SINTEF

SINTEF A24920- Unrestricted

Report

META – Specification of Automated Vehicle Control

Author(s)
Marit Kjøsnes Natvig
Tor Kjetil Moseng

SINTEF ICT
Software Engineering, Safety and Security
2013-09-24

SINTEF IKT
SINTEF ICT

Address:
Postboks 4760 Sluppen
NO-7465 Trondheim
NORWAY

Telephone:+47 73593000
Telefax:+47 73592977

postmottak.IKT@sintef.no
www.sintef.no
Enterprise /VAT No:
NO 948 007 029 MVA

KEYWORDS:
META,
Heavy vehicle control,
Decision support

Report

META – Specification of Automated Vehicle Control

VERSION
3.0

DATE
2013-09-24

AUTHOR(S)
Marit Kjøsnes Natvig
Tor Kjetil Moseng

CLIENT(S)
ITS Norway

CLIENT'S REF.
Trond Hovland

PROJECT NO.
102002330

NUMBER OF PAGES/APPENDICES:
55 pages , 1 Appendix

ABSTRACT

Current control routines of heavy goods vehicles are based on a kind of first-come-first-served approach with the help of the inspection operators experience and intuition. This report is a result from the Automated Vehicle Control activity in the META (More Efficient Transport with ARKTRANS) project. It provides a conceptual specification of an automatic vehicle control system where a decision support system supports the selection of vehicles for manual inspections. The decision support is based on state-of-the-art sensors and cameras that identify and measure passing vehicles and on use of vehicle and transport undertaking information from national and international registries. Consequently, the manual vehicle inspections can become more targeted and inspection resources can are used more efficient.

The ARKTRANS framework is used to document the automatic vehicle control in order to ensure a technology independent system specification and a common deployment across control stations in Norway.

PREPARED BY
Marit Kjøsnes Natvig
SIGNATURE

CHECKED BY
Audun Vennesland
SIGNATURE

APPROVED BY
Eldfrid Øvstedal
SIGNATURE

REPORT NO.	ISBN	CLASSIFICATION	CLASSIFICATION THIS PAGE
SINTEF A24920	978-82-14-05330-2	Unrestricted	Unrestricted

Document history

VERSION	DATE	VERSION DESCRIPTION
1.0	2012-06-26	Preliminary version
2.0	2012-08.20	Updated version
3.0	2013-09.24	Final version updated with input from NonStop

Table of contents

List of figures

1 Introduction

This report is established by the META (More Efficient Transport with ARKTRANS) project which is supported by the Norwegian Research Council. In META the ARKTRANS framework [1] is used as a tool and a methodology to specify 1) standardised information exchange within multimodal supply chains; and 2) a new national solution for automated support to heavy vehicle inspections. The last is addressed by this report.

1.1 ARKTRANS

ARKTRANS is a conceptual model of the transport sector. The roles of the stakeholders, their need for functionality, the processes that are carried out and the required information exchanges in these processes are described in a top down approach. ARKTRANS also represents a methodology for specification of ICT solutions for the transport sector. More details on ARKTRANS can be found in Annex A.

1.2 Automated support to vehicle control

In 2011 about 3600 vehicles were inspected in the Sør-Trøndelag County of Norway. Regulation violations were discovered in less than one third of the inspections. Due to capacity problems we assume that many vehicles with technical defects, driving and resting time violations, lack of insurance, etc. were passing the control stations while law-abiding vehicles were controlled. Due to awareness about on-going manual controls among drivers, we expect that some vehicles probably also take other routes to avoid the control station. Thus, the manual control cannot detect all law violations, and we do not know the real extent of such violations.

Law violation among heavy vehicles is a problem to the society. Many of the vehicles represent a safety risk; those with overweight cause considerable road wear; and they all carry out their business in competition with more law-abiding vehicles.

In META the Norwegian Public Road Authority (NPRA) has started data capturing trials with sensor technologies. The vehicles' registration numbers, along with physical characteristics of the vehicles are captured. This information gives indications on whether laws and regulations are violated or not. Based on these trials, META suggests a decision support solution. Possible law violations are detected and indicated to support the selection of vehicles for manual inspection. The solution is also adapted to on-going national and European initiatives.

1.3 About the document

This document is a functional and conceptual specification of a solution for automated support to vehicle controls where the focus is on decision support to inspection operators. The document identifies both existing functions as well as possible future extensions that may be realized with the introduction of new technology, governmental directives and regulations.

To allow for a national deployment of automated support to vehicle controls, the ARKTRANS framework is used to specify the stakeholder roles, activities involved, interfaces and information flows involved. By following the ARKTRANS methodology, a common and holistic solution is ensured – a solution that uses open information interfaces between the systems. When possible, the information exchange is defined by means of European standards like DATEX.

This report is structured both to be read from beginning to end and to be used as a reference to find details about specifics of the systems. However, there is a logical overall structure to the document, from describing the different physical systems to which interactions they have and what information they exchange. The document includes the following sections:

- Chapter 2 provides an overall system overview with the physical components that interact to solve the overall task of automatic vehicle control.
- Chapter 3 defines the relevant roles that shall fulfil the required responsibilities and their relation to the ARKTRANS Reference Model.

- Chapter 4 defines the functional view. The relevant use cases are identified.
- Chapter 5 defines the process view. A hierarchical description of processes and their activities are provided. The processes are described according to the methodology defined by ARKTRANS, as described in Annex A.
- Chapter 6 defines the information view. The information content of the information flows in the process view is defined, along with the service interfaces to be used.
- Chapter 7 describes implementation aspects relating to the solution described in this report.
- Annex A describes the notation and approach used.

2 System overview

The most essential system in the automated support to vehicle controls is the decision support system (DSS). It delivers information on control candidates to the control system which is used by the inspection operators during manual controls. The decision support system depends on information from other systems to be able to do an assessment of the passing vehicles – the more information sources, the better. Figure 1 shows a schematic view on the decision support system and its relations to the other systems. Each system is described below.

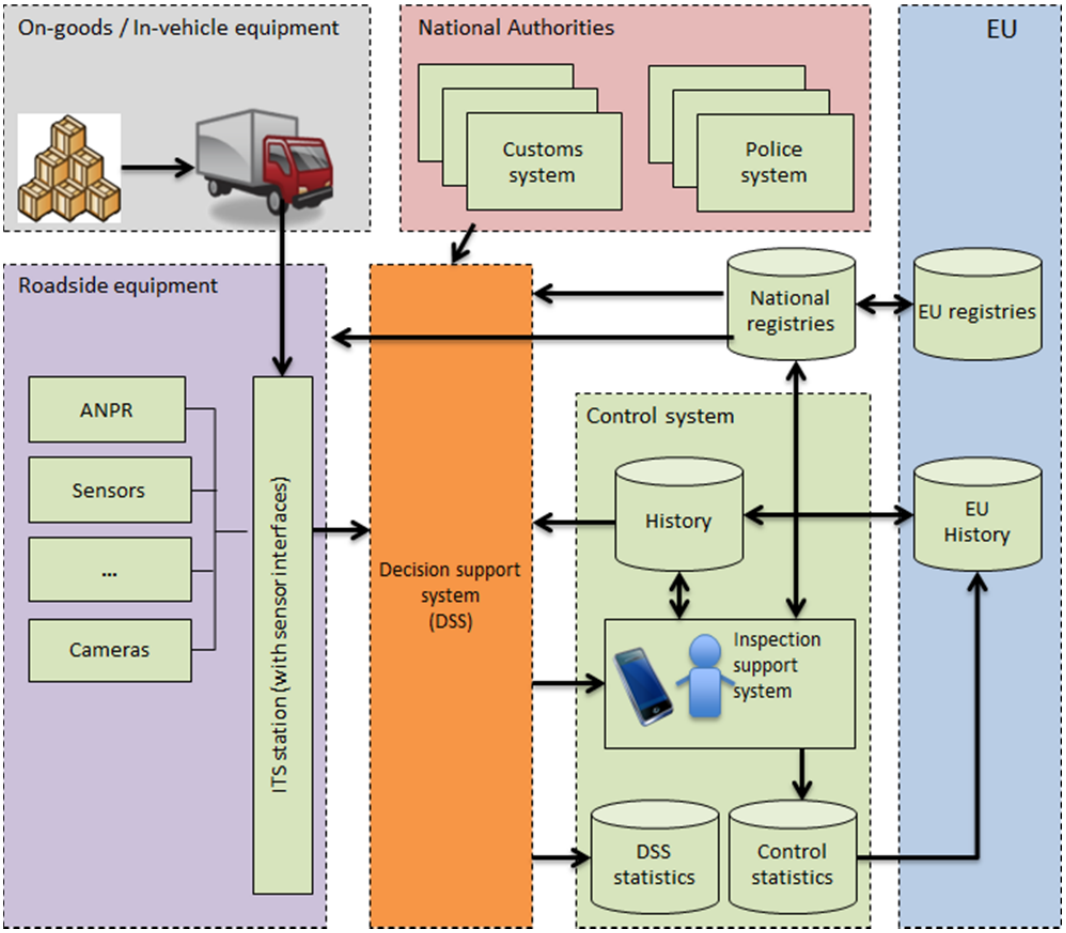

Figure 1: System overview

2.1 Roadside equipment

The roadside equipment is sensors and cameras that captures data about the vehicles and an ITS station that will interface the sensors, fuse the information from several sensors and prepare the fused sensor information for transmission to the decision support system. In the future the ITS station will also have roadside antennas receiving information directly from vehicle. This may for example be electronic registration book information and driving resting times. By means of the information collected by the roadside equipment it is possible to identify and give physical characteristics of the passing vehicle (e.g. weight, height, length, brake temperature on each axle, etc.).

2.2 Decision support system

The decision support system does an assessment of available information about all passing vehicles, and based on pre-defined rules, vehicles that are candidates for a manual control are identified. The system compares data from roadside equipment with vehicle information in national registries to detect divagations, and the system may also check for any unresolved issues like lack of tax payments and insurances. In addition, the vehicle's control history and reports from authorities like police and customs may be consulted for an even better assessment. Information on the identified control candidates is further sent to the control

system. Note that the decision support system only indicates law violations. The indications must be checked and validated by manual controls to be legally valid.

2.3 National registries

National registries (e.g. AutoSys) will hold information on drivers, vehicles and transport undertakings, among others registration information and information on fulfilment of duties such as insurance, taxes, etc.

2.4 Control system

The control system is a collection of sub-systems that supports the manual inspection and the management of control related information.

- The inspection support system presents the indications from the decision support system to the inspection operator to support the selection of control candidates. During an inspection, any information needed by the inspection operator will be retrieved from the control history and national registries, and the documentation of results from the manual inspections is also supported.
- The control history stores the results for the manual inspections of vehicles and drivers. Note that the use of this control history must be managed according to national laws and regulations.
- The control statistics is statistics from the manual controls
- The DSS statistics is statistics from the findings of the decision support system. The DSS statistics may provide valuable knowledge on law violations outside the times of manual inspections and may also support the tuning of sensors.

2.5 On-goods / In-vehicle equipment

Goods related information, transport related information, driver related information and vehicle related information might in the future be communicated electronically from in-vehicle equipment. Currently, the inspection operator must manually acquire such information. Current European directives on electronic exchange of registration book information will be deployed in the near future, and the future may hold for a more extensive automatic exchange of this type of information – e.g. to the ITS station.

2.6 National authorities

Information from national authorities includes information from the customs and the police. Such information can indicate violations on laws and regulations and other issues that require the vehicle to be stopped. Most likely, the use of such information will require that the authorities themselves are present during the manual inspections.

2.7 EU

As vehicles and drivers are not restricted to national borders, information exchange on foreign registered vehicles and drivers is required. The same goes for domestic registered vehicles and drivers that operate abroad. European standards and directives will guide the information exchange across borders. Such information exchange with European countries is defined by the EUCARIS and ERRU initiatives.

3 Reference model and roles

The heavy vehicle solution is described by means of the ARKTRANS framework to facilitate a mapping of the solution into a generic and holistic representation of the transport sector. This will make it easier to relate the solution to other systems and solutions that also are defined by means of the ARKTRANS framework.

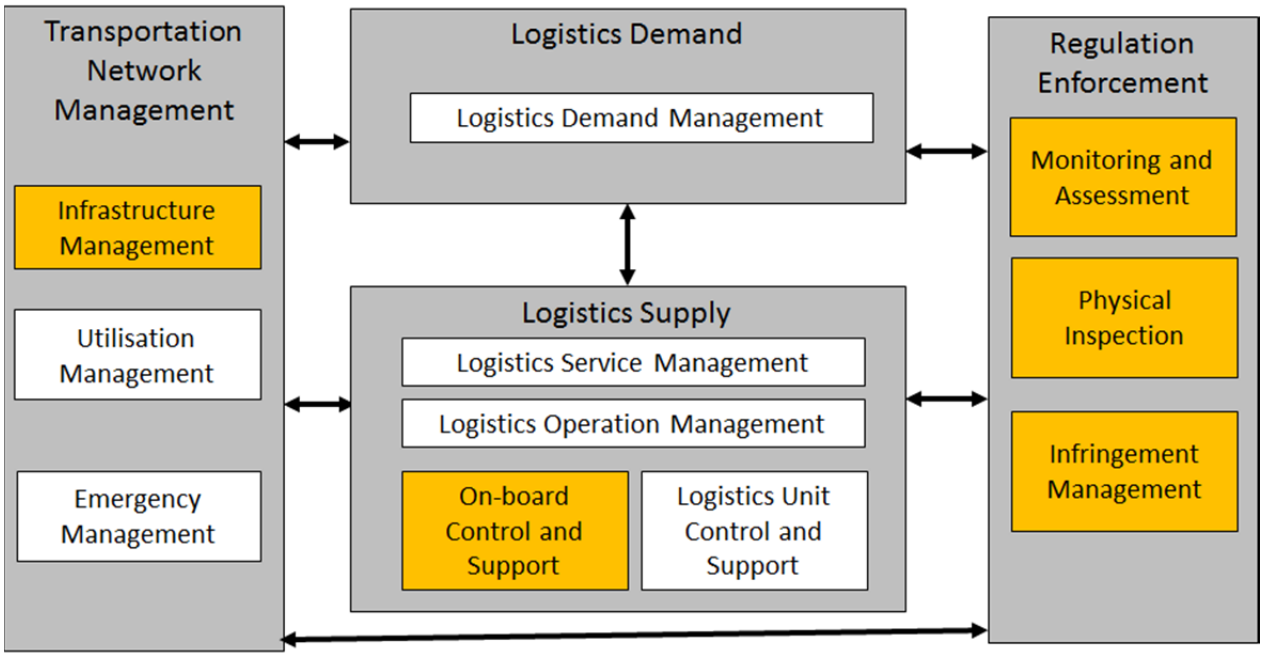

Figure 2 ARKTRANS Reference model med relevant domain highlighted

The ARKTRANS Reference Model in Figure 2 divides the transport sector into manageable domains, and the domains of relevance to heavy vehicle controls are highlighted. According to ARKTRANS each domain addresses a set of responsibilities. The relations between the highlighted domains, the system components in Figure 1 in Chapter 2 and the responsibilities of relevance to automated support to vehicle controls are as described by Table 1.

Table 1 Relation between Reference model and Chapter 2

Domain in Reference Model	Relation to system overview in Figure 1 |	Responsibility description
Transportation Network Management • Infrastructure Management	- Roadside equipment	Continuous operation of road network, roadside equipment like sensors and ITS stations (hardware and software) included.
Logistics Supply • On-board Control and Support	- On-goods / In-vehicle equipment	Operation of the vehicle and provision of vehicle related information.
Regulation Enforcement • Monitoring and Assessment	- National Registries	Approval of transport means and drivers according to laws and regulations and management and provision of related information.
Regulation Enforcement • Physical Inspection	- Control System - Decision Support	Heavy vehicle inspections, decision support included.
Regulation Enforcement • Infringement Management	- National Authorities	Management of infringement information. Authorities like police and customs may provide information on vehicles that are to be stopped.

The responsibilities of a domain are fulfilled by one overall role that may be decomposed into more detailed roles. Each role is related to just domain. In real life a role will be implemented by an actor (person or organisation) or by a system operating on behalf of an actor. The roles of relevance to heavy vehicle controls are described in Table 2. In most cases ARKTRANS roles can be used. Two detailed roles related to vehicle inspections are however added.

Table 2: Involved roles in automated vehicle control

Domains	Role hierarchy	Responsibilities	Actors
Transportation Network Management - Infrastructure Management	Transportation Infrastructure Manager (ARKTRANS role)	Operation of physical road network, roadside equipment included.	• NPRA
Logistics Supply - On-board Control and Support	On-board Manger (ARKTRANS role)	Operation of the vehicle and adaption to traffic situation, laws and regulations. Provision of information about driver, vehicle, transport company and cargo.	• Driver
Regulation Enforcement	Transport Regulator (ARKTRANS role)	Authority tasks. For details - see below.	• NPRA • Road administration of foreign countries
Regulation Enforcement - Monitoring and Assessment	License Authority (ARKTRANS role)	Issuing licences and certificates to persons or companies, monitoring of qualifications and related enforcement of laws and regulations. Management of related registries.	
	Transport Means Regulatory Authority (ARKTRANS role)	Approval and certification and registration of Transport Means to ensure adherence to safety regulations and related enforcement of laws and regulations. Management of related registries.	
Regulation Enforcement - Physical Inspection	Transport Means Inspection Authority (ARKTRANS role)	Inspection of transport means, crew and cargo to ensure that the required certificates are in place and adherence to safety regulations.	
	Transport Means Inspection Manager	Overall management of inspections, information management included.	
	Transport Means Inspection Operator	Execution of individual inspections.	
Regulation Enforcement - Infringement Management	Executive Authority (ARKTRANS role)	Regulation enforcement by means of sanctions and infringement.	Misc. authorities. E.g. • Police • Customs • Immigration authority • Health authority • Agricultural authority • Veterinary authority
	Civil Law Authority (ARKTRANS role)	Provision of input to vehicle controls on infringements or possible infringements and actions towards vehicles, e.g. • Police reports • Customs info • Etc.	
	Customs Authority (ARKTRANS role)		
	Immigration Authority (ARKTRANS role)		
	Health Authority (ARKTRANS role)		
	Agricultural Authority (ARKTRANS role)		
	Veterinary Authority (ARKTRANS role)		

4 Functional view

Figure 3 illustrates the overall use cases related in the transport sector, as defined by the domains of the ARKTRANS Reference Model. Those addressed by META are in green, and the actors addressed by META are also included. The green use cases are further decomposed below.

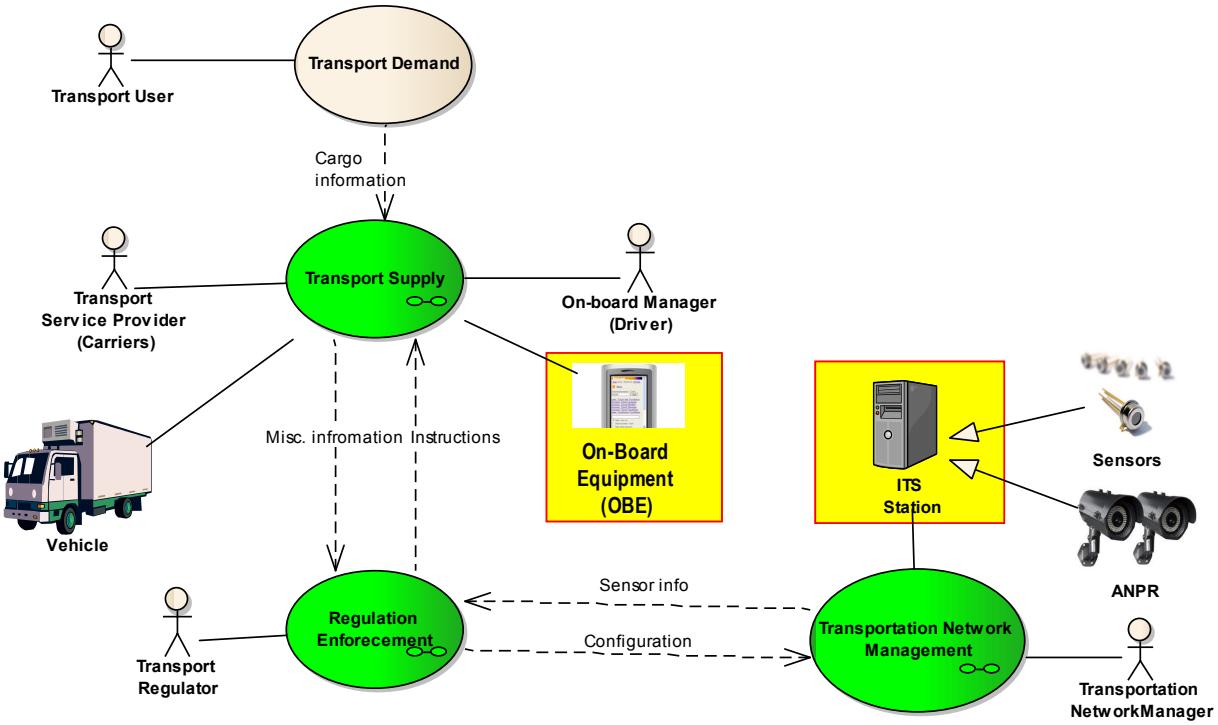

Figure 3: Overall use cases

4.1 Transport Supply use cases

The Transport Supply use case addresses the provision of transport services. In META only On-Board Control and Support is of relevance since on-board equipment in the future may provide information about the vehicle, the driver and the cargo.

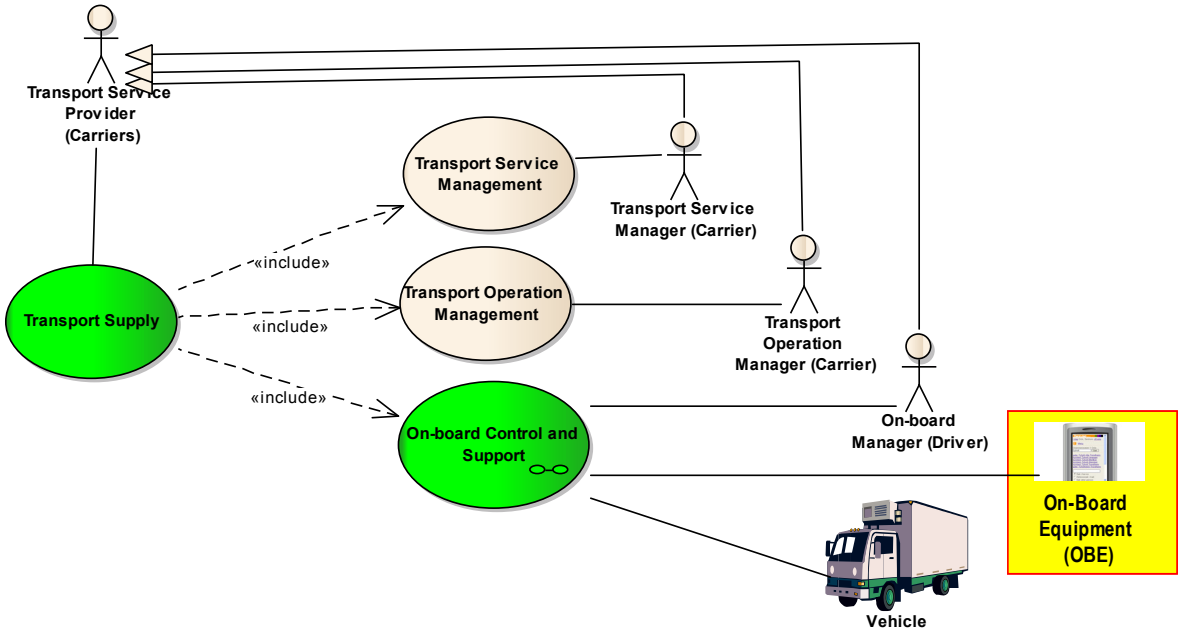

Figure 4: Transport Supply use cases

4.2 Transportation Network Management use cases

The Transportation Network Management use case addresses the management of the transportation infrastructure, and it is decomposed in Figure 5. In META the focus is on the continuous operation of the ITS Station.

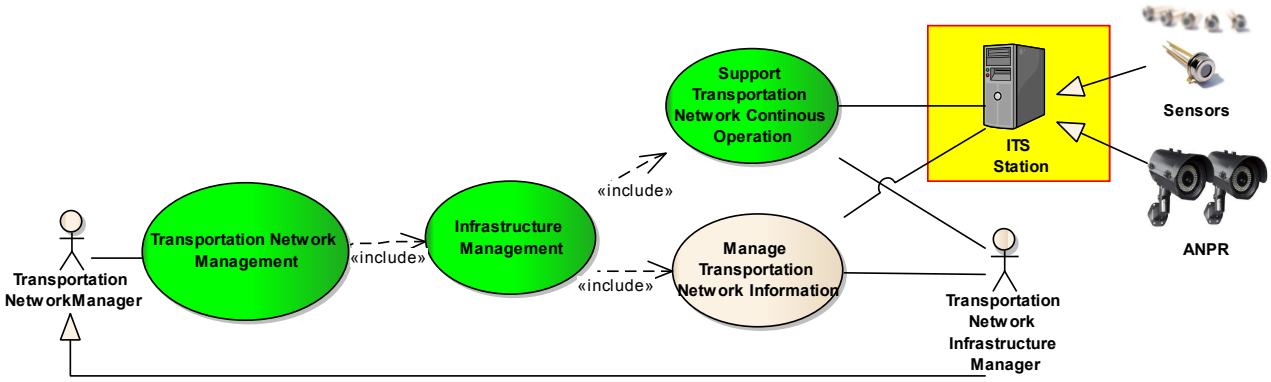

Figure 5: Transportation Network Management use cases

4.3 Regulation Enforcement use cases

The main focus of META is the Regulation Enforcement use case and the associated roles as illustrated in Figure 6. The physical inspection is main focus of this report. To support views at different abstraction levels, the physical inspection is further decomposed as illustrated in Figure 7. The highlighted functionality is further explored and described together with the process diagrams in Chapter 5.

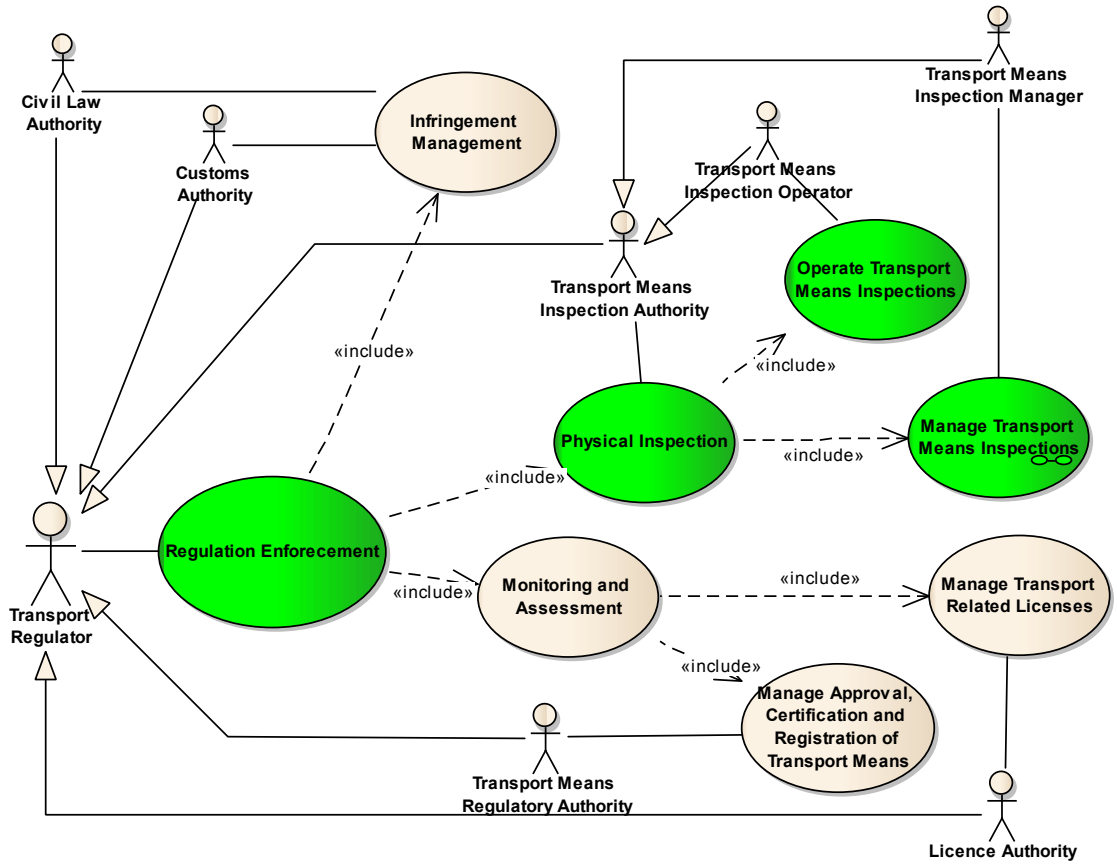

Figure 6: Regulation Enforcement use cases

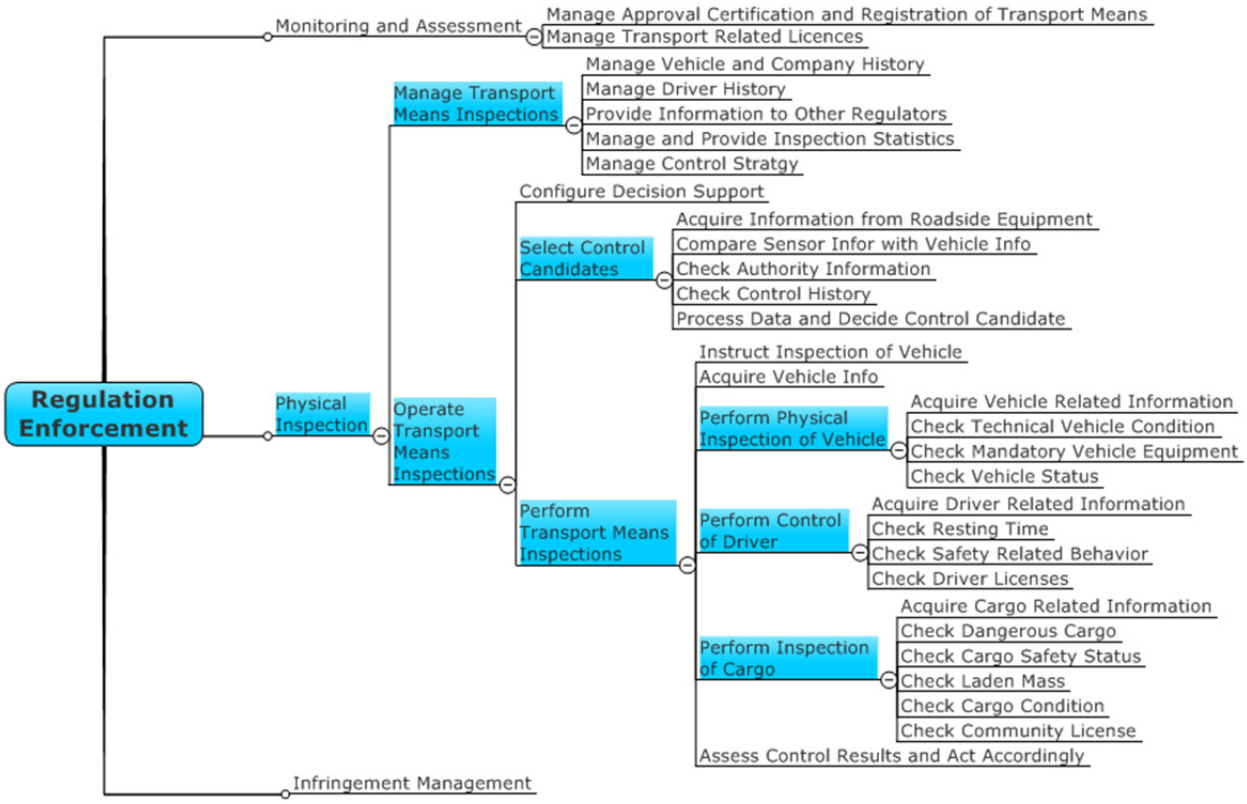

Figure 7: Regulation Enforcement decomposition

5 Process view

Figure 8 shows the overall process with high level activities related to the domains of the Reference Model. The information flows between the activities are also included. They are specified in Chapter 6.

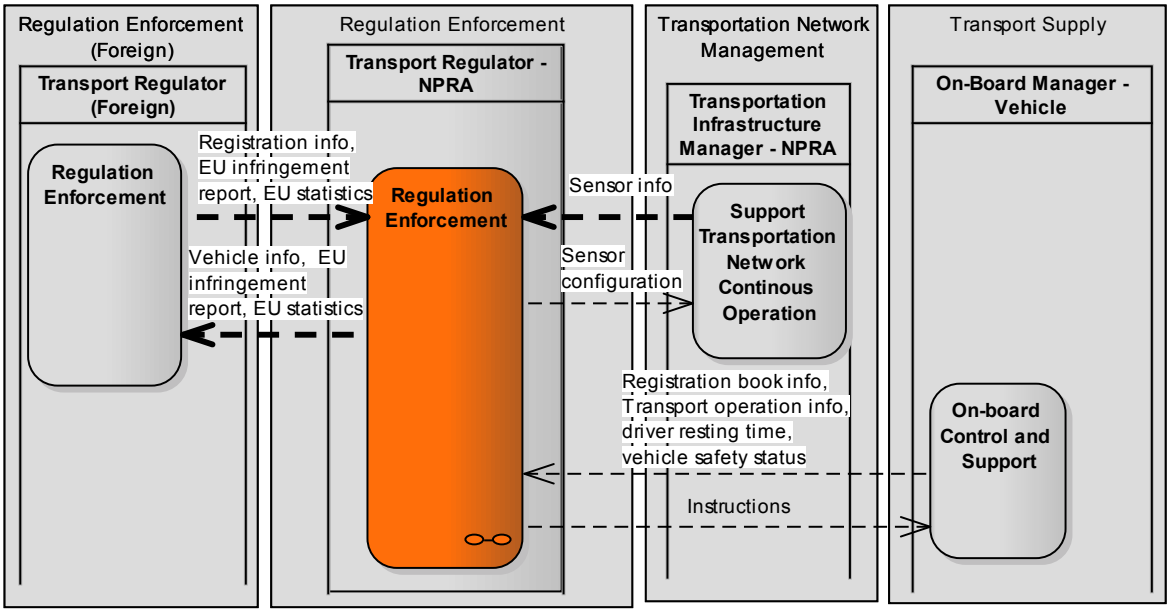

Figure 8: Overall processes

Activity	Description
Support Transportation Continuous Operation	The activity belongs to the Infrastructure Management domain of the Reference model and addresses the operation of the roadside equipment. The activity is not further decomposed as this activity is not addressed by META. However, the activity has to ensure the continuous operation of the equipment so that it can deliver sensor information to the Regulation Enforcement domain. Note however that the configuration of the equipment is a task for the Transport Regulation domain as described in 5.1.2
On-board Control and Support	The activity is not further decomposed as the main focus in META is not on the in-vehicle systems. These systems must however provide information needed by the Regulation Enforcement domain.
Regulation Enforcement (Foreign)	Included to illustrate the international aspect. This will conceptually be equal to the national activity which is decomposed in section 5.1.
Regulation Enforcement	See section 5.1 for more details.

Information in the information flows is provided by the sections below.

5.1 Regulation Enforcement

Regulation Enforcement handles all the activities of the *Transport Regulator* role, including the transport means inspection itself, but also the management of control and inspection data, registered vehicle data and driver licenses. Figure 9 shows the Transport Regulation activities, their responsible roles and interactions.

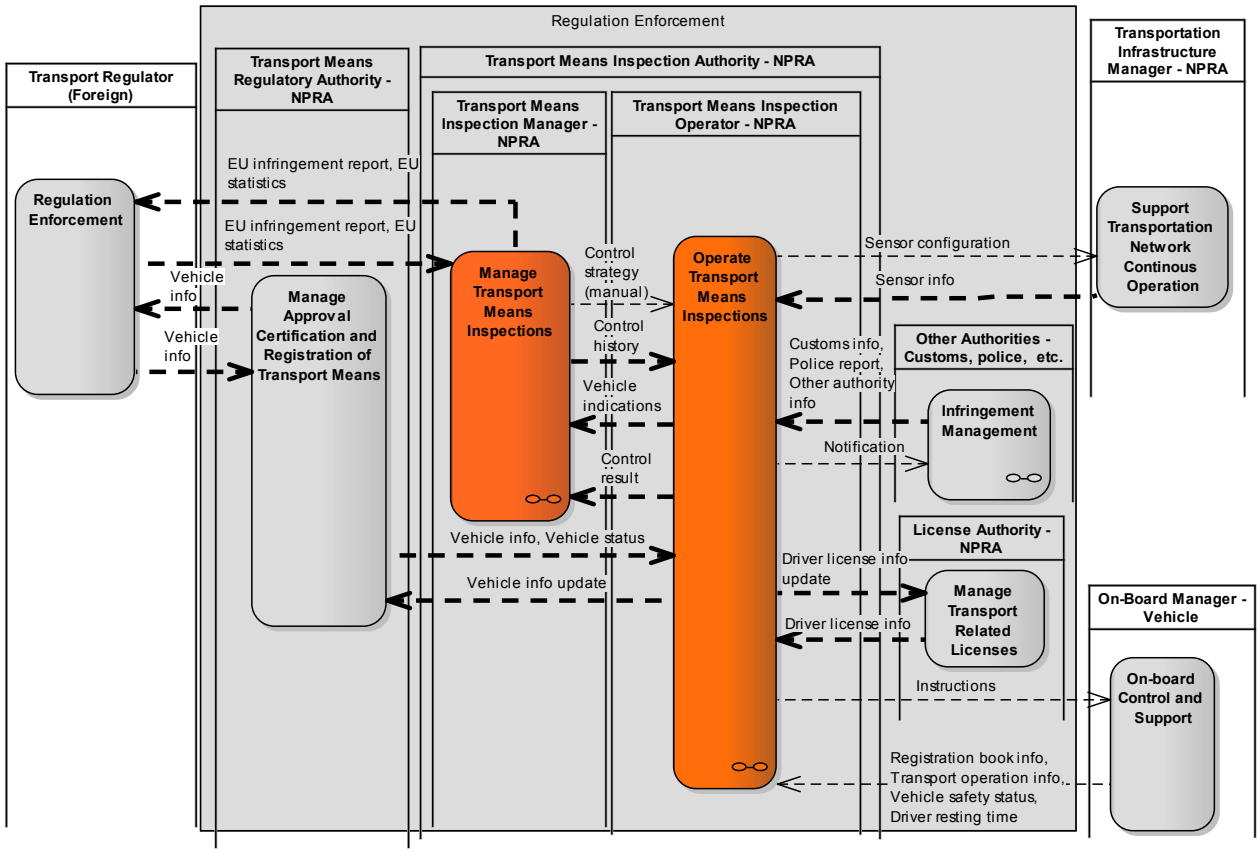

Figure 9: Regulation Enforcement overall process

Activity	Description
Manage Approval Certification and Registration of Transport Means	The activity is the responsibility of the *Transport Means Regulatory Authority*. It manages all registered vehicle information as well as associated information on statuses related to among others insurances and yearly road tax. This information is used during the inspections.
Manage Transport Means Inspection	Further decomposed and described in 5.1.2
Manage Transport Related Licenses	The activity is the responsibility of the *License Authority* and manages licenses related to the cargo and vehicle handling. This information is used during the inspections.
Operate Transport Means Inspections	Further decomposed and described in 5.1.2.
Infringement Management	Several authorities may provide input to and receive information from vehicle controls. The Civil Law Authority and Customs Authority roles are of most relevance, but others such as Immigration Authority, Health Authority, Agricultural Authority and Veterinary Authority may also be involved. The authorities will normally not be involved. However, there can be situations that require an interaction, and all parties can initiate an interaction.

Information flow	Content description
Control history	Control results from previous controls (e.g. infringement information, number of serious infringements and total number of infringements) for driver, vehicle and transport undertaking. See Table 3 in Section 6.1.1.

Control result	Individual control results (and infringements). See Table 3 in Section 6.1.1.
Control strategy	Manual exchange of information about the control strategy to be followed
Customs info	Information from customs authority on issues related to a vehicle. See Table 4 in Section 6.1.2.
Driver license info	Information about driver licenses. See Table 3 in Section 6.1.1.
Driver license info update	Update of driver license information, e.g. confiscation of driver license. See Table 3 in Section 6.1.1.
Driver resting time	Information about driver resting time. See Table 5 in Section 6.1.3.
EU infringement report	Information on infringements related to European vehicles. See Table 4 in Section 6.1.2.
EU statistics	Statistics according to European requirements. See Table 4 in Section 6.1.2.
Instruction	Instructions to the driver from the operator doing the control. See Table 5 in Section 6.1.3.
License info	Information about driver licenses. See Table 3 in Section 6.1.1.
Notification	Manual notification to relevant stakeholders on control results. See Table 5 in Section 6.1.3.
Other authority info	Information from authority on issues related to a vehicle. See Table 5 in Section 6.1.3.
Police report	Information on vehicles involved in criminality (e.g. stolen vehicles). See Table 4 in Section 6.1.2
Registration book info	Information stored in the registration book. See Table 4 in Section 6.1.2.
Sensor configuration	Configuration of the sensor system. See Table 4 in Section 6.1.2
Sensor info	Sensor measurements and control results for a vehicle derived automatically from sensor data. See Table 3 in Section 6.1.1.
Transport operation info	Information about cargo, origin of cargo, destination, etc. See Table 5 in Section 6.1.3.
Vehicle indications	Results from decision support system according to its configuration. See Table 3 in Section 6.1.1.
Vehicle info	Vehicle registration info, and transport undertaking information (community licenses included). See Table 3 in Section 6.1.1.
Vehicle info update	Update of registration information and undertaking information, e.g. removal of number plates or suspension information. See Table 3 in Section 6.1.1.
Vehicle safety status	Safety-related information, e.g. dangerous goods information and status information on vital functions. See Table 4 in Section 6.1.2.
Vehicle status	Information on fulfilment of duties. See Table 3 in Section 6.1.1.

5.1.1 Manage Transport Means Inspections

The *Transport Means Inspection Authority* role is responsible for the *Manage Transport Means Inspection* activity, which manages the control results received from the inspection operator, as well as exchanging information with foreign inspection managers. The inspection manager manages and provides information from inspections both at an aggregated and individual level. Figure 10 shows the included activities.

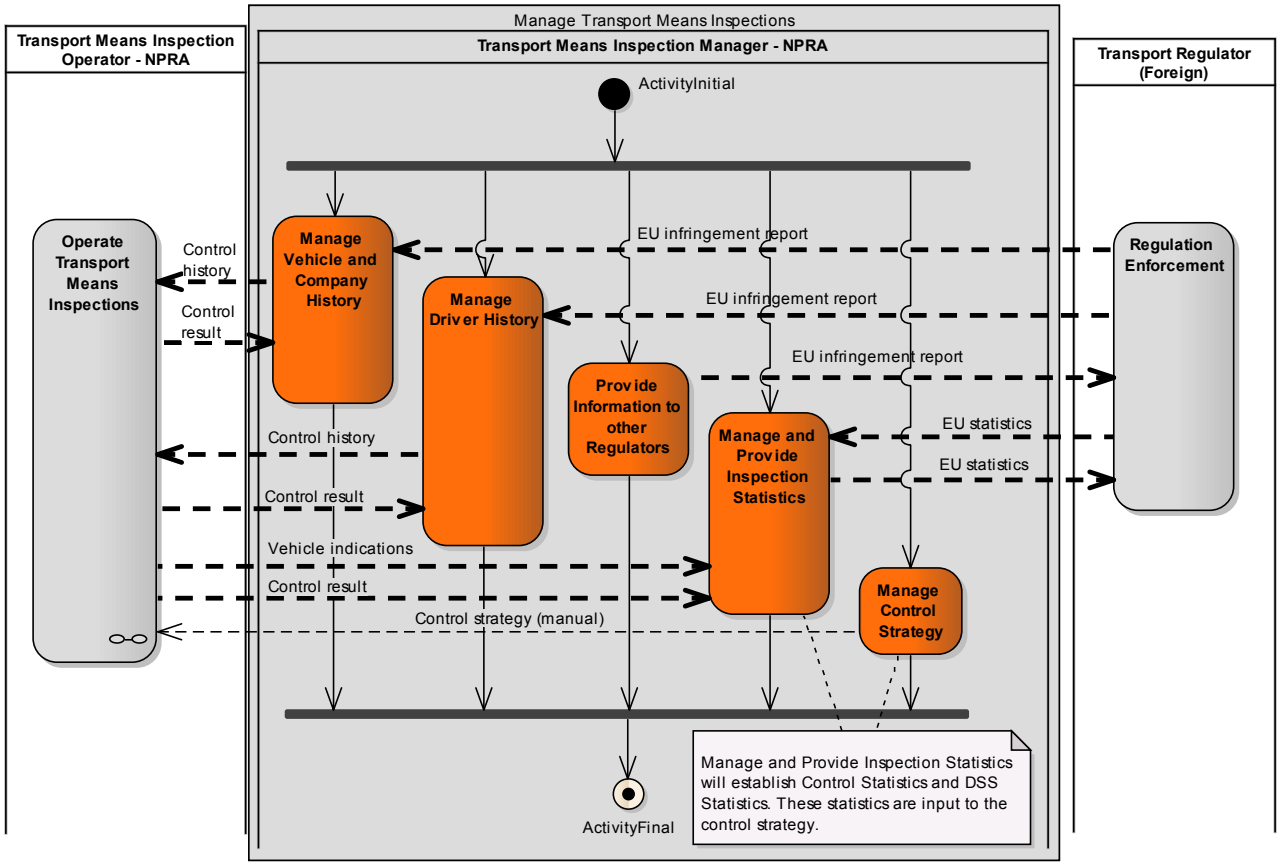

Figure 10: Manage Transport Means Inspections activities

Activity	Description
Manage and Provide Inspection Statistics	Manages and exchanges aggregated vehicle indications and control results as statistics. The vehicle indications will be the basis for the DSS Statistics. The results from manual control will be the basis for the Control Statistics. Will also provide and receive EU statistics according to EU directives.
Manage Control Strategy	The Control Statistics and DSS Statistics are managed, and they provide input to the control strategies. Based on observed patterns and predictions, the inspection manager may for future vehicle controls tune parameters like when, what and where for even more targeted vehicle controls.
Manage Driver History	Control results on the drivers are received and managed and may be used in future controls.
Manage Vehicle and Company History	Control results on the vehicle and company are received and managed. This information may be used in future control, both by the decision support system (e.g. vehicles with more than two negative incidents in the last ten controls will have a higher probability of being stopped), and by the inspection operators during the manual inspections (e.g. recent discovered faults may lead to a stronger reaction if discovered again).
Provide Information to other Regulator	If required, information about foreign registered vehicles, companies and drivers is acquired from foreign transport regulators. Domestic registered history and infringements by foreign vehicles, companies and drivers are provided to foreign regulators.

Information flow	Content description
Control history	Control results from previous controls (e.g. infringement information, number of serious infringements and total number of infringements) for driver, vehicle and transport undertaking. See Table 3 in Section 6.1.1.
Control result	Individual control results (and infringements). See Table 3 in Section 6.1.1.
Control Statistics (not visible in diagram)	Statistics from manual controls. See Table 3 in Section 6.1.1
Control strategy	Manual exchange of information about the control strategy to be followed
DSS Statistics (not visible in diagram)	Not in diagram. Managed by the Manage and Provide Inspection Statistics activity. Statistics from decision support findings. See Table 3 in Section 6.1.1.
EU infringement report	Information on infringements related to European vehicles. See Table 4 in Section 6.1.2.
EU statistics	Statistics according to European requirements. See Table 4 in Section 6.1.2.
Vehicle indications	Results from decision support system according to its configuration. See Table 3 in Section 6.1.1

5.1.2 Operate Transport Means Inspections

The *Transport Means Inspection Operator* role is responsible for the *Operate Transport Means Inspections* activity. The objective of this activity is to decide which vehicles to stop for further inspection, and to actually inspect the vehicle. Based on the control strategy and findings during the control, also the driver and cargo may be controlled.

Figure 11 shows that the inspections are performed in parallel to the control candidate selection, which will run automatically as a decision support system and indicate possible infringements.

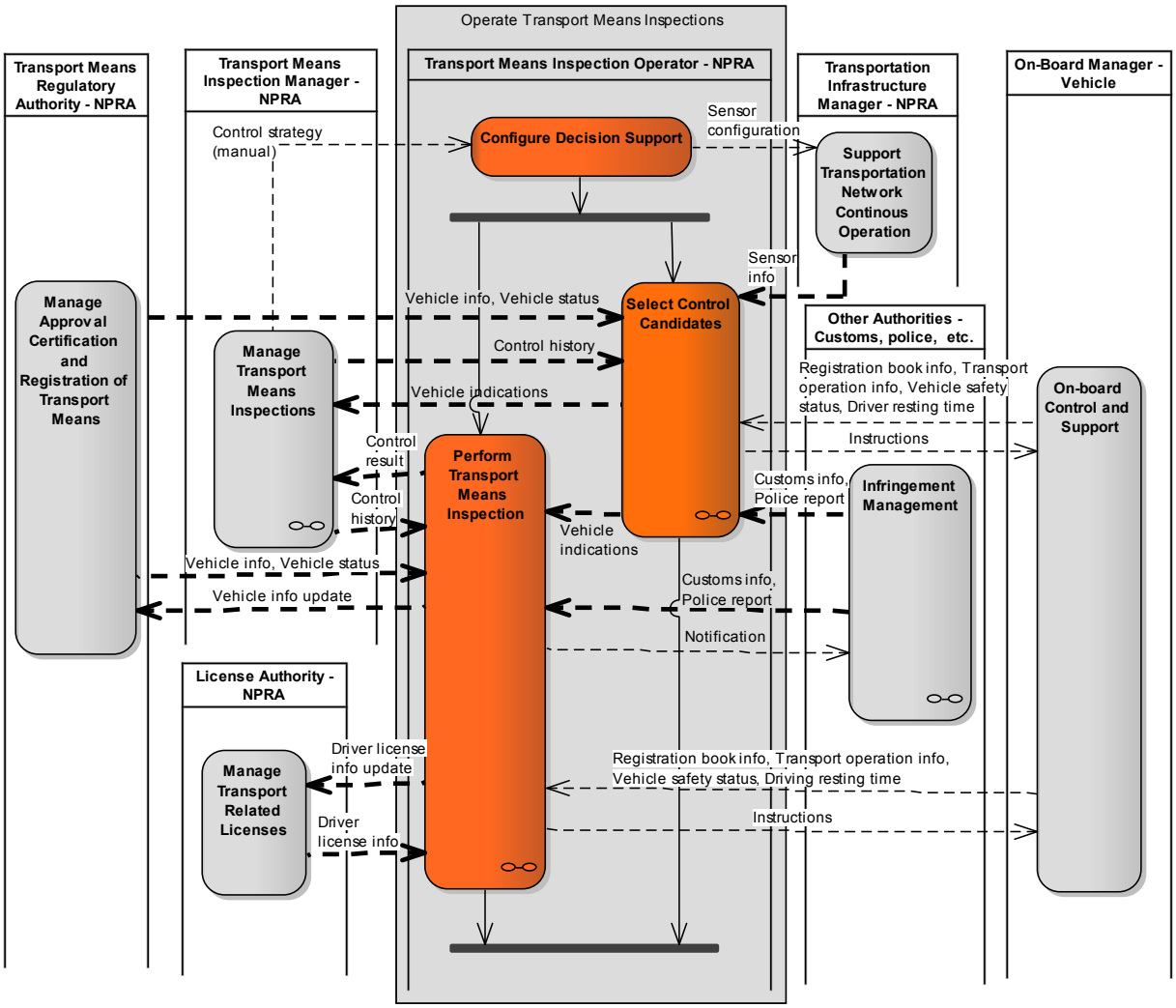

Figure 11: Operate Transport Means Inspection activities

Activity	Description
Configure Decision Support	The activity receives configuration information from the inspection manager on which sensor values to register, which triggers that are attached to the values (i.e. the configuration of the automated indications of infringements), and what and how to report on possible infringements. The sensor systems must be configured accordingly.
Perform Transport Means Inspection	Further decomposed and described in 5.1.2.1.
Select Control Candidates	Further decomposed and described in 5.1.2.2.

Information flow	Content description
Control history	Control results from previous controls (e.g. infringement information, number of serious infringements and total number of infringements) for driver, vehicle and transport undertaking. See Table 3 in Section 6.1.1.
Control result	Individual control results (and infringements). See Table 3 in Section 6.1.1.
Control strategy	Manual exchange of information about the control strategy to be followed. See Table 5 in Section 6.1.3
Customs info	Information from customs authority on issues related to a vehicle. See Table 4 in Section 6.1.2.
Driver license info update	Update of driver license information, e.g. confiscation of driver license. See Table 3 in Section 6.1.1.
Driver resting time	Information about driver resting time. See Table 5 in Section 6.1.3.
Instruction	Instructions to the driver from the operator doing the control. See Table 5 in Section 6.1.3.
License info	Information about driver licenses. See Table 3 in Section 6.1.1.
Notification	Manual notification to relevant stakeholders on control results. See Table 5 in Section 6.1.3.
Police report	Information on vehicles involved in criminality (e.g. stolen vehicles). See Table 4 in Section 6.1.2
Registration book info	Information stored in the registration book. See Table 4 in Section 6.1.2.
Sensor configuration	Configuration of the sensor system. See Table 4 in Section 6.1.2
Sensor info	Sensor measurements and control results for a vehicle derived automatically from sensor data. See Table 3 in Section 6.1.1.
Transport operation info	Information about cargo, origin of cargo, destination, etc. See Table 5 in Section 6.1.3.
Vehicle indications	Results from decision support system according to its configuration. See Table 3 in Section 6.1.1.
Vehicle info	Vehicle registration info, and transport undertaking information (community licenses included). See Table 3 in Section 6.1.1.
Vehicle info update	Update of registration information and undertaking information, e.g. removal of number plates or suspension information. See Table 3 in Section 6.1.1.
Vehicle safety status	Safety-related information, e.g. dangerous goods information and status information on vital functions. See Table 4 in Section 6.1.2.
Vehicle status	Information on fulfilment of duties. See Table 3 in Section 6.1.1.

5.1.2.1 Select Control Candidates

The aim of the *Select Control Candidates* activity is to suggest candidate vehicles for manual inspections based on acquired information from roadside sensors, in-vehicle systems (if available), control history and information from national registries and authorities. The activity is the responsibility of the *Transport Means Inspection Operator*, but is carried out automatically by the decision support system. Figure 12 shows the process, which is mainly split in three phases: acquire information, check information, and decide control candidates. Note that, given the control configuration, neither of the activities in this second phase may be performed (indicated by the direct control flow arrow).

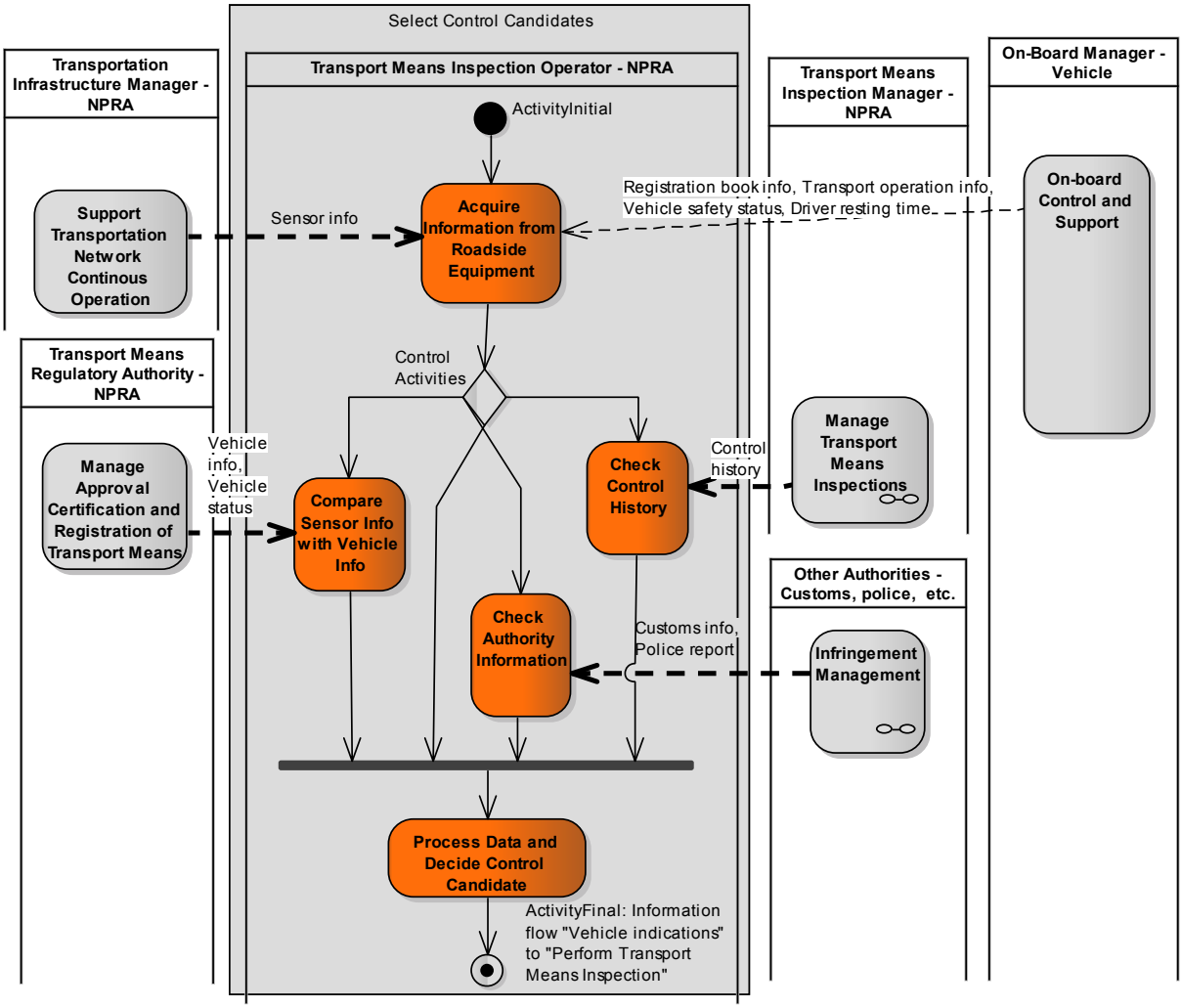

Figure 12: Select Control Candidates activities

Activity	Description
Acquire Information from Roadside Equipment	Acquires sensor information from the road-side equipment and/or Information from on-board equipment (OBE) in vehicles. The sensor information may for example be vehicle identification, vehicle length, vehicle height, vehicle width, vehicle axel weight, vehicle weight, vehicle break temperature, etc. Information on possible deviations that that are detected by the sensor systems may also be included. Information may be obtained directly from the OBEs. Such information may primarily relate to the vehicle and driver, but also cargo related information could be included.
Check Authority Information	Checks information gathered from authorities like the police and customs. Any report on the vehicle will thus make it more probable of being stopped (in cooperation with the authorities themselves).
Check Control History	Gathers information relating to any previous inspections of the vehicle. Previous negative incidents may indicate a higher probability of repeated infringements. The ControlHistoryDeviation indicator in the

	DeviationInformation in the Vehicle Control information model (see Figure 22 in section 6.2.5) is decided.
Compare Sensor Info with Vehicle Info	Looks up vehicle information in national registries and compares this information to the measured sensor values to discover any differences. Information on fulfilment of duties like payment of duty fee and insurance, periodic controls, registration fee, etc. is checked. Relevant parts of the SensorInformation and DeviationInformation in the Vehicle Control information model that is represented in Figure 22 in section 6.2.5 are decided.
Process Data and Decide Control Candidates	Processes the acquired information according to the configuration of the decision support to decide whether there are indications on infringements or not. The output produced by the activity is vehicle indications. (The final decision on stopping a vehicle is however the inspection operators' responsibility). Note that the NonStop project has specified decision rules related to some types of infringements.

Information flow	**Content description**
Control history	Control results from previous controls (e.g. infringement information, number of serious infringements and total number of infringements) for driver, vehicle and transport undertaking. See Table 3 in Section 6.1.1.
Customs info	Information from customs authority on issues related to a vehicle. See Table 4 in Section 6.1.2.
Driver resting time	Information about driver resting time. See Table 5 in Section 6.1.3.
Police report	Information on vehicles involved in criminality (e.g. stolen vehicles). See Table 4 in Section 6.1.2
Registration book info	Information stored in the registration book. See Table 4 in Section 6.1.2.
Sensor info	Sensor measurements and control results for a vehicle derived automatically from sensor data. See Table 3 in Section 6.1.1.
Transport operation info	Information about cargo, origin of cargo, destination, etc. See Table 5 in Section 6.1.3.
Vehicle indications	Results from decision support system according to its configuration. See Table 3 in Section 6.1.1.
Vehicle info	Vehicle registration info, and transport undertaking information (community licenses included). See Table 3 in Section 6.1.1.
Vehicle safety status	Safety-related information, e.g. dangerous goods information and status information on vital functions. See Table 4 in Section 6.1.2.
Vehicle status	Information on fulfilment of duties. See Table 3 in Section 6.1.1.

5.1.2.2 Perform Transport Means Inspection

The *Perform Transport Means Inspection* activity represents the manual vehicle inspection performed by the *Transport Means Inspection Operator*. The indications from the decision support system (i.e. *Vehicle indications*) are used along with other information to detect and act upon possible infringements. Figure 13 shows the parallel handling of vehicle, driver and cargo, and the handling of final control results.

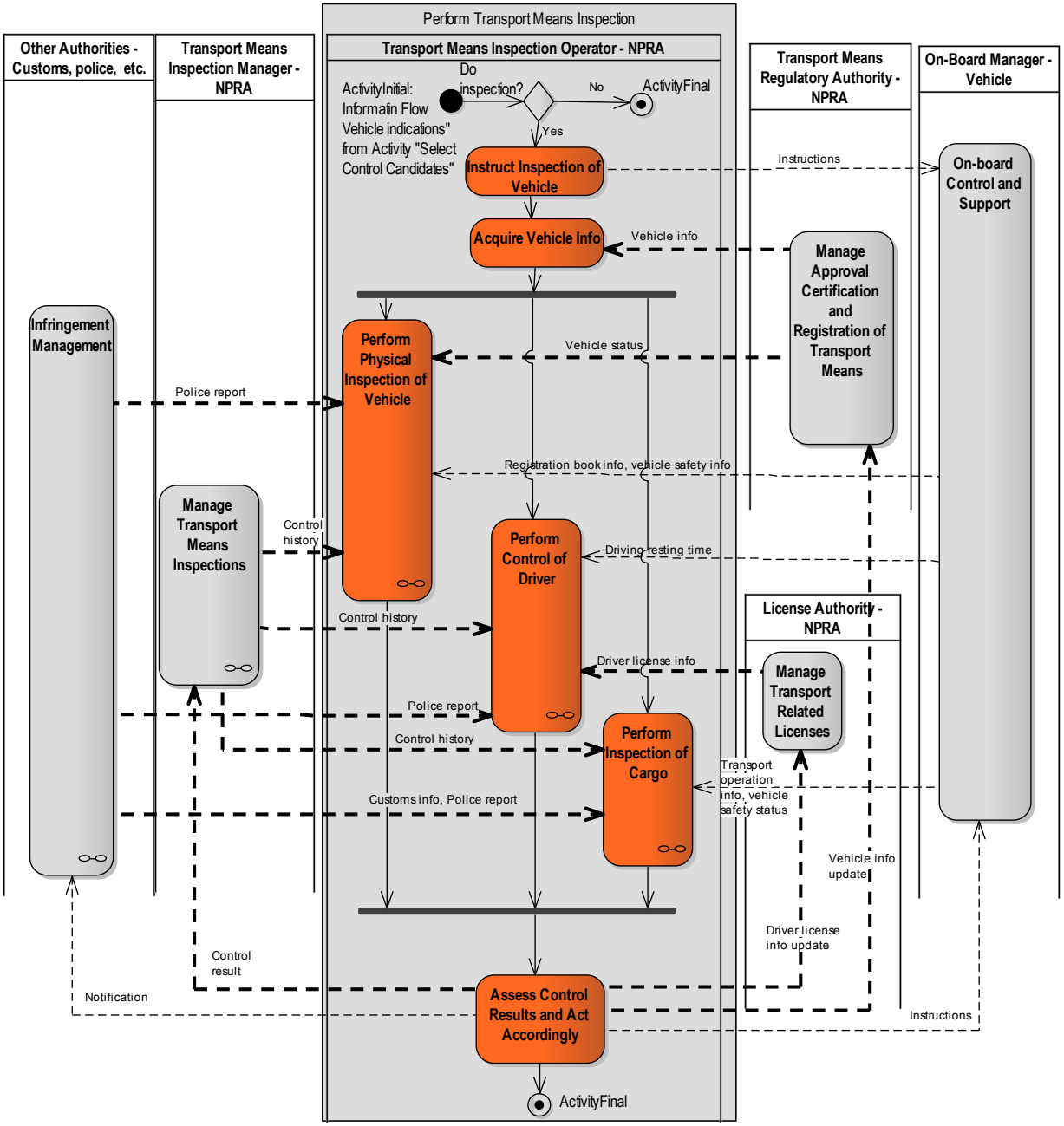

Figure 13: Perform Transport Means Inspection activities

Note that the information flows between the activities of the Perform Transport Means Inspection process are not depicted. Information being acquired in one activity, e.g. the Vehicle info, is assumed to be available to the other activities as well.

Activity	Description
Acquire Vehicle Info	As a pre-activity to the actual inspection and control, the inspection operator will get all registered technical information (i.e. not duty and other payment information) about the specific vehicle from the

	vehicle registry. Such information is essential for the further process and is beneficial to have in hand before contacting the vehicle's driver(s).
Assess Control Results and Act Accordingly	After the inspections and controls necessary, the control results are aggregated and further actions to be taken by the Inspection Operator are considered and decided. All individual control results are sent to the inspection manager (i.e. the *Transport Means Inspection Manager*), while notifications and possibly updates are sent to different authorities and registers as illustrated in Figure 13. The driver's further action is given by the instructions, which format may be a vocal message from the inspection operator, or an electronic message with the possibility to specify waiting area, waiting time, etc.
Instruct Inspection of Vehicle	The inspection operator will, based on the *Vehicle indications* from the decision support system, instruct a vehicle to stop or not. The instructions may be done manually or by electronic communication with the driver (in the future).
Perform Control of Driver	Necessary information, in addition to the Vehicle info which is assumed to be available is acquired. The indications from the decision support system and the inspection itself will guide the information acquisition. The following information may be acquired and consulted: • The control history related to the driver. Earlier violations, if any, should cause new checks. A negative history may also indicate a driver's attitude towards regulations and rules. . Note that the use of control history will depend on national laws for storing and using such data. • License information may be obtained from the License Authority. This includes licenses for operating the vehicle, any associated equipment (e.g. crane) and loaded cargo (e.g. dangerous cargo). • Authority information concerning the driver. It may for example report on issues related to the driver (e.g. criminal records, run away, etc.). In most cases, it is a requirement that the authorities (i.e. the police) are present when using such information. • Resting time information. Such information may be received directly from the vehicle itself. Any exchange of electronic information will require some kind of OBE in the vehicle. OBEs' handling a driver's resting time and sharing this is a probable future scenario – especially in the context of all the erroneous resting times reported around. Information exchange with OBE opens also for acquisition of license information as currently gathered from the License Authority, as mentioned above. The indications from the decision support system, the acquired information and observations done by the inspection operator may trigger the controls of: • Drivers' licenses. They are controlled to ensure that the driver is capable of handling its vehicle and associated equipment and cargo. In addition to the mandatory driving license it is important to check licenses related to the handling of dangerous goods and other special transportations. • The driver's resting time. • The driver's condition. It may be observed through conversations, etc.
Perform Inspection of Cargo	Necessary information in addition to the Vehicle info, which is assumed to be available, is acquired. The indications from the decision support system and the inspection itself will guide the information acquisition. The following information may be acquired and consulted: • Control history for the carrying vehicle on previous cargo handling is obtained. E.g. a history of repeated infringements on unsafe cargo treatment may indicate a trend or disrespect for traffic safety. Relevant control history includes vehicle, company and driver history information. Note that the use of control history will depend on the national laws and directives for storing and using such data. • Relevant authority information concerning the cargo. The police may report on issues like stolen cargo, while the customs may report on issues like missing import declarations. In most cases, it is a requirement that the authorities are present when using such information. • Information directly from the vehicle itself may in the future be received through an OBE. This may be the Transport operation. Another future extension is communication with the cargo itself through On-Goods Equipment (OGE). Indications from the decision support system, the acquired information and observations done by the inspection operator may trigger the controls of: • The condition of the cargo. Cargo like animals will for example have strict requirements to condition associated. • That the loaded cargo is not a threat to people's safety. The inspection operator may for example check e.g. the cargo placement, associated safety equipment, temperature, etc. • That the transport company has the required community license to operate its business (this is the transport undertaking part of the vehicle info). • The fulfilment of rules associated to dangerous.

	• The laden mass of loaded cargo for each vehicle (i.e. tractor and trailer). Indications from decision support system may trigger necessary inspection of the laden mass.
Perform Physical Inspection of Vehicle	Any information needed for the inspection, in addition to the *Vehicle info* which is available, is acquired. The *Vehicle indications* from the decision support system and the actual vehicle inspection strategy will guide the information acquisition. The following information may be acquired and consulted: • The control history. It may indicate that earlier violations should be checked again. A negative history may also indicate that technical conditions should be inspected in greater detail. Note that the use of control history will depend on national laws for storing and using such data. • Vehicle status information from the registries (i.e. AutoSys) on fee payments and other duties may be consulted. • Information about the vehicle and its safety status received directly from the driver or the vehicle itself. Exchange of electronic information will require some kind of OBE in the vehicle. Planned European directives will necessitate interactions with OBE. • Authority information concerning the vehicle from authorities. The police may for example report on issues related to the vehicle (e.g. theft, run away, etc.) for check during the vehicle inspection. In most cases, it is a requirement that the authorities (i.e. the police) are present when using such information. Based on the indications from the decision support system, the acquired information and observations done by the inspection operator may trigger the controls of: • The mandatory vehicle equipment. As an example, all professional transport requires that equipment registering the driver's resting time exists and is functioning. • The technical condition of the vehicle (i.e. tractor and trailer). It is controlled to ensure that the vehicle fulfils the safety requirements for road operation. • The fulfilment of mandatory duties such as. periodic control, the yearly tax payment, insurance, etc.

Information flow	**Content description**
Control history	Control results from previous controls (e.g. infringement information, number of serious infringements and total number of infringements) for driver, vehicle and transport undertaking. See Table 3 in Section 6.1.1.
Control result	Individual control results (and infringements). See Table 3 in Section 6.1.1.
Customs info	Information from customs authority on issues related to a vehicle. See Table 4 in Section 6.1.2.
Driver license info update	Update of driver license information, e.g. confiscation of driver license. See Table 3 in Section 6.1.1.
Driver resting time	Information about driver resting time. See Table 5 in Section 6.1.3.
Instruction	Instructions to the driver from the operator doing the control. See Table 5 in Section 6.1.3.
License info	Information about driver licenses. See Table 3 in Section 6.1.1.
Notification	Manual notification to relevant stakeholders on control results. See Table 5 in Section 6.1.3.
Police report	Information on vehicles involved in criminality (e.g. stolen vehicles). See Table 4 in Section 6.1.2
Registration book info	Information stored in the registration book. See Table 4 in Section 6.1.2.
Transport operation info	Information about cargo, origin of cargo, destination, etc. See Table 5 in Section 6.1.3.
Vehicle indications	Results from decision support system according to its configuration. See Table 3 in Section 6.1.1.
Vehicle info	Vehicle registration info, and transport undertaking information (community licenses included). See Table 3 in Section 6.1.1.
Vehicle info update	Update of registration information and undertaking information, e.g. removal of number plates or suspension information. See Table 3 in Section 6.1.1.
Vehicle safety status	Safety-related information, e.g. dangerous goods information and status information on vital functions. See Table 4 in Section 6.1.2.
Vehicle status	Information on fulfilment of duties. See Table 3 in Section 6.1.1.

6 Information view

This chapter specifies the information content of the information flows depicted in the process diagrams in Chapter 5. An overall description of the information flows is provided as well as information models that specify the detailed information content.

6.1 Information flow overview

The information flows depicted in the process diagrams are of three categories:

- Information flows of which the information content is further specified in this report (i.e. the bold information flows in the process diagrams)
- Information flows that are to be aligned with specification made by others. However, this report may suggest specifications of the content (in such cases the flows are bold in the process diagrams)
- Information flows that are carried out my means of manual activity.

6.1.1 Information flows defined by this report

The table below defines the information flows that are specified by this report. The "Information flow" column refers to the bold flows depicted in the process diagrams. One information flow may cover several purposes, as indicated by the bullet points in the "Description" column. The "Top Node" column refers to information elements in information models defined in section 6.2, while the "Service" column refers to the relevant service interfaces in the information models also defined in section 6.2.

Table 3 Information flows specified by this report

Information flow	Description	Top node (in info model)	Service (in service interface)
Control history	The control results from previous controls – infringement information, number of serious infringements and total number of infringements for • Driver • Vehicle • Transport undertaking	ControlHistory (VehicleControl)	getDriverInfringementHistory (iVehicleControl)
		ControlHistory (VehicleControl)	getVehicleInfringementHistory (iVehicleControl)
		ControlHistory (VehicleControl)	getUndertakingInfringementHistory (iVehicleControl)
Control result	• Control results from manual controls - report and retrieval • A collection of infringements notifications – report and retrieval	VehicleControlInformation (VehicleControl)	reportControlResult (iVehicleControl) getControlResult (iVehicleControl)
		InfringementNotification (Infringement)	reportInfringementNotification (iInfringement) getInfringementNotification

Information flow	Description	Top node (in info model)	Service (in service interface)
			(iInfringement)
Control statistics	• Statistics based on vehicle control results from manual control – report and retrieval	ControlStatisticsEntry (Statistics)	reportControlStatistics (iStatistics) getControlStatistics (iStatistics)
Driver license info	• Driver licence information • Information about crew attestations	DriverLicenceInformation (Driver)	getDriverLicenceInfo (iDriver)
		CrewInformation (Driver)	getCrewAttestationInfo (iDriver)
Driver license info update	• Update of driver licence information, e.g. on confiscation of driver licence	DriverLicenceInformation (Driver)	updateDriverLicenceInfo (iDriver)
DSS statistics	• Statistics based on indications detected by the decision support system – report and retrieval. Should be generated continuously also when manual controls are not performed to generate o Knowledge on the general amount of infringements and when they occur o Knowledge on how manual controls will affect this number o Knowledge on the extent of specific infringements o Data that can be used in evaluations o Data that can be used for tuning of the sensor system	DSSStatisticsEntry (Statistics)	reportDSSStatistics (iStatistics) getDSSStatistics (iStatistics)
Sensor info	• Result derived from sensor measurements	VehicleControlInformation (VehicleControl)	reportSensorMeasurement (iVehicleControl)
Vehicle info	• Vehicle registration information - retrieval • Transport undertaking information (community licenses included) - retrieval	VehicleRegistrationInformation (VehicleRegistration)	getRegistrationInfo (iVehicleRegistration)
		TransportUndertakingInformation (TransportUndertaking)	getTransportUndertakingInfo (iTransportUndertaking)
Vehicle info update	• Update of registration information, e.g. removal of number plates • Update of undertaking information, e.g. suspension information	VehicleRegistrationInformation (VehicleRegistration)	updateRegistrationInfo (iVehicleRegistration)
		TransportUndertakingInformation (TransportUndertaking)	updateTransportUndertakingInfo (iTransportUndertaking)
Vehicle status	• Vehicle status info (i.e. info on all duties, insurance, payment of annual vehicle duty and road-worthiness control)	VehicleStatusInformation (VehicleStatus)	getVehicleStatusInfo getVehiclePaymentInfo getVehicleInsuranceInfo getVehicleRoadworthinessInfo

Information flow	Description	Top node (in info model)	Service (in service interface)
			(iVehicleStatus)
Vehicle indications	• Indications on possible infringements from decision support system - report or retrieval	VehicleControlInformation (VehicleControl)	reportControlResult (iVehicleControl) getControlResult (iVehicleControl)

6.1.2 Information flows to be aligned with other systems

This section provides an overview of information flows that in their final version will be defined elsewhere. Intermediate versions of some of the information flows are however also specified by META to provide some idea of the required information content. The "Information flow" column refers to the information flows depicted in the process diagrams. The "Defined by" column indicates where the final version of the information flow is or will be defined. If META has provided a preliminary specification of the information flow, references are made to the corresponding information flows in section 6.1.1 or to the corresponding information models and service interfaces in section 6.2 in the "Top Node" and "Service" columns.

Table 4 Information flows to be aligned with other systems

Information flow	Description	Defined by	Top node (in info model) that may be similar	Service (in service interface) that may be similar
Customs info	• Information from customs authority on issues related to a vehicle.	PUS (Norwegian Customs Authority)		
Driver license info	• See section 6.1.1	Autosys system	See "Driver licence info" in 6.1.1	See "Driver licence info" in 6.1.1
Driver license info update	• See section 6.1.1	Autosys system	See "Driver licence info update" in 6.1.1	See "Driver licence info update" in 6.1.1
Driving resting time	• Information about the driver's driving and resting time. May in the future be reported electronically from on-board systems.	In-vehicle systems and standards		
EU infringement report	• Provision of notifications about infringements related to European vehicles. • Retrieval of infringement notifications on vehicles	EUCARIS ERRU	InfringementNotification (Infringement)	reportInfringementNotification (iInfringement)
			InfringementNotification (Infringement)	getInfringementNotification (iInfringement)
EU statistics	• Statistics according to European requirements	EUCARIS ERRU	ControlStatisticsEntry (Statistics)	reportControlStatistics (iStatistics) getControlStatistics (iStatistics)
Police report	• Information on vehicles involved in criminality (e.g. stolen vehicles)	ElySys II (Police Authority in Norway)		

Information flow	Description	Defined by	Top node (in info model) that may be similar	Service (in service interface) that may be similar
Registration book info	• Registration book information. May in the future be reported electronically from on-board systems.	Upcoming standard for electronic info	VehicleRegistrationInformation (VehicleRegistration)	reportRegistrationInfo (iVehicleRegistration)
Sensor configuration	• Configuration commands to sensor system - which sensors to be used and how they are to be used.	To be decided		
Transport operation info	• Information about the transport operation, among others the cargo. May in the future be reported electronically from on-board systems.	In-vehicle systems and standards		
Vehicle info	• See section 6.1.1	Autosys system	See "Vehicle info" in 6.1.1	See "Vehicle info" in 6.1.1
Vehicle info update	• See section 6.1.1	Autosys system	See "Vehicle info update" in 6.1.1	See "Vehicle info update" in 6.1.1
Vehicle safety status	• Safety related information, e.g. on dangerous goods and status on vital functions. May in the future be reported electronically from on-board systems.	In-vehicle systems and standards		

6.1.3 Manual information flows

The table below provides an overview of information flows that may be manual in the sense that the information is exchanged verbally, by presentation of paper documents or by other visual means such as for example manual inspections of on-board registration equipment. Some of these manual information flows may in the future also be electronically.

The "Information flow" column refers to the information flows depicted in the process diagrams.

Table 5 Information flows that are or may be manual

Information flow	Description
Driver resting time	Information about driver resting time (may be electronic in the future)
Instructions	Instructions to the driver from the operator doing the control
Notification	Manual notification to relevant stakeholders on control results
Other authority info	Agricultural info, Immigration info, health info, etc.
Registration book info	Registration book information (may be electronic in the future)
Transport Operation info	Information about cargo, origin of cargo, destination, etc.

6.2 Information models

Figure 14 provides an overview of the information packages and their content.

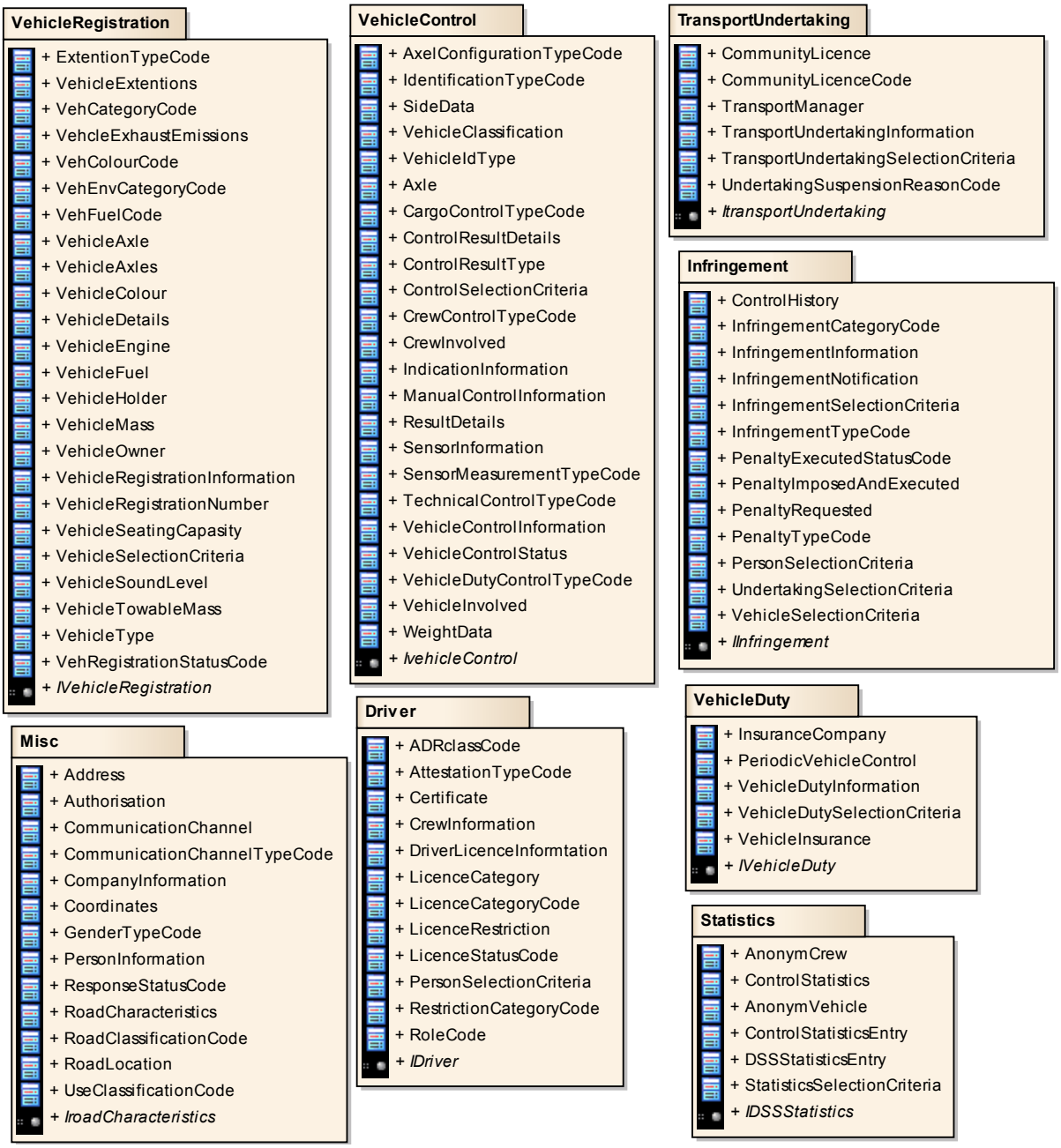

Figure 14 Information model packages, their classes and interfaces.

6.2.1 Vehicle Registration

The VehicleRegistration package defines information elements related to the registration of the vehicle. The Registration Certificate as defined in Annex I of the Council Directive 1999/37/EC, 29-04-1999 is used as the basis for the information modelling.

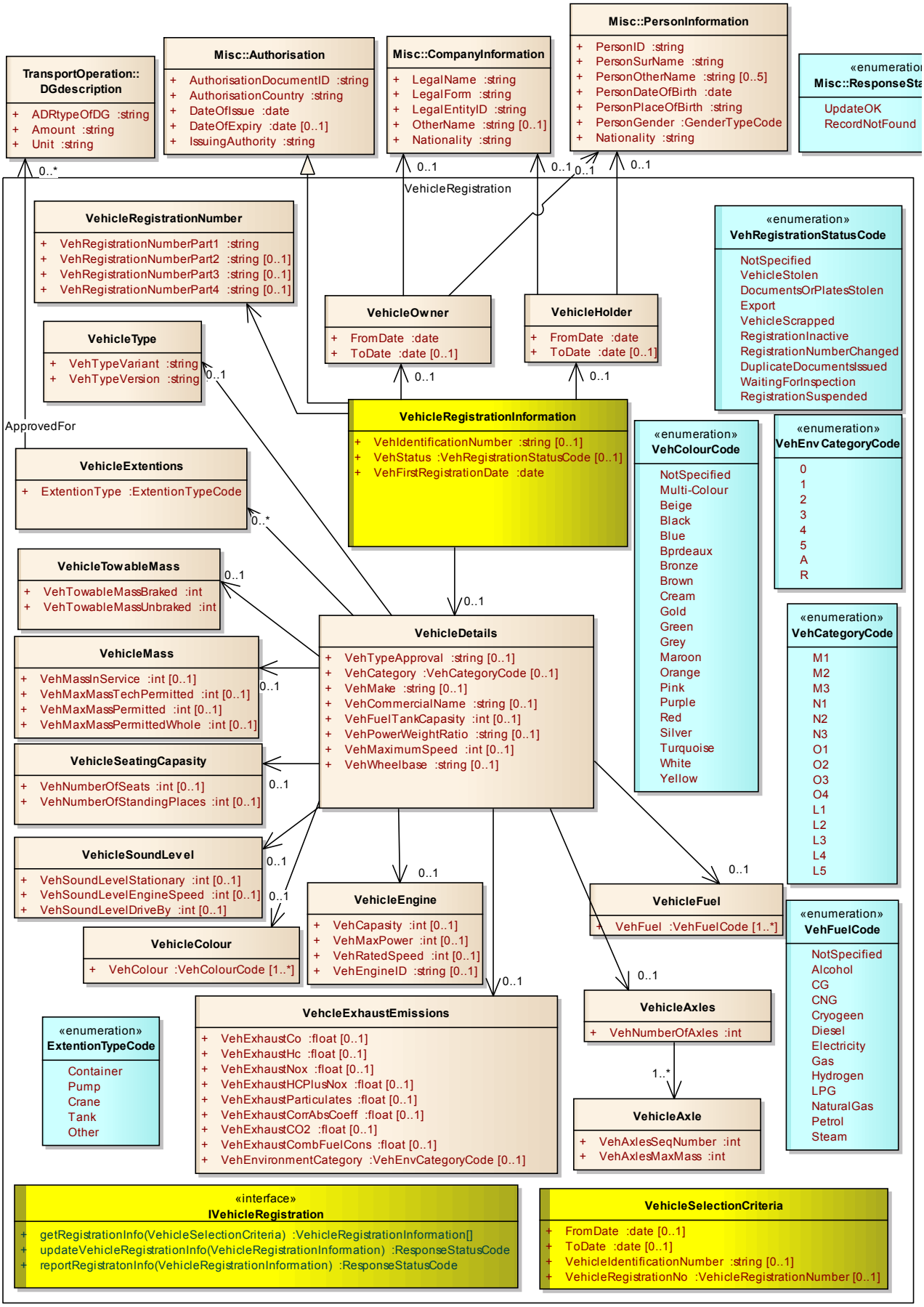

Figure 15 The VehicleRegistration package

Class	Description
ExtentionTypeCode	Codes indicating types of extensions to the vehicle
VehCategoryCode	Category as described in part J of the Registration Certificate - as defined in Annex I of the Council Directive 1999/37/EC,
VehColourCode	Code indicating vehicle colour
VehEnvCategoryCode	Codes applicable to vehicles of EU Category code N2, N3, M2 or M3 (in case VehMaxMassPermitted > 3500 kg): • = Vehicle does not comply to EC emission standards; • = Vehicle complies to rule A (88/77/EEG, amended 96/1/EC); • = Vehicle complies to rule B (88/77/EEG amended 96/1/EC); • = Vehicle complies to rule A (2001/27), year 2000; • = Vehicle complies to rule B1 (2001/27), year 2005; • = Vehicle complies to rule B2 (2001/27), year 2008; Codes applicable to vehicles of EU category code M1, N1 (in case VehMaxMassPermitted <= 3500 kg) • A = Complies to emission demands 2005 (2001/27); • R= Emission of particular pollutants in less than 5 mg/km
VehFuelCode	Code indicating type of fuel used
VehRegistrationStatusCode	Code indication registration status
VehicleExhaustEmissions	Provides information on emissions
VehicleAxle	Top node in information structure providing information on the axles
VehicleColour	Provides information on the colour
VehicleDetails	Top node in information structure providing detailed information on the vehicle.Links to all relevant information elements.
VehicleEngine	Provides information on the engine of the vehicle.
VehicleFuel	Provides information on the fuel type on the vehicle.
VehicleHolder	Provides information on the holder of the vehicle. This may be a company or a person. Link to CompanyInformation or PersonInformation.
VehicleMass	Provides information on the mass allowed.
VehicleOwner	Provides information on the owner of the vehicle. This may be a company or a person. Link to CompanyInformation or PersonInformation.
VehicleRegistrationInformation	Top node in the registration information structure for the vehicle. Specialisation of Authorisation class and inherits information about an authorisation from an authority, in this case the vehicle registration certificate. Links to: • VehicleRegistrationNumber • vehicleOwner • VehicleHolder • vehicleDetails
VehicleRegistrationNumber	The registration number of the vehicle.
VehicleSeatingCapacity	The maximum seating capacity.
VehicleSelectionCriteria	Selection criteria used in the interface.
VehicleSoundLevel	The sound level of the vehicle.
VehicleTowableMass	The maximum towing capacity.
VehicleType	The vehicle type.

6.2.2 Vehicle Status

The VehicleStatus package defines information related to the duties of a vehicle or a vehicle owner such as insurance, vehicle duty payment and compulsory roadworthiness controls. The information structures may be used for information retrieval from registries.

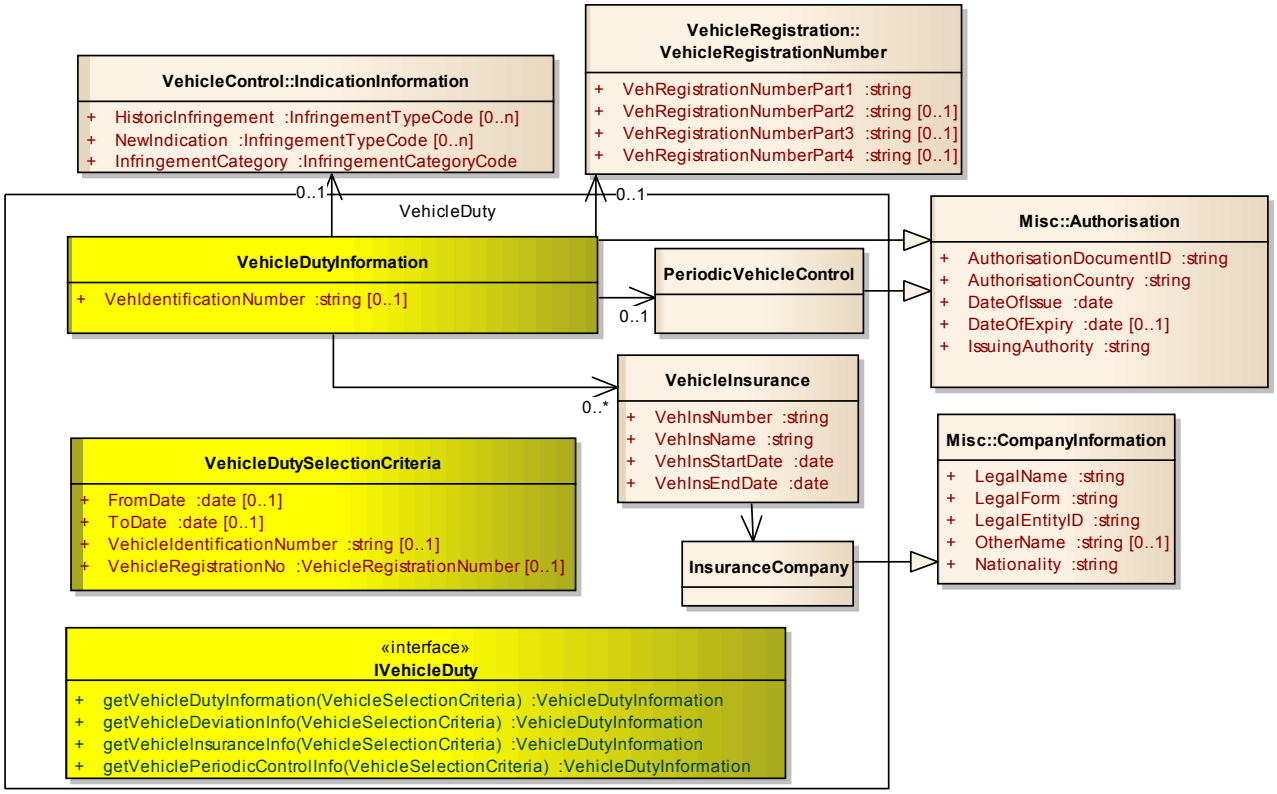

Figure 16 The VehicleStatus package

Class	Description
InsuranceCompany	Specialisation of CompanyInformation. Provides information on the insurance company-
PeriodicVehicleControl	Specialisation of Authorisation to confirm that the compulsory road worthiness control is carried out.
VehicleStatusInfromation	Specialisation of Authorisation to confirm that the information is issued by an authority with access to information about duties. The top node in the information structure informing about infringements related to duties. Links to: • VehicleInsurance • PeriodicVehicleControl • VehicleRegistrationNumebr • IndicationInformation
VehicleStatusSelectionCriteria	Selection criteria for the interface
VehicleInsurance	Detailed information on the insurance of the vehicle. Relation to InsuranceCompany-

6.2.3 Transport Undertaking

The TransportUndertaking package represents information about a transport undertaking.

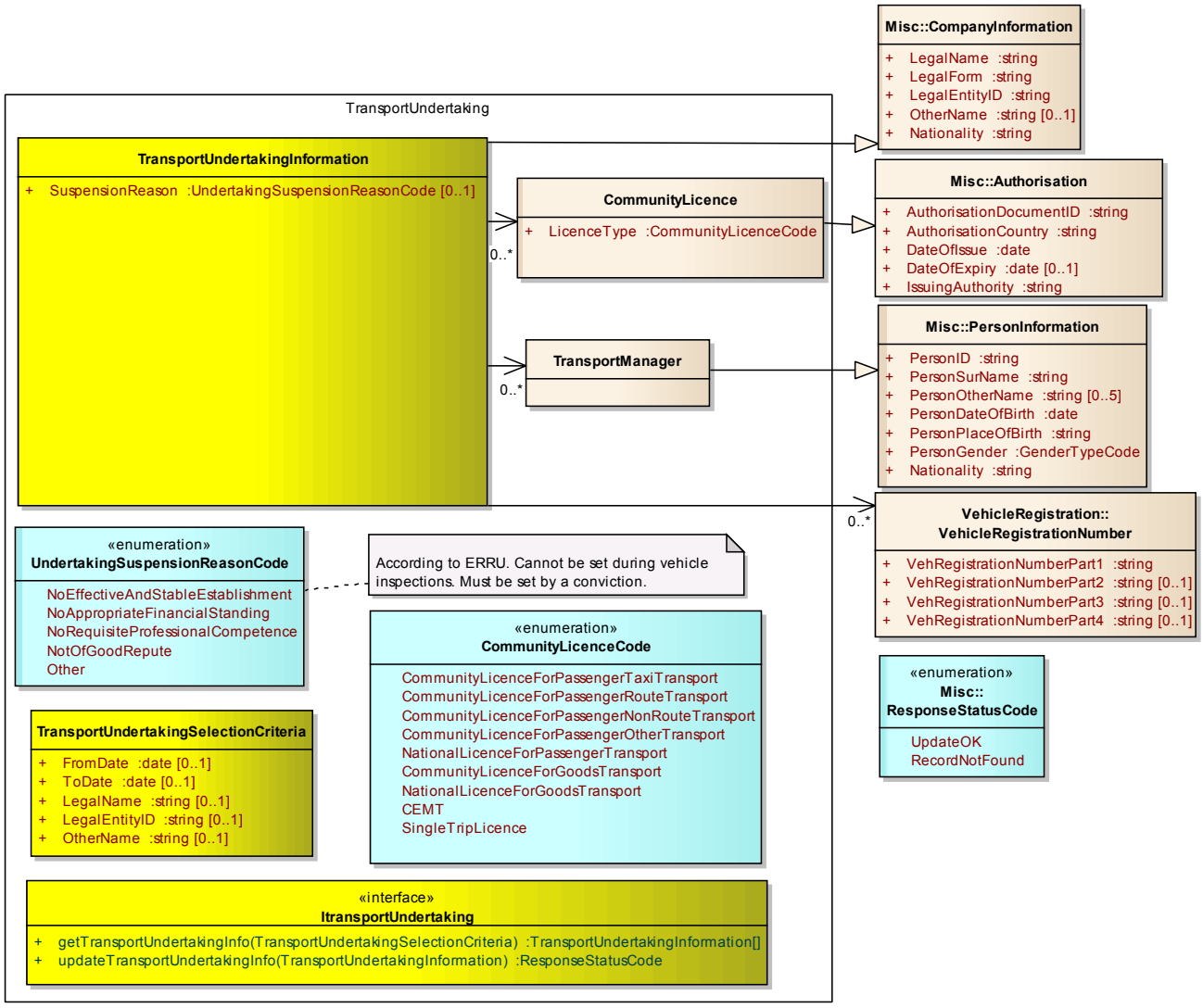

Figure 17 The TransportUndertaking package

Class	Description
CommunityLicence	Specialisation of Authorisation to confirm tha community licence.
CommunityLicenceCode	Codes representing types of licences
TransportManager	The transport manager of the transportundertaking
TransportUndertakingInformation	To node in the transportundertaking information structure. Links to: • CommunityLicence • TransportManager • VehicleRegistrationNumber
TransportUndertakingSelectionCriteria	Selection criteria for the interface.
UndertakingSuspensionReasonCode	Codes representing types of suspension

6.2.4 Driver

The Driver package represents information about the driver. The code lists are aligned with EUCARIS.

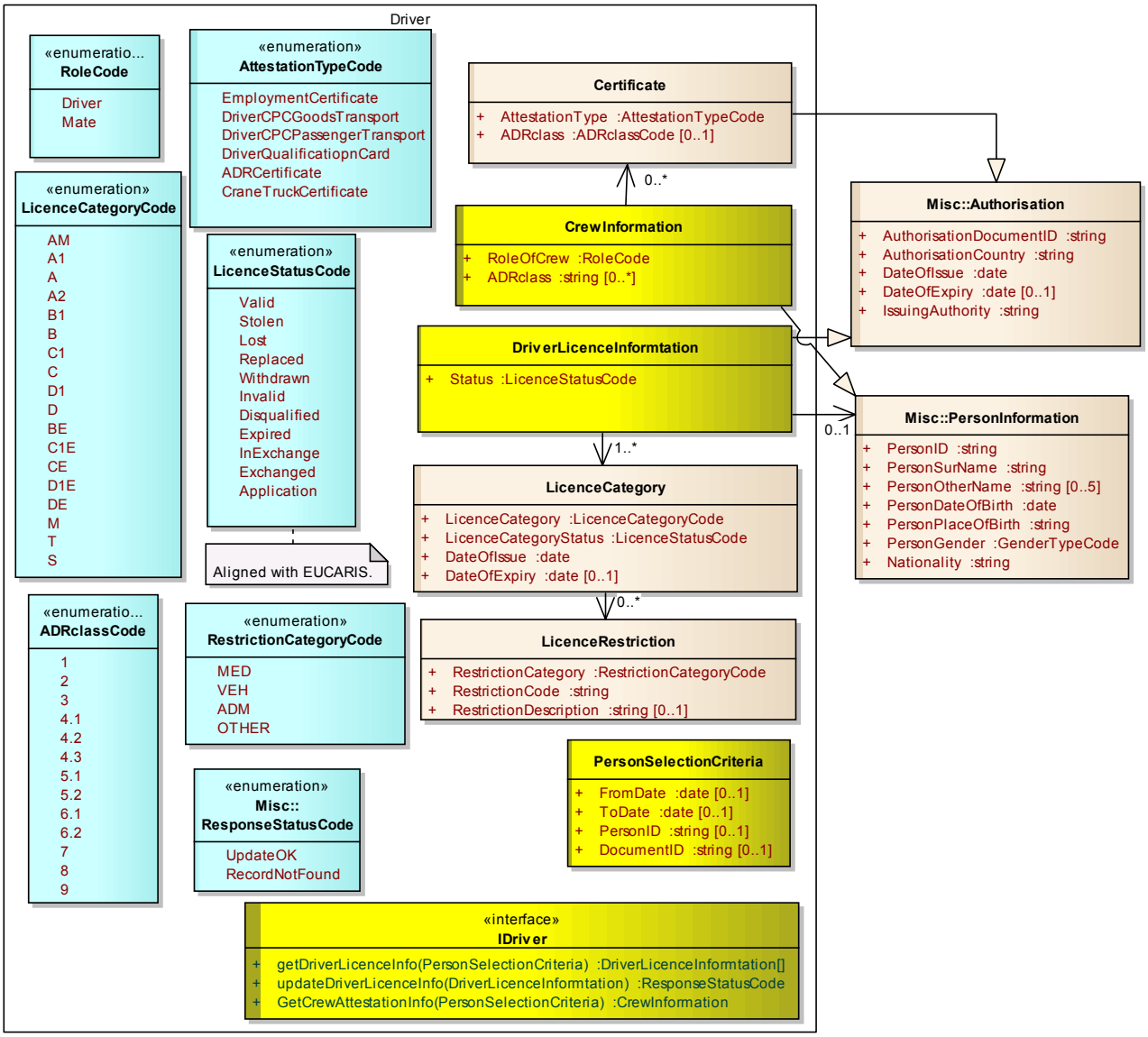

Figure 18 The DriverPackage

Class	Description
ADRclassCode	Codes representing types of dangerous goods.
AttestationTypeCode	Codes representing types of attestation
Certificate	Specialisation of Authorisation to confirm an attestation.
CrewInformation	Specialisation of PersonInformation that provides information about a member of the crew. Link to Certificate.
DriverLicenceInformation	Specialisation of Authorisation to confirm a driver licence. Links to PersonInformation and LicenceCategory.
LicenceCategory	Information about a licence category covered by a driver licence
LicenceCategoryCode	Information about a restriction to a driver licence category
PersonSelectionCriteria	Selection criteria for the interface – when person information is requested.
RestrictionCategoryCode	Code representing driver licence restrictions
RoleCode	Code representing the role of the crew.

6.2.5 Vehicle Control

The VehicleControl package is depicted in Figure 19 and Figure 20.

Subsets of the Vehicle Control information structure are used to provide information in different situation.

- Information from road-side equipment:
  Figure 21 illustrates the substructure for provision of measurements from sensor systems (see the Sensor info information flow in Table 3 in section 6.1.1)
- Information from decision support system:
  Figure 22 illustrates the substructure that provides the indications from the automated Select Control Candidates process (see the Vehicle indications information flow in Table 3 in section 6.1.1).
- Information from manual inspections:
  Figure 23 illustrates the substructure that may provide the Control results from the manual control represented by the Perform Transport Means Inspection process (the Control result information flow in Table 3 in section 6.1.1.) if no information about infringements or penalties are to be provided.
- Information on control history:
  The control history also makes use of the same substructure as used from manual inspections, as illustrated in Figure 23. Information on penalties is not included in the control history.
- Infringement notifications sent to foreign countries.
  InfringementNotification in the Infringement model (see 0) also refers to the information structure starting with the VehicleControlInformation. In this case the same substructure as used in manual inspections are used.
- Complete information set from vehicle inspections:
  Figure 19 illustrates an alternative to the manual control structure in Figure 23 and is used if the complete information set related to the vehicle control process is to be provided – including sensor information, the indications from the decision support system, the results from the manual control and infringement and penalty information.
- Statistics
  The statistics information structures also refers to subsets of the VehicleControl package, as illustrated in 6.2.6.

Details about the elements in Figure 19 and Figure 20 are provided in the sections below. These descriptions also apply to the subsets mentioned above.

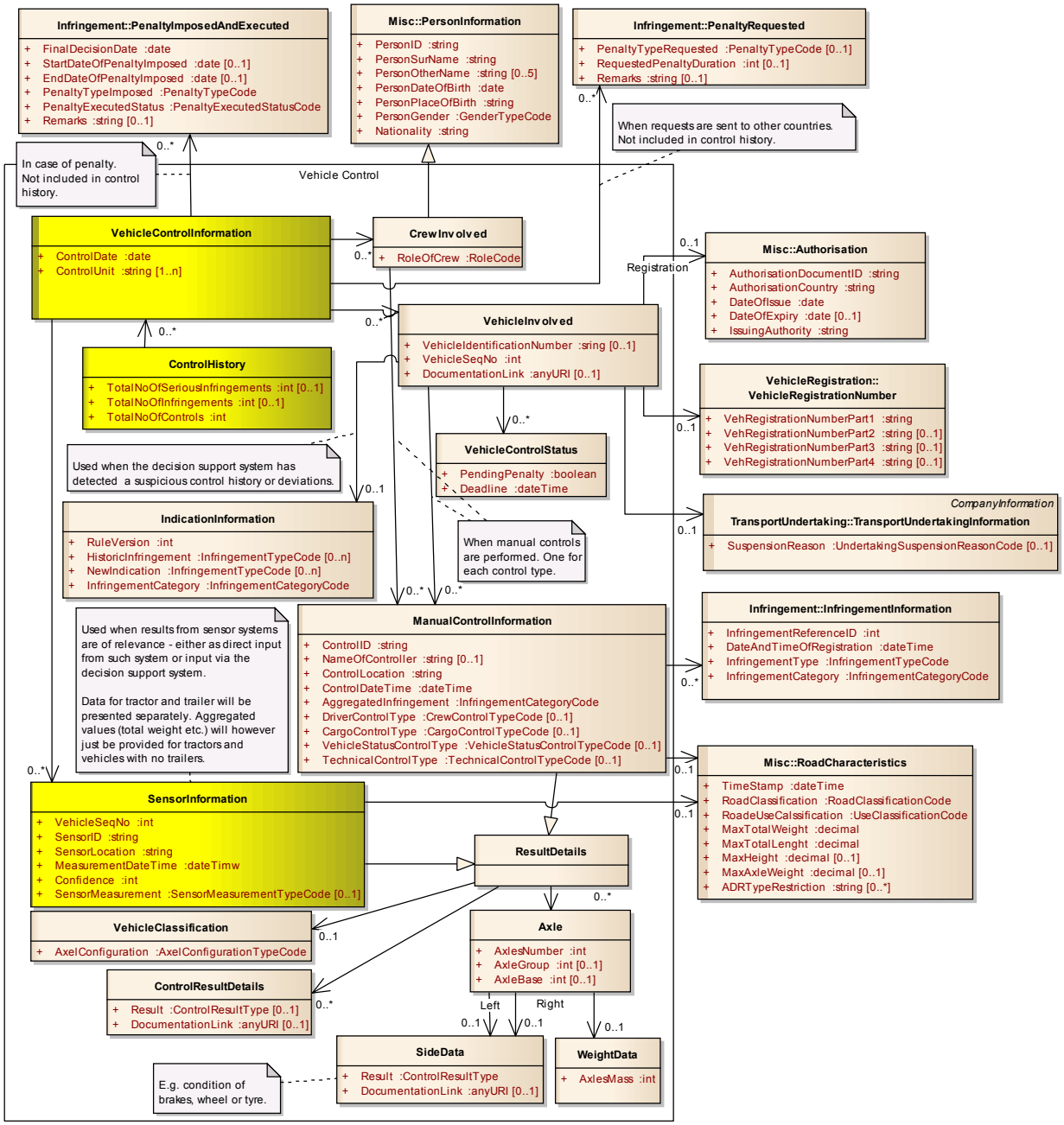

Figure 19 The VehicleControl package – Part 1 of 2

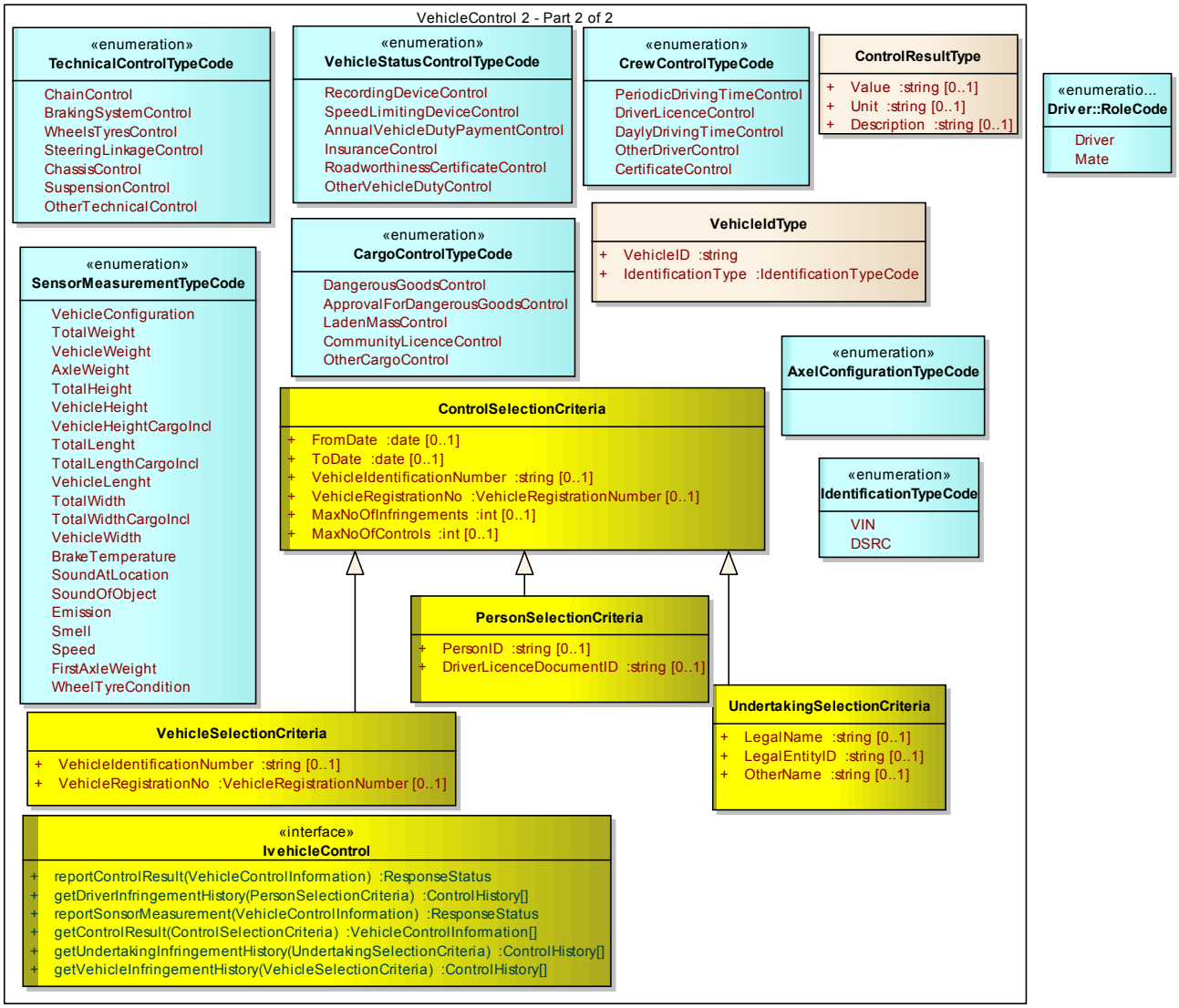

Figure 20 The VehicleControl package – Part 2 of 2

Class	Description
AxelConfigurationTypeCode	Codes that indicate the type of transport means in such a way that the axels belonging to the tractor and the trailers can be identified.
Axel	Top node of information structure providing data on an axle. Provides a sequence number for identification of the axle (one is the first axle, etc.), axle group (one is the first group) and base. The base is the distance between two axles - from the centre of this axle to the centre of the next axle, in direction from the front of the vehicle to the back of the vehicle. Links to: • Left SideData • Right SideData • WeightData for weight information
CargoControlTypeCode	Code that indicates the type of cargo control.
ControlHistory	The top node in an information structure providing control history information
ControlResultDetails	Provides a control result or value sampled by sensors.
ControlResultType	Data type for provision of any type of data by means of a value, a data unit and a description.
ControlSelectionCriteria	Search criteria to be used in interfaces.
CrewControlTypeCode	Code that indicates the type of crew control.
CrewInvolved	Specialisation of PersonInformation. Identifies the crew that is controlled. Links: • ManualControlInformation – one for each control type

IdentificationTypeCode	Code indication the vehicle identifications means used.
IndicationInformation	Indicates the infringements indications associated to a vehicle. Used when the decision support system has detected a suspicious control history or other indications.
ManualControlInformation	Specialisation of ResultDetails. Top node in the information structure informing about the result from a manual inspection of crew and vehicles. There will be one such structure for each type of inspection since such inspections may be carried out by different persons. Link to: • RoadCharacteristics to inform about the road, e.g. weight limitations, etc. when this is relevant to the control • InfringementInformation when infringements are detected
PersonSelectionCriteria	Selection criteria for interface to be used when information on persons is requested.
ResultDetails	Top node in a generic information structure providing information about a vehicle. The information may be captured by sensor, derived from sensor information or registered during manual controls. Note that data for tractor and trailer will be presented separately. Aggregated values (total weight etc.) will however just be provided for tractors and vehicles with no trailers. Links to: • VehicleClassification for provision of axle configuration information • ControlResultDetails for provision of data not related to the individual axles. • Axle for provision of data related to the individual axles.
SensorInformation	Specialisation of ResultDetails. Top node in the information structure providing data from sensors. Used when sensor data is of relevance. Link to: • RoadCharacteristics to inform about the road, e.g. weight limitations, etc.
SensorMeasurementTypeCode	Code indication the type of measurement done by the sensor.
SideData	Enables provision of separate information for left side and right side of an axle, e.g. information on the tyres.
TechnicalControlTypeCode	Code that indicates the type of technical control.
UndertakingSelectionCriteria	Selection criteria for interface to be used when information on transport undertakings is requested
VehicleClassification	The type of transport means addressed. Enables an mapping of axles to the tractor and the trailers can be identified.
VehicleControlInformation	The top node in the information structure providing information about a transport means, which may be composed of one or more vehicles (truck, tractor, trailer, etc.). This information may be: sensor measurements, indications from the decision support system, results from manual inspections, a control history entry, etc. Links to: • CrewInvolved to provide information about the crew • VehicleInvolved to provide information about the individual vehicles • SensorInformation to provide sensor samples - used when sensor systems or the decision support system provides VehicleControlInformation. • PenaltyRequested when penalty requests are sent to foreign countries due to infringements detected during manual inspections. • PenaltyImposedAndExecuted when penalties are imposed and executed due to infringements detected during manual inspections.
VehicleControlStatus	Status for a vehicle selected for control. Just after the control, before the deadline for corrections, the vehicle may still have deviations. If shall however not be stopped for new controls before this deadline expires.
VehicleStatusControlTypeCode	Code that indicates the type of control.
VehicleIdType	Information structure for vehicle identification.
VehicleInvolved	Top node in the information structure providing data on a vehicle. A vehicle may be for example be a truck, a tractor or a trailer, A truck and a tractor will have sequence number one, a trailer will have two or more. Links to: • Authorisation regarding the vehicle registration • VehicleRegisrationNumber

	• TransportUndertaking which is responsible for the required licences. • IndicationInformation to summarize deviation indications detected by the decision support system - used when the decision support system provides VehicleControlInformation. • VehicleControlStatus – may be used after manual controls • ManualControlInformation – one for each control type
VehicleSelectionCriteria	Selection criteria for interface to be used when information on vehicles is requested
WeightData	Weight related to axle.

6.2.5.1 Information from road-side equipment

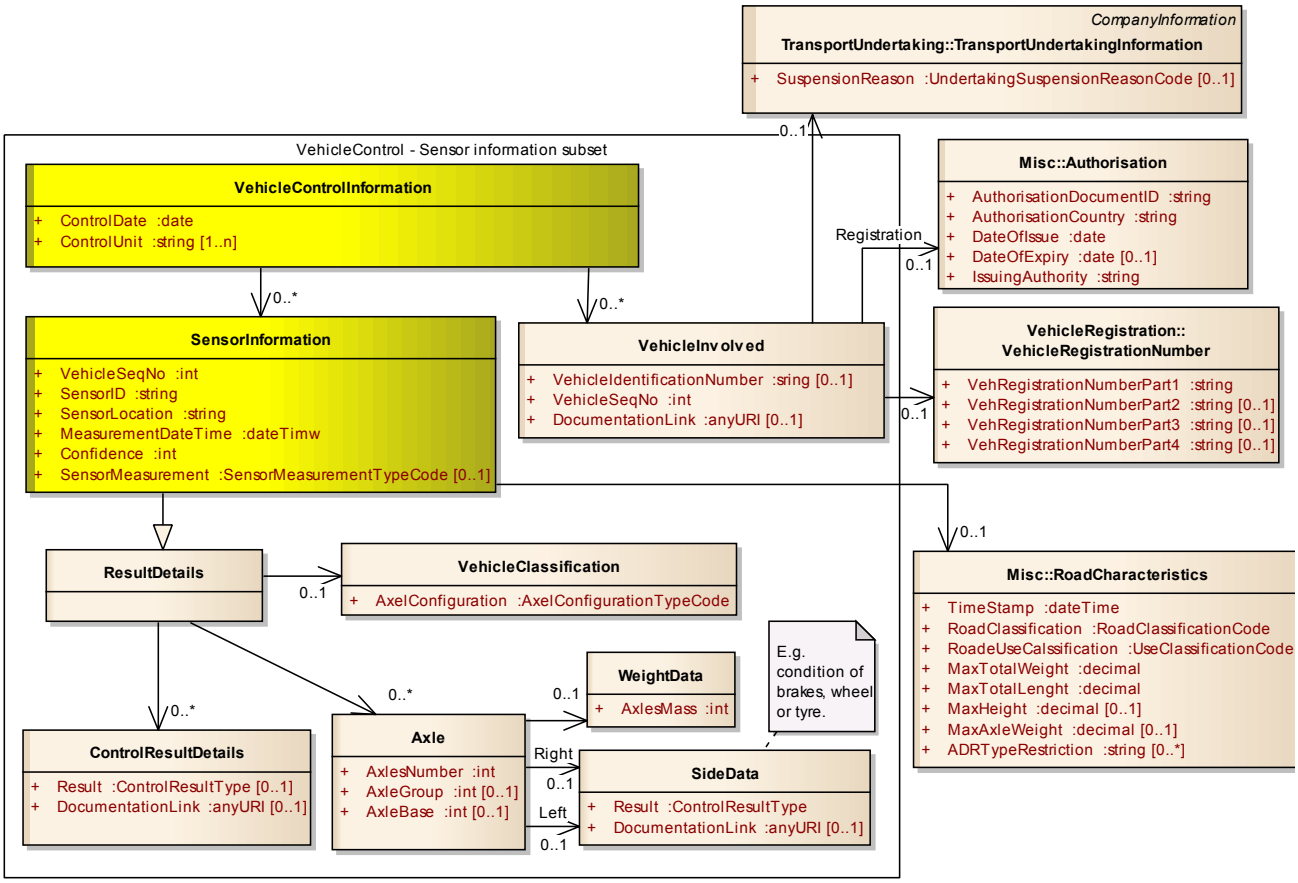

Figure 21 The VehicleControl structure provided by the Sensor info information flow

6.2.5.2 Information from decision support system

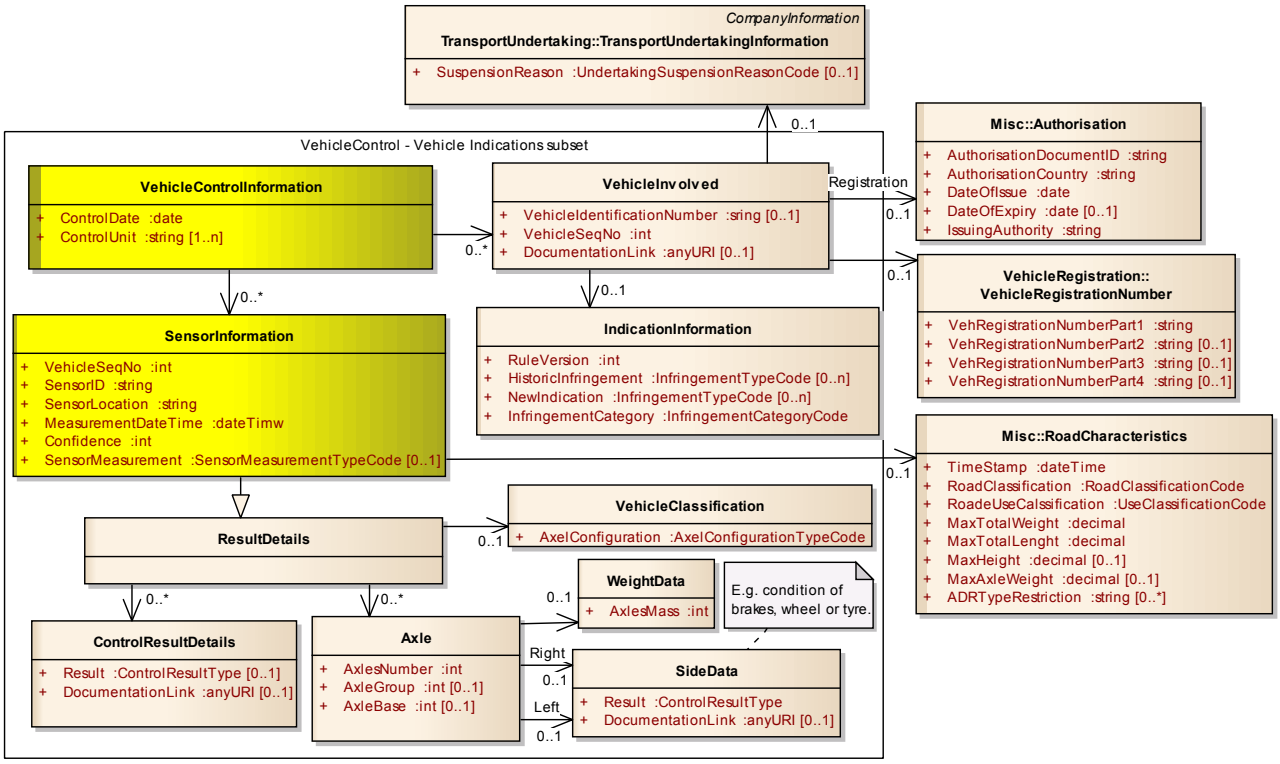

Figure 22 The VehicleControl structure provided by the Vehicle indication information flow

6.2.5.3 Information from manual controls and control history

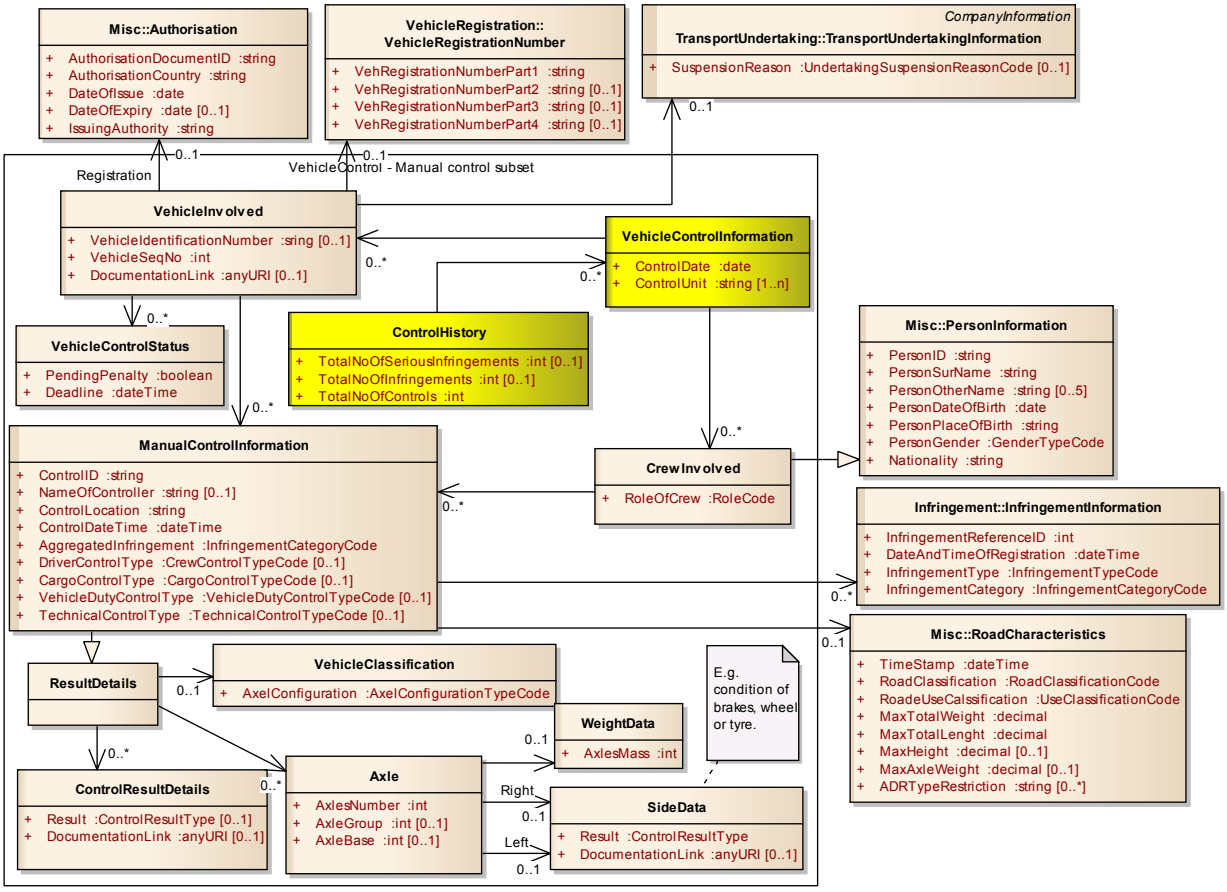

Figure 23 The VehicleControl structure providing the result from a manual control

6.2.6 Statistics

The Statistics package is depicted in Figure 24 and defines information to be included in statistics. There are two types of statistics. The DSS Statistics which holds information about the findings of the decision support system; and Control Statistics which holds information about the manual controls.

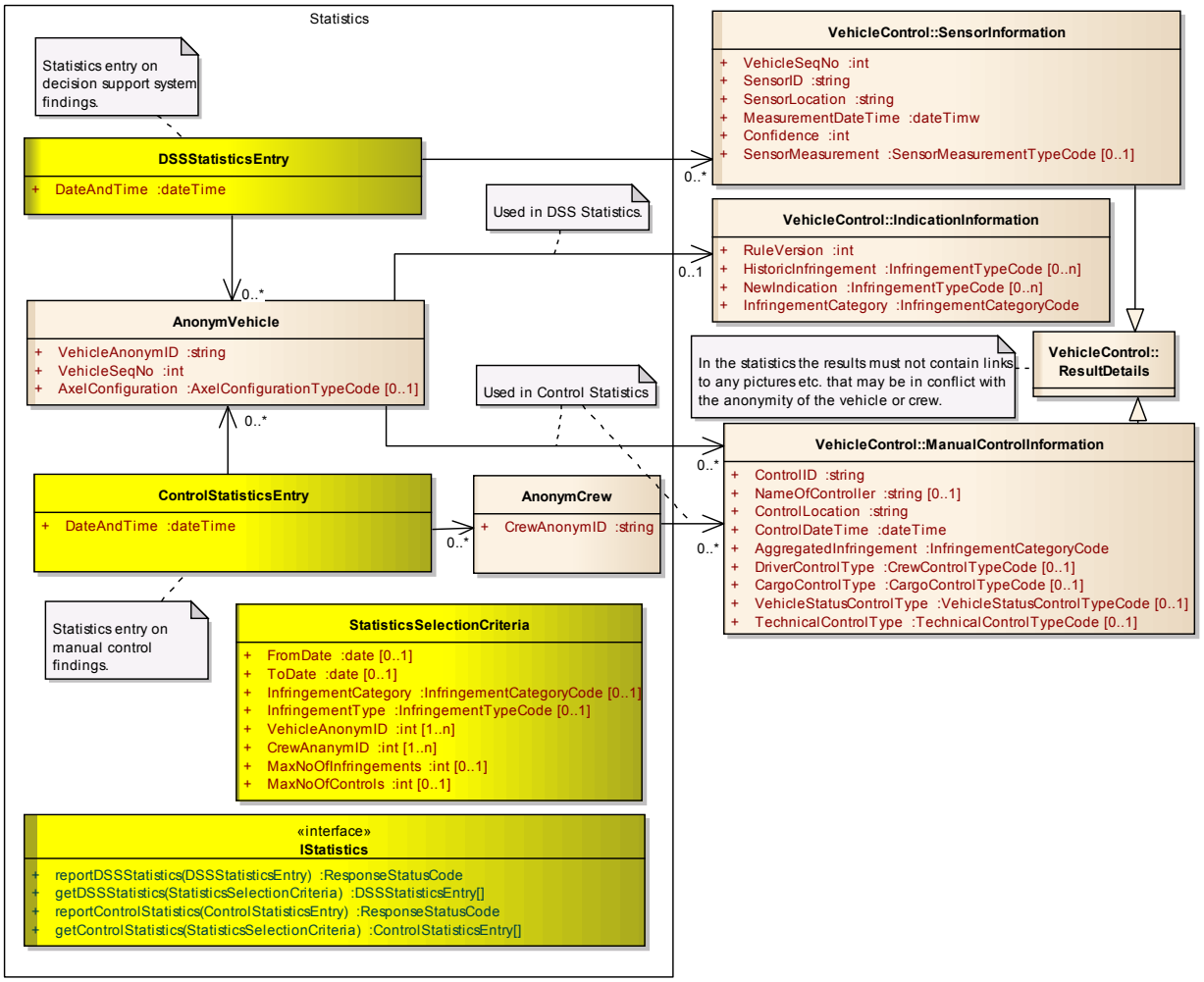

Figure 24 The Statistics package

Class	Description
AnonymCrew	ID that is anonymous and cannot be related a person. Links to ManualControlInformation.
AnonymVehicle	ID that is anonymous and cannot be related a vehicle. Links to ManualControlInformation or indicationInformation depending on type of statistics.
ControlStatisticsEntry	Top node in the information structure representing a Control Statistics entry. Links to AnonymVehicle and/or AnonymCrew.
DSSStatisticsEntry	Top node in the information structure representing a DSS Statistics entry. Links to AnonymVehicle.
StatisticsSelectionCriteria	Selection criteria for the interface

6.2.7 Infringement

The Infringement package provides information on infringements that are detected.
The penalty type codes are aligned with Commission Regulation (EU) No 1213/2010 of 16 December 2010.

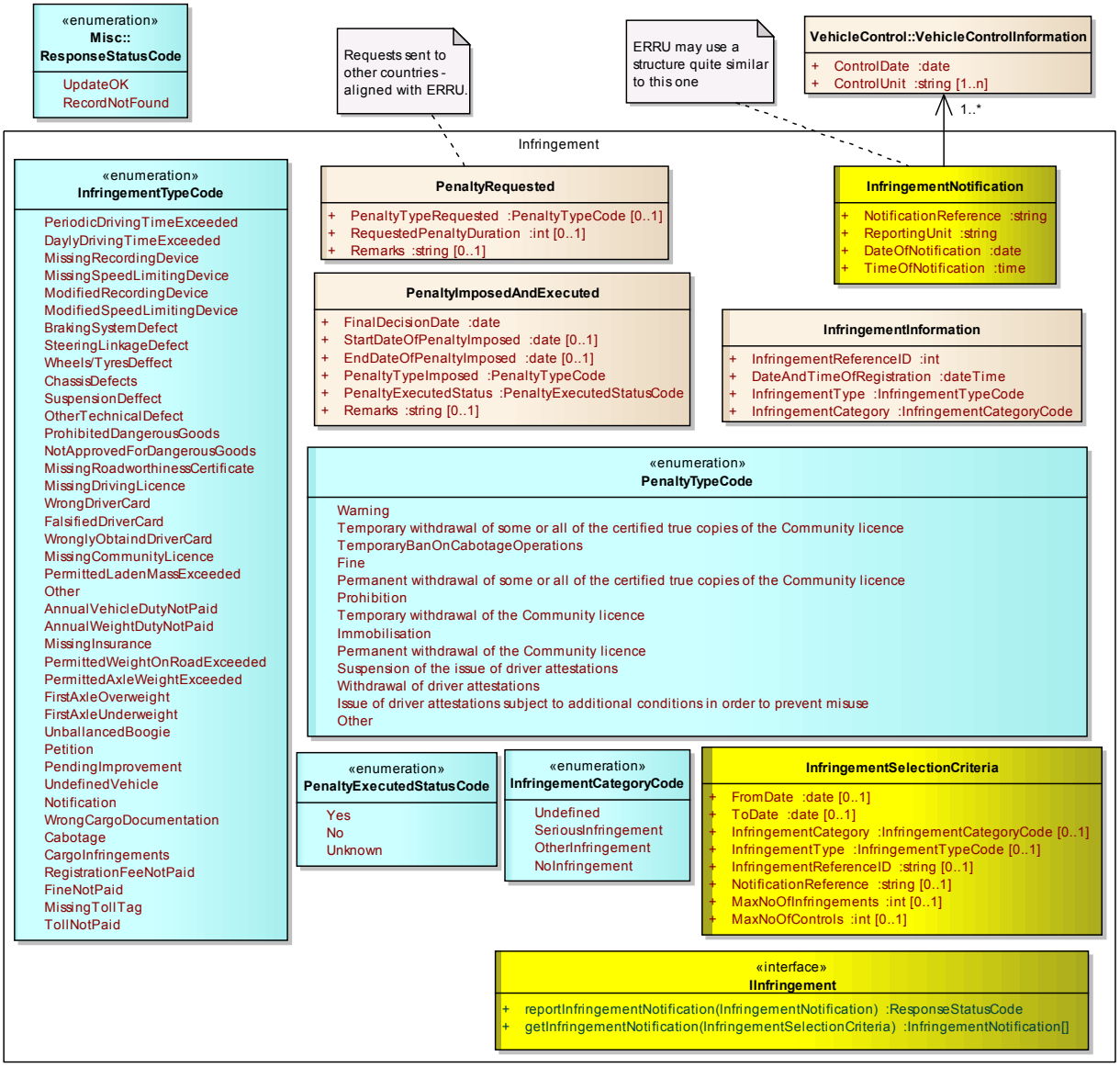

Figure 25 The Infringement package

Class	Description
InfringementCategoryCode	Codes representing types of infringements
InfrimgementInformation	Information on infringement to be used in description of control results.
InfringementNotification	Top node in the information structure to be sent to foreign countries to inform about infringements.
InfringementSelectionCriteria	Selection criteria for the interface
InfringementTypeCode	Codes representing types of infringements
PanaltyExecutedStatusCode	Codes representing the penalty execution status
PanaltyImposedAndExecuted	Information on imposed and executed penalties
RenaltyRequest	Information on penalty request sent to foreign country

6.2.8 Misc.

The Misc package includes miscellaneous classes that are used by the other packages.

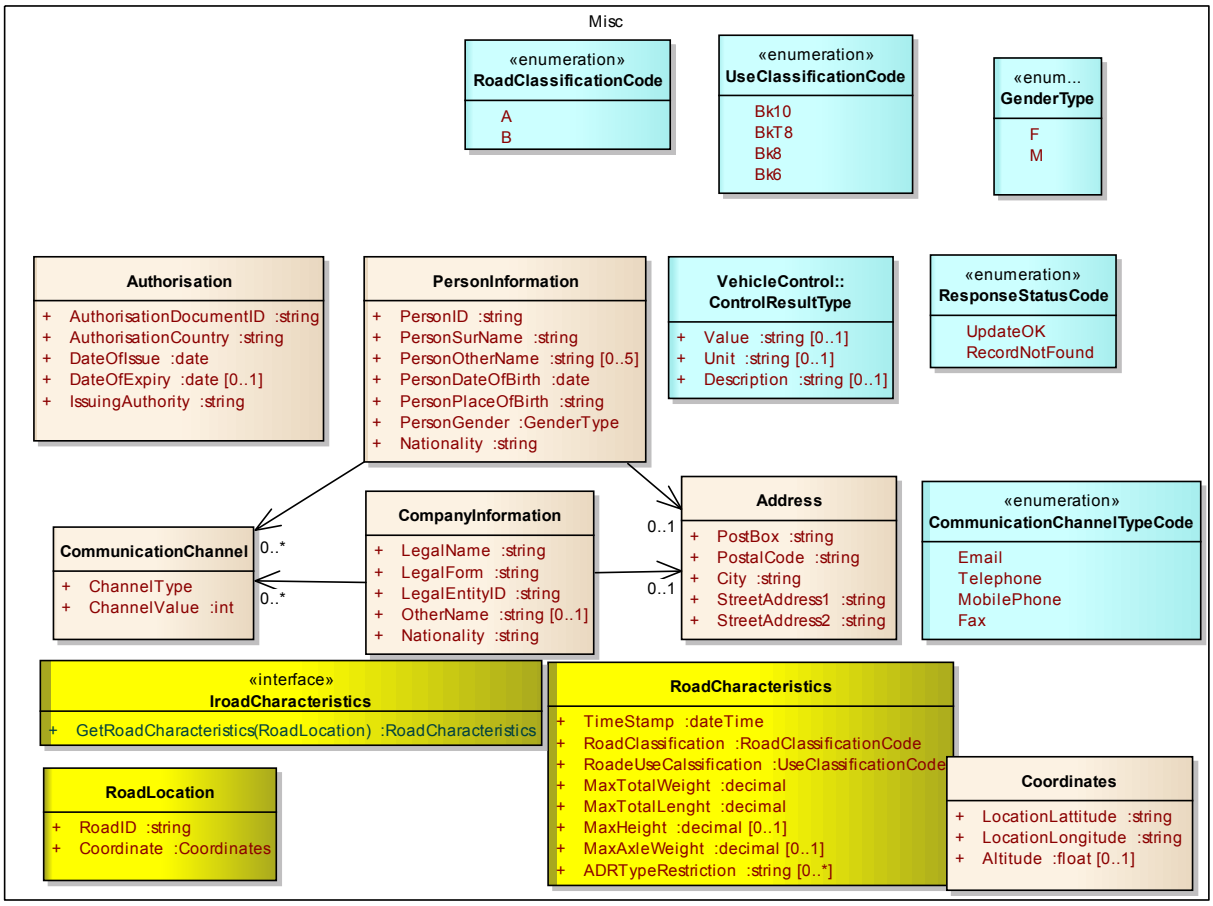

Figure 26 The Misc package

Class	Description
Address	Address information
Authorisation	Authorisation information
CommunicationChannel	Information about communication channel
CommunicationChannelTypeCode	Codes representing types of communication channels
CompanyInformation	Company information. Links to Address and CommunicationChannel
Coordinates	Coordinates of location
GenderTypeCode	Codes representing gender
PersonInformation	Person information. Links to Address and CommunicationChannel
ResponseStatusCode	Codes representing response status
RoadCharacteristics	Information about the road where vehicle controls take place
RoadClassificationCode	Codes for road classification
RoadLocation	Location in road network
UseClassificationCode	Codes for road use classification

7 Implementation

This chapter describes the mapping of information flows and interfaces and activities to the different system components.

7.1 Information flows and interfaces

Figure 27 shows the mapping of the information flow to the different parts of the systems. The actual information flows and their interfaces are described in Chapter 6.

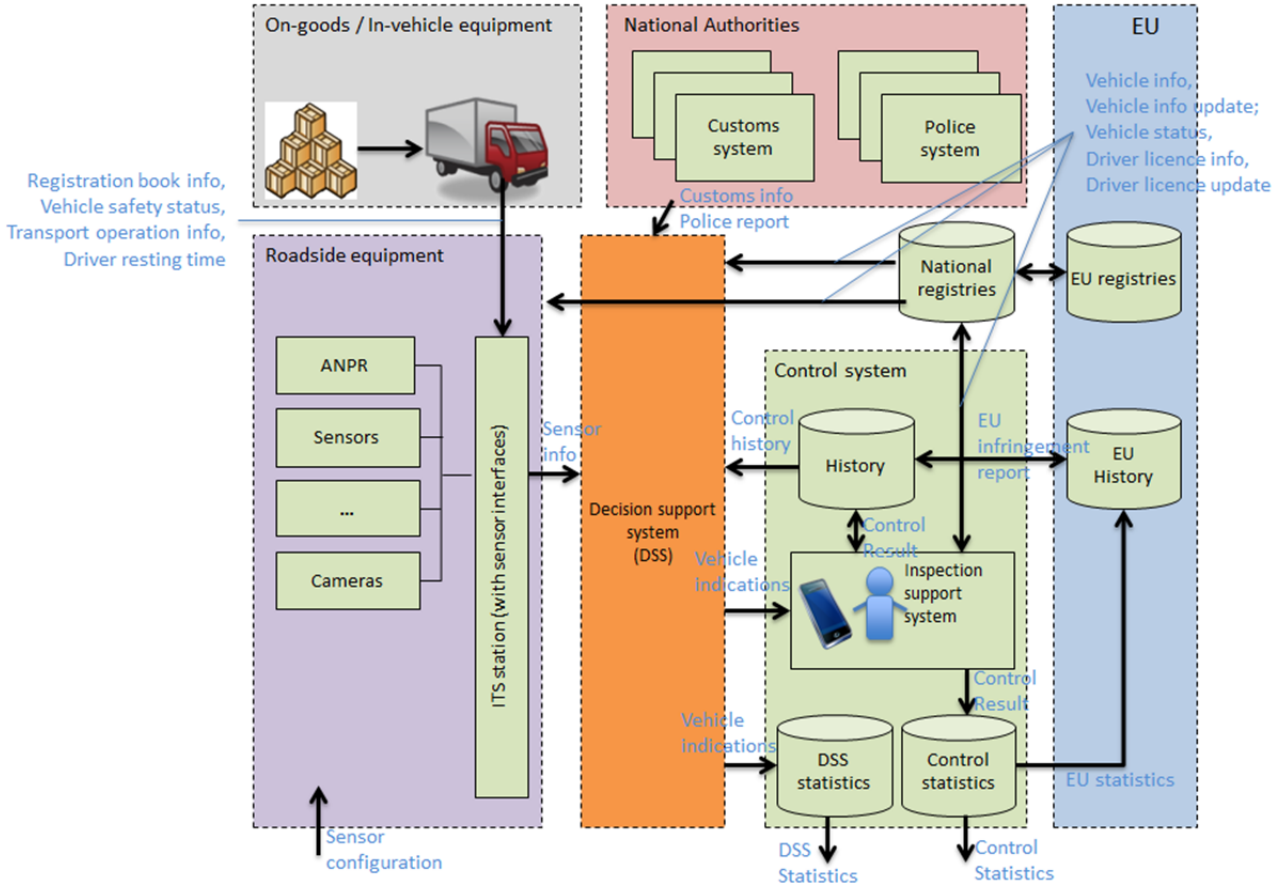

Figure 27 Information flows related to system overview

7.2 Processes and activities

Table 6 shows the mapping between the activities in the process view and the system components related to Figure 27 and real systems.

The *Manage Transport Related Licenses* and *Manage Approval Certification and Registration of Transport Means* activities are realized by NPRA's information systems for management of licences, vehicle registration information, etc., among others the AutoSys system. The management of control results represented by the *Manage Transport Means Inspection* activity is handled by the VADIS system. Both AutoSys and VADIS are existing systems where new versions are in the loop. META will therefore provide important input to their development.

The *Operate Transport Means Inspections* activity includes decision support for selection of control candidates and support to the execution of operational vehicle controls. The latter is supported by the VADIS system. The decision support is the main focus by the NonStop project. NonStop will realise a decision support pilot.

Table 6 Mapping between activities and system components

Activity	Realisation
Regulation Enforcement	
• Manage Transport Related Licenses • Manage Approval Certification and Registration of Transport Means	The activities are realized by NPRA's information systems for management of licences, vehicle registration information, etc., among others the AutoSys system. AutoSys is an existing system, but a new version is in the loop. In Figure 27: National registries
• Manage Transport Means Inspections	The management of manual inspections and control results must be handled by the VADIS system. VADIS is an existing system, but a new version is in the loop.
- Manage Vehicle and Company History - Manage Driver History	Must be supported by new VADIS system. The management and use of the vehicle history must be adapted to Norwegian laws. The NonStop project is going into this issue. In Figure 27: Control System – History
- Provide Information to other Regulators	Must be supported by the new VADIS system. The exchange of infringement information with foreign regulators must be realised in line with the requirements from the ERRU initiatives. In Figure 27: Control System - History
- Manage and Provide Inspection Statistics	Must be supported by new VADIS system. The exchange of statistics with foreign regulators must be realised in line with the requirements from the ERRU initiatives. In Figure 27: Control System – Control statistics and DSS statistics
- Manage Control Strategy	Must be supported by the new VADIS system.
• Operate Transport Means Inspections	Must be supported by the new VADIS system
- Configure Decision Support Strategies	Must be supported by the part of the new VADIS system that supports the operative controls. The NonStop Project will establish a pilot. In Figure 27: Decision support system
- Select Control Candidates	The activity is realized by the decision support system. It acquires sensor information from the ITS stations and vehicle information from registries like AutoSys and compares the information to identify vehicles that are candidates to be stopped for further inspection. The NonStop project will establish a pilot implementation of the system. In Figure 27: Decision support system
- Perform Transport Means Inspection	The manual and inspection of vehicles is performed by NPRA, and the manual inspections must be supported by the new VADIS system. VADIS will enable access to AutoSys and other remote services, and VADIS will also support the registration of the results from the manual inspections. The decision support system will not change any routines related to the actual inspections as its area of appliance stops at informing the operators about possible candidates. Driver related information not part of the Vehicle info is specified to be available through remote service requests. In Figure 27: Control support system
• Infringement Management	The activity is supported by systems managed by different authorities. These systems are not further addressed by META. It will, as today, be included in NPRA's control activities through customs and police information that are used in cooperation with representatives from the authorities themselves. In Figure 27: National Authorities
Support Transportation Network Continuous Operation	Manual procedures and systems that support continuous operation of the sensor systems and road-side equipment like ITS stations. In Figure 27: Roadside equipment
On-board Control and Support	This activity is realised by OBE (On-board Equipment). It is believed that OBEs with the required information will be available in a few years – partly due to European transport directives. For mobile vehicle controls on remote locations, the direct information exchange may to some extent replace central registry requests. In Figure 27: On-goods / In-vehicle equipment

7.3 Domains and roles

Table 7 shows the mapping between the ARKTRANS domain and roles and real stakeholders. It also shows which processes and activities that are the responsibility of the different roles and the related system components in Figure 27.

Table 7 Mapping between domains, roles, stakeholders, processes and system components

ARKTRANS domains	ARKTRANS Roles	Stakeholders	Processes and activities	System components

Regulation Enforcement	Transport authorities subordinated the Transport Regulator role:
	• License Authority
	• Transport Means Regulatory Authority
	• Transport Means Inspection Authority
	  ○ Transport Means Inspection Manager
	  ○ Transport Means Inspection Operator
		• NPRA
		• Road administrations of foreign countries
			Relevant parts of the Transport Regulation process - see 0
			• Manage Transport Related Licenses
			• Manage Approval Certification and Registration of Transport Means
			• Manage Transport Means Inspections
			• Operate Transport Means Inspections
				National systems
				• Decision Support System
				• Control System
				• National Registries
				
				EU systems corresponding to the national, among others:
				• EU Registries
				• EU History

	Roles subordinated the Transport Regulator role: • Civil Law Authority • Customs Authority • Immigration Authority • Health Authority • Agricultural Authority • Veterinary Authority	Authorities like • Police • Customs • Etc.	• The Infringement Management process – see 5.1.	• Customs system • Police system • Etc.
Transportation Network Management	• Transport Means Inspection Authority	NPRA	• Support Transportation Network Continuous Operation – see 5.1.	• Roadside Equipment
Transport Supply	• On-board Manger	Driver	• On-board Control and Support – see 5.1.	• On-goods Equipment • In-vehicle equipment

References

1. Natvig M., W.H., et al., ARKTRANS - The multimodal ITS framework architecture, Version 6. 2009: SINTEF A12001, ISBN 978-82-14-04444-7, 320 pages.
2. OMG, Unified Modeling Language (OMG UML), Superstructure, V2.1.2. 2007.

Annex A. The ARKTRANS approach

This annex presents the methodology and notation used in with respect to the specification of the roles in chapter 3, the process view in chapter 4 and the information view in chapter 6. The methodology is defined by the ARKTRANS framework.

A.1. ARKTRANS

The ARKTRANS framework architecture addresses different aspects of the transport domain, as illustrated in Figure 28. META addresses those parts included in the oval.

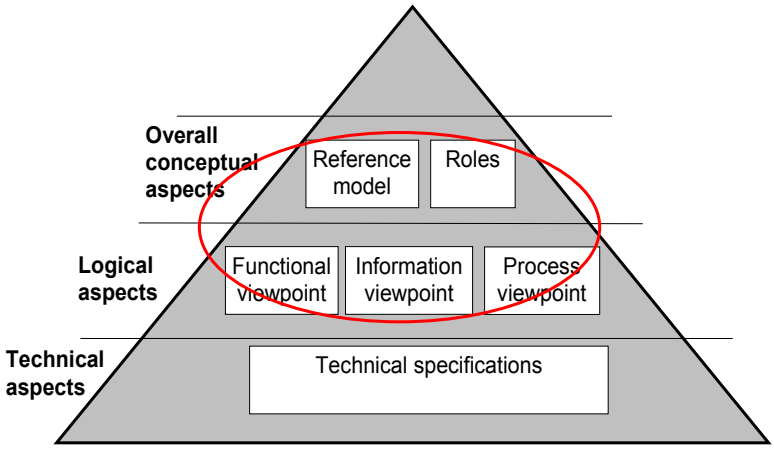

Figure 28: The ARKTRANS framework

The overall concepts define the responsibilities and their scope.

- The ARKTRANS Reference Model divides the transport sector into domains, each with specific responsibilities and focuses. META related its specification to the Reference Model.
- The roles define different types of generic responsibilities that belong to the domains of the Reference Model. META uses the roles defined by ARKTRANS, but to handle the organization of the vehicle control operations, META has defined roles that are subordinate to the overall Transport Means Inspection Authority ARKTRANS role.

The logical aspects define solutions from a logical point of view (i.e. independent of technologies):

- The process viewpoint describes how the activities in the domains of the Reference Model will interact to fulfil their responsibilities and objectives. META define processes that are subordinate to the overall ARKTRANS processes
- The information viewpoint defines the content and structure of information elements, and the service interfaces with APIs that support exchange the information across the domains of the Reference Model. META defines information models related to vehicle control.
- The functional viewpoint describes functional requirements related to the activities that take place in the different domains of the Reference Model. The functional description of the activities in the Process view of META corresponds to this view.

The technical aspects specify the implementation of the relevant parts of the logical aspects.

A.2. Reference model

ARKTRANS divides the transport sector into domains. Those domains of relevance to META are:

- Transport Regulation addresses the authority and regulation issues such as
  - Vehicle inspection
  - Management of information on vehicle registration, licenses and other information that is managed by the authority
  - Enforcement of laws and regulations

- Transportation Network Management addresses the management and operation of the physical transport network, in the case of META the road network. This also includes the continuous operation of roadside equipment.
- Transport Supply addresses the actual transport operations from their initiation based on a transport demand through the management of transport operation and the actual operation of the transport means. In META just the latter is addressed with focus on the vehicle and its driver.

A.3. Roles

A stakeholder may be a person, a team, an organization or an institution. In the architecture description we define the stakeholders by means of generic roles. *One role represents a unique and consistent set of related responsibilities.* By using roles, the architecture description can be generic and independent of organisational issues. Traffic management may for example be organised in different ways in different European cities. The public road administration or the city itself may have the responsibility, or there may be a combination where the public road administration and the city are responsible for different roads. The architecture description is abstracted from such organisational aspects by using the generic Traffic Manager role to represent this traffic management responsibility. The same role can also apply to the traffic management that may be needed in large terminals. A terminal operator may for example play the Traffic Manager role and manage entries, exits and access to terminal areas.

Roles are used as generic names for stakeholders. *A role relate to just one of the domains of the Reference Model*. By means of the roles we can refer to stakeholders, physical entities in a generic way that is independent of local organisations and implementations.

It is important to notice that *an actor or stakeholder in the real world may play one or more roles*. The public road administration may for example have roles like the above mentioned Traffic Manager (responsible for the traffic management) and Transportation Infrastructure Manager (responsible for the physical infrastructure).

A.4. Process viewpoint

Processes are described by means of UML activity diagrams in swim lanes. A top-down and role centric approach is used. Top-down means that the specification starts at an overall level with a set of overall activities, which we can browse. Role centric means that each activity belongs to one role, i.e. a generic actor with a specific set of responsibilities. To maintain the strict relation between the role and the activity, each activity is located inside a swim lane belonging to its role.

Figure 29 shows an example of an activity diagram that describes the terminology used in this document. The UML notation is not described here, but it is referred to reference [2] for information on UML notation.

Comments on roles and activities

- The inner life, or the decomposition, of *ParentActivity*, which consists of the child activities *Activity A_1*, *Activity A_2*, and *Activity A_3*. *Role A* is responsible for all these activities, and the activities are located into the swim lane of *Role A*.
- **Example:** *Role A* could be the Inspection Operator, and the *ParentActivity* may be the Inspect Vehicle activity, which is the responsibility of the Inspection Operator. The decomposed activities *Activity A_1*, *Activity A_2*, and *Activity A_3* may be *Acquire Information*, *Check Information* and *Check Conditions*.

Comments on information flows

- The ParentActivity exchanges information with activities that are under responsibility of other roles, in this case Activity B_1 (Role B is responsible), Activity C_1 (Role C is responsible) and Activity D_1 (Role D is responsible).
- The information flows are the dotted arrows between the respective swim lanes.

- It is important to notice that the information flows between activities belonging to the same swim lane (i.e. role) are not described as these flows are considered as an internal issue for those realising the solution.
- Within one swim lane, just the control flows (the unbroken lines) are depicted.

The information flows can be one of three different types of which the first two types exist or are planned for implementation:

- Automatically exchange of electronic information through interfaces defined by this report - *FlowType1*. This type is depicted as a bold arrow.
- Manually initiated exchange of electronic information (e.g. notifications from the *Inspection Operator* to different authorities) - *FlowType2*.
- Electronic information that will not be implemented in the near future - *FlowType3*. Such flows represent a possibility that, through realization, will enable better and more efficient control of vehicles (e.g. vehicle information automatically sent from in-vehicle devices to the *Inspection Operator*.

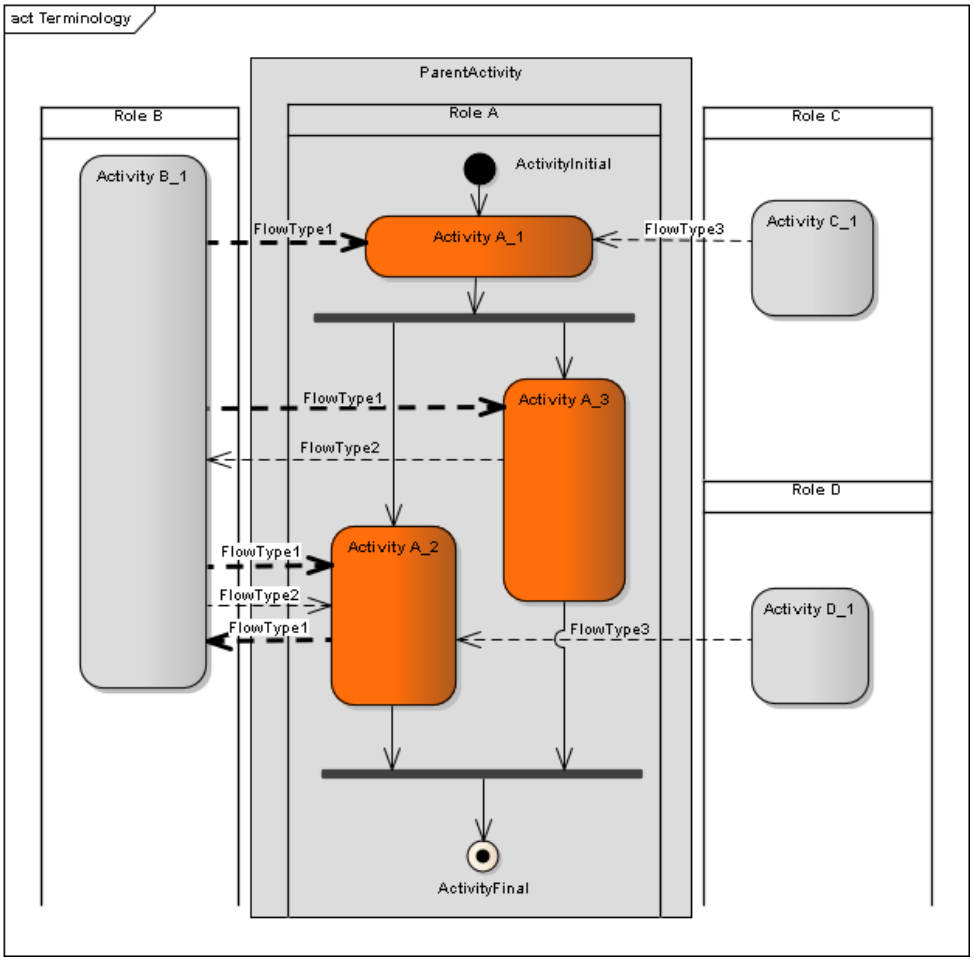

Figure 29: Activity diagram notation

A.5. Information viewpoint

The information flows in the process view is further described, and the information flows depicted as bold arrows in the process diagrams are defined by means of information models. UML class diagrams are used to define the information elements and the structuring of the information. The classes are put together in hierarchies, and code lists and composite data types are defined. These structures are normative for the technical realisation of the information flows.

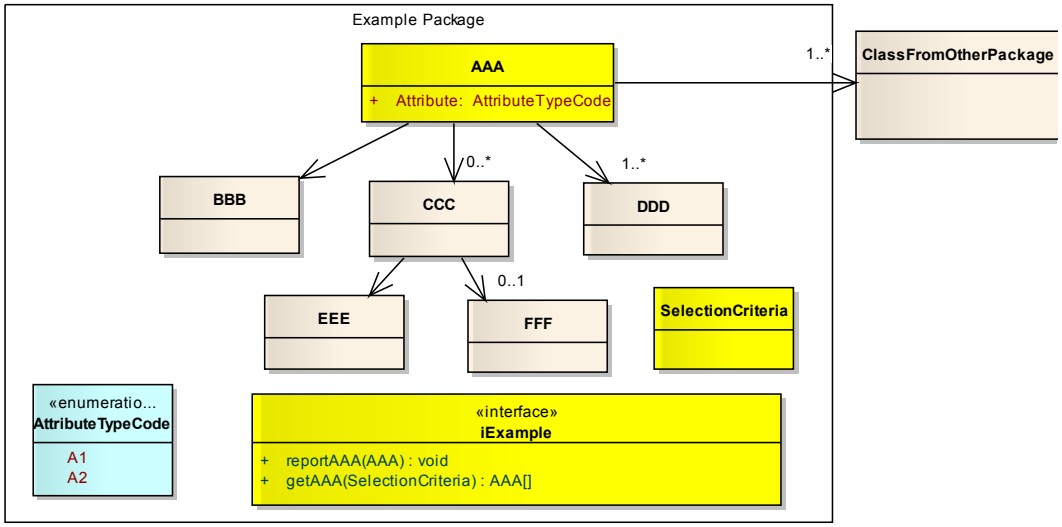

Figure 30 Information model notation

The information models are organised into packages. The classes within one package are logically related, and they are presented in the sections below. In each package a boarder is used as a frame around the classes belonging to the package. Relations towards classes belonging to other packages is also includes. Such classes are depicted outside the frame, as illustrated in Figure 30. It is however important to notice that just the first class outside the package is included. This class may represent the top of a hierarchy with more classes from other packages. The code lists defined are turquoise.

Most packages have an interface. The interface defines the service interfaces that support the required information flows. A yellow colour is used to identify the service interfaces and the top information elements of their input and output parameters as illustrated in Figure 30.

Technology for a better society

www.sintef.no