Transport og samfunn
Transportutvikling
Transportdata
20.08.2021

Statens vegvesen

Requirements specification RTDCE for fixed stations

Vehicles

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Introduction

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

Separate documents describe the interface used for communication (OPC UA) between RTDCE and the NPRA Traffic data system.

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 **Feil! Fant ikke referansekilden.** is an alphabetical list with the explanation of t erms and phrases used in the specifications.

Autosys	Norwegian national vehicle register
Continuous traffic data collection	Continuous in this context means permanent installations collecting traffic data 24/7 throughout the year
Data collecting station	
Data owner	Norwegian Public Roads Administration owns all data collected in connection with the traffic data system
NPRA	Norwegian Public Roads Administration
OPC UA	Open Productivity & Connectivity Unified Architecture. An open and vendor independent standard for transfer of process data.
RTDCE	Roadside Traffic Data Collection Equipment All equipment installed at the roadside with the main objective of collecting information on vehicles and pedestrians. *NOTE 1: The sensors not integrated in the RTDCE itself are not part of the RTDCE, e.g. inductive loops and piezoelectric cables installed in the road pavement.* *NOTE 2: Any traffic sign or road user information equipment, e.g. bicycle displays and vehicle speed information signs, is not part of the RTDCE.*
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.
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 RTDCE
- 6 – Requirements specification reference for RTDCE interface (OPCUA)
- 7 – Price forms
- 8 – Translate RTDCE classes to NorSIKT classes
- SSA-R appendices
- SSA-V appendices[1]
- SSA-K appendices

Documents must be returned in two copies:

- Original version for evaluation
- Censored version

References and standards

[1] *2 – Requirements specification – RTDCE interface – OPCUA*

[1] If there's already a maintenance agreement between NPRA and the Bidder where new RTDCEs can be included, that agreement will be used and no new SSA-V appendices needs to be included in the tender.

1. General description

Automated and real-time collection, mining and application of big data from the road network is key for the Norwegian public roads administration (NPRA) in order to monitor, plan and manage roads and traffic. The network of traffic sensors spread throughout the country collects traffic data in real time – volume, vehicle types, traffic speeds and density on the roads – on a 24/7 basis. The network of traffic data stations generates vast volumes of data (ie "big data"), and the ambition of the NPRA is to publish 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 sensor(s) collect passing vehicle information, convert the data into traffic event data and submit (via roadside network equipment) the events to the NPRA Traffic data system for further processing, storage and publishing.

All information exchange between the roadside equipment and the NPRA Traffic data system, uses the OPC UA standard [1]. A distributed architecture in the NPRA Traffic data system ensures very high performance and scalability, while enabling close to real-time detection of certain types of abnormal traffic patterns or traffic hazards.

This framework agreement is about traffic data collection regarding vehicles (yellow circle in figure 1).

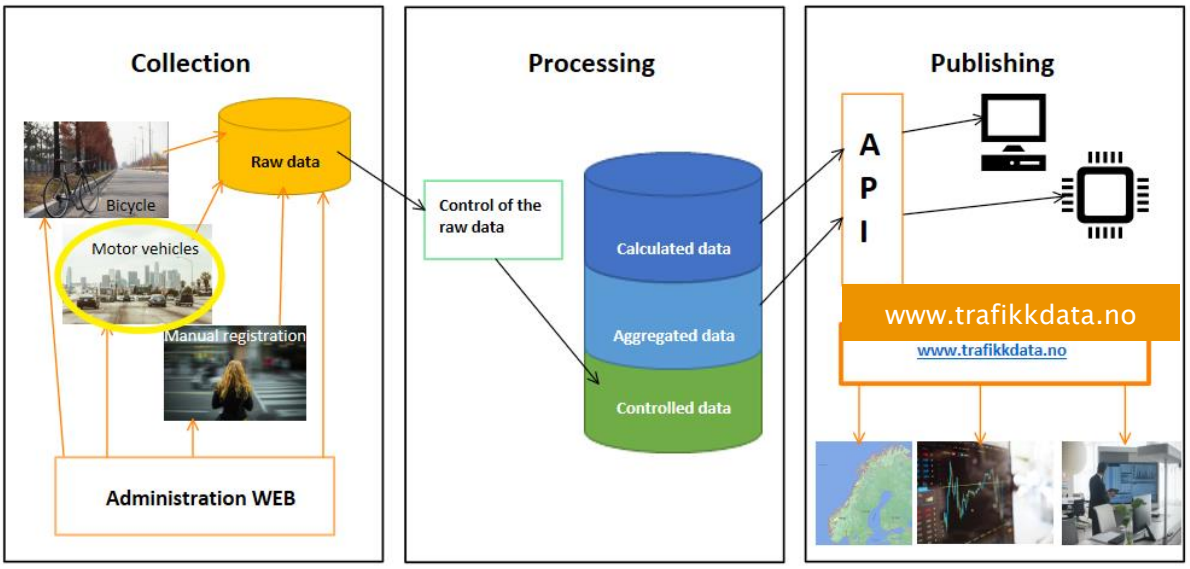


Figure 1. Traffic data collection in NPRA, from data collection to data publishing.

1.1 Traffic data collection with one RTDCE on more than one road

Most traffic data collection stations are placed at roads with two or more lanes, and the RTDCE just need to handle one cross section of the road (A & B in figure 2). Some traffic data collection stations are placed at an intersection. In an intersection the RTDCE collects traffic data from more than one road (C & D in figure 2). To make this possible, NPRA needs to know which sensor(s) is connected to which lane. In the NPRA Traffic data system we then manage the lanes and creates a traffic data collection point for each cross section. For another even more complicated example of traffic data collection in an intersection, see Appendix 9.

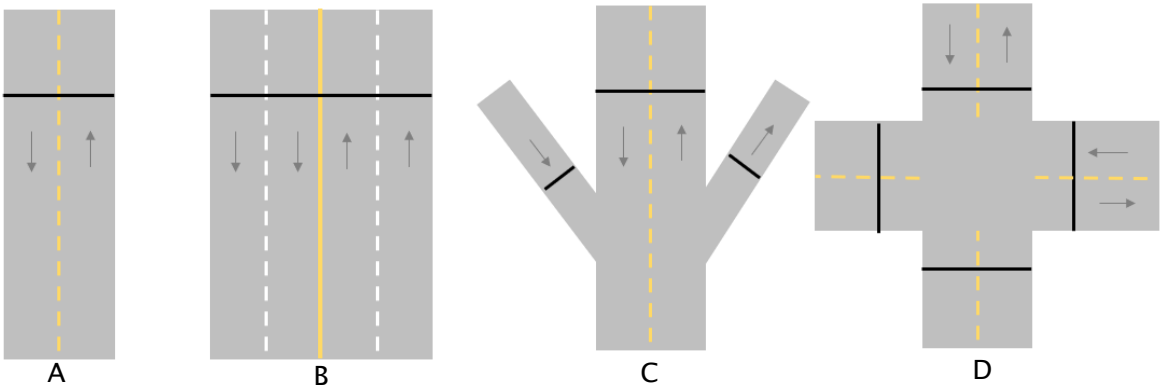


Figure 2 Examples of traffic data collection stations with different cross section(s) setups.

There may be different ways to handle configuration for C and D:

i) External sensors installed in each cross section, connected to one RTDCE in a cabinet.
ii) Use a RTDCE with integrated sensors for each cross section and a device with one OPCUA server in a cabinet to separate data from the RTDCEs in different lanes.
iii) Use one RTDCE for each cross section.

1.2 Description of objective/requirements

NPRA is responsible for collecting traffic data on the national road network in Norway, and the Counties for collecting traffic data on the county road network. RTDCE bought in this agreement will be placed at data collecting stations on national and county roads.

A distinction is made here between bicycle traffic and motorised vehicles. Recording of traffic takes place at both fixed traffic data collection sites with monitoring throughout the year, so-called continuous data collection, and periodic traffic data collection in fixed or non-fixed (mobile) sites.

The NPRA invites tenders for delivery of equipment regarding fixed RTDCE for fixed traffic data collection sites for motorised vehicles, according to specified requirements.

1.3 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 data owner (NPRA or County) must have full control of the data, and not be dependent on obtaining data via a third party.

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

Separation of concerns: the Suppliers are responsible for fixing any issues related to their own RTDCE (such as defective equipment, damaged equipment etc.), while the NPRA is responsible for everything else in the traffic data collection ecosystem. The SSA-V appendix 5 covers the procedure for issue management. This ensures a maximum degree of transparency, supporting the aim of acquiring traffic data where quality parameters (such as % of vehicles registered, quality of speed measurements) are as transparent as possible for the NPRA.

The NPRA aims for a data collection system where

- The collected traffic data satisfy the specified data quality requirements
- Observational data is acquired in a uniform manner from systems using OPC UA interface
- The system requires a minimum of administration and maintenance, particularly on-site, and is reliable, robust and flexible

1.4 System for collecting traffic data

The NPRA Traffic data system combines technology principles and tools from "Internet of Things" and "Big Data", in combination with a strong focus on modern software architecture principles and front-end usability. The combination of mature technology (Java) with robust code libraries (Akka) ensures fast data processing. The big data volumes are stored using NoSQL technology (Elasticsearch), enabling inclusions of data in statistics and data visualisations without delays. Currently, it takes less than one (1) second from a vehicle passes the sensor until the data is shown in the central data visualisation tool.

1.4.1 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. All equipment offered in this tender will be placed into the NPRA Data Acquisition Network, a separate, private and isolated VPN.

The RTDCE shall provide a light weight operational historian[2], or a buffer, from which data can be transmitted, and retransmitted if needed, for example if there was a communications network outage during the initial transfer attempt. The OPC UA history read feature is used for the historian feature.

Accumulation of data will take place in the NPRA Traffic data system. This system is not a part of the tender. A test kit simulating the interface to Datainn will be made available for the suppliers for ensuring compliance with generic OPC UA protocol demands as well as namespace matching.

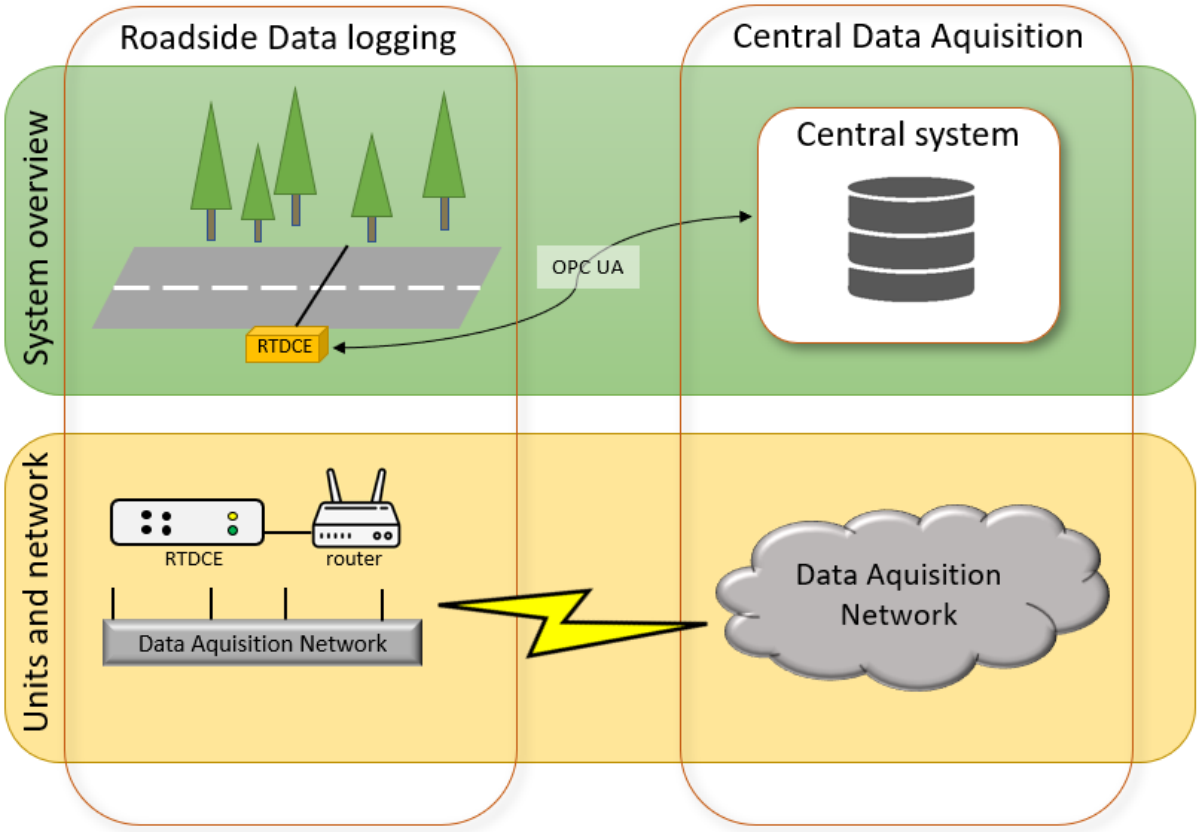


Figure 3. System overview for traffic data collection.

NPRA routers are deployed roadside, extending the NPRA Data Acquisition Network from the roadside cabinets to our central data centers.

Equipment in the NPRA Data Acquisition Network will not access the public internet. Inbound VPN access can be arranged, allowing troubleshooting or similar tasks.

[2] A time-based database for telemetry and process information.

The solution will consist of RTDCE providing a local, built-in OPC UA server. See [1] for a more detailed description of the use of OPC UA for collecting traffic data. The NPRA Traffic data system will act as an OPC UA client.

1.4.2 Vehicle parameters

The equipment for traffic data collection shall collect data with parameters as specified in the address space for OPC UA, described in [1].

1.4.3 Measuring accuracy

*Table 1*1 shows the requirements for measurement functionality and minimum accuracy and precision. The RTDCE must detect and collect data from at least 99 % of the traffic passing the sensor(s).

Table 1. Accuracy for mandatory parameters

Detection	**Definition**	**Accuracy**		**Precision**	
Parameter	**Definition/ Application**	**Requirements for measuring accuracy**			
		Unit	**Accuracy**		**Required resolution**
Timestamp	Timestamp for vehicle registration	UTC	1s		milliseconds
Length	Vehicle length (or vehicle with trailer)	meter	1 - 7,6 m; ± 0,2 m	± 0,2m	0.01m
			7,6 - 26: ± 0,5m	± 0,5m	
Speed	Speed of vehicle	Km/h	0-20 km/h:		0.1 km/h
			20-100 km/h: ±2km/h	±2km/h	
			>100 km/h: ±2 %	±2 %	
Speed quality[3]	A quality parameter denoting the accuracy of the measured speed. If the RTDCE speed measurement of a single vehicle consists of more than one speed value sample, the SpeedQuality should be the absolute value of difference between the maximum and minimum value. (This may be indicative of the uncertainty in the measurements, but also of the vehicle's acceleration across the measured sample space.)				
Classification	NorSIKT (Appendix 3)				Level 3
Lane	Lane number for vehicle registration	Integer	100 %	100%	
Direction	Direction of vehicle	Integer	100 %	100%	
Gap	The time interval between two successive vehicles passing a point measured from back of the first vehicle to the front of the second vehicle.	seconds	0,1s	0,1s	0,01s

[3] Mandatory if the RTDCE speed measurement of a single vehicle consists of more than one speed value sample, otherweise optional.

Table 2. Accuracy for optional parameters

Detection	Definition	Accuracy		Precision	Required resolution
Parameter	Definition/ Application	Requirements for measuring accuracy			
		Unit	Accuracy		
Quality meta-data	To be specified by supplier				
ClassQuality	A quality parameter denoting the accuracy of the class assigned to the event.				
Axles	Number of vehcle axles	Integer	95 %		1
Axel distance	Distance between vehicle axles.	Meter	0.1m		0.01m
Axel weight		kg	90 %		10 kg
Other parameters	To be specified by Bidder	metric (if applicable)	To be specified by Bidder		

2. Description of the delivery

2.1 In general

The purpose of this tender is to enter a framework agreement for the acquisition of equipment for RTDCEs (vehicles) at fixed traffic data collection sites. The RTDCEs purchased in this framework agreemen will be used for:

Continuous traffic data collection (motor vehicles). Equipment is connected to the regular power grid.

2.2 Scope

2.2.1 Objectives and principles for procurement

This specification is a technical and functional specification for equipment for traffic data collection of vehicles with permanent installations.

The procurement will be done by call-offs.

2.2.2 Equipment that shall be included in a delivery

A delivery include the RTDCE, which can be either a complete registration unit with sensor features integrated or with external sensors. Examples of external sensors are (but not limited to) piezo electric sensors and magnetometers. Inductive loops as external sensors are not a part of the delivery, but will be delivered by NPRA if needed.

The delivery must also include cables to connect the RTDCE to the regular power grid (see requirement 13), cables to connect the RTDCE to external sensors (if needed) and Ethernet cable to connect to the router.

GNSS-antenna and cables for battery backup are options.

The procurement includes interface based on OPC UA, see [1]

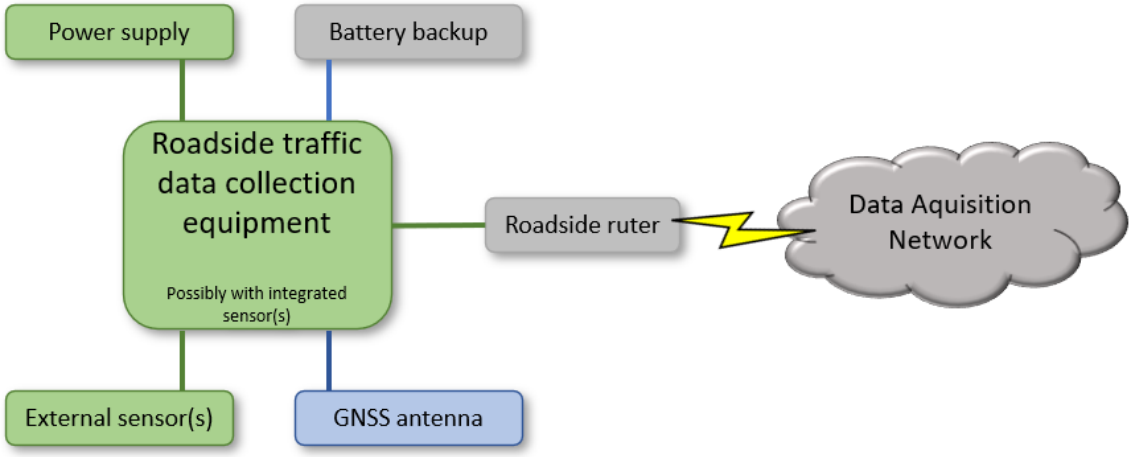


Figure 4. Main elements in delivery for Part A

2.2.3 Structure

This specification consists of requirements for RTDCE regarding vehicles at fixed traffic data collection sites.

The specifications are divided into technical and performance requirements, requirements for the communication interface are given in [1].

The test strategy is described in 3 – Test strategy.

3. Technical requirements

Requirement type	Information
Absolute	An absolute requirement is a mandatory 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. Gradation requirements may include a minimum requirement.
Wanted functionality	Wanted functionality are not requirements, but may provide useful functionality.

Test	Information
Blank	Technical documentation.
FAT	Factory acceptance test, documentation is either internal test reports or references from sites in operation.
SAT-T	Site acceptance test on NPRA test site.
SAT	Site acceptance test

Note: *More information about the different tests are described in 3 – Test procedure.*

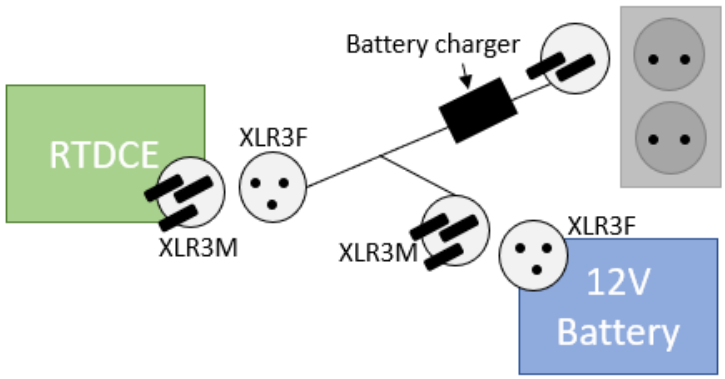
3.1 General requirements

ID	Requirements	Type	Test
1.	The technical service life shall not be less than 10 years.	Absolute	
2.	The space in our roadside cabinets is limited, and therefor equipment and cables to be installed in cabinets must fit in our standard cabinets. We have gauged that an RTDCE including attached cables may have the following dimension as a maximum, but an installation of the equipment onsite will be decisive if this requirement is fulfilled or not. Height: 30 cm Width: 40 cm Depth: 25 cm	Absolute	SAT-T
3.	Packaging and RTDCE shall be labelled with: • QR code and human readable text displaying RTDCE serial number • QR code and human readable text displaying MAC address • QR code and human readable text displaying Traffic type(s) (i.e vehicles, bicycles or pedestrians) and number of lanes (i.e. 4, 8). The QR code shall contain the traffic type a space and a number for lanes. The human readable text shall display vehicle type and then "X lanes" on the next row. The QR code shall be encoded at Level H (High) error correction. The QR code physical dimensions shall be no less than 3cm x 3cm. 4cm x 4cm is recommended. The Bidder shall give an example how the labelling will look like, and where it will be located on packaging and RTDCE. These are our examples (not to scale): Serial number S1337 MAC address 001122334455 Vehicles 8 lanes	Absolute	SAT-T
4.	The RTDCE must be clearly marked for connection with external sensors. The marking must be according to NPRA standard of lane and sensor numbering, see appendix 1.	Absolute	SAT-T SAT
5.	The RTDCE must have diodes or display showing at least - If the unit is connected to power - If the unit is detecting vehicles - if the unit is connected to a network	Absolute	SAT-T SAT

3.2 Environmental requirements

ID	Requirements	Type	Test
6.	RTDCE that needs to be installed outside NPRA roadside cabinets shall tolerate normal road maintenance such as sweeping, snow-clearing, scattering of gravel and salting.	Absolute	
7.	Electronic units and equipment that are installed in a cabinet or below the road surface shall function properly within the temperature range -40°C to +80°C.	Absolute	
8.	Electronic units, sensors and equipment outside cabinets must function properly within the temperature range -40°C to +40°C.	Absolute	
9.	The encapsulation of the RTDCE must as a minimum meet the requirements for IP65.	Absolute	
10.	Sensors and equipment that is exposed to open air shall work within the relative humidity range of 5% to 95%.	Absolute	

3.3 Power supply and electricity requirements

ID	Requirements	Type	Test
11.	All electronic equipment must have a CE certification.	Absolute	SAT-T
12.	The registration equipment must be attachable to the regular power grid and a battery backup in accordance with the figure:  XLR3M on the RTDCE can be a port on the unit, or it can be a cable with an XLR3M, connected to the RTDCE.	Absolute	

3.4 Time and positioning

ID	Requirements	Type	Test
13.	The RTDCE shall be able to synchronize the clock with external sources using NTP. NTP shall be used as the primary source for timestamp.	Absolute	SAT-T
14.	The RTDCE shall be able to synchronize the clock with GNSS. GNSS shall be used as the secondary source for timestamp.	Absolute	SAT-T
15.	The RTDCE shall have a standard SMA connection to an external GNSS antenna. RTDCE with internal GNSS antenna must also have a SMA connection.	Absolute	SAT-T
16.	The RTDCE must after every power-up/reboot try to synchronize the clock continuously until its successfully synchronized with NTP or GNSS.	Absolute	
17.	The internal clock must not have an expected drift of more than one minute per month. The Bidder shall specify the expected drift per month (seconds) of the internal clock in normal and worst case, given no connection to NTP nor GNSS.	Absolute	
18.	Position from GNSS shall use decimal degrees with at least five decimals for latitude and longitude indicating the position of the RTDCE.	Absolute	SAT-T

3.5 Data storage and control of data quality

ID	Requirements	Type	Test
19.	After a total loss of power the RTDCE unit shall start up automatically without requiring reconfiguration, and resume normal operation without manual intervention.	Absolute	SAT-T
20.	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
21.	The RTDCE shall be equipped with sufficient memory to store vbv data equivalent to 10 000 000 events before any new data overwrites the oldest data. Thus the buffer shall not be overwritten until its capacity is at / near max, to ensure a minimal chance of data loss.	Absolute	
22.	Should the data storage become full, the oldest data must be overwritten first. The RTDCE shall never fail because the data store is full. The Bidder shall describe how a full data storage will be handled.	Absolute	
23.	Each stored data object shall have a unique numeric sequential identity as described in [1]. All sequence numbers exposed on OPC UA must be strictly monotonously increasing.	Absolute	SAT-T
24.	The sequence number shall not be set before the 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	

25.	In case of communication failure between the station and the central data acquisition system (no matter the cause – network, OPC-UA connection etc.), the RTDCE shall continue to collect and store data locally.	Absolute	SAT-T
26.	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.	Wanted functionality	

3.6 Interface and communication

ID	Requirements	Type	Test
27.	Communication between Datainn and RTDCE shall comply with description in [1].	Absolute	SAT-T
28.	All configuration and settings on the RTDCE must be exposed through OPC UA. This means no vendor specific software is to be used when installing the RTDCE and/or sensors.	Absolute	SAT-T
29.	The OPC UA address space must be described in detail in a document delivered in the tender.	Absolute	

30.	The Bidder shall specify a development plan for OPC UA address space compliance. The plan must include the following:
	- What, if any, pre-requisites the Bidder foresees that need to be in place before
	  ○ Development can start
	  ○ OPC UA compliant RTDCE can be delivered for testing
	- Any requirements the Bidder needs the NPRA to meet
	- Expected calendar time needed to finish OPC UA integration
	- Expected assistance needed from the NPRA
	- Whom the Bidder will use to develop OPC UA integration and expected skill set/experience of said resources (full CV not needed)
	- Any experience the Bidder has with OPC UA
		Graded	

31.	All firmware/software upgrades shall be opaque/atomic from the perspective of the NPRA. It is the responsibility of the Contractor to ensure firmware/software compatibility among the modules on the RTDCE. In other words, using the firmware/software update method described in [1] in one single operation initiated from the client side, shall be sufficient to upgrade all parts of the RTDCE. N.B Some stations are located in areas where the telecommunication signals are weak. It can therefor be difficult to transfer big data files.	Absolute	SAT-T
32.	Whenever new firmware/software is available, the NPRA shall be notified of this by e-mail to trafikkdata@vegvesen.no. The firmware/software must be made available at an HTTP accessible endpoint for download by the NPRA. Any needed authentication must be communicated to the contact person(s).	Absolute	
33.	The vendors must provide a change log with each firmware/software update. This shall be provided along with the firmware/software update itself. All changes, both internal to the RTDCE and exposed changes through OPC UA must be detailed.	Absolute	
34.	New firmware shall be approved by the NPRA before upgrading of RTDCEs in production.	Absolute	
35.	When new firmware versions are installed, the RTDCE must use a checksum function or the like to ensure the firmware is fully installed and verified.	Absolute	

ID	Requirements	Type	Test
36.	RTDCE shall have Ethernet port for connection with NPRA routers.	Absolute	SAT-T
37.	The interface/cable(s) between the RTDCE and any external sensors must be included in the delivery.	Absolute	

3.7 Service and maintenance

ID	Requirements	Type	Test
38.	The Bidder must show how they plan for redundancy in key personnel so that the response and resolution times detailed in ssa-v will be met.	Absolute	
39.	The Contractor shall provide technical support for its equipment as described in the SSA-V agreement. The contractor must fill inn information about the support, service and regular maintenance in the SSA-V appendices (yellow marking).	Absolute	
40.	The Contractor must enclose information with each new delivered RTDCE about: - Maximum number of lanes - Serial number - MAC-address - High or low frequency loop card - Other information about the unit that the Contractor wants to add The information will be sent by e-mail or made available for download to the receiver of the RTDCE.	Absolute	
41.	The Contractor must enclose information when returning a RTDCE from service: - Test report (including serial number and MAC-address) - Other information about the unit that the Contractor wants to add. The information will be sent by e-mail or made available for download to the receiver of the RTDCE.	Absolute	

3.8 Manuals

ID	Requirements	Type	Test
42.	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: - System/component overview, both hardware and software and storage solution - Safety information/measures, including but not limited to authentication, authorisation, penetration avoidance etc - Interface with external components/OPC UA/network - System flow/data flow	Absolute	
43.	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: - Installation procedure - Approximate time for installation - A description of lane setup and if more than one RTDCE can be put together in a module etc. - Limitations - Special infrastructure required for installation - Required and recommended maintenance	Absolute	
44.	User manual for external and built in sensors. The Bidder shall provide a user manual for the sensors, with guidance in installation and maintenance. The manual shall include at least (if applicable): - Sensor type (e.g. type of cable, sensor) - Requirements and limitations regarding the sensors - Expected lifetime of the sensors - Installation procedure, including geometry and depth of sensors - Approximate time for installation, and if the road needs to be closed during installation according to NPRA guidelines. - Describe any need of special equipment, limitations in weather conditions and other important factors for a successful installation. - Maximum length of feeder cable - Maintenance needed for a long lifetime of sensors	Absolute	

4. Performance requirements

4.1 Lane and sensor numbering

ID	Requirements	Type	Test
45.	Lane numbering shall follow the description in appendix 1.	Absolute	SAT-T SAT
46.	Sensor numbering for external sensors shall follow the description in appendix 1.	Absolute	SAT-T
47.	The Bidder shall specify the number of lanes one RTDCE can handle.	Absolute	
48.	The Bidder shall inform in the tender response if the RTDCE can collect traffic data from more than one cross section or not (e.g. a road like C or D in figure 1 or document 9 – EV16 Osterøybrua). If the RTDCE can collect traffic data from more than one crosss section, the Bidder must document how this is done.	Graded	
49.	If the RTDCE/sensor is only covering one lane, the Supplier must describe how two or more RTDCE/sensors can be connected together to work as one RTDCE covering two or more lanes and how many can be connected at most.	Absolute	
50.	If the RTDCE/sensor is covering more than one lane, the Bidder must describe how the registrations will be split in lanes according to appendix 1.	Absolute	
51.	If external sensors are used, the sensors must be connected in the roadside cabinet, in a way that makes it clear which lane each sensor is connected to.	Absolute	SAT-T
52.	The Bidder must provide information about known restrictions for the RTDCE and sensors regarding installation site (e.g. tunnels, light conditions, weather conditions, road surface, parallel roads, distance to other sensors etc.)	Absolute	

4.2 Measurements

ID	Requirements	Type	Test
53.	Collected traffic data must comply with [1] and measuring accuracy described in 1.4.3.	Graded	SAT-T SAT
54.	Every vehicle registration must be time-stamped using the UTC millisecond format.	Absolute	SAT-T
55.	The RTDCE shall distinguish between the different lanes the vehicles are using, as described in appendix 1.	Absolute	SAT-T
56.	The RTDCE shall distinguish between the directions of the vehicles passing, as described in [1].	Absolute	SAT-T
57.	The RTDCE should register vehicles in accordance to the NorSIKT classification table, specified in appendix 3. If the RTDCE uses another classification table, the Bidder must document how the classes are to be comparable to NorSIKT classes, in “8 - Translate RTDCE classes to NorSIKT classes”. How NPRA translate data from Autosys classes to NorSIKT classes is documented in “4 – Autosys classes to NorSIKT classes”.	Absolute	SAT-T
58.	The RTDCE shall classify vehicles at minimum NorSIKT level 3.	Absolute	SAT-T
59.	The Bidder must state whether the RTDCE classifies trailers.	Graded	SAT-T
60.	If other entities (e.g. bicycles) are recorded, they shall be treated in the monitoring system in such a way that they are not confused with the vehicle registrations.	Absolute	

ID	Requirements	Type	Test
61.	If optional parameters are registered, the Bidder shall give information about the accuracy and precision if applicable.	Wanted functionality	
62.	The Bidder must specify what is the shortest and longest vehicle length the RTCE can measure. Minimum 1m – 26 m.	Absolute	
63.	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 length and classes be affected when slow traffic and queue?	Absolute	

4.3 External sensors

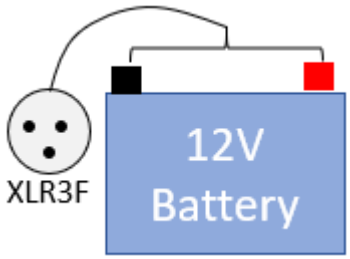
ID	Requirements	Gradation	Test
64.	RTDCE using inductive loops as external sensors must be compatible with Norwegian standard for inductive loops, see appendix 2.	Absolute	SAT-T
65.	External sensors shall tolerate normal road maintenance such as sweeping, snow-clearing, scattering of gravel and salting.	Absolute	
66.	The Bidder shall describe the different type of sensors and sensor geometry available to use with the RTDCE.	Absolute	
67.	The Bidder must specify expected lifetime of the external sensors.	Absolute	

5. Options

5.1 Antennas

ID	Requirements	Gradation	Test
68.	A standard GNSS receiver that supports EGNOS and can be connected to the RTDCE with a SMA connection.	Absolute	SAT-T

5.2 Cables for backup battery

ID	Requirements	Gradation	Test
69.	A cable to connect a backup battery (battery is not a part of the delivery) using XLR3F. 	Absolute	

5.3 DIN-rail mounting

ID	Requirements	Gradation	Test
70.	Some new cabinets are equipped with DIN-rails. If the Bidder can offer RTDCE with DIN-rail mounting it shall be specified here.	Wanted functionality	

Appendix 1 – Principles for lane and sensor numbering

In most cases, individual lanes are monitored. Lane codes are used to identify the different lanes. Figure 5 and Figure 6 shows the lane numbering (white numbers to the left) and sensor numbering. These codes specify the position of the lanes across the road. The lanes are numbered from the middle of the road and out to each side. Odd numbers are used for lanes in the metering direction and even numbers for lanes running counter to the metering direction. The sensors are numbered by the same principle as the lanes. The blue circles show the sensor numbering using one sensor per lane, and the green circles show the sensor numbering using two sensors per lane. Note that the sensor numbers for two sensors per lane, are increasing in the traffic direction.

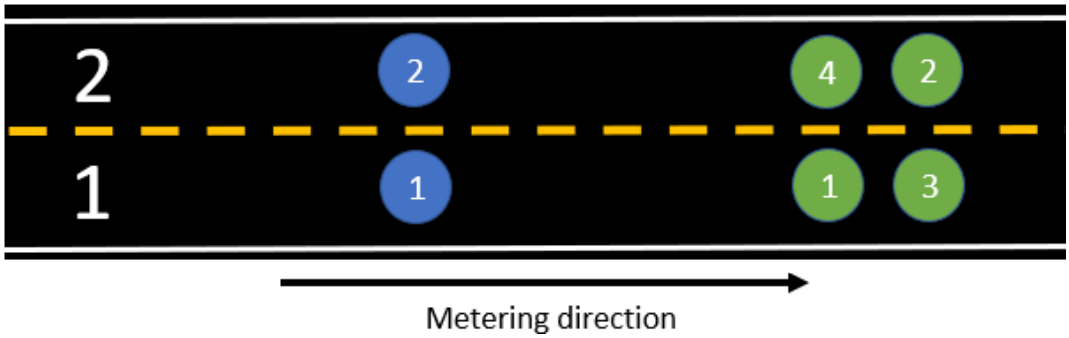


Figure 5. Road type 1: A two lane road.

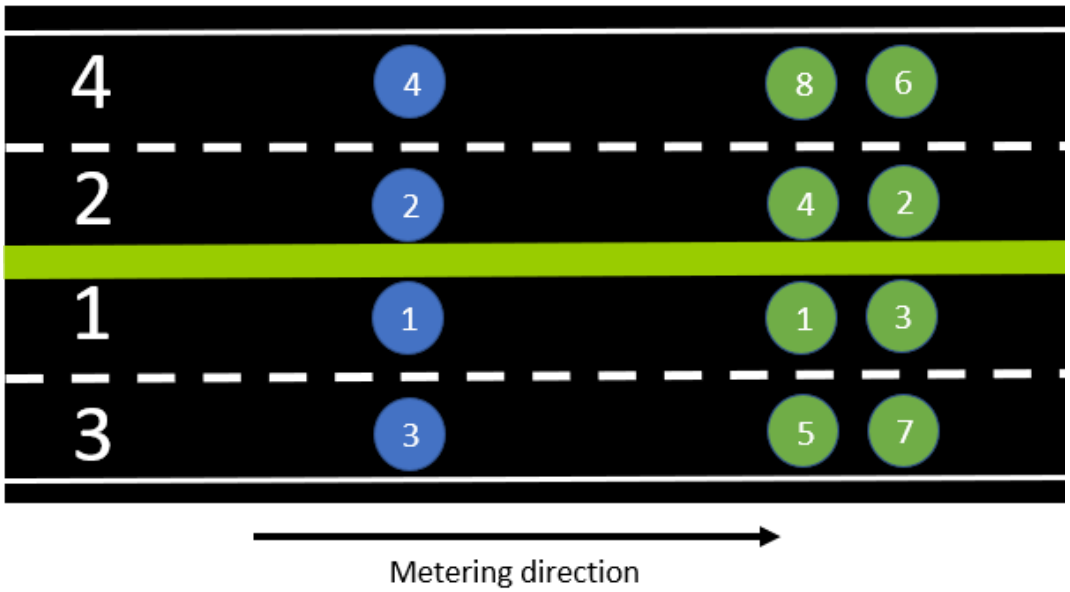


Figure 6. Road type 2: A four lane road.

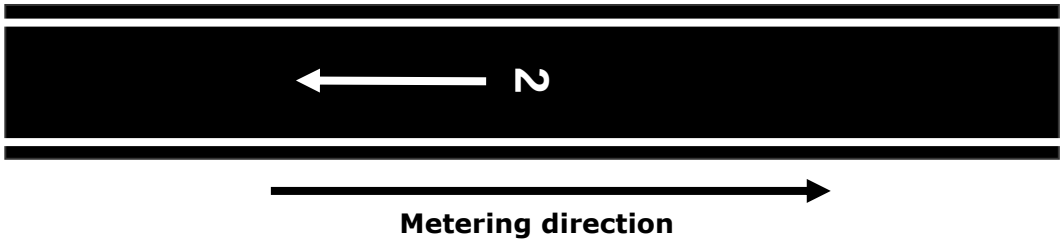
Special cases

A ramp is handled as a separate road, with independent metering. Turn lanes inherit the metering from the corresponding main road.

A one lane road, were the driving direction is the same as the metering direction, is numbered 1. If the driving direction is counter to the metering direction, it is numbered 2. See also Figure 7.

Narrow roads with one lane and traffic in both directions, as shown in Figure 8, is numbered 1 and 2. Lanes shorter than five meters is not registered as separate lanes, but is included in the main lane.

Bicycle traffic on bicycle tracks and sidewalks will be bidirectional.



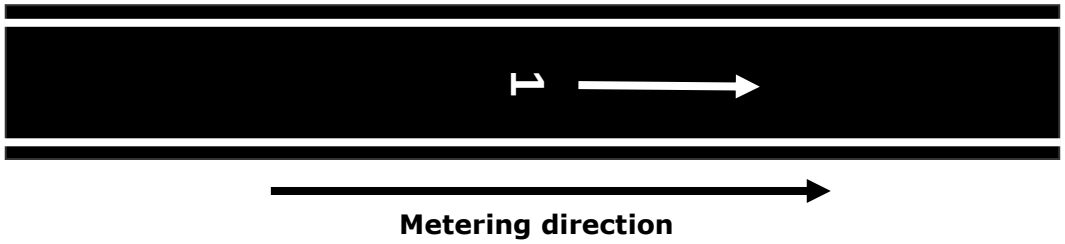


Figure 7 Lane numbers on one lane road

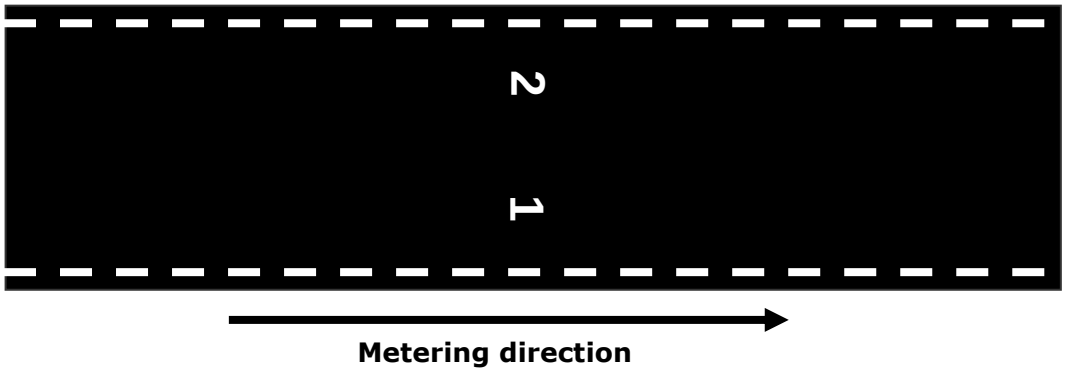


Figure 8 Lane numbers on narrow two lane road

Appendix 2 – Standard Norwegian loops

Cable: 2,5 mm² isolated copper cable.

Turns: 3 turns per sensor

Depth: Usually 5-10cm bellow the asphalt surface.

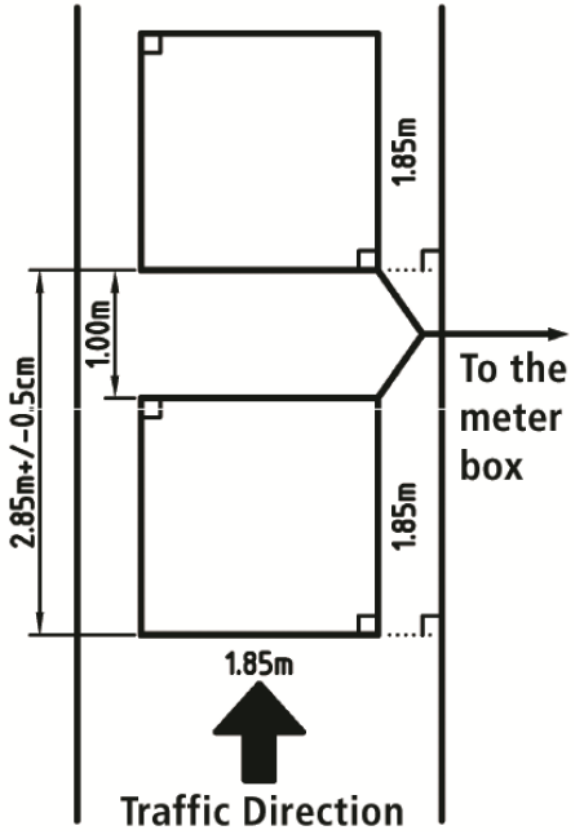


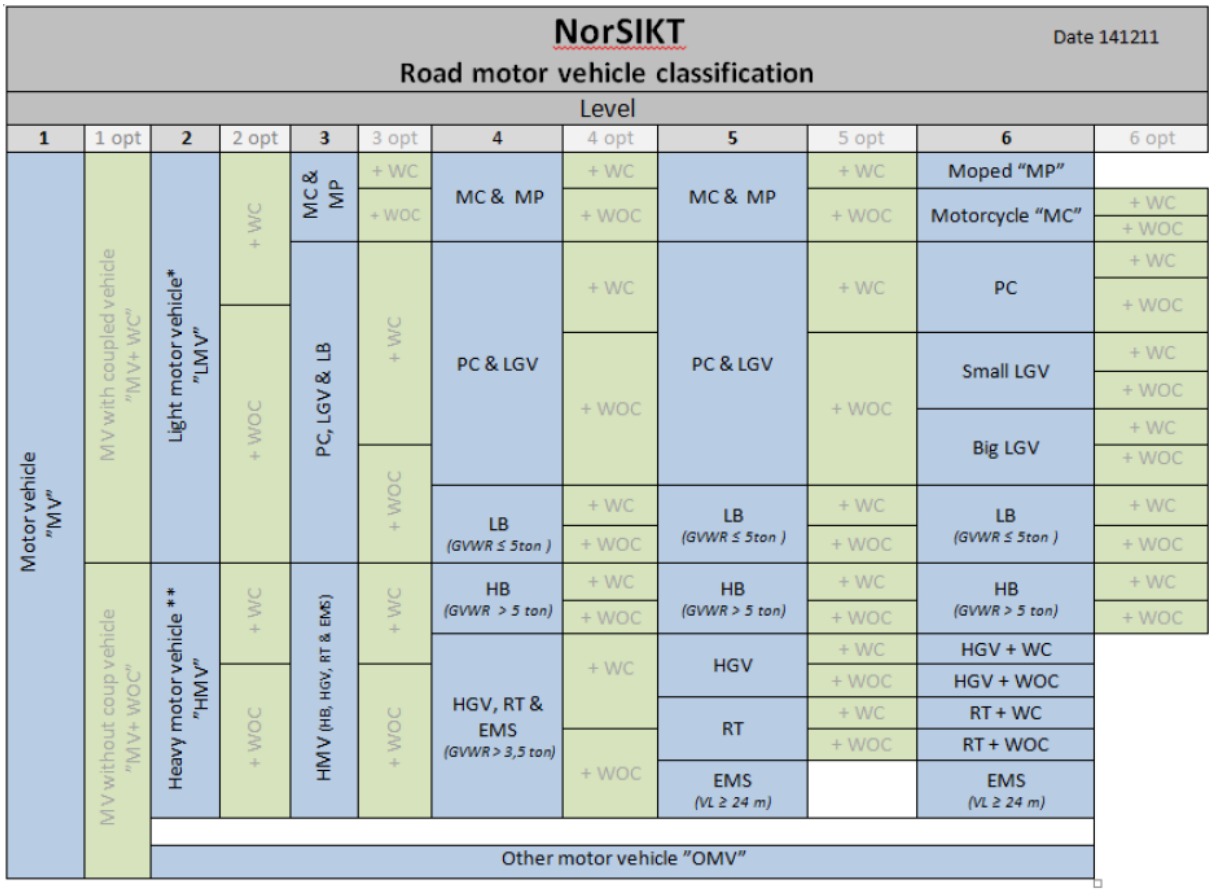
Figure 9. Loop geomatrics

Appendix 3 – NorSIKT classes

Figure 10 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.



* 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 10. NorSIKT classification scheme

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