

Test report No:  
NIE: 65849RTT.001

## Field Test report

### E2E performance testing of parking sensors system

(*) Identification of item tested	E2E Parking System
(*) Trademark	Parking Pilot Sensorsystem
(*) Model and /or type reference	LoRa-Groundsensor
(*) Features	Sensor based detection of Parking Space Occupancystate and Parkingduration measurement in combination with SCS Ticket-Application
Manufacturer	Smart City System GmbH Schwabacher Straße 510c 90763 Fuerth Germany
Test method requested, standard	Test method and test plan developed by DEKRA Testing and Certification S.A.U., according to the test purpose received by Smart City System GmbH. Test setup considerations provided by Smart City System GmbH.
Testing purpose	Validation of the vehicle change detection accuracy of the E2E parking system
Approved by (name / position & signature)	Lourdes Sánchez Espejo Connected Car Services Director
Date of issue	2020-10-08
Report template No	FTT19_02 (*) "Data provided by the client"

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## Introduction

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DEKRA Testing and Certification S.A.U., has received a request from Smart City System GmbH in order to validate the general quality of detection of their E2E parking system. The aim of this request is to perform testing in order to prove that there is no case where their E2E parking system reports an occupation time which exceeds the real occupancy time of the vehicle in the parking spot. The testing also involves the validation of other features such as, reporting always the real arrival time of the vehicles, reporting the real occupancy status, and the influence of external conditions such as different neighbor cars or the disturbances of the magnetic field on the resetting of the real arrival time.

**A test plan has been developed by DEKRA Testing and Certification S.A.U., defining different testing scenarios, which alternate parking and gap durations, and using different vehicles types, either alone at the testing area or with other neighbor vehicles. The Validation of the LoRa communication at different distances between sensors and gateways is out of the scope.**

After customer acceptance, samples have been sent to DEKRA Testing and Certification S.A.U. facilities for installation and posterior calibration by the customer.

## Competences and guarantees

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DEKRA Testing and Certification S.A.U. guarantees the reliability of the data presented in this report, which is the result of the measurements and the tests performed to the item under test on the date and under the conditions stated on the report and, it is based on the knowledge and technical facilities available at DEKRA Testing and Certification S.A.U. at the time of performance of the test.

DEKRA Testing and Certification S.A.U. is liable to the client for the maintenance of the confidentiality of all information related to the item under test and the results of the test.

The results presented in this Test Report apply only to the particular item under test established in this document.

DEKRA Testing and Certification S.A.U. cannot guarantee that the reduced setup, and for the limited duration of the test execution, has shown all possible failure behaviors that the full setup would show in the field

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## General conditions

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1. This report is only referred to the items that have undergone the test.
2. This report does not constitute or imply on its own an approval of the product by the Certification Bodies or competent Authorities.
3. This document is only valid if complete; no partial reproduction can be made without previous written permission of DEKRA Testing and Certification S.A.U.
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## Data provided by the client

The following data has been provided by the client:

1. Information relating to the description of the sample ("Identification of the item tested", "Trademark", "Model and/or type reference tested").
2. Instructions for the placement of the test setup. For more information please refer to attached file "01\_Installation\_of\_the\_Sensorsystem.pdf"
3. Apk file name "ticket\_pilot.apk" installed in an android device in order to track the live occupancy states of the 5 sensors. For more information please refer to attached file "ticket\_pilot\_apk"

DEKRA Testing and Certification S.A.U. declines any responsibility with respect to the information provided by the client and that may affect the validity of results.

## Usage of samples

Samples undergoing test have been selected by: the client

Sample M1/01 is composed of the following elements:

DEKRA Control Nº	Description	Model	Serial Nº	Date of reception
65849B#001	Ground Sensor	Labeled as 01	78639	28/08/2020
65849B#002	Ground Sensor	Labeled as 02	78642	28/08/2020
65849B#003	Ground Sensor	Labeled as 03	78647	28/08/2020
65849B#004	Ground Sensor	Labeled as 04	78645	28/08/2020
65849B#005	Ground Sensor	Labeled as 05	78637	28/08/2020
65849B#010	Gateway Box	-	75954	28/08/2020
65849B#011	Gateway Box	-	75880	28/08/2020

All Samples have undergone total or partially the test(s) specified in subclause "Test method requested".

### 3 Different type of vehicles have been needed to perform the testing:

- Vehicle A: BMW Serie 3 320d Automatic
- Vehicle B: Seat Ibiza 1.0 MPI 75 CV of the year 2017
- Vehicle C: Renault Megan Berlina Life Energy dci 90 of the year 2014



## Test sample description

The test sample consists of ground sensors and gateway boxes

## Identification of the client

Smart City System GmbH  
Schwabacher Straße 510c 90763 Fuerth Germany

## Test Plan and Test Setup

The test purpose, as indicated by Smart City System GmbH, was to ensure that the sensor-based parking-duration-recordings never exceed the actual time that the cars are located in the parking. The recorded durations must be sufficiently reliable to punish violation concerning exceeding of allowed parking-duration. Therefore, the recorded durations must not exceed the real parking durations in any case. The testing also involves the validation of other features such as, reporting always the real arrival time of the vehicles, reporting the real occupancy status, and the influence of external conditions such as different neighbor cars or the disturbances of the magnetic field on the resetting of the real arrival time. For more information, please refer to "99\_PP\_Systemdescription\_general.pdf".

The test plan used for this validation has been developed by DEKRA Testing and Certification S.A.U., according to the test purpose indicated above. The following aspects have been taken into account:

- Usage of different vehicles
- Different positions of the vehicles during the testing
- Different number of neighbor vehicles
- The use of the 5 sensors units available during the testing, to ensure the functioning of all testing elements

With these considerations in mind, the following test plan was defined:

E2E Parking System Field Testing Plan					
Scenario 1: Vehicle A as a main vehicle, alone at the parking and with others vehicles around					
Test Case	Iteration Number	Location of neighbour vehicle	Distance of the gateway	Vehicle ID	Description
1	1	N/A	10m	A	Vehicle parked for 1min, leave the parking for 10 sec and then return to the parking
1	2	N/A	10m	A	Vehicle parked for 1min, leave the parking for 10 sec and then return to the parking
1	3	N/A	10m	A	Vehicle parked for 1min, leave the parking for 10 sec and then return to the parking
2	1	N/A	10m	A	Vehicle parked for 2min, leave the parking for 20 sec and then return to the parking
2	2	N/A	10m	A	Vehicle parked for 2min, leave the parking for 20 sec and then return to the parking
2	3	N/A	10m	A	Vehicle parked for 2min, leave the parking for 20 sec and then return to the parking
3	1	N/A	10m	A	Vehicle parked for 5min, leave the parking for 1min and then return to the parking
3	2	N/A	10m	A	Vehicle parked for 5min, leave the parking for 1min and then return to the parking

3	3	N/A	10m	A	Vehicle parked for 5min, leave the parking for 1min and then return to the parking
4	N/A	Left (C)	10m	A	Vehicle parked for 15min, leave the parking for 5min and then return to the parking
5	N/A	Right (C)	10m	A	Vehicle parked for 40min, leave the parking for 10min and then return to the parking
6	N/A	Left/Right (B/C)	10m	A	Vehicle parked for 1 hour then leave the parking
<b>Scenario 2: Vehicles B and C as main vehicles</b>					
7	1	Left (C)	10m	B	Vehicle parked for 1min, leave the parking for 10 sec and then return to the parking
7	2	Left (C)	10m	B	Vehicle parked for 1min, leave the parking for 10 sec and then return to the parking
7	3	Left (C)	10m	B	Vehicle parked for 1min, leave the parking for 10 sec and then return to the parking
8	1	Right (B)	10m	C	Vehicle parked for 2min, leave the parking for 20 sec and then return to the parking
8	2	Right (B)	10m	C	Vehicle parked for 2min, leave the parking for 20 sec and then return to the parking
8	3	Right (B)	10m	C	Vehicle parked for 2min, leave the parking for 20 sec and then return to the parking
9	1	N/A	10m		Vehicle parked for 5min, leave the parking for 1min and then return to the parking
9	2	N/A	10m		Vehicle parked for 5min, leave the parking for 1min and then return to the parking
9	3	N/A	10m	B	Vehicle parked for 5min, leave the parking for 1min and then return to the parking
10	N/A	Left/Right (A/B)	10m	C	Vehicle parked for 10min, leave the parking for 5min and then return to the parking
11	N/A	Right (A)	10m	B	Vehicle parked for 40min, leave the parking for 10min and then return to the parking
12	N/A	Left (A)	10m	C	Vehicle parked for 1 hour then leave the parking

Additionally, in order to test more variety of parking durations of the E2E parking system, the following 5 extra tests cases were posteriorly added to the test plan:

<b>Extra test cases</b>					
Test Case	Iteration Number	Location of neighbour vehicle	Distance of the gateway	Vehicle ID	Description
13	N/A	N/A	10m	C	Vehicle parked for 1h30 then leave the parking
14	N/A	N/A	10m	C	Vehicle parked for 15min then leave the parking
15	N/A	N/A	10m	A	Vehicle parked for 10sec and then leave the parking
16	N/A	N/A	10m	A	Vehicle parked for 20sec and then leave the parking
17	N/A	N/A	10m	A	Vehicle parked for 30sec and then leave the parking

Testing to be performed outdoors.

The test setup instructions were provided by Smart City System as follows:

- The placement of both gateways together and connected permanently with a minimum high of 4 meters and no further than 30 meters for an optimal functioning
- The 5 sensors placed in row, one per parking space
- The E2E system composed by 5 sensors and 2 gateways
- Each parking space with a width of 2.5 meters
- The placement of the sensors should be 1.2 meters on the opposite side of the vehicle entrance
- Power lines should not be present under the parking spaces
- Test execution limited to one working day.

For testing verdicts, considerations below have been taken into account according to Smart City System instructions:

- Vehicle change detections (and the consequent ticketing for final users) are identified by reset operations of the arrival time.
- An early reset of the arrival time is not considered a failure, as it would not generate an undeserved ticket for the final user
- Occupancy states not updated do not mean that a vehicle change detection has been missed

## Testing period and place

Test Location	DEKRA Testing and Certification S.A.U.
	Málaga 36.747910 – 4.5555303
Date (start)	2020-09-15 – 8:00
Date (finish)	2020-09-15 – 17:00

## Document history

Report number	Date	Description
65849BRTT.001	2020-10-08	First release

## Remarks and comments

After the test setup installation according to customer instructions, the test setup had to be calibrated by the customer in a scenario where no vehicles were available 5 meters around the sensors. The test setup calibration took 3 hours approximately.

All testing has been recorded with the camera provided by the customer as requested.

## Environmental conditions

Field trials are executed in live network, outdoors, and with the environmental conditions below, (uncertainty of  $\pm 5^{\circ}\text{C}$ ):

Temperature	Min. = $19^{\circ}\text{C}$
	Max. = $28^{\circ}\text{C}$

## Testing verdicts

Not applicable.. :	N/A
Pass .....	PASS
Fail .....	Fail
Delayed.....:	Delayed
Not measured .. :	N/M

## Summary

The recorded parking duration, calculated as the difference between two consecutive reset operations of the arrival time, did not exceed the real parking duration in 100% of the test cases executed. There was no vehicle change the system did not detect.

In one case, specifically test case nº9, the occupancy state detection was delayed for a few minutes, nevertheless the parking duration measurement worked correctly.

In every case when a car was moved onto the parking space, the arrival time was correctly set.

The test results along with all relevant information can be found on the enclosed test plan in Appendix A.

## Appendix A: Test results

E2E Parking System Field Testing Plan											
Scenario 1: Vehicle A as a main vehicle, alone at the parking and with others vehicles around											
Test Case	Iteration Number	Location of neighbour vehicle	Distance of the gateway	Vehicle ID	Description	Reality: occupancy state	Sensorsystem: occupancy state	Parking spaces	Verdict "Vehicle-Change Detection"	Verdict "Occupancy-state"	Comments
1	1	N/A	10m	A	Vehicle parked for 1min, leave the parking for 10 sec and then return to the parking	Occupied	Occupied	2	PASS	PASS	N/A
1	2	N/A	10m	A	Vehicle parked for 1min, leave the parking for 10 sec and then return to the parking	Occupied	Occupied	2	PASS	PASS	N/A
1	3	N/A	10m	A	Vehicle parked for 1min, leave the parking for 10 sec and then return to the parking	Occupied	Occupied	2	PASS	PASS	N/A
2	1	N/A	10m	A	Vehicle parked for 2min, leave the parking for 20 sec and then return to the parking	Occupied	Occupied	2	PASS	PASS	N/A
2	2	N/A	10m	A	Vehicle parked for 2min, leave the parking for 20 sec and then return to the parking	Occupied	Occupied	3	PASS	PASS	N/A

2	3	N/A	10m	A	Vehicle parked for 2min, leave the parking for 20 sec and then return to the parking	Occupied	Occupied	4	PASS	PASS	N/A
3	1	N/A	10m	A	Vehicle parked for 5min, leave the parking for 1min and then return to the parking	Occupied	Occupied	4	PASS	PASS	N/A
3	2	N/A	10m	A	Vehicle parked for 5min, leave the parking for 1min and then return to the parking	Occupied	Occupied	1	PASS	PASS	N/A
3	3	N/A	10m	A	Vehicle parked for 5min, leave the parking for 1min and then return to the parking	Occupied	Occupied	1	PASS	PASS	N/A
4	N/A	Left (C)	10m	A	Vehicle parked for 15min, leave the parking for 5min and then return to the parking	Occupied	Occupied	4 & 5	PASS	PASS	N/A
5	N/A	Right (C)	10m	A	Vehicle parked for 40min, leave the parking for 10min and then return to the parking	Occupied	Occupied	2 & 3	PASS	PASS	N/A
6	N/A	Left/Right (B/C)	10m	A	Vehicle parked for 1 hour then leave the parking	Occupied	Occupied	2 & 3 & 4	PASS	PASS	N/A
<b>Scenario 2: Vehicles B and C as main vehicles</b>											
7	1	Left (C)	10m	B	Vehicle parked for 1min, leave the	Occupied	Occupied	3 & 4	PASS	PASS	N/A

					parking for 10 sec and then return to the parking						
7	2	Left (C)	10m	B	Vehicle parked for 1min, leave the parking for 10 sec and then return to the parking	Occupied	Occupied	3 & 4	PASS	PASS	N/A
7	3	Left (C)	10m	B	Vehicle parked for 1min, leave the parking for 10 sec and then return to the parking	Occupied	Occupied	3 & 4	PASS	PASS	N/A
8	1	Right (B)	10m	C	Vehicle parked for 2min, leave the parking for 20 sec and then return to the parking	Occupied	Occupied	1	PASS	PASS	N/A
8	2	Right (B)	10m	C	Vehicle parked for 2min, leave the parking for 20 sec and then return to the parking	Occupied	Occupied	1	PASS	PASS	N/A
8	3	Right (B)	10m	C	Vehicle parked for 2min, leave the parking for 20 sec and then return to the parking	Occupied	Occupied	1	PASS	PASS	N/A
9	1	N/A	10m		Vehicle parked for 5min, leave the parking for 1min and then return to the parking	Occupied	Occupied	3	PASS	PASS	N/A
9	2	N/A	10m		Vehicle parked for 5min, leave the parking for 1min	Occupied	Occupied	3	PASS	PASS	N/A



					and then return to the parking						
9	3	N/A	10m	B	Vehicle parked for 5min, leave the parking for 1min and then return to the parking	Occupied	Occupied	3	PASS	Delayed*	* After taking back the vehicle from parking space nº 3, the dashboard remained displaying the sensor system occupancy state "occupied", and reset its arrival time. Afterwards, the vehicle was placed on the parking space nº3 again and we see the same behavior, with the dashboard resetting the arrival time and maintaining the sensor system occupancy state "occupied". The operation was repeated 2 more times with the same results. After a duration of approximately 10min, the sensor recovered its correct state, which was free in that instant.
10	N/A	Left/Right (A/B)	10m	C	Vehicle parked for 10min, leave the parking for 5min and then return to the parking	Occupied	Occupied	2 & 3 & 4	PASS	PASS	N/A
11	N/A	Right (A)	10m	B	Vehicle parked for 40min, leave the parking for 10min	Occupied	Occupied	1 & 2	PASS	PASS	N/A

					and then return to the parking						
12	N/A	Left (A)	10m	C	Vehicle parked for 1 hour then leave the parking	Occupied	Occupied	4 & 5	PASS	PASS*	<p>* After approximately 45 min, vehicle A engine was started, without moving it from its parking space. As a result, the system reset the arrival time. This happened only once in this test case Note: According to discussions with Smart City System, this is expected behavior according to the system design. Once, started, the vehicle is causing electromagnetic field disturbances. It is decided to reset the arrival time in order to be on the safe side.</p>
Extra test cases											
13	N/A	N/A	10m	C	Vehicle parked for 1h30 then leave the parking	Occupied	Occupied	3	PASS	PASS	N/A
14	N/A	N/A	10m	C	Vehicle parked for 15min then leave the parking	Occupied	Occupied	3	PASS	PASS	N/A
15	N/A	N/A	10m	A	Vehicle parked for 10sec and then leave the parking	Occupied	Occupied	1	PASS	PASS	N/A

16	N/A	N/A	10m	A	Vehicle parked for 20sec and then leave the parking	Occupied	Occupied	2	PASS	PASS	N/A
17	N/A	N/A	10m	A	Vehicle parked for 30sec and then leave the parking	Occupied	Occupied	2	PASS	PASS	N/A

## Appendix B: Photographs

**Sensors and Gateways locations:**



**Sensors and Gateways locations:**



**Vehicles employed for the testing:**





**Some Inspections App occupancy states:**

