of security mechanisms.
- On-board weighing (OBW): The revision of Directive 96/53/EC may introduce the use of OBW devices with a DSRC interface to communicate the weight data to officials or roadside automatic inspection systems without stopping the vehicle.

These services/applications are seen as the **relevant** ones, as they (will) apply to most heavy vehicles – in contrast to services/applications concerning e.g. the management of livestock. Moreover, these key applications are **regulatory** – in contrast to fleet and freight management services/applications – which enables a good opportunity to **align** the ongoing initiatives and create a **stepwise** approach for the adoption of an open in-vehicle platform architecture.

An open in-vehicle platform should not only be able to integrate the above-mentioned regulatory key applications. It should also be able to integrate or connect to **other (potential) regulatory applications** (e.g. eCall, Event Data Recorder (EDR), remote checking of roadworthiness) for establishing a **future proof** open in-vehicle platform.

[2] This second study is a follow-up of the first study into an open in-vehicle platform architecture: Rapp Trans (2010). *ITS Action Plan – Specific Action 4.1: Adoption of an open in-vehicle platform architecture for the provision of ITS services and applications, including standard interfaces – Final Report*, Framework Service Contract: TREN/G4/FV-2008/475/01

Moreover, the **market view cannot be limited to regulatory ITS applications only**. Rather it is necessary to understand how the total market for ITS applications is structured. Especially the availability of **voluntary ITS applications** would be **decisive for the success** of an open in-vehicle platform. On this market, the services branches of the vehicle manufacturers and third party service providers **compete**.

Both market actors (want to) provide transport companies with ITS services on vehicle management (e.g. maintenance, fuel consumption, scheduling, routing). However, there is a **risk** that vehicle manufacturers will **use their monopoly** of having prime access to data and other vehicle resources **to exclude competition** by not granting other parties non-discriminatory access to these resources (e.g. vehicle and movement data, communication channels, HMI). Indeed, the **FMS-interface** allows for a safe data connection of third party devices to selected vehicle data of a commercial vehicle, but this interface is optional, comes with costs and does not give access to all vehicle resources (e.g. communication channels, HMI).

What to achieve?

Each stakeholder has a **different view** on what an open in-vehicle platform should be. The elaboration of the **goals of the stakeholders** and **generic goals** can be summarised as follows:

- The **European Commission** has set **open and undistorted competition** as one of the prime goals for the ITS market. An **open in-vehicle platform architecture is a critical element to establish a competitive market** for ITS services.
- The **consumer** (driver, transport company/operator) is interested in an open services market with an **utmost freedom to buy ITS services**, ranging from **generic** services (e.g. navigation, maintenance) to **sector-specific and tailored** services (e.g. routing for pickup-and-delivery companies, services related to special goods, such as livestock, refrigerated goods or hazardous goods), ideally comparable to the plug-and-play concept of today's smart phone or personal computer.
- **Vehicle manufacturers and service providers** have **conflicting interests** and hence different views on what an open in-vehicle platform architecture should be. The **most critical issues** refer to **access to data and access to vehicle resources** (e.g. GNSS, DSRC, GSM-GPRS, HMI). Vehicle manufacturers are interested in **binding customers** that buy their vehicles, not only as being the manufacturer of the vehicle, but also as a complete "solution provider" offering a range of ITS services. **Service providers** are interested in creating **new business opportunities**, ideally having access to all information needed (be it data **on board** of a vehicle or data stored at the **central data server** of a vehicle manufacturer) in a non-discriminatory way.

- A common element is a **services-based** approach on the ITS market. The industry does not primarily sell "boxes" any more (like navigation devices) but is marketing services.
- **Data ownership**, as a key issue, needs to be elaborated in order to clarify who has the legal rights and complete control over the data collected by the vehicles and the applications.
- In the interest of all stakeholders, **security** (e.g. encryption of data, authentication/authorisation mechanisms) and **interoperability** (e.g. common communications standards, no barriers to trade) are other key issues that need to be taken care of.
- Moreover, for an open in-vehicle platform to be future proof, a **sharing of resources is indispensable**. The new regulatory background introduces the **same technologies** (especially GNSS and DSRC) in the three key applications EETS, DT and OBW (see Figure 1). Also other (regulatory) applications – both current and future – (will) require similar technologies.

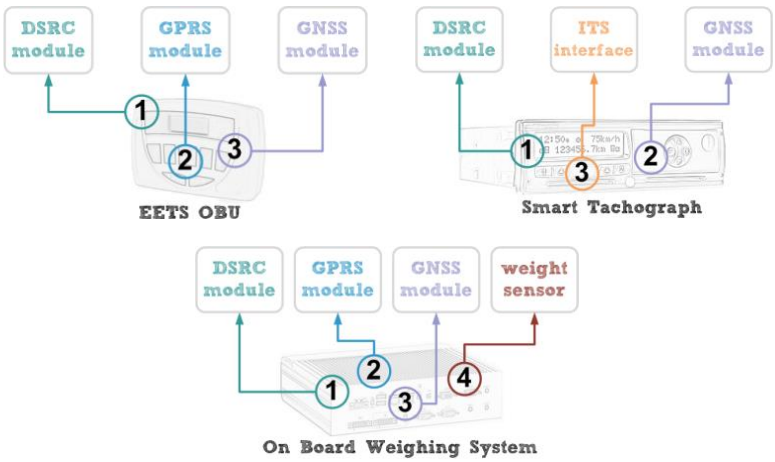

Figure 1 – Components of an EETS OBU, Smart Tachograph and OBW system

These goals were taken as **starting point for further analysis** of the steps towards establishing an open in-vehicle platform architecture for the provision of ITS services in heavy vehicles.

Platform readiness

To structure the discussion on the development of an open in-vehicle platform, a **holistic view** on a **common architecture** is presented, consisting of the following five **abstraction layers**: Governance, Business, Application, System and Components (see Figure 2).

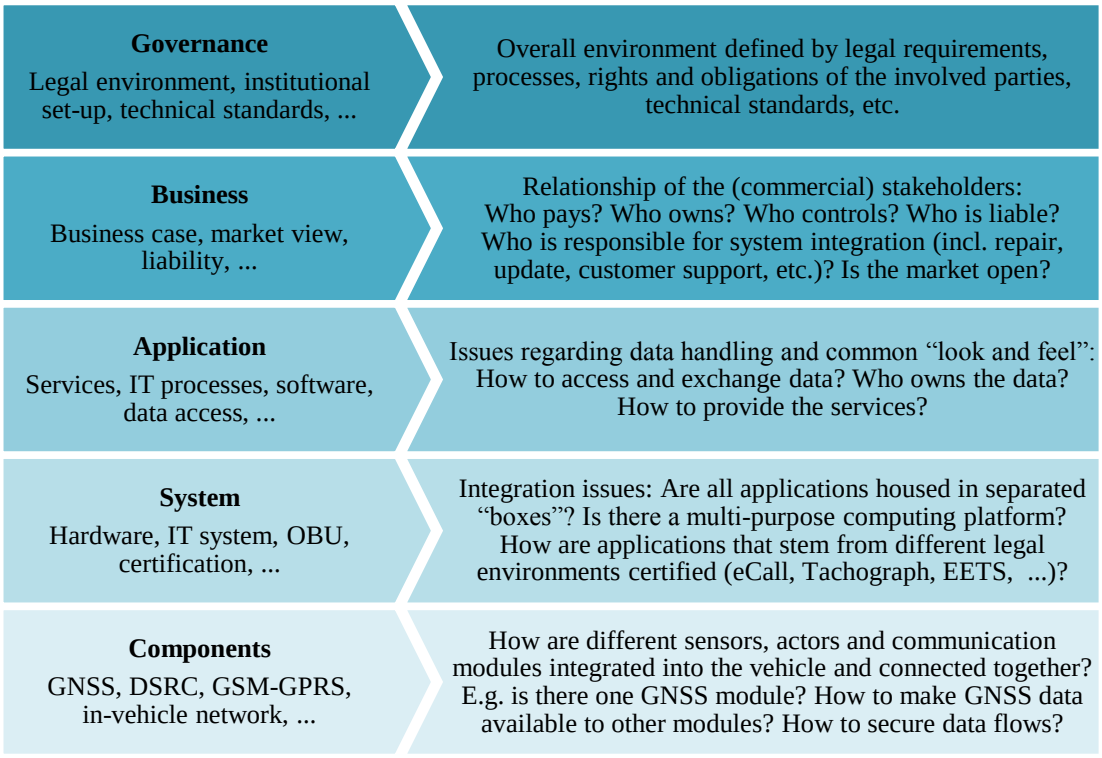

Figure 2 – Five layers of a common architecture for an open in-vehicle platform

A solution that is restricted to one of these layers only, falls short of providing a solution that is simultaneously viable from a technical, a business and a policy perspective. Hence it is of critical importance for an open in-vehicle platform architecture that **all layers must be "platform-ready"**, in other words: **a solution must work on all levels**.

Platform readiness can be achieved **more easily on the lower layers** compared to the higher layers. For example, on the components layer there are only few obstacles to overcome for a joint use of technological resources, such as GNSS or DSRC, or other components, such as antenna or cabling.

The **platform-readiness of higher layers is more difficult** to achieve. For example, European legislation is in general not platform-ready: e.g. EETS has its own certification process which is different from the certification process of the DT. Also applications driven by the vehicle manufacturers are not platform-ready (yet), since many function as a closed box based on proprietary in-vehicle networks. On the higher layers, **obstacles are routed in conflicts of interests of stakeholders**.

The EC has notably a role at the **governance** layer. All other layers should be market-driven. However, what is done on the governance layer will influence the lower layers, intended or not. Therefore, a **good understanding of all layers** is indispensable.

Prerequisites for the platform readiness of the common in-vehicle platform architecture include for each layer the following:

- **Components layer**: no duplication of modules but instead shared vehicle resources; the vehicle should have only one GNSS module and one DSRC module, which are generally accessible to all in-vehicle applications requiring the GNSS and DSRC functionalities.
- **System layer**: specifications should not include elements that may hinder the development of integrated devices; certification processes of integrated devices should be defined such that parts can be (re)certified independently from one another.
- **Application layer**: answers are needed on key issues of data access and data ownership; ideally the consumer owns the data and decides on allowing or not access to these data to other parties.
- **Business layer**: solution to the "conflict of interest" between vehicle manufacturers and service providers regarding full access to vehicle data; the vehicle owner, i.e. the transport company, should be free to decide who can access and process data both in the vehicle and centrally; liability issues appear to be manageable.
- **Governance layer**: a services approach (in accordance with the current market trend) to promote opening up of the transport markets to free and undistorted competition; regulatory applications provided as regulated services; voluntarily fulfillment of compliance through incentives; standardization and certification especially for integrated devices.

Recommendations

Regulatory applications (e.g. EETS, DT, OBW) can be an **enabler** in opening the markets. Indeed, they are the **most demanding** ones regarding interoperability, certification and security and due to their legal requirements can well **define the core applications of an open in-vehicle platform architecture**.

The **regulator enjoys large powers and can set the stage**. Already the DT specifications provide for an excellent opportunity to open access to vehicle data, making the DT a core ITS application in the vehicle. Unfortunately, the "ITS interface" that is foreseen for this purpose is voluntary only and it is therefore questionable whether it will be able to fulfil its role.

However, the **availability of market-ready voluntary ITS applications** would be **decisive for the success** of an open in-vehicle platform. Those applications might be provided by the vehicle manufacturer or by third party suppliers, whereby the latter need to consider concerns of the vehicle manufacturers. **Competition may even be blocked** by the diverging interests of vehicle manufacturers who want to provide ITS services of their own and independent from third party service providers.

Appropriate regulatory requirements and technical standards could **trigger** the deployment of an open in-vehicle platform and the development of voluntary ITS applications.

Based on the findings above, the following **7 recommendations addressing the EC** were given to facilitate development and realisation of a truly open in-vehicle platform architecture for heavy vehicles and to **support open and competitive markets** for road transport related telematics services:

1. **No hindrance for coexisting applications**

The EC is recommended to ensure that there are no elements in the technical specifications accompanying the respective regulations (EETS, DT, OBW) that may hinder the coexistence of these applications with one another on integrated devices.

Although one open multi-applications computer in the vehicle is deemed unrealistic, several second-best options are already on the market or will presumably be developed by the industry. Consider, for example, **multi-application devices**, where several applications are provided on a single platform. Legislation should not pose specifications or certification procedures that hinder the development of such devices (e.g. applications on an integrated device should be (re)certified independently from one another).

2. **Open access to vehicle resources**

The EC is recommended to create appropriate legal provisions such that vehicle resources, such as communication channels (e.g. DSRC, GSM-GPRS) and HMI components (display, controls) are openly accessible to any third party via a standardised and mandatory interface ("ITS connector").

Without an open access point for third party service providers, **the market of ITS service provision will be controlled by vehicle manufacturers** who enjoy a natural monopoly through their unique access to their in-vehicle networks. Ideally the EC should **act on a legislative basis and mandate open access** to in-vehicle resources, requiring in the legal document that specifications are developed for a standardised "ITS connector" and a standardised "ITS installation bay". Note that such an opening of interfaces and specifications has been achieved in the past for the **OBD interface** (esp. in private cars) and may serve as an example.

3. Clarify ownership of vehicle and movement data

The EC is recommended to create appropriate legal provisions such that vehicle and movement data produced by busses, trucks and trailers of an operator are openly accessible to and controlled by the operator and may freely be distributed to third parties with the prior consent of the operator. This applies both to open and unhindered access to data stored in the vehicle as well as to data stored centrally.

The EC should make **clear statements** as to the ownership of vehicle data, as several stakeholders may lay a **potential claim** to this ownership:

- *Consumer* (driver, transport company/operator): the party to whom the data relates
- *Vehicle manufacturer*: the party that enables the collection of the data
- *Service provider*: the party that provides the application based on the data
- *Authorities*: the party that triggers / mandates the collection of the data

Logically, the **transport company**, and for some personal data also the driver, owns the data and decides who has access, may store and process the data.

4. GNSS, DSRC and other communication modules generally accessible

The EC is recommended to give mandates to the European Standard Organisations (ESO) to develop interface specifications for the GNSS, DSRC and other communication modules to be generally accessible resources in heavy vehicles.

Duplication of modules with the same functionality should be **avoided**. The EC should therefore insist on having **one GNSS module** and **one DSRC module** in the vehicle, which are generally accessible by the applications requiring these functionalities. Requirements on the functionalities with respect to data format, data exchange, etc. should be derived from the respective legislation. The process of preparing GNSS and DSRC specifications for the revised DT provides for an excellent opportunity to develop standardised interfaces. Ideally, **common in-vehicle networks** should be used and **proper security** should be provided.

5. Security appropriate for regulatory applications

The EC is recommended to consider the highest conceivable security requirements when specifying general resources (e.g. DSRC or GNSS). The security level has to be appropriate for regulatory applications, being the ones with the highest security requirements.

There is **no "one size fits all" security model**, because each application has its own security needs. The task of the EC should be to focus **on cross-cutting issues** of the **regulatory applications**. It is necessary to ensure that the possible threats and vulnerable points on each layer of a common architecture are well understood to come up with appropriate solutions. This starts on the business layer (e.g. Who would be the beneficiary of an attack?) and goes down to the components layer (e.g. Where do we need cryptographic safeguarding?).

6. Free trusted Position, Velocity, Time

The EC is recommended to investigate whether the GNSS receiver should be defined as trusted and requiring certification under the Digital Tachograph regime.

GNSS might be seen as a **generic resource** in many in-vehicle applications. The EC should recognise the importance of both **trusted GNSS signals and receivers** and take appropriate actions surrounding the provision of signals free of charge and the certification of receivers.

7. Embrace the services paradigm also for regulatory applications

The EC is recommended to gradually move towards a services-based paradigm for regulatory applications. In a migration phase users may voluntarily opt for fulfilling their obligations through a services model instead of or in addition to the traditional process.

In view of an open in-vehicle platform architecture, **obvious benefits** of the new services paradigm are being assumed. With a focus on its functionality instead of the device itself, a concept lasts much longer, since it is **not bound** to relatively **short-lived technology**.

Although it is recognised that the legislative process is slow, the EC should **align** any new regulations with this **market trend** over time. In contrast to USA and Australia, it is **not anchored** in European thinking to work with the market and with service providers. One way forward to align with the **services-based market trend** is to allow for such services as **an option**, either replacing or additional to the original option.