



IEEE Standard Adoption of Moving Picture, Audio and Data Coding by Artificial Intelligence (MPAI) Technical Specification Object and Scene Description V1.0

STANDARDS

Developed by the
Entity Collaborative Activities Governance Board
of the
IEEE SA Board of Governors
Base specification contributed by MPAI community



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IEEE SA Standards Board

Abstract: This standard adopts MPAl Technical Specification V1.0 as an IEEE Standard. The Moving Picture, Audio and Data Coding by Artificial Intelligence (MPAl) Technical Specification Object and Scene Description (MPAl-OSD) V1.0 specifies data formats to enable description and localization of uni- and multi-model object and scenes in a virtual space for uniform use across MPAl Technical Specifications.

Keywords: adoption, AI module, AI workflow, avatar, IEEE 3308™, MPAl, MPAl-OSD, object and scene description

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Moving Picture, Audio and Data Coding
by Artificial Intelligence
www.mpai.community

MPAI Technical Specification

Object and Scene Description

V1.0

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Readers are invited to review Annex 2 - Notices and Disclaimers.

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Object and Scene Description V1.0

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1 Introduction

Technical Specification: Object and Scene Description (MPAI-OSD) – in the following also called MPAI-OSD – has been developed by MPAI – Moving Picture, Audio, and Data Coding by Artificial Intelligence, the international, unaffiliated, non-profit organisation developing standards for Artificial Intelligence (AI)-based data coding with clear Intellectual Property Rights licensing frameworks in compliance with the rigorous MPAI Process [8,9] in pursuit of the following policies:

1. Be friendly to the AI context but, to the extent possible, agnostic to the technology – AI or Data Processing – used in an implementation.
2. Be attractive to different industries, end users, and regulators.
3. Address three levels of standardisation all exposing standard interfaces with an aggregation level decided by the implementer:
 - 3.1. data types.
 - 3.2. Components called AI Modules (AIM).
 - 3.3. Configurations of AIMs called AI Workflows (AIW).
4. Specify the data exchanged by AIMs with as clear a semantic as possible.

Technical Specification: AI Framework (MPAI-AIF) [1] specifies a standard AI Framework (AIF) that enables dynamic configuration, initialisation, and control of AIWs depicted in Figure 1.

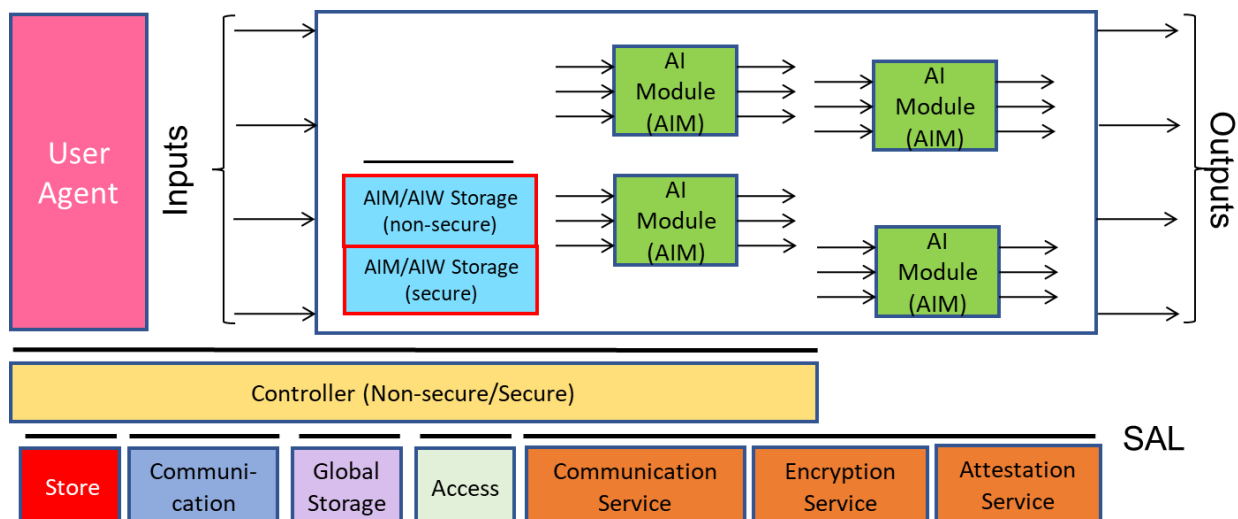


Figure 1 - The AI Framework (MPAI-AIF) V2.0 Reference Model

MPAI-AIF enables the secure execution of AI Workflows (AIW) that can be constituted by AI Modules (AIM). Thus, users can have machines whose internal operation they understand to some degree, rather than machines that are just “black boxes” resulting from unknown training with unknown data and component developers can provide components with standard interfaces that can have improved performance compared to other implementations.

An AIW and its AIMs may have 3 interoperability levels:

Level 1 – Implementer-specific and satisfying the MPAI-AIF Standard.

Level 2 – Specified by an MPAI Application Standard.

Level 3 – Specified by an MPAI Application Standard and certified by a Performance Assessor.

Users are free to adopt any of the three levels.

AIM can execute data processing or Artificial Intelligence algorithms and can be implemented in hardware, software, or hybrid hardware/software. AI Module can be Composite if they include connected AI Modules.

The MPAI-MMC V2 Technical Specification can be implemented in one of the following modalities:

1. As a specific AIW implementing a Use Case, as specified in this document.
2. As a specific AIM, as specified in this document.
3. As a specific data type, as specified in this document.

However, MPAI does not mandate the choice of modality, which remains the sole decision of the implementer.

In many MPAI Technical Specifications there are data types that refer to Objects and Scenes that can be uni- and multimodal and possibly refer to locations that may be in a physical or virtual space.

MPAI values the consistent use of data types across its Technical Specifications. Therefore, MPAI-OSD has been developed to be the reference point for the consistent use of data types across MPAI standards. When consistency is not possible because different usages are consolidated, such usages are clearly identified, and individual specific usages recorded.

Currently, there are no MPAI-OSD specific Use Cases. Therefore, only the Scope, Reference Models, and I/O Data of relevant Use Cases from other Technical Specifications are reported here. The full Use Case specification can be found in the Technical Specifications that own the Use Cases. All Use Cases are assumed to be implemented according to the MPAI-AIF.

MPAI-OSD will be accompanied by the Reference Software, Conformance Testing, and Performance Assessment Specifications. Conformance Testing specifies methods enabling users to ascertain whether a data type generated by an AIM, an AIM, or an AIW conform with this Technical Specification.

2 Scope

Technical Specification: Object and Scenes Description (MPAI-OSD) specifies Data Formats to enable description and localisation of uni- and multi-modal Objects and Scenes in a Virtual Space for uniform use across MPAI Technical Specifications.

MPAI-OSD has been developed by the Context-based Audio Enhancement (MPAI-CAE), Multi-modal Conversation (MPAI-MMC), and Portable Avatar Format (MPAI-PAF) Development Committees, and by the Connected Autonomous Vehicle (CAV) group of the Requirements Standing Committee.

3 Definitions

Terms beginning with a capital letter and specific of this Technical Specification have the meaning defined in Table 1. Terms beginning with a small letter have the meaning commonly defined for the context in which they are used. For instance, Table 1 defines *Object* and *Scene* but does not define *object* and *scene*.

A dash “-” preceding a Term in Table 1 indicates the following readings according to the font:

1. Normal font: the Term in the table without a dash and preceding the one with a dash should be read before that Term. For example, “Avatar” and “- Model” will yield "Avatar Model."
2. *Italic* font: the Term in the table without a dash and preceding the one with a dash should be read after that Term. For example, “Avatar” and “- *Portable*” will yield "Portable Avatar."

Table 1 - General MPAI-HMC terms

Term	Definition
Audio	Digital representation of an analogue audio signal sampled at a frequency between 8-192 kHz with a number of bits/sample between 8 and 32, and non-linear and linear quantisation. Data with characteristics of Audio may be synthetically produced.
Avatar	An Object rendered to represent a Human of a Machine in a virtual space.
- Model	An inanimate Avatar exposing animation interfaces.
- <i>Portable</i>	A Data Type including Avatar ID, Time, Audio-VisualScene Descriptors, Spatial Attitude, Avatar Model, Body Descriptors, Face Descriptors, Language Preference, Speech Coding, Speech Data, Text, and Personal Status [4].
Centre Point	The point of an Object selected to have coordinates (0,0,0).
Context	Additional information about a communication emitted by an Entity, such as language, culture etc..
Data	Information in digital form.

- Format	The standard digital representation of Data.
- Type	An instance of Data with a specific Data Format.
Descriptor	The Digital Representation of a feature of an Object.
- <i>Body</i>	A Data Type including the digital representation of the features of the body of a real or digital human.
- <i>Face</i>	A Data Type including the digital representation of a feature of the face of a real or digital human.
Digital Representation	Data corresponding to and representing a physical entity.
Environment	A Virtual Space that may be null or may include an Audio-Visual Scene.
Human	A human being in a real space.
- <i>Digital</i>	A Digitised or a Virtual Human.
- <i>Digitised</i>	An Object that has the appearance of a specific human when rendered.
- <i>Virtual</i>	An Object created by a computer that has a human appearance when rendered but is not a Digitised Human.
Identifier	The label uniquely associated with a human or an Object.
Instance	An element of a set of entities – Objects, Digital Humans etc. – belonging to some levels in a hierarchical classification (taxonomy).
- <i>Audio</i>	The instance of an Audio Object.
- <i>Visual</i>	The instance of a Visual Object.
Object	A data structure that can be rendered to cause an Experience.
- <i>Audio</i>	An Object described by Audio Descriptors.
- <i>Audio-Visual</i>	An Object described by Audio-Visual Descriptors.
- <i>Body</i>	A digital representation of the body of a Human or a Machine.
- <i>Descriptor</i>	The digital representation of the feature of an Object.
- <i>Digital</i>	A Digitised or a Virtual Object.
- <i>Digitised</i>	The digital representation of a real object.
- <i>Face</i>	The digital representation of the face of a Human or a Machine.
- <i>Speech</i>	An Object described by Speech Descriptors.
- <i>Text</i>	A string of Text.
- <i>Virtual</i>	An Object not representing an object in the real environment.
- <i>Visual</i>	An Object described by Visual Descriptors.
Orientation	The 3 Euler angles of an Object in a Virtual Space.
Position	The coordinates of a representative point for an object in a Virtual Space with respect to a set of coordinate axes.
Rendering	The process of instantiating a Virtual Space as a human-perceptible entity.
Scene	A composition of Objects located according to a Scene Geometry.
- <i>Audio</i>	A Scene composed of Audio Objects.
- <i>Digital</i>	A digitised scene or a Virtual Scene
- <i>Audio-Visual</i>	A Scene composed of Audio Objects, Visual Objects and co-located Audio-Visual Objects.
- <i>Visual</i>	A Scene composed of Visual Objects.
Scene Descriptors	The digital representation of a feature of a scene.
- <i>Audio</i>	A Data Type including the digital representation of the audio features of a digital scene.
- <i>Audio-Visual</i>	A Data Type combining the Audio or Visual Scene Descriptors.
- <i>Visual</i>	A Data Type including the digital representation of the visual features of a digital scene.
Scene Geometry	The digital representation of the Object arrangement of a Scene.

- <i>Audio</i>	A Data Type describing the Spatial arrangement of the Visual Objects of a Scene.
- <i>Audio-Visual</i>	A Data Type describing the Spatial arrangement of the Audio, Visual, and Audio-Visual Objects of a Scene.
- <i>Visual</i>	A Data Type describing the Spatial arrangement of the Visual Objects of a Scene.
Attitude	
- <i>Spatial</i>	Position and Orientation and their velocities and accelerations of a Human and Visual Object in a Virtual Environment.
Virtual Space	A space generated and maintained by a computing platform that can be rendered.
Speech	Digital representation of analogue speech sampled at a frequency between 8 kHz and 96 kHz with a number of bits/sample of 8, 16 or 24, and non-linear and linear quantisation or compressed. Data with characteristics of Speech may be synthetically produced.
Universally Unique Identifier	(UUID) a 128-bit label used to identify Data entities.

The Terms used in this standard whose first letter is capital and are not already included in **Error! Reference source not found.** are defined in Table 2. To concentrate in one place all the Terms that are composed of a common name followed by other words (e.g., the word Data followed by one of the words Format, Type, or Semantics), the definition given to a Terms preceded by a dash “-” applies to a Term composed by that Term without the dash preceded by the Term that precedes it in the column without a dash.

Table 2 - MPAI-wide Terms

Term	Definition
Access	Static or slowly changing data that are required by an application such as domain knowledge data, data models, etc.
AI Framework (AIF)	The environment where AIWs are executed.
AI Model (AIM)	A data processing element receiving AIM-specific Inputs and producing AIM-specific Outputs according to according to its Function. An AIM may be an aggregation of AIMs.
AI Workflow (AIW)	A structured aggregation of AIMs implementing a Use Case receiving AIW-specific inputs and producing AIW-specific outputs according to the AIW Function.
Application Standard	An MPAI Standard designed to enable a particular application domain.
Channel	A connection between an output port of an AIM and an input port of an AIM. The term “connection” is also used as synonymous.
Communication	The infrastructure that implements message passing between AIMs.
Component	One of the 7 AIF elements: Access, Communication, Controller, Internal Storage, Global Storage, Store, and User Agent
Composite AIM	An AIM aggregating more than one AIM.
Component	One of the 7 AIF elements: Access, Communication, Controller, Internal Storage, Global Storage, Store, and User Agent
Conformance	The attribute of an Implementation of being a correct technical Implementation of a Technical Specification.