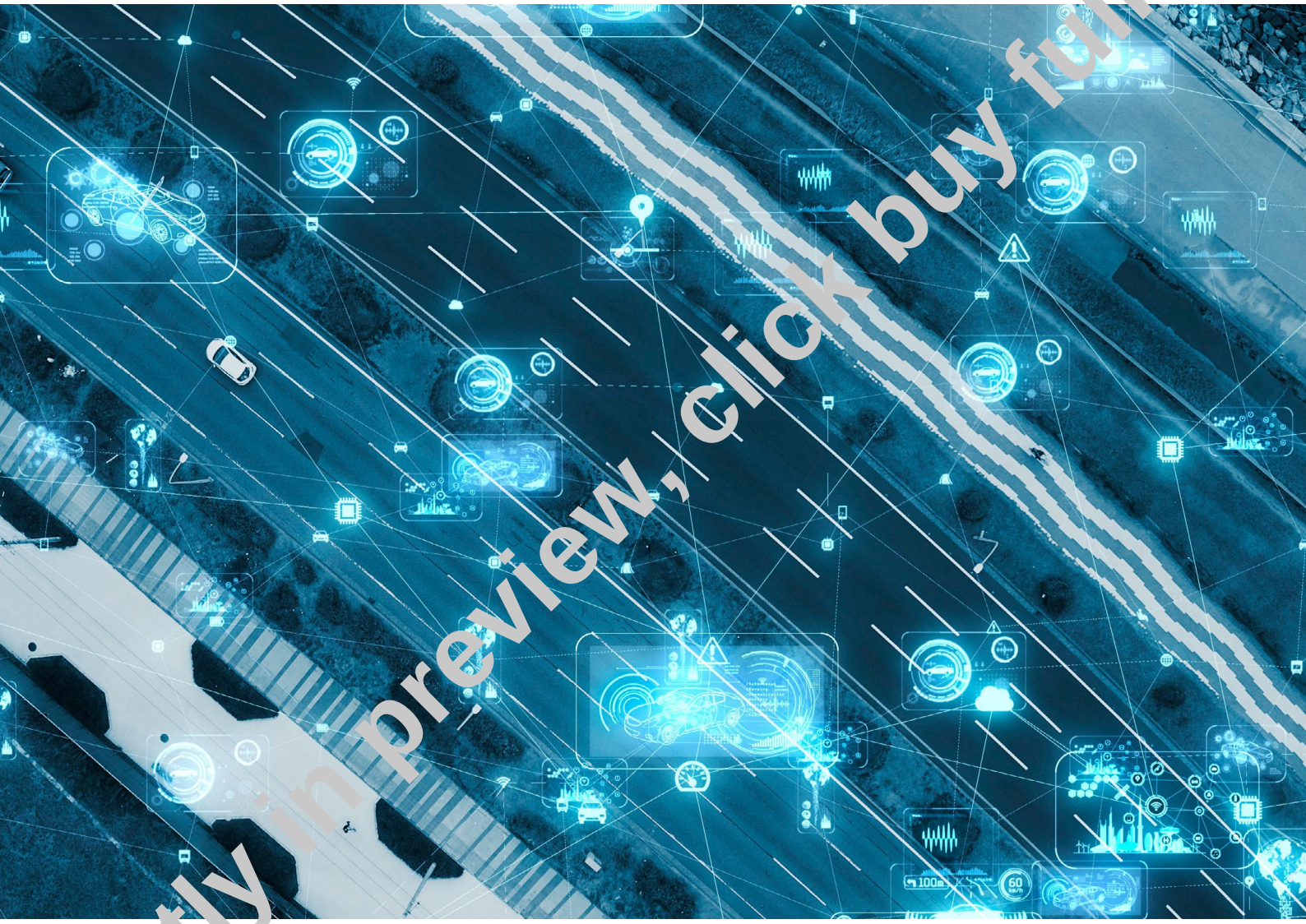
Natural language description for abstract scenarios for automated driving systems — Specification

July 2022 Version 1



BSI Flex 1889 v1.0:2022-07

Centre for Connected
& Autonomous Vehicles

bsi.

Publishing and copyright information

Published by BSI Standards Limited 2022

ISBN 978 0 539 20471 1

ICS 35.040.50; 43.020; 19.100

This BSI Flex is part of a wider programme of work around CAVs. For more information, go to:
https://www.bsigroup.com/en-GB/CAV/

BSI's Flex standards provide a new, flexible way to develop consensus-based good practice that dynamically adapts to keep pace with fast-changing markets. For more information, go to:
https://www.bsigroup.com/en-GB/our-services/standards-services/flex/

Release history

First released July 2022

Contents

Foreword

This BSI Flex was sponsored by the Centre for Connected and Autonomous Vehicles. Its development was facilitated by BSI Standards Limited and it was released under licence from The British Standards Institution. It came into effect on 28th July 2022.

Acknowledgement is given to Siddartha Khastgir of WMG, University of Warwick, as the technical author, and the following organizations that were involved in the development of this BSI Flex as members of the Advisory Group:

- Audi/Cariad
- AVL
- Burges Salmon
- Centre for Connected and Autonomous Vehicles (CCAV)
- Disabled Persons Transport Advisory Committee (DPTAC)
- Driver and Vehicle Standards Agency (DVSA)
- Fusion Processing
- Transport for Greater Manchester (TFGM)
- Thatcham
- Vehicle Certification Agency (VCA)
- Waymo
- Wayve
- WMG, University of Warwick

The BSI Flex development process enables a specification to be developed rapidly, and on an iterative basis, in order to fulfil an immediate stakeholder need. A BSI Flex can be considered for further development as a PAS or British Standard, or constitute part of the UK input into the development of a European or International Standard.

The content in this version is part of an iterative process, it is likely to change from time to time with subsequent iterations.

Information about this document

This release is Version 1 of BSI Flex 1889 which has been released to enable industry to engage with the initial content and feedback comments. All comments received will be reviewed to inform the future direction of this standard. However, at present there are no plans to develop further versions. Interested parties are encouraged to check the BSI website for any updates regarding future versions.

This publication can be withdrawn, revised, partially superseded or superseded. Information regarding the status of this publication can be found in the Standards Catalogue on the BSI website at bsigroup.com/standards, or by contacting the Customer Services team.

Where websites and webpages have been cited, they are provided for ease of reference and are correct at the time of publication. The location of a webpage or website, or its contents, cannot be guaranteed.

Relationship with other publications

This document is part of BSI's Connected and Automated Vehicles programme and is intended to be read alongside:

- PAS 1880:2020
- PAS 1881:2022
- PAS 1882:2021
- PAS 1883:2020
- PAS 1884:2021
- PAS 1885:2018
- BSI Flex 1890 v4.0:2022-03
- PAS 11281:2018

- safety and stakeholder requirements, including the Department for Transport's Code of practice: Automated vehicle trialling, Transport for London's Connected and autonomous vehicles: Guidance for London trials, and Highways England's GG104: Requirements for safety risk assessment; and
- existing legislation for UK vehicles and roads.

Presentational conventions

The provisions of this BSI Flex are presented in roman (i.e. upright) type. Its requirements are expressed in sentences in which the principal auxiliary verb is "shall".

Commentary, explanation and general informative material is presented in smaller italic type, and does not constitute a normative element.

Where words have alternative spellings, the preferred spelling of the Shorter Oxford English Dictionary is used (e.g. "organization" rather than "organisation").

Contractual and legal considerations

This publication has been prepared in good faith, however no representation, warranty, assurance or undertaking (express or implied) is or will be made, and no responsibility or liability is or will be accepted by BSI in relation to the adequacy, accuracy, completeness or reasonableness of this publication. All and any such responsibility and liability is expressly disclaimed to the full extent permitted by the law.

This publication is provided as is, and is to be used at the recipient's own risk.

The recipient is advised to consider seeking professional guidance with respect to its use of this publication.

This publication is not intended to constitute a contract. Users are responsible for its correct application.

Compliance with a BSI Flex cannot confer immunity from legal obligations.

0 Introduction

0.1 Vehicles equipped with Automated Driving Systems (ADS) bring many potential benefits such as potentially increased safety, reduced congestion, and more efficient traffic flow. However, due to the complexity of ADS, safety assurance poses challenges.

Figure 1 illustrates the V model for system development; on the right-hand side of the V model are the different levels of testing, whereas on the left side are the system development phases. Using a traditional distance-based approach, *Kalra et al.* [1] suggested that it would take 11 billion miles to demonstrate ADS are 20% better than an average human driver. This has therefore shifted the industry and academia towards a scenario-based approach for the development and testing of the system. Within a scenario-based approach for ADS development, purposely defined scenarios are used throughout the whole V model - from operational concept definition to requirements and architecture definition, to detailed design and development, and finally to the testing phases of the system.

0.2 When incorporating scenarios along the V model, it is important to appreciate the diversity of its end users (e.g. ADS developer, simulation test engineer, regulator, the public, etc.). ADS developers might favour a common format to share across organizations and systems, which raises the need for standardization. Simulation test engineers might favour a highly detailed, machine-readable format for their execution and analysis. Regulators and the public might prefer a higher abstraction level and human readable natural language format. Given these competing requirements, the industry has concluded that different levels of scenarios are needed for the ADS development. As generally applicable terminology, the *PEGASUS* project [2] has defined three different levels of abstraction:

a) functional scenarios (semantic descriptions);
b) logical scenarios (including ranges for variable scenario parameters); and
c) concrete scenarios (with concrete values for each parameter range).

Neurohr et al. [3] have extended that by adding a fourth layer between functional and logical called "abstract" scenarios. The resulting levels with the corresponding descriptions are depicted in Figure 2.

Figure 1 – V model for system development

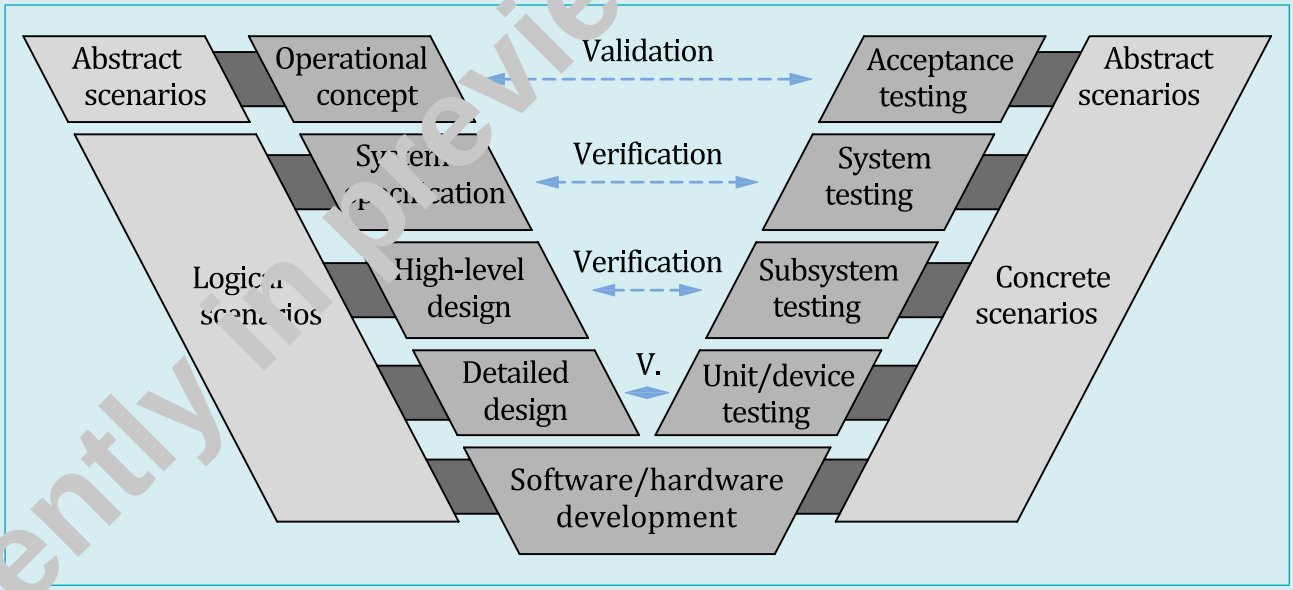
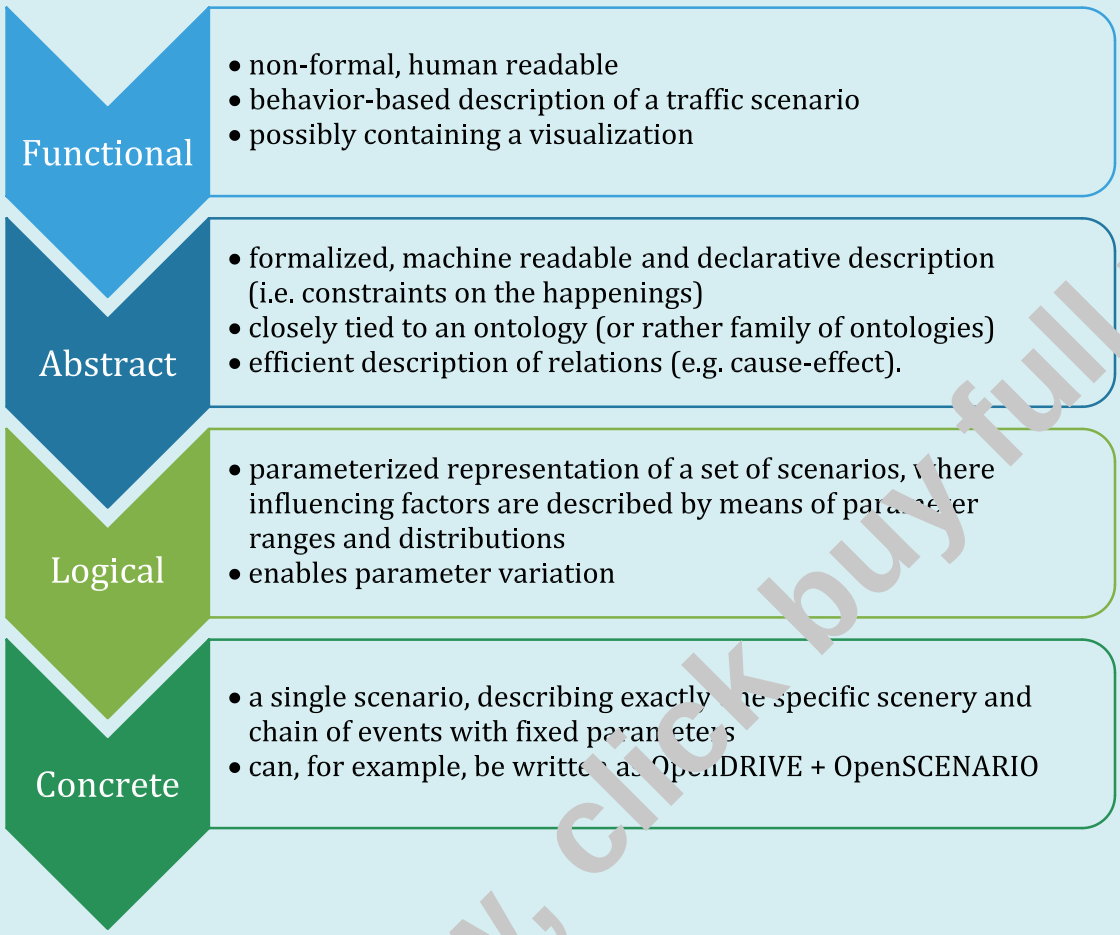


Figure 2 – Scenario abstraction levels



NOTE *Taken from Neurohr et al. [3].*

0.3 Functional scenarios are textual descriptions in free text (without any templates or regulations regarding grammar and vocabulary) and are therefore out of scope of this standard. Abstract scenarios are formalized versions of these scenarios. Logical and concrete scenarios are low level abstraction, parameterized and machine interpretable scenarios. While considerable industry effort has been made to tackle the scenarios description at these abstraction levels, there lacks a standard and unified description format for the natural language-based format at the abstract scenario level, which this standard seeks to address.

1 Scope

This BSI Flex specifies requirements for a structured natural language format for test scenario definition of an automated driving system (ADS) Level 3 and higher.

NOTE 1 *See ISO/SAE 22736 for the definitions of each ADS Level.*

The requirements define the test scenario definition formats related to the:

a) scenery;

b) dynamic elements;

c) environment definitions; and

d) definition for events and triggers, as a time series.

NOTE 2 *This BSI Flex acknowledges the need to align with existing standards and frameworks.*

The scenarios aim to help the user understand how an ADS is behaving but do not cover the processes required to assess or approve if that ADS is safe.

This BSI Flex is intended to be used by organizations providing test/audit services of the systems and processes related to the assurance of an ADS and automated vehicle (AV). It might also be of interest to manufacturers or developers of Level 3 and higher ADS and suppliers of components and subcomponents.

This BSI Flex might also be of use to regulators, development engineers, test engineers, scenario editors, scenario database maintainers and requirement engineers.