Annex E (Technical Conditions)

Annex to the EETS Domain Statement concerning the Danish Kilometer Tolling Scheme

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1 DOCUMENT HISTORY

Date of first appearance of this entry into the register	1 February 2024
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2 DEFINITIONS AND ABBREVIATIONS

All definitions in the EETS Domain Statement shall have the same meaning in this Annex.

In addition to the definitions in the EETS Domain Statement the following definitions shall apply for this Annex:

"**Exception Lists**" means the Whitelists (only containing valid OBE) and Blacklists (not valid OBE) shared between the EETS Provider and the Toll Charger.

"**Haversine Formula**" means a mathematical equation used to calculate the great-circle distance between two points on the surface of a sphere (such as Earth) given their latitude and longitude.

"**OBE Type 1**" means the complete set of hardware and software components to be used as part of the toll service which is installed or carried on board a vehicle in order to collect, store, process and remotely receive/transmit data enabling toll collection on the KmToll Domain and is compliant with EN 12813:2019 and EN 15509:2023 along with OBE Type 1 requirements defined in this document.

"OBE Type 2" means the complete set of hardware and software components to be used as part of the toll service which is installed or carried on board a vehicle in order to collect, store, process and remotely receive/transmit data enabling toll collection on the KmToll Domain and is compliant with OBE Type 2 requirements defined in this document – see section 6.3. In contrast to OBE Type 1, OBE Type 2 is a supplemental solution without DSRC according to requirements defined by the Toll Charger. It is a national, non-interoperable offering and not part of EETS.

"Unique Vehicle Identity (UVI)" is a collection of data fields which together uniquely identify a vehicle and its current operating parameters (weight etc.). The relevant data items which make up the UVI are shown below (identifiers in brackets are the relevant data fields in the Toll Declarations):

- OBE manufacturer Identifier (ObeId.manufacturerId)
- OBE identifier (ObeId.equipmentObuId)
- Country of registration (vehicleLPNr.LPN.countryCode)
- Vehicle license Plate (vehicleLPNr.LPN.licensePlateNumber)
- Country of Service Provider (contractProvider.countryCode)
- Service Provider Identifier (contractProvider.providerIdentifier)
- User PAN (personalAccountNumber)
- Vehicle Weight (vehicleTechnicalMaxLadenWeight)
- Time Class (timeWhenMeasured)
- Environmental Characteristics (euCO2EmissionClass)
- Local Vehicle Class (VehicleDescription.class)

3 INTRODUCTION

This Annex contains the technical conditions applicable for the EETS Provider under the KmToll Scheme. The Annex contains the Toll Charger's EETS Domain specific requirements concerning technical standards, technical conditions, business processes, OBE requirements and technical relation to interfaces described in Annex F (Interface Specifications).

Reading this Annex, the EETS Provider will obtain the necessary knowledge on technical requirements and conditions of the Toll Charger for the EETS Provider to provide EETS to the EETS User and comply with technical requirements and regulations required by the Toll Charger.

The next sections of this Annex are structured as follows:

(i) **Section 4**: A general description of the system architecture and interfaces between the Toll Charger and the EETS Provider.

(ii) **Section 5:** Information related to applicable technical standards.

(iii) **Section 6:** The Toll Charger's requirements towards OBE types.

(iv) **Section 7:** Information related to Exception List handling.

(v) **Section 8:** Information regarding the Payment Claim process.

(vi) **Section 9:** Information related to data transfer mechanism.

(VII) **Section 10:** The Toll Charger's security requirements.

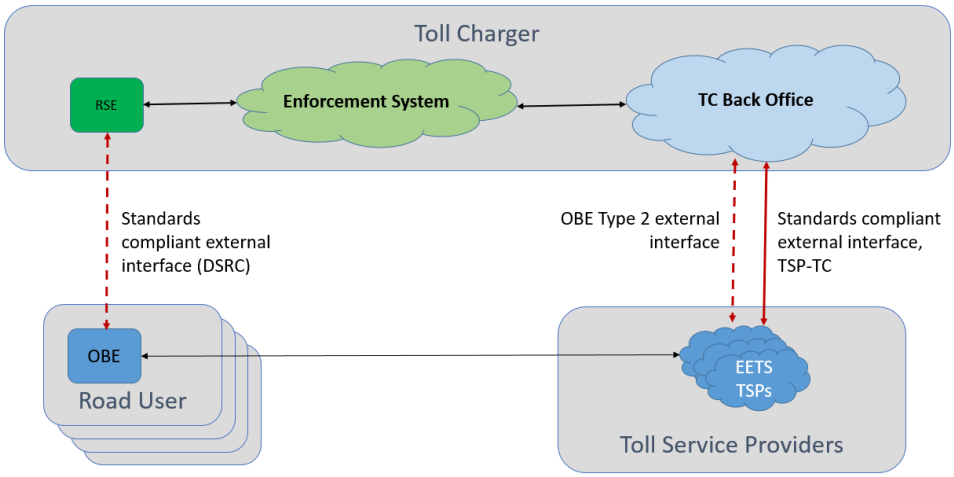
4 SYSTEM ARCHITECTURE AND INTERFACES

The architecture of the KmToll Scheme is designed to facilitate and comply with EETS. The figure and description below outline how the EETS Provider are expected to interface with the Toll Charger.

Figure 1 illustrates a simplified system architecture of the KmToll Scheme. Interfaces between the Toll Charger and the EETS Provider are shown in red. The interfaces defined in this Annex are further defined in detail in Annex F (Interface Specifications):

- A Tolling Interface between the TSP and the TC for the exchange of tolling-related data (toll declarations, exceptions lists, billing details etc.).
- An Enforcement Interface between the OBE in a toll-liable vehicle and the Roadside Equipment of the Enforcement system (DSRC) related to OBE Type 1 (EN/ISO 12813:2019) and if an OBE Type 2 is offered, an OBE Type 2 external interface (which is not defined in applicable standards but specified separately by TC) related to compliance check data used in TC's enforcement processes. Both marked with a dotted red line in the figure.

Figure 1. Simplified System Architecture



The contents of the interfaces are defined in Annex F (Interface Specifications).

The KmToll Scheme is a Toll Charger dominant scheme which means that toll calculation takes place centrally in TC Back Office. To aid the EETS Provider in providing information regarding toll liability to the EETS User, the Toll Charger will within the Billing Details, list the tolled road segments, price and details. Along with the toll information the Billing detail also contain a link to an interactive map viewer that the EETS Provider can, if they wish, expose to the EETS User. The interactive viewer will allow the EETS User to explore the Billing Details in a visual manner on a map to understand and inspect the toll charged. The interactive map will be available for 180 days after the Billing Details are forwarded to the EETS Provider.

For further detail on toll differentiating vehicle characteristics weight and CO2 class, see Annex F (Interface Specifications) and related applicable technical standards. The attribute vehicle weight is also described in section 6.1.4. The vehicle CO2 class – euCO2EmissionClass - attribute will be used as required in the Eurovignette Directive. It is identified in prEN 16986:2023 by the type Co2Class, and in the associated XML Schema Profile by the element euCO2EmissionClass and type EuCO2EmissionClass, which is coded as an integer. See further details on how to determine a vehicle's CO2 class is provided by or published by the Danish authorities following the Eurovignette Directive.

5 APPLICABLE TECHNICAL STANDARDS

All interfaces relating to the exchange of tolling data must be compliant with the standards identified in the EETS Directive (EU) 2019/520, Commission Delegated Regulation (EU) 2020/203 of 28 November 2019, and Commission Implementing Regulation (EU) 2020/204 of 28 November 2019. The solution must in addition ensure that all data required to comply with the Eurovignette Directive 2022/362 are exchanged.

Note that a few standards referred to are under revision or recently approved which will lead to or has led to revision of the versions referred to in the directives. As the KmToll Scheme started operation in 2025 the system will currently be based on the latest available standard in 1st Quarter 2023. If not, all applicable standards are approved there may be reference to standards with a prEN status.

In addition to the standards mentioned in the directives, several standards mentioned in the referred standards are also applicable.

The data exchange between Toll Charger and EETS Provider is divided between categories where different standards are relevant:

- Road-Side Equipment (RSE)/On-board Equipment (OBE) – where the purpose is to identify that the OBE function according to requirement. Detailed in section 5.1 and section 6.2.
- Data exchange between the Toll Charger's and EETS Provider's back office – where the purpose is to ensure that the data necessary to charge for road usage and perform financial settlement are available timeously. Detailed in section 5.2.

5.1 RSE/OBE Compliance Checking Communication

OBE Type 1 communications between EETS User's On-board Equipment and the Road Enforcement System for the purposes of compliance checking, shall be compliant with standards EN ISO 12813:2019 and EN 15509:2023.

OBE Type 2 does not require DSRC based communication for CCC communication at the RSE. For the EETS Provider to provide an OBE Type 2 solution to the EETS User in the KmToll Domain the Toll Charger require the EETS Provider to establish and implement a CCC data request and response mechanism. The purpose of the backend based CCC communication – which is an interface between Toll Charger's back office and the EETS Provider's back office – is to simulate a similar CCC transaction enabling efficient enforcement processes. The Toll Charger will, once a whitelisted OBE Type 2 vehicle is identified at the roadside, send a CCC data request according to the defined CCC data interfaces in Annex F (Interface Specifications).

5.2 Data exchange between the Toll Charger and EETS Provider

Communication between the back offices of the Toll Charger and of the EETS Provider shall be compliant with prEN 16986:2023, except where specifically identified. It is recognised that prEN 16986:2023 is currently still in draft form (identified by the "pr" prefix). See Annex F (Interface Specifications) for more details on the use of EN 16986. In this document, references to EN 16986 should be taken to mean prEN 16986:2023.

The EN 16986 standard defines several profiles, covering different tolling solutions. The KmToll Scheme will use the SectionAutonomous profile with Toll Charger (TC) dominance. This means that section 8, 10 and 11 of the EN 16986 standard are not relevant.

The following interfaces between the EETS Provider's back office and the Toll Charger's back office will be required:

- Acknowledgements (both directions)
- Exception Lists
- Contract Issuer List
- Toll Declarations
- Payment Claims
- Payment Announcements
- Billing Details
- CCC Data Request
- CCC Data Response
- Trust Objects
- Actor Table exchange

All the above interfaces other than Trust Objects and Actor Table Exchange will be implemented as REST (Representational State Transfer) APIs. See section 10 for further detail on back-office interfaces.

Data will be exchanged in the sequence as defined in EN 16986 to perform toll calculation and collection. Toll Declarations must be forwarded from the EETS Provider to the Toll Charger in a rapid manner, allowing toll to be calculated shortly after driving on the road-network. See Section 6.1 for more details on the timings related to Toll Declarations. The Toll Charger requires the EETS Provider to send Toll Declarations in a continuous manner as soon as Toll Declarations are available and not in bulk. See section 6.1 for more details. This is governed by KPIs defined in Annex G (Key Performance Indicators) and no later than six (6) calendar months after the GNSS data is recorded.

5.3 Time and Date

Date and time information is coded as defined in ISO 8601, using the Generalised Time format. Time is reported to the nearest second. As ISO 8601 allows different levels of representations and precision, the exact format used is as defined in ISO 12855:2022 and its annexes. This is also reflected in the interfaces defined in Annex F (Interface Specifications). Wherever time is stored in any part of the KmToll system, or where time is transferred between systems, the time must be in UTC, not local time.

Note that this does not define how time is presented to the EETS User, which will generally be done in local time. This means that time shown to the EETS User on computer screens, invoices, bills etc. must be shown in local Danish time.

6 OBE REQUIREMENTS

On the KmToll Domain two types of OBEs are allowed:

1. OBE Type 1 – a GNSS capable OBE including DSRC and compliant with ISO 12813:2019 and EN 15509:2023; and
2. OBE Type 2 – a GNSS capable OBE.

Requirements towards each of the two types is detailed in the below sections. Section 6.1 define requirements applicable for both types of OBE. Section 6.2 define requirements specific to OBE Type 1. Section 6.3 define requirements specific to OBE Type 2.

The EETS Provider must clearly state type of OBE in the Contract Issuer List according to ISO 12855:2022 and EN 16986.

6.1 General OBE requirements

The OBE must comply with (EU) 2020/203 Annex II and (EU) 2020/203 Annex I based on the approved standard, however, compliance will be reduced slightly for OBE Type 2 based on the nature of OBE Type 2, see section 6.3.1.

The OBE must be able to obtain high quality and precise GNSS locational data – standard GNSS coordinates WGS84 - within the geographical area of Denmark with a frequency of one (1) position point per five (5) seconds along with required additionalGNSSData for each position point and send it continuously over mobile cellular network, or other data connection, to the EETS Provider's back office enabling the EETS Provider to send Toll Declarations to the Toll Charger according to the requirements in Annex F (Interface Specifications).

The OBE must reliably obtain and be collect GNSS data once activated when positioned in an open-sky environment as soon as possible.

The OBE shall collect sufficient position data before entering the KmToll Domain and after leaving the KmToll Domain for the Toll Charger to be able to unambiguously identify that the border was

crossed and the point at which it was crossed in the data added to Toll Declaration. The volume of position data outside the KmToll Domain for this identification must be as low as possible.

In case the OBE loses back-office connectivity, the OBE must be able to continue to operate and collect data for a minimum of one (1) day. When the storage capacity of the OBE runs out following minimum one (1) day of operations without back-office connectivity the OBE must stop operating and turn to status 2 as defined in section 6.1.2. As soon as mobile cellular network or another data connection is re-established all stored data in the OBE must be sent to the EETS Provider's back-office and forwarded to Toll Charger.

Each Toll Declaration should contain GNSS data covering a maximum of 60 geo-locations (i.e. a time span of five (5) minutes recording one geo-location every five (5) seconds) starting at the first GNSS locational data recorded and passed to the Toll Charger continuously. Data collected when driving past midnight shall not need to be split into two packages by the EETS Provider – the Toll Charger will handle midnight cases where the data will be split into two Billing Details.

It is not necessary to always wait for 60 geo-locations before sending a Toll Declaration. If an OBE stops sending geo-locations (e.g. the vehicle stops and switches off for the night), the EETS Provider can choose to send a Toll Declaration after a timeout, for example after five (5) minutes.

It is neither required, nor indeed desirable, for Toll Declarations to start and end on exact minute boundaries. So for example, if an OBE records its first geo-location after startup at 08:01:23, the first Toll Declaration should cover the period 08:01:23 – 08:06:22.

6.1.1 Distinguishing OBE type

To undertake enforcement processes for OBE Type 1 and OBE Type 2 the OBE type must be clearly distinguishable listed on the Contract Issuer List using the attribute *typeOfEfcApplication* and as required according to interface specifications in both the Toll Declaration and Exception Lists.

Note: See release notes on interfaces for details.

6.1.2 Personalisation of OBE

All OBE must be initialised by the EETS Provider prior to use by ensuring accurate OBE personalisation.

The EETS Provider is allowed to perform personalisation of the OBE and change to personalisation over-the-air (OTA).

All toll rate relevant parameters of the vehicle description – Vehicle Class, Vehicle Weight Limits and Vehicle CO2Class – are by default of static nature and not dynamic – which only the EETS Provider is allowed to initially set and change in the OBE.

No dynamic vehicle information such as vehicle axles is used for toll calculation, and it is therefore not a requirement that the EETS User configure and maintain dynamic vehicle information.

6.1.3 Man machine interface (MMI) elements of the OBE

The OBE shall have at least the following user interface elements to fulfil the required functionality:

- An optical element

The optical element shall visually indicate as minimum the following information required for the use of the OBE in the KmToll Domain:

- The operational status of the OBE

The indication of the operational status of the OBE shall have at least the following states listed in Table 1:

Table 1. OBE minimum operation status indicators

State	Operational status indication to the OBE user
State 1	The OBE is working correctly in the KmToll Domain
State 2	The OBE is not working correctly in the KmToll Domain

The EETS Provider is allowed to incorporate additional states provided that the EETS User is clearly instructed in the use and meaning of each state – preferably using an intuitive coloured indicator scheme (State 1 could be green, State 2 could be red).

State 1 and State 2 must be used in relation to the OBE status (attribute OBEstatusHistory).

Visibility requirement related to the operational status of the OBE differ between OBE types, see section 6.2 and 6.3.

Note on acoustic MMI element: No acoustic information signal shall take place in relation to the communication between RSE and the OBE. This is to be supported by SET-MMI codes when passing an RSE. SET-MMI code 255 will be used so the buzzer provides 'no beep'. 'No beep' is applied for road safety reasons and as DSRC communication is solely used for enforcement purposes.

Acoustic MMI element is allowed for other purposes like informing the user about OBE malfunction or similar.

6.1.4 Requirements to data sets in OBE

The required data described in this section must be in the OBE (personalisation) and identically in the Toll Declarations originating from the OBE when sent to the Toll Charger by the EETS Provider according to Annex F (Interface Specifications).

Data definitions follow EN 12813:2019 while further details and requirements to specific attributes is highlighted below in Table 2:

Table 2. Required data sets in OBE

Attribute	Reference to 12813:2019 EFC attributeID
CCC-ContextMark	0
EquipmentOBUID	24
PaymentMeans	32
OBEStatusHistory	53
VehicleLicensePlateNumber	16
VehicleClass	17
VehicleWeightLimits	20

The following sections provide in-depth notes to attributes defined in EN 16986 relevant for the KmToll Scheme.

6.1.4.1 Attribute 0: CCC-ContextMark

OBE Type must be clearly distinguishable both when read by RSE and listed on Exception Lists.

To distinguish OBE types the CCC-ContextMark attribute and Payment Means attribute as stated on the Contract Issuer List will be used.

The Contract Issuer List from EETS Provider must for each entry include information stating type of OBE and version of OBE.

Each type/version must be supplemented by detailed information describing each OBE type and version to access the equipment (new or update).

The EETS Provider must inform the Toll Charger clearly based on the CCC-ContextMark and Payment Means which type of OBE it is.

6.1.4.2 Attribute 24: EquipmentOBUId

The EquipmentOBUId shall be a unique identification number assigned to OBE by the manufacturer during the production process.

The PAN identify a specific OBE e.g., for blacklisting purposes (together with the ManufacturerId, submitted in VST).

If the attribute EquipmentOBUID is shorter than 4 Byte (+1 Byte length indicator), it is rightpadded with 0'B to achieve the desired length of 4 Bytes.

6.1.4.3 Attribute 16: VehicleLicensePlateNumber

This attribute is holding information about the vehicles licence plate content (LPN) and the registering country. The licence plate information can have up to 14 characters acc. To EN 15509:2023.

The license plate information shall always be padded with NULL characters after the last character to achieve the total length indicated by the length determinant.

For the LPN only Latin Alphabet No. 1 (according to ISO 8859-1) upper case letters and numbers (without any spaces and hyphens) shall be used.

Non-Latin Alphabet No. 1 characters used in an LPN (i.e., characters from ISO 8859-2 Latin Alphabet No. 2 and ISO 8859-5 Latin/Cyrillic alphabet) shall be coded as lower-case letters applying the translation table from Annex E of EN ISO 14906 [EFC API].

6.1.4.4 Attribute 17: VehicleClass

The attribute VehicleClass may hold information about trailer presence, the value for European vehicle Group.

The letter N2, N3 on the vehicle registration certificate may be determined based on the technically permissible maximum laden mass (F.1) which may lead to a weight just below the limit.

Table 3. Vehicle classification attributes

EN 15509:2023 European Vehicle Group (Byte 1)		**Comment**
Value (bin)	Description	
x000 0000	No entry	
X001 0000	Group 1 - Small passenger vehicles (UNECE class M 1)	M1 (See note 1)
X010 0000	Group 2 - Light Goods Vehicles (UNECE class N 1)	N1 (See note 2)
X011 0000	Group 3 - Large passenger vehicles (UNECE class M 2, M 3)	M2, M3 (See note 3)
X100 0000	Heavy Goods Vehicles up to 12 T (UNECE class N 2)	
X101 0000	Group 5 - Heavy Goods Vehicles over 12 T (UNECE class N 3)	
X110 0000	Group 6 – Motorcycles (UNECE class L)	
X111 0000	Group 7 - Other vehicles including vehicles above 3,5 T not included in previous groups	See note 4

Note 1: Assumed to be ≤3.5 tons, otherwise assigned to group 7

Note 2: Assumed to have 2 axles, otherwise the vehicle is assigned to group 7

Note 3: Assumed to be >3.5 tons Note that a few of these vehicles may be ≤3.5 tons

Note 4: Any vehicle not defined in European Vehicle Groups 1- 6. This includes small passenger vehicles weighing more than 3.5 tons.

6.1.4.5 Attribute 20: VehicleWeightLimits

The attribute VehicleWeightLimits holds information about vehicle weight limits according to ISO1176.

VehicleWeightLimits has three data elements as defined in ISO14906. The data elements VehicleMaxLadenWeight and VehicleTrainMaximumWeight must be provided. For vehicles which do not have the capacity to tow a trailer the VehicleTrainMaximumWeight must contain the same value as VehicleMaxLadenWeight.

The field VehicleMaxLadenWeight will contain the value of the maximum technical weight of the complete vehicle (F.3), as defined in ISO 1176. It shall be reported in 10kg units, rounded down to the next 10kg step.

6.2 OBE Type 1 specific requirements

The OBE Type 1 must be able to communicate in a multilane environment with overlapping communication zones using different RF-channels. The performance of the OBE must not decrease due to the multilane free-flow functionality or disturb multilane RSE when transmitting.

The optical information elements related to operational status shall always be easily visible.

The OBE Type 1 must support CEN compatible DSRC communications at 5.8 GHz and must conform with EN 15509:2023 and EN 12813:2019. Related to EN 15509:2023 DSRC security profile 1 shall be supported.

The following standards apply for OBE Type 1:

- EN 14906:2023 - Application Interface for EFC
- EN 15509:2023 – Interoperability application profile for DSRC
- EN 12813:2019 - CCC for autonomous systems

6.2.1 DSRC based CCC transaction

When performing a transaction between RSE and OBE Type 1 the following must be supported and transmitted upon request from Toll Charger's RSE:

Table 4. CCC transaction attributes

Attribute	Attribute ID	Length	Data set
CCC-ContextMark	0	6	Identification
EquipmentOBUId	24	5 (1+4)	Identification
PaymentMean	32	14	Identification
OBEStatusHistory	53	23	Status
VehicleLicencePlateNumber	16	13 to 17	Vehicle
VehicleClass	17	1	Vehicle
VehicleWeightLimits	20	6	Vehicle

The CCC transaction attribute list in Table 4 is an extract from the CCC attribute list as defined in ISO14906, EN 15509:2023 and ISO/TS 17573-3 where they are defined.

Note that the CCC transaction attributes in Table 4 corresponds to attributes listed in Table 2. While Table 2 define data set required in the OBE, Table 4 defines the attributes which must be supported for DSRC transmission and specific length and data set according to the standard.

6.3 OBE Type 2 specific requirements

OBE Type 2 constitutes an OBE type which is not governed by standard EETS OBE requirements. The core purpose of OBE Type 2 is to enable GNSS based tolling identically to OBE Type 1, however without the requirement of a DSRC module. OBE Type 2 allows for a wider range of hardware and software combinations – also where the EETS Provider provides the application software enabling the OBE to run on hardware that the user provide themselves either as a separate hardware unit or as part of a unit used for other technical purposes as well.

The OBE Type 2 specimen subject to accreditation is the combination of hardware, OS platform version and the application version. The EETS Provider must, as part of its' application provide a list of combination and proposed grouping ("OBE Type 2 List"). The EETS Provider may request that multiple combinations are to be considered as one OBE specimen altogether due to significant similarity in characteristics. See section 6.3.1 for further details on the required documentation for during the Accreditation Procedure.

The Toll Charger's specific requirements to OBE Type 2 are:

- The OBE Type 2 must comply with general OBE requirements listed in section 6.1 of this Annex – collecting GNSS locational data and enabling toll collection.
- The OBE Type 2 must allow the EETS User to undertake toll data collection effectively while driving on the road without imposing a personal or traffic safety risk, while also complying with relevant road regulations. The EETS Provider must clearly guide and instruct the user on how to mount and operate the OBE during operation.
- The OBE Type 2 must reliably collect precise GNSS locational data and provide associated additionalGnssData as specified in Annex F (Interface Specifications), section 6.7.4 – Data element "heading" must be calculated preferability using the Haversine Formula providing a precise heading information based on the actual direction of travel. The purpose is to ensure robustness against faulty mounting of the OBE.
- In case the EETS Provider only provides the software as part of OBE Type 2, the software application must be designed to be robust against changes to OS platform updates and upgrades on which the application is run.
- A software-based OBE Type 2 may only operate on hardware on which the EETS Provider can ensure a stable and robust performance. The hardware that the OBE Type 2 can operate on must be specified as part of the accreditation and changes must be handled according to procedures of recertification as outlined in Annex H (Testing).
- A software-based OBE Type 2 may only operate on OS platforms which the EETS Provider can ensure a stable and robust performance and are still subject to error and security updates. The specific version of OS must not be 'end of life'.
- The software-based OBE Type 2 must allow and aid the user to easily operate the unit and start toll data collection when starting to drive on the KmToll Domain.
- The software-based OBE Type 2 may only allow the user to start toll data collection when sufficient GNSS signal is available.
- An optical information element related to operational status shall be easily visible when the application is in use and displayed as a highlighted element as part of applicable notification services as notification centre, lock-screen or home screen or similar when the OBE Type 2 is activated making it easily interpretable to the user if data collection for tolling purposes is active or not.

- The OBE Type 2 must optically display at least the following information clearly to the user while in use; operational status, OBE Type 2 version information and OBE personalisation information.
- The OBE Type 2 must not allow the user to change toll dependent vehicle characteristics directly on the unit.
- The OBE Type 2 must be designed to notify the user within 2 minutes if operationally required external signals (GNSS, mobile cellular or similar) are lost during active toll data collection and notify the user clearly about the consequence loss of signal have in relation to toll collection.
- The OBE Type 2 must in case GNSS signal is lost and not obtained again within 15 minutes force stop toll data collection and notify the user clearly that toll data collection has stopped.
- The OBE Type 2 must be designed to notify the user in case required external power or battery on the unit is not sufficient for operation and notify the user clearly about the consequence of insufficient power have in relation to toll collections.
- The EETS Provider must ensure that the Toll Charger can identify OBE Type 2 as an OBE Type 2 by the *typeOfEfcApplication* in the Contract Issuer List, and the *obeType* field in the Toll Declaration and Incremental exception list. See requirements in section 6.1.4 about attribute 0.

6.3.1 OBE Type 2 specific CCC transaction

DSRC communication capability is not a requirement for OBE Type 2. Therefore, the function of the CCC data communication must be enabled through other means. This will be through CCC data request and response interfaces as described in section 8 to verify OBE compliance when an OBE Type 2 whitelisted vehicle is detected at an enforcement point based on vehicle license plate identification.

OBE Type 2 CCC data communication will take place on request by the Toll Charger when an enforcement case for a known OBE Type 2 user must be qualified. As specified in Annex F (Interface Specifications) a CCC Data Request and CCC Data Response interface must be implemented if the EETS Provider seeks accreditation and wants to operate with an OBE Type 2. The process that the interface is to support, is to allow the Toll Charger to obtain CCC data for an OBE Type 2 based on road enforcement observations with a specific time and date.

The CCC data request from the Toll Charger to the EETS Provider can take place shortly after the road enforcement observation of a known OBE Type 2 user. The EETS Provider is allowed some time as specified in Annex F (Interface Specifications) to respond to a CCC data request from the Toll Charger through the CCC data response. In case the EETS Provider does not have CCC information within this time, it must respond with "unavailable". The Toll Charger will request the CCC data again 24 hours later.

Based on the CCC data request the EETS Provider is to respond with the data required in the interface specification of the CCC data response. The GNSS location field must be reported to the last known GNSS location at the date and time of the enforcement case as requested in the CCC data request.

The EETS Provider is required to store and maintain OBE Type 2 usage and status history enabling a CCC data exchange following a request from Toll Charger up to 90 days.

Note: The CCC Data Request and CCC Data Response interfaces are only required to be implemented if the EETS Provider seeks accreditation of OBE Type 2 and operate with OBE Type 2 as a product offering to their customers.

6.3.2 OBE Type 2 specific accreditation documentation

When seeking accreditation of an OBE Type 2 the EETS Provider must provide supporting documentation descripting the solution, which hardware and OS platform(s) the solution will operate on, and how the solution was tested along with a risk assessment. Documentation requirements are outlined in the table below Table 5.

The documentation for accreditation of an OBE Type 2 will form the basis of Toll Charger's assessment prior to initiating any accreditation tests as defined in the EETS Domain Statement. The EETS Provider is requested to deliver a comprehensive, well-structured and high-quality documentation package covering all documentation requirements. Toll Charger reserves the right to request additional documentation to ensure completeness of the documentation package.

Table 5. Documentation requirements for OBE Type 2

Document title	Document description and quality criteria
OBE Type 2 List	Complete list of hardware, hardware attributes like GNSS chipset or similar and OS platform software combination which the OBE Type 2 solution is developed to operate on. The list will form the group of combinations of hardware and OS platform software version on which the OBE Type 2 accreditation is based. Quality criteria: • The list must clearly outline the hardware and software scope the OBE Type 2 solution.
OBE Type 2 Solution Description	The description must clearly outline the OBE Type 2 solution subject to accreditation. It must include detailed information on the solution design, solution features, applied technology used for core functionality and built-in operational mechanism that ensures the solution is suitable and fully aligned with the requirements in this Annex. Additionally, the description should complement the OBE Type 2 List by explaining the selection decisions that led to the content of the list. Quality criteria: • The description must provide a clear and comprehensive understanding of the solution including the design decisions and operational mechanism that contribute to the robustness, stability and suitability of the OBE Type 2 solution. • The description must clearly explain the rationale behind the selection of hardware and software combinations. This explanation should demonstrate to the Toll Charger how the selected combinations ensure sufficient similarity and reliability, resulting in a homogeneous and stable OBE Type 2 solution across all combinations in the OBE Type 2 List.
Test report	The test report must comprehensively provide a description and details of the EETS Provider's own tests conducted on the OBE Type 2 solution. It must include the following elements: • **Test scope definition**: A clear outline of the scope of the tests performed. • **Test setup description**: A detailed description of the test setup including environments and configurations. • **Test case details**: Information on individual test cases including acceptance criteria. • **Test results**: Documentation of the test outcomes, including both successful and non-successful tests. • **Test conclusion**: A summary of findings from the tests. The inclusion of both successful and non-successful tests results is essential, as they serve as supporting evidence for the OBE Type 2 List and the OBE Type 2 Solution Description. The test report must also cover both functional and non-functional testing of the solution, including its GNSS data capture capabilities.

	Quality criteria: • The test report must clearly demonstrate to the Toll Charger how the OBE Type 2 solution has been tested and provide sufficient evidence to confirm the solution's suitability for use. • The test report must provide evidence contributing to the likelihood that the OBE Type 2 solution will pass accreditation tests successfully. Key elements include usability, GNSS precision and long-term stability.
Risk assessment	The risk assessment for the OBE Type 2 solution must provide a detailed description of the identified risks associated with the solution's design, testing, and finalization, as well as the measures taken to mitigate these risks. Given that the hardware and OS platform for an OBE Type 2 is not dedicated for the OBE purpose, the risk assessment must also address potential solution future risks which can be foreseen. Furthermore, it should describe how the EETS Provider plans to manage these risks during the OBE Type 2's operational life cycle. Quality requirements: • The risk assessment must clearly outline the functional and operational risks identified by the EETS Provider and specify how these risks have been mitigated or will be addressed if they arise during operation. • The risk assessment must provide sufficient information to enable the Toll Charger to evaluate the operational maturity and reliability of the OBE Type 2 solution.

For accreditation purposes it should be noted that the following requirement of EETS Commission Implementing Regulation (EU) 2020/204 do not apply:

- Annex I, clause 1
- Annex III, Module A, (a) (ii)
- Annex III, Module A, (a) (iii) – "drawings" is to be subtracted from the requirement.

7 ABNORMAL OBE NOTIFICATION SERVICE

The EETS Provider shall notify the EETS User when abnormal OBE behaviour is detected, either by the EETS Provider or by the Toll Charger. To facilitate effective communication between the EETS Provider and the EETS User, the EETS Provider shall provide a digital service allowing the EETS User to manage when and how to receive notifications related to the OBE functionality, abnormal behaviour or changes to the OBE. The abnormal OBE notification service is a separate and additional service besides the OBE MMI elements in the OBE as described in section 6.1.3 in this document.

The purpose is to ensure that the EETS User or EETS contract holder effectively is notified centrally beyond the OBE based notification services.

The abnormal OBE notification service shall actively be marketed to the EETS User either directly by the EETS Provider or through sales partners.

7.1 Abnormal OBE notification functional requirements

The abnormal OBE notification service shall support notifications detected by the EETS Provider themselves as well as notifications sent by the Toll Charger to the EETS Provider through the interface EETS Report abnormal OBE as described in Annex F.

The notification service shall allow the EETS contract holder to choose how to receive the notifications in a timely manner close to real time and manage notification preference on OBE-level. While some notifications may be optional other notifications shall be mandatory at the discretion of the EETS Provider or as agreed between the EETS Provider and Toll Charger.

8 EXCEPTION LIST HANDLING

Exception Lists are exchanged between the EETS Provider and the Toll Charger with the purpose of the EETS Provider to state and identify the OBE issued to the EETS User on which the EETS Provider guarantee toll payment as the OBE is used on the KmToll Domain.

The EETS Provider must provide Exceptions Lists in form of both a Whitelist and Blacklist to the Toll Charger on a regular basis.

Lists are updated using the Incremental Exception List interface, as described in Annex F (Interface Specifications). This interface allows the EETS Provider to transfer a single White- or Blacklist entry at a time. For any specific OBE, the most recent entry added to the lists takes precedence.

For an EETS Provider newly joining the KmToll Scheme, the initial complete White- and Blacklists should be transferred one entry at a time using the given interface. Once the initial transfer is complete, it is the responsibility of the EETS Provider to ensure that the most recent status of each of its OBUs which are allowed to circulate in the KmToll Domain is communicated to the Toll Charger.

8.1 Time of validity

Validity of Exception Lists is determined by the time of acknowledgement of list transfer by the Toll Charger according to Annex F (Interface Specifications). **Note** that the field entryValidityStart is supported and must be used. For Whitelists and Blacklists the time of validity is specified in Table 6.

Table 6. Exception List - Validity

Exception List type	Time of validity
Whitelist	Valid from the moment the transfer is acknowledged by the Toll Charger. In case of a time in the future, the time listed in *entryValidityStart* applies.
Blacklist	Valid from the moment the transfer is acknowledged by the Toll Charger. In case of a time in the future, the time listed in *entryValidityStart* applies.

8.2 Whitelisting and Blacklisting process

All the EETS Provider's current EETS Users must be on the Whitelist. Adding an OBE to the Whitelist takes effect immediately after the transfer of the Whitelist entry is complete and acknowledged by the Toll Charger, or at the time indicated in the *entryValidityStart* field, whichever is the later.

Adding a new EETS User to the Whitelist is achieved by sending an *EETS Incremental Exception List* message with *exceptionListType* set to "whiteListIncremental" (12) and *actionCode* set to "send" (0).

If an EETS User is Blacklisted and needs to be Whitelisted or some parameter(s) need to be changed, this is achieved by sending an *EETS Incremental Exception List* message with *exceptionListType* set to "whiteListIncremental" (12) and *actionCode* set to "adjust" (3).

If the EETS Provider wishes to blacklist an existing EETS User, meaning that the EETS Provider chooses to block the usage and thereby does not guarantee for toll payment related to the OBE, the EETS User must be added to the Blacklist. Adding an OBE to the Blacklist takes effect immediately after the transfer of the Blacklist entry is complete and acknowledged by the Toll Charger, or at the time indicated in the *entryValidityStart* field, whichever is the later. Adding an EETS User who is currently on a Whitelist to the Blacklist is achieved by sending an *EETS Incremental Exception List* message with *exceptionListType* set to "blackListIncremental" (11) and *actionCode* set to "adjust" (3).

It is also possible to add a new EETS User directly to a Blacklist. This is achieved by sending an *EETS Incremental Exception List* message with *exceptionListType* set to "blackListIncremental" (11) and *actionCode* set to "send" (0).

The most recent Whitelist or Blacklist entry takes precedence; hence it is not necessary to remove an EETS User from the Whitelist before adding it to the Blacklist, and vice versa.

If an EETS Provider wishes to remove a user who is currently on a Whitelist or Blacklist, for example if the OBE is permanently disabled or scrapped, this is achieved by sending an *EETS Incremental Exception List* message with *exceptionListType* set to "blackListIncremental" (11) or "whitelistincremental" (12) as appropriate, and *actionCode* set to "revoke" (1). The EETS Provider must remove entries from the Blacklist a maximum of three (3) calendar months after blacklisting.

If an EETS User moves an OBE from one vehicle to another the existing Whitelist entry must be revoked, by sending an *EETS Incremental Exception List* message with *exceptionListType* set to "whiteListIncremental" (12) and *actionCode* set to "revoke" (1), and a new Whitelist entry created for the new vehicle, by sending an *EETS Incremental Exception List* message with *exceptionListType* set to "whiteListIncremental" (12) and *actionCode* set to "send" (0).

8.3 Acknowledgement of Exception Lists

Exception Lists are acknowledged by Toll Charger using the Acknowledge ADU process, as described in Annex F (Interface Specifications). Exception List entries only take effect when the Acknowledge ADU has been received by the EETS Provider.

If no acknowledgement is received within the allowed timeframe the Exception List entry is considered lost and must be resent using a new APDU identifier to have the OBE properly registered at the Toll Charger.

8.4 Exception List Scenario Samples

This section describes the common Exception List scenarios in terms of whitelisting and blacklisting OBEs.

8.4.1 Scenario 1 - Register new OBE as Whitelisted

On 02.01.2025, register new OBE 043111101A as whitelisted, starting immediately.

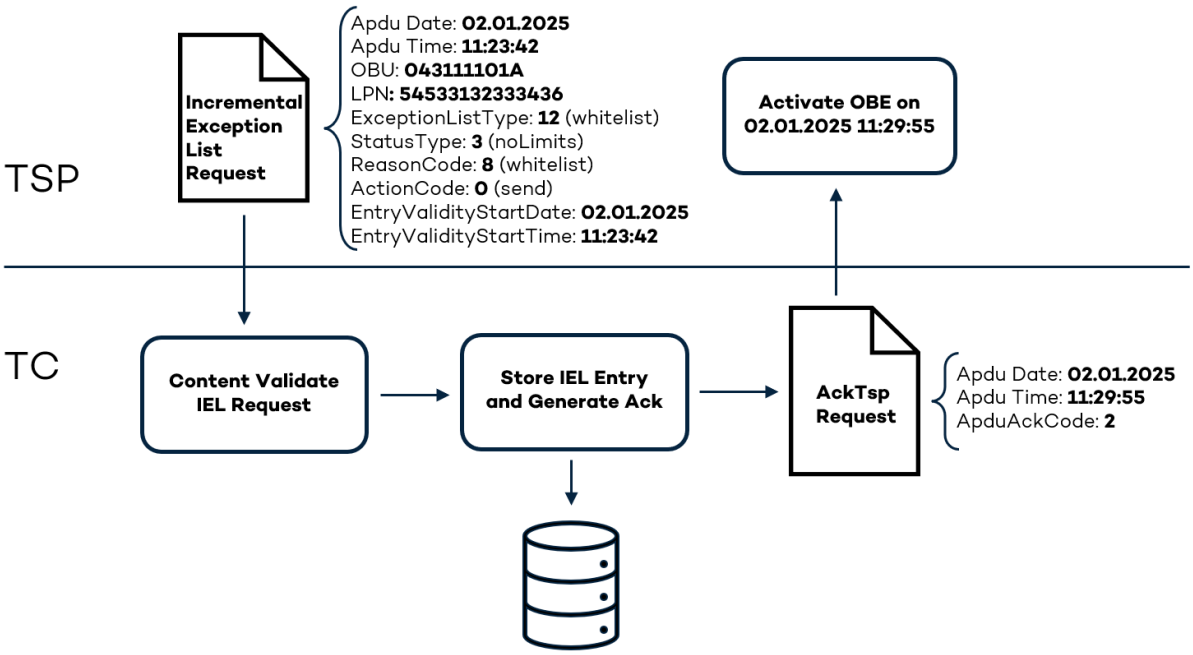


Figure 2 - Register new OBE as Whitelisted

8.4.2 Scenario 2 - Register new OBE as Whitelisted - future dated

On 05.01.2025, register new OBE 043211101A as Whitelisted, starting from 01.02.2025.

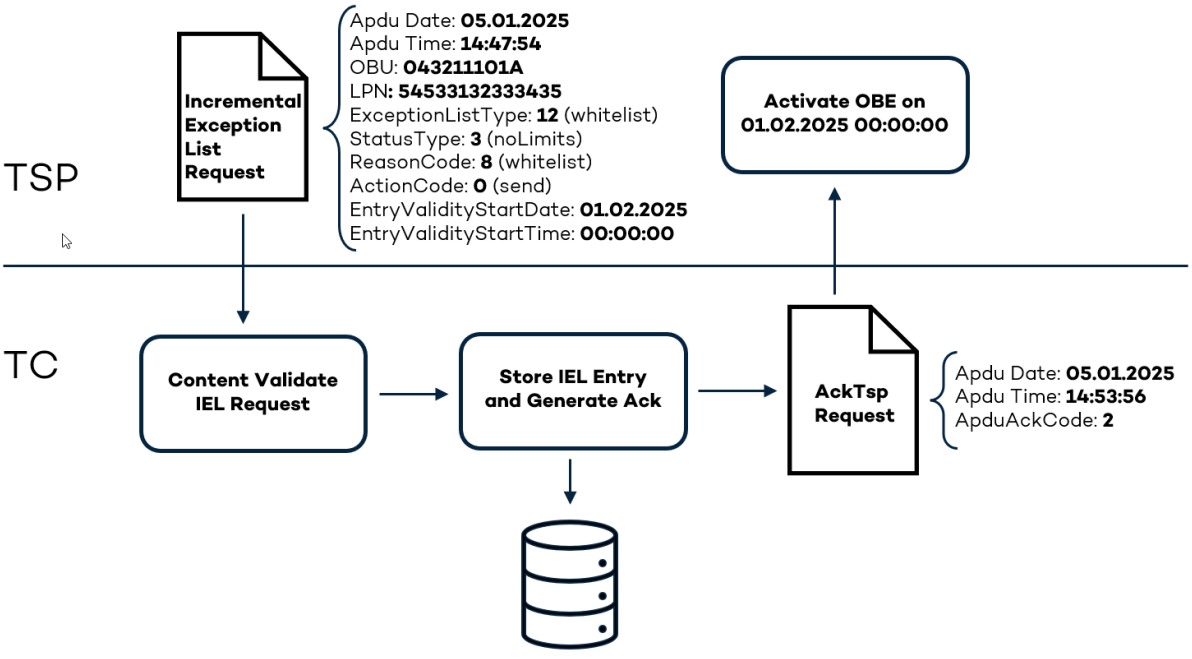


Figure 3 - Register new OBE as Whitelisted - future dated

8.4.3 Scenario 3 - Register OBE as Blacklisted

On 06.01.2025, register OBE 043211101B as blacklisted, starting immediately.

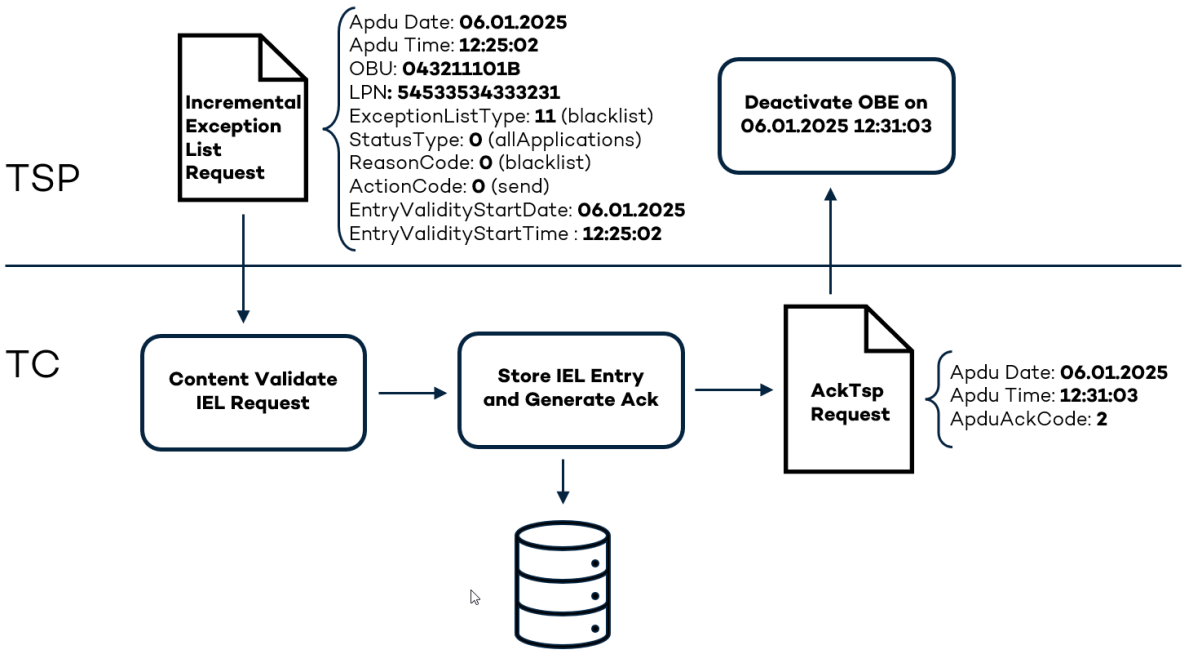


Figure 4 - Register OBE as Blacklisted

8.4.4 Scenario 4 - Blacklist already Whitelisted OBE

On 10.01.2025, update whitelisted OBE 043111101A to blacklisted starting from 11.01.2025

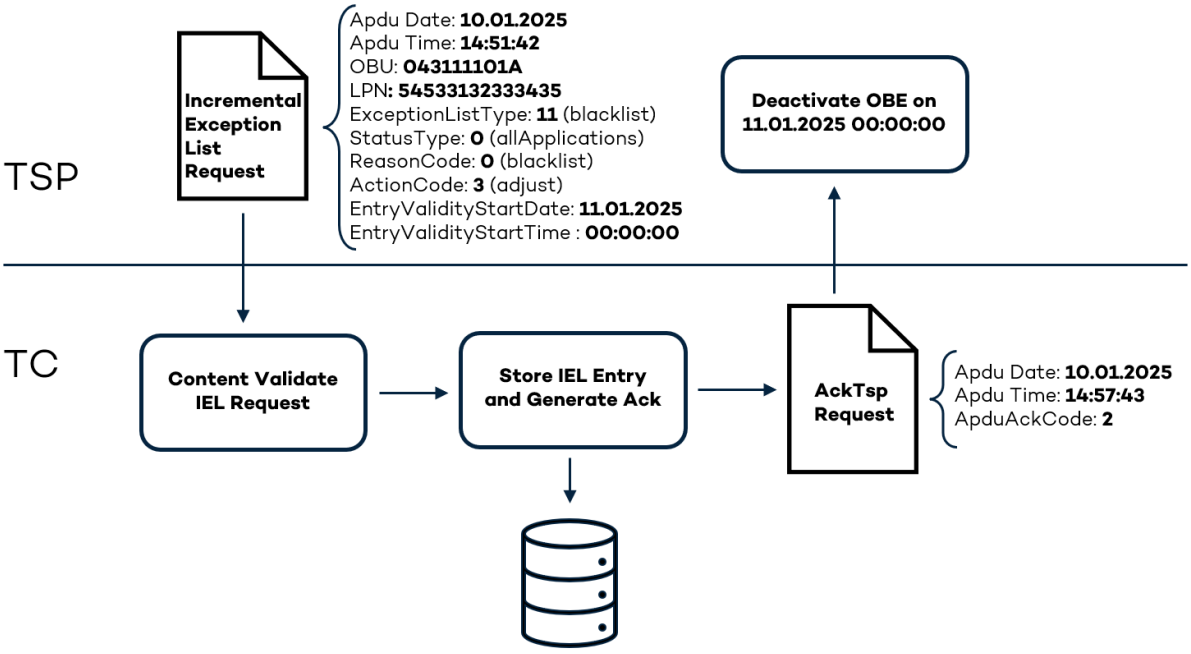


Figure 5 - Blacklist already Whitelisted OBE

8.4.5 Scenario 5 - Whitelist already Blacklisted OBE

On 12.01.2025, update blacklisted OBE 043211101B to whitelisted, starting immediately.

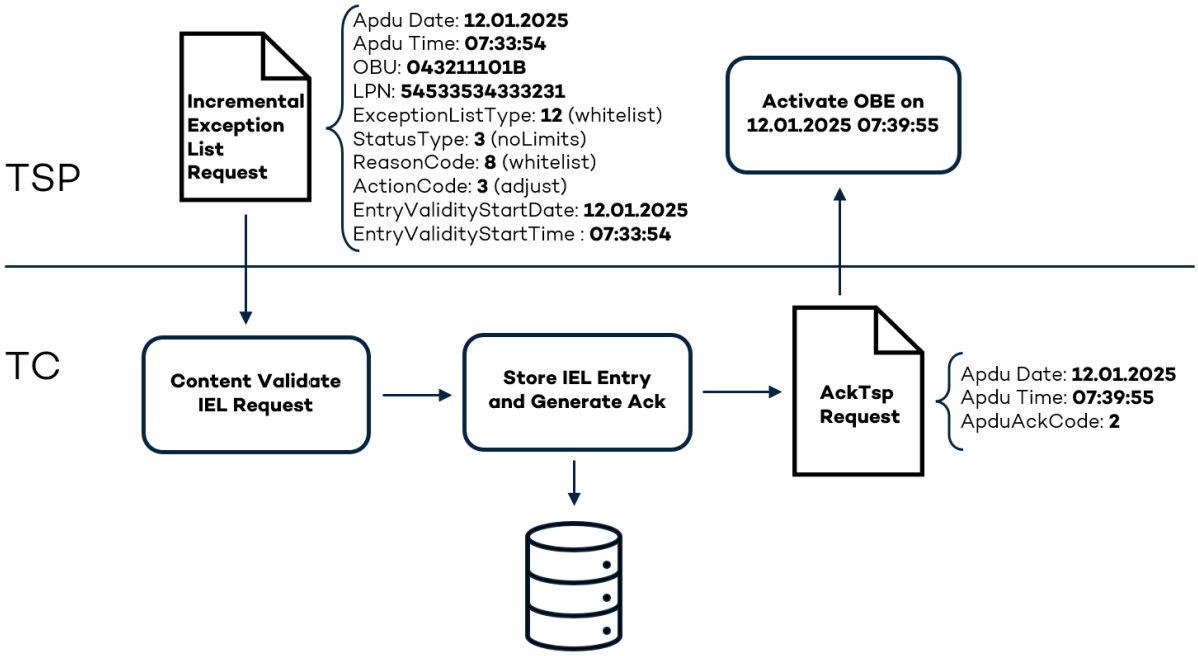


Figure 6 - Whitelist already Blacklisted OBE

8.4.6 Scenario 6 - Move OBE from one vehicle to another

On 17.01.2025, update OBE 043211101B from one vehicle to another, starting immediately is in 2 steps.

- Step 1, revoke the exception list registration for the current vehicle.
- Step 2, add a new exception list registration for the new vehicle.

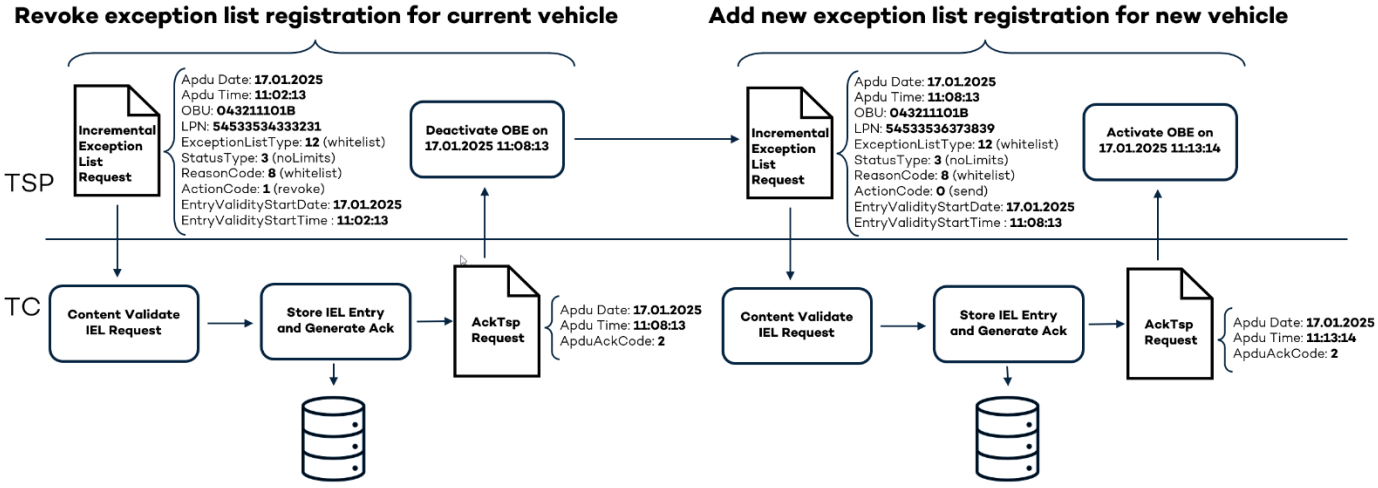
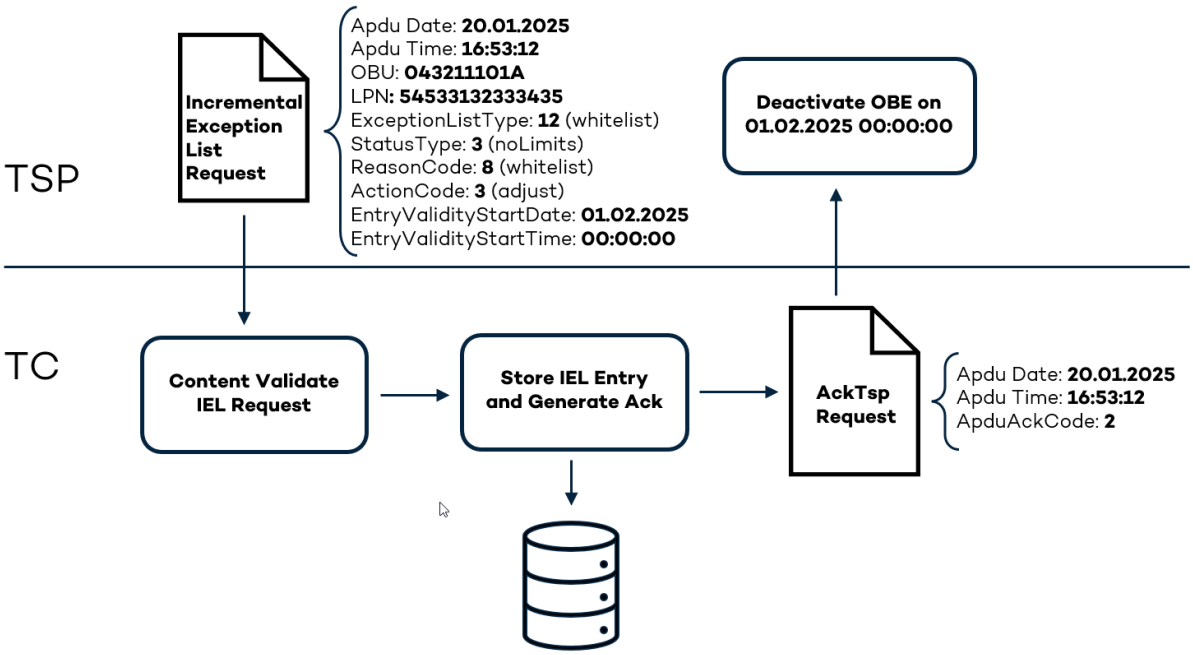


Figure 7 - Move OBE from one vehicle to another

8.4.7 Scenario 7 - Remove OBE Exception List Registration – Future dated

On 20.01.2025, remove whitelisted OBE 043211101A from exception list, effective from 01.02.2025

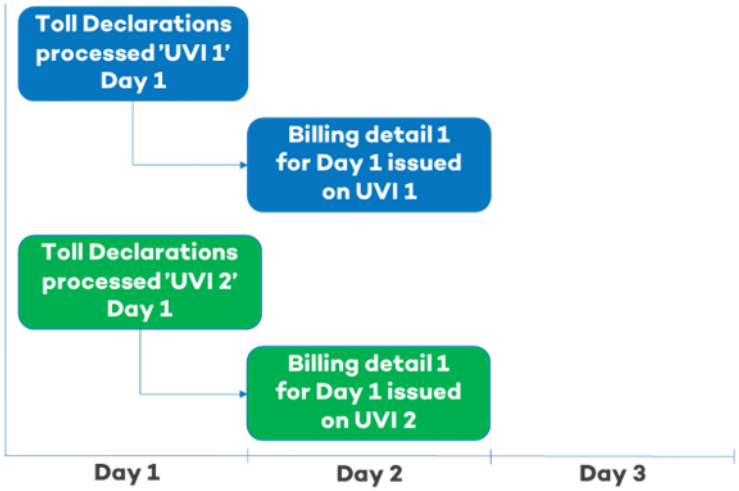


9 BILLING DETAILS

Billing Details are issued when driving is registered on the Danish toll liable road network.

A Billing Details (BD) is issued for a Unique Vehicle Identity (UVI) based on several parameters – see definition in section 2. If one of these parameters is changed within the billing period, this will result in a new UVI, and an additional BD is issued for the new UVI.

Figure 8 Trip is driven on day where the Unique Vehicle Identity (UVI) is changed



To ensure collection of tolls for both EETS Provider (TSP) and Toll Charger (TC) a BD is issued for the part of driving where toll can be calculated for a specific billing period. This means the part automatically processed by the TC's Tolling Engine will be issued on one BD. If some received data cannot be automatically map-matched, the Tolling Engine will identify this data as relating to a "gap" which will require manual checking. This manual checking is referred to as "gap closing" and will result in an additional BD being issued for the gap closed part of the journey.

It is also possible that a BD needs editing after it has been issued, normally because of a complaint from a user etc. A change made to a BD for a particular day will result in all BDs for that user on that day being revoked and replaced with a single consolidated BD. This is shown in more detail in the example scenarios below.

The Billing Period is one whole day from midnight-to-midnight Danish local time (currently defined as UTC+1, or UTC+2 during daylight saving season). If driving across midnight, the toll segment that the vehicle was on at midnight will be charged to the first day. The first new toll segment detected after midnight will be charged to the second day see section 9.2. If a Toll Declaration is received after the end of the Billing period, at least one additional BD will be issued for the late received driving data. See section 9.7

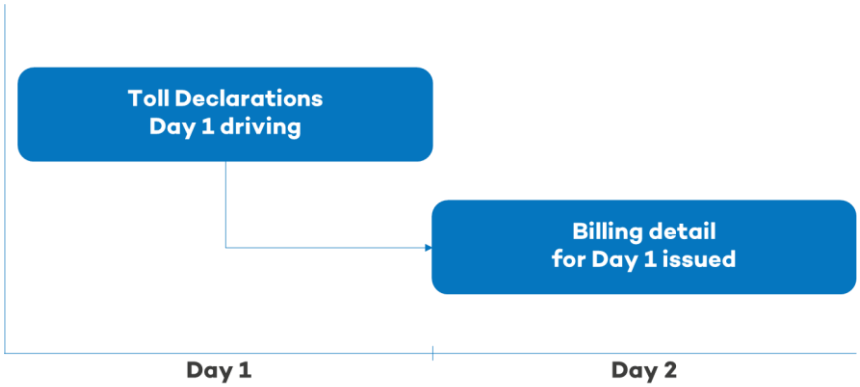
The Action Code for the messages are used actively as both Send and Revoke action codes are used for the Billing Detail message.

The following sections 9.1 to 9.9 illustrate the process of various scenarios which may result in revoking and/or re-issuing new or additional Billing Details. The word "Trip" is in this context used to describe a journey undertaken by a vehicle, which may stretch across the boundary from one Billing Period to the next.

9.1 Trip is driven on day 1 only, no gaps identified

This is the normal flow, where driving data for a day is correctly processed and Billing Details is issued the following day.

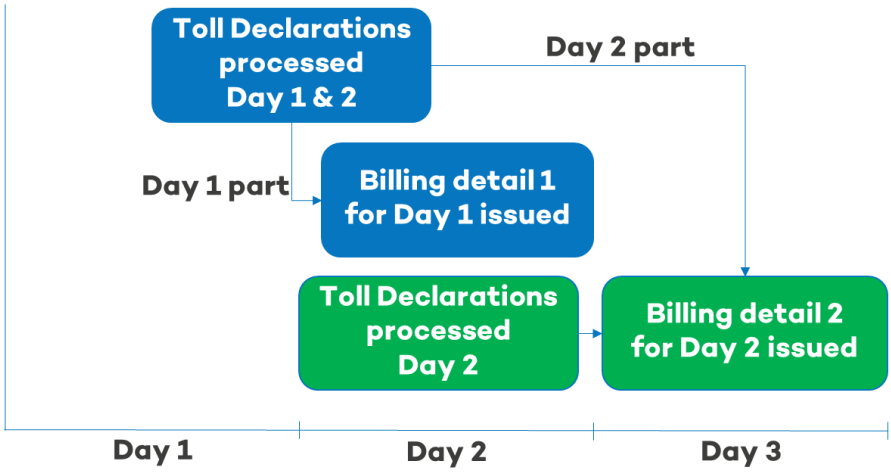
Figure 9. Process - Billing Detail for Day 1 issued



9.2 Trip is driven on day 1 and 2 crossing midnight

Scenario where a Trip is driven across midnight, Danish local time, having a Billing Detail generated for day 1 (before midnight) and day 2 (after midnight).

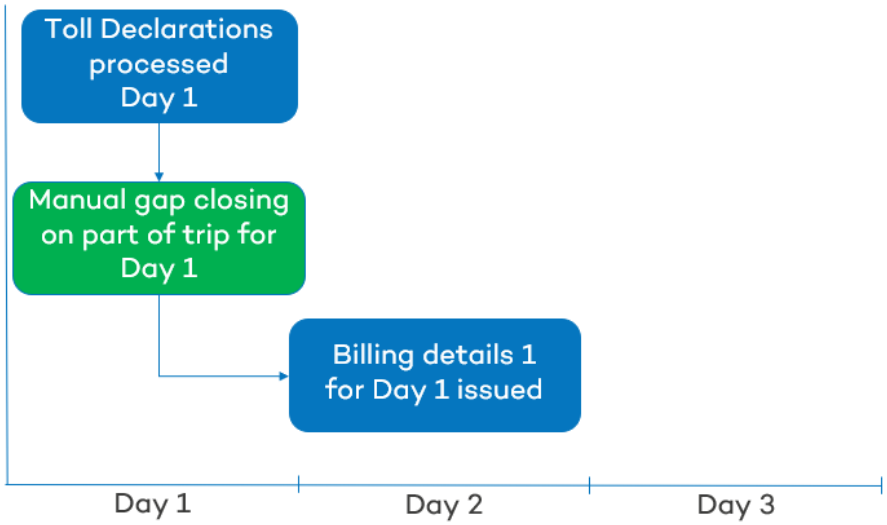
Figure 10 - Trip driven across midnight



9.3 **Trip is driven on day 1 only, gaps identified and manually closed on day 1**

In this scenario, gaps identified during map matching are processed by an operator on the same day that the driving takes place. A single Billing Details is created for the trip which includes the gap-closed data.

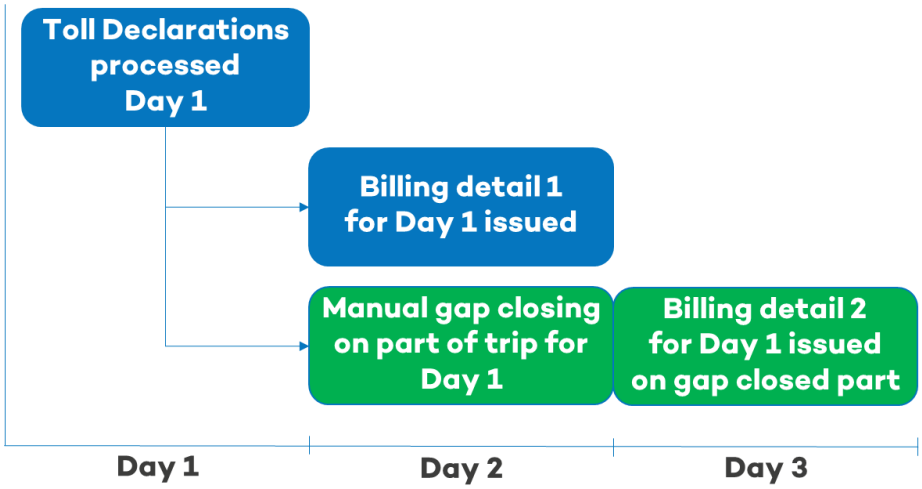
Figure 11. Process - Manual gap closing on Day 1, single BD created



9.4 **Trip is driven on day 1 only, gaps identified and manually closed after day 1**

This is like the scenario in 9.3, but the gaps are processed after the BD for day 1 has been issued. This results in an additional BD being created.

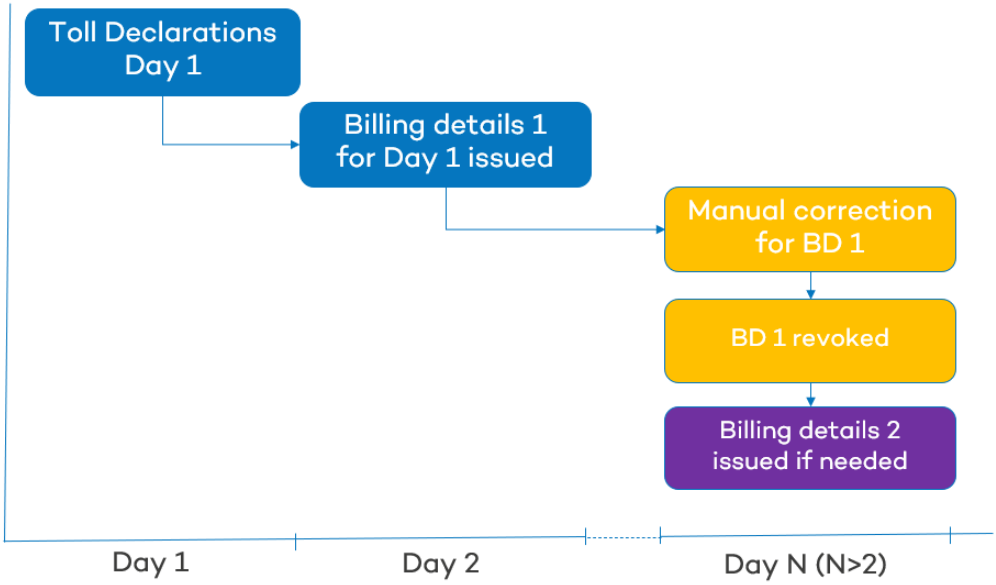
Figure 12. Process - Manual gap closing on Day 2, additional BD created



9.5 Trip is driven on day 1 only, BD edited after issue

In this scenario, previously issued BD is edited, resulting in a change in BD. The previous BD is revoked, and a new BD is issued if required. If the editing results in the entire trip being cancelled, no new BD will be issued. **Note** that the new BD is issued immediately after the edit is committed.

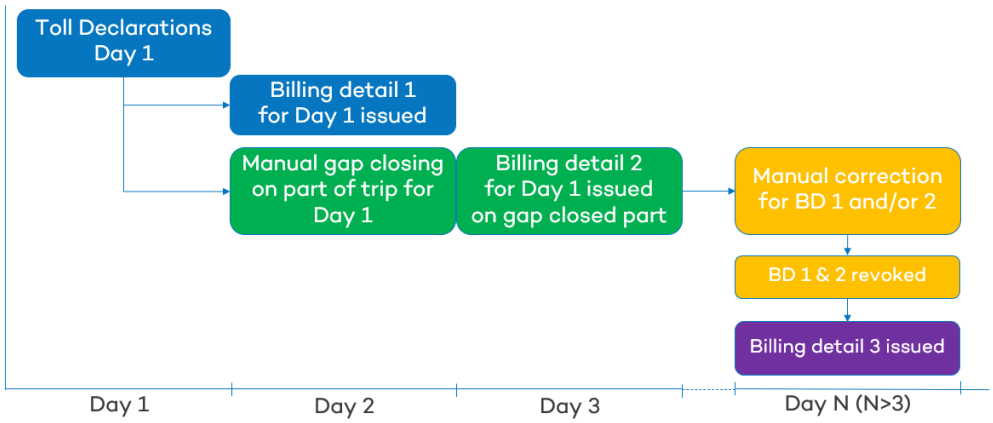
Figure 13. Process - Manual correction of BD, BD 1 revoked and BD 2 created



9.6 Trip is driven on day 1 only, gaps closed and subsequently edited

In this scenario, either the BD containing the gap closed data, or the original BD is edited (or both). All BDs related to that trip are revoked and replaced with a single new BD.

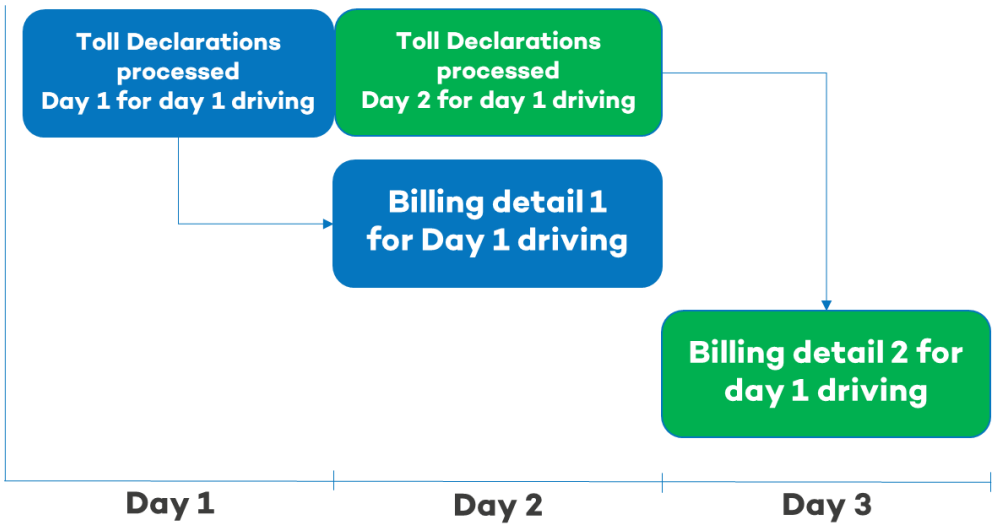
Figure 14Pprocess - Manual gap closing or correction of BD 1 and/or 2, BD 3 created



9.7 **Trip is driven on day 1, data is received over 2 days (day 1 + day 2)**

In this scenario, data for a trip on day 1 is received over two days, resulting in two BDs being produced.

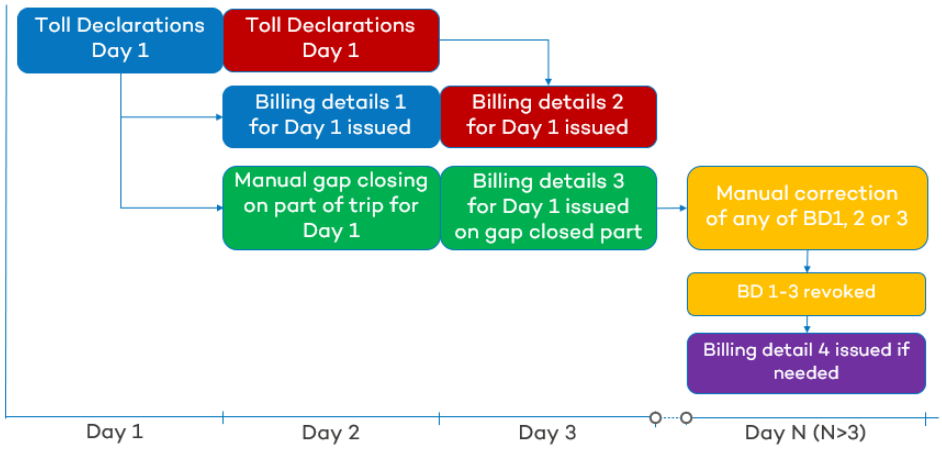
Figure 15. Process - Data received over two days resulting in two BD created



9.8 **Trip data is received over 2 days and gap-closed and edited**

In this scenario, data for a trip on day 1 is received over two days and is gap closed, resulting in 3 different BDs being produced for the trip. On some future day, one or more of the BDs are edited resulting in a change in the total cost of the trip. In this case, all previous BDs for this trip are revoked and replaced with a single new BD.

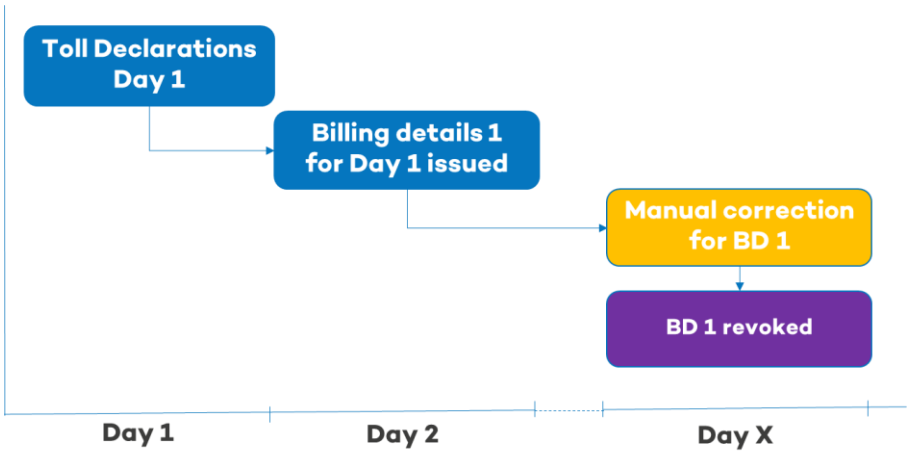
Figure 16. Process - Data received over two days are manually gap closed and/or corrected resulting in BD 4 being created



9.9 Trip data is received for 1 day and there is a complaint on day x resulting in a revoke/Cancel

In this scenario, data for a trip on day 1 is received and BD is issued on day 2. On day x TC receives a complaint for the BD from the TSP resulting in correction to the BD to 0Dkk or that the trip is cancelled by TC. TC issue the BD with action code revoke to debit the original BD.

Figure 17 Trip is driven has manual correction to 0dkk or is cancelled



10 PAYMENT CLAIM PROCESS

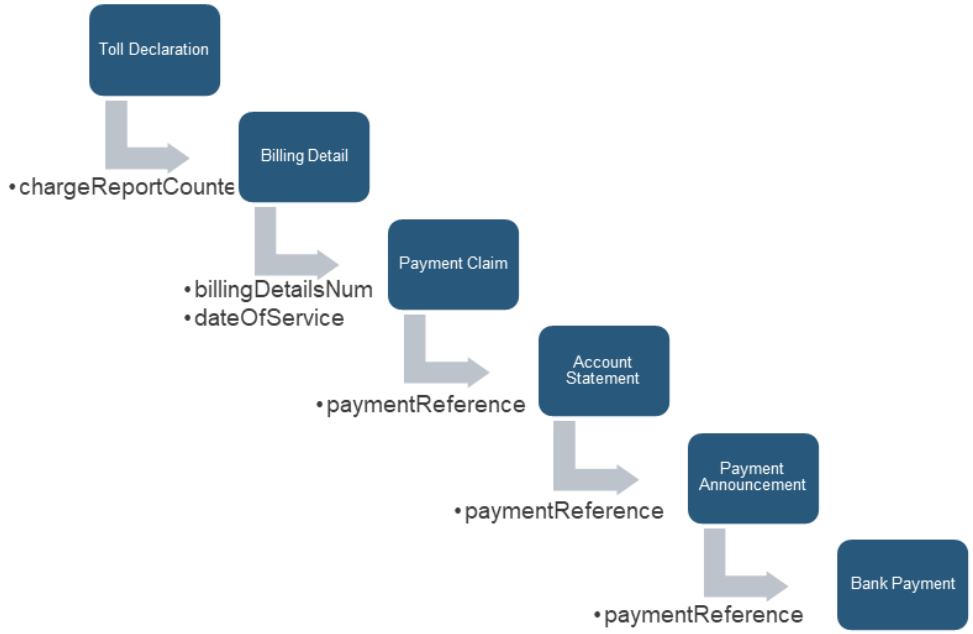
The high-level flow in Figure 18 illustrates the main positive flow from Toll Declaration to Payment Announcement. In the illustrated flow it is assumed that all messages are positively acknowledged on ADU level.

In Figure 18 the boxes illustrate the ADU and the arrow with text beneath it shows the data fields that define the relation to the next step.

Read from the top the Toll Declaration contains a *chargeReportCounter* data field, the value of which refers to the Toll Declaration from the created Billing Detail. The *billingDetailNum* is used as

reference in the Payment Claim. The *paymentReference* is the reference from the Payment Claim used as reference in the Payment Announcement, Account Statement as well as in the bank payment.

Figure 18. Tolling Main Flow



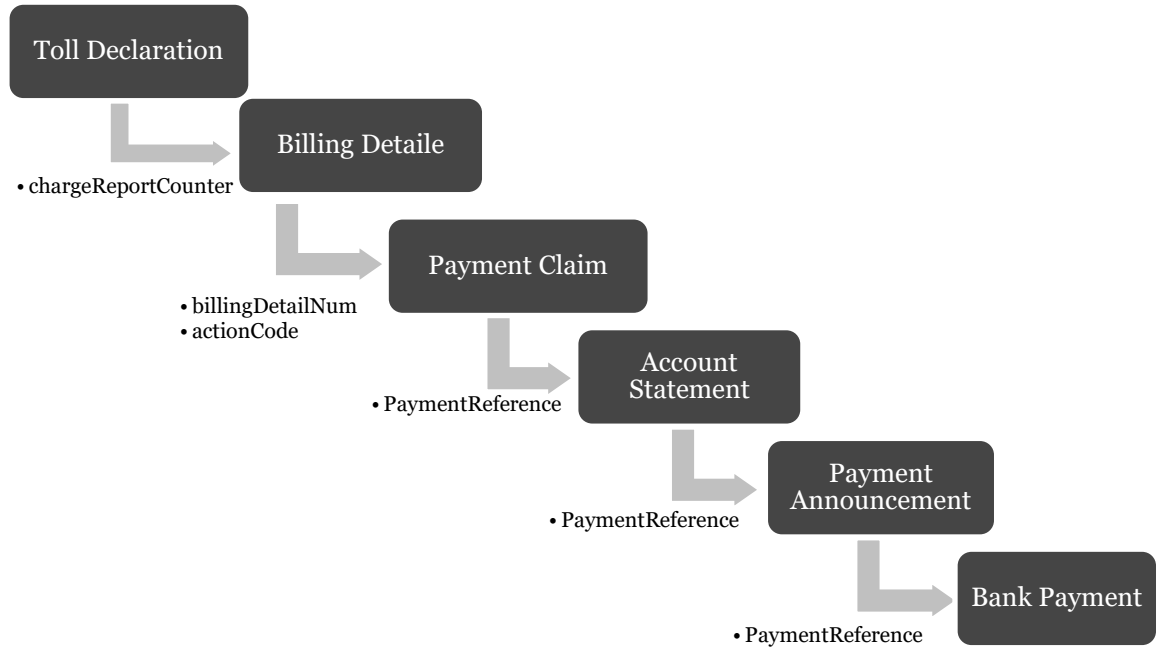
10.1 Planed change to Payment Claim message

It is planned to make a minor change to Payment claim API messages. The change is expected in first quarter of 2026 and will be released as version 2 of the PaymentClaim API.

Payment Claim API Version 2 includes a change to the Billing detail reference list entries. In the current version (version 1) the Billing Detail reference consists of 'billingDetailsNum' and 'dateOfService'. After the release of version 2, the 'dateOfService' is exchanged with 'actionCode' to provide visibility to whether it is a 'Send' or 'Revoke' Billing Detail which is referenced in the

Payment Claim. This means that it will become easier to determine whether it is a debit or a credit Billing Detail that is referenced.

Figure 19 - Toll Process (Payment Claim version 2)

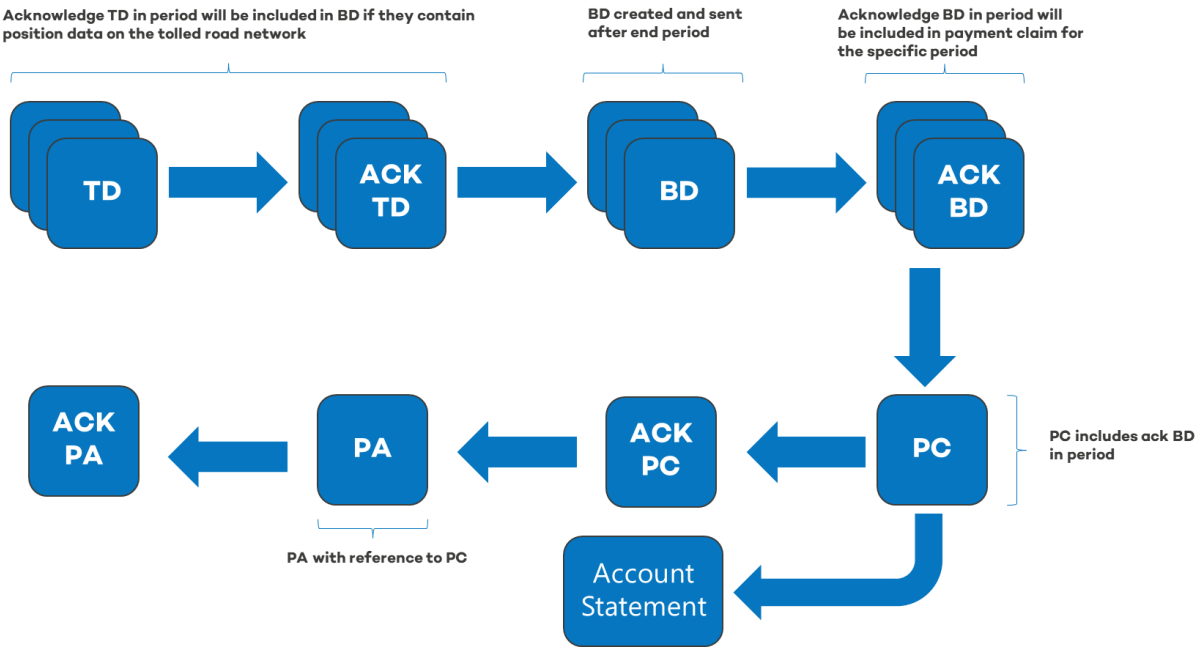


10.2 ADU Process Flow

The flow in Figure 20 Tolling Claim Flow shows that each message needs to be acknowledged before it is used by the Toll Charger to claim Toll. The happy flow starts with EETS Provider sending in a Toll Declaration which is positively acknowledged by the Toll Charger, and if the Toll Declaration contains position data that can be matched to a toll liable road segment, the segment is added to a Billing Detail after expiration of the Billing Detail period, and the Billing Detail is sent to the EETS Provider, who sends acknowledgement of the Billing Detail to the Toll Charger.

The positively acknowledged Billing Detail will then be included in the Payment Claim after expiration of the Payment Claim period and sent to the EETS Provider who sends a positive acknowledgement to the Toll Charger. The process ends with the EETS Provider sending a Payment Announcement to the Toll Charger referring to the Payment Claim and transferring the collected Toll to the Toll Charger's bank account with the 'paymentReference' issued in the Payment Claim and announced in the 'Payment Announcement'.

Figure 20 Tolling Claim Flow



10.3 Date and time in ADU

In all API messages and in the payload exchanged in the API, date and time data fields shall be in UTC datetime format as defined in the interface specifications (in is not allowed to use local date or time). The date and time must be transformed to Danish local time by the EETS Provider when used towards end users in web tools, billing or invoicing etc.

10.4 Billing Detail period definition

The Billing Detail period covers a calendar day from midnight to midnight in Danish local time (UTC +1) including summertime (UTC +2 from last Sunday in March to last Sunday in October).

Billing Details generated based on map matching or gap closing are created and sent in the period between 02:00 – 08:00 UTC. Billing Details generated based on trip editing are sent throughout the day. Each Billing Detail must be acknowledged by the EETS Provider within one (1) hour. All Billing Details that are acknowledged within the period of the Payment Claim will be included in the Payment Claim. Revoked Billing Details are included in the payment claim for the period in which the original billing detail was revoked, (*actionCode* value "1" (revoke)).

A Billing Detail contains references to all Toll Declarations that contain geoposition data for toll liable roads and was used to calculate the toll. Toll Declarations received within Billing Detail period are included. Additional Billing Details concerning the Billing Detail period can be produced later due to manual review performed by the Toll Charger and the additional Billing Details will reference the Toll Declarations relevant to the toll calculation.

10.5 Payment Claim period definition

The default Payment Claim period covers a calendar month and all Billing Details which are acknowledged within that calendar month are included in the Payment Claim. The Payment Claim must be acknowledged within one (1) hour from reception by the EETS Provider. The Payment Claim contains references to all the Billing Details included in the Payment Claim. If for some reason TC decide that an EETS Provider is not suitable for a payment period of a month, TC can define a shorter payment claim period between 1 day and a calendar month. TC will schedule a payment claim period so it does not go across a month shift.

10.6 Account Statement

The Payment Claim will be followed by a payment request in the form of an Account Statement with reference to the Payment Claim.

The Account Statement will be issued to the EETS Provider a few days after the start of the calendar month following the claim period by the Toll Charger. The Account Statement is sent though manual channel to EETS Provider. See contract for details.

10.7 Payment Announcement

The Payment Announcement is sent by the EETS Provider to the Toll Charger to announce that the payment is scheduled to be transferred to the Toll Charger's bank account. The Payment Announcement will be positively acknowledged by the Toll Charger if the Payment Announcement include the correct *paymentReference*, *referencedAduIdentifier* and the payment amount from the Payment Claim.

The Payment Announcement must be sent within 15 Business Days of the receipt of the Payment Claim, and the Toll Charger will acknowledge the Payment Announcement within one (1) hour. For further details see section 10.8.

10.8 Timing

Table 6 shows the timing, which is expected in a happy flow scenario. For each ADU the "Time to acknowledge" column states the allowable time from receiving a transaction and sending the corresponding acknowledgement ("Time1" in ISO12855). The "Interval" column states how often the messages are sent. The description column provides additional relevant information.

Table 7. ADU timing

ADU	Time to Acknowledge	Interval	Description
Toll Declaration	One (1) minute	<=5 min	Synchronous flow, time can be less than five (5) minutes (Synchronous flow means that the Toll Declaration for a specific OBE must be acknowledged before sending the next Toll Declaration for that OBE).
Billing Detail	One (1) hour	Daily	Is mainly sent between 02:00 and 08:00 UTC the day after the end of the Billing Detail period.
Payment Claim	One (1) hour	Monthly	Is sent on the first day of the month after end of the Payment Claim period.
Payment Announcement	One (1) hour	Monthly	Is sent maximum 15 Business Days after the Payment Claim.
Account Statement*	N/A	Monthly	Three (3) Business Days in the calendar month after the Payment Claim period.

* The Account Statement is not an ADU message but will be sent to the EETS Provider through a manual channel. It is included for the sake of having an overview of message timing in the table.

10.9 Impact of Billing Details Revoke

The scheme allows for the possibility for Billing Details to be revoked, and this can have an impact on the Payment Claim process, depending on exactly when the Billing Details are revoked compared to the Payment Claim period – see section 10.5 above for the definition of Claim Period.

Billing Details may be revoked if an error is found in the original Billing Details. Billing Details are revoked by sending a Billing Details message using the AduIdentifier of the Billing Details being revoked, but with the actionCode set to "revoke", as described in section 9.

The impact of revoking Billing Details depends on whether the revoke happens in the same Payment Claim period as the original Billing Details, or in a different Payment Claim period. The following actions apply:

- If a Billing Details with a specific AduIdentifier is received once during a Payment Claim period with an actionCode equal to "send", the amount of the Billing Details is included in the Payment Claim (i.e. toll must be paid)
- If a Billing Details with a specific AduIdentifier is received once during a Payment Claim period with an actionCode equal to "revoke", the amount of the Billing Details is deducted in the Payment Claim (i.e. a refund is issued).
  *Note that there must have been a related Billing Details with the same AduIdentifier with actionCode equal to "send" in a previous Payment Claim period.
- If a Billing Details with a specific AduIdentifier is received twice during a Payment Claim period, once with an actionCode equal to "send" and once with an actionCode equal to "revoke", no money is claimed or refunded in this Payment Claim.

All positively acknowledge Billing Details regardless of 'actionCode' "send" or "revoked" are included in a Payment Claim

10.10 Acknowledgement terms

This section describes a selection of the requirements related to the Payment Claim flow. The relevant section in Annex F (Interface Specifications) must be read as well to get the complete set of requirements

10.10.1 APDU Acknowledge Codes

The *apduAckCode* used can be found in table 9 of ISO12855. But in this section, we highlight some *apduAckCodes* used by the Toll Charger's system.

Table 8. apduAckCode

Name	Semantics	Value
apduOk	The APDU was accepted	2
apduNotOk	The APDU was rejected	3
originatorRejected	The APDU was rejected because the APDU Originator is not known, or no valid contract exists	7

All relevant codes of table 9 in ISO12855 can be used according to the standard and must be supported. See the entire table in ISO12855.

Example of how *apduAckCode* is used negatively acknowledge (reject) an APDU and ADU:

Sample 1. apduAckCode example

```
"apduIdentifier": 9900,
"apduAckCode": 3,
"issues": [
```

10.10.2 Issue Codes

ISO 12885:2022 *AduReasonCode* Table 11 contains pre-defined values for use in the *issueCode* entry of the *Issues* array of acknowledged ADUs.

The Toll Charger has defined the following extension values to be used to identify specific issues in Payment Claim flow. Currently, three values are defined. The private extensions values are:

- 10700: Duplicate Billing Details *aduIdentifer* rejected.
- 10701: *chargeReportCounter* is invalid for this OBE.
- 10900: Payment Announcement ADU not accepted. The data in the Payment Announcement contains errors or inconsistencies. See the *issueText* entry for further detail.

All issue code related to the ADU of table 11 in ISO12855 must be supported.

The private extensions 10900 is valid for Payment Claim as 10700 and 10701 is for Billing Detail and Toll Declaration.

Example of an issue code:

Sample 2. issueCode example


```
"ackAdus": [
    {
        "apduIdentifier": 8899,
        "apduAckCode": 3,
        "issues": [
            {
                "issueAduIdentifier": 1234567890,
                "issueLocation": "Json path to issue",
                "issueContent": "Payment reference",
                "issueCode": 10900,
                "issueText": "PaymentReference value is not identical to referenceAduIdentifier paymentReference value"
            }
        ],
```


10.11 Interoperability

To ensure that the EETS Provider and Toll Charger are aware of what Toll to claim and pay, the reference to Billing Detail ensures transparency and the Payment Claim lists all claimed Billing Details within the period. The claimed amount in Payment Claim is an summation of all Billing Details positively acknowledged as ether (send) debit or (revoked) credit.

10.11.1 Accounting

The Toll Charger does not have any additional requirements towards the EETS Provider for accounting purposes besides the requirements derived from EU and local legislation. The Toll Charger cannot provide dates for accounting purposes through any ADUs and therefore the Billing Detail and the Payment Claim is the actual claim from the Toll Charger for a given period.

The EETS Provider must invoice all acknowledged Billing Details to their EETS Users.

10.12 Date and time in ADU

This section will explain how the date and time data in the APDU and ADU is used.

None of the date fields can be used for accounting purposes.

Table 9. Date and time in ADU

ADU	Data field	Description
All	apduDate	Date and time of the creation of the APDU. Will typically be close to the time of sending the APDU.
Toll Declaration	timeWhenMeasured	Date and time of when a position was measured. Will be used as *tollEventTime* for segment detection for the position data used to detect the segment.
Billing Detail	dateOfService	Date and time of the creation of the Billing Detail. A revoke Billing Detail will have the dateOfService related to the creation of the revoke Billing Detail itself and not the date related to the creation of the original Billing Detail.

Billing Detail	period	Start and end date and time of the billing period according to the Toll Declaration "timeWhenMeasured" *Note: Date is in UTC and shall be transformed to Danish local time.*
Billing Detail	tollEventTime	Specifies the time and date of the tolling event, the time from the GNSS position "timeWhenMeasured" used to detect the toll segment
Payment Claim	startDateTime	Start date time of the Payment Claim period Billing Details acknowledge between the "startDateTime" and the "endDateTime" and was processed by TC within that period is included. *Note: Date is in UTC and shall be transformed to Danish local time.*
Payment Claim	endDateTime	End date time of the Payment Claim period *Note: Date is in UTC and shall be transformed to Danish local time.*
Payment Announcement	dueDate	Provides the date and time when the amount has been actually paid to the Toll Charger.
Payment Announcement	valueDate	Specify the date when the amount of the specific reference detail was due according to contractual agreement between the EETS Provider and the Toll Charger.

10.12.1 Example of a Payment Claim

Payment Claim for October, 2025: All Billing Details that have been acknowledged and processed by Toll Charger between "startDateTime" "2024.10.01.00:00:00Z" and "endDateTime" "2024.10.31.23:59:59Z in Payment Claim, are included in the Payment Claim, no matter what the Billing Details period is (as corrections regarding Billing Detail claimed in earlier Payment Claim periods is included as well).

11 DATA TRANSFER MECHANISM

The KmToll Scheme will use REST API as data transfer mechanism and the data to be transferred (APDU)will be coded in JSON (JavaScript Object Notation), not XML as defined in ISO 12855:2022.

EN 16986 specifies that generic data transfer to use either web services using SOAP V1.2, or FTP – except for transfer of trust objects. Web services using SOAP V1.2 or FTP are not deemed optimal for the data transfer envisaged, so the data transfer mechanism to be used is REST API. REST APIs has been employed throughout the software industry and is widely accepted for creating stateless, reliable and secure web APIs. Details of the REST API, data formats and coding are defined in Annex F (Interface Specifications).

Note that data format is JSON (JavaScript Object Notation).

JSON (JavaScript Object Notation) is a lightweight data-interchange format. It is easy to read and write for humans. Its lightweight format makes efficient for machines to parse and generate. JSON is based on a subset of the JavaScript Programming Language Standard ECMA-262 3rd Edition - December 1999. JSON is a text format that is completely language independent but uses conventions that are familiar to most programmers as it belongs to the C-family coding languages, which includes C, C++, C#, Java, JavaScript, Perl, Python, and others. These properties make JSON an ideal data-interchange language.

JSON is built on two structures:

- A collection of name/value pairs. In various languages, this is realized as an object, record, struct, dictionary, hash table, keyed list, or associative array.
- An ordered list of values. In most languages, this is realized as an array, vector, list, or sequence.

These are universal data structures. Virtually all modern programming languages support JSON in one form or another. Therefore, it makes sense for the TC to use a data format that is interchangeable with most programming languages there is also based on these structures.

All data transfer between the EETS Provider and the Toll Charger will use REST API, with the exception of trust objects, which will be transferred using a web-based data transferring mechanism defined by Toll Charger for the EETS Provider to securely upload trust objects to the road side enforcement system separately, and Actor Table exchanges which will be agreed bilaterally between the EETS Provider and the Toll Charger.

By default, data will be PUSHed from sender to receiver.

Annex F (Interface Specifications) provides the full details of interface specifications. The below table provides an overview of the interfaces and data to be exchanged:

Table 10. Interfaces and data to be exchanged

Data to be exchanged	Normal Frequency of exchange	Direction
Ack_TC	Dependent on data exchange being acknowledged	TSP - TC
Ack_TSP	Dependent on data exchange being acknowledged	TC - TSP
Exception Lists	Ad-hoc	TSP - TC
Trust Objects	Ad-hoc	TSP - TC
Contract Issuer List	Ad-hoc	TSP – TC
Toll Declarations	Once every five (5) minutes for each OBE	TSP – TC
Payment Claims	Monthly	TC – TSP
Payment Announcements	Monthly	TSP – TC
Billing Details	Daily for each Unique Vehicle Identity *	TC – TSP
CCC Data Request	Ad-hoc	TC - TSP
CCC Data Response	Ad-hoc	TSP - TC
Actor Table exchange	Ad-hoc	TSP – TC TC - TSP

* If the UVI changes during the billing period, a new Billing Details will be created for the new vehicle identity.

Note: In case of incidents and the unlikely scenario where data flow is interrupted in such a way that already acknowledged Toll Declarations have been lost the EETS Provider is required to resend Toll Declarations upon request and specification of Toll Charger up to 30 days after Toll Charger has acknowledged the original Toll Declaration sent from the EETS Provider to the Toll Charger.

12 SECURITY

The Toll Charger uses a risk-based approach to information and IT security based on the CIS framework and comply with the ISO 27001 standard. This means that the Toll Charger demand that the EETS Provider and/or third parties to comply with the same requirements and standards.

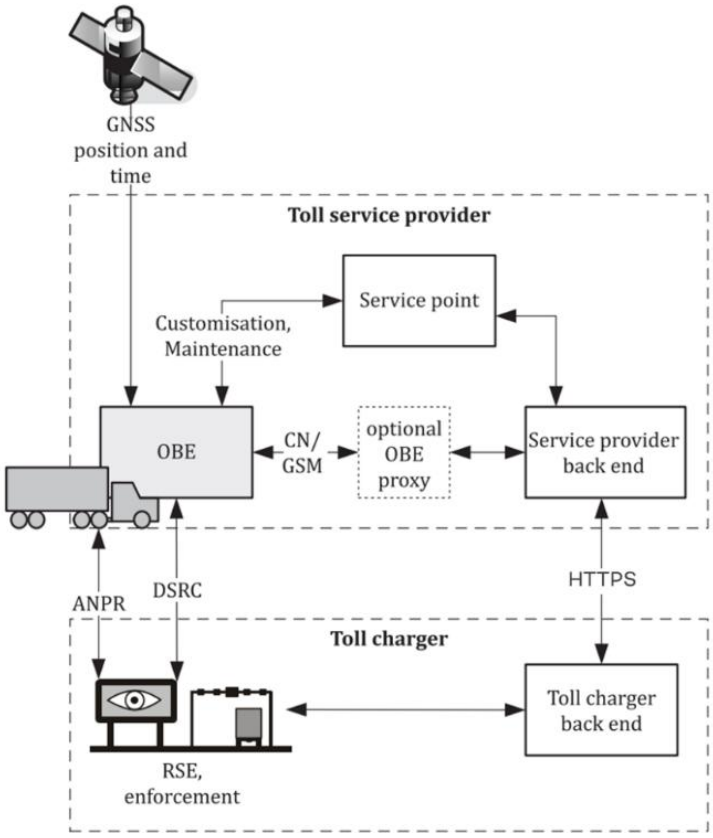
The EETS Provider's solution must comply with ISO 27001:2017 with the requirements stated in ISO 27002:2017 and ISO 19299 Electronic fee collection security framework.

Security and data integrity is a key element addressed in three key areas:

- The EETS Provider's compliance with overall requirements in the EETS Domain Statement;
- OBE Type 1 DSRC security requirements defined in section 5.1; and
- Data interface security requirements defined in Annex F (Interface Specifications) as part of the interface definitions and built in security model.

Note: Main interfaces connection is shown in ISO:19299, see Figure 21. Please note that the interface between the EETS Provider and the Toll Charger is HTTPS.

Figure 21. Interface connections between EETS Provider and the Toll Charger



12.1 Security requirements

Below are the formalised security requirements that the Toll Charger requires the EETS Provider to comply with in connection with accreditation and in operation after the accreditation is granted. The EETS Provider must:

- have internal processes in place that ensures secure handling of data (data processing);
- provide a threat analysis addressing the risks set out in ISO 19299 Annex D;
- have a clear plan for business continuity/disaster recovery;
- actively address and work with patch and vulnerability management; and
- have implemented an Information Security Management (ISM) system.

For the EETS Provider to demonstrate compliance with the above listed security requirements, the EETS Provider shall present the Toll Charger with the documentation defined in Table 3 in Annex C (Accreditation Procedure).

13 CODING OF LICENSE PLATE NUMBERS

This section describes how to format license plate number (LPN) in the Toll Declaration, Exception List etc. and how to convert non-Latin Alpha No.1 character into Latin Alpha no.1.

It is imperative that the coding of licence plates is consistent across the various parts of the technical solution of the KmToll Scheme. This section clarifies the requirements for the coding of licence plates in the various parts of the system.

The vehicle licence plate is used in multiple parts of the technical solution of the KmToll Scheme, for example:

- In Toll Declarations, as it identifies the vehicle being tolled.
- In Billing Details, as it identifies the vehicle being tolled.
- In Exception Lists it identifies if a vehicle is on a white- or blacklist.
- It is displayed and entered on various user interfaces when a vehicle is being searched for, or details of the vehicle are being displayed.
- In the tolling system it forms part of the unique identifier, together with other attributes like OBE identifier, vehicle characteristics etc., used to identify the entity being tolled.
- In the DSRC interface it is used to identify the vehicle in which the responding OBE is mounted.
- In the CCC interface it is used to identify the vehicle for which CCC data is being requested.

In the enforcement process flow, violations are detected by matching licence plate information from the ANPR system (which never contains whitespaces or hyphens) to licence plate information in Exception Lists, OBE data (read from the DSRC interface), and Biling Details (which in turn is derived from the licence plate data from Toll Declarations). To ensure that users and TSPs are not incorrectly identified as violators, and hence penalised, it is imperative that the licence plate information is consistent across these various interfaces and platforms.

To ensure consistency across the various platforms used in the KmToll Scheme, the EETS Provider must only apply the following:

- Licence plates are consistently coded across all interface and platforms
- Licence plate string must consist of valid licence plate characters. Generally, this consists of characters 0-9, A-Z, and Å, Æ, Ø, Ö, Ü and Ä.
- Licence plate strings must never contain whitespace characters, hyphens, or dots, either as leading characters, trailing characters, or between characters.

13.1 Examples of LPN coding

Danish licence plate:

Figure 22 LPN coding Danish LPN

License plate coding	Licence plate number
Correct coding	"DD12312"
Incorrect coding	"DD 12312"
	"DD-12 312"
	"DD 12 312"
	"DD-12312"
	"DD12312 "

German licence plate

License plate coding	Licence plate number
Correct coding	"RAKL8136",
Incorrect coding	"RA KL8136"
	"RA KL 8136"
	"RA-KL8136"
	"RA-KL 8136"
	"RAKL8136 "

For the avoidance of doubt, this consistency must be implemented across all interfaces and platforms.

13.2 Convert non-Latin Alpha No.1 character

Figure 23 Conversion table show how to convert non-Latin Alpha No.1 character into Latin Alpha no.1. lower case characters in both OBE and interfaces using license plate number.

Table is defined according to ISO14906 Annex D.

Figure 23 Conversion table

Source standard	Upper/ Lower case spe-	Mapping to lower case
ISO 8859-2 (Latin2)	Č- č	c
ISO 8859-2 (Latin2)	Š- š	s
ISO 8859-2 (Latin2)	Ž- ž	z
ISO 8859-5	Б-б	v
ISO 8859-5	Г-г	g
ISO 8859-5	Д-д	d
ISO 8859-5	Ё-ё	e
ISO 8859-5	Ж-ж	x

ISO 8859-5	З-з	k
ISO 8859-5	И-и	n
ISO 8859-5	Й-й	j
ISO 8859-5	Л-л	l
ISO 8859-5	П-п	p
ISO 8859-5	У-у	y
ISO 8859-5	Ф-ф	o
ISO 8859-5	Ц-ц	u
ISO 8859-5	Ч-ч	i
ISO 8859-5	Ш-ш	w
ISO 8859-5	Щ-щ	m
ISO 8859-5	Ъ-ъ	b
ISO 8859-5	Ы-ы	q
ISO 8859-5	Ь-ь	h
ISO 8859-5	Э-э	h
ISO 8859-5	Ю-ю	t
ISO 8859-5	Я-я	r
IEC 8859-7 (Latin/Greek Alphabet)	Λ-λ	a
ISO/IEC 8859-16 (Latin Alphabet No 10) NOTE Be aware that there is a similar looking character in ISO/IEC 8859-1 ("Eth")	Đ - đ	ä
ISO/IEC 8859-16 (Latin Alphabet No.10)	Ć - ć	ü

13.3 **License plate number is format**

The license plate number is formatted according to below description:

The license plate number is a string of characters, with a maximum length of 14 characters. For reasons of backward compatibility, the license plate number is coded as a string of hexadecimal characters, which encode the license plate number according to "latinAlphabetNo1", similar to extended 8-bit ASCII. The hexadecimal character string is composed of two hexadecimal characters for each license plate number character. The LPN is maximum 14 characters long, with each character represented by 2 hexadecimal values.

Examples:

- Danish license plate "AB12345" is encoded as the hexadecimal string "41423132333435",

- Danish license plate "ABØ123" is encoded as the hexadecimal string "4142D8313233".

Restrictions: In general, European license plates consist of only the characters 0-9, A-Z, for some Nordic countries the characters Å, Æ, and Ø, and for Germany the characters Ö, Ü and (historically) Ä. Lowercase letters, including ä and ü, must only be used to convert special characters according to ISO14906 Annex D or in section 1.1 listed table.

13.4 License plate number pattern

Both with and without a conversion from above table the license plate number must fit in the this regular expression "^(?:(?:3[0-9]|4[1-9A-F]|5[0-9A]|6[1-9A-F]|7[0-9A]|D8|C6|C5|D6|DC|C4|E4|FC)){2,14}$" as the tolling scheme do not allow other characters.