Annex H (Testing)

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

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1 DOCUMENT HISTORY

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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:

"EC Declaration" shall have the meaning as described in section 5.1.

"**Pilot Operation**" shall have the meaning as described in section 5.3.

"Suitability for use" means the ability for interoperability constituents to achieve and maintain a specified performance when in service, integrated representatively into EETS in relation with a toll charger system.

3 INTRODUCTION

Testing under the KmToll Scheme will follow the Time Schedule described in Annex C (Accreditation Procedure).

This Annex focuses on testing relevant to any new EETS Provider during the Accreditation Procedure described in Annex C (Accreditation Procedure).

The next sections of this Annex are structured as follows:

(i) **Section 4**: In this section, general requirements related to test is detailed including information regarding roles and responsibilities and approval of test;

(ii) **Section 5:** In this section, information relevant for the EETS Provider related to testing during the Accreditation Procedure are described;

(iii) **Section 6:** In this section, the Toll Charger's requirements related to re-certification are described.

4 GENERAL REQUIREMENTS RELATED TO TEST

4.1 Roles and responsibilities

The division of roles and responsibilities of tasks between the EETS Provider and the Toll Charger shall be as follow:

The Toll Charger's responsibilities

(i) Propose the overall test planning and validate it with the EETS Provider;

(ii) Define the test plans, the test cases and the detailed tests requirements. This includes the criteria on which the success and/or the failure of a test will be based;

(iii) Execute, or collaborate in the execution by the EETS Provider of the test(s) according to the test plan defined by the Toll Charger;

(iv) Draw up a test report detailing the progress and results of the test(s);

(v) Share this test report with the EETS Provider; and

(vi) Based on the test report, validate or not the success of the test.

The EETS Provider's responsibilities

(i) Prepare detailed test planning and validate it together with the Toll Charger;

(ii) Provide the Toll Charger with the resources necessary for the execution of the test(s);

(iii) Provide APIs and the necessary information for the Toll Charger to access these APIs, according to requirements in Annex F (Interface specifications);

(iv) Provide the Toll Charger with configured OBE to be used for the tests, according to requirements in Annex E (Technical Conditions);

(v) Provide the vehicles necessary for test drives for execution of specific test(s) according to the requirements of this Annex; and

(vi) Execute, or collaborate in the execution by the Toll Charger of the test(s) according to the test plan and test protocols defined by the Toll Charger.

(vii) Ensure the availability of resources to promptly investigate and address defects to ensure efficient execution of testing.

4.2 Approval of test

For the EETS Provider to pass a test, and for the Toll Charger to approve the test report, the following requirements must be met:

(i) The test(s) must be completed according to this Annex, the test plan and test case requirements of the Toll Charger;

(ii) The Toll Charger must have access to follow / oversee the test(s) as agreed;

(iii) The test and test results of tests conducted by the EETS Provider must be documented in a test report demonstrating the EETS Provider's successful execution of the test; and

(iv) If the Toll Charger chooses to approve a test notwithstanding the presence of defects, known to both parties, such defects must be entered on the EETS Provider's defect list, and subsequently be remedied by the EETS Provider. The EETS Provider must inform the Toll Charger and obtain the Toll Charger's approval when the defects have been remedied.

Any test is only deemed approved when the test report has been produced and approved by the Toll Charger and a written notification has been given to the EETS Provider.

4.3 Tools

The Toll Charger uses a test management tool for development activities respectively for planning, executing and reporting test activities related to the Accreditation Procedure. The EETS Provider will not be granted access to the Toll Charger's test management tool. The EETS Provider will be granted access to test cases and reporting templates in other formats and in both cases to be provided to the EETS Provider by the Toll Charger.

To help the EETS Provider integrate towards the Toll Charger's APIs, a Developer Portal will be deployed. For details, please refer to Annex F (Interface Specifications).

The Toll Charger makes use of a service management system during the Accreditation Procedure. In other words, the system is used for any communication, incident reporting etc. related to execution of tests with the EETS Provider. It is the Toll Charger's responsibility that the EETS Provider gets a registered user in the service management system and that the EETS Provider receives the necessary information to use the tool correctly.

4.4 Environments

As part of developing its' back office the Toll Charger will provide and operate environments for development and test activities. The Toll Charger will use five (5) environments as listed in Table 1.

The educational environment (KMToll-EDU) will be available to the EETS Provider to demonstrate connectivity as part of Phase 3 (Preparation of test). The educational environment mirrors the production environment (KMToll-PROD). The service level agreement is the same for the KMToll-EDU and the KMToll-PROD.

The development environment (KMToll-DEV) and the integration environment (KMToll-SIT) are used for internal test of the Toll Charger's back office systems. These environments have no outbound integration towards the EETS Provider.

The user-acceptance environment (KMToll-UAT) is used for a wide variety of test activities which involves both the EETS Provider, the Toll Charger and the Toll Charger's other suppliers.

Multiple stakeholders are involved in test activities to be executed in the KMToll-UAT. Therefore, the EETS Provider is required to follow the guidelines for testing in this environment to be described by the Toll Charger in the relevant test plan. This includes guidelines concerning communication, API load restrictions, environment availability, test data retention policy in the Toll Charger's environments, environment maintenance activities, e.g., patches, upgrades, and data refresh.

The KMToll-PROD is used for the Pilot Operation in Phase 5 as well as live toll collection in Phase 6.

Table 1. Environments provided and operated by the Toll Charger

The Toll Charger's Environments				
Env. name	**Env. purpose**	**Env. Description**	**Test Level Ref.**	**Env. Users/ Groups**
KMToll-EDU	Educational	Toll collection subscription used as accreditation environment for EETS Providers.	Preparation for test (connectivity test)	EETS Provider and Toll Charger
KMToll-UAT	User acceptance test	Toll collection subscription for user acceptance environment.	Interface test GNSS test End-to-end test	EETS Provider, Toll Charger and 3rd party suppliers

KMToll-PROD	Production	Toll collection subscription for production environment.	Pilot Operation	EETS Provider, Toll Charger and 3rd party suppliers
KMToll-DEV	Development	Toll collection subscription for development environment.	Not applicable for the EETS Provider	Toll Charger and 3rd party suppliers
KMToll-SIT	System integration test	Toll collection subscription for test environment (outbound integration not possible).	Not applicable for the EETS Provider	Toll Charger and 3rd party suppliers

4.5 Sharing detailed test documentation

Detailed test documentation concerning Phase 3, Phase 4 and Phase 5 is not publicly available, instead the Toll Charger will make the test plans as well as detailed test cases available to the EETS Provider as part of the Accreditation Procedure. The Toll Charger will share detailed test documentation with the EETS Provider once the Agreement has been signed. The Toll Charger may choose to share detailed test documentation with the EETS Provider prior to signing the Agreement, in such cases the EETS Provider will be required to sign a non-disclosure agreement.

5 TESTING DURING THE ACCREDITATION PROCEDURE

5.1 Conformity to specifications

The proof of conformity of the OBE according to Article 15 of the Directive EU/2019/520 shall be provided by the EETS Provider in the format of a manufacturer's declaration of conformity to specification as defined in the Directive (the "**EC Declaration**"). The EC Declaration is assessed during the procedure for registering EETS Provider in the Member State where the EETS Provider is registered according to Article 4b of the Directive EC/2019/520.

The Toll Charger requires that the EC Declaration is valid and not outdated and prove conformity of the OBE according to EN/ISO TS 12813:2019. In case a new version of EN/ISO TS 12813 is adopted the Toll Charger reserves the right to apply the latest version.

Detailed OBE requirements are found in Annex E (Technical Conditions).

The Toll Charger must receive the EC Declaration from the EETS Provider as part of Phase 1 (Application and Evaluation), cf. Annex C (Accreditation Procedure). The Toll Charger is entitled to examine the EC Declaration and perform specific tests of the EETS Provider's OBE if it is deemed necessary. The Toll Charger is furthermore entitled to request specific test reports from the EETS Provider to support the examination of the EC Declaration.

5.2 Connectivity test ("Phase 3")

5.2.1 Objective

The objective of Phase 3 is to allow the EETS Provider and Toll Charger to prepare for Phase 4 (Suitability for use tests) by ensuring that the EETS Provider can integrate towards the Toll Charger's APIs and demonstrating this by completing a connectivity test. In general, the EETS Provider must during Phase 3 demonstrate successful connectivity between the EETS Provider's and the Toll Charger's back office systems, including evidence of correctly configured network and security set-up to be allowed to initiate suitability for use tests.

The detailed requirements for Phase 3 (Connectivity test) towards the EETS Provider is described in the test plan 'TSI06 Test Plan EETS connectivity test (Phase 3)' containing information on e.g.,

test scope, prerequisites, acceptance criteria, time schedule. Test cases associated with TSI07 will be shared together with TSI06.

Following approval of Phase 3 the EETS Provider and Toll Charger will jointly ensure integration of UAT environments which will be used for Phase 4 testing. Any available time between completion of Phase 3 and initiation of Phase 4 can be used by the EETS Provider to perform development and preparation for Phase 4. The UAT environment will be available as described in section 4.4.

5.3 Suitability for use test ("Phase 4")

The required proof of suitability for use shall be provided by means of suitability for use tests. The procedure for the suitability for use test constitute Phase 4 of the Accreditation Procedure. Overall Phase 4 includes the following type of tests, which will be described in the following sections.

(i) Interface test

(ii) DSRC test

(iii) GNSS test

(iv) End-to-end test

The detailed requirements for Phase 4 (Suitability for use test) towards the EETS Provider is described in the test plan 'TSI07 Test Plan EETS suitability for use test (Phase 4)' containing information on e.g., test scope, prerequisites, acceptance criteria, time schedule. Test cases associated with TSI07 will be shared together with TSI07.

5.3.1 Objective

5.3.1.1 Interface test

The purpose of the Interface test is to verify the exchange of data between the EETS Provider's and the Toll Charger's back office systems to ensure proper functioning of the toll collection system. The EETS Provider shall demonstrate that they can handle and support EETS interfaces and related business logic.

The interface specifications to be tested during the Interface test are to be found in Annex F (Interface Specifications).

The EETS Provider shall follow the described security and authentication requirements for REST APIs as described in section 5.2 of Annex F (Interface Specifications).

5.3.1.2 DSRC test

The purpose of the DSRC test is to check if DSRC communication is correct, complete and reliable and, thus, verify compatibility between the EETS Provider's OBE and the Toll Charger's roadside equipment.

The Toll Charger will make roadside equipment available for the DSRC test, which will be used to check that the OBE communicates correctly under realistic circumstances.

The EETS Provider shall provide the Toll Charger with three (3) specimens of each of the OBE type to be approved for use in the KmToll Domain. The OBE must be correctly configured including security keys (trust objects). The DSRC test will be performed by the Toll Charger using test vehicles equipped with the OBE provided by the EETS Provider.

In general, the DSRC test consists of lab tests followed by roadside tests. The objective of the lab tests is to verify that the provided trust objects from the EETS Provider can be used to successfully communicate with the RSE of the Toll Charger and verify that the DSRC transceiver in the OBE of the EETS Provider is properly configured to support communication with the Toll Charger's RSE.

The objective of the roadside tests is to verify that DSRC data from the OBE of the EETS Provider can be successfully read and contains data structured according to specification to ensure interoperability when deployed in production and verify that DSRC data from the OBE of the EETS Provider can be successfully read from an OBE correctly mounted in a vehicle passing by a flexible enforcement point in normal traffic driving scenarios.

For OBE that have not previously been used in a an EETS Domain or have only been used in a limited number of EETS Domains the Toll Charger may decide to request additional laboratory tests from the EETS Provider to check the OBE. If such additional tests are requested by the Toll Charger, the appropriate documentation including test reports must be provided by the EETS Provider to the Toll Charger as part of Phase 3 of the Accreditation Procedure.

DSRC test is applicable in rule for any OBE proposed by the EETS Provider. In cases, where the OBE proposed by the EETS Provider does not rely on DSRC technology, the Toll Charger reserves the right to waive the requirement for DSRC test and impose other relevant tests.

5.3.1.3 **GNSS tests**

The purpose of the GNSS test is to verify the OBE's functional compliance with specifications and in Annex E with emphasis on GNSS locational data quality in terms of the accuracy, availability and correctness of the positioning data forwarded from the EETS Provider's OBE to the Toll Charger through the EETS interfaces.

The Toll Charger will define routes for representative parts of the tolled road network representing both normal conditions and challenges within urban and rural areas.

The GNSS test will be performed by the Toll Charger by testing the OBE's core functionality, user interface and by driving the defined routes using vehicles equipped with the OBE provided by the EETS Provider.

The GNSS test will consists of two parts;

1) A road driving test followed by data assessment. The objective of the roadside test will be to verify that GNSS position data is transferred continuously and in correct sequence to the Toll Charger driving in urban and rural areas with the EETS Provider's OBE. The objective of the data assessment will be to evaluate the received Toll Declarations and generate Billing Details with the purpose of verifying the level of correct detection of toll segments by the EETS Provider's OBE.

2) OBE hardware test. The objective of the OBE hardware test is to verify that the OBE comply with requirements in Annex E specific for the OBE Type. This includes the OBEs ability to obtain GNSS signal reliability after a complete and long power-down, MMI interface functionality and update of related vehicle characteristics. The Toll Charger is responsible for conducting the tests with the EETS Provider as active participant performing updates to the OBE vehicle characteristics configuration at the request by the Toll Charger.

The EETS Provider is required to provide multiple specimens of each OBE type to be approved for use in the KmToll Domain.

- For accreditation of OBE Type 1 the EETS Provider is required to provide three (3) specimens of each OBE type to be approved for use in the KmToll Domain.
- For accreditation of OBE Type 2 the EETS Provider is required to provide at least three (3) specimens of each OBE type agreed with the Toll Charger to be approved for use in the KmToll Domain. The EETS Provider must document that the number and selection of OBE Type 2 hardware, OS platform version and application version is suitable to be representative for the variation in the population of hardware platforms and versions on which the application is designed to operate on.

5.3.1.4 End-to-end test

The objective of the End-to-end test is to validate the correct functioning of all components of the technical solution and the business processes of the EETS Provider to ensure proper functioning of the toll collection system.

Several test scenarios related to operation of the KmToll Scheme will be tested, representing both the "happy flow" and "special scenarios".

The End-to-end test must be executed by the EETS Provider in close collaboration with the Toll Charger. Concerning roadside test, the EETS Provider's on-site presence in Denmark is required as the EETS Provider is responsible for executing the roadside test. The Toll Charger is responsible for specifying the test route characteristics to be driven as part of the test.

Test must be performed with three (3) specimens of each OBE as part of the accreditation procedure. It is allowed for the EETS Provider to use light-weight vehicle(s) below 3.5 tonnes for execution of the End-to-end test. The Toll Charger has the right and obligation to oversee the test.

The End-to-end test will in general consists of the following test scenarios:

- Toll collection
- Exception List handling
- Financial flow
- Customer complaint
- Tolling – special cases
- Interface load test
- OBE Type 2 Enforcement (only relevant for an EETS Provider with OBE Type 2)

5.4 Pilot Operation ("Phase 5")

5.4.1 Objective

From initiation of the Pilot Phase, the EETS Provider operates in the KmToll production environment (KmToll-PROD) under restricted accreditation and delivers Services to EETS Users in accordance with the Agreement. The objective is to validate end-to-end readiness, production-scale performance, and compliance with KPIs and service levels defined in Annex G (Key Performance Indicators), with real EETS Users and real operational conditions where vehicles and EETS Users part of the Pilot Operation is being tolled for road usages using the OBE activated by the EETS Provider in each roll-out step of the Pilot Operation.

Phase 5 is executed as a gradual rollout with three steps and three quality gates, cf. Table 2. The duration of each roll-out step is at least 14 calendar days and each gate criteria must be met, verified and approved by the Toll Charger before moving to the next roll-out step. The Toll Charger actively analyses the activated OBU population daily during workdays and will communicate performance evaluation to the EETS Provider in a proactive manner.

5.3.2 Pilot Operation roll-out steps

Table 2. Roll-out step of the Pilot Operation ("Phase 5")

Roll-out step	# of OBUs activated	Gate acceptance criteria	Duration
1	Up to 200 OBUs (unique IDs) can be activated by the EETS Provider for the KmToll Domain.	• At least 5,000 km tolled on the toll liable road network. • At least 20 distinct OBUs generating transactions. • Target Service Levels, cf. Annex G (Key Performance Indicators) is met for at least five (5) consecutive days.	• At least 14 days
2	Up to 2000 OBUs (unique IDs) can be activated by the EETS Provider for the KmToll Domain.	• At least 50,000 km tolled on the toll liable road network. • At least 200 distinct OBUs generating transactions. • Target Service Levels, cf. Annex G (Key Performance Indicators) is met for at least ten (10) consecutive days.	• At least 14 days
3	Full Delivery of Services The EETS Provider is authorised to activate an unlimited number of OBUs.	• Target Service Levels, cf. Annex G (Key Performance Indicators) is met for at least 30 consecutive days. • No unresolved critical pilot-related technical defects.	• At least 30 days

During Phase 5, the Toll Charger may pause, reduce, or roll back the active OBU count in case of anomalies or KPI critical shortfalls until corrective actions are implemented and verified.

Phase 5 has a standard duration of at least two (2) calendar months. The Toll Charger may grant one extension of up to one (1) calendar month where objective, documented conditions apply, including unresolved critical pilot-related defects or KPI under-performance against thresholds, cf. Annex G (Key Performance Indicators).

The detailed requirements for Phase 5 (Pilot operation) towards the EETS Provider is described in the test plan 'TSI08 Test Plan EETS Pilot Operation' containing information on e.g., test scope, prerequisites, acceptance criteria, time schedule.

Upon approval of roll-out step 3 Phase 5 is complete and the EETS Provider is granted full accreditation to the KmToll Domain.

5.3.3 Governance during the Pilot Operation

A weekly operational status meeting serves as the formal status reporting during Phase 5. The EETS Provider must submit a weekly status report at least end-of-business the day before the status meeting covering:

i. the number of users with activated service for the KmToll Domain.

ii. the number of active users in the KmToll Domain the recent week

iii. the number of Toll Declaration packages sent to the Toll Charger.

iv. the number of Billing Details received.

v. the amount of Toll due for collection.

vi. any technical anomalies detected by the EETS Provider.

The purpose is to review operational status and KPI performance according to Annex G (Key Performance Indicators) and discuss corrective actions if required.

The Toll Charger may ask the EETS Provider to conduct any test necessary in case the Toll Charger has reason to believe that EETS Provider's technical solution does not meet requirements and/or is not performing according to requirements.

5.3.4 EETS User enforcement during the Pilot Operation

Phase 5 takes place during operational conditions with the EETS Users, thus the EETS User will be tolled when circulating on the toll liable road network and enforcement procedures will apply. The Toll Charger remunerates the EETS Provider, cf. Annex D (Remuneration).

During Phase 5 if an enforcement case is detected for a vehicle associated with the EETS Provider under restricted accreditation, the OBU will be analysed by the Toll Charger and discussed with the EETS Provider during weekly meetings to determine if the case is associated with pilot-related technical issues or may be due to fraudulent behavior by the EETS User. Potential penalty cases involving EETS Providers under restricted accreditation are flagged via the Exception List.

Pilot-related technical faults include:

- Integration fault between the Toll Charger and the EETS Provider causing missing or late Toll Declarations.
- System outage under restricted accreditation.

No fines will be issued to the EETS User without investigation and dialogue with the EETS Provider during Phase 5. The Toll Charger's enforcement flow is based on the vehicle license plate.

In case of non-corresponding vehicle obtained through DSRC by a OBE and vehicle license plate identified at the roadside will the enforcement case be flagged for further investigation. The investigation will involve the EETS Provider prior to opening a penalty case towards the EETs User allowing the EETS Provider to investigate and handle the non-corresponding issue with the EETS User.

Once the EETS Provider is fully accredited normal enforcement practices under the KmToll Scheme apply without pre-liminary investigation of enforcement cases related to vehicles associated with one of the EETS Providers activated OBU.

6 THE RECERTIFICATION PROCEDURE

The recertification procedure enters into force from the Operation Date and applies in steady-state operation.

In the event that changes to the OBE provided by the EETS Provider are expected, the EETS Provider must inform the Toll Charger hereof. Some of the most relevant cases which may give rise for re-certification of an OBE are as follows:

(i) Changes to other OBE hardware and/or software;

(ii) Changes to the OBE management system;

(iii) New OBE functionality; and

(iv) Changes to the back office interfaces between the EETS Provider and Toll Charger.

The EETS Provider shall always report changes to the OBE to the Toll Charger in writing. The EETS Provider must prove to the Toll Charger that the configured/changed OBE meets the applicable requirements and provide the Toll Charger with a risk assessment. The Toll Charger decides on the

basis of this risk assessment whether the entire procedure for conformity to specifications and suitability for use tests, or just parts of the procedure is required to be redone.

Note: Recertification of OBE Type 2 will always be required in case of changes to OS platform or other fundaments of the OBE Type 2 changes unless the EETS Provider can document – based on a risk based assessment - that changes and updates do not affect the fundamentals on which the OBE Type 2 accreditation is conducted and do not compromise precision and operational liability of the OBE Type 2.

Relevant changes to the EETS Provider's back office systems that is expected to impact the Toll Charger shall be made in consultation with the Toll Charger. The EETS Provider shall report to the Toll Charger in writing including a risk assessment. Based on this, the Toll Charger will assess the impact of the change(s) and decide which tests procedure, if any, must be redone. It is the EETS Provider's prerogative to add new and/or improve existing functions of its' back office without informing the Toll Charger as long as operation of the Services is not impacted and the EETS Provider is compliant with the Toll Charger requirements.