Annex H (Testing)

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

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1 DOCUMENT HISTORY

Version	Date	Comment	Initials
0.5	10 February 2023	Draft version published to the EETS Provider for information and review purposes as part of the accreditation procedure.	MLBR
0.6	17 May 2023	Updated draft version published to the EETS Provider reflecting the current requirements for the accreditation procedure. Final version of the document is published once the KmToll Law is passed in Danish Parliament.	MLBR

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 5.4.

"**Service Trial**" shall have the meaning as described in section 5.5.

"Suitability for use" means the ability for an 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).

As described in Annex C (Accreditation Procedure) the first round of Accreditation Procedure calls for a special approach, thus, testing will also be adapted accordingly since the Toll Charger will have to manage testing with several EETS Providers in parallel. This places a high expectation on the EETS Provider's participation during test phases and contribution related to test activities.

This Annex will in its first version be focused on testing during the first round of Accreditation Procedure. As the implementation of the KmToll Scheme, and thus the Accreditation Procedure, progresses this Annex will be adapted to reflect the expected testing relevant to any new EETS Provider applying to the KmToll Scheme after the date where the scheme has been commissioned.

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, information relevant for the EETS Provider related to testing during operation are described; and

(iv) **Section 7:** 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 test planning and validate it with the EETS Provider;

(ii) Define the test protocols, 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) Validate the test planning proposed by the Toll Charger;

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

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

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

(v) 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.

4.2 Approval of test

In order 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 overall test strategy for the Danish Kilometer Tolling Scheme, 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 sent to the Toll Charger who will compile the complete test report and ultimately approve the test and inform the EETS Provider in writing; 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.

4.3 Tools

The Toll Charger uses Azure DevOps for development and test activities. The EETS Provider is expected to contribute to the execution of test in the Toll Charger's DevOps. The Toll Charger will arrange for the necessary access and licenses for the EETS Provider. A project in Azure DevOps

will be set-up with access only for relevant employees of the Toll Charger and the EETS Provider's employees.

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

Table 1. Environments provided and operated by the Toll Charger

Subscription name	Environment	Description
KMToll-DEV	Development	Toll collection subscription for development environment.
KMToll-SIT	System integration test	Toll collection subscription for test environment.
KMToll-UAT	User acceptance test	Toll collection subscription for User acceptance environment.
KMToll-Prod	Production	Toll collection subscription for production environment.
KMToll-EDU	Education	Toll collection subscription used as accreditation environment for EETS Providers.

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. 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 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 Preparation of test ("Phase 3")

5.2.1 Objectives

During Phase 3 the Toll Charger will firstly provide the EETS Provider with relevant test documentation, including test cases to be reviewed as well as requirements concerning test reporting, and the EETS Provider may ask clarifying questions concerning details of the test plan and time schedule.

Secondly, the Toll Charger will make available educational services for the EETS Provider to test its own systems against. The scope of the educational services will be to receive data, validate data formats and forward a dummy response to the EETS Provider. Furthermore, the Toll Charger will make resources available for trouble shooting and communication with the EETS Provider during this Phase.

Finally, the Toll Charger will present the EETS Provider with the collaborative tools and booking systems, or similar, to be used during the upcoming test phases.

5.2.2 Duration

- 4 months (expectedly)

5.2.3 Test prerequisites

- Conformity to specifications is demonstrated and approved by the Toll Charger
- The Agreement and Addendum have been signed
- The Toll Charger's back office is ready for connectivity testing
- Educational services are available in the KMToll-EDU environment

5.2.4 Acceptance criteria

- The general approval requirements, cf. section 4.2 have been met by the EETS Provider
- The requirements set out in the test protocol for the connectivity test have been met by the EETS Provider
- The EETS Provider has demonstrated 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 in order to be allowed to initiate suitability for use tests.
- The Toll Charger has drawn up a test report, in cooperation with the EETS Provider, demonstrating connectivity on both parts. The EETS Provider will be informed when this test report can be approved by the Toll Charger and when the EETS Provider can be allowed to initiate suitability for use tests.

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 tests

(ii) DSRC tests

(iii) GNSS tests

(iv) End-to-end tests

5.3.1 **Interface test**

5.3.1.1 Objective

The purpose of the interface tests 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 tests will include data necessary for both the toll calculation as well as the operation of the enforcement system. The interface specifications to be tested during the interface tests are to be found in Annex F (Interface Specifications).

5.3.1.2 Duration

- 3 months including preparation (expectedly)

5.3.1.3 Test prerequisites

- Preparation of test ("Phase 3") has been successfully completed by the EETS Provider according to the requirements of this Annex and the test documentation in general, and the Toll Charger have approved in writing the test report for the connectivity test
- The EETS Provider's IT systems are operational and ready to complete the interface tests according to specification

5.3.1.4 Acceptance criteria

- The general approval requirements, cf. section 4.2 have been met by the EETS Provider
- The requirements set out for the interface tests in the test protocol for the suitability for use test have been met by the EETS Provider

5.3.2 **DSRC tests**

5.3.2.1 Objective

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

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 DSRC test will be performed by the Toll Charger by the use of test vehicles.

Furthermore, for OBE that have not previously been used in a toll domain or have only been used in a limited number of toll domains the Toll Charger may decide to request additional laboratory tests from the EETS Provider in order to check the OBE. If such additional test 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.

NB DSRC tests are 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 tests and impose other relevant tests.

5.3.2.2 Duration

- 3 months including preparation (expectedly)
- DSRC is currently planned to take place simultaneously with interface tests, however, duration and timing of the DSRC test may be subject to adjustments. DSRC tests may be executed later than depicted in the Time Schedule, cf. Annex C (Accreditation Procedure)

5.3.2.3 Test prerequisites

- Preparation of test ("Phase 3") has been successfully completed by the EETS Provider according to the requirements of this Annex and the test documentation in general, and the Toll Charger have approved in writing the test report for the connectivity and integration test.
- The Toll Charger have acquired and prepared a flexible enforcement point including vehicles for functional testing
- The EETS Provider have provided a number of OBE with the necessary configuration (vehicle parameters, DSRC security keys, OBU status etc.) to the Toll Charger. The relevant documentation describing the OBE configurations will be provided to the EETS Provider in Phase 3 of the Accreditation Procedure.

5.3.2.4 Acceptance criteria

- The general approval requirements, cf. section 4.2 have been met by the EETS Provider
- The requirements set out for the DSRC tests in the test protocol for the suitability for use test have been met by the EETS Provider

5.3.3 **GNSS tests**

5.3.3.1 Objective

The purpose of the GNSS tests is to verify the accuracy, availability, correctness and timeliness of the positioning data forwarded from the EETS Provider's OBE to the Toll Charger's back-office system through the EETS Provider's back-office system and interfaces to the Toll Charger.

The Toll Charger will carry out the GNSS test. The Toll Charger will define routes for representative parts of the tolled road network. The GNSS test will be performed by driving these routes using vehicles equipped with several OBE provided by the EETS Provider. The EETS Provider is required to provide a number of OBE to the Toll Charger.

5.3.3.2 Duration

- 1 month including preparation (expectedly)
- Test vehicles are ready

5.3.3.3 Test prerequisites

- The EETS Provider have successfully completed the interface tests according to requirements in the test protocol for suitability for use test
- The GNSS tolling engine is ready for integration testing
- The Toll Charger have acquired and prepared vehicles for testing

5.3.3.4 Acceptance criteria

- The general approval requirements, cf. section 4.2 have been met by the EETS Provider
- The requirements set out for the GNSS tests in the test protocol for the suitability for use test have been met by the EETS Provider.
- All GNSS positioning data must have been forwarded correctly by the EETS Provider and successfully received by the Toll Charger.

5.3.4 **End-to-end tests**

5.3.4.1 Objective

The purpose of the end-to-end tests 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 both the toll collection system and enforcement system.

The end-to-end tests will be conducted in two parts, by executing:

(i) a number of test scenarios; and

(ii) driving tests on defined routes.

A number of test scenarios related to the EETS Provider during operation of the KmToll Scheme will be tested, representing both normal and abnormal events which can occur during operation. The test scenarios must be executed by the EETS Provider in close collaboration with the Toll Charger. Some test cases may be carried out remotely with no need of on-site presence of the EETS Provider.

Concerning the driving test, the EETS Provider's on-site presence in Denmark is required. The EETS Provider shall conduct the driving test using vehicles equipped with all types of OBE, both software and hardware versions, expected to be used in operation, driving on the tolled road network. It is allowed for the EETS Provider to use trucks down to 3.5 tonnes for execution of the end-to-end tests. The Toll Charger is responsible for specifying the routes which the EETS Provider shall complete. The Toll Charger has the right and obligation to oversee the test.

Specifications of test scenarios and driving test will be shared with the EETS Provider during Phase 3.

5.3.4.2 Duration

- 3 months including preparation (expectedly)

5.3.4.3 Test prerequisites

- The requirements set out for the End-to-end tests in the test protocol for the suitability for use test have been met by the EETS Provider
- The EETS Provider have acquired and prepared vehicles for testing

5.3.4.4 Acceptance criteria

- The general approval requirements, cf. section 4.2 have been met by the EETS Provider
- The requirements set out for the End-to-end tests in the test protocol for the suitability for use test have been met by the EETS Provider.

5.4 **Pilot Operation ("Phase 5")**

5.4.1 Objective

The first round of accreditation take place simultaneously with the KmToll Scheme being implemented, thus, the purpose of the Pilot Operation is trialling the entire KmToll Scheme to ensure the system is ready for commissioning.

During Phase 5 the EETS Provider, and real EETS Users, participation is required and entire business processes are tested under operational like conditions. The EETS Provider is asked by the Toll Charger to engage a number of its EETS Users. A number of trucks will have to be equipped with OBE and required to circulate on the tolled road network. All systems will work as if the Toll was collected, however, no EETS Users are billed.

The Pilot Operation will make it possible for the Toll Charger to correct issues and make the necessary adjustment to the technical, procedural and/or organisational processes prior to the go-live date of the KmToll Scheme. Furthermore, the Pilot Operation will help the EETS Provider ramp up and ensure readiness of its Services and equipment of its EETS Users prior to the date where the KmToll Scheme enters into force.

5.4.2 Duration

- 4 months including preparation

5.4.3 Test prerequisites

- The EETS Provider have successfully completed all previous tests according to requirements in the test protocol for suitability for use test
- The EETS Provider have arranged with EETS Users to participate in the Pilot Operation and ensured equipment of their vehicles according to the requirements set out in the test protocol for the Pilot Operation
- Technical teams are available both on part of the Toll Charger and the EETS Provider

5.4.4 Acceptance criteria

- The general approval requirements, cf. section 4.2 have been met by the EETS Provider
- The requirements set out in the test protocol for the Pilot Operation have been met by the EETS Provider.

5.5 **Service trial ("Phase 6")**

5.5.1 Objective

From the time of initiation of Phase 6 the EETS Provider starts operation and is required to deliver its Service to the EETS Users, cf. the Agreement. The purpose of Phase 6 is for the EETS Provider to monitor KPI and service levels and demonstrate to the Toll Charger that the EETS Provider sufficiently can perform according to the required performance levels.

Detailed specification of the service trials including thresholds are to be defined.

5.5.2 Duration

- During the Service Trial the EETS Provider must ensure that the Services are in operation with normal and/or better functions, and that all KPIs and service levels in a period of at least 100 consecutive days without any large system changes or reconfigurations are performed.

5.5.3 Test prerequisites

- The general approval requirements, cf. section 4.2 have been met by the EETS Provider
- All previous tests are successfully completed and the EETS Provider has received the Toll Chargers written approval to move on to production, thus is restricted accredited.
- Production environment is ready for go-live

5.5.4 Acceptance criteria

- The general approval requirements, cf. section 4.2 have been met by the EETS Provider
- The requirements set out for the Service Trial have been met by the EETS Provider

The EETS Provider is responsible to keep its development team available in case of issues, so these issues can be resolved as quickly as possible and furthermore from time to time optimise their technical solution to any extent necessary. The EETS Provider must be at the Toll Charger's disposal for answering questions of operational nature, including providing a hotline service.

During Phase 6 the EETS provider will have to present the Toll Charger with a weekly status report including operational information of the Services provided by the EETS provider. Elements to include are

(i) The number of activated users in the KmToll Domain;

(ii) The number of active users the KmToll Domain;

(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; and

(vi) Any technical anomalies detected by the EETS Provider.

When the EETS Provider have fulfilled the requirements for Phase 6, the Toll Charger will approve this in writing. The Toll Charger will also provide the EETS Provider with a Proof of Accreditation stating that the EETS Provider have fulfilled its obligations under the Addendum. The Proof of Accreditation will be provided by the Toll Charger in writing, in a format deemed relevant by the Toll Charger.

6 TESTING DURING OPERATION

The Toll Charger can 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. In the event that Toll Charger's suspicions are confirmed and an issue/defect is identified, the EETS Provider will be responsible for bearing the cost associated with the test, and any remedial action required. In the event that Toll Charger's suspicion is refuted, the Toll Charger will bear the cost associated with the test.

7 THE RECERTIFICATION PROCEDURE

The recertification procedure enters into force from the Operation Date.

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) Change to other OBE hardware and/or software;

(ii) Change to the OBE management system; and

(iii) New OBE functionality.

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. The Toll Charger decides on the basis of this report whether the entire procedure for conformity to specifications and suitability for use tests, or just parts of the procedure is required to be redone.

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. Based on the change report, 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.

Prior to the Operation Date the Toll Charger will present requirements, if any, for the format of the report from the EETS Provider related to the recertification procedure.