



Connected Places Catapult

Requirements Capture

December 2019

Autonomous Valet Parking

Version Number	Reason for Update	Updated By	Date
0.1	First release	Maysun Hassanaly	28/10/2018
1.0	Testing in a controlled environment	Maysun Hassanaly	26/03/2019
2.0	Testing in a car park	Maysun Hassanaly	21/11/2019
2.1	Ready for Publication	Maysun Hassanaly	19/12/2019

Description:

The requirements' purpose is to capture the project objectives in clear, unambiguous statements that can be tested and demonstrated throughout the programme.

This document provides the user, and more generally stakeholders, requirements for the system as compiled from workshops, documentation and discussions with individual stakeholders.

The first page lists all the requirements for the project milestones. The next pages list the requirements for testing in a controlled environment, and lastly the requirements for testing in a controlled car park. This is a live document, and the requirements are continuously being updated, verified, and validated.

The requirements define the benchmark against which the solution will be verified and the requirements will be managed throughout the project lifecycle through the Verification & Validation (V&V) process in order to demonstrate that the project has met its objectives upon completion.

The requirements are based on the system operational concept and are used to direct the development of the system architecture, system design and verification and validation.

Changes may be made following:

- Updates to the Project Scope
- Output of the System Design process
- Comments received following requirements review
- Site specific elicitation sessions

The purpose of verification and validation (V&V) activities is to ensure that the project meets its objectives. Verification and validation activities support System Assurance and provide evidence for the safety case as well as providing evidence to stakeholders to demonstrate their requirements have been met.

Each requirement will be assessed to determine what evidence and at what stages of the project the design must be verified/validated.

Most requirements in the document will need to be verified during the design review and demonstrated by inspection or test before and during trial.

Notice

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FUNDING:

The Autonomous Valet Parking project is part-funded by the Centre for Connected and Autonomous Vehicles (CCAV), delivered in partnership with Innovate UK. It is part of the government's £100 million Intelligent Mobility Fund, supporting the Future of Mobility Grand Challenge.

As a key part of the UK government's modern Industrial Strategy, the Future of Mobility Grand Challenge was announced in 2017 to encourage and support extraordinary innovation in UK engineering and technology, making the UK a world leader within the transport industries.

This includes facilitating profound changes in transport technologies and business models, to make the movement of people, goods and services across the nation greener, safer, easier and more reliable.

Innovate UK



Centre for Connected
& Autonomous Vehicles

Attribute	Description
ID	Unique identifier.
Requirement Text	The actual requirement text, constructed and formatted in accordance with the Requirements Quality and Style Guidelines
Life Cycle	Stage Gate requirements needs to be Verified / Validated
Object Type	Informs reader whether the Requirement Statement is either a Requirement, Information or a Heading.
Rationale	Justification for the existence of the requirement and for any parameters specified within the requirement text.
Source	Stakeholder (individual or organisation) or source document for the requirement.
Supporting Information	Any additional information which provides clarification, context or indicative solutions.
Acceptance Criteria	Defines what evidence is required to assure the requirement owner that their need has been delivered.
Stakeholder	Owner of the requirement
Verification Method	<p>According to ISO29148, there are four standard methods to verify that requirements have been fulfilled:</p> <ul style="list-style-type: none"> * Analysis (including modelling and simulation) - use of analytical data or simulations under defined conditions to show theoretical compliance * Inspection - an examination of the item against applicable documentation to confirm compliance with requirements. * Demonstration - a qualitative exhibition of functional performance, usually accomplished with no or minimal instrumentation or test equipment * Test - an action by which the operability, supportability, or performance capability of an item is quantitatively verified when subjected to controlled conditions that are real or simulated
Status	<p>The Universal Modeling Language (UML), on which SysML is based, defines five verdicts that can be assigned to a verification activity, these are</p> <ul style="list-style-type: none"> * none - The test case has not been executed yet. * pass - The system under test adheres to the expectations. * inconclusive - The evaluation cannot be evaluated to be pass or fail. * fail - The system under test differs from the expectation. * error - An error has occurred within the testing environment.
V&V evidence	Document Reference and link to evidence (and highlight section of document which is relevant)
Satisfactory Argument	Explanation if requirement not satisfied (impact on project)

AUTONOMOUS VALET PARKING - REQUIREMENTS

ID	Requirement Text	Object Type	Rationale	Source	Supporting Information	Acceptance Criteria	Stakeholder	V&V Method	V&V Gateway (Prior to)	V&V Status	V&V evidence	Satisfactory Argument	Test Cases	Status Based on Previous (Controlled Environment) testing	Safety Critical
Path Planning															
1	The vehicle shall be able to successfully navigate a preset route, including straight sections of lanes in the Parking, left and right bends, and entering relatively tightly spaced parking bay.	Requirement	Needed to deliver the overall project objectives as described in the operational concept for the Autonomous Valet Parking system	Requirement workshop 04/06/2018	This is part of the RAMS	Demonstration by simulation and test drive	Parkopedia	Testing and Demonstration	Testing in closed/semi closed car park, Static Environment				Demonstrate that the vehicle can navigate a preset route, including straight sections of road, left and right bends, and entering relatively tight spaces.		Yes
Trajectory Control															
Sub-heading															
3	The system shall plan a route by producing incremental 1m goals using a combination of location data and route file data.	Requirement	To avoid path error propagation (due to inaccurate localisation) and allow correct path recovery	Additional Requirement	Small incremental goals allow rapid trajectory correction by recalculating path at high frequency.	Demonstration by simulation and test drive	Parkopedia	Analysis Demonstration	Testing in closed/semi closed car park, Static Environment				TBC		No
Localisation															
Sub-sub-heading															
5	The system shall provide location estimate at a minimum of 10 Hz	Requirement	To permit the system to calculate its global position with a minimal error	Requirement workshop 04/06/2018	The system need to generate a point cloud with hundreds of thousands of points, updated at approximately 10 Hz	Demonstration by simulation and test drive Frequency achieved 99% of the time over 5 minutes test period	Parkopedia University of Surrey	Analysis and Testing	Testing in closed/semi closed car park, Static Environment				Demonstrate that the location estimation is at minimum of 10 Hz		No
6	The localisation system shall be used to determine the accurate vehicle position. (accuracy of 10 cm)	Requirement	To improve the robustness and reliability of the systems	Requirement workshop 04/06/2018	Visual odometry is the process of determining the position and orientation of the vehicle by analyzing the associated camera images and sensors	Demonstration by simulation and test drive	Parkopedia University of Surrey	Testing and Demonstration	Testing in closed/semi closed car park, Static Environment				Demonstrate that the localisation has an accuracy of 10cm		Yes
Categorisation															
Sub-sub-heading															
13	The system shall be able to detect static objects	Requirement	To be able to draw an obstacle-free path, recognise waypoints and avoid accidents.	Requirement workshop 04/06/2018	Perception feature to categorise car park elements for the vehicle (wall, parking spots, non-available parking spots, entry, exits, etc) Perception feature to categorise dynamic object for the vehicle (pedestrian, other cars, etc)	Testing/check and compare with the car park map/structure	Parkopedia	Testing and demonstration	Testing in closed/semi closed car park, Static Environment				Demonstrate that the system is able to detect static objects in the car park		Yes
Simulation															
Sub-sub-heading															
32	The full software stack shall be testable in a physical simulator	Requirement	To recreate virtual scenarios on the test track, to improve overall system performance	Requirement workshop 04/06/2018	N/A	Simulation running full stack as if on a real car	Parkopedia	Analysis	Testing in closed/semi closed car park, Static Environment				N/A		No
Failsafe															
Sub-heading															
34	Each module shall consider their inputs and raise an error condition if outside of the normal range (20cm Deviation)	Requirement	To detect and recover from computer malfunctions	Requirement workshop 04/06/2018	This function is used to check module performance and error.	Request vehicle safe stop	Parkopedia	Analysis, Testing and Demonstration	Testing in closed/semi closed car park, Static Environment				In case of deviation from planned path is above 20 cm driver will notified. Demonstrate that the safety driver can take over in the event of a failure.		No
36	In the event of an error condition (30cm deviation), the system will handover control to the safety driver or come to emergency stop & come out of autonomous mode	Requirement	To prevent and avoid any injury or accident	Meeting 21/03/2019	The method statement will capture this. In addition, the alarm system will inform the driver of the vehicle status.	Demonstration Visible alarm (3 colours diode)	Parkopedia	Testing and demonstration	Testing in closed/semi closed car park, Static Environment				In case of deviation from planned path is above 30cm, vehicle will break (one time break & will need manual intervention to take control) & come out of autonomous mode.		Yes
37	In case of a breach of the virtual safety cage, the vehicle will come to an immediate stop and handover control to the safety driver	Requirement	To prevent and avoid any injury or accident	Meeting 21/03/2020	The method statement will capture this. In addition, the alarm system will inform the driver of the vehicle status.	Demonstration Visible alarm (3 colours diode)	Parkopedia	Testing and demonstration	Testing in closed/semi closed car park, Static Environment				Demonstrate on breach of the virtual safety cage, the vehicle will come to an immediate stop and handover control to the safety driver		Yes
Testing area															
Heading															
42	The testing area shall be made safe for any kind of agreed user (car park users, staff, safety driver, car driver, media etc)	Requirement	To prevent and avoid any injury	Requirement workshop 04/06/2018	A RAMS document will be submitted for each car park test	Car park check	CPC Parkopedia	Inspection	Testing in closed/semi closed car park, Static Environment				N/A		Yes
129	The trial shall happen in good visibility	Requirement	To prevent and avoid any injury and sensor malfunction	Additional Requirement 05/11/2018	Adverse weather such as heavy rain or snow could hinder driver safety/wellbeing and the trial shall be postponed. However, the trial may proceed in light to medium rain.	Car park check	Parkopedia	Inspection	Testing in closed/semi closed car park, Static Environment				N/A		Yes
Vehicle															
Sub-heading															

AUTONOMOUS VALET PARKING - REQUIREMENTS

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49	The system shall allow the vehicle to have several operating states: "autonomous drive", "e-stop" & "manual". Those states which shall be clearly visible and known to the Safety Driver at anytime.	Requirement	To allow the vehicle to be overridden or stopped in the event of malfunction or failure, or other. The safety driver shall make known of these modes and trained in the event of having to switch between the modes.	Requirement workshop 04/06/2018	Before entering the car park, the vehicle will be in manual operating mode, the autonomous drive will be switched on when the vehicle drops the driver.	Correct state information provided to safety driver. Information is visible and can be read from outside of the vehicle.	Parkopedia	Inspection, Testing	Testing in closed/semi closed car park, Static Environment				Demonstrate ACS integration with the vehicle HMI and correct state information provided to safety driver. Demonstrate clearly visible and known even from outside of the vehicle.		Yes
Speed Subheading															
50	The maximum driving speed is 10 mph for manual Mode. The maximum driving speed is 5 mph for Autonomous Mode	Requirement	This is the maximum driving speed in car parks. This also ensure that the vehicle is able to stop for all hazards, bearing in mind the time required for the system to track an object, decide a response, and actuate the brakes.	Meeting 21/03/2019	The software shall set the maximum driving speed to 10 mph. The safety driver shall override manually if they feel that the speed, acceleration or path of the vehicle are unsafe.	Trials are conducted within the speed limit.	Parkopedia	Inspection, Testing	Testing in closed/semi closed car park, Static Environment				Demonstrate speed limits are respected		No
Safety Case Subheading															
52	A safety case shall be produced and updated for each stage of the trials	Requirement	To ensure safety	Requirement workshop 04/06/2018	The safety case will comprise of a RAMS document and a method statement for each of the trial phase	Method statement Safety Case	CPC	Inspection	Testing in closed/semi closed car park, Static Environment				N/A		Yes
Safety Driver Control Sub-sub-heading															
38	The safety driver must take manual control in the events of failures or activities that the vehicle cannot support (eg. Stop the vehicle to check something or speak to the team)	Requirement	To prevent and avoid any injury or accident	Additional Requirement 05/11/2018	Indicated in the Method Statement. Safety Driver must take manual if there is a need to.	Safety driver able to take over on time	Parkopedia	Testing and demonstration	Testing in closed/semi closed car park, Static Environment				Inject a hardware failure and demonstrate that the safety driver can take over safely.		Yes
39	The safety driver must be able to take control of the vehicle at all times, when handed over	Requirement	To prevent and avoid any injury or accident	Additional Requirement 05/11/2018	Indicated in the Method Statement. Safety Driver must take manual if there is a need to.	Safety driver able to take over on time	Parkopedia	Testing and demonstration	Testing in closed/semi closed car park, Static Environment				Demonstrate during the trials safety driver can take control in various scenarios when handed over.		Yes
Healthy Sub-sub-heading															
54	The safety driver shall be able to drive, is licensed, has a good vision and is a healthy individual (shall not be under the influence of illegal drugs or legal medicines that preclude driving for medicines that can cause drowsiness and could potentially be incompatible with driving, the discretion of the driver should be used to judge whether they are affected), and shall not exceed the legal limit for blood alcohol concentration	Requirement	To make sure the safety driver is competent and able to react as required, to avoid accidents and/or injuries	Requirement workshop 04/06/2018	N/A	Medical check License check Driving Test	Parkopedia Safety Driver	Inspection	Testing in closed/semi closed car park, Static Environment				N/A		Yes
Trial duration Sub-sub-heading															
130	The safety driver shall not drive for more than 2 hours continuously without taking a break of at least half an hour.	Requirement	2 hours of trials require a great amount of focus from the Safety Driver.	Additional Requirement 05/11/2018	The safety driver and/or the Trial Engineer have the right to stop the trial drive at any time when they do not feel comfortable.	Trial is stopped after 2 hours of driving	Parkopedia	Inspection	Testing in closed/semi closed car park, Static Environment				N/A		Yes
Training Sub-sub-heading															
55	The safety driver shall be trained on the functionality of the system	Requirement	To enable the driver to select the appropriate commands whenever needed and understand the vehicle and the AVP technology	Requirement workshop 04/06/2018	The safety driver shall not use their mobile phone while vehicle is in motion, control any the equipment (e.g. radio) or eat while driving. A Trial Engineer will be present at all times to monitor data and make computer inputs as required. This role may be done from within or outside the vehicle; however, if the Trial Engineer is outside the vehicle, they must have a radio/ walkie-talkie or other such means to communicate verbally with the driver.	Training material System description document Method Statement	Parkopedia StreetDrone Safety Driver	Testing and demonstration	Testing in closed/semi closed car park, Static Environment			Method Statement Driving tests	Demonstrate that the safety driver and trial engineer acts as expected		Yes
56	The safety driver shall be trained to drive the vehicle in a safe manner	Requirement	To make sure no other car park user is harmed in the event of a failure or malfunction, to make sure the vehicle behaves as planned	Requirement workshop 04/06/2018	N/A	Driving Test Training	Parkopedia StreetDrone Safety Driver	Testing and demonstration	Testing in closed/semi closed car park, Static Environment				Demonstrate that the safety driver is able to drive the vehicle conforming to the training		Yes
57	The driver shall be trained according to the requirements of the Car Parking operator	Requirement	To respect the testing ground operator's safety guidelines and requirements, and avoid any risks or disputes.	Requirement workshop 04/06/2018	N/A	RAMS agreed by car park operator	Parkopedia	Inspection	Testing in closed/semi closed car park, Static Environment				N/A		Yes
131	All Safety Drivers shall have no more than 6 penalty points on their driving license	Requirement	To ensure the safety driver is capable	CPC prior project experience requirement	N/A	Requirement checked	Parkopedia	Inspection	Testing in closed/semi closed car park, Static Environment				N/A		Yes
132	The Safety Driver shall have never been disqualified from driving	Requirement	To ensure the safety driver is capable	CPC prior project experience requirement	N/A	Requirement checked	Parkopedia	Inspection	Testing in closed/semi closed car park, Static Environment				N/A		Yes
133	The Safety Driver shall gain familiarity with the vehicle on a private test rack before testing on the public road	Requirement	To build up confidence for the safety driver	CPC prior project experience requirement	N/A	Testing ground-operator sign-off on training Test Report	Parkopedia	Inspection	Testing in closed/semi closed car park, Static Environment				N/A		Yes
Safety Subheading															
134	The Safety Driver must wear seatbelts at all times that the vehicle is in motion	Requirement	To ensure the safety driver's safety	CPC prior project experience requirement	N/A	Safety Driver wear their seatbelts when the vehicle is in motion	Parkopedia	Inspection	Testing in closed/semi closed car park, Static Environment				N/A		Yes
Operational Environment Subheading															
78	The operational environment shall be suitable to ensure research questions and project dissemination objectives can be met safely.	Requirement	N/A	Requirement workshop 04/06/2018	N/A	Testing environment chosen to suit the trial objectives	Parkopedia	Inspection	Testing in closed/semi closed car park, Static Environment				Car Park is Chosen to make sure research questions and project dissemination objectives can be met safely.		No
Vehicle		Heading													

AUTONOMOUS VALET PARKING - REQUIREMENTS

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Sensors Sub-heading															
98	Visual and inertial sensors available, with extrinsic calibration	Requirement	N/A	Requirement workshop 04/06/2018	N/A	Sensor fusion can be performed reliably	StreetDrone Parkopedia University of Surrey	Testing and demonstration	Testing in closed/semi closed car park, Static Environment				N/A		No
100	Vehicle shall not be capable of powered movement when any e-stop (autonomous stop & manual by safety driver in Vehicle) is engaged.	Requirement	To limit or avert harm to someone or something in emergency conditions	Parkopedia High Level Vehicle Architecture	The Auto Safe Stop (AS) will quickly stop the vehicle in case of red-zone collision hazards	Vehicle does not move after the stop functionality is engaged	Parkopedia	Testing and demonstration	Testing in closed/semi closed car park, Static Environment				Demonstration by showing that the vehicle does not move when the e-stop is engaged (eg. Provide acceleration/steering data)		Yes
101	The vehicle shall have the means of bringing itself to a complete stop in the event of an emergency.	Requirement	To avoid an accident.	Parkopedia High Level Vehicle Architecture	The Auto Safe Stop (AS) will quickly stop the vehicle in case of red-zone collision hazards or performing a safe-stop when the failsafe and recovery is activated.	Vehicle in complete stop after emergency	Parkopedia	Testing and demonstration	Testing in closed/semi closed car park, Static Environment				Demonstration by injecting a braking request (eg. Placing an obstacle in the vehicle path)		Yes
102	The vehicle shall have a failsafe system capable of holding the vehicle stationary on a slope	Requirement	To limit or avert harm to someone or something in emergency conditions on a slope.	Additional Requirement	The Auto Safe Stop (AS) will quickly stop the vehicle in case of red-zone collision hazards	Vehicle does not move when stopping on the slope	Parkopedia	Testing and demonstration	Testing in closed/semi closed car park, Static Environment				Demonstration by showing that the vehicle does not move on a slope (eg. Provide acceleration/steering data)		Yes
Signal Sub-heading															
105	The vehicle shall be able to auto-signal	Requirement				Giving out signal to other road users	StreetDrone	Testing and demonstration	Testing in closed/semi closed car park, Static Environment				Demonstrate that the vehicle is		
Commands Sub-sub-heading															
108	The vehicle shall be able to transition from forward to reverse and vice-versa under autonomous control without intervention.	Requirement	To give more autonomy to the vehicle without having the safety driver to intervene	Requirement workshop 04/06/2018	N/A	The vehicle is able to transition from forward to reverse and vice-versa under autonomous control without intervention.	StreetDrone Parkopedia	Testing	Testing in closed/semi closed car park, Static Environment				Test capability of transitioning from forward to reverse and vice-versa under autonomous control without intervention		No
109	The vehicle shall accept instructions to set the steering angle and throttle over the CAN bus.	Requirement	To give more autonomy to the vehicle without having the safety driver to intervene	Requirement workshop 04/06/2018	The CAN bus will send information to the vehicle which will physically execute the commands	The vehicle accepts instructions to set the steering angle and throttle over the CAN bus.	StreetDrone Parkopedia	Testing and demonstration	Testing in closed/semi closed car park, Static Environment				Test the CAN bus by making sure the vehicle executes the right command (send a random break/accelerate/steer command and demonstrate that the vehicle executes it)		Yes
110	The commands shall include the steering angle, reverse, brake, speed etc	Requirement	To give more autonomy to the vehicle without having the safety driver to intervene	Requirement workshop 04/06/2018	Those are the most necessary commands the software sends to the vehicle	The commands include the steering angle, reverse, brake, speed etc (to be defined)	StreetDrone Parkopedia	Inspection	Testing in closed/semi closed car park, Static Environment				Demonstrate the vehicle responds correctly to the commands		Yes
Check Sub-heading															
136	The vehicle shall be inspected to ensure it is in good condition at least once per 5 days of testing (e.g. check tyre pressures, all equipment secure, fluid levels correct etc.)	Requirement	To ensure the vehicle is in good condition prior to trials	CPC prior project experience requirement	N/A	Vehicle is inspected at least once per 5 days of testing	Parkopedia	Inspection	Testing in closed/semi closed car park, Static Environment				N/A		Yes
Mobile application															
Operating Software Compatibility Sub-heading															
80	The mobile application shall run on the Android operating system	Requirement	N/A	Requirement workshop 04/06/2018	N/A	Testing_deploy on the Android operating software	Parkopedia	Testing and demonstration	Testing in closed/semi closed car park, Static Environment				Demonstrate that the app works on Android systems		No
Mobile Phone Dataspeed Sub-heading															
61	Mobile reception (or wi-fi) shall be available in the pick-up/drop-off location	Requirement	The driver will be dropped off and picked-up at the drop-off and pick-up location, where they will activate the parking or pick-up features on the app, which require connectivity	Requirement workshop 04/06/2018	The AVP system will only work in car parks with connectivity enabled.	Mobile reception works and app can be functional	Parkopedia	Testing and demonstration	Testing in closed/semi closed car park, Static Environment				- Demonstrate that mobile reception works in the pick-up/drop-off location by checking signal - Demonstrate that safety driver is able to take over when signal logs off		No
Driver / user Sub-heading															
40	The app shall allow the user to select a pre-programmed destinations entered via the "route file" and then provide the user with visual/audible guidance from the current location to the selected destination.	Requirement	To show/tell the path to the parking spot to the safety driver/engineer, to ensure the vehicle is following the right direction	Requirement workshop 04/06/2018	The screen visualisation will be placed inside or outside of the vehicle and display the route. The safety driver should not be distracted by the screen and therefore the Engineer will have the responsibility of monitoring the screen, inside or outside of the vehicle.	Demonstrate ACS integration with user App and correct guidance provided to user. Test base vehicle implementation.	Parkopedia	Testing and demonstration	Testing in closed/semi closed car park, Static Environment				Demonstrate that the vehicle shows correct guidance		No
User interface / Identification Sub-heading															
20	The software shall allow the user ID to help user and vehicle to identify each other	Requirement	To enable a unique user/vehicle authentication	Requirement workshop 04/06/2018	N/A	User ID feature built in	Parkopedia	Testing and demonstration	Testing in closed/semi closed car park, Static Environment				Demonstrate the secure pairing feature by trying to pair the app with another vehicle and demonstrate the user receives notifications from their vehicle and is able to control it.		No
21	The software shall have a user log-in	Requirement	To enable the user to gain access safely with a unique user ID	Requirement workshop 04/06/2018	The software will have a username/ID and password feature	Testing if log-in works Check that a log-in feature and registration has been built	Parkopedia	Testing	Testing in closed/semi closed car park, Static Environment				Software log-in testing		No
22	The mobile app shall be paired with a unique QR code	Requirement	To enable a unique user/vehicle authentication	Meeting CPC-Parkopedia 16/08/2018	A unique QR code will be placed at the back of the vehicle	Pairing successful	Parkopedia	Testing and demonstration	Testing in closed/semi closed car park, Static Environment				Demonstrate the secure pairing feature by trying to pair the app with another vehicle and demonstrate the user receives notifications from their vehicle and is able to control it.		No
Notification Sub-heading															

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84	The app shall notify the driver when it reaches the destination	Requirement	To inform the driver the parking activity has been completed.	Requirement workshop 04/06/2018	Additional information can be supplied to the driver, such as parking spot, and location on a map.	Notification received within a few seconds	Parkopedia	Testing and demonstration	Testing in closed/semi closed car park, Static Environment				Demonstrate: 1. That a notification has been sent and received to the user 2. The notification was received within a few seconds 3. The notification includes the relevant information		No
85	The app shall indicate when it has a live connection to the vehicle software	Requirement	To indicate to the driver that the AVP feature can be switched on	Requirement workshop 04/06/2018	When there is no connection, the user shall not be able to press the app functions	An icon/colour scheme changes when the connection changes from "dead" (no heartbeat) to live, and vice-versa	Parkopedia	Testing and demonstration	Testing in closed/semi closed car park, Static Environment				Demonstrate: 1. That the app is functional when the connection the vehicle software is live 2. The connection status is shown with the icon/colour scheme changes 3. The app commands cannot be executed when the connection is off		No
Connectivity Sub-heading															
15	The software sends a notification to the app	Requirement	To immediately provide the driver with information on the status of the vehicle.	Requirement workshop 04/06/2018	Notifications will be sent when the vehicle is parked and summoned. 3G/4G connectivity needs to be enabled on the mobile app and in the car park.	Testing scenarios: park,summon	Parkopedia	Testing and demonstration	Testing in closed/semi closed car park, Static Environment				Demonstrate that the user receives notifications from their vehicle when the park and summon commands are activated		No
16	The software shall be connected to the app in the car park	Requirement	To make sure the app commands work	Requirement workshop 04/06/2018	The app can only send a command to the vehicle when there is 3G/4G connectivity.	Check connectivity in car park	Parkopedia	Testing and demonstration	Testing in closed/semi closed car park, Static Environment				Demonstrate vehicle/app connectivity and pairing in the car park		No
Vehicle Identification Sub-heading															
87	The app shall have a registration and log in feature	Requirement	To ensure the uniqueness of the vehicle driver	Requirement workshop 04/06/2018	N/A	Testing	Parkopedia	Testing	Testing in closed/semi closed car park, Static Environment				App log-in testing		No
88	Secure way of pairing	Requirement	To ensure no other mobile phone can control the vehicle and that the vehicle doesn't send notifications to another mobile phone.	Requirement workshop 04/06/2018	Pairing will be done via QR code scanning. The QR code will be located at the back of the vehicle.	Testing	Parkopedia	Testing and demonstration	Testing in closed/semi closed car park, Static Environment				Demonstrate the secure pairing feature by trying to pair the app with another vehicle		No
89	The mobile application shall be able to communicate with the car using a unique ID (and secure)	Requirement	To ensure no other mobile phone can control the vehicle and that the vehicle doesn't send notifications to another mobile phone.	Requirement workshop 04/06/2018	Pairing will be done via QR code scanning. The QR code will be located at the back of the vehicle.	Testing	Parkopedia	Testing and demonstration	Testing in closed/semi closed car park, Static Environment				Demonstrate the secure pairing feature by trying to pair the app with another vehicle		No
Failsafe Sub-heading															
91	There shall be a command interface on the application to stop the vehicle	Requirement	During specific scenarios, the driver might need the vehicle to stop(e.g forgetting an item in the vehicle, vehicle losing control, vehicle not reacting as normal etc.)	Requirement workshop 04/06/2018	The command will trigger the vehicle to stop immediately.	Vehicles comes to stop within a defined time	Parkopedia StreetDrone	Testing and demonstration	Testing in closed/semi closed car park, Static Environment				Demonstrate the stop command works and that the vehicle responds by stopping		No
92	The vehicle shall not be capable of powered movement when the app stop functionality is engaged	Requirement	To avoid any collision	Additional Requirement 24/10/19	N/A	Vehicle does not move when the app stop button has been activated	Parkopedia	Testing and demonstration	Testing in closed/semi closed car park, Static Environment				Demonstrate that the vehicle does not move then the app stop button has been activated		No
34	Each module shall consider their inputs and raise an error condition if outside of the normal range	Requirement	To detect and recover from computer malfunctions	Requirement workshop 04/06/2018	This function is used to check module performance and error.	Request vehicle safe stop	Parkopedia	Testing and demonstration	Testing in controlled environment				In case of deviation from planned path is above 20 cm driver will notified. Demonstrate that the safety driver can take over in the event of a failure.		No
Functionalities Sub-heading															
93	The app must include a "park" functionality to be tested	Requirement	To instruct the vehicle to go park in the pre-designated parking spot from the drop-off point	Additional Requirement 24/10/19	N/A	Vehicle goes to park at the designed spot	Parkopedia	Testing and demonstration	Testing in closed/semi closed car park, Static Environment				Demonstrate that the vehicle responds to the app command and parks at the designed spot		No
94	The app must include a "summon" functionality to be tested	Requirement	To instruct the vehicle to come back to the drop-off point	Additional Requirement 24/10/20	N/A	Vehicle comes back to the drop-off point	Parkopedia	Testing and demonstration	Testing in closed/semi closed car park, Static Environment				Demonstrate that the vehicle responds to the app command and comes back to the designed spot		No
96	The app must include a "state" functionality to be tested	Requirement	To check the location and state of the vehicle	Additional Requirement 24/10/22	N/A	Precise location and state of the vehicle are shown on the app	Parkopedia	Testing and demonstration	Testing in closed/semi closed car park, Static Environment				Demonstrate that the vehicle responds to the app command and shows the precise localisation of the vehicle on a map		No
Visualisation Sub-heading															

AUTONOMOUS VALET PARKING - REQUIREMENTS

ID	Requirement Text	Object Type	Rationale	Source	Supporting Information	Acceptance Criteria	Stakeholder	V&V Method	V&V Gateway (Prior to)	V&V Status	V&V evidence	Satisfactory Argument	Test Cases	Status Based on Previous (Controlled Environment) testing	Safety Critical
90	The app shall provide the driver with an estimate of the location of the car within the car park, shown on a 2D floor plan with the standard dev error ellipse.	Requirement	To check the location and state of the vehicle	Requirement workshop 04/06/2018	N/A	Floor plan shown on app with dot moving in line with the vehicle	Parkopedia University of Surrey	Testing and demonstration	Testing in car parks				Demonstrate that: 1. The position of the vehicle is accurate 2. The path of the vehicle is shown and accurate Demonstrate by comparing the actual vs. shown (app) position		No
Marshalls Heading															
45	Marshalls shall be suitably trained/briefed	Requirement	In order to get an understanding of the scenarios to be demonstrated and to be able to react as appropriate and ensure safety	Requirement workshop 04/06/2018	The method statement will capture this. Marshalls will be trained/briefed before the demonstrations.	Method statement, briefing, RAMS	CPC	Inspection	Testing in car parks				N/A		Yes
44	Sufficient number to ensure minimal risk of collision with other car park users	Requirement	To prevent and avoid any injury and to inform other car park users	Requirement workshop 04/06/2018	The method statement will capture this. There needs to be enough marshalls to ensure safety of other car park users.	Refer to method statement	CPC	Inspection	Testing in car parks				N/A		Yes
Incident Reporting Process Heading															
135	Testing shall be stopped at any time that the Event Data Recorder is unable to function	Requirement	Data recording is crucial to the project and to the AVP system	CPC prior project experience requirement	N/A	Testing is halted if the event data recorder stops recording	Parkopedia	Inspection	Testing in car parks				N/A		Yes