

# Roadside Traffic Data Collection

Requirement specification

## RTDCE for periodic mobile traffic data collection



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Authorisation	Name	Date	Signature
Author	Malin Eriksson		
Co. author	Snorre Hansen		
Norwegian Public Roads Administration	Kristin Gryteselv		

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## Introduction

This document covers the requirements related to mobile Roadside Traffic Data Collection Equipment (RTDCE) for data collection regarding vehicles.

Separate documents [1] describe the interface used for communication between RTDCE and the backend system, Datainn.

*This document serves the following purposes:*

- It is the basis for the response to the Tender documents.
- Development of a test plan and at a later stage, detailed test procedures, for qualifying the equipment on the requirements in this document.

*The audience for this document is:*

- The bidders for the RTDC equipment.
- The Bidder's personnel who is involved in realising the system, such as HW/SW engineers involved in development, test engineers and project management.
- The Customer's personnel who are involved in the commissioning of the delivered RTDC equipment.

## Definitions

The glossary in Table 1 is an alphabetical list with the explanation of terms and phrases used in the specifications.

*Table 1. Definitions*

API	Application programming interface
Continuous traffic data collection	Continuous in this context means permanent installations collecting traffic data 24/7 throughout the year
Data owner	Norwegian Public Roads Administration owns all data collected in connection with the traffic data system
GNSS	A Global Navigation Satellite System (GNSS) is a space-based satellite navigation system that provides location and time information
GPS	The Global Positioning System (GPS) is a GNSS
Mobile traffic data collection	Short term traffic data collection with non-permanent installation without fixed power, with or without continuous data transfer.
NPRA	Norwegian Public Roads Administration
NTP	Network Time Protocol is a networking protocol for clock synchronization between computer systems over packet-switched, variable-latency data networks.
Periodic traffic data collection	Traffic data collection in a planned and determined period. Installations can be mobile or permanent, but may not have fixed power or continuous data transfer.
RTDCE	Roadside Traffic Data Collection Equipment All equipment installed at the roadside with the main objective of collecting information on vehicles and pedestrians.
SAT	Site Acceptance Test
SAT-T	Site Acceptance Test – NPRA test station
Technical service life	A product's technical service life is its expected lifetime, or the acceptable period of use in service. It is the time that any manufactured item can be expected to be 'serviceable' or supported by its manufacturer.
True traffic	Video recordings of traffic where vehicles are manually counted and licence plate are manually registered. Information about length and class are obtained from the vehicle register (AutoSys).
UTC	Coordinated Universal Time, the primary time standard by which the world regulates clocks and time
VbV	Vehicle by vehicle, i.e. every vehicle shall be detected and handled individually
Vehicle	Motor vehicle

## Documents to be returned with tender

The following documents need to be filled in by the Bidder, and returned with the tender.

- 5 - Requirements specification reference for 1
- 6 - Price forms

## References and standards

- [1] API functional requirements
- [2] SSA-V
- [3] SSA-R
- [4] RTDCE – Test strategy

## 1. General description

Automated and real-time collection, mining and application of big data from the roads network is key for the Norwegian public roads administration (NPRA) in order to monitor, plan and manage roads and traffic. The NPRA uses a network of traffic sensors spread throughout the country that collects traffic data in real time - volume, vehicle types, traffic speeds and density on the roads – on a 24/7 basis. As a complement to the network with continuous traffic data collection sites, NPRA also performs periodic traffic data collection with mobile equipment.

Periodic mobile registrations are performed on both city streets and country roads. Usually one employee starts several surveys at different places during one day, and brings the necessary RTDCEs in a standard passenger car.

The sensor network generates large volumes of data. The NPRA is in the process of publishing raw, aggregated and enriched data openly for third party entities, the public in general and real time data management systems in order to rationalise road maintenance, anticipate and manage traffic, uncover safety hazards and improve road safety.

In short, the sensors collect passing motor vehicle and bicycle information, convert the data into traffic event data and submit (via roadside network equipment) the events to the Datainn platform for further processing and storage. A distributed architecture in Datainn ensures very high performance and scalability, while enabling close to real-time detection of certain types of abnormal traffic patterns or traffic hazards.

### 1.1 Description of objective/requirements

The NPRA is responsible for collecting traffic data on the national and county road network in Norway. RTDCE bought in this agreement will be used for short term registrations at various places on national and county roads. Some may also be placed on municipal roads.

The NPRA invites tenders for delivery of mobile RTDCE for motorised vehicles according to specified requirements.

### 1.2 Goals for the delivery

The delivery shall contribute to realising general objectives and strategies with respect to collection of traffic data.

The primary goals for the whole system is that collection of traffic data should take place efficiently, and achieving high quality data both for real-time observation and traffic statistics.

The NPRA wishes to enter into a framework agreement with Bidders who can offer reliable, appropriate and innovative equipment for mobile roadside traffic data collection.

The Contractors are responsible for fixing any issues related to their own RTDCE (such as defective equipment, damaged equipment etc.) and backend system as well as API for delivering traffic data to the NPRA. The SSA-V appendix 5 [2] covers the procedure for issue management.

The NPRA aims for a data collection system where

- The collected traffic data has as high quality as possible
- The system requires a minimum of administration and maintenance, particularly onsite, and is reliable, robust and flexible

### 1.3 System for collecting traffic data

#### 1.3.1 Principles and overview

The overall objective is to have a differentiated traffic data collection system where one uses the technology that is most appropriate in relation to the data needed, local conditions and available infrastructure.

The main principle for roadside traffic data collection is that the data must be processed on a VbV basis. The Contractor will be responsible for collecting data from their RTDCEs to their own back-end system. Data shall then be made available through an API, so that NPRA can transfer data to its central traffic data collection system [1].

Accumulation of data will take place in the central system. This system is not a part of the tender.

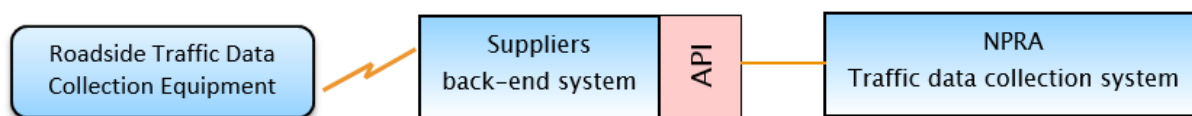


Figure 1. System overview for traffic data collection.

For periodic mobile RTDCE the Bidder shall describe a solution for how and when data is transferred between the RTDCE and the Contractors backend system. The unit might be placed where there is no access to any 3G/4G network data. Data should be transmitted to the Bidder’s backend without the need for manual interference.

The mobile RTDCE must be able to work on a battery for at least 10 days.

#### 1.3.2 Vehicle parameters

The RTDCE must detect and collect data from at least 90 % of the traffic passing the sensor(s).

Table 2 shows the requirements for measurement functionality. NPRA will test each RTDCE regarding accuracy and precision, as a part of the tender competition. Accuracy and precision for length and classification will be set by NPRA after testing. Requirements for accuracy and precision can be set in mini tender competitions.

Table 2. Mandatory and optional parameters

Parameter	Description	Unit	Resolution	Mandatory/Optional
Timestamp	Timestamp for vehicle registration	UTC	milliseconds	Mandatory
Lane	Lane number for vehicle registration	Integer		Mandatory
Direction	Direction of vehicle	Boolean		Mandatory
Speed	Speed of vehicle	Km/h	0,1 km/h	Mandatory
Gap	Time back to front	Seconds	0,01s	Mandatory
Coordinates	Position	See req. 1.5.5.	See req. 1.5.5.	Mandatory
Vehicle class	See Appendix A1			Optional
Length	Vehicle length	Meter	0,01 m	Optional
Quality meta-data	To be specified by Bidder			Optional



## 2. Description of the delivery

### 2.1 In general

The purpose of this tender is to enter into framework agreements for the acquisition of equipment for MOBILE periodic traffic data collection regarding motor vehicles. RTDCE for continuous data collection regarding vehicles, RTDCE for continuous data collection regarding bicycles and mobile RTDCE regarding bicycles are covered in other framework agreements.

### 2.2 Scope

#### 2.2.1 Objectives and principles for procurement

This specification is a functional specification for equipment for traffic data collection of vehicles with mobile installations.

The actual equipment procurement will be distributed between the Contractors with 25 % of the total volume, and 50 % will be arranged through mini tender competitions, as described in SSA-R appendix 2 [3].

#### 2.2.2 What the delivery will include

For mobile equipment the communication unit must be integrated in the RTDCE.

The RTDCE must have a battery inside the encapsulation or cabinet. The battery must be rechargeable. The Bidder shall describe the solution and options for power supply to the RTDCE, see reqs 1.3.4.

Encapsulation or cabinet for the RTDCE must be included in the offer. Attachments of the RTDCE or cabinet to the roadside equipment (i.e. road pole, light pole etc.) is also a part of the delivery. Type of attachment will be specified in the mini tender.

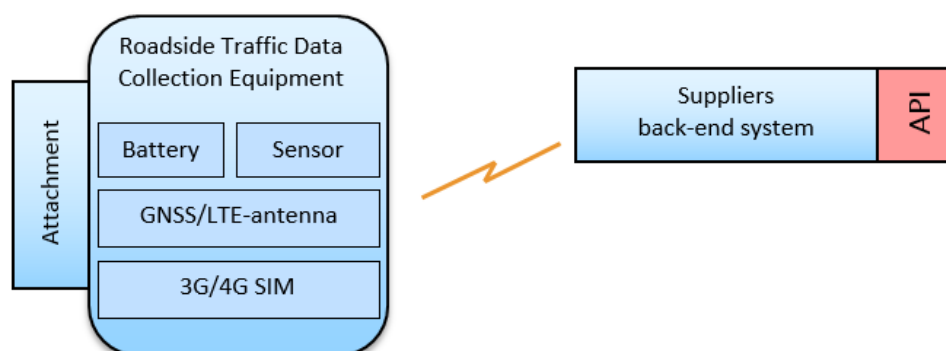


Figure 2. Main elements in delivery for mobile RTDCE

#### 2.2.3 Structure

This specification consists of requirements for mobile RTDCE regarding motor vehicles. The specifications are divided into technical and performance requirements.

The test strategy is described in RTDCE Test strategy [4].

### 3. Requirements

Requirement type	Information
Absolute	An absolute requirement is a requirement that is approved or not approved and will not be evaluated on a scale.
Graded	An answer to a graded requirement will be evaluated on a scale. Graded requirements may include a minimum requirement.

**Note:** Graded requirements with a minimum requirement can be altered in the mini tender competitions. The NPRA shall give fair warning of which requirements that are to be tightened and allow a sufficient time period for the Contractors to comply with these requirement changes.

Test	Information
Blank	DVT ( Design verification test). Technical documentation.
FAT	Factory acceptance test, documentation is either internal testreports or references from sites in operation.
SAT-T	Site acceptance test on NPRA test site.
SAT	Site acceptance test
KPI	Key performance indicator

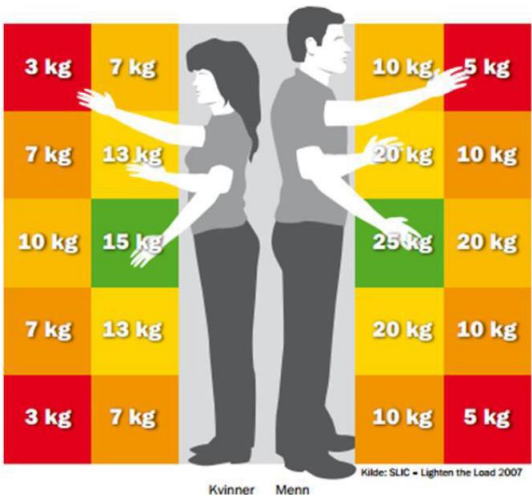
**Note:** More information about the different tests are described in RTDCE Test Strategy [4].

### 3.1 Technical requirements

#### 3.1.1 General technical requirements

ID	Requirements	Type	Test
1.1.1	The guarantee period for the RTDCE shall be in accordance to clause 2.1.6 in the SSA-K-condensed [3].	Absolute	
1.1.2	The technical service life shall not be less than 10 years.	Absolute	
1.1.3	Packaging and RTDCE shall be labelled with: <ul style="list-style-type: none"> <li>• RTDCE serial number</li> <li>• which type(s) of traffic it is used to register, i.e motor vehicles, bicycles or pedestrians</li> </ul>	Absolute	SAT-T, SAT
1.1.4	The RTDCE must be equipped with integrated sensor(s).	Absolute	
1.1.5	The Bidder must have a mobile app for the RTDCE. These functions must at a minimum be handled by the app: <ul style="list-style-type: none"> <li>- Show power level of the RTDCE (alternatively: display on unit)</li> <li>- Process for configuring and verifying traffic flow in each lane</li> <li>- Showing current RTDCE clock (alternatively: display on unit)</li> <li>- Show GNSS signal strength (Signals from enough satellites for positioning)</li> <li>- Any configuration of the RTDCE necessary to start a new registration period</li> <li>- Starting a new registration period</li> </ul>	Graded	SAT-T SAT
1.1.6	The mobile app must be available on both Android and Apple hand-held clients like mobile phones and tablets.	Absolute	SAT-T
1.1.7	The Bidder must have a «web solution» where NPRA can see and get information about each RTDCE, previous registrations and status.	Graded	SAT-T

### 3.1.2 Installation requirements

ID	Requirements	Type	Test
1.2.1	<p>The physical installation/set-up of the RTDCE must be easy and user friendly with hand held mounting tools e.g. electric drill and spanner. The RTDCE must be designed for installation by only one person with no extra equipment such as lift, ladder or stool.</p>  <p style="text-align: center;"><small>Kilde: SLIC - Lighten the Load 2007</small></p>	Graded	SAT-T
1.2.2	When installing the RTDCE, as much as possible of configuration should be automated. It's very important that the installation is not very time-consuming.	Graded	SAT-T
1.2.3	The Bidder must describe the possibilities for attaching the RTDCE in different ways, to e.g. a small traffic sign pole to a tree-size thick pole and roadside railing.	Absolute	
1.2.4	The Bidder shall describe how the RTDCE is turned on and off.	Absolute	

### 3.1.3 Environmental requirements

ID	Requirements	Type	Test
1.3.1	Equipment exposed to open air shall tolerate normal road maintenance such as sweeping, snow-clearing, scattering of gravel and salting.	Absolute	
1.3.2	Electronic units, sensors and equipment that are installed in a cabinet shall function properly within the temperature range -40°C to +80°C.	Absolute	
1.3.3	Electronic units, sensors and equipment outside cabinets must function properly within the temperature range -40°C to +40°C.	Absolute	
1.3.4	The encapsulation of the RTDCE must as a minimum meet the requirements for IP65.	Absolute	
1.3.5	Equipment that is exposed to open air shall work within the relative humidity range of 5% to 95%.	Absolute	

### 3.1.4 Power supply and electricity requirements

ID	Requirements	Type	Test
1.4.1	All electronic equipment shall be checked and approved in accordance with applicable regulations.	Absolute	
1.4.2	The Bidder must describe the solution for connecting the RTDCE to a power supply. E.g. is it using rechargeable integrated batteries or replaceable batteries. The description shall also specify if the battery change can be performed by the operator or if service by the Supplier is required.  The Bidder shall also describe if there are alternative solutions to extend the length of a registration to more than one normal battery cycle. E.g. changing battery during registration, additional or other powersources.	Graded	
1.4.3	The Bidder must specify expected length of registration (days) before recharging or change of integrated battery is needed. Minimum 8 days.	Graded	SAT-T
1.4.4	The description should include an expected number of surveys (8x24h) which can be performed before the capacity of the provided/specified battery is reduced to a point where it no longer meets the required minimum for a surveys length.	Graded	

### 3.1.5 Time and positioning

ID	Requirements	Type	Test
1.5.1	The RTDCE shall have an GNSS receiver that supports EGNOS, and an integrated GNSS antenna.	Absolute	
1.5.2	GNSS shall be used as the primary source and NTP as secondary source for timestamp. The Bidder must specify how often the clock is synchronized.	Graded	
1.5.3	The RTDCE must after every power-up/reboot try to synchronize the clock continuously until its successfully synchronized to GNSS/NTP.	Absolute	
1.5.4	The Bidder shall specify the expected drift per month of the internal clock, given no connection to GNSS. The internal clock must not have an expected drift that exceeds 50 PPM.	Absolute	
1.5.5	Positions from GNSS shall use decimal degrees with at least five decimals for latitude and longitude indicating the position of the RTDCE.	Absolute	SAT-T

### 3.1.6 Data storage and control of data quality

ID	Requirements	Type	Test
1.6.1	Traffic events must be stored internally in such a way that in the event of a power loss, the unit shall not lose more than one – 1 – minute of traffic data due to in memory storage, other internal configuration choices by the Bidder or other factors within the Bidders control.	Absolute	SAT-T
1.6.2	The RTDCE shall be equipped with sufficient memory to store vbv data equivalent to 1 000 000 events before any new data overwrites the oldest data.	Graded	
1.6.3	The buffer shall not be overwritten until its capacity is at / near max to ensure a minimal chance of data loss.	Absolute	

ID	Requirements	Type	Test
1.6.4	Should the data storage become full, the oldest data must be overwritten first. The unit shall never fail because the data store is full. The Bidder shall describe how a full data storage will be handled.	Absolute	
1.6.5	Each stored data object shall have a unique numeric sequential identity. All sequence numbers must be strictly monotonously increasing. The sequence cannot be restarted.	Absolute	SAT-T
1.6.6	The sequential number shall be set by the RTDCE, not by the backend system.	Absolute	
1.6.7	The sequence number shall not be set before a registration is complete and verified by the RTDCE. In other words, there should be no jump in sequence numbers due to faulty registrations (due to e.g. straddling or slow-moving vehicles).	Absolute	
1.6.8	If the unit calculates quality meta-data connected to its measured attributes, then this data must be transmitted along with the data in the record or measurement. The Bidder shall describe what quality metadata can be provided.	Graded	SAT-T

### 3.1.7 Interface and communication

ID	Requirements	Type	Test
1.7.1	All necessary firmware/software upgrades on (e.g. due to new functionality required by the NPRA, bug fixes etc) the RTDCE shall be handled by the Contractor over the air.	Absolute	
1.7.2	All new firmware upgrades related to change in functionality/bug fixes on the RTDCE must be approved by NPRA before upgrading all units.	Absolute	KPI
1.7.3	When new firmware related to change in functionality/bug fixes is installed, NPRA must receive a change log for the firmware and installation date/period.	Absolute	KPI
1.7.4	The Contractor is responsible for traffic data being transferred between the RTDCE and the Contractors backend system. The Bidder must describe the mechanisms for transfer, including functionality for handling spotty/lacking network connections (and not losing events due to this or other factors), whether connections are persistent or no, acknowledgements of transfer and so on.	Graded	
1.7.5	The Bidder must detail how the complete transfer of all registrations from a site can be confirmed.	Graded	
1.7.6	Bidder must develop an API for NPRA to use for transfer data (see [1]). Bidders will be judged on the merits and principles described in [1].  Note that [1] specifies principles rather than strict requirements (exception: event/device events in the form of JSON documents). The exact specification of the API/integration is left for the negotiation period with Bidders, but evaluation will be based on the principles described in [1].	Graded	SAT-T

### 3.1.8 Documentation

ID	Requirements	Type	Test
1.8.1	All documentation shall be given in English or a Scandinavian language.	Absolute	
1.8.2	The Contractor shall provide technical support for its equipment as described in "RTDCE ssa-v_appendices_2015.eng.doc".	Absolute	
1.8.3	<p>System manual. The Bidder shall provide a system manual, with detailed technical description of all equipment, intended for use by system administrators in the NPRA. The system manual shall include the following:</p> <ul style="list-style-type: none"> <li>- System/component overview, both hardware and software and storage solution</li> <li>- Safety information/measures, including but not limited to authentication, authorisation, penetration avoidance etc</li> <li>- Interface with external components/network</li> <li>- System flow/data flow</li> </ul> <p>To be useable the system manual must be as short and concise as possible and <i>maximum 25 pages</i>.</p>	Graded	
1.8.4	<p>User manual for the RTDCE. The Bidder shall provide a user manual for the RTDCE with guidance in installation, use and maintenance. The manual shall include at least:</p> <ul style="list-style-type: none"> <li>- Installation procedure</li> <li>- Approximate time for installation</li> <li>- Limitations</li> <li>- Special infrastructure required for installation</li> <li>- Required and recommended maintenance</li> <li>- Sensor type</li> <li>- Maintenance needed for a long lifetime of sensors/RTDCE</li> </ul> <p>To be useable the user manual must be as short and concise as possible and <i>maximum 30 pages</i>.</p>	Graded	
1.8.5	<p>The Contractor must enclose information with each new delivered RTDCE about:</p> <ul style="list-style-type: none"> <li>- Serial number</li> <li>- Mini tender competition number</li> <li>- Other information about the unit that the Contractor wants to add</li> </ul> <p>The information will be sent by e-mail or made available for download to the receiver of the RTDCE.</p>	Absolute	
1.8.6	<p>The Contractor must enclose information when returning a RTDCE from service:</p> <ul style="list-style-type: none"> <li>- Test report (including serial number, and date of test)</li> <li>- Other information about the unit that the Contractor wants to add.</li> </ul> <p>The information will be sent by e-mail or made available for download to the receiver of the RTDCE.</p>	Absolute	

## 3.2 Performance requirements

### 3.2.1 Road type

ID	Requirements	Type	Test
2.1.1	The RTDCE shall handle two lane roads with bidirectional traffic, single lane roads with bidirectional traffic and single lane roads with unidirectional traffic.	Absolute	
2.1.2	The Bidder shall specify the maximum traffic volume (pr hour) the RTDCE can handle.	Graded	FAT
2.1.3	The Bidder shall provide information about known restrictions for the RTDCE and sensors regarding installation site and traffic (e.g. tunnels, slow traffic, queue, light conditions, weather conditions, road surface, parallel roads, distance to other sensors etc.)	Absolute	

### 3.2.2 Measurements

ID	Requirements	Type	Test
2.2.1	The RTDCE must be able to register and recognise vehicles in the range between 1,5 m and 26 m.	Absolute	
2.2.2	The RTDCE shall register at least 90 % of true traffic.	Graded	SAT-T KPI
2.2.3	Every vehicle registration must be time-stamped using the UTC millisecond format.	Absolute	SAT-T
2.2.4	Every vehicle registration must include coordinates (see requirement 1.5.5).	Absolute	SAT-T
2.2.5	The RTDCE shall distinguish between the different lanes the vehicles are using. The lane closest to the RTDCE shall be set to 1 and the furthest to 2.	Absolute	SAT-T
2.2.6	The RTDCE shall distinguish between whether vehicles pass towards or away from the direction the RTDCE is facing. The direction parameter shall be set to TRUE if vehicles pass away from the RTDCE and FALSE if towards.	Absolute	SAT-T
2.2.7	If the RTDCE classifies vehicles, the Bidder shall use NorSIKT-classification, or provide a conversion table between the RTDCE classification and the NorSIKT-classification. Use appendix A2.	Absolute	SAT-T
2.2.8	If the RTDCE classifies vehicles, the NPRA will test the RTDCE for NorSIKT level 2.	Graded	SAT-T
2.2.9	NPRA will test the RTDCE regarding speed registrations.	Graded	SAT-T
2.2.10	The speed shall be absolute. Negative speed as a result of a vehicle driving in the "wrong" direction is not accepted.	Absolute	SAT-T
2.2.11	If the RTDCE registers length, the NPRA will test the RTDCE regarding accuracy and precision.	Graded	SAT-T
2.2.12	If other entities (e.g. bicycles or pedestrians) are recorded, they shall be treated in the monitoring system in such a way that they are not confused with the vehicle registrations.	Absolute	
2.2.13	The Bidder must describe how the RTDCE handles slow traffic and queue. Are there any restrictions about slowest vehicle speed and how will the vehicle classes be affected by slow traffic and queues?	Absolute	



### 3.2.3 General performance requirement

ID	Requirements	Type	Test
2.3.1	The RTDCE shall have a log for when power has been switched on and off, including due to power failures, so it is possible to know the time periods with and without traffic registrations. This shall be available through the API.	Absolute	SAT-T

## Appendix

### A1. NorSIKT classes

Figure 3 show the classification method developed as a part of the NordFoU project NorSIKT.

In addition to the lowest level, level 1, where there is no distinction between types of vehicles; there are 5 different levels for motor vehicles with a progressively finer classification of vehicle types. The Nordic method distinguishes whether the vehicle units are with or without trailer.

The main idea behind the Nordic classification method is that it should be possible to assemble nationally customized groups of vehicles regardless of the level section. Within each country, it is expected a user adapted traffic data collection system, and it is envisaged that the procurement of equipment is done from the objective to meet actual needs.

NorSIKT												Date 141211	
Road motor vehicle classification													
Level													
1	1 opt	2	2 opt	3	3 opt	4	4 opt	5	5 opt	6	6 opt		
Motor vehicle "MV"	MV with coupled vehicle "MV+ WC"	Light motor vehicle* "LMV"	+ WC	MC & MP	+ WC	MC & MP	+ WC	MC & MP	+ WC	Moped "MP"			
					+ WOC		+ WOC		+ WOC	Motorcycle "MC"	+ WC		
			+ WOC	PC, LGV & LB	+ WC	PC & LGV	+ WC	PC & LGV	+ WC	PC & LGV	+ WC	PC	+ WC
							+ WOC		+ WOC		+ WOC	Small LGV	+ WC
			+ WOC	+ WOC	+ WOC	+ WOC	LB (GVWR ≤ 5ton)	+ WC	LB (GVWR ≤ 5ton)	+ WC	+ WC	LB (GVWR ≤ 5ton)	+ WC
													+ WOC
	MV without coup vehicle "MV+ WOC"	Heavy motor vehicle** "HMV"	+ WC	HMV (HB, HGV, RT & EMS)	+ WC	+ WC	HB (GVWR > 5 ton)	+ WC	HB (GVWR > 5 ton)	+ WC	HB (GVWR > 5 ton)	+ WC	
								+ WOC		+ WOC		+ WOC	HGV + WC
			+ WOC	+ WOC	+ WOC	+ WOC	HG, RT & EMS (GVWR > 3,5 ton)	+ WC	HG, RT & EMS (GVWR > 3,5 ton)	+ WC	+ WC	HG, RT & EMS (GVWR > 3,5 ton)	HGV + WOC
													+ WOC
			+ WOC	+ WOC	+ WOC	+ WOC	+ WOC	+ WOC	+ WOC	+ WOC	+ WOC	+ WOC	RT + WOC
													+ WOC
Other motor vehicle "OMV"											EMS (VL ≥ 24 m)		

\* Motor vehicle "MV" with total weight ≤ 3 500 kg, GVWR ≤ 3 500 kg (except light bus "LB" GVWR ≤ 5 000 kg and all OMV)  
 \*\* Motor vehicle "MV" with total weight ≥ 3 500 kg, GVWR ≥ 3 500 kg (except heavy bus "HB" GVWR ≥ 5 000 kg and all OMV)  
 VL = Vehicle length, WC = With a coupled vehicle, WOC = Without a coupled vehicle

Figure 3. NorSIKT classification scheme

## A2. NorSIKT conversion table

NorSIKT (level 2)	RTDCE
LMV	
HMV	
OMV	