Intelligente Verkeers Regel Installatie (iVRI) – Fase 2

Deliverable 3f: Test specifications

FAT test specification TLC

Datum: 23 november 2016
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1 Voorwoord

In mei 2016 is opdracht verstrekt door het Ministerie van Infrastructuur en Milieu via het Beter Benutten Vervolg (BBV) programma aan vijf VRA leveranciers om de in fase 1 opgeleverde iVRI architectuur, te bouwen en te testen in samenwerking met applicatiebouwers.

Dit document is onderdeel van Deliverable 3f van de afgesproken leverdelen in de opdrachtverstrekking en beschrijft de FAT test specificatie voor de TLC.

Dit document is tot stand gekomen door samenwerking van de vier leveranciers in de werkgroep bestaande uit:

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NB. De rest van dit document is geschreven in het Engels om internationale uitwisseling te ondersteunen.

The rest of this deliverable has been written in English to facilitate international exchange.

DOCUMENT CONTROL SHEET

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CONTENT

2 Introduction

This document describes the FAT test specification for the TLC Facilities.

2.1 System overview
The iTLC architecture defines several interfaces of the iTLC. Figure 1 shows these interfaces. See [Ref 1] for a detailed architecture description.
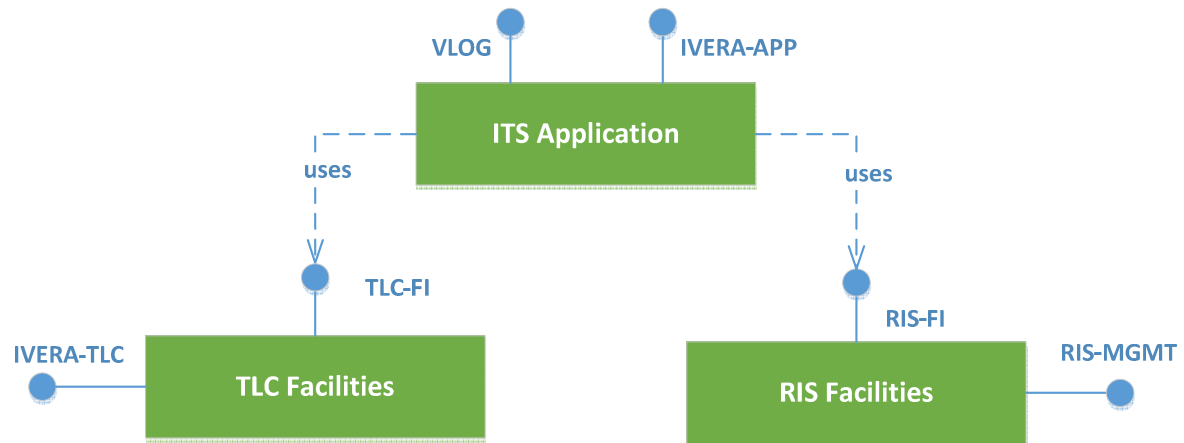
Figure 1 System overview

2.2 Document overview

2.2.1 Purpose
This document provides specifications for the testing of the TLC Facilities. This document is a part of a set of test specifications, which together form deliverable 3f. See [Ref 8] for the description of the iVRI test strategy.

2.2.2 Document structure
Chapter 3 contains references to normative and informative documents.
Chapter 4 explains acronyms and used definitions and concepts.
Chapter 5 outlines the test setup
Chapter 6 outlines guidelines for the execution of the test scenarios.
Chapter 7 outlines guidelines for the interpretation of the test output.
Chapter 8 outlines the formal specification of the test cases.

2.3 Advise for the reader

It is advised that the reader understands the iTLC Architecture as described in [Ref 1].

3 References

3.1 Normative

ID	Reference
[Ref 1]	Beter Benutten Vervolg, project iVRI, Deliverable F, iTLC Architecture, v1.2
[Ref 2]	Beter Benutten Vervolg, project iVRI, Deliverable G2, IRS TLC Facilities Interface v1.2, jan 2016
[Ref 3]	Beter Benutten Vervolg, project iVRI – fase 2, Deliverable 1ab IDD Generic Facilities Interface v1.1, nov 2016
[Ref 4]	Beter Benutten Vervolg, project iVRI – fase 2, Deliverable 1a IDD TLC Facilities Interface v1.1, nov 2016
[Ref 5]	Beter Benutten Vervolg, project iVRI – fase 2, Deliverable 1d IRS security v1.0, aug 2016
[Ref 6]	Beter Benutten Vervolg, project iVRI – fase 2, Deliverable 1b IDD RIS Facilities Interface v1.0, nov 2016
[Ref 7]	Beter Benutten Vervolg, project iVRI – fase 2, Del. G3 IRS IDD iTLC IVERA 4.00 v2.0

3.2 Informative

ID	Reference
[Ref 8]	Beter Benutten Vervolg, project iVRI – fase 2, Deliverable 3f iVRI test strategy v1.0, sep 2016
[Ref 9]	Beter Benutten Vervolg, project iVRI – fase 2, Deliverable 3f FAT test specification ITS-CLA v1.0, nov 2016

4 Acronyms, abbreviations and concepts

Acronyms and abbreviations

C-ITS	Cooperative ITS functionality for exchange of data between in-vehicle and or road side devices making use of either cellular or short range wireless communication
FAT	Factory Acceptance Test
IDD	Interface Design Description
IRS	Interface Requirements Specification
iTLC (Dutch iVRI)	Intelligent TLC performing traffic light controller and C-ITS functions and providing access to these functions for ITS applications
ITS	Intelligent Transport Systems
ITS-A	ITS Application
ITS-CRA	ITS consumer application
ITS-CLA	ITS control application
ITS-PRA	ITS provider application
ITS Station	Functional entity specified by the ITS station reference architecture (see [Ref 1])
IVERA	Management protocol for traffic light controllers in the Netherlands
IVERA-APP	Management protocol for ITS applications.
IVERA-TLC	Management protocol supported by the RLC Facilities.
RIS	See R-ITS-S
RIS-FI	R-ITS-S Facilities Interface
R-ITS-S	Roadside ITS Station, responsible for C-ITS functionality within a geographical area.
TLC	Traffic Light Controller; controls the signal of one or more intersections
TLC-FI	Traffic Light Controller Facilities Interface
TLS	Transport Layer Security

Concepts

ITS Control Application	A Traffic Control Application which uses TLC- and/or RIS-interfaces
ITS Application	An application which supports one or more ITS use-cases. Range of possible ITS Applications include an ITS Control Application
RIS Facilities	Component providing RIS Facilities to users (internal and/or external). Includes amongst others: • Access to information stored in the LDM • Services to trigger C-ITS messages
TLC Facilities	Component providing facilities of a TLC to users (internal and/or external). Includes amongst others: • Access to information from the TLC • Services to trigger actuators

5 Test setup

5.1 Introduction
This chapter outlines the test setup.

5.2 Device under test
The device under test (DUT) is an iVRI compliant TLC that implements the TLC-FI and IVERA-TLC interfaces.
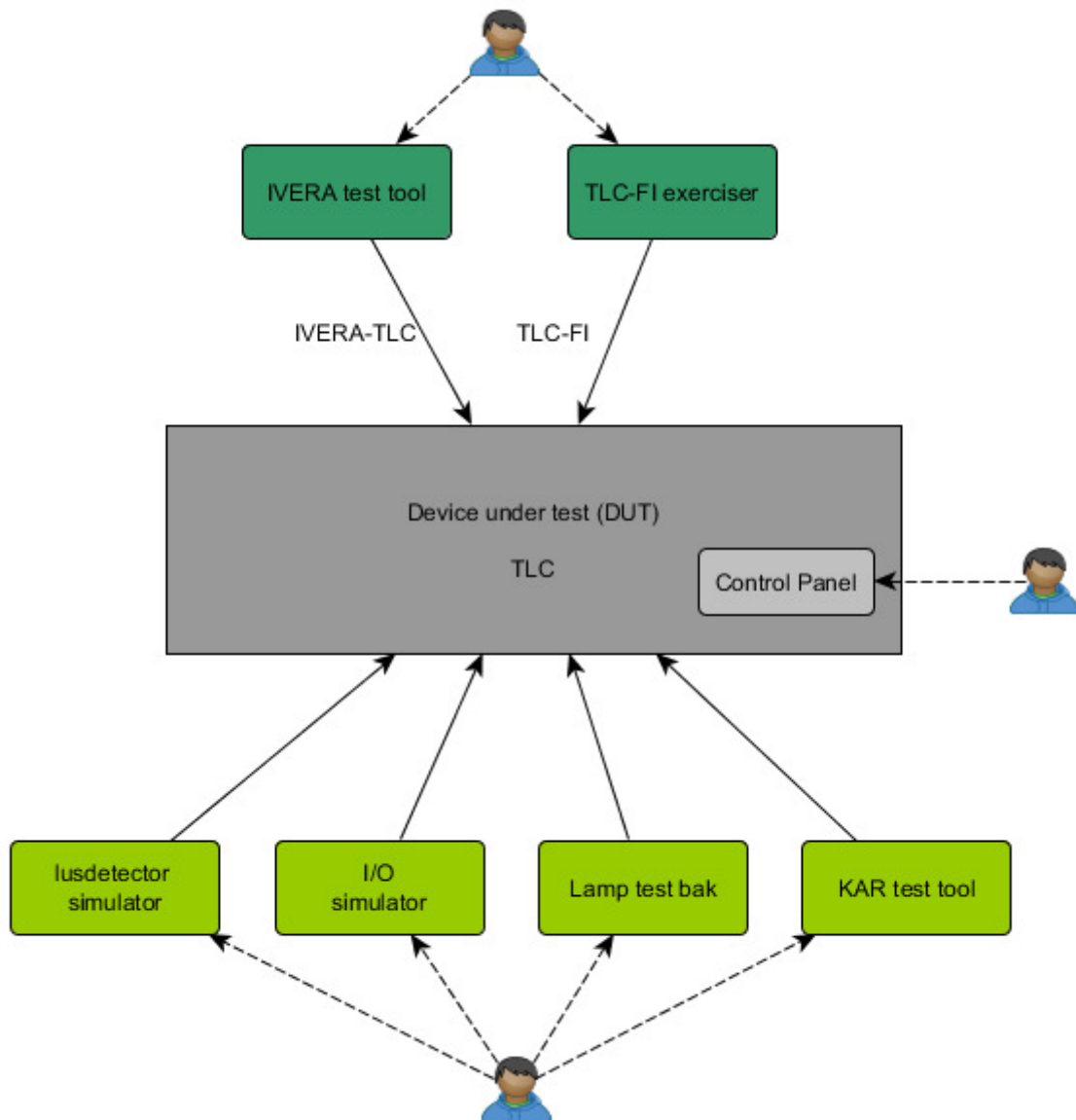
5.3 TLC-FI exerciser
To be able to perform tests on the TLC-FI interface a software tool is needed. The test tool for testing the TLC-FI is called the TLC-FI exerciser.

5.4 IVERA exerciser
To be able to perform tests on the IVERA-TLC interface a software tool is needed. The test tool for testing the IVERA-TLC interface is called the IVERA exerciser (or IVERA test tool).

5.5 Test intersection

The TLC must be configured with the test intersection. The configuration can be found in [Ref 8].

6 Test execution

6.1 Introduction
This chapter provides guidelines for the execution of the test scenarios specified in this document.

6.2 Structure
During a test the Device Under Test (DUT) is subjected to the documented test cases. This test specification is structured as follows:
- Test specification
  - Test scenario(s)
    - Test case(s)
      - Test step (s)

6.3 Execution
The tests are executed in the documented order. No alternations should be made to the device under test (the TLC) during the test, unless explicitly documented.

The results are documented per test step.
A test step has passed if the pass criteria has been met.
A test step has failed if the pass criteria has not been met.
A test case has passed if all test steps have passed.
A test scenario has passed if all test cases have passed.

6.4 Test case notation format
The following format is used to specify the test cases and document the test results.

Test Case:			
ID:			
Objective:			
Pre-conditions:			
STEP	DESCRIPTION	PASS / FAIL	REMARKS/ACTIONS
1.	Actions **Verify**		
2.			
3.			
Tested by:		Date:	

- Test case: A short description of the test case.
- ID: A unique ID
- Objective: The objective of the test case.
- Pre-conditions: The pre-conditions before the test case is executed.
- STEP: Number of the step.
- DESCRIPTION: A description of the actions to be executed and a description of the items to be verified.
- PASS/FAIL: The test result.
- REMARKS/ACTIONS: Remarks and action related to the test results.
- Tested by: Person who executed the test case.
- Date: The date at which the test case was executed.

6.5 Remarks / actions

A remark shall be documented if:
- If the test step does not meet the pass criteria;
- If the test step cannot be executed;
- If the test is interrupted;
- If the test results are unusable;

6.6 Test Readiness Review

A Test Readiness Review (TRR) is held to verify readiness for formal TLC type testing. The conditions are:
- The test configuration as specified in [Ref 8] is available.
- A release version of the TLC software is loaded on the DUT.
- The test intersection is configured in the TLC.
- The pre-conditions as documented in the test scenarios/test cases are met.
- All required mocks and drivers are available.
- The pre-test table is filled in

Before testing:

Software release:	
DUT:	
Pre-conditions met:	
Tested by:		Date:	

After testing

Software release:	
DUT:	
General PASS/FAIL:	
Remarks	
Actions	
Tested by:		Date:	

7 Test verification

7.1 Introduction
This chapter provides guidelines how to interpret the test output.

7.2 Levels of verification
The test setup supports three levels of verification.

1)	The iTLC exerciser displays the current status. The tester uses this information to verify if the TLC has published the correct information on the TLC-FI.
	The status of the outputs and lamps (connected to the TLC) are displayed on the I/O and lamp simulator. The tester uses this information to verify if the TLC has correctly executed a request.
2)	The iTLC exerciser maintains diagnostic counters on all kind of information exchanged via TLC-FI.
3)	The iTLC exerciser logs all information transfer via the TCP socket in a file. Any issues detected by the iTLC in the information received via the TLC-FI interface are also logged in the file. The tester can perform a detailed analysis of the TLC-FI protocol by reviewing the log file.

Where possible verification is done using level 1.

8 Test scenarios

8.1 Introduction

The test scenarios will start with the happy flow; exceptions will be done in separate test scenarios.
This chapter describes the test scenarios and the test cases per scenario.

8.2 Scenario 1: ITS consumer application happy flow

In this scenario an ITS-CRA connects and registers to the TLC-FI. The ITS-CRA shows all metadata and information of all objects. The tester verifies the information. The tester verifies that detector, signal group, I/O, variable changes and events are shown in the ITS-CRA. Optionally log files can be verified whether there are errors or not and that the right sequences are present.

8.2.1 Test case 1: iTLC start up

Test Case:	iTLC start up		
ID:	SC1.CRA.01.HA		
Objective:	Verify that the TLC starts up properly		
Pre-conditions:	The TLC Facilities is switched off (traffic lights are dark) No ITS-CLA is available to connect and take control No back-up application is available		
STEP	**DESCRIPTION**	**PASS / FAIL**	**REMARKS/ACTIONS**
1.	Switch on the TLC Facilities **Verify** that within one minute the state of the TLC will change from Dark to Amber Flashing. **Verify** that the TLC Facilities stays in the status Amber Flashing, also after the Start up application selection timeout. The total wait time is 30 seconds		
Tested by:		**Date:**	

8.2.2 Test case 2: Connect and register - CRA

Test Case:	Connect and register – CRA		
ID:	SC1.CRA.02.HA		
Objective:	Verify that the ITS-CRA can connect and register to the TLC-FI		
Pre-conditions:	The TLC Facilities is initiated and available		
STEP	**DESCRIPTION**	**PASS / FAIL**	**REMARKS/ACTIONS**
1.	Configure the Session details of the TLC-FI in the ITS-CRA. User: Consumer1 Password: Password1 Application type: ITS-CRA		
2.	Activate the connect and register procedure. **Verify** that the ITS-CRA is connected and registered to the TLC-FI. **Verify** that the TLC Facilities stays in the Standby mode (Amber Flashing) **Verify** that the connection is secured with TLS. **Verify** that the audit log contains the start of connection events. **Verify** that the correct protocol version is reported		
Tested by:		**Date:**	

8.2.3 Test case 3: Meta data

Test Case:	Meta data		
ID:	SC1.CRA.03.HA		
Objective:	Verify that the retrieved metadata corresponds with the test intersection specification		
Pre-conditions:	The ITS-CRA is connected and registered to the TLC-FI		
STEP	**DESCRIPTION**	**PASS / FAIL**	**REMARKS/ACTIONS**
1.	Make the ITS-CRA retrieve the metadata of all objects.		
2.	**Verify** that the intersection(s) are shown correctly		
3.	**Verify** that all detectors are shown correctly		
4.	**Verify** that all inputs are shown correctly		
5.	**Verify** that all non-exclusive outputs are shown correctly		
6.	**Verify** that all exclusive outputs are shown correctly		
7.	**Verify** that all signal groups are shown correctly		

8.	**Verify** that all variables are shown correctly		
9.	**Verify** that all special vehicles are shown correctly		
10.	**Verify** that the conflict matrix is shown correctly		
11.	**Verify** that the TLC Facilities is shown correctly		
12.	**Verify** that no exceptions occurred		
Tested by:		**Date:**	

8.2.4 Test case 4: Subscribe to objects

Test Case:		Subscribe to objects		
ID:		SC1.CRA.04.HA		
Objective:		Verify that the ITS-CRA can subscribe to receive notifications on change of objects		
Pre-conditions:		The ITS-CRA is connected and registered to the TLC-FI		
STEP	**DESCRIPTION**		**PASS / FAIL**	**REMARKS/ACTIONS**
1.	The ITS-CRA subscribes to all objects of the TLC-FI **Verify** that the ITS-CRA received a confirmation of the subscription, a unique subscription identifier and the actual attributes to which it subscribed			
Tested by:			**Date:**	

8.2.5 Test case 5: Subscribe to a filtered object

Test Case:		Subscribe to a filtered object		
ID:		SC1.CRA.05.HA		
Objective:		Verify that the ITS-CRA can subscribe to filtered objects		
Pre-conditions:		An ITS-CRA is connected and registered to the TLC-FI		
STEP	**DESCRIPTION**		**PASS / FAIL**	**REMARKS/ACTIONS**
1.	The ITS-CRA subscribes to object **d5** **Verify** that the ITS-CRA receives a confirmation of the subscription and the actual attributes to which it subscribed			
2.	Repeat step 1 for detector d2, signal group fc05, inputB, output ds2 and variable varA			

Tested by:		Date:	

8.2.6 Test case 6: Detectors

Test Case:	Detectors		
ID:	SC1.CRA.06.HA		
Objective:	Verify that the changes to detectors states, detector faults, detector SWICO state and detector events are correctly received in the ITS-CRA		
Pre-conditions:	The ITS-CRA has subscribed itself to updates of the detector objects All detectors are unoccupied, no detector SWICO's are set and there are no detector errors in the TLC. IVERA is connected and registered with the user 'Verkeerskundige'		
STEP	**DESCRIPTION**	**PASS / FAIL**	**REMARKS/ACTIONS**
1.	Change the state of detector **d2** from 0 to 1 on the detector simulator. **Verify** that the state of that detector changes in the ITS-CRA **Verify** that the state of the other detectors is unchanged in the ITS-CRA		
2.	Change the state of detector **d2** from 1 to 0 on the detector simulator. **Verify** that the state of that detector changes in the ITS-CRA **Verify** that the state of the other detectors is unchanged in the ITS-CRA		
3.	Toggle the state of detector **d2** 4 times (0 -> 1 -> 0) on the detector simulator. **Verify** that the ITS-CRA has counted exactly 5 transitions. **Verify** that the ITS-CRA has counted 0 transitions on all other detectors.		
4.	Repeat step 1 and 2 for all other detectors. - d3, d5, d7, d8, dk-21, dk33_1, dk33_2		
5.	Use the detector simulator to generate an event for detector **ds2**. **Verify** that the event, including the attributes is correctly shown in the ITS-CRA.		
6.	Repeat step 5 for 3 other events -		

7.	Use IVERA-TLC to control the SWICO for detector **dk21**. Set SwicoOn using IVERA-TLC **Verify** that the SWICO state is shown as SwicoOn in the ITS-CRA. **Verify** that the detector state is shown as Occupied in the ITS-CRA		
8.	Change the state of the detector **dk21** to Occupied on the detector simulator. Set SwicoOff using IVERA-TLC **Verify** that the SWICO state is shown as SwicoOff in the ITS-CRA. **Verify** that the detector state is shown as Unoccupied in the ITS-CRA		
9.	For the detector **dk21** set NoSwico using the IVERA-TLC **Verify** that the SWICO state is shown as NoSwico in the ITS-CRA. **Verify** that the detector state is shown as Occupied in the ITS-CRA		
10.	Change the state of the detector **dk21** to unoccupied on the detector simulator. **Verify** that the SWICO state is shown as NoSwico in the ITS-CRA. **Verify** that the detector state is shown as Unoccupied in the ITS-CRA		
11.	Disconnect the detector **d3** for the detector simulator (to generate a detector fault). **Verify** that the detector fault state is shown as HardwareError in the ITS-CRA **Verify** that the detector state is shown as Occupied in the ITS-CRA		
12.	Connect the detector **d3** for the detector simulator (to clear the detector fault). **Verify** that the detector fault state is shown as None in the ITS-CRA **Verify** that the detector state is shown as Unoccupied in the ITS-CRA		

13.	Use IVERA-TLC to configure 'bovengedrag' and 'ondergedrag' for detector **d3** (TDOG=2 minutes, TDBG=1 minute). Change the state of the detector **d3** to <u>Occupied</u> on the detector simulator and wait until the 1 minute timeout is expired. **Verify** that the detector fault state is shown as <u>TooLongOccupied</u> in the ITS-CRA		
14.	Change the state of the detector **d3** to <u>Unoccupied</u> on the detector simulator. **Verify** that the detector fault state is shown as <u>None</u> in the ITS-CRA. Wait until the 2 minute timeout is expired **Verify** that the detector fault state is shown as <u>TooLongUnoccupied</u> in the ITS-CRA		
15.	Change the state of the detector **d3** to <u>Occupied</u> on the detector simulator. **Verify** that the detector fault state is shown as <u>None</u> in the ITS-CRA		
16.	Reset the 'bovengedrag' and 'ondergedrag' parameter to the default values.		
17.	Rapidly change the state of a loop on the loop detector simulator, this is done to simulate flutter. **Verify** that the TLC Facilities recognises the flutter and that the ITS-CRA is informed about it		
Tested by:		**Date:**	

8.2.7   Test case 7: Inputs

Test Case:	Inputs		
ID:	SC1.CRA.07.HA		
Objective:	Verify that the changes to inputs are correctly received in the ITS-CRA		
Pre-conditions:	The ITS-CRA is connected and registered to the TLC-FI		
	All inputs are set to 0, no input SWICO's are set and there are no input errors in the TLC		
	IVERA is connected and registered with the user 'Verkeerskundige'		
STEP	**DESCRIPTION**	**PASS / FAIL**	**REMARKS/ACTIONS**
1.	Change the state of **inputA** from 0 to 1 on the I/O simulator **Verify** that the state of **inputA** changes in the ITS-CRA **Verify** that the state of the other inputs is unchanged in the ITS-CRA		
2.	Change the state of **inputA** from 1 to 0 on the I/O simulator **Verify** that the state of **inputA** changes in the ITS-CRA **Verify** that the state of the other inputs is unchanged in the ITS-CRA		
3.	Toggle the state of **inputA** 4 times (0 -> 1 -> 0) on the I/O simulator **Verify** that the ITS-CRA has counted exactly 10 transitions **Verify** that the ITS-CRA has counted 0 transitions on all other inputs		
4.	Repeat step 1 and 2 for input inputB, 1, 2 and fix		
5.	Use IVERA-TLC to control the SWICO for **inputA** Set SwicoOn using IVERA-TLC **Verify** that the SWICO state is shown as SwicoOn in the ITS-CRA **Verify** that the input state is shown as 1 in the ITS-CRA		
6.	Change the state of **inputA** to 1 on the I/O simulator Set SwicoOff using IVERA-TLC **Verify** that the SWICO state is shown as SwicoOff in the ITS-CRA. **Verify** that the input state is shown as 0 in the ITS-CRA		

7.	For **inputA** set NoSwico using the IVERA-TLC **Verify** that the SWICO state is shown as NoSwico in the ITS-CRA. **Verify** that the input state is shown as 1 in the ITS-CRA		
8.	Change the state of **inputA** to 0 on the I/O simulator **Verify** that the SWICO state is shown as NoSwico in the ITS-CRA. **Verify** that the input state is shown as 0 in the ITS-CRA		
Tested by:		**Date:**	

8.2.8   Test case 8: Outputs - read

Test Case:	Outputs - read		
ID:	SC1.CRA.08.HA		
Objective:	Verify that the values of the outputs are correctly received in the ITS-CRA		
Pre-conditions:	The ITS-CRA is connected and registered to the TLC-FI		
STEP	DESCRIPTION	PASS / FAIL	REMARKS/ACTIONS
1.	**Verify** that the default state of **exclOutputA** is shown in the ITS-CRA.		
2.	Repeat step 1 for output exclOutputB, 1, 2, fix, w21 and w31		
Tested by:		**Date:**	

8.2.9   Test case 9: Signal group objects - read

Test Case:	Signal group objects - read		
ID:	SC1.CRA.09.HA		
Objective:	Verify that the signal group objects are correctly received in the ITS-CRA		
Pre-conditions:	The ITS-CRA is connected and registered to the TLC-FI The intersection state is standby (Amber flashing)		
STEP	DESCRIPTION	PASS / FAIL	REMARKS/ACTIONS

1.	The *Signal Group* object contains the following attributes:
	    - Signal group state
	    - Signal group predictions
	    - Meta information
	        o ObjectID		

	o Intersection ID o Timing (E.g. Minimum red, minimum green) o Signal Conflicts (intergreen time)		
2.	**Verify** that the states of object **fc02** in the ITS-CRA are correct		
3.	**Verify** that the states of object **fc03** in the ITS-CRA are correct		
4.	**Verify** that the states of object **fc05** in the ITS-CRA are correct		
5.	**Verify** that the states of object **fc07** in the ITS-CRA are correct		
6.	**Verify** that the states of object **fc08** in the ITS-CRA are correct		
7.	**Verify** that the states of object **21** in the ITS-CRA are correct		
8.	**Verify** that the states of object **31** in the ITS-CRA are correct		
Tested by:		**Date:**	

8.2.10 Test case 10: Special vehicles

Test Case:	Special vehicles		
ID:	SC1.CRA.10.HA		
Objective:	Verify that the changes to the Special Vehicles object are correctly received in the ITS-CRA		
Pre-conditions:	The ITS-CRA is connected and registered to the TLC-FI		
STEP	**DESCRIPTION**	**PASS / FAIL**	**REMARKS/ACTIONS**
1.	Create a KAR message with the following details: - Announcement = Checkin - Vehicle = Bus - SG = fc02 - distToStopline = 1500 - lineNr = 102 - journeyCat = PublicJourney - punctuality = OnTime - punctualityTime = 0 - Status = Driving - speed = 80 - Length = 12		

			PASS / FAIL	REMARKS/ACTIONS
	Verify that in the ITS-CRA the event is shown with all given attributes correctly set			
2.	Repeat step 1 with different values for the attributes. Recommended is to test at least 'Checkin', 'Checkout' and for line 108 (the only other option). Also, all attributes are optional and the given list is not exhaustive			
3.	Create a KAR message with the following details: - Announcement = Checkin - Vehicle = Police - SG = fc05 - distToStopline = 1000 - Priority = AlarmLight - Status = Driving - Speed = 99 **Verify** that in the ITS-CRA the event is shown with all given attributes correctly set			
4.	Repeat step 3 with different values for the attributes. Recommended is to test at least 'PreCheckin', 'Checkout', different vehicles and different priorities. Also, all attributes are optional and the given list is not exhaustive			
Tested by:			**Date:**	

8.2.11 Test case 11: Variables – read

Test Case:	Variables – read			
ID:	SC1.CRA.11.HA			
Objective:	Verify that the ITS-CRA can read the values of variables			
Pre-conditions:	The ITS-CRA is connected and registered to the TLC-FI Each variable has a different default value			
STEP	**DESCRIPTION**		**PASS / FAIL**	**REMARKS/ACTIONS**
1.	**Verify** that all variables are correctly shown in the ITS-CRA (varA, 1, aVeryLongVariableNameIncludingTheAllowedSpecialCharacters-_)			
Tested by:			**Date:**	

8.3 Scenario 2: ITS provider application happy flow

In this scenario an ITS-PRA connects and registers to the TLC-FI. The ITS-PRA shows all metadata and information of all objects. The tester verifies the information. The tester verifies that detector, signal group, I/O, variable changes and events are shown in the ITS-PRA. The tester verifies that changes to non-exclusive outputs in the ITS-PRA are shown on the I/O simulator. Optionally log files can be verified whether there are errors or not and that the right sequences are present.

Below are only test cases given for situations that are not yet tested using the ITS-CRA or which have a value changed, which makes testing it important.

8.3.1 Test case 1: Connect and register - PRA

Test Case:	Connect and register - PRA		
ID:	SC2.PRA.01.HA		
Objective:	Verify that the ITS-PRA can connect and register to the TLC-FI		
Pre-conditions:	The TLC Facilities is initiated and available		
STEP	**DESCRIPTION**	**PASS / FAIL**	**REMARKS/ACTIONS**
1.	Configure the Session details of the TLC-FI in the ITS-PRA. User: Provider1 Password: Pr.v.d.r1 Application type: ITS-PRA		
2.	Activate the connect and register procedure. **Verify** that the ITS-PRA is connected and registered to the TLC-FI **Verify** that the TLC Facilities stays in the Standby mode (Amber Flashing) **Verify** that the connection is secured with TLS. **Verify** that the audit log contains the start of connection events.		
Tested by:		**Date:**	

8.3.2   Test case 2: Non-exclusive outputs - change

Test Case:		Non-exclusive outputs – change		
ID:		SC2.PRA.02.HA		
Objective:		Verify that the ITS-PRA can change the value of a non-exclusive output on the TLC Facilities		
Pre-conditions:		The ITS-PRA is connected and registered to the TLC-FI All non-exclusive outputs are set to the value 0		
STEP		DESCRIPTION	PASS / FAIL	REMARKS/ACTIONS
1.		Let the ITS-PRA change the state of output **1** from 0 to 1 **Verify** that the state of output **1** changes from 0 to 1 in the I/O simulator and in the ITS-PRA **Verify** that the state of the other outputs is unchanged		
2.		Let the ITS-PRA change the state of output **1** from 1 to 0 **Verify** that the state of output **1** changes from 1 to 0 in the I/O simulator and in the ITS-PRA **Verify** that the state of the other outputs is unchanged		
3.		Toggle the state of output **1** 4 times (0 -> 1 -> 0) in the ITS-PRA **Verify** that the ITS-PRA and the I/O simulator have counted exactly 10 transitions for output **1** **Verify** that the ITS-PRA and the I/O simulator have counted 0 transitions on all other outputs		
4.		Repeat step 1 and 2 for output 2 and fix		
Tested by:			Date:	

8.3.3 Test case 3: Variable – change

Test Case:	Variable - change		
ID:	SC2.PRA.03.HA		
Objective:	Verify that the ITS-PRA can change the value of a variable		
Pre-conditions:	The ITS-PRA is connected and registered to the TLC-FI		
STEP	**DESCRIPTION**	**PASS / FAIL**	**REMARKS/ACTIONS**
1.	Let the ITS-PRA change the value of **varA** to 50 and set the lifetime to 100 seconds **Verify** that the value of the variable changes to 50 in the TLC Facilities and the lifetime to 100 **Verify** that the value of the other variables is unchanged		
2.	Wait at least 10 seconds and then let the ITS-PRA change the value of **varA** again to 50 and set the lifetime again to 100 seconds **Verify** that the value of the variable stays the same in the TLC Facilities and that the lifetime is set back to 100 seconds **Verify** that the value of the other variables is unchanged		
3.	Let the ITS-PRA change the value of **varA** to -38 and set the lifetime to 20 seconds **Verify** that the value of the variable changes to -38 in the TLC Facilities and the lifetime to 20 **Verify** that the value of the other variables is unchanged		
4.	Wait 20 seconds **Verify** that the value of the variable is set back to default		
5.	Repeat step 1 to 4 for variable 1 and aVeryLongVariableNameIncludingTheAllowedSpecialCharacters-_. Use for the lifetime at least the value 1 Use for the value at least the values -1, 1 -32768 and 32767		
Tested by:		**Date:**	

8.4 Scenario 3: ITS control application happy flow

In this scenario an ITS-CLA connects and registers to the TLC-FI. The ITS-CLA takes control. The ITS-CLA shows all metadata and information of all objects. The tester verifies the information. The tester verifies that detector, signal group, I/O, variable changes and events are shown in the ITS-CLA. The tester verifies that changes to exclusive and non-exclusive outputs in the ITS-CLA are shown on the I/O simulator. The tester verifies that changes to signal groups are shown on the lamp-simulator. The tester verifies that changes to the intersection state from the ITS-CLA are shown on the lamp-simulator. Optionally through log files can be verified whether there are errors or not and that the right sequences are present.

Below are only test cases given for situations that are not yet tested using the ITS-CRA, the ITS-PRA or which have a value changed, which makes testing it important.

8.4.1 Test case 1: Connect and register - CLA

Test Case:	Connect and register – CLA		
ID:	SC3.CLA.01.HA		
Objective:	Verify that the ITS-CLA can connect and register to the TLC-FI		
Pre-conditions:	The TLC Facilities is initiated and available		
STEP	**DESCRIPTION**	**PASS / FAIL**	**REMARKS/ACTIONS**
1.	Configure the Session details of the TLC-FI in the ITS-CLA. User: Control1 Password: Im?h@ppy!2meet(<you>)&5isSpeci@l Application type: ITS-CLA		
2.	Activate the connect and register procedure. **Verify** that the ITS-CLA is connected and registered to the TLC-FI. **Verify** that the TLC Facilities stays in the Standby mode (Amber Flashing) **Verify** that the connection is secured with TLS. **Verify** that the audit log contains the start of connection events.		
3.	Let the ITS-CLA go to the state offline (taking all the appropriate steps) **Verify** that the ITS-CLA is in the state Offline **Verify** that the audit log contains the state change of the application		
Tested by:		**Date:**	

8.4.2 Test case 2: Take control over an intersection

Test Case:	Take control over an intersection		
ID:	SC3.CLA.02.HA		
Objective:	Verify that the ITS-CLA can control the state of an intersection		
Pre-conditions:	The ITS-CLA is in control state Offline		
STEP	**DESCRIPTION**	**PASS / FAIL**	**REMARKS/ACTIONS**
1.	Let the ITS-CLA request to go to the state ReadyToControl **Verify** that the TLC-FI puts the ITS-CLA in the state ReadyToControl		
2.	The TLC decides that the ITS-CLA should be put in control and sets the application state to StartControl. The ITS-CLA responds to this by setting the request state to InControl **Verify** that the ITS-CLA receives the state update 'StartControl'. Then it requests the state InControl		
3.	The TLC sets the ITS-CLA state to InControl **Verify** that the ITS-CLA is in control of the TLC Facilities (Control.State = InControl)		
4.	Change the Intersection state to Control **Verify** that the ITS-CLA is now in control of the intersection **Verify** that after 15 seconds the state of the TLC will change from Amber Flashing to Amber **Verify** that after 5 seconds the state of the TLC will change from Amber to AllRed		
5.	Once all signal groups are red, let detector **d3** and **d7** come up. **Verify** that after 11 seconds (starting counting from the moment all signal groups turn red) either fc03 or fc07 becomes green on the lamp simulator		
6.	Change the intersection state to AllRed **Verify** that the intersection state is AllRed		

Tested by:		Date:	

8.4.3   Test case 3: Exclusive outputs - change

Test Case:	Exclusive Outputs - change		
ID:	SC3.CLA.03.HA		
Objective:	Verify that the ITS-CLA can change exclusive outputs on the TLC Facilities		
Pre-conditions:	The ITS-CLA is in control of the intersection All outputs are set to the value 0		
STEP	**DESCRIPTION**	**PASS / FAIL**	**REMARKS/ACTIONS**
1.	Let the ITS-CLA change the state of **exclOutputA** from 0 to 1 **Verify** that the state of **exclOutputA** changes from 0 to 1 in the I/O simulator and in the ITS-CLA **Verify** that the state of the other outputs is unchanged		
2.	Let the ITS-CLA change the state of **exclOutputA** from 1 to 0 **Verify** that the state of **exclOutputA** changes from 1 to 0 in the I/O simulator and in the ITS-CLA **Verify** that the state of the other outputs is unchanged		
3.	Toggle the state of **exclOutputA** 4 times (0 -> 1 -> 0) in the ITS-CLA **Verify** that the ITS-CLA and the I/O simulator have counted exactly 10 transitions for **exclOutputA** **Verify** that the ITS-CLA and the I/O simulator have counted 0 transitions on all other detectors		
4.	Repeat step 1 and 2 for exclOutputB, w21 and w31		
Tested by:		**Date:**	

8.4.4   Test case 4: Signal groups - change

Test Case:	Signal group - change		
ID:	SC3.CLA.04.HA		
Objective:	Verify that the ITS-CLA can change the signal groups on the TLC-FI		
Pre-conditions:	The ITS-CLA is in control of the intersection All signal groups are 'Red'		
STEP	**DESCRIPTION**	**PASS / FAIL**	**REMARKS/ACTIONS**
1.	Change the state of signal group **fc05** from 'Red' to 'Green' **Verify** that the state of **fc05** changes in the lamp simulator from 'Red' to 'Green' **Verify** that the state of the other signal groups is unchanged in the lamp simulator		
2.	Change the state of signal group **fc05** from 'Green' to 'Amber' **Verify** that the state of **fc05** changes in the lamp simulator from 'Green' to 'Amber' **Verify** that the state of the other signal groups is unchanged in the lamp simulator		
3.	Change the state of signal group **fc05** from 'Amber' to 'Red' **Verify** that the state of **fc05** changes in the lamp simulator from 'Amber' to 'Red' **Verify** that the state of the other signal groups is unchanged in the lamp simulator		
4.	Repeat step 1 to 3 for signal groups 21, 31, fc03 and fc07		
5.	Make an atomic change to the states of signal group **fc02**, **fc07** and **fc08**. Change all of them from 'Red' to 'Green' **Verify** that the states of **fc02**, **fc07** and **fc08** change in the lamp simulator from 'Red' to 'Green' **Verify** that the state of the other signal groups is unchanged in the lamp simulator		

6.	Make an atomic change to the states of signal group **fc02**, **fc07** and **fc08**. Change all of them from 'Green' to 'Red' **Verify** that the states of **fc02**, **fc07** and **fc08** change in the lamp simulator from 'Green' to 'Amber' to 'Red' with appropriate minimum signal group times **Verify** that the state of the other signal groups is unchanged in the lamp simulator		
Tested by:		**Date:**	

8.4.5   Test case 5: Signal group predictions - change

Test Case:		Signal group predictions - change		
ID:		SC3.CLA.05.HA		
Objective:		Verify that the ITS-CLA can change the signal group predictions on the TLC-FI		
Pre-conditions:		The ITS-CLA is in control of the intersection		
STEP		DESCRIPTION	PASS / FAIL	REMARKS/ACTIONS
1.		Let the ITS-CLA request to change the state of the signal group prediction for **fc03** **Verify** that the state of the signal group prediction of **fc03** changes in the ITS-CLA **Verify** that the state of the other signal group predictions is unchanged in the ITS-CLA		
2.		Repeat step 1 for the signal groups predictions of fc02, fc05, fc07, fc08, 21 and 31		
Tested by:			**Date:**	

8.5   Scenario 4: ITS Application connections happy flow

In this scenario several ITS Applications will connect to the TLC-FI. The objective is to see whether the TLC-FI can handle all requests and register all ITS Applications. The tester verifies that the ITS-CLA is in control and can change exclusive output and signal group states. The tester also verifies that all ITS-CRA's and ITS-PRA's that are registered and subscribed to the changed object receive an update within the

maximum allowed latency time. The tester verifies that both the ITS-CLA and the ITS-PRA can change non-exclusive output and that subscribed ITS-CRA's receive updates. The tester verifies that the control of an intersection can be hand over from one ITS-CLA to another ITS-CLA Optionally log files can be verified whether there are errors or not and that the right sequences are present.

8.5.1 Test case 1: Connect and register several ITS Applications

Test Case:		Connect and register several ITS Applications		
ID:		SC3.CLA.01.HA		
Objective:		Verify that multiple ITS-A's can connect and register to the TLC-FI		
Pre-conditions:		The TLC Facilities is initiated, available and has no applications registered to it		
STEP	**DESCRIPTION**		**PASS / FAIL**	**REMARKS/ACTIONS**
1.	Configure the Session details of the TLC-FI for all ITS-A's. Use the user accounts given in Table 1. User: <User> Password: <Password> Application type: <Type>			
2.	Activate the connect and register procedure for all 10 applications **Verify** that the ITS-A's are connected and registered to the TLC-FI **Verify** that the connections are secured with TLS. **Verify** that the audit log contains the start of connection events.			
Tested by:			**Date:**	

Table 1: The credentials used for the different ITS-A's

<User>	<Password>	<Type>	Program number
Control1	Im?h@ppy!2meet(<you>)&5isSpeci@l	Control	1
Control2	Spec('~!@#$%^&*_+-={}[]:;<>.?/)	Control	3
Control3	C1ShouldBelonger	Control	
Control4	WeNeedEnoughUsers!10min	Control	
Provider1	Pr.v.d.r1	Provider	
Provider2	123456789012345678901234567890	Provider	
Provider3	My.p@ssw0rd4	Provider	
Consumer1	Password1	Consumer	
Consumer2	Password2	Consumer	

Consumer3	L0gin4You!	Consumer	
Consumer4	Littleprairy!7	Consumer	

8.5.2   Test case 2: Exclusive output – read/write

Test Case:		Exclusive outputs – read/write		
ID:		SC4.ITSA.02.HA		
Objective:		Verify that the changes to outputs are correctly received in the ITS-CRA's, ITS-PRA's and ITS-CLA's		
Pre-conditions:		All ITS-A's are connected and registered to the TLC-FI An ITS-CLA is in control		
STEP		**DESCRIPTION**	**PASS / FAIL**	**REMARKS/ACTIONS**
1.		Let an ITS-CLA change the state of **exclOutputA** from 0 to 1 **Verify** that the state of **exclOutputA** changes from 0 to 1 in all subscribed ITS-A's **Verify** that the state of the other outputs is unchanged		
2.		Let an ITS-CLA change the state of **exclOutputA** from 1 to 0 **Verify** that the state of **exclOutputA** changed from 1 to 0 in all subscribed ITS-A's **Verify** that the state of the other outputs is unchanged		
3.		Toggle the state of **exclOutputA** 4 times (0 -> 1 -> 0) in an ITS-CLA **Verify** that all subscribed ITS-A's have counted exactly 10 transitions for **exclOutputA** **Verify** that all subscribed ITS-A's have counted 0 transitions on all other outputs		
4.		Repeat step 1 and 2 for exclOutputB, w21 and w31		
Tested by:			**Date:**	

8.5.3   Test case 3: Non-exclusive output – read/write

Test Case:		Non-exclusive outputs – read/write		
ID:		SC4.ITSA.03.HA		
Objective:		Verify that the changes to outputs are correctly received in all subscribed ITS-A's		
Pre-conditions:		All ITS-A's are connected and registered to the TLC-FI		
STEP		**DESCRIPTION**	**PASS / FAIL**	**REMARKS/ACTIONS**
1.		Let an ITS-PRA change the state of output **1** from 0 to 1 **Verify** that the state of output **1** changes from 0 to 1 in all subscribed ITS-A's**Verify** that the state of the other outputs is unchanged		
2.		Let an ITS-PRA change the state of output **1** from 1 to 0 **Verify** that the state of output **1** changes from 1 to 0 in all subscribed ITS-A's**Verify** that the state of the other outputs is unchanged		
3.		Toggle the state of output **1** 4 times (0 -> 1 -> 0) in an ITS-PRA **Verify** that all subscribed ITS-A's have counted exactly 10 transitions for output **1** **Verify** that all subscribed ITS-A's have counted 0 transitions on all other outputs		
4.		Repeat step 1 and 2 for output 2 and fix		
Tested by:			**Date:**	

8.5.4 Test case 4: Signal group – read/write

Test Case:	Signal groups – read/write		
ID:	SC4.ITSA.04.HA		
Objective:	Verify that the changes to signal groups are correctly received in all subscribed ITS-A's		
Pre-conditions:	All ITS-A's are connected and registered to the TLC-FI. An ITS-CLA is in control of the intersection All signal groups are 'Red'		
STEP	**DESCRIPTION**	**PASS / FAIL**	**REMARKS/ACTIONS**
1.	Change the state of signal group **fc05** from 3 (StopAndRemain) to 5 (PermissiveMovementAllowed) **Verify** that the state of **fc05** changes in the ITS-A's from 3 (StopAndRemain) to 5 (PermissiveMovementAllowed) **Verify** that the state of the other signal groups is unchanged		
2.	Change the state of signal group **fc05** from 5 (PermissiveMovementAllowed) to 7 (PermissiveClearance) **Verify** that the state of **fc05** changes in the ITS-A's from 5 (PermissiveMovementAllowed) to 7 (PermissiveClearance) **Verify** that the state of the other signal groups is unchanged		
3.	Change the state of signal group **fc05** from 7 (PermissiveClearance) to 3 (StopAndRemain) **Verify** that the state of **fc05** changes in the ITS-A's from 7 (PermissiveClearance) to 3 (StopAndRemain) **Verify** that the state of the other signal groups is unchanged		
4.	Repeat step 1 to 3 for signal groups 21, fc03 and fc07. Keep in mind that all of these have protected signal groups		
5.	Make an atomic change to signal group **fc02**, **fc07** and **fc08**. Change all of them from 3 (StopAndRemain) to 6 (ProtectedMovementAllowed) **Verify** that the states of **fc02**, **fc07** and **fc08** change in the ITS-A's from 3 (StopAndRemain) to 6 (ProtectedMovementAllowed)		

	Verify that the state of the other signal groups is unchanged		
6.	Make an atomic change to signal group **fc02**, **fc07** and **fc08**. Change all of them from 6 (ProtectedMovementAllowed) to 3 (StopAndRemain) **Verify** that the states of **fc02**, **fc07** and **fc08** change in the ITS-A's from 6 (ProtectedMovementAllowed) to 8 (ProtectedClearance) to 3 (StopAndRemain) with appropriate minimum signal group times **Verify** that the state of the other signal groups is unchanged		
Tested by:		**Date:**	

8.5.5 Test case 5: Signal group predictions – read/write

Test Case:		**Signal group predictions – read/write**	
ID:		SC4.ITSA.05.HA	
Objective:		Verify that the changes to signal group predictions are correctly received in all ITS-A's	
Pre-conditions:		All ITS-A's are connected and registered to the TLC-FI An ITS-CLA is in control of the intersection	
STEP	**DESCRIPTION**	**PASS / FAIL**	**REMARKS/ACTIONS**
1.	Let the ITS-CLA request to change the state of the signal group prediction for **fc03** to 10 seconds **Verify** that the state of the signal group prediction of **fc03** changes in all subscribed ITS-CLA's **Verify** that the state of the other signal group predictions is unchanged		
2.	Repeat step 1 for the signal groups predictions of fc02, fc05, fc07, fc08, 21 and 31		
Tested by:		**Date:**	

8.5.6   Test case 6: Handover intersection control

Test Case:		Handover intersection control		
ID:		SC4.ITSA.06.HA		
Objective:		Verify that the ITS-CLA can hand over control of an intersection to another ITS-CLA		
Pre-conditions:		ITS-CLA1 is in control of the intersection ITS-CLA2 is ready to control		
STEP	DESCRIPTION		PASS / FAIL	REMARKS/ACTIONS
1.	ITS-CLA1 starts the handover procedure by requesting EndControl. The used procedure is Pre-Defined. After ITS-CLA1 has released control over the intersection it goes directly to ReadyToControl. **Verify** that the TLC-FI removes the control from ITS-CLA1 **Verify** that the TLC-FI gives control back to ITS-CLA1, unless it already selected another ITS-CLA			
2.	ITS-CLA1 starts the handover procedure by requesting EndControl. The used handover procedure is Direct. The ITS-CLA1 goes to offline. **Verify** that the TLC-FI removes the control from ITS-CLA1 **Verify** that the TLC-FI gives control to ITS-CLA2			
3.	When ITS-CLA2 is in control, let ITS-CLA1 go to ready to control again **Verify** that ITS-CLA1 is ready to control			
4.	The TLC Facilities starts the handover procedure to put ITS-CLA1 back in control. The used handover procedure is Cleared. **Verify** that the TLC-FI removes the control from ITS-CLA2, meanwhile respecting the minimum control time (180 seconds) **Verify** that the TLC-FI gives control to ITS-CLA1			
Tested by:			Date:	

8.5.7 Test case 7: Deregister from TLC Facilities

Test Case:	Deregister from TLC Facilities		
ID:	SC4.ITSA.07.HA		
Objective:	Verify that an ITS-A can deregister itself from the TLC		
Pre-conditions:	ITS-A is connected and registered to the TLC		
STEP	**DESCRIPTION**	**PASS / FAIL**	**REMARKS/ACTIONS**
1.	The ITS-A sends a deregister request to the TLC Facilities **Verify** that the ITS-A becomes deregistered and that it receives a confirmation of the deregistering. **Verify** that the audit log contains the deregistration event.		
Tested by:		**Date:**	

8.5.8 Test case 8: ITS-A: number of subscriptions

Test Case:	ITS-A: number of subscriptions		
ID:	SC4.ITSA.08.HA		
Objective:	Verify that a TLC can handle several subscriptions from one ITS application		
Pre-conditions:	Ten ITS-A's are connected and registered to the TLC-FI, but have made no subscriptions yet		
STEP	**DESCRIPTION**	**PASS / FAIL**	**REMARKS/ACTIONS**
1.	Let all ITS-A's subscribe to detector **d5**, signal group **fc05**, input **inputA**, output **1** and variable **varA** **Verify** that all ITS-A's are subscribed to the objects		
Tested by:		**Date:**	

8.5.9   Test case 9: ITS-A: number of requests / replies

Test Case:		ITS-A: number of requests / replies		
ID:		SC4.ITSA.09.HA		
Objective:		Verify that a TLC can handle a certain amount of request/replies per second per ITS-A		
Pre-conditions:		Ten ITS-A's are connected and registered to the TLC-FI		
STEP		DESCRIPTION	PASS / FAIL	REMARKS/ACTIONS
1.		Let all ITS-A's make so many requests per second that the TLC-FI has to process 10 requests/replies per second per ITS-A. **Verify** that all requests/replies are handled properly		
Tested by:			Date:	

8.5.10 Test case 10: ITS-A: number of notifications

Test Case:		ITS-A: number of notifications		
ID:		SC4.ITSA.10.HA		
Objective:		Verify that a TLC can handle a certain amount of notifications per second per ITS-A		
Pre-conditions:		Ten ITS-A's are connected and registered to the TLC-FI		
STEP		DESCRIPTION	PASS / FAIL	REMARKS/ACTIONS
1.		Let an ITS-A make so many requests per second that the TLC sends 10 notifications per second to each ITS-A **Verify** that all notifications are sent and received		
Tested by:			Date:	

8.6 Scenario 5: IVERA

In this scenario basic functionality of IVERA will be tested. This will cover some basic functionality needed for normal operation, it is not intended to test all IVERA requirements.

8.6.1 Test case 1: Accessibility on TLC Facilities

Test Case:	Accessibility on TLC Facilities		
ID:	SC5.IVA.01.HA		
Objective:	Verify that each TLC Facilities provides an IVERA-TLC interface and that it contains all mandatory IVERA objects		
Pre-conditions:	An IVERA master is available An TLC is available		
STEP	DESCRIPTION	PASS / FAIL	REMARKS/ACTIONS
1.	Connect with an IVERA master to a TLC Facilities **Verify** that the connection can be made and that all mandatory objects are present. See [Ref 7] for a complete list of mandatory objects **Verify** that the connection is secured with TLS. **Verify** that the audit log contains the start of connection event.		
Tested by:		Date:	

8.6.2 Test case 2: Request location ITS-CLA's from TLC Facilities

Test Case:	Request location ITS-CLA's from TLC Facilities		
ID:	SC5.IVA.02.HA		
Objective:	Verify that an IVERA master can request the URL's for the different ITS-A's connected to an TLC Facilities		
Pre-conditions:	An TLC Facilities is running and has several ITS-A's connected with it An IVERA master is available		
STEP	DESCRIPTION	PASS / FAIL	REMARKS/ACTIONS
1.	The IVERA master requests to the TLC Facilities to send the URL's of the location of the ITS-A's **Verify** that the IVERA master receives the following information: - ITS Application ID		

	- ITS Application role when using the TLC Facilities Interface (TLC-FI) - IP address at which the ITS Application can be accessed - TCP port number at which the ITS Application provides the IVERA-APP interface (if supported by the application)		
Tested by:		**Date:**	

8.6.3   Test case 3: IVERA changes usernames in TLC

Test Case:	**IVERA changes usernames in TLC**		
ID:	SC5.IVA.03.HA		
Objective:	Verify that through IVERA admin usernames and passwords can be adjusted in the TLC		
Pre-conditions:	A connection between the IVERA master and the TLC is established		
STEP	**DESCRIPTION**	**PASS / FAIL**	**REMARKS/ACTIONS**
1.	Through IVERA username 'Control1' is changed to 'Control1a' in the TLC Facilities **Verify** that the username changed in the TLC Facilities **Verify** that the audit log contains the username change event		
2.	Through IVERA username 'Control1a' is changed to 'Control1' in the TLC Facilities **Verify** that the username changed in the TLC Facilities **Verify** that the audit log contains the username change event		
3.	Repeat step 1 and 2 for username Provider1, Consumer1 and Control2		
4.	Through IVERA the password of user 'Control2' is changed to 'MY.newPassw0rd!1' **Verify** that the password changed in the TLC Facilities **Verify** that the audit log contains the password change event		
5.	Through IVERA the password of user 'Control2' is changed back to 'Spec('~!@#$%^&*_+-={}[]:;<>.?/)' **Verify** that the password changed in the TLC Facilities		

		Verify that the audit log contains the password change events.		
6.		Repeat step 4 and 5 for username Provider2, Consumer2 and Control3		
7.		Through IVERA the application type of user 'Control3' is changed to ITS-CRA

Verify that the application type changed in the TLC Facilities
Verify that the audit log contains the application type change event | | |
| 8. | | Through IVERA the application type of user 'Control3' is changed to ITS-CLA

Verify that the application type changed in the TLC Facilities
Verify that the audit log contains the application type change event | | |
| 9. | | Repeat step 7 and 8 for Provider1, Provider3 and Consumer3 (change this one to ITS-CLA) | | |
| Tested by: | | | Date: | |

8.6.4   Test case 4: Trigger event with identification

Test Case:		Trigger event with identification		
ID:		SC5.IVA.04.HA		
Objective:		Verify that the IVERA slaves send triggers to the TMS trigger port		
Pre-conditions:		A TMS is available
A TLC is available with an active IVERA link		
STEP		DESCRIPTION	PASS / FAIL	REMARKS/ACTIONS
1.		The TLC sends a trigger to the TMS

Verify that the TMS receives the trigger and that the TLC includes an identification | | |
| Tested by: | | | Date: | |

8.6.5   Test case 5: User management TLC-FI

Test Case:		User management TLC-FI		
ID:		SC5.IVA.5.HA		
Objective:		Verify that users and their credentials can be added and removed		
Pre-conditions:		An IVERA master is connected to the TLC Facilities		
STEP		**DESCRIPTION**	**PASS / FAIL**	**REMARKS/ACTIONS**
1.		Through IVERA add a user with username 'NewUser1'. This is an ITS-CLA **Verify** that the username has been added in the TLC Facilities **Verify** that the audit log contains the username add event.		
2.		Repeat step 1 for usernames '4youIadded' (ITS-PRA) and 'InewCRA' (ITS-CRA)		
3.		Through IVERA remove user 'NewUser1' **Verify** that the user has been removed from the TLC Facilities **Verify** that the audit log contains the remove event.		
4.		Repeat step 3 for user '4youIadded', 'InewCRA' and Control1		
5.		Through IVERA add a user with username 'Control1'. This is an ITS-CLA **Verify** that the username has been added in the TLC Facilities **Verify** that the audit log contains the username add event.		
Tested by:			**Date:**	

8.6.6   Test case 6: Application status

Test Case:	Application status		
ID:	SC5.IVA.06.HA		
Objective:	Verify that the session state of ITS-A's can be requested from the TLC Facilities		
Pre-conditions:	An IVERA master is connected to the TLC Facilities		
STEP	**DESCRIPTION**	**PASS / FAIL**	**REMARKS/ACTIONS**
1.	Through IVERA the status of ITS-A's is requested from the TLC Facilities		

	Verify that the TLC Facilities answers with the status of the ITS-A's		
Tested by:		**Date:**	

8.7 Scenario 6: Time synchronisation happy flow

In this scenario the ITS applications are connected to the TLC. The tester verifies that the calendar of the ITS applications is in sync with the calendar of the TLC. The tester verifies that the time of the ITS applications are in sync with the time of the TLC. The tester verifies that the latency times are not exceeded.

8.7.1 Test case 1: UTC time

Test Case:	UTC time		
ID:	SC6.TIME.1.HA		
Objective:	Verify that UTC time between the ITS-A and TLC Facilities are synchronised		
Pre-conditions:	An ITS-A is connected to the TLC Facilities TLC is synchronizing time with UTC ITS-A is synchronizing time with UTC		
STEP	**DESCRIPTION**	**PASS / FAIL**	**REMARKS/ACTIONS**
1.	The ITS-A and TLC Facilities are connected for a while **Verify** that the UTC times from the ITS-A and the TLC Facilities are synchronised. They are considered synchronised when the deviation is lower than the maximum deviation of 100 ms		
Tested by:		**Date:**	

8.7.2   Test case 2: Latency: request ITS-A to receive ITS-A

Test Case:		Latency: request ITS-A to receive ITS-A		
ID:		SC6.TIME.2.HA		
Objective:		Verify that the communication between the ITS-A and the TLC-FI is quickly enough		
Pre-conditions:		An ITS-A is connected and registered to the TLC Facilities		
STEP		DESCRIPTION	PASS / FAIL	REMARKS/ACTIONS
1.		The ITS-A sends an update request for signal group fc02 to the TLC-FI. The TLC-FI processes it and sends a response. **Verify** that the latency time between sending the message and receiving the answer is maximum 250 ms		
2.		Repeat step 1 for signal group fc05, output 1 and variable varA		
Tested by:			Date:	

8.7.3   Test case 3. Latency: time between change of input and state update

Test Case:		Latency: time between change of input and state update		
ID:		SC6.TIME.3.HA		
Objective:		Verify that the time between a change in input and the update of the object state is quickly enough		
Pre-conditions:		An ITS-A is subscribed to all objects of a TLC Facilities		
STEP		DESCRIPTION	PASS / FAIL	REMARKS/ACTIONS
1.		**InputA** has its value changed and the TLC Facilities updates the corresponding object state. Then it sends a notification to all subscribed ITS-A's. **Verify** that the maximum latency time is not exceeded. The latency from the internal update to the ITS-A's is 125 ms. The latency time from the TLC to the hardware is vendor dependent.		
2.		Repeat step 1 for different value changes and repeat the changes a few times to test for consistent latency times		
3.		Repeat step 1 and 2 for input inputB, 1 and fix		
Tested by:			Date:	

8.7.4 Test case 4: Latency: time between change of object and output

Test Case:		Latency: time between change of object and output		
ID:		SC6.TIME.4.HA		
Objective:		Verify that the time between a change in object state and the change in output is quickly enough		
Pre-conditions:		An ITS-CLA is connected to the TLC Facilities		
STEP	DESCRIPTION		PASS / FAIL	REMARKS/ACTIONS
1.	The ITS-CLA sends a request to change output exclOutputA. The TLC updates the internal object and sends the update to the output hardware. **Verify** that the maximum latency time is not exceeded. The latency from the ITS-CLA to the internal update is 125 ms. The latency time from the TLC to the hardware is vendor dependent.			
2.	Repeat step 1 for different value changes and several times to check for consistent latency times			
3.	Repeat step 1 and 2 for output exclOutputB, 1, fix and w31			
Tested by:			Date:	

8.7.5 Test case 5: Latency: ITS-A requests change of signal group

Test Case:		Latency: ITS-A requests change of signal group		
ID:		SC6.TIME.05.HA		
Objective:		Verify that the TLC Facilities manages to change the object state of a signal group fast enough		
Pre-conditions:		An ITS-CLA is in control of an intersection		
STEP	DESCRIPTION		PASS / FAIL	REMARKS/ACTIONS
1.	The ITS-A sends a request to the TLC Facilities to change signal group fc03. The TLC-FI updates the signal group output. **Verify** that the signal group on the I/O simulator changes within the maximum latency time of 175 ms NB: includes the latency in the exceptional case the safety-facility kicks in			
2.	Repeat step 1 for signal groups fc07, fc08 and 21			
Tested by:			Date:	

8.8 Scenario 7: Protocol happy flow
In this scenario the happy flow of protocol compatibility is tested

8.8.1 Test case 1: Application using older (supported) protocol version

Test Case:		Application using older (supported) protocol version		
ID:		SC7.PROT.01.HA		
Objective:		Verify that the TLC Facilities can handle an application using an older (supported) protocol version		
Pre-conditions:		The TLC Facilities is available (up and running) An ITS-A is available with an older (supported) protocol version		
STEP		DESCRIPTION	PASS / FAIL	REMARKS/ACTIONS
1.		The ITS-A connects and registers itself to the TLC Facilities **Verify** that the TLC Facilities lets the ITS-A connect and register. It will take the difference in functionality in account, but let the ITS-A function normal		
Tested by:			Date:	

8.8.2 Test case 2: Application using newer protocol version

Test Case:		Application using newer protocol version		
ID:		SC7.PROT.02.HA		
Objective:		Verify that the TLC Facilities can handle an application using a newer protocol version		
Pre-conditions:		The TLC Facilities is available (up and running) An ITS-A is available with a newer protocol version		
STEP		DESCRIPTION	PASS / FAIL	REMARKS/ACTIONS
1.		The ITS-A connects and registers itself to the TLC Facilities **Verify** that the TLC Facilities accepts the connection of the ITS-A and that the ITS-A is the one who takes measures to ensure proper communication.		
Tested by:			Date:	

8.8.3 Test case 3: Access channel – secure

Test Case:		Access channel – secure		
ID:		SC7.PROT.03.HA		
Objective:		Verify that the TLC Facilities has a specific channel or port number for encrypted access		
Pre-conditions:		An ITS-A is connected to the TLC Facilities		
STEP	DESCRIPTION		PASS / FAIL	REMARKS/ACTIONS
1.	**Verify** that the connection uses TLS and that it is secure			
Tested by:			Date:	

9 Exception test scenarios

9.1 Introduction

This chapter describes the exception test scenarios and the exception test cases per scenario. There is also described what the expected response is from both the TLC Facilities as the ITS applications.

9.2 Scenario 1: ITS consumer application exceptions

In this scenario an ITS-CRA connects and registers to the TLC-FI. It will do this first with invalid Session details. Later it will do it with valid Session details. The tester verifies that the application cannot register using the invalid Session details. When the application is registered it will show all metadata and information of all objects. The tester verifies this information. The test verifies that the ITS-CRA cannot place a subscription on an object it is not allowed to read. Optionally through log files can be verified whether there are errors or not and that the right sequences are present.

9.2.1 Test case 1: Obtain updates from TLC object – subscription on an object without allowance

Test Case:	Obtain updates of TLC State Objects – subscription on an object without allowance		
ID:	SC1.CRA.01.EXC		
Objective:	Verify that the TLC Facilities rejects the complete subscription		
Pre-conditions:	The ITS-CRA is connected to the TLC-FI An ITS-A is connected to the TLC-FI and its sessionID is known		
STEP	**DESCRIPTION**	**PASS / FAIL**	**REMARKS/ACTIONS**
1.	The ITS-CRA subscribes to the sessionID of another ITS-A **Verify** that the TLC Facilities rejects the subscription **Verify** that the TLC Facilities responds with an error		
Tested by:		**Date:**	

9.2.2   Test case 2: Object updates – place subscription on invalid object identifier

Test Case:		Object updates – place subscription on an invalid object identifier		
ID:		SC1.CRA.02.EXC		
Objective:		Verify that the TLC Facilities rejects the complete subscription		
Pre-conditions:		The ITS-CRA is connected to the TLC-FI		
STEP		**DESCRIPTION**	**PASS / FAIL**	**REMARKS/ACTIONS**
1.		The ITS-CRA places a subscription on several objects of which one is invalid **Verify** that the TLC Facilities rejects the complete subscription, including any valid identifiers **Verify** that the TLC Facilities responds with an error		
Tested by:			**Date:**	

9.2.3   Test case 3: Signal groups – ITS-CRA change

Test Case:		Signal groups – ITS-CRA change		
ID:		SC1.CRA.03.EXC		
Objective:		Verify that the TLC Facilities doesn't allow an ITS-CRA to change signal groups		
Pre-conditions:		ITS-CRA is connected and registered to the TLC All signal groups are red		
STEP		**DESCRIPTION**	**PASS / FAIL**	**REMARKS/ACTIONS**
1.		ITS-CRA sends a request to change signal group **fc07** to 6 (ProtectedMovementAllowed) **Verify** that the signal group doesn't change		
2.		Repeat step 1 for signal group fc02, fc03, fc05, fc08, 21 and 31		
Tested by:			**Date:**	

9.2.4 Test case 4: Exclusive outputs - ITS-CRA change

Test Case:		Exclusive outputs - ITS-CRA change		
ID:		SC1.CRA.04.EXC		
Objective:		Verify that the TLC Facilities doesn't change exclusive outputs when the request comes from an ITS-CRA		
Pre-conditions:		ITS-CRA is connected and registered to the TLC		
STEP	DESCRIPTION		PASS / FAIL	REMARKS/ACTIONS
1.	ITS-CRA sends a request to change **exclOutputA** **Verify** that the output doesn't change			
2.	Repeat step 1 for output exclOutputB, 1, 2, fix, w21 and w31			
Tested by:			Date:	

9.2.5 Test case 5: Unsubscribe from objects

Test Case:		Unsubscribe from objects		
ID:		SC1.CRA.05.EXC		
Objective:		Verify that an ITS-CRA can unsubscribe from object updates		
Pre-conditions:		ITS-CRA is connected and registered to the TLC		
STEP	DESCRIPTION		PASS / FAIL	REMARKS/ACTIONS
1.	ITS-CRA sends a request to unsubscribe from future updates of detector d5, d8 and dk-21, signal group fc02, fc07, fc31, input inputA, output exclOutputA, w21 and variable varA **Verify** that the ITS-CRA receives a confirmation			
2.	Change the state of detector d5 and d7 **Verify** that the ITS-CRA doesn't receive the changed value for d5, but it does receive an update for d7			
3.	Change the state of fc02, fc07 and fc08 to 6 (ProtectedMovementAllowed) **Verify** that the ITS-CRA receives an update for fc08, but not for fc02 and fc07			
4.	Change the state of inputA to 1			

	Verify that the ITS-CRA is not informed about the state change		
5.	Change the state of output exclOutputA and w31 to 1 **Verify** that the ITS-CRA is informed about the state change for w31 and not for the state change of exclOutputA		
6.	Change the variable varA to the value 10 with lifetime 15 **Verify** that the ITS-CRA is not informed about the state changes		
Tested by:		**Date:**	

9.3 Scenario 2: ITS provider application exceptions

In this scenario an ITS-PRA connects and registers to the TLC-FI. The tester verifies that detector, signal group, I/O, variable changes and events are shown in the ITS-PRA. The tester verifies that changes to non-exclusive outputs in the ITS-PRA are shown on the I/O simulator. Optionally through log files can be verified whether there are errors or not and that the right sequences are present.

Below are only test cases given for situations that are not yet tested using the ITS-CRA or which have a value changed, which makes testing it important.

9.3.1 Test case 1: Non-exclusive output: set Output.reqState without subscription

Test Case:		**Non-exclusive output: set Output.reqState without subscription**	
ID:		SC2.PRA.01.EXC	
Objective:		Verify that only subscribed applications can request a change in output	
Pre-conditions:		The ITS-PRA is connected and registered to the TLC-FI The ITS-PRA hasn't subscribed to output 1	
STEP	**DESCRIPTION**	**PASS / FAIL**	**REMARKS/ACTIONS**
1.	The ITS-PRA send a request to change output **1** **Verify** that the TLC Facilities ignores the request		
2.	Repeat step 1 for output 2 and fix		
Tested by:		**Date:**	

9.3.2 Test case 2: Non-exclusive output: ITS-A gets disconnected

Test Case:		Non-exclusive output: ITS-A gets disconnected		
ID:		SC2.PRA.02.EXC		
Objective:		Verify that the TLC Facilities can handle it when an ITS-PRA gets disconnected		
Pre-conditions:		The ITS-PRA is connected and registered to the TLC-FI		
		Only one ITS-A is controlling non-exclusive outputs		
STEP		DESCRIPTION	PASS / FAIL	REMARKS/ACTIONS
1.		The ITS-PRA changes the value of output **1**		
2.		**Verify** that the value of output **1** changes in the I/O simulator		
3.		Let the ITS-PRA get disconnected **Verify** that after a timeout the TLC Facilities sets output **1** to a configured default value		
4.		Repeat step 1 to 3 for output 2 and fix		
Tested by:			Date:	

9.4 Scenario 3: ITS control application exceptions

In this scenario exception tests will be performed using an ITS-CLA. First there will be tested whether the TLC Facilities can handle it when the ITS-CLA doesn't go through the proper registration procedure. Secondly tests will be performed to see what happens when there are problems with the connection or a fault appears. Finally test cases are described to see whether the TLC Facilities can handle invalid requests, violations of times and more things like this.

Optionally through log files can be verified whether there are errors or not and that the right sequences are present.

Below are only test cases given for situations that are not yet tested using the ITS-CRA or ITS-PRA or which have a value changed, which makes testing it important.

9.4.1 Test case 1: Error encountered during configuration of the ITS-CLA with the TLC-FI

Test Case:		Error encountered during configuration of the ITS-CLA with the TLC-FI		
ID:		SC3.CLA.01.EXC		
Objective:		Verify that the TLC-FI stays in standby when the ITS-CLA cannot connect and register itself		
Pre-conditions:		The TLC Facilities is in standby mode		
STEP		DESCRIPTION	PASS / FAIL	REMARKS/ACTIONS
1.		Configure the ITS-CLA with invalid Session details		
2.		Let the ITS-CLA try to connect with the TLC Facilities **Verify** that the ITS-CLA cannot configure itself with the TLC-FI **Verify** that the TLC Facilities stays in standby mode **Verify** that the audit log contains failed connect and register event		
Tested by:			Date:	

9.4.2 Test case 2: An ITS-CLA connects with the TLC-FI, but stays offline

Test Case:		An ITS-CLA connects with the TLC-FI, but stays offline		
ID:		SC3.CLA.02.EXC		
Objective:		Verify that the TLC-FI stays in standby when the ITS-CLA stays offline		
Pre-conditions:		The TLC Facilities is in standby mode		
STEP		DESCRIPTION	PASS / FAIL	REMARKS/ACTIONS
1.		Configure the Session details of the TLC-FI in the ITS-CLA. User: Control1 Password: Im?h@ppy!2meet(<you>)&5isSpeci@l.		
2.		Let the ITS-CLA connect and register with the TLC Facilities **Verify** that the ITS-CLA is configured with the TLC-FI, but stays in the offline state **Verify** that the TLC Facilities stays in standby mode **Verify** that the audit log contains the connect and register event		
Tested by:			Date:	

9.4.3 Test case 3: The connection with an ITS-CLA is lost, an error occurs or it goes into the offline state

Test Case:	The connection with an ITS-CLA is lost, an error occurs or it goes into the offline state		
ID:	SC3.CLA.03.EXC		
Objective:	Verify that the TLC Facilities can handle it when an ITS-CLA suddenly stops controlling an intersection		
Pre-conditions:	The ITS-CLA is in control of the intersection Signal group fc02 and fc03 are green, the other signal groups are red		
STEP	DESCRIPTION	PASS / FAIL	REMARKS/ACTIONS
1.	The ITS-CLA goes to the state Offline **Verify** that the TLC Facilities goes to a defined state (AllRed) **Verify** that the TLC Facilities goes to standby (Amber Flashing) after the clearance times have passed		
2.	The ITS-CLA tells to the TLC-FI that it is ready to control **Verify** that the ITS-CLA gets control again		
3.	Turn the ITS-CLA off **Verify** that the TLC Facilities goes to a defined state (AllRed) **Verify** that the TLC Facilities goes to standby (Amber Flashing) after the clearance times have passed		
Tested by:		Date:	

9.4.4 Test case 4: A fault occurs in the TLC

Test Case:	**A fault occurs in the TLC**		
ID:	SC3.CLA.04.EXC		
Objective:	Verify that the TLC Facilities can handle faults properly		
Pre-conditions:	The ITS-CLA is in control of the intersection		
STEP	**DESCRIPTION**	**PASS / FAIL**	**REMARKS/ACTIONS**
1.	A fault occurs in the TLC (for example a lamp fault or supervision) **Verify** that the TLC Facilities brings the intersection to a defined state (Intersection.State) **Verify** that the ITS-CLA remains the active application (Application.controlState = InControl)		
Tested by:		**Date:**	

9.4.5 Test case 5: Invalid requested intersection state by the ITS-CLA

Test Case:	**Invalid requested intersection state by the ITS-CLA**		
ID:	SC3.CLA.05.EXC		
Objective:	Verify that the TLC Facilities can handle invalid requests from the ITS-CLA		
Pre-conditions:	The ITS-CLA is in control		
STEP	**DESCRIPTION**	**PASS / FAIL**	**REMARKS/ACTIONS**
1.	The ITS-CLA makes an invalid intersection state request. (Intersection.reqState = Error, SwitchOn or SwitchOff) **Verify** that the TLC Facilities ignores the intersection state request		
Tested by:		**Date:**	

9.4.6 Test case 6: Violation of minimum signal group timing

Test Case:	Violation of minimum signal group timing		
ID:	SC3.CLA.06.EXC		
Objective:	Verify that the TLC Facilities prevents violation of the minimum signal group timing		
Pre-conditions:	The ITS-CLA is in control of the intersection All signal groups are red		
STEP	**DESCRIPTION**	**PASS / FAIL**	**REMARKS/ACTIONS**
1.	Change signal group **fc05** to 5 (PermissiveMovementAllowed) **Verify** that the signal group changes to Green on the lamp simulator		
2.	Before the minimum signal group timing is expired, change signal group **fc05** to 7 (PermissiveClearance) **Verify** that the signal group stays Green until the minimum signal group timing (4.5 seconds) is expired and that afterwards it changes to Amber on the lamp simulator		
3.	Before the minimum signal group timing is expired, change signal group **fc05** to 3 (StopandRemain) **Verify** that the signal group stays Amber until the minimum signal group timing (3 seconds) is expired and that afterwards it changes to Red on the lamp simulator		
4.	Before the minimum signal group timing is expired, change signal group **fc05** to 5 (PermissiveMovementAllowed) **Verify** that the signal group stays Red until the minimum signal group timing (2 seconds) is expired and that afterwards it changes to Green on the lamp simulator		
5.	Change the signal group **fc05** to 3 (StopandRemain) **Verify** that the signal group stays Amber until the minimum signal group timing (3 seconds) is expired and that afterwards it changes to Red on the lamp simulator		

6.	Before the clearance time is expired (6.2 seconds), change signal group **fc02** to 5 (PermissiveMovementAllowed) **Verify** that the signal group stays Red until the clearance time (6.2 seconds) is expired. Afterwards the signal group changes to 5 (PermissiveMovementAllowed)		
7.	Repeat step 1 to 6 for signal groups fc02, fc07, 21 and 31**Be aware** the minimum signal group times and clearance times can vary		
Tested by:		**Date:**	

9.4.7 Test case 7: Violation of maximum signal group timing

Test Case:		Violation of maximum signal group timing		
ID:		SC3.CLA.07.EXC		
Objective:		Verify that the TLC Facilities prevents violation of the maximum signal group timing		
Pre-conditions:		The ITS-CLA is in control of the intersection All signal groups are red		
STEP	**DESCRIPTION**		**PASS / FAIL**	**REMARKS/ACTIONS**
1.	Change the signal group **fc08** to 6 (ProtectedMovementAllowed) **Verify** that the signal group changes to Green on the lamp simulator			
2.	Change the signal group **fc08** to 8 (ProtectedClearance) **Verify** that the signal group changes to Amber on the lamp simulator **Verify** that the signal group stays Amber until the maximum signal group timing (3 seconds) is expired and that afterwards it changes to Red			
3.	Repeat step 1 and 2 for signal groups fc02, fc03, 21 and 31 **Be aware** the maximum signal group times can vary. See [Ref 8]			
Tested by:			**Date:**	

9.4.8 Test case 8: Invalid signal group state transitions

Test Case:		Invalid signal group state transitions		
ID:		SC3.CLA.08.EXC		
Objective:		Verify that the TLC Facilities prevents signal group state transitions that are not allowed		
Pre-conditions:		The ITS-CLA is in control of the intersection All signal groups are red		
STEP		**DESCRIPTION**	**PASS / FAIL**	**REMARKS/ACTIONS**
1.		The ITS-CLA sends the request to change signal group **fc03** to 8 (ProtectedClearance) **Verify** that the TLC Facilities doesn't change the signal group		
2.		The ITS-CLA sends the request to change signal group **fc03** to 6 (ProtectedMovementAllowed) **Verify** that the signal group becomes Green on the lamp simulator		
3.		The ITS-CLA sends the request to change signal group **fc03** to 8 (ProtectedClearance) **Verify** that the signal group becomes Amber on the lamp simulator		
4.		The ITS-CLA sends the request to change signal group **fc03** to 6 (ProtectedMovementAllowed) **Verify** that the TLC Facilities doesn't change the signal group (in some regions it is allowed to change to Green)		
5.		Repeat step 1 to 4 for signal group fc02, fc05, fc07, fc08, 21 and 31		
Tested by:			**Date:**	

9.4.9   Test case 9: ITS-CLA requests conflicting signal groups

Test Case:		ITS-CLA requests conflicting signal groups		
ID:		SC3.CLA.9.EXC		
Objective:		Verify that the TLC Facilities doesn't allow conflicting signal groups in an atomic update		
Pre-conditions:		The ITS-CLA is in control of the intersection All signal groups are red		
STEP		**DESCRIPTION**	**PASS / FAIL**	**REMARKS/ACTIONS**
1.		The ITS-CLA sends an atomic update with 6 (ProtectedMovementAllowed) for signal group **fc03**, **fc07** and **fc08** **Verify** that the signal groups changes from Red to Amber Flashing, meanwhile respecting the clearance times **Verify** that the ITS-CLA is removed from control and put in the Error state **Verify** that the ITS-CLA is informed about the failure		
2.		Repeat step 1 for the following combinations of signal groups: - fc02, fc05 and fc08 - fc02 and 31 - fc05 and 21		
Tested by:			Date:	

9.4.10 Test case 10: Signal group – no change when intersection != control

Test Case:		Signal group – no change when intersection != control		
ID:		SC3.CLA.10.EXC		
Objective:		Verify that the TLC only listens to requests for the signal groups if an ITS-CLA is in control of the intersection		
Pre-conditions:		ITS-CLA is in the state InControl The intersection state is Amber Flashing		
STEP		**DESCRIPTION**	**PASS / FAIL**	**REMARKS/ACTIONS**
1.		The ITS-CLA sends a request to change signal group **fc07** to 3 (StopandRemain) **Verify** that the signal group doesn't change		
2.		Repeat step 1 for signal group fc02, fc05 and 31		

3.	The ITS-CLA changes the intersection state to AllRed The ITS-CLA sends a request to change signal group **fc07** to 6 (ProtectedMovementAllowed) **Verify** that the signal group doesn't change		
4.	Repeat step 3 for signal group fc03, fc08 and 21		
5.	The ITS-CLA changes the intersection state to control The ITS-CLA sends a request to change signal group **fc07** to 6 (ProtectedMovementAllowed) **Verify** that the signal group changes		
6.	Repeat step 4 for signal group fc02, fc08 and 31 (taking legal transitions and times into account)		
7.	The ITS-CLA changes the intersection state to AllRed The ITS-CLA sends a request to change signal group **fc07** to 6 (ProtectedMovementAllowed) **Verify** that the signal group doesn't change		
8.	Repeat step 7 for signal group fc02, fc05, and 31		
Tested by:		**Date:**	

9.4.11 Test case 11: Signal group predictions – invalid predictions

Test Case:	Signal group predictions – invalid predictions		
ID:	SC3.CLA.11.EXC		
Objective:	Verify that the TLC Facilities can handle invalid signal group predictions		
Pre-conditions:	The ITS-CLA is in control of the intersection		
STEP	**DESCRIPTION**	**PASS / FAIL**	**REMARKS/ACTIONS**
1.	The ITS-CLA sends requested signal group predictions for **fc02** that violates the minimum signal group timing to the TLC-FI **Verify** that the TLC Facilities removes the requested prediction and sets it to null (= unknown)		
2.	Repeat step 1 for predictions violating maximum or clearance times		

3.	Repeat step 1 and 2 for fc03, fc07and 31		
Tested by:		**Date:**	

9.4.12 Test case 12: Signal group predictions – ITS-CLA not in control

Test Case:		**Signal group predictions – ITS-CLA not in control**		
ID:		SC3.CLA.12.EXC		
Objective:		Verify that the TLC Facilities can only let an ITS-CLA that is in control of an intersection change the signal group predictions		
Pre-conditions:		The ITS-CLA is not in control		
STEP	**DESCRIPTION**		**PASS / FAIL**	**REMARKS/ACTIONS**
1.	The ITS-CLA sends requested signal group predictions for **fc02** **Verify** that the TLC Facilities ignores the request			
2.	The ITS-CLA is put in control, but Intersection.State = Allred The ITS-CLA sends requested signal group predictions for **fc02** **Verify** that the TLC Facilities ignores the request			
3.	The ITS-CLA changes Intersection.State = control The ITS-CLA sends requested signal group predictions for **fc02** **Verify** that the TLC Facilities updates the signal group predictions to the new value			
4.	Repeat step 1 and 2 for fc03, fc07and 21			
Tested by:			**Date:**	

9.4.13 Test case 13: Exclusive outputs - ITS-CLA is not in-control

Test Case:		Exclusive outputs - ITS-CLA is not in-control		
ID:		SC3.CLA.13.EXC		
Objective:		Verify that the TLC Facilities only changes the exclusive outputs if the request comes from the ITS-CLA that is in control		
Pre-conditions:		ITS-CLA1 is in control of the intersection ITS-CLA2 is connected and registered to the TLC Facilities and not in control All signal groups are red		
STEP	DESCRIPTION		PASS / FAIL	REMARKS/ACTIONS
1.	ITS-CLA2 sends a request to change **exclOutputA** from 0 to 1 **Verify** that the output doesn't change			
2.	Repeat step 1 for signal group exclOutputB, w21 and w31			
Tested by:			Date:	

9.4.14 Test case 14: ITS-CLA gets disconnected

Test Case:		ITS-CLA gets disconnected		
ID:		SC3.CLA.14.EXC		
Objective:		Verify that the TLC Facilities can handle it when an ITS-CLA gets disconnected		
Pre-conditions:		The ITS-CLA is in control of the intersection All outputs are different than their default values		
STEP	DESCRIPTION		PASS / FAIL	REMARKS/ACTIONS
1.	The ITS-CLA gets disconnected **Verify** that the TLC Facilities sets the exclusive outputs back to their default values. The non-exclusive outputs change back to default after the timeout period of 30 seconds is expired **Verify** that the intersection is brought into a defined state and if no other ITS-CLA is available brought into standby mode			
Tested by:			Date:	

9.5 Scenario 4: ITS Application connections exceptions

In this scenario we will test exceptions that could appear using several ITS-A's at the same time. These can be regarded to communication problems, network problems, invalid settings or a malfunctioning system. Tests are done regarding invalid login attempts, problems resulting in a handover and more.

Optionally through log files can be verified whether there are errors or not and that the right sequences are present.

Below are only test cases given for situations that are not yet tested using only an ITS-CRA, ITS-PRA or ITS-CLA or which have a value changed, which makes testing it important.

9.5.1   Test case 1: Connect and register with an invalid username

Test Case:		Connect and register with an invalid username		
ID:		SC4.ITSA.01.EXC		
Objective:		Verify that the TLC Facilities rejects applications logging in with an invalid username		
Pre-conditions:		The TLC Facilities is initiated and available		
STEP	**DESCRIPTION**		**PASS / FAIL**	**REMARKS/ACTIONS**
1.	Configure the Session details of the TLC-FI in the ITS-A. The credentials to be used can be found in table 3. User: <user> Password: <password> Application type: <Type>			
2.	Activate the connect and register procedure **Verify** that the login attempt of the ITS-A is rejected and that an appropriate error message is returned **Verify** that the audit log contains the failed connect and register event			
3.	Repeat step 1 and 2 for all usernames given in table 2			
Tested by:			**Date:**	

Table 2: An overview of invalid user – password – type combinations that should be used to test the login feature of the TLC-FI

User	Password	Type	Program number	Comment
Control	Im?h@ppy!2meet(<you>)&5isSpeci@l	Control		Wrong username
	WeNeedEnoughUsers!10min	Control		No username
Provider1	Wrong_password	Provider		Wrong password
Provider1	My.p@ssw0rd4	Provider		Wrong user-password combination

Consumer1		Consumer		No password
Consumer1	Password1	Control		Wrong specified application type

9.5.2 Test case 2: Connect and register 2 times with the same valid credentials

Test Case:		Connect and register 2 times with the same valid credentials		
ID:		SC4.ITSA.02.EXC		
Objective:		Verify that the TLC Facilities only allows one session per valid username		
Pre-conditions:		The TLC Facilities is initiated and available		
STEP		**DESCRIPTION**	**PASS / FAIL**	**REMARKS/ACTIONS**
1.		Configure the Session details of the TLC-FI in the ITS-CLA1 User: Control1 Password: Im?h@ppy!2meet(<you>)&5isSpeci@l		
2.		Activate the connect and register procedure **Verify** that the ITS-CLA1 is connected and registered to the TLC-FI **Verify** that the audit log contains the connect and register event		
3.		Configure the Session details of the TLC-FI in the ITS-CLA2 User: Control1 Password: Im?h@ppy!2meet(<you>)&5isSpeci@l		
4.		Activate the connect and register procedure **Verify** that the TLC Facilities rejects the ITS-CLA, because an application with the same username is already logged in. **Verify** that ITS-CLA1 remains connected, registered and active		
Tested by:			**Date:**	

9.5.3   Test case 3: Handover: ITS-CLA1 doesn't acknowledge the EndControl request

Test Case:	Handover intersection control – ITS-CLA1 doesn't acknowledge the EndControl request		
ID:	SC4.ITSA.03.EXC		
Objective:	Verify that the TLC Facilities can handle it if the ITS-CLA doesn't acknowledge the handover procedure		
Pre-conditions:	ITS-CLA1 is in control of the intersection ITS-CLA2 is ready to control		
STEP	DESCRIPTION	PASS / FAIL	REMARKS/ACTIONS
1.	The TLC Facilities requests ITS-CLA1 to handover the control over the intersection. ITS-CLA1 doesn't respond to the EndControl request **Verify** that the TLC Facilities waits for the EndControl timeout(180s) before removing control from ITS-CLA1 **Verify** that after the control is removed, the intersection state is changed to AllRed **Verify** that after the AllRed period is expired, ITS-CLA2 is brought into control		
Tested by:		Date:	

9.5.4   Test case 4: Handover: ITS-CLA2 gets disconnected or goes offline

Test Case:	Handover: ITS-CLA2 gets disconnected or goes offline		
ID:	SC4.ITSA.04.EXC		
Objective:	Verify that the TLC Facilities can handle it if ITS-CLA2 gets disconnected during handover		
Pre-conditions:	ITS-CLA1 is in control of the intersection ITS-CLA2 is ReadyToControl No other ITS-CLA's are ReadyToControl		
STEP	DESCRIPTION	PASS / FAIL	REMARKS/ACTIONS
1.	ITS-CLA1 goes to the state Offline **Verify** that the TLC Facilities removes the control from ITS-CLA1 and that the intersection state goes to AllRed		

2.	Before the AllRed period is expired, let ITS-CLA2 change its state to Offline and ITS-CLA1 change its state to ReadyToControl **Verify** that the TLC-FI gives control back to ITS-CLA1		
3.	Change the state of ITS-CLA2 to ReadyToControl. The TLC-FI starts the handover procedure **Verify** that the control of ITS-CLA1 is removed and that the intersection state goes to AllRed (cleared handover)		
4.	Before the AllRed period is expired, disconnect the ITS-CLA2 and change the state of ITS-CLA1 to Offline **Verify** that the TLC-FI puts the intersection to Standby		
Tested by:		**Date:**	

9.5.5   Test case 5: Multiple ITS-A's write to one non-exclusive output

Test Case:	**Multiple ITS-A's write to one non-exclusive output**		
ID:	SC4.ITSA.05.EXC		
Objective:	Verify that the TLC Facilities can handle it when several ITS-A's are writing different request states to the same output		
Pre-conditions:	Several ITS-A's are connected and registered to the TLC-FI and are able to request a state for the non-exclusive outputs		
STEP	**DESCRIPTION**	**PASS / FAIL**	**REMARKS/ACTIONS**
1.	Let ITS-PRA1 change the state of output **1** from 0 to 1 **Verify** that the state of output **1** changes from 0 to 1 in the I/O simulator and in the ITS-A's **Verify** that the state of the other outputs is unchanged		

2.	Let ITS-PRA2 change the state of output **1** from 1 to 0		
	Verify that the state of output **1** changes from 1 to 0 in the I/O simulator and in the ITS-PRA **Verify** that the state of the other outputs is unchanged		
3.	Let ITS-CLA1 change the state of output **1** from 0 to 1		
	Verify that the state of output **1** changes from 0 to 1 in the I/O simulator and in the ITS-A's **Verify** that the state of the other outputs is unchanged		
4.	Let ITS-PRA2 change the state of output **1** from 1 to 0		
	Verify that the state of output **1** changes from 1 to 0 in the I/O simulator and in the ITS-PRA **Verify** that the state of the other outputs is unchanged		
5.	Repeat step 1 to 4 for output 2 and fix		
Tested by:		**Date:**	

9.5.6 Test case 6: Message bursts

Test Case:	Message bursts		
ID:	SC4.ITSA.06.EXC		
Objective:	Verify that the TLC Facilities can handle bursts of messages (for example due to a network delay)		
Pre-conditions:	An ITS-A driver is connected and registered an able to send burst messages		
STEP	**DESCRIPTION**	**PASS / FAIL**	**REMARKS/ACTIONS**
1.	The ITS-A sends a message burst. The burst shall consist of 10 messages, which should be sent separate within a time span of 100 ms. **Verify** that the TLC Facilities handles the messages in the proper order (through the time ticks)		
2.	The ITS-A sends a message burst. The burst shall consist of 100 messages, which should be sent separate within a time span of 100 ms.		

Verify that the TLC Facilities handles the messages in the proper order (through the time ticks)			
Tested by:		**Date:**	

9.5.7   Test case 7: Multiple sockets

Test Case:		Multiple sockets		
ID:		SC4.ITSA.07.EXC		
Objective:		Verify that the TLC Facilities can handle ITS-A with the same IP address, but unique usernames		
Pre-conditions:		ITS-A1 is connected with the TLC Facilities		
STEP	**DESCRIPTION**		**PASS / FAIL**	**REMARKS/ACTIONS**
1.	ITS-A2 connects to the TLC Facilities with a valid and unique username using the same IP address as ITS-A1 **Verify** that the TLC Facilities lets the ITS-A connect and register without closing the connection with ITS-A1			
Tested by:		**Date:**		

9.5.8   Test case 8: Alive check fails

Test Case:		Alive check fails		
ID:		SC4.ITSA.08.EXC		
Objective:		Verify that the TLC Facilities takes correct actions when no keep alive message is received		
Pre-conditions:		The ITS-A is connected and registered to the TLC-FI		
STEP	**DESCRIPTION**		**PASS / FAIL**	**REMARKS/ACTIONS**
1.	The ITS-A sends keep alive messages **Verify** that the connection between the TLC and the ITS-A remains active			
2.	The ITS-A stops sending keep alive messages **Verify** that the TLC-FI keeps sending keep alive messages			

	Verify that after 2.5 times the interval (2s interval for an ITS-CLA, 10s interval for an ITS-CRA or PRA) the ITS-A gets disconnected and the session terminated **Verify** that the ITS-A cannot update any data from any object and neither receive updates		
Tested by:		**Date:**	

9.5.9 Test case 9: TLC Facilities restart (soft)

Test Case:		**TLC Facilities restart (soft)**		
ID:		SC4.ITSA.09.EXC		
Objective:		Verify that the Facilities informs all ITS-A's about the restart and deregisters them all		
Pre-conditions:		The TLC Facilities is running and has ITS-A's connected and registered		
STEP	**DESCRIPTION**		**PASS / FAIL**	**REMARKS/ACTIONS**
1.	Start the restart procedure **Verify** that the TLC Facilities informs all registered ITS-A's about the restart **Verify** that all ITS-A's are deregistered before the restart			
Tested by:			**Date:**	

9.5.10 Test case 10: A peer connects without registration request

Test Case:		A peer connects without registration request		
ID:		SC4.ITSA.10.EXC		
Objective:		Verify that an ITS-A gets disconnected if it connects but doesn't provide a registration request		
Pre-conditions:		The TLC Facilities is available		
STEP	**DESCRIPTION**		**PASS / FAIL**	**REMARKS/ACTIONS**
1.	An ITS-A connects to the TLC-FI, but doesn't send a registration request **Verify** that the TLC Facilities terminates the session with the ITS-A after the alive timeout period (2.5 times the interval) is expired			
Tested by:			**Date:**	

9.5.11 Test case 11: Registration within active session

Test Case:	Registration within active session		
ID:	SC4.ITSA.11.EXC		
Objective:	Verify that the TLC Facilities can handle a registration within an active session		
Pre-conditions:	An ITS-A has an active session with the TLC Facilities		
STEP	**DESCRIPTION**	**PASS / FAIL**	**REMARKS/ACTIONS**
1.	The ITS-A sends a registration request to the TLC-FI **Verify** that the active (connected) session is deregistered		
Tested by:		**Date:**	

9.5.12 Test case 12: Unknown methods

Test Case:	Unknown methods		
ID:	SC4.ITSA.12.EXC		
Objective:	Verify that the TLC sends a proper respond when an unsupported (or undefined) method is received		
Pre-conditions:	An ITS-A is connected to the TLC		
STEP	**DESCRIPTION**	**PASS / FAIL**	**REMARKS/ACTIONS**
1.	The TLC Facilities receives a method which is not supported by the TLC-FI **Verify** that the TLC-FI sends in response a message with the error code -32601 (*method not found) (*when a response is requested)		
Tested by:		**Date:**	

9.5.13 Test case 13: Unknown object types

Test Case:	Unknown object types		
ID:	SC4.ITSA.13.EXC		
Objective:	Verify that the TLC Facilities can handle a request for an unknown object type		
Pre-conditions:	An ITS-A is connected to the TLC-FI		
STEP	**DESCRIPTION**	**PASS / FAIL**	**REMARKS/ACTIONS**
1.	The ITS-A requests information for the object 'NiceObjectName'		

	Verify that the TLC-FI: - Rejects the message - Discard the object(s) updated in the message - When part of a request: send an error code UnknownObjectType - When notification: Log error		
Tested by:		**Date:**	

9.5.14 Test case 14: Unknown attributes

Test Case:	Unknown attributes		
ID:	SC4.ITSA.14.EXC		
Objective:	Verify that the TLC Facilities can handle unknown attributes		
Pre-conditions:	An ITS-A is connected to the TLC-FI		
STEP	**DESCRIPTION**	**PASS / FAIL**	**REMARKS/ACTIONS**
1.	The TLC Facilities receives several attributes of which one is not supported by the TLC-FI. The object updated is **fc05** with the following attributes: - SignalGroupState.requestedState (instead of reqState) - SignalGroupPrediction.reqPredictions **Verify** that the TLC Facilities ignores the attribute and continues to process the remaining attributes		
Tested by:		**Date:**	

9.5.15 Test case 15: Invalid attribute value types

Test Case:	Invalid attribute value types		
ID:	SC4.ITSA.15.EXC		
Objective:	Verify that the TLC Facilities can handle a received attribute of an invalid type		
Pre-conditions:	An ITS-A is registered to the TLC Facilities		
STEP	**DESCRIPTION**	**PASS / FAIL**	**REMARKS/ACTIONS**
1.	The TLC Facilities receives an update to the attribute value of **varA**. The value should be an integer, but the send value is 'one'		

	Verify that the TLC Facilities shall take the following actions: - Reject the attribute - Discard the object(s) updated in this message - When part of a request: Send an error code InvalidAttributeType - When notification: Log error		
Tested by:		**Date:**	

9.5.16 Test case 16: Invalid attribute values

Test Case:	**Invalid attribute values**		
ID:	SC4.ITSA.16.EXC		
Objective:	Verify that the TLC Facilities can handle attribute containing invalid values		
Pre-conditions:	An ITS-A is connected to the TLC Facilities An ITS-CLA is in control of the intersection All signal groups are red		
STEP	**DESCRIPTION**	**PASS / FAIL**	**REMARKS/ACTIONS**
1.	The ITS-A requests to change output **1** to the value 38000 **Verify** that the TLC Facilities notes that the value is out of range and takes the following actions: - Reject the attribute - Discard the object(s) updated in this message - When part of request: Send an error code InvalidAttributeValue - When notification: Log error		
2.	The ITS-CLA requests to change the signal group state of **fc05** to 12 (signal groups are represented by integers. The highest has the value 11) and the signal group prediction to: - State: 5 - min = 10000 (10 seconds) - max = 12000 (12 seconds) - likely = 11000 (11 seconds) - confidence = 90		

	Verify that the TLC Facilities notes that the value is out of range and takes the following actions: - Reject the attribute - Discard the object(s) updated in this message - When part of request: Send an error code InvalidAttributeValue - When notification: Log error		
Tested by:		**Date:**	

9.5.17 Test case 17: Invalid object reference

Test Case:	**Invalid object reference**		
ID:	SC4.ITSA.17.EXC		
Objective:	Verify that the TLC Facilities can handle a request on an invalid Object reference		
Pre-conditions:	An ITS-A is connected to the TLC Facilities An ITS-PRA is connected to the TLC Facilities		

STEP	DESCRIPTION	PASS / FAIL	REMARKS/ACTIONS
1.	An ITS-A requests to be subscribed to signal group **fc04** **Verify** that the TLC Facilities takes the following actions: - Reject the attribute - Discard the object(s) updated in this message - When part of request: Send an error code InvalidObjectReference - When notification: Log error		
2.	The ITS-PRA requests to change the output of **w41** to 1 **Verify** that the TLC Facilities takes the following actions: - Reject the attribute - Discard the object(s) updated in this message - When part of request: Send an error code InvalidObjectReference - When notification: Log error		
Tested by:		**Date:**	

9.5.18 Test case 18: Invalid JSON message

Test Case:	Invalid JSON message		
ID:	SC4.ITSA.18.EXC		
Objective:	Verify that the TLC Facilities can handle invalid JSON messages		
Pre-conditions:	An ITS-A is connected to the TLC		
STEP	DESCRIPTION	PASS / FAIL	REMARKS/ACTIONS

1.	The ITS-A sends the following invalid JSON message:
	{"jsonrpc": "2.0", "method": "foobar, "params": "bar", "baz]
	
	Verify that the TLC Facilities takes the following actions:
	  - Update diagnostics
	  - Stop processing messages from the source
	  - Disconnect session		

Tested by:		Date:	

9.5.19 Test case 19: Buffer overflow

Test Case:	Buffer overflow		
ID:	SC4.ITSA.19.EXC		
Objective:	Verify that the TLC Facilities takes appropriate actions when a buffer overflow is encountered		
Pre-conditions:	An ITS-A is connected to the TLC		
STEP	DESCRIPTION	PASS / FAIL	REMARKS/ACTIONS

1.	The ITS-A sends a large valid JSON encoded message to the TLC Facilities. The size of this message is bigger than the buffer of the TLC-FI
	
	Verify that the TLC Facilities takes the following actions:
	  - Discard the complete message
	  - Stop processing messages from the source
	  - Disconnect session		

Tested by:		Date:	

9.5.20 Test case 20: Revoke ITS-Application authorisation

Test Case:	Revoke ITS-Application authorisation		
ID:	SC4.ITSA.20.EXC		
Objective:	Verify that the TLC Facilities can revoke the authorisation of a ITS-A		
Pre-conditions:	An ITS-A is connected and registered to the TLC Facilities		
STEP	DESCRIPTION	PASS / FAIL	REMARKS/ACTIONS
1.	The TLC Facilities decides to revoke the authorisation of the ITS-A **Verify** that the ITS-A gets disconnected and the session terminated **Verify** that the ITS-A cannot update any data from any object and neither receive updates		
Tested by:		Date:	

9.6   Scenario 5: IVERA exceptions

This scenario describes the IVERA exceptions

9.6.1   Test case 1: TMS compatibility

Test Case:	TMS compatibility		
ID:	SC5.IVA.01.EXC		
Objective:	Verify that older TMS instances cannot connect to IVERA4.0 slaves		
Pre-conditions:	An older TMS instance is available An IVERA4.0 slave is available		
STEP	DESCRIPTION	PASS / FAIL	REMARKS/ACTIONS
1.	The TMS tries to connect to the IVERA4.0 slave **Verify** that the TMS cannot connect to the IVERA4.0 slave		
Tested by:		Date:	

9.6.2   Test case 2: TLS invalid certificate

Test Case:	TLS invalid certificate		
ID:	SC5.IVA.02.HA		
Objective:	Verify that the TLC Facilities removes connections when an invalid TLS certificate is used		
Pre-conditions:	The IVERA-TLC is available		
STEP	**DESCRIPTION**	**PASS / FAIL**	**REMARKS/ACTIONS**
1.	An IVERA master tries to connect with the IVERA-TLC with an invalid certificate **Verify** that the IVERA-TLC removes the connection		
Tested by:		**Date:**	

9.7   Scenario 6: Time synchronisation exceptions

In this scenario we will test time synchronisation exceptions.

9.7.1   Test case 1: Time-tick inconsistency

Test Case:	Time-tick inconsistency		
ID:	SC6.TIME.01.EXC		
Objective:	Verify that the TLC Facilities can handle a time-tick inconsistency with an ITS-A		
Pre-conditions:	An ITS-A with an adjustable time-tick is connected and registered to the TLC		
STEP	**DESCRIPTION**	**PASS / FAIL**	**REMARKS/ACTIONS**
1.	Adjust the time-tick of the ITS-A so that it is (significantly) slower than the one of the TLC Facilities		
2.	The ITS-A sends several messages to the TLC Facilities **Verify** that the TLC Facilities can handle it when it doesn't receive any messages during a system tick		
3.	Adjust the time-tick of the ITS-A so that it is (significantly) faster than the one of the TLC Facilities		
4.	The ITS-A sends several messages to the TLC Facilities		

	Verify that the TLC Facilities can handle it when it receives multiple sets of messages during a system tick		
Tested by:		**Date:**	

9.7.2 Test case 2: Time-tick overflow

Test Case:	**Time-tick overflow**		
ID:	SC6.TIME.02.EXC		
Objective:	Verify that the TLC Facilities can handle a time-tick overflow		
Pre-conditions:	An ITS-A is connected to the TLC Facilities		
STEP	**DESCRIPTION**	**PASS / FAIL**	**REMARKS/ACTIONS**
1.	The time-tick of the TLC Facilities overflows between two received messages **Verify** that the TLC Facilities handles the messages properly and that no errors emerge		
Tested by:		**Date:**	

9.8   Scenario 7: Protocol exceptions
In this scenario we will test the protocol compatibility of different versions.

9.8.1 Test case 1: Incompatible protocol

Test Case:	**Incompatible protocol**		
ID:	SC7.PROT.01.EXC		
Objective:	Verify that the TLC Facilities takes appropriate actions when an ITS-CLA with an incompatible protocol tries to connect and register itself		
Pre-conditions:	The TLC Facilities is available (up and running) An ITS-A is available with an incompatible protocol version		
STEP	**DESCRIPTION**	**PASS / FAIL**	**REMARKS/ACTIONS**
1.	The ITS-A tries to connect and register itself to the TLC Facilities **Verify** that the TLC Facilities does the following:		

	- Parse the incoming data stream, taking into account that the data may not be coming for a peer supporting the TLC-FI protocol - Not crash as a result of another application opening and using the TCP port - Disconnect if the parsing of the incoming data fails - Disconnect after 2.5 * 10 seconds		
Tested by:		**Date:**	

9.8.2   Test case 2: Application using older (un-supported) protocol version

Test Case:	Application using older (un-supported) protocol version		
ID:	SC7.PROT.02.EXC		
Objective:	Verify that the TLC Facilities can handle an application using an older (un-supported) protocol version		
Pre-conditions:	The TLC Facilities is available (up and running) An ITS-A is available with an older (un-supported) protocol version		
STEP	**DESCRIPTION**	**PASS / FAIL**	**REMARKS/ACTIONS**
1.	The ITS-A tries to connect and register itself to the TLC Facilities **Verify** that the TLC Facilities detects that the ITS-A has an un-supported protocol version and that it reports this explicitly back to the ITS-A. It is the responsibility of the ITS-A to stop communicating with the TLC		
Tested by:		**Date:**	

APPENDIX 1: Requirements traceability

This section provides a statement of the compliance of this test specification with the Beter Benutten Vervolg, project iVRI, Deliverable G2, IRS TLC Facilities Interface v1.2, jan 2016 (see [Ref 2])

The following statements are made for compliance with a requirement:

- C = Covered
- P = Partially covered
- N = Not covered

A list of sections in this document in which the requirement is supported is listed and a comment describing the compliance statement.

Requirement	Compliance	Sections	Comments
IRS-TLCFI-TIME-001	C	8.7.1	
IRS-TLCFI-PROT-001	N		No dedicated test case required
IRS-TLCFI-PROT-002	N		There has been decided to have all communication use TLS. This means non-secure access is impossible
IRS-TLCFI-PROT-003	C	8.8.3	
IRS-TLCFI-COM-001	C	8.2.3	
IRS-TLCFI-COM-002	P	8.2.4, 9.2.1, 9.2.2, 9.2.5	Updates on state changes, no periodic updates
IRS-TLCFI-COM-003	C	9.2.5, 9.5.8	
IRS-TLCFI-COM-004	N		No periodic updates supported
IRS-TLCFI-COM-005	P	8.2.5	Filtering based on type and subset of object ids
IRS-TLCFI-COM-006	N		No pre-defined filters supported
IRS-TLCFI-REG-001	P	8.2.2, 8.3.1, 8.4.1, 8.5.1, 9.4.1, 9.5.1, 9.5.10	No priority levels
IRS-TLCFI-REG-002	C	8.2.2, 8.3.1, 8.4.1, 8.5.1	
IRS-TLCFI-REG-003	N		No priority levels
IRS-TLCFI-REG-004	C	8.5.7	
IRS-TLCFI-REG-005	C	9.5.20	
IRS-TLCFI-REG-006	C	9.5.8	
IRS-TLCFI-REG-007	C	9.5.8	
IRS-TLCFI-ICA-REG-001	C	8.4.1, 8.4.2	
IRS-TLCFI-ICA-AD-001	C	8.4.2	
IRS-TLCFI-ICA-AD-002	C	8.4.2	

IRS-TLCFI-ICA-AD-003	C	8.5.6	
IRS-TLCFI-ICA-AD-004	C	8.5.6	
IRS-TLCFI-ICA-AD-005	C	8.5.6	
IRS-TLCFI-ICA-AD-006	N		An ITS-CLA controls one intersection. Multiple sessions are needed.
IRS-TLCFI-ICA-AD-007	N		Will not be tested due to the fact that only one test intersection is defined
IRS-TLCFI-TIF-OD-001	P	8.2.3, 8.2.4	No pre-defined filters
IRS-TLCFI-TIF-OD-002	C	8.2.3, 8.2.4	
IRS-TLCFI-TIF-OD-003	C	8.2.3	
IRS-TLCFI-TIF-OD-004	C	8.2.3	
IRS-TLCFI-TIF-OD-005	P	8.2.6 – 8.2.11, 8.3.2, 8.3.3, 8.4.3 - 8.4.5, 8.5.2-8.5.5, 9.2.3, 9.2.4, 9.3.1	No addable / deletable objects
IRS-TLCFI-TIF-OD-006	C	9.2.2	
IRS-TLCFI-TIF-OM-001	N		No addable / deletable objects
IRS-TLCFI-TIF-OM-002	C	8.3.2, 8.3.3, 8.4.3 - 8.4.5, 8.5.20 - 8.5.5, 9.2.1, 9.2.3, 9.2.4, 9.3.1, 9.4.10	
IRS-TLCFI-TIF-OM-003	C	8.2.5 - 8.2.11, 8.5.2- 8.5.5, 9.2.1	
IRS-TLCFI-TIF-OM-004	N		No addable / deletable objects
IRS-TLCFI-TIF-OT-001	C	8.2.3	
IRS-TLCFI-TIF-OT-002	P	8.2.3	Object doesn't contain: - Fault state - Special function variables - Active ITS-CLA (security concern)
IRS-TLCFI-TIF-OT-003	P	8.4.2, 9.4.5	The ITS-CLA is not informed of a higher priority request
IRS-TLCFI-TIF-OT-004	P	8.2.9, 8.4.4, 8.5.4	Object doesn't contain: - Internal signal group state (including format) - Reason for deviation from external state - Fault state (deadlock, lamps)

			- Special function variables and status Meta: - Type (vehicle, bicycle, pedestrian, tram) - Related detectors
IRS-TLCFI-TIF-OT-005	C	8.4.4, 8.5.4, 9.2.3, 9.4.6, 9.4.7, 9.4.8	
IRS-TLCFI-TIF-OT-006	C	8.2.9, 8.4.5, 8.5.5, 9.4.9, 9.4.11, 9.4.12	
IRS-TLCFI-TIF-OT-007	P	8.2.6	Object doesn't contain: Meta: Type
IRS-TLCFI-TIF-OT-008	C	8.2.10	
IRS-TLCFI-TIF-OT-009	C	8.2.7	
IRS-TLCFI-TIF-OT-010	C	8.2.8, 8.3.2, 8.4.3, 8.5.2, 8.5.3, 9.2.4, 9.3.2	
IRS-TLCFI-TIF-OT-011	C	8.2.11, 8.3.3	
IRS-TLCFI-TIF-OT-012	P	8.2.3	Objects don't provide: - Intersection topology data - ITS Application status (security concern) - TLC Capability classes
IRS-TLCFI-QA-PERF-001	N		Not a requirement for testing, just a definition
IRS-TLCFI-QA-PERF-002	C	8.5.1	No limit imposed in technology, objects or methods
IRS-TLCFI-QA-PERF-003	C	8.5.8	No limit imposed in technology, objects or methods
IRS-TLCFI-QA-PERF-004	C	8.5.9	No limit imposed in technology, objects or methods
IRS-TLCFI-QA-PERF-005	C	8.5.10	No limit imposed in technology, objects or methods
IRS-TLCFI-QA-PERF-006	C	8.7.2	No limit imposed in technology, objects or methods
IRS-TLCFI-QA-PERF-007	C	8.7.2, 8.7.3	No limit imposed in technology, objects or methods
IRS-TLCFI-QA-AVAIL-001	C	9.5.8	
IRS-TLCFI-QA-AVAIL-002	N		No quality information is provided by an ITS-CLA
IRS-TLCFI-QA-AVAIL-003	N		No dedicated test case required

IRS-TLCFI-QA-AVAIL-004	N		No reliance on UTC for the object exchange
IRS-TLCFI-QA-EVO-001	C	8.8.1, 8.8.2, 9.8.1, 9.8.2	
IRS-IVERA-01	C	9.6.1	
IRS-IVERA-02	N		This test case is for IVERA masters, not for the TLC Facilities
IRS-IVERA-03	C	[Ref 9]	
IRS-IVERA-04	C	[Ref 9]	
IRS-IVERA-05	C	8.6.1	
IRS-IVERA-06	C	8.6.1	
IRS-IVERA-07	C	8.6.2	
IRS-IVERA-08	C	8.6.2	
IRS-IVERA-09	C	8.6.4	
IRS-IVERA-10	C	8.6.5	
IRS-IVERA-11	N		No requirement for the TLC
IRS-IVERA-12	C	8.6.6	
IRS-IVERA-13	N	[Ref 9]	This is functionality implemented on the TMS, not on the TLC
IRS-IVERA-14	C	8.6.1	
IRS-IVERA-15	C	[Ref 9]	Covered through verifies
IRS-IVERA-16	C	[Ref 9]	Covered through verifies

APPENDIX 2: Use cases traceability

This section provides traceability to the use cases that are defined in the documents iVRI2_del_1ab_IDD_Generic-FI_v1.0 and iVRI2_del_1a_IDD_TLC-FI_v1.0. This can be used to see whether all defined use cases are tested.
The following statements are made for coverage of the given use cases:
- C = Covered
- P = Partially covered
- N = Not covered

A list of sections in this document in which the requirement is supported is listed and a comment describing the compliance statement.

Use case	Compliance	Sections	Comments
8.1 [Ref 3]	C	8.2.2, 8.2.3, 8.3.1, 8.4.1, 9.5.1, 9.5.2	
8.2 [Ref 3]	C	8.5.7	The exception is handled in [Ref 9]
8.3 [Ref 3]	C	9.5.20	
8.4 [Ref 3]	C	9.5.8	The happy flow is tested with every test case that lasts more than 2.5 times the interval.
9.1 [Ref 3]	C	Use case 8.4, 8.5.1, 9.5.6, 9.5.7	The network problems are found through the keep alive messages, which is covered in use case 8.4
9.2 [Ref 3]	C	9.5.1, 9.5.2, 9.5.1, 9.5.2, 9.5.8, 9.5.9, 9.5.10, 9.5.11	
9.3 [Ref 3]	C	8.8.1, 8.8.2, 9.8.1, 9.8.2	
9.4 [Ref 3]	C	9.7.1, 9.7.2	
9.5 [Ref 3]	C	9.5.12, 9.5.13, 9.5.14, **Error! Reference source not found.**, 9.5.15, 9.5.16, 9.5.17, 9.5.18, 9.5.19	
7.1 [Ref 4]	C	8.2.1, 9.4.1, 9.4.2	
7.2 [Ref 4]	C	9.4.4, 9.4.5, 9.5.4	
7.3 [Ref 4]	C	8.5.6, 9.5.3, 9.5.4	
7.4 [Ref 4]	C	8.5.6, 9.5.4	
7.5 [Ref 4]	C	8.5.6, 9.5.5	
7.6 [Ref 4]	C	8.4.2, 9.4.5	Exception 1 is handled in [Ref 9]
7.7 [Ref 4]	C	8.4.4, 8.5.4, 9.4.6, 9.4.7, 9.4.8, 9.4.9, 9.4.10	

7.8 [Ref 4]	C	8.4.4, 9.4.13, 9.4.14	
7.9 [Ref 4]	C	8.3.2, 9.3.1, 9.3.2, 9.5.5	
7.10 [Ref 4]	C	8.2.6 – 8.2.11, 8.5.2 – 8.5.5, 9.2.1, 9.2.2	
7.11 [Ref 4]	C	8.3.2, 8.4.2 – 8.4.5, 8.5.2 – 8.5.7	
7.12 [Ref 4]	C	8.5.5, 9.4.11, 9.4.12	
7.13 [Ref 4]	C	8.3.3	
8.1 [Ref 4]	C	8.5.6	Exception 1 is partially handled in [Ref 9]
8.2 [Ref 4]	C	9.5.8	
8.3 [Ref 4]	C	9.5.20	
8.4 [Ref 4]	C	9.4.11	Exception 1 is handled in [Ref 9]