EasyGo test strategy

Annex 2.6 to
Joint Venture Agreement
Toll Service Provider Agreement

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Document Revision History

Version	Date	Author	Main changes
2.0	2013.02.27	LHB/SGA	Approved by Steering Committee
2.2	2013.11.27	Arild Skadsheim	Generalising document (from CREATE to EasyGo)
2.3	2014.02.28	SR	Comments from WG2-meeting
2.4	2014.04.04	MHS	Comments after discussion in EM
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1 Introduction

1.1 Scope

This document gives an overview of all tests required:

1. before a new TC or TSP connects to the EasyGo services
2. when an existing TSP introduces new or modified OBEs
3. when there is a change in the back office data exchange interfaces defined in Annex 2.3 or its procedures defined in Annex 2.1
4. in case of major changes of RSE or Central System
5. when there is a general update to the EasyGo services

It defines the different test steps and states the required tests to be performed before any of the above described changes are allowed to be put into production include the following:

- Integration test between an actor (TC/TSP) and the EasyGo HUB (INT1)
- Integration test between two actors (INT2)
- End-to-End (E2E) tests in the test environment
- End-to-End (E2E) tests in the production environment
- Trial operation
- In service tests

The required test steps and the amount of testing needed may vary depending on the actual situation of the imposed change. It is possible that certain test steps may be limited or even omitted if decided by the EasyGo management (EM) when there is no additional value seen in them.

The document does not provide details regarding file formats/specification or details of the validations the actor (TC/TSP) and the EasyGo HUB should exercise during the file exchange. These details are described in Annex 2.1.

Each test shall be documented and approved by both the TC/TSP and the EM. Signed test protocols are a prerequisite for the approval of a new TC or TSP.

The tests described in this document do not include internal FAT or SAT testing performed by an actor (TC/TSP) on his equipment (e.g. RSE, CS or OBEs …) prior to the INT1 test. It is a pre-condition prior to start of tests with EasyGo that an actor (TC/TSP) has a stable implementation of the required functionality on his test or production system depending on the test to be performed.

The goal of the testing described in this document is to verify the correct functionality of all equipment and interfaces between an actor and the EasyGo HUB or between two actors. If the tests reveal internal problems in the systems of the EasyGo HUB or an actor

(TC/TSP) the tests are stopped and will only resume when such errors have been corrected.

1.2 Roles and responsibilities

The roles defined in EasyGo are in compliance with ISO 17573 and are shown in Figure 1 below.

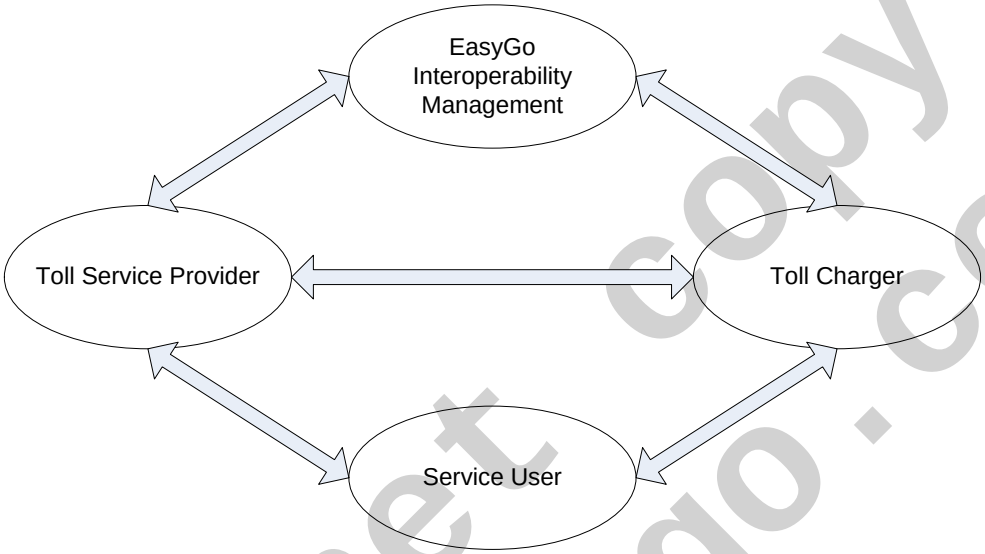

Figure 1: Roles in the toll charging environment

1.2.1 EasyGo interoperability management (EIM)

The EIM consists of EasyGo steering committee (ESC), EasyGo management (EM) and the EasyGo security group (ESG).

The ESC has the final decision on any issues in regard to testing raised to it.

The ESC has no direct role in testing.

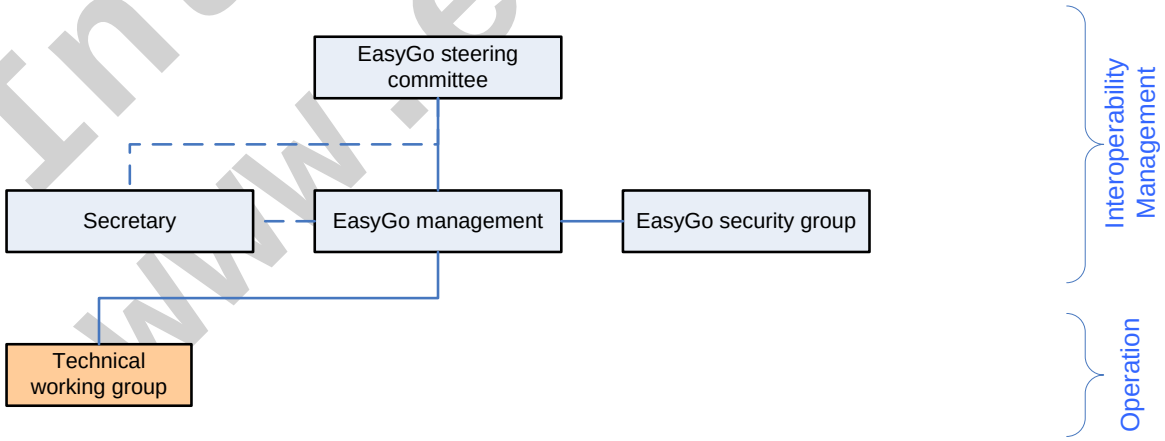

Figure 2: Management structure

The EM is overall responsible for the execution of all testing and will involve ESC and ESG, if necessary.

The technical working group (WG2) is responsible for:

- definition of a test schedule between the EasyGo HUB operation and all involved actors
- nomination of a test manager
- supervision of the test progress and reporting it to the EM
- checking the quality of the test documentation
- verification of the test results of each test and reporting them to the EM
- reporting of any topics it cannot solve to the EM, if necessary

1.2.2 Toll Service Provider (TSP)

The TSP is in charge of performing any tests regarding:

- communication interfaces of the back office data exchange (e.g. VPN connection)
- data formats of the back office data exchange interfaces to the EasyGo HUB
- OBEs in use (e.g. software/firmware update where applicable)
- introduction of new OBEs
- personalisation of OBEs (where applicable)
- security for the interfaces or equipment employed by the TSP
- central system of the TSP which could influence the overall availability and performance of the EasyGo services
- invoicing in the name and on behalf of the TC
- payment of mutually agreed transactions to TC

The TSP is responsible for the:

- nomination of a test coordinator to participate in WG2 meetings on testing
- nomination of a system responsible with sufficient knowledge about the system under test (SUT)
- provision of sufficient test resources to meet the test schedule agreed in WG2
- documenting the test results including test protocols and proof documents
- reporting the results to the WG2
- recruiting of test users for the trial period or in service tests (if applicable)

1.2.3 Toll Charger (TC)

The TC is in charge of performing any tests regarding:

- communication interfaces of the back office data exchange (e.g. VPN connection)

- data formats of the back office data exchange interfaces to the EasyGo HUB
- communication between the Road Side Equipment (RSE) and the OBE through the DSRC interface
- data transfer between RSE and the central system of the TC
- central system of the TC which could influence the overall availability and performance of the EasyGo services

The TC is responsible for:

- nomination of a test coordinator to participate in WG2 meetings on testing
- nomination of a system responsible with sufficient knowledge about the system under test (SUT)
- documenting the test results including test protocols and proof documents
- reporting the results to the WG2
- provision of sufficient test resources to meet the test schedule agreed in WG2

1.2.3.1 EasyGo HUB

The EasyGo HUB is the central cluster equipment of the TCs and is therefore considered a part of the TC role. The EasyGo HUB is operated by the EasyGo HUB operation which reports to WG2.

The EasyGo HUB operation will be in charge of performing any tests regarding:

- communication interfaces of the back office data exchange (e.g. VPN connection)
- data formats of the back office data exchange interfaces to the actors (TC/TSP)
- security for the interfaces or equipment employed by the TSP
- central system of the EasyGo HUB (including operating system, database and application …)

The EasyGo HUB operation is responsible for the:

- nomination of a test coordinator to participate in WG2 meetings on testing
- nomination of a system responsible with sufficient knowledge about the system under test (SUT)
- provision of sufficient test resources to meet the test schedule agreed in WG2
- documenting the test results including test protocols and proof documents
- reporting the results to the WG2

1.2.4 Service User (SU)

During the trial period the recruited test users will be responsible for following the instructions received from their TSP regarding the trial period including giving feedback to the TSP as requested.

1.3 Back office data exchange

The procedures of the back office data exchange are described in Annex 2.1 in detail.

The formats used in the back office exchange are described in Annex 2.3.

The information required to establish a connection to the EasyGo HUB is described in Annex 2.8.

2 Test overview

Figure 3 below shows the EasyGo actors and the data exchange interfaces subject to testing. The figure also shows the corresponding interfaces to be tested when EETS Providers shall connect to the EasyGo service.

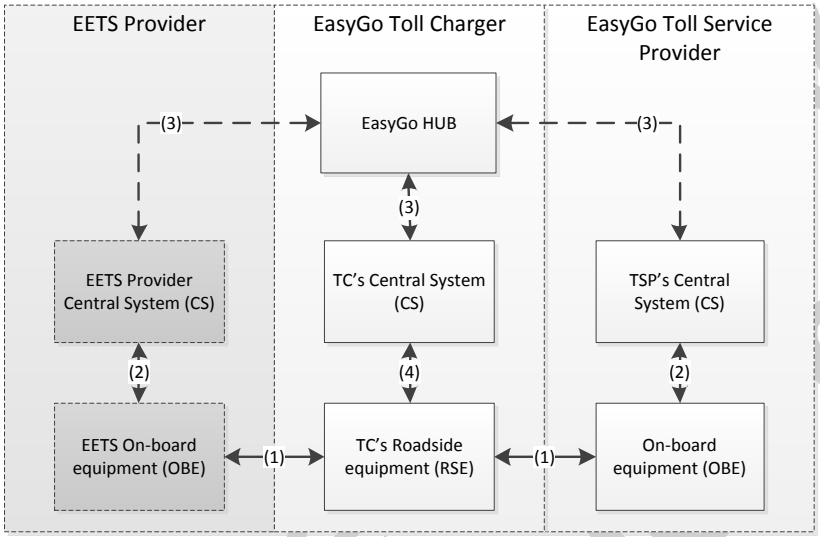

Figure 3: EasyGo actors and data exchange interfaces subject to testing

The interfaces subject to testing are between TSP OBE and TC RSE – marked (1), and between TSP CS and TC CS via the EasyGo HUB – marked (3) in the figure above.

The requirements and related test specifications for the interfaces are:

- Interface (1) between TSP OBE and TC RSE:
  - Roadside and on-board equipment (Annex 2.2).
- Interface (3) between TSP CS and TC CS via the EasyGo HUB:
  - Requirements for central systems and EasyGo HUB (Annex 2.1)
  - Technical requirements data formats and interface specifications (Annex 2.3)
  - General requirements for data and information exchange (Annex 2.4)
  - Obligations to invoicing specifications (Annex 3.4)
  - Key distribution (Annex 2.5)
  - Interface test specification. Central systems – EasyGo HUB (Annex 2.7)
  - Requirements for VPN access to the EasyGo HUB (Annex 2.8)

The interfaces (2) and (4) in Figure 3 are internal and thus under the sole responsibility of the respective actor. Interface (2) between the EETS TSP's CS and his OBE is applicable for personalisation purposes and software/firmware updates (if applicable). Interface (4) is between the TC's CS and RSE.

2.1 Test principles

The tests of any new or changed equipment shall verify its conformance to technical specifications, agreed operational procedures and the suitability for use within the context of EasyGo. Equipment is suitable for use if it works according to the defined EasyGo quality levels and fulfils the service level agreements defined within EasyGo. Depending of the actual type of new or changed equipment that is subject to testing the EasyGo management and WG2 will decide which test steps shall be performed and to which extent.

With respect to testing the incorporation of a new actor (TC/TSP) into EasyGo or the change of equipment by an existing actor, it will be the new actor or actor introducing the change who shall perform the necessary tests with the support of the existing actors (TC/TSP) to verify the EasyGo functionality while WG2 will supervise and approve the tests.

Each actor shall define the required personnel to perform the tests.

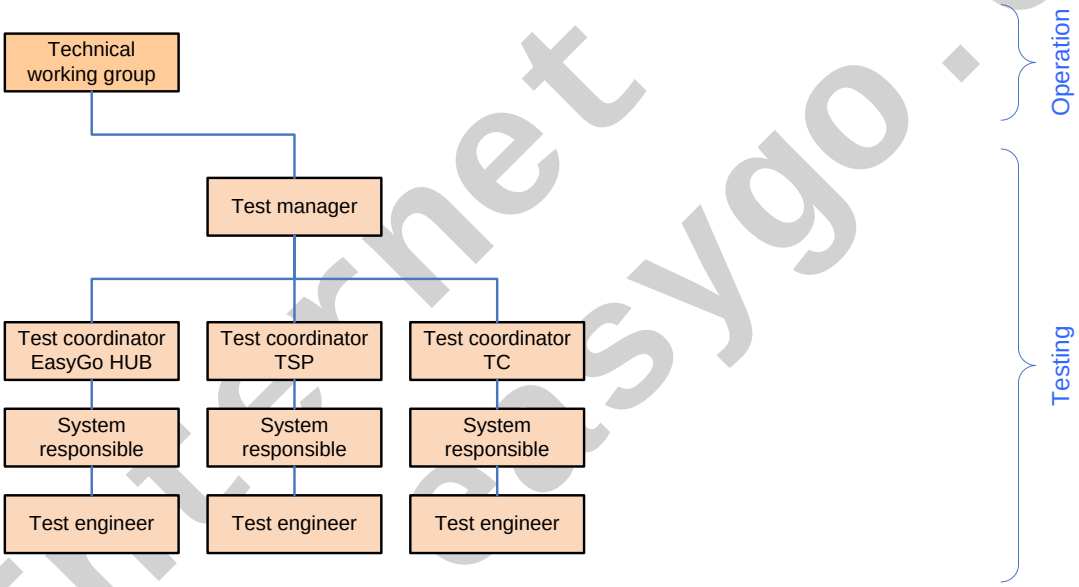

Figure 4: **EasyGo test personnel**

The test manager is appointed by WG2.

The test coordinator, system responsible and test engineer are appointed by each actor or the EasyGo HUB operation involved in testing a system. These different roles may be performed by the same physical person.

2.2 Test structure

2.2.1 Required test steps

It is a challenge to integrate new actors, new functionality or new or changed equipment during regular operation. The test strategy therefore clearly describes how any new or changed equipment, new functionality or new actor shall be tested before a start of

operation. Such a test shall incorporate all new functions/changes and provide a test structure that does not compromise the ongoing operation.

The steps required to implement and test new functionality are:

1. Define specification of new or changed equipment or functionality including any now or changed requirements to interfaces
2. Verification of specification by suppliers and owners

Steps 1 and 2 shall be performed by either the actor(s), the EasyGo HUB operation or the EIM (involving WG2) and are not part of the EasyGo tests.

3. Provide specification to WG2 and EM for analysis and discussion
4. Agree on new functionality/required changes in WG2 on a technical level, in EM on an operational level and ESC on a contractual/financial level
5. Decide upon the required test steps in EM in consultation with WG2
6. Nominate a test manager in WG2
7. Define and agree upon a test plan in WG2 including milestones and timing

Steps 3-7 are required for the introduction of any new functionality/required change and cannot be omitted.

8. Procurement and implementation of new functionality/required changes by the actor(s) and the EasyGo HUB operation
9. Factory Acceptance Test (FAT) and installation verification by supplier(s) of the actor(s) and the EasyGo HUB operation
10. Site Acceptance Test (SAT) of functionality and interface implementation by the actor(s) and the EasyGo HUB operation

Steps 8-10 shall be performed locally by the actor(s) and the EasyGo HUB operation and are not part of the EasyGo tests. It is nevertheless required that the status of activities is reported and any deviations in the progress are notified to the test manager.

The prerequisites are finalised after completion of step 10 and the EasyGo tests can start with the following steps:

11. Integration test 1 (CS-HUB interface tests performed in a test environment)
12. Integration test 2 (CS-HUB-CS interface test in a test environment)
13. End-to-End test (E2E) covering all EasyGo processes and functions including invoicing of customers performed in a test environment
14. When E2E in a test environment has been approved the same test shall be repeated in the production environment, including production OBEs, prior to start of trial operation
15. Trial operation with a limited number of SUs
16. In-Service Test (IST) during normal operation

Steps 11-16 are the joint tests to be specified and performed within the scope of EasyGo.

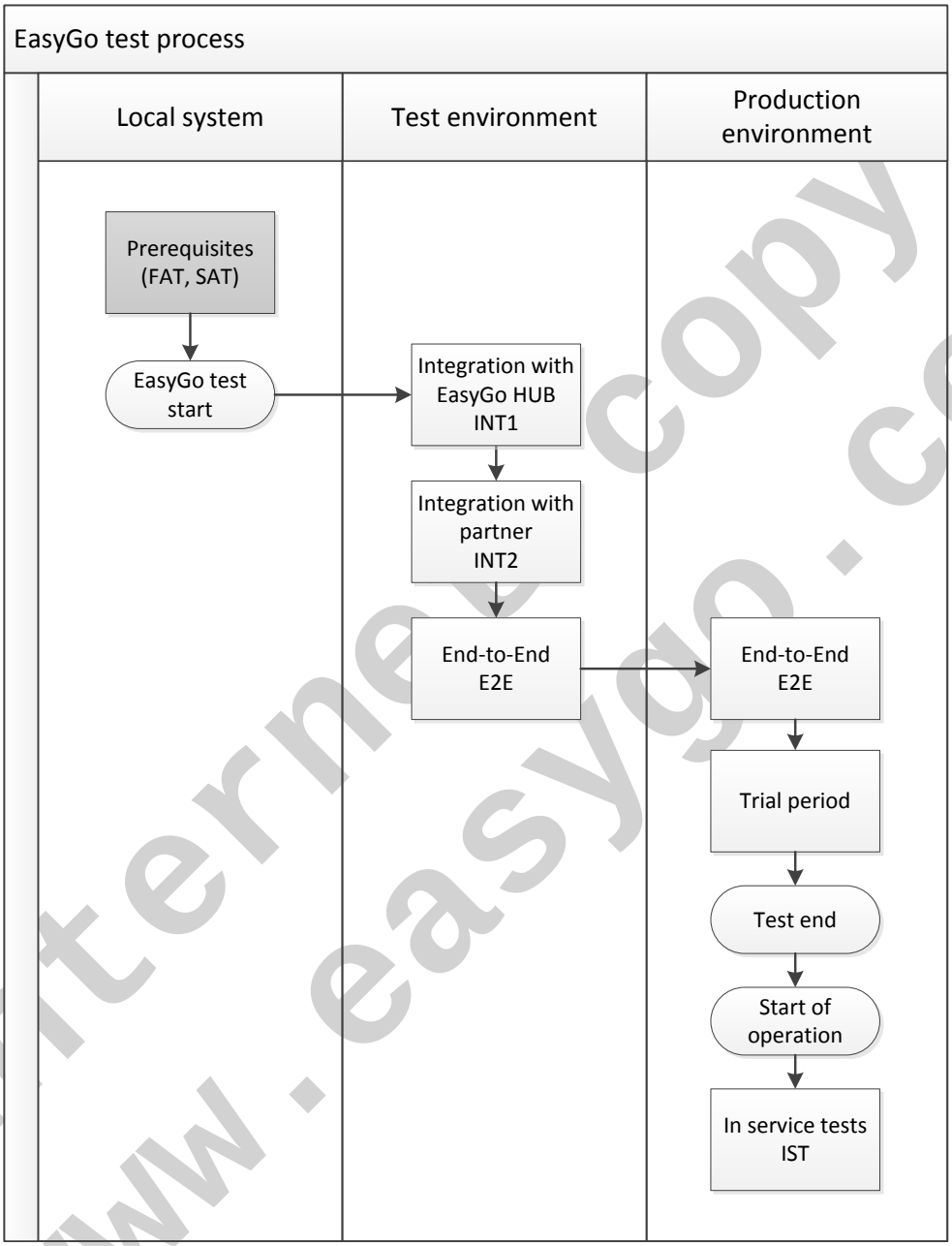

Figure 5: EasyGo test steps

2.2.2 Prerequisites

The definition of the specification will be supervised by the actor whose system or OBEs are to be tested (steps 1 and 2 above).

The analysis of the provided specification and the decision on the required changes to implement will be supervised by WG2, EM and ESC (steps 3 to 5 above). The preparation of the test organisation will be supervised by WG2 (steps 6 and 7 above).

The local testing will be supervised and controlled by the actor whose system or OBEs are to be tested (steps 8 to 10 above).

Each local test coordinator is responsible for providing progress reports and test reports of the FAT/SAT tests to the test manager.

The local FAT/SAT tests shall verify the basic EasyGo/EasyGo+ functionality in the local system of the actor together with the manufacturer.

Local FAT/SAT tests shall also be carried out when introducing a new OBE or a new RSE.

It is a prerequisite that the new RSE/new OBE conform to specification according to EN 15509 as required according to EETS Decision (2009/750/EC).

The final report shall provide proof that the EasyGo specifications have been implemented and that FAT/SAT tests have been fulfilled (identifying and documenting the performed tests).

When the FAT/SAT tests have been successfully executed the EasyGo tests may start with the integration tests.

2.2.3 Integration tests

The integration tests shall include those EasyGo actors that will be affected by the change. Tests are described on a general level and each actor shall perform the tests according to local conditions.

The tests shall be organised, executed, documented and approved by the test coordinator of the actor or the EasyGo HUB operation with the help of their respective system responsibles and test engineers. Test reports from each actor or the EasyGo HUB operation shall be written and approved by the test manager (see chapter 4 for details).

Both integration tests (INT1 and INT2) shall be performed in a test environment with the objective to verify that all the updates of file formats and interfaces are correct.

2.2.3.1 Integration test 1 (INT1)

The INT1 test shall test the interface from the actor's CS to the EasyGo HUB. Test of transactions may be done using simulated transactions.

The details of the INT1 are specified in Annex 2.7.

If new OBEs are introduced, they shall be included in the INT1 test (OBE – RSE – CS – HUB).

2.2.3.2 Integration test 2 (INT2)

The INT2 test shall test the interface from the sending actor's CS to the EasyGo HUB and to the CS of the receiving actor. In principle the test will be performed in the same way as INT1.

If new OBEs are introduced, they shall be included in the INT2 test (OBE – RSE – CS – HUB - CS).

The details of the INT2 are specified in Annex 2.7.

2.2.4 End-to-End test (E2E)

E2E tests are performed in the test environment and any new functionality/changes may only be implemented in the production environment if the tests have been passed. Test of transactions may be done using simulated transactions if no physical test environment is available on the RSE.

E2E functionality is described as:

"*An interoperable EasyGo contract/OBE is established by a TSP. This valid OBE is detected by a TC's RSE and a transaction including correct price is generated and transferred through the EasyGo HUB to the TSP's CS and cleared. A corresponding invoice is generated according to this contract with the TSP and the TC is paid accordingly. The TSP is generating a corresponding issuer fee invoice for the TC which is paid.*"

The E2E tests will be carried out by test personnel (no real customers are involved).

The E2E test will cover a number of scenarios where an interoperable contract is established for the test personnel. Based on the type of contract, transactions are made within the various TC's equipment. The status of the contract may be changed as well as various types of enforcement situations are set up according to the test plan from the test manager.

When new OBEs are introduced the TSP shall perform E2E tests with the new OBE in cooperation with chosen EasyGo TCs.

When the E2E test has been executed and approved in a test environment the same test shall be executed in the production environment. Tests of transactions may only be done using physical OBEs and RSE transactions.

E2E testing is described in the EasyGo E2E test case overview in Annex 2.7.

2.2.5 Trial operation

When the E2E tests have been completed and approved the trial operation may start.

The preparation for the trial operation should start at a much earlier stage to acquire and prepare the SUs (drivers and organisations) involved in the trial operation. Transaction handling, customer service or other processes (e.g. claim handling) during the trial operation shall be part of the normal service even if special attention and handling is necessary to some extent. It is important that the customer service and operations personnel are informed and receive adequate training in advance.

During the trial operation real ("friendly") service users will use all the EasyGo functions for paying their tolls.

2.2.6 In-Service Test (IST)

After the trial operation and start of regular/commercial operation, there will be a period of verification of performance. This period is referred to as the IST. Such tests will especially be performed if quality issues arise during operation.

The practical execution of the IST will consist of a more intense follow up of KPIs during the IST period.

2.2.7 Test conclusion

Success criteria for each of the above test steps are defined in the test specifications by the test manager. They shall as a minimum include the approval of the individual test steps as well as start and finalisation of trial operation, start of commercial operation and end of IST period.

2.3 Test organisation

The implementation and testing of new or changed functionality will as a minimum be performed by actors that will be affected and the EasyGo HUB operation. Other EasyGo TCs and/or TSPs are involved in tests to the extent necessary to secure that the new/changed functionality works throughout the entire EasyGo services.

Test role	**Responsibility (function)**	**Reports to**
EasyGo management (EM)	Overall responsible for the execution of all testing, information, customer relations and education.	EasyGo Steering Committee
Technical working group (WG2)	Responsible for the topics listed under chapter 1.2.1 Appoints the test manager.	EasyGo management
Test manager (WG2)	Responsible for all administrative and operational aspects of testing. Defines test plan including milestones and timing Approves test reports by actors Provide status reports on progress and final test report for approval.	WG2
Test coordinator (local)	Responsible at each actor and the EasyGo HUB operation for organisation, execution, documentation and approval of tests.	Test manager
System responsible (local)	Responsible for a particular system module: - EasyGo HUB - ACFC responsible[1] - TSP (CS–HUB) responsible	Test coordinator

[1] The ACFC is not (directly) a part of EasyGo but is acting on behalf of Norwegian TCs or TSPs

Test role	Responsibility (function)	Reports to
	- TSP (CS–PE) responsible - TSP (customer relations) - TSP (financial relations) - TC (CS–HUB) responsible - TC (RSE-OBE) responsible - TC (RSE-CS) responsible - TC (financial relations)	
Test engineer (local)	Executing the test activities	System responsible/test coordinator

For each new project, test persons at relevant organisations are appointed prior to the start of the project.

3 Test process and functions to be tested

3.1 Overview

The test plan needs to define for each test step, which parts of the systems of the actor(s) and the EasyGo HUB need to be tested and also defines the sequence of the tests.

The process for each test during the test steps 9 to 16 is shown in Figure 6.

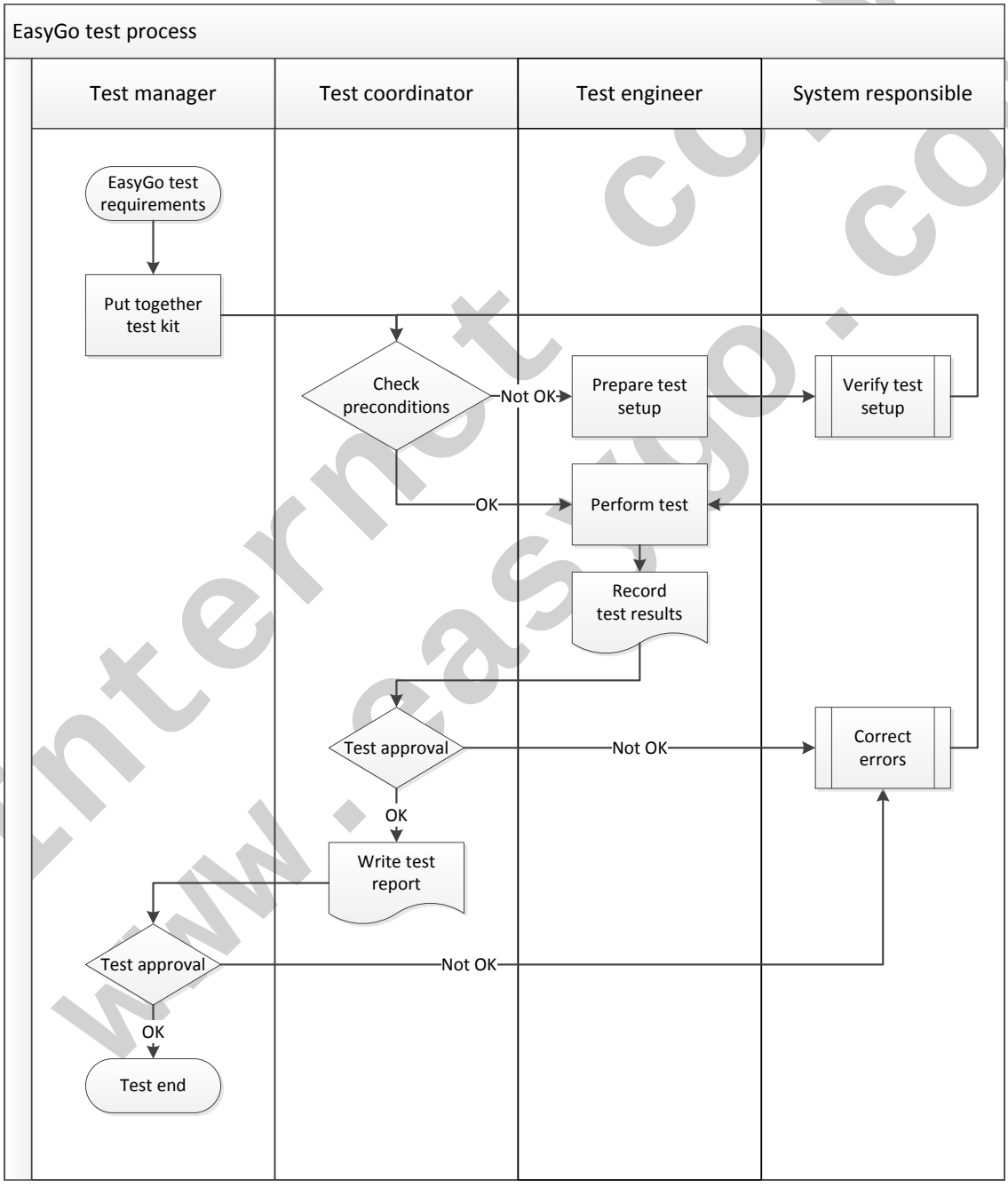

Figure 6: **EasyGo test process**

The description of the testing on the involved systems is described in the remaining parts of chapter 3 and Annex 2.7.

3.2 EasyGo HUB

The test process for the testing of the EasyGo HUB is dependent on the nature of the new or changed functionality. The test plan needs to distinguish between the following test scenarios:

- Adding of a new type of back office data exchange: If a new type of back office data exchange is to be tested, it can be limited to the testing of this new type only if the design of the change assures that there are no side-effects on other parts of the back office data exchange. If this cannot be assured, all affected types of back office data exchange need to be (re-)tested as well.
- Changing an existing type of back office data exchange: If a change of an existing type of back office data exchange is to be tested, it will involve a complete re-test of this type and possibly also all other types which depend on the processed data (e.g. a test of the change of the AIT will also involve a re-test of the verification processes in the NAT, HGV and TIF which are dependent on the AIT data).
- Adding a new actor (TC/TSP): All applicable types of back office data exchange need to be tested with the new actor.

The following rules apply for the testing of the EasyGo HUB independently of the test scenarios descried above:

- The tests of the back office data exchange are only performed in the test step INT1 according to the specifications listed in chapter 2.
- After approval of this test step the remaining test steps are processed on the EasyGo HUB first in the test environment (INT2, E2E) and then in the production environment (E2E, trial operation, IST).
- Any modification to any type of back office data exchange after the INT1 test has been approved will require a re-test of the INT1 test step and any following test steps.

The functions of the EasyGo HUB which shall be tested are:

A. input interface (file name)
B. manual entry of data received per email (functionality, if applicable)
C. general data verification on reception (file name, syntax, semantics)
D. specific data verification on reception (semantics, if applicable)
E. generation of alarms and error handling (functionality, moving files, if applicable)
F. generation of confirmation data (syntax, semantics, if applicable)
G. output interface for confirmation data (file name, if applicable)
H. internal data processing/aggregation (functionality, if applicable)

I. generation of KPIs (functionality, if applicable)

J. generation of output data (syntax, semantics, if applicable)

K. output interface for output data (file name, if applicable)

The file names, syntax, semantics and functionality for the EasyGo HUB are described in Annexes 2.1, 2.3, 2.7 and 2.8.

3.3 Toll Service Providers (TSP)

3.3.1 Central system (CS)

The test process for the testing of the CS-functions of a TSP is dependent on the nature of the new or changed functionality. The test plan needs to distinguish between the following test scenarios:

- Adding of a new type of back office data exchange: If a new type of back office data exchange is to be tested, it can be limited to the testing of this new type only if the design of the change assures that there are no side-effects on other parts of the back office data exchange. If this cannot be assured, all affected parts of the system need to be tested as well.
- Changing an existing type of back office data exchange: If a change of an existing type of back office data exchange is to be tested, it will involve a complete re-test of this type and possibly also all other types which depend on the processed data (e.g. a test of the change of the TIF will also involve a re-test of the ERP and the invoicing system).
- Adding a new actor (TC/TSP): All applicable types of back office data exchange need to be tested with the new actor.

The following rules for testing the CS of the TSP apply independently of the test scenarios described above:

- The tests of the back office data exchange are performed in the test step INT1 against the EasyGo HUB in the test environment according to the specifications listed in chapter 2.
- The tests of the back office data exchange are performed in the test steps INT2 and E2E against a representative selection of other TCs in the test environment according to the specifications listed in chapter 2.
- The tests of the back office data exchange are performed in the test steps E2E, trial operation and IST against a representative selection of other TCs in the production environment according to the specifications listed in chapter 2.
- Any modification to any type of back office data exchange after the INT1 test has been approved will require a re-test of the INT1 test step and any following test steps.

The functions of the CS of the TSP upon reception of a back office data exchange which shall be tested are:

A. connection to the EasyGo HUB (login)
B. retrieval of input data (downloading, deleting file)
C. verification of input interface (file name, syntax)
D. data verification on reception (semantics, if applicable)
E. generation of alarms and error handling (functionality, if applicable)
F. retrieval of confirmation data (downloading, deleting file, if applicable)
G. verification of input interface for confirmation data (file name, syntax, if applicable)
H. generation of alarms and error handling (functionality, if applicable)
I. internal data processing (functionality)
J. generation of invoices to SUs (syntax, semantics, if applicable)
K. payment collection/reception from SUs (functionality, if applicable)
L. generation of invoices for issuer fees to TCs (syntax, semantics, if applicable)
M. payment to TCs with/without deduction of issuer fees (functionality, if applicable)
N. payment collection/reception of issuer fees from TCs (functionality, if applicable)
O. generation of single transaction lists (syntax, semantics, if applicable)

The functions of the CS of the TSP upon sending of a back office data exchange which shall be tested are:

A. collection of output data (functionality)
B. validation of output data (syntax, semantics)
C. generation of output data (syntax, semantics)
D. output interface for output data (file name)
E. connection to the EasyGo HUB (login)
F. sending of output data (uploading, moving)
G. collection of confirmation data (functionality, if applicable)
H. validation of confirmation data (syntax, semantics, if applicable)
I. generation of confirmation data (syntax, semantics, if applicable)
J. output interface (file name, if applicable)
K. sending of confirmation data (uploading, moving)

The requirements for the file exchange are described in Annex 2.1, 2.3, 2.7, 2.8 and 3.4

3.3.2 On Board Equipment (OBE)

The test process for the testing of the OBE of a TSP is dependent on the nature of the new or changed functionality. The test plan needs to distinguish between the following test scenarios:

- Adding of a new type of OBE: A new type of OBE needs to be tested for suitability for use against all types of implemented RSE (and all software/firmware revisions).
- Changing an existing OBE currently in use: If a change of an existing type of OBE through a software/firmware update is to be tested, it will involve a complete suitability for use test of this OBE type (e.g. update of a future GNSS OBE over the air) against all types of implemented RSE (and all software/firmware revisions).
- Adding a new actor (TSP): All applicable types of OBE of the new TSP need to be tested for suitability for use against all types of implemented RSE (and all software/firmware revisions).

The following rules for testing the OBE of the TSP apply independently of the test scenarios described above:

- The suitability for use tests of new OBE can be limited to the testing only at one TC, if the design of the OBE assures that the performance at other TCs is expected to be equal and if this is agreed between the TSP and the TCs. If this cannot be assured, the suitability for use testing has to be performed at all TCs according to the specifications listed in Annex 2.2.

The functions of the OBE which shall be tested are:

1. Signalling to SU (sound in OBU, if applicable)
2. Exchange of OBE (semantics)
3. Re-personalisation of OBE (functionality, if applicable)

Basic EasyGo OBEs and EasyGo+ OBEs shall be subject to the same types of tests but the test procedures cover different communication aspects.

When introducing new OBEs the TSP shall perform FAT, SAT and “Suitability for use tests”, before joint tests with EasyGo can be initiated (See chapter 2.2.2 “Prerequisites”).

Specific test procedures for EasyGo+ OBEs are described in Annex 2.2 enclosure E.

The tests related to new OBEs will differ if the OBEs are a new model introduced by an existing TSP or if a new TSP seeks to join EasyGo using an already known OBE model.

3.4 Toll Chargers (TC)

3.4.1 Central system (CS)

The test process for the testing of the CS-functions of a TC is dependent on the nature of the new or changed functionality. The test plan needs to distinguish between the following test scenarios:

- Adding of a new type of back office data exchange: If a new type of back office data exchange is to be tested, it can be limited to the testing of this new type only, if the design of the change assures that there are no side-effects on other parts of the back office data exchange. If this cannot be assured, all affected parts of the system need to be tested as well.
- Changing an existing type of back office data exchange: If a change of an existing type of back office data exchange is to be tested, it will involve a complete re-test of this type and possibly also all other types which depend on the processed data (e.g. a test of the change of the TIF will also involve a re-test of the ERP and the invoicing system).
- Adding a new actor (TC/TSP): All applicable types of back office data exchange need to be tested with the new actor.

The following rules for testing the CS of the TC apply independently of the test scenarios described above:

- The tests of the back office data exchange are performed in the test step INT1 against the EasyGo HUB in the test environment according to the specifications listed in chapter 2.
- The tests of the back office data exchange are performed in the test steps INT2 and E2E against a representative selection of other TSPs in the test environment according to the specifications listed in chapter 2.
- The tests of the back office data exchange are performed in the test steps E2E, trial operation and IST against a representative selection of other TSPs in the production environment according to the specifications listed in chapter 2.
- Any modification to any type of back office data exchange after the INT1 test has been approved will require a re-test of the INT1 test step and any following test steps.

The functions of the CS of the TC upon reception of a back office data exchange which shall be tested are:

A. connection to the EasyGo HUB (login)
B. retrieval of input data (downloading, deleting file)
C. verification of input interface (file name, syntax)
D. data verification on reception (semantics, if applicable)
E. generation of alarms and error handling (functionality, if applicable)

F. retrieval of confirmation data (downloading, deleting file, if applicable)

G. verification of input interface for confirmation data (file name, syntax, if applicable)

H. generation of alarms and error handling (functionality, if applicable)

I. internal data processing (functionality, if applicable)

J. distribution of EFC context marks, key information or white/black list data to RSE (functionality)

K. payment of issuer fees to TSPs (functionality, if applicable)

L. payment collection/reception of tolls from TSPs (functionality, if applicable)

The functions of the CS of the TC upon sending of a back office data exchange which shall be tested are:

A. collection of output data (syntax, semantics)

B. validation of output data (syntax, semantics)

C. generation of output data (syntax, semantics)

D. output interface for output data (file name)

E. connection to the EasyGo HUB (login)

F. sending of output data (uploading, moving)

G. collection of confirmation data (functionality, if applicable)

H. validation of confirmation data (syntax, semantics, if applicable)

I. generation of confirmation data (syntax, semantics, if applicable)

J. output interface (file name, if applicable)

K. sending of confirmation data (uploading, moving)

L. verification of invoices to SUs (syntax, semantics, if applicable)

M. verification of invoices to TCs (syntax, semantics, if applicable)

N. payment collection/reception from TSPs (functionality, if applicable)

O. payment to TSPs of issuer fees (functionality, if applicable)

The requirements for the file exchange are described in Annex 2.1, 2.3, 2.7, 2.8 and 3.4

3.4.2 Road Side Equipment (RSE)

The test process for the testing of the RSE of a TC is dependent on the nature of the new or changed functionality. The test plan needs to distinguish between the following test scenarios:

- Adding of a new type of RSE: A new type of RSE needs to be tested against all types of accepted OBE for suitability for use.

- Changing an existing RSE currently in use: If a change of an existing type of RSE through a software/firmware update is to be tested, it will involve either a complete or at least parts of the suitability for use test against all types of accepted OBE.
- Adding a new actor (TC): All applicable types of RSE of the new TC need to be tested for suitability for use against all types of accepted OBE.

The following rules for testing the RSE of the TC apply independently of the test scenarios described above:

- The suitability for use tests of new RSE can be limited to the testing against only one OBE, if the design of the RSE assures that the performance with other types of OBE is expected to be equal and if this is agreed between the TSPs and the TC. If this cannot be assured, the suitability for use testing has to be performed against all types of OBE according to the specifications listed in Annex 2.2.

The functions of the RSE which shall be tested are:

1. distribution of EFC context marks
2. electronic reading of OBE (functionality, in various positions, differing environmental conditions, lab and road)
3. degraded mode handling (functionality, if applicable)
4. shielding of OBE (functionality)
5. blocking of OBE (functionality, timing)
6. unblocking of OBE (functionality, timing)
7. signalling to SU (light in lane, if applicable)
8. enforcement (TC internal functionality, if applicable)
9. sending of transaction data to CS of TC (functionality, timing)

The test of the OBE RSE interface shall cover a number of different OBEs with different status (e.g. ordinary, blacklisted) at various test sites at the choice of TC. Within the EasyGo toll domains the TC must ensure that the reading of existing basic EasyGo OBEs and EasyGo+ OBEs is not affected by any update of the RSE.

These functions refer to descriptions in Annex 2.2.

4 Test management, reporting and approval

4.1 Test tracking

A test tracking and bug tracking tool is made available for the EasyGo tests. Details of the tool (description of use, user login, password and URL) shall be provided by test manager to the test personnel.

4.2 Test reports

Test reports shall be written by the test coordinator. Sufficient detailed test documentation shall be included to enable the test manager to approve the report.

EasyGo test status levels:

I. Not started
II. In progress
III. Local test failed
IV. Local test passed
V. EasyGo rejection of test report
VI. EasyGo approval of test report

When providing a test report, each test shall be identified by a name and a number.

The following table identifying the test and the reported result shall be applied.

Test name	Each test shall be identified by a name and a number	No.:
Description	Describe purpose and what to be tested	
Precondition	Describe the preparations, the test setup and the preconditions to be met prior to the test	
Expected result	Describe expected type of result and how this should be expressed (proof of result) Acceptance criteria cannot be defined on a general level and shall be defined for each test setup.	
Actual result	Write the actual result of the test	
Test status	State the status of the test	
Deviations	State the deviation if a test failed	
Comment	Give a comment when appropriate for a passed test and always when a test has failed	

4.3 Deviations

During execution of the tests, deviations (i.e. errors or failure to meet the requirements) may be encountered. Deviations will be classified into a severity class and dealt with as follows:

Severity class	**Definition**	**Action**
A	The deviation needs to be corrected before tests can continue	After correction, the concerned tests are repeated.
B	The deviation may be corrected by	ad a) The assessment of the consequences of the change in

Severity class	Definition	Action
	changing: a) The requirement, and/ or b) The test procedure.	requirement is done by the actor and is documented in the test report. ad b) The test procedure is changed, the test is executed in accordance with the new procedure, and the change is logged in the test report. (Applicable only in case of changed requirements or if test procedure is defined imperfectly)
C	Deviation with minor consequences which can be: a) Accepted, or b) Corrected at a later stage.	The evaluation of the deviation is done by the test coordinator and is documented in the test report along with the possible corrective actions.

Categorisation of the deviations is done by the test coordinator in cooperation with the system responsible. The test report shall not be approved by the test manager if there are deviations of severity class "A" or “B”.

All class A deviations shall be corrected and the test repeated.

The requirements or test procedure shall be corrected for all class B deviations and the tests shall be repeated.

Remaining class C deviations shall be included in an action plan (including responsible part for corrections, retesting and a time schedule) prior to EasyGo approval of the test report.

4.4 Notification requirements

To enable all parties to prepare their necessary actions to support the change procedures, early information and minimum notification periods need to be met.

To be able to track the most important steps later, expressively defined notifications need to be in written form (“Change Notification”, an example form is attached as Annex A, available as Word template). An example of a change notification schedule for introduction of a new OBU type is included in Annex B.

In minimum, the following documentation must be provided for changes concerning more than one entity:

Action	Phase	Documentation	Provider	Receiver	Deadline	Forms (condition)
Preliminary Information about changes with rough schedule	Begin	Notification	changing entity	WG2, EM	TBD	Change notification (mandatory)
Change Notification Schedule		Notification Schedule	WG2	EM	TBD	This Spreadsheet (mandatory)
Productive Start Notification		Notification	changing entity, WG2	EM	TBD	Change notification (mandatory)
Productive Start Release	End	Notification	EM	SC	TBD	Change notification (mandatory)

5 Annexes

5.1 Annex A Example form for Change Notification

EasyGo change notification

To	EM, WG2
From	TSP
Date	
Change	**New OBU**
Document content	Prel. information

Short description

xxx

Proposed actions

zzzz

Enclosures

"yyy"

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5.2 Annex B Example of a Change Notification schedule (Introduction of a new OBU type)

Action	Phase	Documentation	Provider	Receiver	Deadline	Forms (condition)
Preliminary Information about changes with rough schedule	Begin	Notification	changing entity (TSP)	WG2, EM	>> X - 6 months	Change notification (mandatory)
Change Notification Schedule		Notification Schedule	WG2	EM	> X - 6 months	This Spreadsheet (mandatory)
Information with test plan + detailed schedule		test plan, schedule	changing entity (TSP)	WG2	X - 6 months	
Utility request (OBU)	Integration	OBU data content	all TC	TSP	X - 4 months	
Utility delivery (OBU)	Integration	OBU data content	TSP	requesting TC	X - 3 months	
Utility request (OBU)	E2E	OBU data content	all TC	TSP	X - 4 months	
Utility delivery	E2E	OBU data content	TSP	requesting TC	X - 3 months	
Integration tests	Integration	Test report	TC	WG2	X - 1 month	
E2E tests	E2E	Test report	TSP	WG2	X - 1 month	
Productive Start Notification		Notification	changing entity, WG2	EM	X - 1 month	Change notification (mandatory)
Productive Start Release	End	Notification	EM	SC	X	Change notification (mandatory)