

Safety Pool™ Scenario Database: Scenario catalogue for Automated Driving System Approval in the UK

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UNECE (WP.29/GRVA) Working Party on Automated/Autonomous and Connected Vehicles (18th session)
23 January 2024

Motivation










- Scenario based testing will be essential part Automated Driving safety assurance
- Key aspect: availability of “relevant” scenarios. Scenarios will be stored in a catalogue.
- Each developer will have their own scenario catalogue
- However, for trust in the process: **Independence is key!**
- Central independent catalogue to **complement** industry’s internal catalogues

Our Journey

- Started in **2019**: Funded by UK's Centre for Connected & Autonomous Vehicles (CCAV – Govt. department)
- **2019 – early 2020**: **Requirements gathering for a scenario catalogue**
- **2020**: Technical implementation of UK's Scenario catalogue development
- **2021**: **Public launch of Safety Pool™**. On-going maintenance funding by CCAV
- **2023**: Vehicle Certification Agency (VCA) using Safety Pool™ for future ADS approval
- **Present**: Constant new feature (content) additions (requested by users / stakeholders)

Understanding Requirements

- Large **semi-structured interview** (scientific study) undertaken
- **Over 60 stakeholders** (from both 1958 & 1998 agreement member nations) globally interviewed
 - OEMs
 - ADS developers
 - Tier 1s
 - Regulators / Certification bodies
 - Academia
- UK will be happy to share the findings and the identified requirements

-  Home
-  Scenarios
-  Libraries
-  Test Suites
-  Testbeds
-  Users
-  Roles
-  Settings
-  Audit Log

Welcome

The Safety Pool Database is an extensive collection of curated test scenarios which can be used for testing connected and autonomous driving technologies.

[Learn more](#)

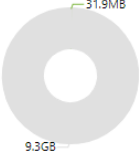


Safety Pool™ Scenario Database

World's Largest Public Scenario Database

File Storage

Quota used



In use: 31.9MB
Quota: 9.3GB
Quota used: 0%

License

Maximum Active Users
20

File Storage Quota
9.3GB

Agreement
[Safety Pool™ License Agreement](#)

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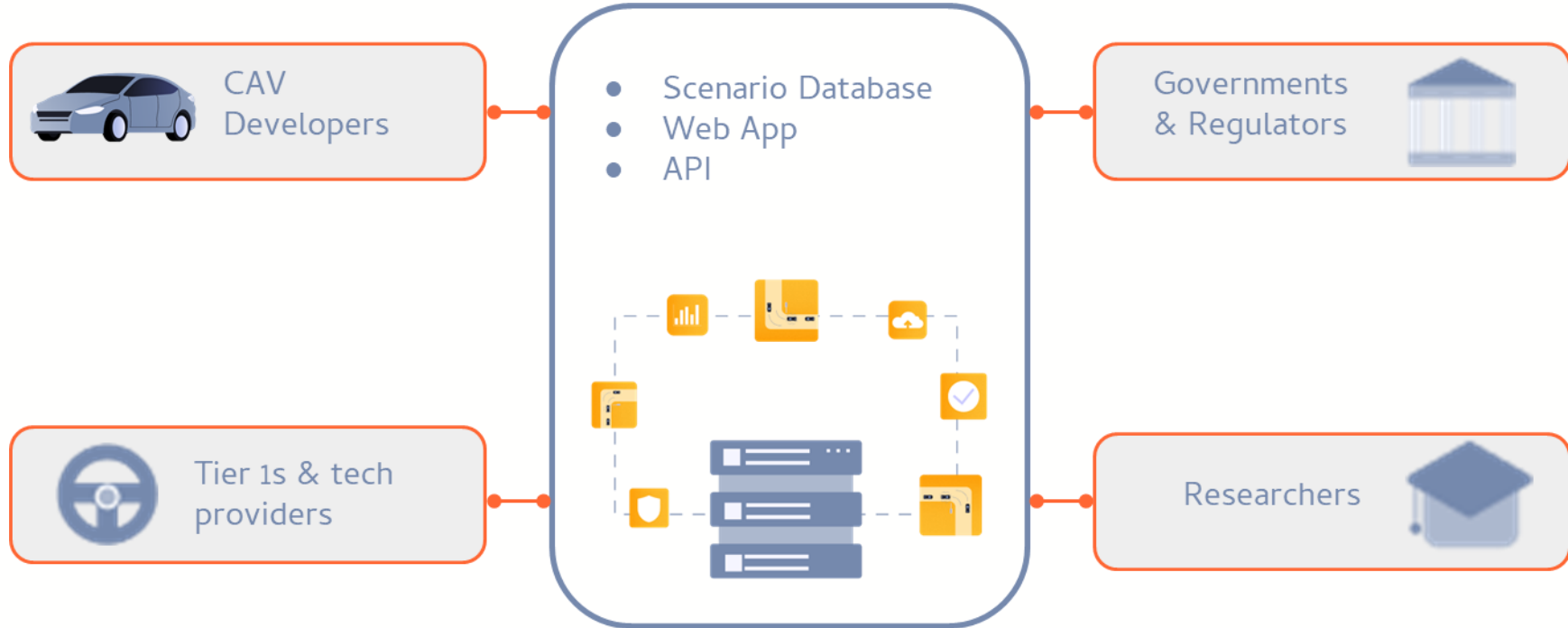


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File Storage	License
<p>Quota used</p> <p>In use: 31.9MB Quota: 9.3GB Quota used: 0%</p>	<p>Maximum Active Users 20 File Storage Quota 9.3GB Agreement Safety Pool™ License Agreement</p>

Over 250,000 edge case scenarios

What is the Safety Pool™ Scenario Database?



Scalability: Technology Stack

Secure, Scalable, Portable, Independent, low maintenance, industry standard. Rated as “low risk” by a recognized third party security certification entity.



WebApp (Microsoft Blazor)



API (Microsoft ASP.NET Core)



Scenario Database - Microsoft SQL Server 2019



Containerisation - Kubernetes & Docker



Cloud Hosting - Microsoft Azure

Security

- Any IT undertaking needs to be secure
- Annual **third-party security testing**
 - NCC Group
- Monthly security updates on the database



Safety Pool™ Scenario Database

The Platform



Features Map



ODD & Behavior
Tagging



Real World Route
matching



Simulation
Platform
integration



Tag-based logical
search



Tokenized
Scenario exchange



Efficient Test
management

ODD & Behavior Tagging

Scenario Files are tagged along three dimensions

ODD Tags - Scenery, weather conditions, dynamic elements

Behaviors Tags - Maneuver types

Admin Tags - Authorship, version, function under test

Custom tags - tags can be extended with custom labels

Tags	Definition	Files	Route Locations
Scenery			
▪ Direction of travel [Left]			▪ Shoulder (paved or gravel)
▪ Horizontal plane [Radius (m): 0]			▪ Traffic lane
▪ Lane dimensions [Width (m): 4 to 4.2]			▪ Uniform
▪ Lane marking			▪ Vertical plane [Gradient: 0]
▪ Minor road			▪ Wet road
▪ Number of lanes [Lanes: 2]			
Environmental Conditions			
▪ Cloudiness [Cloud cover (oktas): 5 to 7]			▪ Vehicle lighting
▪ Rainfall [Intensity (mm/h): 0 to 2.5]			▪ Wind [Speed (m/s): 17.2 to 20.7]
▪ Street lighting			

Tags aligned with



Tag-Based Logical Search

Look for scenarios in your public and/or private libraries using Scenario Tags and logic search

Choose the libraries of interest

Libraries

Search and filter along tags-values pairs

Tags ¹

- ODD
 - + Dynamic Elements
 - + Environmental Conditions
 - + Scenery
- Behaviours
 - + Animals
 - + Pedestrians
 - + Road users
- + Meta Data

Launch complex logical queries

Search Criteria

- Number of lanes : Lanes = 2 ×
- Level plane ×
- Straights ×
- Lane dimensions : Width (m) = 4.1 ×
- (
 - Minor road ×
 - Or Distributor road ×
-)
- Excluding Night ×

Safety Pool™ Scenario Database

The Scenarios



Safety Pool™

Scenario Description Language

Alignment with Standardized SDLs and Custom SDLs

OpenScenario

ASAM OpenScenario XML
(soon OSC DSL also)

Scenarios are released with an
OSC file attached, and
OpenDRIVE file

Available

BSI Flex 1889: NL - SDL

Natural Language SDL

Converters to BSI Flex 1889
are going to be available for
functional and abstract
scenarios (natural language
definition)

Available

Custom SDLs

Custom or proprietary SDLs

Get assistance from Safety
Pool technical team to build
and support converters to
your own proprietary SDL

support@safetypool.ai

Scenarios Generation

Safety Pool Scenario Database gathers curated scenarios generated from multiple sources, from Knowledge-based approaches to data-based approaches

Knowledge/expert-Based Generation



Analytical hazard based approaches like STPA analysis

Real world data generation



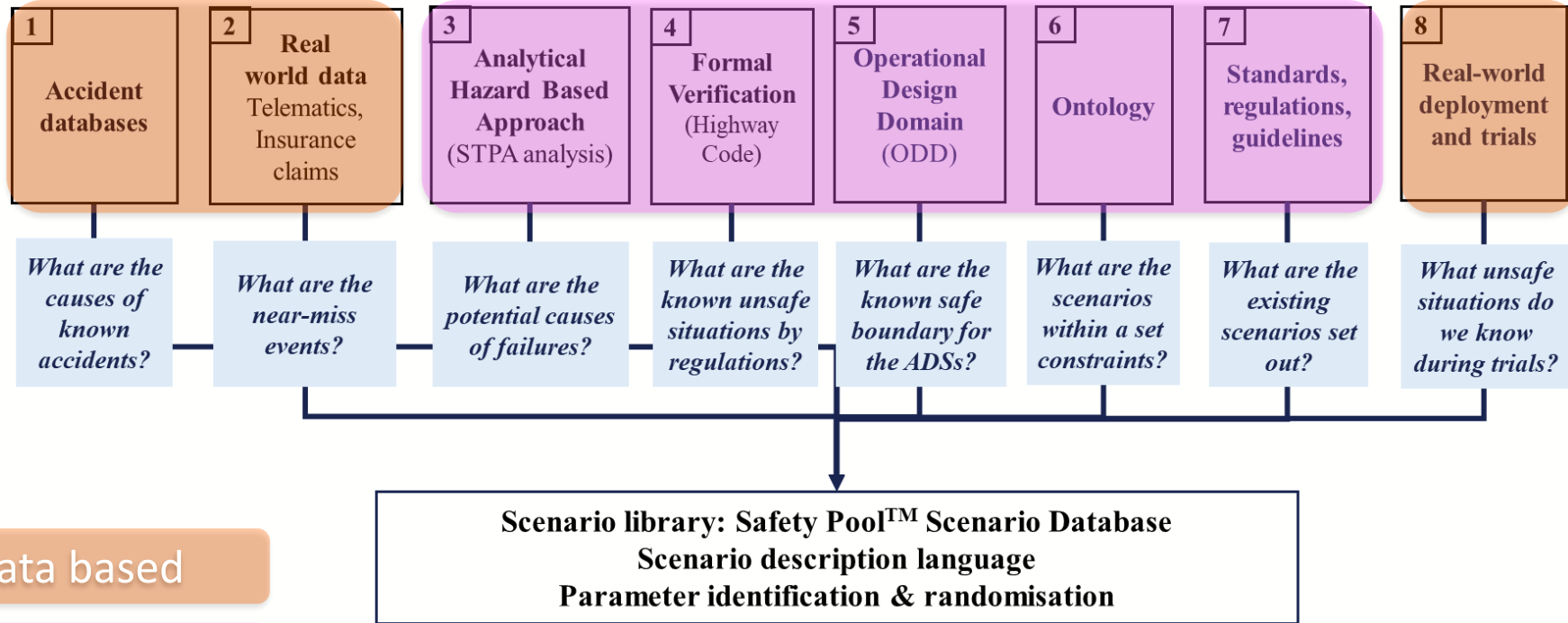
Scenarios extracted from data logs of real world drives with instrumented vehicles

Accident Databases



Scenarios are generated from accident databases or insurance claims record

Scenarios Generation



Data based

Knowledge based

The Scenarios Use cases

Safety Pool Scenario database targets and collects scenarios for multiple use cases and functions under test*



*Organizations have access to a limited portion of the available scenarios. Further access will be granted based on contribution following the Tokenized Scenario Exchange scheme

← Scenario

Download

Add to Test Suite

stat19_1_82482

Tags Definition Files Route Locations Versions

Scenery

- Broken line
- Contaminated
- Drive on left
- Lane dimensions [Width (m): 3.4 to 3.7]
- Level plane
- Normal roundabout
- Number of lanes [Lanes: 2]
- Radial road
- Shoulder (grass)
- Straights
- Traffic lane
- Undivided road
- Uniform surface

Environmental Conditions

- Cloudiness [Cloud cover (okta): 0 to 1]
- Day
- Sun elevation [Angle (degree): 10 to 30]
- Sun to the right
- Wind [Speed (m/s): 10.8 to 13.8]

Agents

- Cut-in
- Lane change left
- Vehicle

Meta Data

- Fatal collision

General



URN

d025e967-a9eb-452e-bd13-af66ec99a318

Library

STATS-19

License

Safety Pool™ Test Script License

Version

1.0

Home

Scenarios

Libraries

Test Suites

Testbeds

Users

Roles

Settings

Audit Log

← Scenario



stat19_1_82482

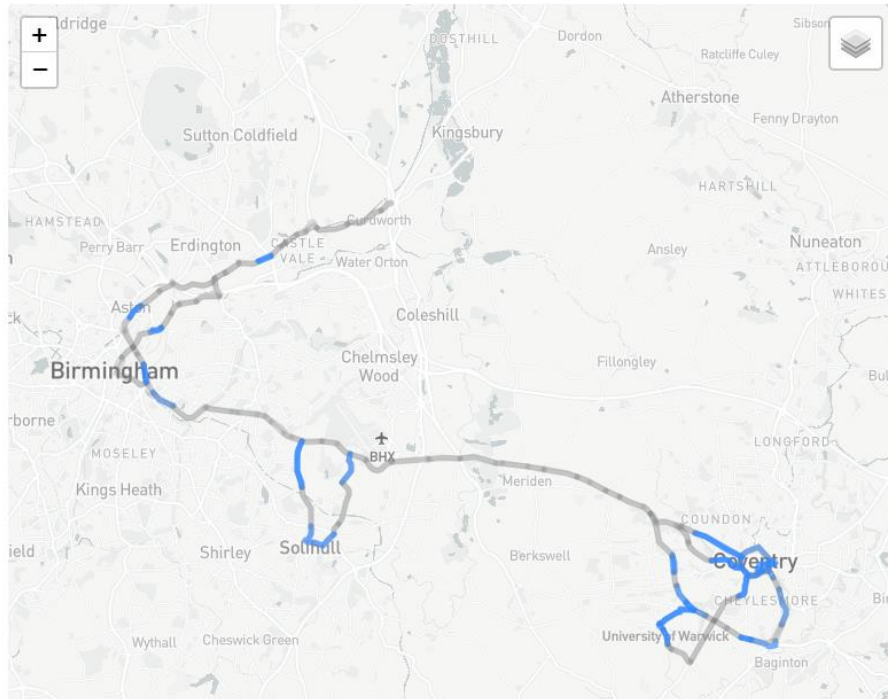
Download

Add to Test Suite

Tags Definition Files **Route Locations** Versions

Midlands Future Mobility Search 38 possible testing locations found

This testbed does not support all of the tags for this scenario i



General



URN

d025e967-a9eb-452e-bd13-af66ec99a318

Library

[STATS-19](#)

License i

[Safety Pool™ Test Script License](#)

Version

1.0

← Scenario

stat19_1_82482

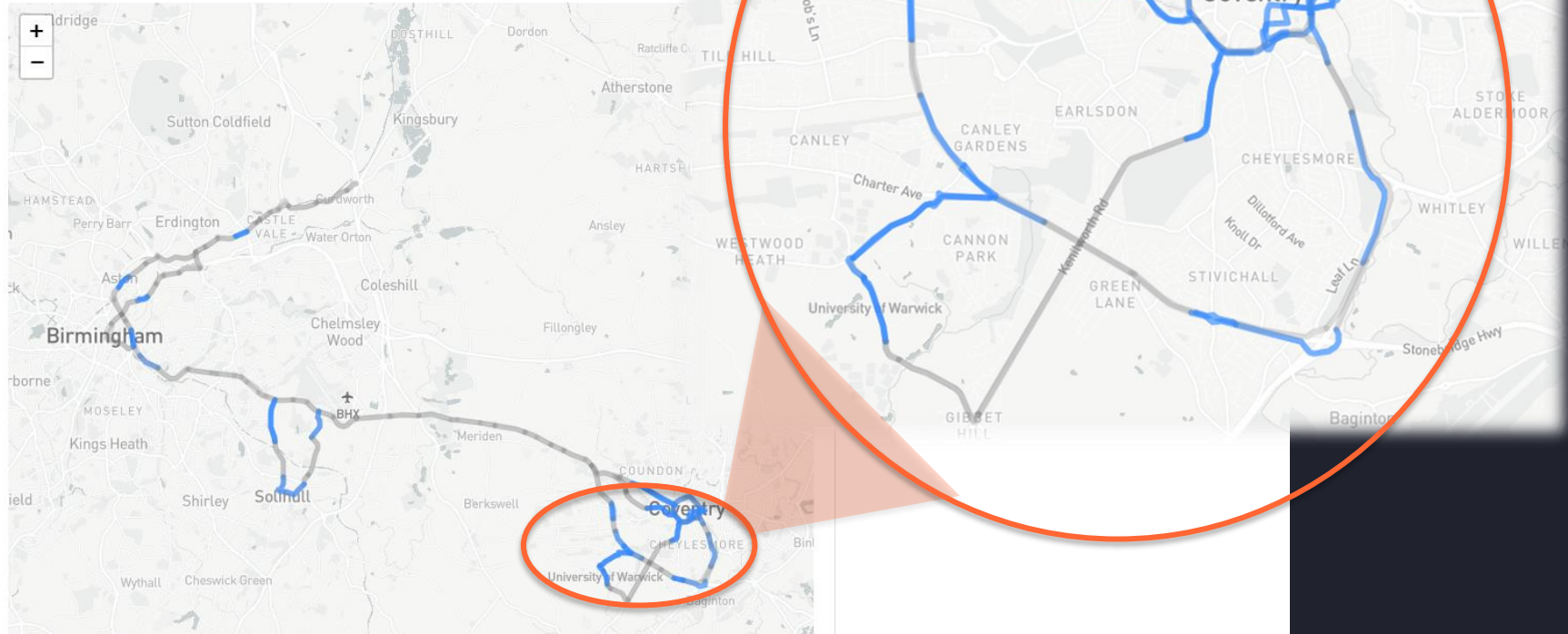
Tags Definition Files **Route Locations** Versions

Midlands Future Mobility

Search

38 possible testing locations

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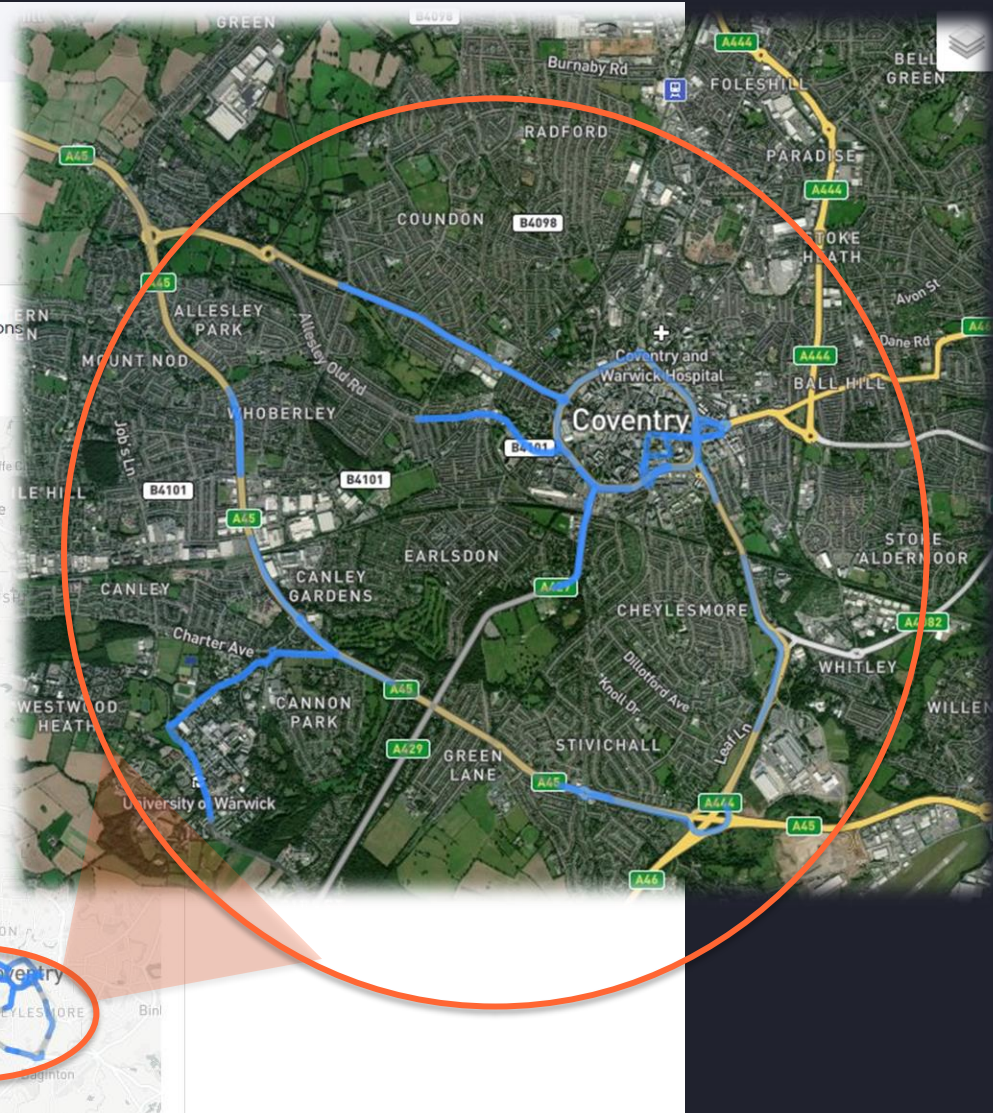
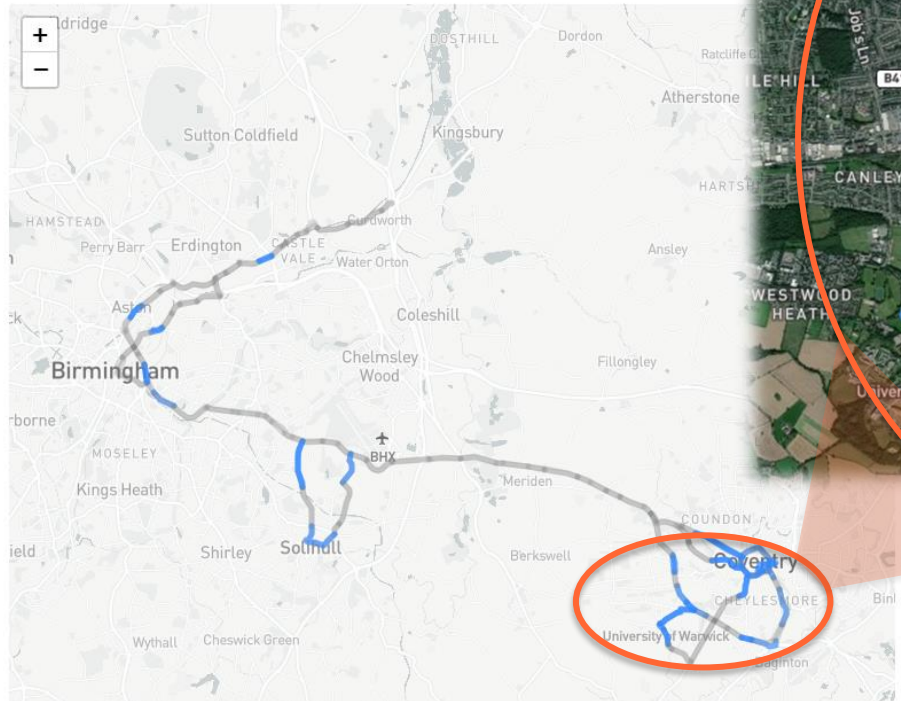
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← Scenario

Download Add to Test Suite

stat19_1_82482

Tags Definition Files Route Locations Versions

Midlands Future Mobility Search 38 posts

This testbed does not support all of the tags for this scenario

5NW
Gibbet Hill Road/Lord Bhattacharyya Way to Kirby Corner Road/Gibbet Hill Road

- Bus stop
- Curves
- Number of lanes [Lanes: 1 to 2]
- Roundabout
- Shoulder (grass)
- Shoulder (paved or gravel)
- Signalised normal roundabout
- Splitting lanes
- Straights
- Traffic island
- Uncontrolled crossing
- Vegetation

[Street View](#)



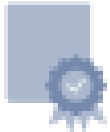
Version 1.0

API

Use Safety Pool API to access scenarios and test suites from your private section and the public material you have access to. All through a single API key.



RESTful API accessible and easy to use it with any language or tool



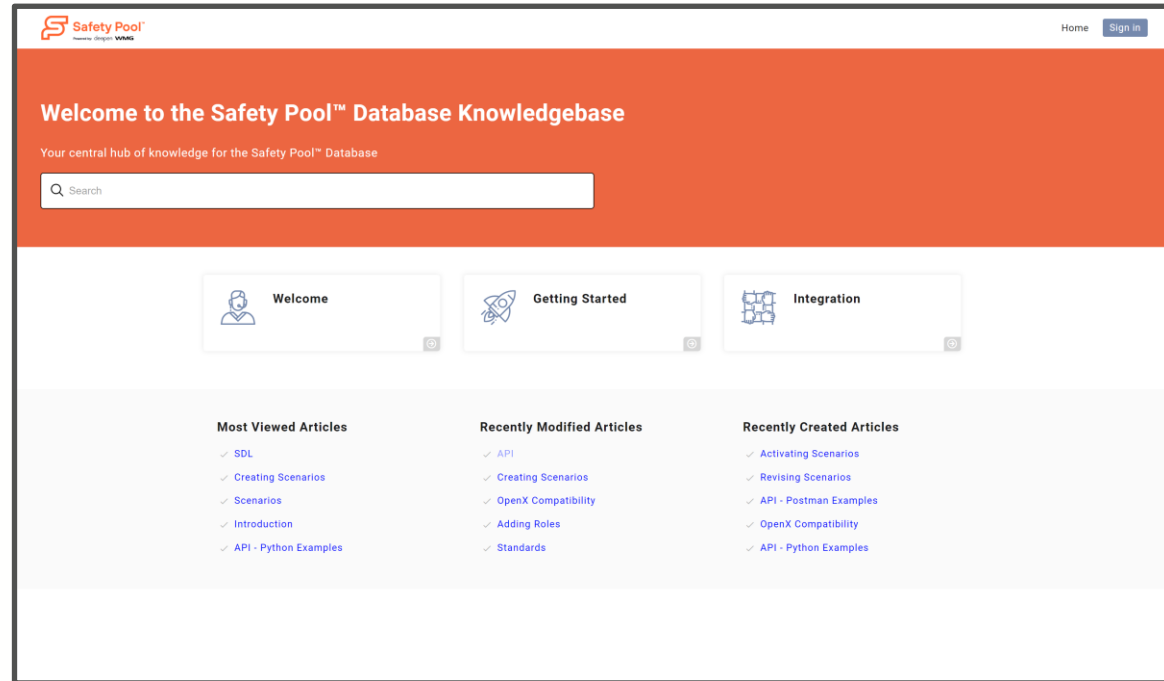
Extensive API documentation available for onboarded organizations



Retrieve scenarios, test suites or any other data you are entitled to based on your account permissions

Documentation

- Online documentation with examples
- Each aspect of the catalogue usage documented
- Freely available



Holistic Approach

- In gathering requirements, **some contracting parties require the ability for wider ecosystem stakeholders** (e.g. road safety charities, fire service, ambulance service, police etc.) **to be able to share scenarios**
- **Features:**
 - Easy to create and share scenarios
 - Intuitive user-interface
 - Ability to use even without Automated Driving Background

Holistic Approach



Holistic Approach

- In gathering requirements, **some contracting parties require the ability for wider ecosystem stakeholders** (e.g. road safety charities, fire service, ambulance service, police etc.) **to be able to share scenarios**
- **Features:**
 - Easy to create and share scenarios
 - Intuitive user-interface
 - Ability to use even without Automated Driving Background
- **Democratising safety**
- **Voice to wider stakeholders**
- **Robust curation process for new scenarios**

Summary

Scenario catalogue is essential part of ODD-based scenario-based approval of Automated Driving Systems.

Central catalogue should **meet the needs of all stakeholders**. Need to identify these needs through requirements capture.

Developers will have their own catalogue. **Independent catalogue** needed to **complement** them & to ensure trust in the approval process.

Catalogue should be underpinned by ODD concepts & **align with existing and future standards**.

Success will be dependent upon suitable collaboration and data sharing, and **common understanding**, nationally and internationally.



Thank you... Discussions...



X @siddkhastgir

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 Safety Pool™
Powered by: deepen & WVG

 WVG
THE UNIVERSITY OF WARWICK