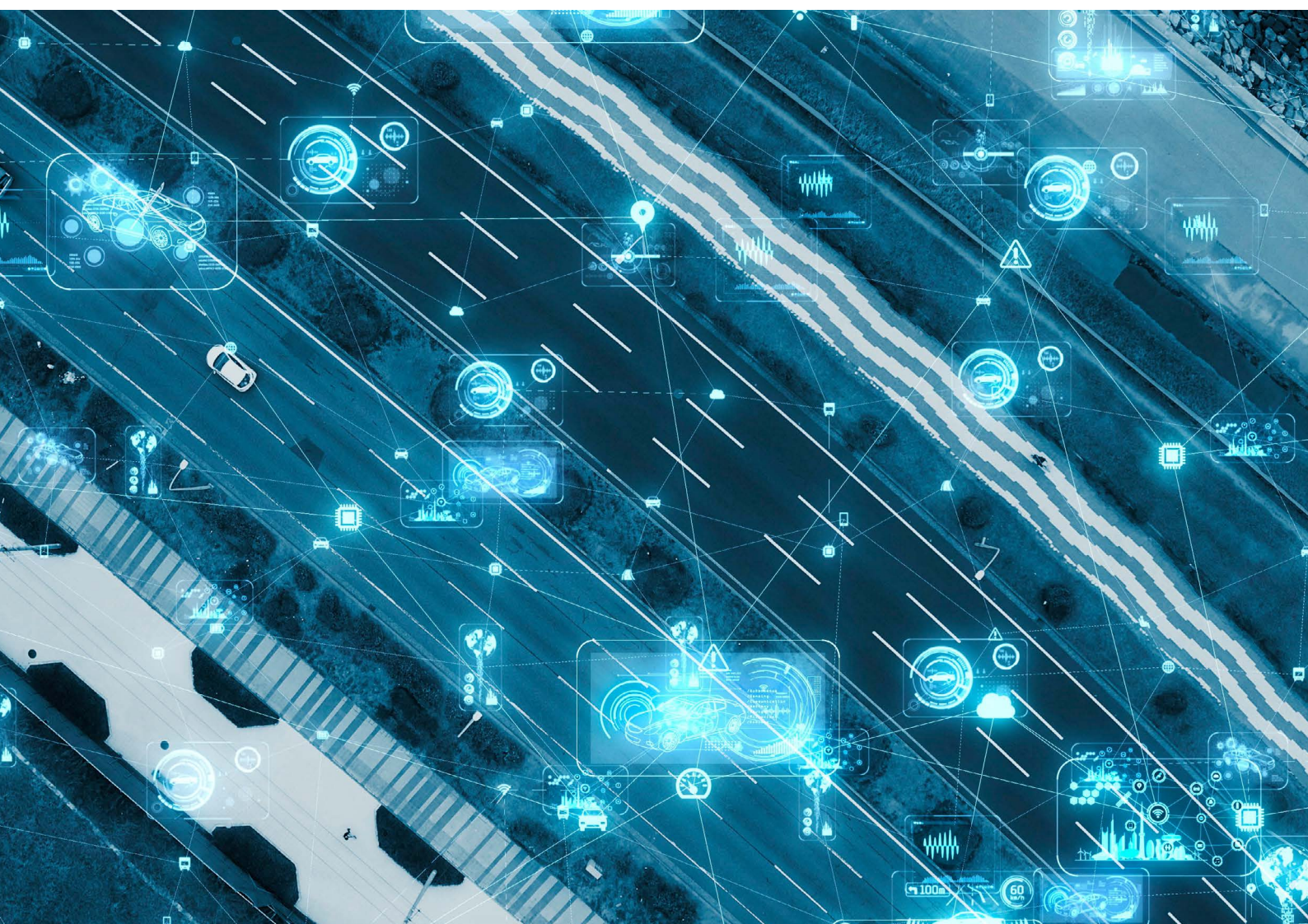


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Formalised natural language description of scenarios for automated driving systems – Specification

September 2023 Version 2



BSI Flex 1889 v2.0:2023-09



Centre for Connected
& Autonomous Vehicles

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Foreword

This BSI Flex was sponsored by the Centre for Connected and Autonomous Vehicles (CCAV). Its development was facilitated by BSI Standards Limited and it was released under licence from The British Standards Institution. It came into effect on 30th September 2023.

Acknowledgement is given to Siddhartha 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
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- National Highways
- Thatcham
- University of Warwick
- Vehicle Certification Agency (VCA)
- Wayve

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

Supersession

This version of BSI Flex 1889 supersedes BSI Flex 1889 v1.0:2022-07, which is withdrawn.

Information about this document

This is a full update of the document, and introduces the following principal changes:

- addition of an informative annex;
- additional detail in grammar definitions; and
- reordering of scenario elements.

Copyright is claimed on Figure 1. Copyright holders are *Abstract Natural Scenario Language Version 1.0* [1], Technical Disclosure Commons. Copyright is claimed on Figure 2. Copyright holders are *Criticality Analysis for the Verification and Validation of Automated Vehicles* [2], IEEE Access.

This release is Version 2 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This publication can be withdrawn, revised, partially superseded or superseded.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.

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Relationship with other publications

This document is part of BSI's Connected and Automated Mobility programme which aims to develop a suite of technical standards and guidance to help promote the design, testing and safe deployment of automated vehicles on UK roads. This document is issued as a vocabulary document that underpins the suite of CAM-related publications. It is intended to be read in conjunction with:

- publications on system safety, including PAS 1881, PAS 1883, PAS 1884, PAS 1885, BSI Flex 1890 and PAS 11281;
- publications on safety critical data, including PAS 1882;
- 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 National Highways' Safety risk assurance for connected and autonomous vehicle (CAV) trials on the strategic road network (SRN) Guidance Document; 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").

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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.

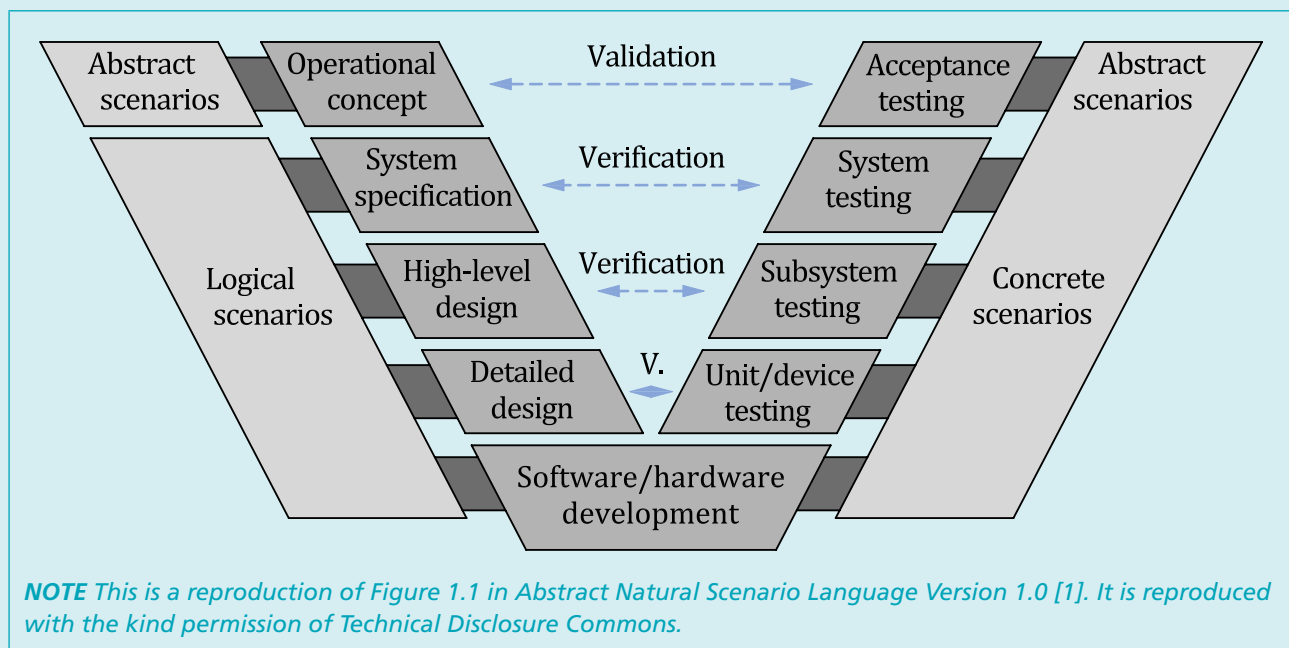
Figure 1 illustrates the V model for system development; on the right-hand side of the V model are the different levels of testing, whereas on the left side are the system development phases. Using a traditional distance-based approach, *Kalra et al.* [3] suggested that it would take 11 billion miles 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 [4] 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).

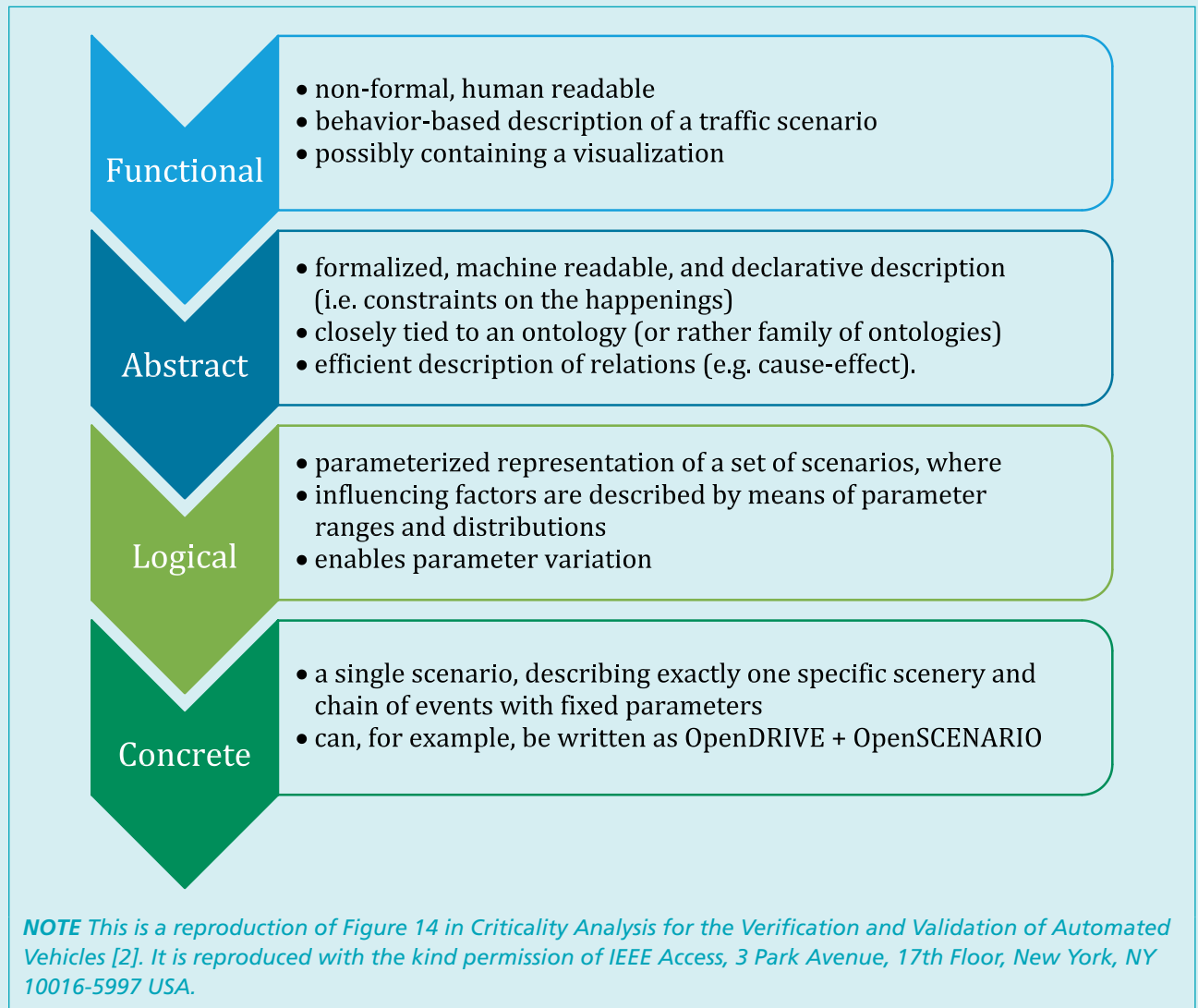
Neurohr et al. [2] have extended that by adding a fourth layer between functional and logical called “abstract” scenarios. The resulting levels with the corresponding descriptions are depicted in Figure 2.

Figure 1 – V model for system development



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Figure 2 – Scenario abstraction levels



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 those 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.

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1 Scope

This BSI Flex sets out requirements for a structured natural language format for test scenario definition of an automated driving system (ADS) Level 3 and higher. BSI Flex 1889 v2.0 supports users of scenarios by providing a natural language for the description of scenarios used in scenario-based testing of ADS. This BSI Flex, however, does not cover the processes required to assess or approve that an 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, developers of Level 3 and higher ADS, suppliers of components and subcomponents, simulators and anyone involved in scenario-based testing.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes provisions of this document¹⁾.

PAS 1883, *Operational Design Domain (ODD) taxonomy for an automated driving system (ADS) – Specification*

¹⁾ Documents that are referred to solely in an informative manner are listed in the Bibliography.