System Test Plan

AAS Digital Nameplate Generator

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|  |  |  |
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# Introduction

The System Test Plan (STP) of the project “AAS Digital Nameplate Generator” is designed to stipulate the scope, approach, resources, and schedule of all testing activities. Hence, its purpose is to identify the tasks and activities to be performed so that all aspects of the system are adequately tested, and the quality of the software is ensured.

# Scope

# Quality Objective

The objective of this document is to verify the “AAS Digital Nameplate Generator’s” Functionality. Testing the correct view of assets of an arbitrary “Asset Administration Shell” is of particular significance. Moreover, the responsive and compatible GUI with different environments is needed to ensure a user-friendly front-end application. Besides, the installation and performance of the application is substantiated as well.

Therefore, the testing should focus on guaranteeing a normal user experience from installing as well as searching an asset to downloading a nameplate on different browsers and hardware.

# In Scope

All the functional requirements of the nameplate generator which are defined in the Software Requirements Specification (SRS) of the project need to be tested. The priority of requirements is scaled from 0 to 5. While 5 represents necessary requirements, issues with 0 may be neglected.

|  |  |  |  |
| --- | --- | --- | --- |
| Requirement ID | Functionality | Priority | Testsuite ID or TCS Link |
| DNG.GUI.001 | Responsive and compatible GUI | 2 | TC.CON.001.F  TC.CON.002.F  TC.NAV.001.F  TC.NAV.002.F  TC.OV.001.F  TC.NP.001.F  TC.NP.002.F |
| DNG.GUI.002 | Download menu for SVG and PNG format | 4 | TC.NP.001.F  TC.NP.002.F |
| DNG.GUI.003 | Search functionality | 3 | TC.CON.001.F  TC.CON.002.F  TC.PERF.001.F |
| DNG.GUI.004 | Navigation buttons | 1 | TC.NAV.001.F  TC.NAV.002.F |
| DNG.GUI.005 | QR-code generator | 5 | TC.NP.001.F  TC.NP.002.F |
| DNG.GUI.006 | Nameplate generator | 5 | TC.NP.001.F  TC.NP.002.F |
| DNG.GUI.007 | Error handling | 4 | TC.INST.001.F  TC.CON.001.F  TC.CON.002.F  TC.OV.001.F  TC.NP.001.F  TC.NP.002.F  TC.PERF.001.F |
| DNG.PERF.001 | Performance | 3 | TC.PERF.001.F |

# Out of Scope

However, due to the lack of time available for the project, this STP will focus on integration testing procedures. Following features are not tested since they are not included in the functional requirements.

* Application programming interface (API)
* Security
* Usable and easy to understand for its users

# Reference Material

The sources cited below are utilized as a reference for this document.

* TINF21C\_SRS\_Team\_2\_2v0
* IEEE Standard 829-1998, Standard for Software Test Documentation
* [Testfallentwurfsverfahren | SpringerLink](https://link.springer.com/chapter/10.1007/978-3-662-44028-5_4)

# Definitions and Acronyms

**STP** System Test Plan

**SRS** Software Requirements Specification

**DNG** Digital Nameplate Generator

**TS** Test Suite

**TC** Testcase

**AAS** Asset Administration Shell

**STR** System Test Report

**API** Application programming interface

# Document Maintenance

This document will be reviewed and updated as needed, as the project proceeds through each phase of the system development life cycle.

This document contains a revision history log. When changes occur, the document’s revision history log will reflect an updated version number as well as the date, the owner making the change, and change description will be recorded in the revision history log of the document.

# Participants Roles and Responsibilities in Test and Evaluation

In charge of Test and Evaluation is the Test Manager. First, they are responsible for overseeing the Test and Evaluation process, including creating test plans, execution, review, and coordinating acceptance. They may assign tasks to the developer team to assist the testing.

Furthermore, the document is created after the development phase. Its intended audience is the Product manager and Test Manager. Some portions of the document may on occasion be shared with the customer whose input and approval of the testing process is needed.

# Approach

In this project, requirements-based testing should be conducted. Test cases are designed based on test objectives as well as conditions derived from the SRS.

The requirements-based method used in this document for creating test cases is black box testing. It is a method of software testing that is used to evaluate the functionality of a system or application without any knowledge of its internal workings. Instead, the tester interacts with the system through its user interface, inputs various test cases, and observes the output to ensure that the system behaves as expected. Additionally, since black box testing focuses on the system's behavior, it may not be suitable for testing non-functional requirements such as performance, scalability, and security.

There are several techniques that can be used in black box testing, including equivalence partitioning, boundary value analysis, and pairwise testing. Equivalence partitioning involves dividing the input space into groups of equivalent inputs, while boundary value analysis focuses on testing the boundaries of the input space. The pairwise testing approach involves selecting pairs of input parameters or factors that are most likely to interact with each other and create defects. To reduce decision tables the open-source tool ALLPAIRS by James Bach is used. These three methods are used in conjunction to ensure thorough testing of the system.

# Test Data

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Test data: | TD.001 | | | | |
| Dataset | Device | IP address | Default  gateway | Net mask | Expected result |
| 01 | Windows | 192.168.0.254 | 192.168.0.1 | 192.168.0.1 | PASS |
| 02 | Mac | 192.168.0.254 | 192.168.0.1 | 192.168.0.1 | PASS |
| 03 | IPhone | 192.168.0.254 | 192.168.0.1 | 192.168.0.1 | PASS |
| 04 | Windows | 192.168.0.254 | 192.168.0.0 | 192.168.0.1 | FAIL |
| 05 | Mac | 192.168.0.254 | 192.168.0.0 | 192.168.0.1 | FAIL |
| 06 | IPhone | 192.168.0.254 | 192.168.0.0 | 192.168.0.1 | FAIL |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Test data: | TD.002 | | | |
| Dataset | Browser | Screen size | Operating  system | Expected result |
| 01 | Google Chrome 111.0 | 1920 x 1080 | Windows 10 | PASS |
| 02 | Google Chrome 111.0 | 3840 x 2160 | Windows 10 | PASS |
| 03 | Google Chrome 111.0 | 3088 x 1440 | macOS | PASS |
| 04 | Microsoft Edge 110.0 | 1920 x 1080 | Windows 10 | PASS |
| 05 | Microsoft Edge 110.0 | 3840 x 2160 | Windows 10 | PASS |
| 06 | Microsoft Edge 110.0 | 3088 x 1440 | macOS | PASS |
| 07 | Firefox 111.0 | 1920 x 1080 | macOS | PASS |
| 08 | Firefox 111.0 | 3840 x 2160 | macOS | PASS |
| 09 | Firefox 111.0 | 3088 x 1440 | Windows 10 | PASS |
| 10 | Safari 16.1 | 1920 x 1080 | macOS | PASS |
| 11 | Safari 16.1 | 2340 x 1080 | iOS | PASS |

|  |  |  |  |
| --- | --- | --- | --- |
| Test data: | TD.003 | | |
| Dataset | AAS server link | API | Expected result |
| 01 | https://admin-shell-io.com/5001 | V1 API | PASS |
| 02 | https://ccae4836-001e-48c2-a4f9-235554f9400b.ma.bw-cloud-instance.org/ | V3 API | PASS |
| 03 | http://aas.murrelektronik.com:4001/aas | V3 API | PASS |
| 04 | ccae4836-001e-48c2-a4f9-235554f9400b.ma.bw-cloud-instance.org/ | V3 API | FAIL |

The test server can be accessed with the link *https://ccae4836-001e-48c2-a4f9-235554f9400b.ma.bw-cloud-instance.org/*.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Test data | TD.004 | | | |
| Dataset | Asset | AAS server | Product  image | Expected result |
| 01 | Norgren\_B84G\_4GK\_AP3\_RME | Test server | Width: 400px  Height: 600px | PASS |
| 02 | TestAsset\_PINone\_MI\_None | Test server | None | PASS |
| 03 | TestAsset\_PIBroken\_MI\_Broken | Test server | Broken | PASS |
| 04 | TestAsset\_PiSmaller | Test server | Smaller than max size | PASS |
| 05 | TestAsset\_PiBigger | Test server | Bigger than max size | PASS |
| 06 | TestAsset\_Many | Test server | More than one picture | PASS |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Test data: | TD.005 | | | |
| Dataset | Asset | Server | Marking image | Expected result |
| 01 | Norgren\_B84G\_4GK\_AP3\_RME | Test server | None | PASS |
| 02 | AAS\_Type\_VUVS-L25-M52-AD-G14-F8-1C1 | Test server | One | PASS |
| 03 | AAS\_Demo\_CytroPac | Test server | Many | PASS |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Test data: | TD.006 | | | |
| Dataset | Asset | Server | Nameplate | Expected result |
| 01 | Norgren\_B84G\_4GK\_AP3\_RME | Test server | Adequate | PASS |
| 02 | ExampleMotor | Test server | None | PASS |

# 

# Test Items

# Testsuite <TS.INST: Access via Link>

|  |  |  |  |
| --- | --- | --- | --- |
| Test case | | | |
| ID: | | <TC.INST.001.F> | |
| Name: | | Access front end on local machine | |
| Req. -ID: | | DNG.GUI.007 | |
| Description: | | *The test case verifies the correct functionality of the hyperlink of the web application as well as the device’s configuration and internet connection. It verifies the forwarding from the project’s GitHub page. The test case verifies compatibility with relevant browsers, screen sizes and operating systems.*  *The test case uses the test data from table TD.001 and TD.002.*  *The test set up consists of a computer, which is connected to the internet.* | |
| Test steps | | | |
| Step | Action | | Expected result |
| 1 | Go to project’s GitHub | | Display project’s GitHub page |
| 2 | Click on the Link for the Digital Nameplate Generator in the  ReadMe file | | Display home page; no connection to the Internet or a misconfigured network lead to no access |
|  | | | |

# Testsuite <TS.CON: Connect to AAS-Server>

|  |  |  |  |
| --- | --- | --- | --- |
| Test case | | | |
| ID: | | <TC.CON.001.F> | |
| Name: | | Connect to AAS-Server via search bar | |
| Req. -ID: | | DNG.GUI.001; DNG.GUI.003; DNG.GUI.007 | |
| Description: | | *The test case verifies the correct functionality of the search bar. It verifies the connection to AAS-Servers. Links missing https:\\ are not supported. The test case verifies compatibility with relevant browsers, screen sizes and operating systems.*  *The test case uses the test data from table TD.002 and TD.003.*  *The test set up consists of a computer, which is connected to the internet.* | |
| Test steps | | | |
| Step | Action | | Expected result |
| 1 | Go to home page | | Display home page |
| 2 | Click on search bar | | Search bar is selected. A drop-down list of search suggestions is opened. |
| 3 | Enter a string into search bar | | For each character the suggestion of the drop-down list is filtered. |
| 4 | Click on search button | | All assets from the server are loaded. The asset list is displayed; missing images are replaced with default image; invalid parameters produce the display of an error message. |
|  | | | |

|  |  |  |  |
| --- | --- | --- | --- |
| Test case | | | |
| ID: | | <TC.CON.002.F> | |
| Name: | | Connect to suggested AAS-Server via search bar | |
| Req. -ID: | | DNG.GUI.001; DNG.GUI.003; DNG.GUI.007 | |
| Description: | | *The test case verifies the correct functionality of the search bar and its suggestions. It verifies the connection to AAS-Servers. The test case verifies compatibility with relevant browsers, screen sizes and operating systems.*  *The test case uses the test data from table TD.002 and TD.003.*  *The test set up consists of a computer, which is connected to the internet.* | |
| Test steps | | | |
| Step | Action | | Expected result |
| 1 | Go to home page | | Display home page |
| 2 | Click on search bar | | Search bar is selected. A drop-down list of search suggestions is opened. |
| 3 | Enter a string into search bar | | For each character the suggestion of the drop-down list is filtered. |
| 4 | Click on one of the suggested server addresses | | All assets from the server are loaded. The asset list is displayed; missing images are replaced with default image; invalid parameters produce the display of an error message. |
|  | | | |

# Testsuite <TS.NAV: Navigation>

|  |  |  |  |
| --- | --- | --- | --- |
| Test case | | | |
| ID: | | <TC.NAV.001.F> | |
| Name: | | Navigation bar | |
| Req. -ID: | | DNG.GUI.001; DNG.GUI.004 | |
| Description: | | *The test case verifies the correct forwarding of the navigation bar. It verifies compatibility with relevant browsers, screen sizes and operating systems.*  *The test case uses test data from table TD.002.*  *The test set up consists of a computer, which is connected to the internet.* | |
| Test steps | | | |
| Step | Action | | Expected result |
| 1 | Go to home page | | Display home page |
| 2 | Click on menu button | | Open menu |
| 3 | Click on “About” row | | Forwarding to about page |
| 4 | Click on menu button | | Open menu |
| 5 | Click on “Home” row | | Forwarding to home page |
| 6 | Click on menu button | | Open menu |
| 7 | Click on “GitHub” row | | Forwarding to project’s GitHub page |
|  | | | |

|  |  |  |  |
| --- | --- | --- | --- |
| Test case | | | |
| ID: | | <TC.NAV.002.F> | |
| Name: | | Browser’s navigation buttons | |
| Req. -ID: | | DNG.GUI.001; DNG.GUI.004 | |
| Description: | | *The test case verifies the correct functionality of the browser’s navigation buttons. It verifies compatibility with relevant browsers, screen sizes and operating systems.*  *The test case uses test data from table TD.002.*  *The test set up consists of a computer, which is connected to the internet.* | |
| Test steps | | | |
| Step | Action | | Expected result |
| 1 | Go to an asset view | | Display asset view |
| 2 | Click on back button | | Back to asset list |
| 3 | Click on back button | | Back to home page |
| 4 | Click on “about” | | Display about page |
| 5 | Click on back button | | Back to home page |
|  | | | |

# Testsuite <TS.OV: Overview>

|  |  |  |  |
| --- | --- | --- | --- |
| Test case | | | |
| ID: | | <TC.OV.001.F> | |
| Name: | | Choose asset of asset list | |
| Req. -ID: | | DNG.GUI.001; DNG.GUI.007 | |
| Description: | | *The test case verifies the correct functionality of the asset list. It verifies that the images of the product and markings are adjusted. The test case verifies compatibility with relevant browsers, screen sizes and operating systems.*  *The test case uses the test data from table TD.002, TD.004, TD.005 and TD.006.*  *The test set up consists of a computer, which is connected to the internet.* | |
| Test steps | | | |
| Step | Action | | Expected result |
| 1 | Go to asset list | | Display asset list |
| 3 | Click on search bar with search box text “Asset Name” | | Search bar is selected |
|  | Enter a string into search bar | | For each character the assets are filtered matching the string. |
| 2 | Hover on a table row | | Currently selected asset appears in another color. |
| 3 | Click on table row of specific asset | | The asset view of the specific asset is opened. Product image, nameplate and asset details are displayed; missing submodel details produce a corrupted overview |
| 4 | Click on collapse item | | Further details of category are expanded |
|  | | | |

# Testsuite <TS.NP: Nameplate>

|  |  |  |  |
| --- | --- | --- | --- |
| Test case | | | |
| ID: | | <TC.NP.001.F> | |
| Name: | | Download nameplate in SVG | |
| Req. -ID: | | DNG.GUI.001; DNG.GUI.002; DNG.GUI.005; DNG.GUI.006; DNG.GUI.007 | |
| Description: | | *The test case verifies the correct functionality of downloading a nameplate in SVG format and scanning its QR code with a smartphone. It verifies the decryption of the complete nameplate submodel details as a string. The test case verifies compatibility with relevant browsers, screen sizes and operating systems.*  *The test case uses the test data from table TD.002 and TD.006.*  *The test set up consists of a smartphone with scanning function and a computer, which is connected to the internet.* | |
| Test steps | | | |
| Step | Action | | Expected result |
| 1 | Go to asset view | | Asset view is displayed |
| 2 | Click on “Download SVG” button | | Nameplate in SVG format is downloaded |
| 3 | Open the file | | Nameplate in SVG format is displayed |
| 4 | Open scan application on device | | Camera to scan a QR-Code is opened |
| 5 | Scan QR code | | Response with a string containing all nameplate submodel information is displayed; failed scanning produces the display of an error message. |
|  | | | |

|  |  |  |  |
| --- | --- | --- | --- |
| Test case | | | |
| ID: | | <TC.NP.002.F> | |
| Name: | | Download nameplate in PNG | |
| Req. -ID: | | DNG.GUI.001; DNG.GUI.002; DNG.GUI.005; DNG.GUI.006; DNG.GUI.007 | |
| Description: | | *The test case verifies the correct functionality of downloading a nameplate inf PNG format and scanning its QR code with a smartphone. It verifies the decryption to the complete nameplate submodel details as a string. The test case verifies compatibility with relevant browsers, screen sizes and operating systems.*  *The test case uses the test data from table TD.002 and TD.006.*  *The test set up consists of a smartphone with scanning function and a computer, which is connected to the internet.* | |
| Test steps | | | |
| Step | Action | | Expected result |
| 1 | Go to asset view | | Asset view is displayed |
| 2 | Click on “Download PNG” button | | Nameplate in PNG format is downloaded |
| 3 | Open the file | | Nameplate in PNG format is displayed |
| 4 | Open scan application on device | | Camera to scan a QR-Code is opened |
| 5 | Scan QR code | | Response with a string containing all nameplate submodel information is displayed; failed scanning produces the display of an error message. |
|  | | | |

# Testsuite <TS.PERF: Performance>

|  |  |  |  |
| --- | --- | --- | --- |
| Test case | | | |
| ID: | | <TC.PERF.001.F> | |
| Name: | | Performant under expected or peak loads | |
| Req. -ID: | | DNG.GUI.003; DNG.GUI.007; DNG.PERF.001 | |
| Description: | | *The test case verifies fast website loads below seven seconds. It verifies the time fetching data from the server and displaying it.*  *The test case uses the test data from table TD.003.*  *The test set up consists of a timer and a computer, which is connected to the internet.* | |
| Test steps | | | |
| Step | Action | | Expected result |
| 1 | Go to home page | | Display home page |
| 2 | Click on search bar | | Search bar is selected. A drop-down list of search suggestions is opened. |
| 3 | Enter a string into search bar | | For each character the suggestion of the drop-down list is filtered. |
| 4 | Click on search button | | All assets from the server are loaded. The asset list is displayed; missing images are replaced with default image; invalid parameters produce the display of an error message. |
| 5 | Click on one of the suggested server addresses and measure time | | All assets from the selected server are loaded below seven seconds. The asset list is displayed; invalid parameters produce the display of an error message. |
|  | | | |

# Requirements Traceability Matrix

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Requirement Identifiers | Reqs  Tested | DNG  .GUI  .001 | DNG  .GUI  .002 | DNG  .GUI  .003 | DNG  .GUI  .004 | DNG  .GUI  .005 | DNG  .GUI  .006 | DNG  .GUI  .007 | DNG  .PERF  .001 |
| Test Cases | 26 | 7 | 2 | 3 | 2 | 2 | 2 | 7 | 1 |
| TC.INST  .001.F | 1 |  |  |  |  |  |  | X |  |
| TC.CON  .001.F | 3 | X |  | X |  |  |  | X |  |
| TC.CON  .002.F | 3 | X |  | X |  |  |  | X |  |
| TC.NAV  .001.F | 2 | X |  |  | X |  |  |  |  |
| TC.NAV  .002.F | 2 | X |  |  | X |  |  |  |  |
| TC.OV  .001.F | 2 | X |  |  |  |  |  | X |  |
| TC.NP  .001.F | 5 | X | X |  |  | X | X | X |  |
| TC.NP  .002.F | 5 | X | X |  |  | X | X | X |  |
| TC.PERF  .001.F | 3 |  |  | X |  |  |  | X | X |

*Figure 10.1: Requirements Traceability Matrix*

# Incident Management

GitHub will be used as an incident tracking log. Issues will be used to capture the details of each incident. In particular, the error message and the possible cause are described. Furthermore, these issues receive Tags, which indicated the priorities. These will be determined as follows.

* **Critical**: the application isn’t available or doesn’t work, preventing any further testing
* **Major**: the product does not function as expected, or the results don’t meet the acceptance criteria
* **Medium**: the problem conflicts with business logic, tested parts work incorrectly, or additional features don’t work as designed
* **Low**: bugs don’t contradict the product’s logic and can be easily fixed

Moreover, defects will be reported by the Test Manager to the development team directly via arbitrary communication channel. While the development team is responsible for fixing upcoming issues, the test manager will do the retesting. The following process description gives a global view of testing activities, in particular the defect reporting process.

Ein Bild, das Diagramm enthält.

Automatisch generierte Beschreibung

*Figure 11.1: Process description of testing activities*

# Pass/Fail Criteria

To pass the system integration test, every feature must function properly. Therefore, the main functionality to receive a nameplate of any asset from an AAS-Server is guaranteed. Furthermore, the QR code of its nameplate must be scannable. All points of integration within the system work as defined in SRS. Therefore, the criteria that denote a successful completion of a test phase is a mandatory run rate at 100% unless a clear reason is given.

# Suspension Criteria and Resumption Requirements

# Normal Criteria

At the end of each day (20:00 p.m.) testing will be suspended. At that time, all test cases executed during the day should be marked as such. The Test Manager will initiate a backup routine to save the day’s updated test files.

When all test cases of a test suite have been executed, the test will be suspended, and the results are documented for the System Test Report (STR).

# Abnormal Criteria

If the team members report that there are 40% of test cases failed, testing will be suspended until the development team fixes all the failed cases. When a change is being migrated to the test environment, the Test Manager must be notified in advance to schedule a time for the move. After the move has been completed, a retest of previously tested functions should be performed. If a critical incident is reported, as defined by the defect reporting process, testing should be suspended until the defects have been fixed. When the fixed issue is moved back into the test environment, any previously performed tests that are affected by the incident should be performed again to ensure new defects were not created as a result of the fix.

# Test Environment

It mentions the minimum hardware and software requirements that will be used to test the application.

|  |  |  |
| --- | --- | --- |
| Testing Tools | | |
| No. | Resources | Descriptions |
| 01 | Network | Setup a connection to the internet with a speed of at least 1 mb/s. Firewalls and proxies may block access to the site |
| 02 | Computer | Computers with MacOS and Windows 10 that fulfills the minimum requirements for a current version of a modern browser that supports at least ECMAScript 2018 (Chrome, Edge, Safari, Firefox, ...) |
| 03 | Smartphone | At least one smart phone with iOS |
| 04 | Server | Need an AAS server where assets can be added |

The following software are required in addition to client-specific software.

* Firefox 111.0
* Microsoft Edge 110.0
* Google Chrome 111.0
* Application to scan the QR code
* Application to measure time

# Test Schedule and Budget

|  |  |  |
| --- | --- | --- |
| Attempted test suite | Date | Responsible |
| <TS.INST: Local installation> | 03.05.2023 | Janin Ahlemeyer |
| <TS.CON: Connect to AssetServer> | 03.05.2023 | Janin Ahlemeyer |
| <TS.NAV: Navigation> | 04.05.2023 | Janin Ahlemeyer |
| <TS.OV: Overview> | 04.05.2023 | Janin Ahlemeyer |
| <TS.NP: Nameplate> | 06.05.2023 | Janin Ahlemeyer |
| <TS.PERF: Performance> | 06.05.2023 | Janin Ahlemeyer |

No budget is required as all tests are conducted manually.

# Plan Approvals

|  |  |  |  |
| --- | --- | --- | --- |
| Role | Name and Title | Signature | Date |
| Team Lead | Adrian Khairi |  | 25.04.2023 |
| Product Manager | Erika Zhang |  | 25.04.2023 |
| Test Manager | Ahlemeyer, Janin |  | 25.04.2023 |