# CEN

# WORKSHOP

# AGREEMENT

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English version

## Building a common simulation space

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## European foreword

This CEN Workshop Agreement (CWA 17515:2020)has been developed in accordance with CEN-CENELEC Guide 29 'CEN/CENELEC Workshop Agreements – The way to rapid consensus' and with the relevant provision of CEN/CENELEC Internal Regulations – Part 2. It was approved by a Workshop of representatives of interested parties on 2019-07-09, the constitution of which was supported by CEN following the public call for participation made on 2019-06-10. However, this CEN Workshop Agreement does not necessarily reflect the views of all stakeholders that might have an interest in its subject matter.

This CEN Workshop Agreement (CWA) is based on the results of the DRIVER+ research project, which received funding from the European Union's 7th Framework Programme for Research, Technological Development and Demonstration under Grant Agreement (GA) N° 607798.

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The following organizations and individuals developed and approved this CEN Workshop Agreement:

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— Riskaware Ltd./ Martyn Bull, Russell Mills, James England;

— Thales SIX GTS France SAS/ Jean-Benoit Bonne; and

— XVR Simulation B.V./ Martijn Hendriks, Steven van Campen.

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# Introduction

Due to the unimpeded population growth and our ever-increasing dependency on technology, effects in one domain can have a big impact on other domains, e.g. flooding can cause power and communication outages. Although the current focus on domain-specific simulators allows an increasing effectiveness of modeling a behavior to be as fine-grained as required, it also gives rise to the desire to interconnect multiple simulators together to simulate the co-dependence between different domains. Interoperability refers to the ability of computerized systems to connect and communicate with one another readily, even if they were developed by widely different manufacturers in different industries. CWA 17515 focuses on the interoperability between specialized simulators to facilitate a common simulation space used, for example, for exercises, operational setups and experiments that take place especially for crisis management inside the shared domain of these connected simulators.

Current and future challenges, due to increasingly severe consequences of natural disasters and terrorist threats, require the development and uptake of innovative solutions that address the operational needs of practitioners dealing with crisis management. DRIVER+ (Driving Innovation in Crisis Management for European Resilience) was a European research project funded under the 7th Framework Programme (FP7) that aimed to improve the way capability development and innovation management is tackled [1]. One of the objectives of this project was to develop an infrastructure to create relevant environments for enabling the trialing of new solutions and to explore and share crisis management capabilities. This development and use of the infrastructure within DRIVER+ provided a basis that led to the creation of this CWA.

For training and exercising in the crisis management domain, there is a growing need for a more realistic simulation of the crisis or incident, including an interactive 3D visualization of the incident site as well as the cascading effects that may follow the original incident. For example, a flooding may cause a power failure, which in turn causes a failure of the communication infrastructures and traffic management systems, leading to further disruptions. As these effects typically cover many domains, it is unlikely that there is a single simulator that covers all these aspects, so multiple simulators have to be connected and have to cooperate to create such an immersive fictive crisis.

Although similar standards regarding interoperability are available these standards are predominantly used within the military field. Examples for this are:

— IEEE 1516:2010 Modeling and Simulation (M&S) High Level Architecture (HLA) – Framework and rules

— IEEE 1516.1:2010 Modeling and Simulation (M&S) High Level Architecture (HLA) – Federate interface specification

— IEEE 1516.2:2010 Modeling and Simulation (M&S) High Level Architecture (HLA) – Object Model Template (OMT) specification

— IEEE 1278.1:2012 Distributed Interactive Simulation (DIS) – Application protocols

— IEEE 1278.2:2015 Distributed Interactive Simulation (DIS) – Communication services and Profiles

— IEEE 1278.3:1996 Recommended practice for distributed interactive simulation – Exercise management and feedback

— IEEE 1278.4:1997 Recommended practice for distributed interactive simulation – Verification, validation, and accreditation

The implementation of such standards in the crisis management domain is difficult, because:

— tooling is expensive for crisis management organizations, there is no real open source alternative, and the community of practitioners is small;

— tooling typically only offers code generators for the programming languages Java, C++ and C#, and for applications using web service description language, which excludes many simulators;

— implementing such standards requires a steep learning curve, and although some work has been done in creating a crisis management Federation Object Model (FOM), no mature interaction standards are available;

— few, if any, simulators operating in the crisis management domain currently support HLA or DIS standards.

This CWA defines a set of architectural and interfacing guidelines for easily connecting simulators developed by different manufacturers from different industries. A reference implementation of the guidelines described in this document and created for DRIVER+ can be found at the DRIVER+ GitHub repository [2]. It has to be noted that other domains than crisis management may find benefit in implementing the dispositions of this CWA.

The structure of this document is as follows: Section 1 to 4 specifies general information about the content of the CWA, for example the scope, definitions and abbreviations. Section 5 defines architectural guidelines that are recommended when building a common simulation space, while Section 6 through 9 define the messages used inside the proposed architectural guidelines to communicate in the common simulation space. In order to provide the reader with practical examples of the use of the guidelines and messages, Annex B presents several use cases that represent common interactions when dealing with interoperability. These use cases intend to provide a frame of reference for the reader to understand the general vision of this CWA and for simulators to add specific protocols, messages, or applications relevant for their common simulation space in line with these guidelines.

# 1 Scope

This document defines a technical framework for connecting simulators and supporting tools aiming to facilitate interoperability between multiple stand-alone simulators, in order to jointly create and maintain a common simulation space. It specifies infrastructure and accompanied protocol parameters, common simulation message formats, and a set of services or tools facilitating the common simulation space functionalities. This document is intended to be used by system integrators and developers of individual simulators who jointly want to use an interoperability framework to share (parts of) their own simulation domain with simulators from another domain.

The aim for this CEN Workshop Agreement (CWA) is to provide a solid foundation of architectural guidelines to be used for jointly configuring a common simulation space. This CWA does not have the aim to closely integrate connected applications together. The general vision is that simulators are created for one or more specific domain knowledge areas with their own granularity, boundaries and purposes. To closely integrate these simulators would mean to integrate these domains as well, most likely causing irredeemable conflicts in the individual granularities, boundaries and purposes. In order to maintain individuality of the simulators, a common simulation space provides a framework for communication, based on a minimum commonality of the data accepted and produced by the individual simulators and an event-driven design philosophy.

The document provides a set of protocols and associated message formats to facilitate elementary interaction processes for simulators to function inside a common simulation space. To provide a better understanding of the proposed guidelines, this CWA also provides a repository of example interactions between simulators connected to a common simulation space. These examples are not described to limit the use of this document but are carefully chosen to reflect the most common types of interaction simulators would be expected to encounter when using a common simulation space. Each use case consists of a brief description of its intention, accompanied with a scenario description to provide an example for this use case. Based on this scenario, the desired information exchange flow and the required guidelines, messages, infrastructures and services to implement this flow are defined. Please note that the scenarios used inside each use case can be easily translated to other topics or configurations that serve the same purpose of the use case.

It is not the aim of this CWA to impose one global and general common simulation space to which all interested simulators have to connect to. A specific common simulation space should be configured based on, for example, the needs of an exercise, experiment or operational setup. This allows more flexibility for the simulators to find common ground for sharing domain-specific knowledge on a case-by-case basis. In order to ensure flexibility to fit the specific interoperability needs between simulators, the architectural guidelines posed in this document are categorized per interaction, allowing developers to jointly decide to implement the attached protocols and message formats, if required. If an interaction (e.g. change of ownership, updates of areas) is not necessary for the configured common simulation space or is not relevant for a specific simulator, its implementation is not mandatory.

Although numerous parties were involved in defining the architectural guidelines, it is inevitable that a specific (future) domain and/or interaction will be found that does not fit in the described architectural guidelines. Therefore, these guidelines focus on the elementary interaction processes, while supporting customization and expansion to fit specific interoperability needs. Because this CWA stresses the importance of a joint process of design and configuration, whenever the current architectural guidelines do not, it is encouraged to add new protocols and/or message formats that fit the need of a specific common simulation space.

# 2 Normative references

There are no normative references in this document.