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

MPAI Technical Specification

Data Types, Formats, and Attributes (MPAI-TFA)

V1.3

WARNING

Use of the technologies described in this Technical Specification may infringe patents, copyrights or intellectual property rights of MPAI Members or non-members.

MPAI and its Members accept no responsibility whatsoever for damages or liability, direct or consequential, which may result from the use of this Technical Specification.

Readers are invited to review Notices and Disclaimers.

Data Types, Formats, and Attributes (MPAI-TFA) V1.3

1 Foreword

The international, unaffiliated, non-profit ***Moving Picture, Audio, and Data Coding by Artificial Intelligence (MPAI)*** organisation was established in September 2020 in the context of:

1. **Increasing** use of Artificial Intelligence (AI) technologies applied to a broad range of domains affecting millions of people
2. **Marginal** reliance on standards in the development of those AI applications
3. **Unprecedented** impact exerted by standards on the digital media industry affecting billions of people

believing that AI-based data coding standards will have a similar positive impact on the Information and Communication Technology industry.

The design principles of the MPAI organisation as established by the MPAI Statutes are the development of AI-based Data Coding standards in pursuit of the following policies:

1. Publish upfront clear Intellectual Property Rights licensing frameworks.
2. Adhere to a rigorous standard development process.
3. Be friendly to the AI context but, to the extent possible, remain agnostic to the technology thus allowing developers freedom in the selection of the more appropriate – AI or Data Processing – technologies for their needs.
4. Be attractive to different industries, end users, and regulators.
5. Address five standardisation areas:
    1. *Data Type*, a particular type of Data, e.g., Audio, Visual, Object, Scenes, and Descriptors with as clear semantics as possible.
    2. *Qualifier*, specialised Metadata conveying information on Sub-Types, Formats, and Attributes of a Data Type.
    3. *AI Module* (AIM), processing elements with identified functions and input/output Data Types.
    4. *AI Workflow* (AIW), MPAI-specified configurations of AIMs with identified functions and input/output Data Types.
    5. *AI Framework* (AIF), an environment enabling dynamic configuration, initialisation, execution, and control of AIWs.
6. Provide appropriate Governance of the ecosystem created by MPAI Technical Specifications enabling users to:
    1. *Operate* Reference Software Implementations of MPAI Technical Specifications provided together with Reference Software Specifications
    2. *Test* the conformance of an implementation with a Technical Specification using the Conformance Testing Specification.
    3. *Assess* the performance of an implementation of a Technical Specification using the Performance Assessment Specification.
    4. *Obtain* conforming implementations possibly with a performance assessment report from a trusted source through the MPAI Store.

MPAI operates on four solid pillars:

1. The MPAI Patent Policy specifies the MPAI standard development process and the Framework Licence development guidelines.
2. *Technical Specification: Artificial Intelligence Framework (MPAI-AIF)* V2.1 specifies an environment enabling initialisation, dynamic configuration, and control of AIWs in the standard AI Framework environment depicted in Figure 1. An AI Framework can execute AI applications called AI Workflows (AIW) typically including interconnected AI Modules (AIM). MPAI-AIF supports small- and large-scale high-performance components and promotes solutions with improved explainability.

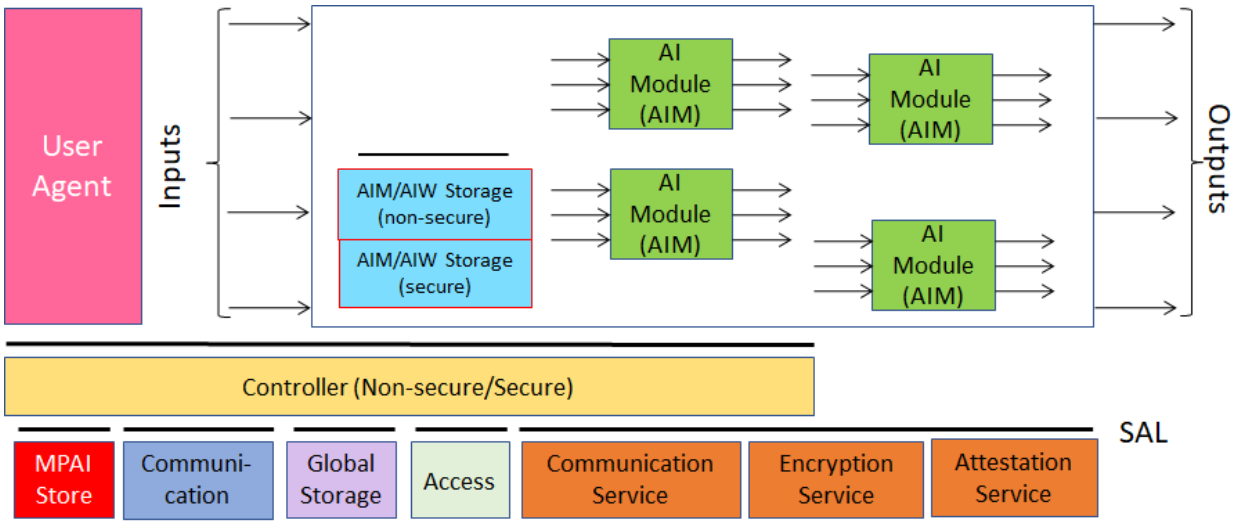

Figure 1 – The AI Framework (MPAI-AIF) V2 Reference Model

3. ***Technical Specification: Data Types, Formats, and Attributes (MPAI-TFA) V1.2*** specifies Qualifiers, a type of metadata supporting the operation of AIMs receiving data from other AIMs or from input data. Qualifiers convey information on Sub-Types (e.g., the type of colour), Formats (e.g., the type of compression and transport), and Attributes (e.g., semantic information in the Content). Although Qualifiers are human-readable, they are only intended to be used by AIMs. Therefore, Text, Speech, Audio, Visual, and other Data received by or exchanged between AIWs and AIMs should be interpreted as being composed of Content (Text, Speech, Audio, and Visual as appropriate) and associated Qualifiers. For instance, a Text Object is composed of Text Data and Text Qualifier. The specification of most MPAI Data Types reflects this point.
4. ***Technical Specification: Governance of the MPAI Ecosystem (MPAI-GME) V1.1*** defines the following elements:
    1. Standards, i.e., the ensemble of Technical Specifications, Reference Software, Conformance Testing, and Performance Assessment.
    2. Developers of MPAI-specified AIMs and Integrators of MPAI-specified AIWS (Implementers).
    3. MPAI Store in charge of making AIMs and AIWs submitted by Implementers available to Integrators and End Users.
    4. Performance Assessors, independent entities assessing the performance of implementations in terms of Reliability, Replicability, Robustness, and Fairness.
    5. End Users.

The interaction between and among actors of the MPAI Ecosystem are depicted in Figure 2.

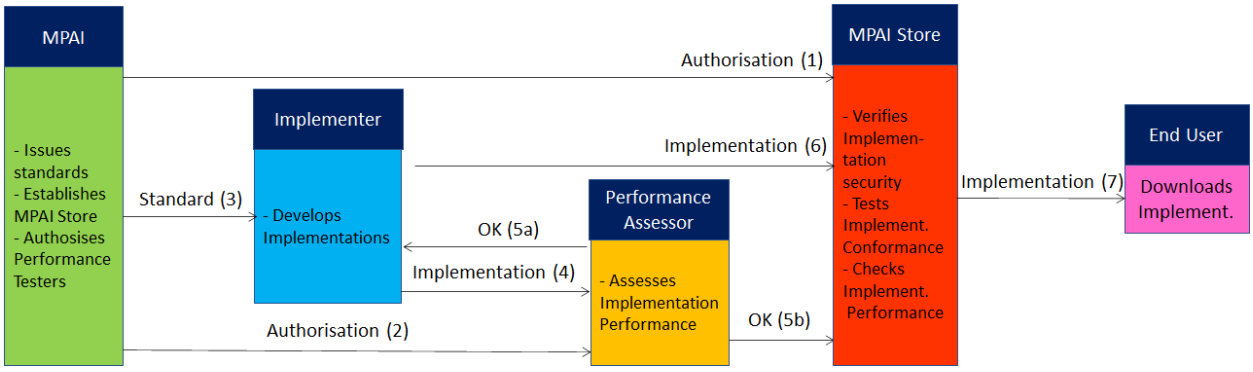

Figure 2 – The MPAI Ecosystem

2 Introduction

(Informative)

Technical Specification: AI Framework (MPAI-AIF) V2.1 is a key element of the MPAI approach to AI-based Data Coding standards. It is based on a framework enabling initialisation, dynamic configuration, and control of AIWs in the standard AI Framework environment depicted in Figure 1. The Data Data produced by executing specific functions by AI Modules (AIM) are communicated to other AIMs in an AIW.

The functions performed by an AIM may improve if it knows more about the **capabilities of the AIMs** it is connected to and the **Data** they receive. For example, an instance of the MPAI Natural Language Processing (MMC-NLU) AIM has the task to refine the text it receives and produce the Meaning of the Text. This can be dome using other sources of information, such as:

1. The **identifiers of the object** referenced in the text.
2. The **context of the object** in a relevant space.

If the instance of the NLU AIM has access to this additional information, it is likely that an AIM able to process it will provide improved accuracy of the refined text and Meaning.

Technical Specification: AI Module Profiles (MPAI-PRF) enables an AIM instance to signal the *Attributes* - that uniquely characterise it, e.g. input data, output data, and functionality and *Sub-Attributes* – such as languages supported by a *Text and Speech Translation* AIM. Currently, MPAI-PRF defines the Attributes of eight AIMs but Profiles for more AIMs are likely to be defined in the future.

The effectiveness of the functions performed by an AIM can be enabled or enhanced if the AIM has even more knowledge about the **characteristics of the Data** received. Examples of characteristics include:

- The CIE 1931 colour space of an instance of the Visual Data Type.
- The MP3 format of a speech segment.
- The WAV file format of an audio segment.
- The gamma correction applied to the device that produced a video.
- The Instance ID of an object in an audio segment.
- The Text conveyed by a speech segment.

Technical Specification: Data Types, Formats, and Attributes (MPAI-TFA) V1.3 specifies the Qualifier Data Type, a container that can be used to represent, for instance, that a Visual Data Type instance:

- Uses a given colour space (Sub-Type)
- Was produced by an AVC encoder (Format).
- Is described by Dublin Core Metadata (Attribute).

Therefore, Qualifiers are a specialised type of metadata intended to support the operation of AIMs receiving data from other AIMs and conveying information on Sub-Types, Formats, and Attributes related to the Content. The information conveyed by Qualifiers is intended for use by an AIM, even though they are human-readable. The combination of "*Content*" (the Data of a Data Type) and "*Qualifier*" (the combination of Sub-Type, Format, and Attributes) is called "*Object*".

MPAI provides a standard method to attach information to a Data Type instance called Annotation. This is defined as Data attached to an Object or a Scene. As opposed to a Qualifier that describes the intrinsic properties of a Data Type, an Annotation is spatially and temporally local and changeable.

MPAI plans of publishing new versions of MPAI-TFA each time an application standard requires Qualifiers or when there is a need to extend existing Qualifiers. MPAI-TFA users may

communicate their need for extension of existing and specification of additional Data Type Qualifiers to the MPAI Secretariat. Therefore, versioning of Qualifiers is a critical component of MPAI-TFA.
The Chapters, Sections, and Annexes of this Technical Specification are Normative unless they are explicitly labelled as Informative. In all Chapters and Sections, Terms beginning with a capital letter are defined in *Table 1* if they are specific to this Technical Specification. All MPAI-defined Terms are accessible online. All Chapters and Annexes are Normative unless they are labelled as Informative.

3 Scope

Technical Specification: Data Types, Formats and Attributes (MPAI-TFA) V1.3 – in the following also called MPAI-TFA V1.3 or MPAI-TFA – specifies Qualifiers, i.e., additional information to an instance of a Data Type, a particular type of Data e.g., Text, Speech, and Visual that an AI Module may need to properly process the instance.
MPAI-TFA classifies that additional information as:

1. *Sub-Types*, information related to the different forms that can be taken by a Data Type instance, for example, Colour Space is a Sub-Type of the Visual Data Type.
2. *Formats*, the different ways in which a Data Type can be digitally represented or transported, for example, AAC is a Format of the Speech Data Type.
3. *Attributes*, the different types of information providing details on a Data Type instance, for example, the ID of an Object in a picture.

Sub-Types, Formats, and Attributes are further organised into subordinate hierarchies. New elements of the hierarchy may be added to this Technical Specification based on requests coming from application domains.
All information elements of a Qualifier are optional. The decision to add a particular element of the Qualifiers defined by this Technical Specification resides solely with the user.
The current version of MPAI-TFA specifies Qualifiers for the following Data Types: Text, Speech, Audio, and Visual.
This Technical Specification has been developed by CAE-DC, MMC-DC, PAF-DC, XRV-DC, and the CAV, MMM, and OSD groups of the Requirements Standing Committee. MPAI may publish new versions of MPAI-TFA or new standards covering – or extending – the scope currently covered by MPAI-TFA.

4 Definitions

Terms beginning with a capital letter have the meaning defined in *Table 1*. All MPAI-defined Terms are accessible online.
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 *Table 1* 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 - Terms and Definitions relevant to MPAI-TFA

Terms	Definitions

Attribute	Information describing the features of a Data Type instance in addition to Sub-Type and Format.
Audio	A Data Type an instance of which represents analogue signals – or is rendered to be perceived – in the human-audible range (16 Hz - 20 kHz).
Data Type	A type of Data, such as Text, Speech, Audio, and Visual.
Dynamic	Refers to a Data Type that is time dependent.
Format	Information about the digital representation of a Sub-Type.
Machine Learning	A Process using training data to create a Model able to perform specific tasks such as classification.
Real	Refers to a Data Type instance that has been produced in a Real Space.
Qualifier	A Data Type including Sub-Types (e.g., colour space information), Format (e.g., compression and transport), and Attributes (e.g., semantic information) of a Data Type instance.
Space	
- *Real*	A space that is part of the Universe, i.e., the real world.
- *Virtual*	A space generated and maintained by a computing platform that can be rendered.
Speech	A Data Type an instance of which represents – or is rendered to be perceived – as an analogue signal with vocal characteristics.
Static	Refers to a Data Type that is not time dependent.
Sub-Type	A sub-category within a Data Type.
Synthetic	Refers to a Data Type instance that has been produced in a Virtual Space.
Text	A series of characters drawn from the finite alphabet of a Character Set.
Visual	A Data Type an instance of which represents analogue signals – or is rendered to be perceived – in the human-visible range (380 to 700 nanometres).
Universe	A synonym of the “real world”.

5 Data Types

MPAI-TFA V1.2 specifies Qualifiers for the following Data Types:

Automotive	GNSS Qualifier	LiDAR Qualifier	Offline Map Qualifier	RADAR Qualifier	Ultrasound Qualifier
Health	ECG Qualifier	EEG Qualifier	EHR Qualifier	Genomics Qualifier	Medical Images Qualifier
Machine Learning	ML Model Qualifier				
Media	3D Model Qualifier	Audio Qualifier	Audio-Visual Qualifier	MoCap Qualifier	Speech Qualifier
	Text Qualifier	Visual Qualifier			

Metaverse	Certificate Qualifier	Contract Qualifier	Currency Qualifier	Discovery Qualifier	Information Qualifier
	Interpretation Qualifier	Metaverse API	Program Qualifier		
Space-Time	Location Qualifier	Time Qualifier			
Theatrical	Control Qualifier				

5.1 3D Model Qualifier

5.1.1 Definition

3D Model Qualifier is a set of Data providing additional information on 3D Model Data for potential use by a machine.
The combination of 3D Model Data and 3D Model Qualifier is called 3D Model Object, specified by MPAI-OSD V1.3.

5.1.2 Functional Requirements

3D Model Qualifier allow the expression of the following Elements:

1. Sub-Types
2. Formats
    1. Content
    2. Transport

Users needing additional entries in the3D Model Qualifier or support of new Qualifiers should make a documented request to the MPAI Secretariat. Requests will be considered by the appropriate MPAI committee.

5.1.3 Syntax

https://schemas.mpai.community/TFA/V1.3/data/3DModelQualifier.json

5.1.4 Semantics

1. **Sub-Types**
    1. Source
        1. Virtual
            1. Definition: the 3D Model instance is fully composed of synthetic data.
        2. Hybrid
            1. Definition: the 3D Model instance is composed of data that are partly synthetic and partly obtained from the digtial capture of visual information.
        3. Real
            1. Definition: the digital twin of a real object.
    2. Type
        1. Human:
            1. Definition: the 3D Model instance represents a human or humanoid.
        2. Non-human
            1. Definition: Definition: the 3D Model instance represents a generic object.

2. **Formats**
    1. **Content**
        1. Definition: the type of data organisation used to represent a 3D Model.
        2. Types
            1. Static
                1. Definition: the 3D Model instance does not contain time information
                2. Types
                    1. 3DS
                    2. glTF
                    3. OBJ
                    4. USD
            2. Dynamic
                1. Definition: the 3D Model instance includes time information
                2. Types
                    1. FBX
                    2. glTF
                    3. USD.
    2. **Transport**
        1. Definition: the type of data organisation used to used to transport a 3D Model
        2. Types:
            1. DASH
            2. HTTP Live Streaming

5.2 Audio Qualifier

5.2.1 Definition

Audio Qualifier is a set of Data providing additional information on Audio Data for potential use by a machine.
The combination of Audio Data and Audio Qualifier is called Audio Object, specified by MPAI-OSD V1.3.

5.2.2 Functional Requirements

Audio Qualifier must allow the expression of the following Qualifier elements:

1. Formats
    1. Content
    2. Transport
2. Attributes
    1. Source
    2. Metadata
    3. Spatial Attributes
    4. Device

Users needing additional entries in the Audio Qualifier or support of new Qualifiers should make a documented request to the MPAI Secretariat. Requests will be considered by the appropriate MPAI committee.

5.2.3 Syntax

https://schemas.mpai.community/TFA/V1.3/data/AudioQualifier.json

5.2.4 Semantics

1. **Sub-Types**
2. **Formats**
    1. Content
        1. Definition: the type of data arrangement used to digitally represent speech.
        2. Types:
            1. Raw Audio
                1. Definition: the type of data arrangement used to digitally represent samples or their transform coefficients.
                2. Types:
                    1. Sample Space
                        1. Definition: the representation with samples having the meaning of Audio level.
                        2. Characteristics
                            1. Sampling frequency Number expressing kHz
                            2. Sample precision Integer expressing bits/sample
                    2. Transform Space
                        1. Definition: the characteristics of the representation with samples having the meaning of Spatial Fourier Transform coefficients.
                        2. Characteristics
                            1. Sequence
                                1. Sequential
                                2. Interleaved
                            2. Precision
                                1. float32
                                2. float64
                    3. Spherical Harmonic Decomposition
                        1. Definition: the characteristics of the representation with samples having the meaning of Spherical Fourier Transform coefficients.
                        2. Characteristics
                            1. Sequence
                                1. Sequential
                                2. Interleaved
                            2. Precision
                                1. float32
                                2. float64
                    4. Ambisonics
                        1. Definition: the types of *full-sphere surround sound format* covering the horizontal plane, above, and below.
                        2. Types
                            1. 1st Order
                            2. 2nd Order
                            3. 3rd Order
                            4. 4th Ord
                            5. 5th Order

6. 6th Order
7. 7th Order

2. Compression Formats
    1. Definition: the type of data arrangement used to reduce the number of bits required to represent an Audio instance.
    2. Types
        1. MP3: (ISO/IEC 13818-3:1998)
        2. AAC-2: (ISO/IEC 13818-7:2006)
        3. AAC-4: (ISO/IEC 14496-3:2019)
        4. USAC (ISO/IEC 23003-3:2020)
        5. ALS (ISO/IEC 14496-3
        6. MPEG-H Audio (ISO/IEC 23008-3:2022)

2. Transport
    1. Definition: the type of data arrangement used to transport an Audio Data Type instance
    2. Types
        1. File
            1. WAV
            2. Core Audio Format
            3. RF64
            4. MP4 (ISO/IEC 14496-12:2022)
            5. IAMF: https://aomediacodec.github.io/iamf/
        2. Stream
            1. DASH (ISO/IEC 23009-1:2022)
            2. HTTP Live Streaming

2. Attributes

1. Source Type
    1. Definition: the types of an Audio instance
    2. Types:
        1. Vocal
            1. Real
            2. Synthetic
        2. Music
            1. Real
            2. Synthetic
        3. Sound effects
            1. Real
            2. Synthetic
        4. Noise
            1. Real
            2. Synthetic

2. Metadata
    1. Definition: the type of data arrangement used to attach information to an instance of Speech Data Type.
    2. Types
        1. General
            1. Dublin Core
            2. ID3
            3. IPTC Phot0 Metadata
            4. ADM: ITU-R 2076-3 (2025)

5. Object Identity
    1. Definition: the ID of an object in a Audio data Type instance
        1. Instance Identifier

3. Spatial Attributes
    1. Definition: Attributes that define the Audio Data Type instance in space such as direction, distance, and orientation.
    2. Types
        1. Binaural Cues
            1. Definition: Cues that provide information on the direction of a sound in the horizontal plane by relying on differences in sounds received by the two ears.
            2. Types
                1. Interaural level difference (ILD) Array of frequencies and associated level difference (Nx2)
                2. Interaural time delay (ITD) Array of frequencies and associated time delays (Nx2)
                3. Interaural phase difference (IPD) Array of frequencies and associated phase differences (Nx2)
        2. Spectral Cues
            1. Definition: Cues that contribute to the resolution of front/back confusions when different sound sources create the same interaural cues, and are critical for accurate localization of elevation in the median plane where interaural cues are negligible.
            2. Type
                1. Array of frequencies and associated frequency spectra (Nx5)
                – 2 for left ear (real and imaginary)
                – 2 for right (real and imaginary)
        3. Interchannel Differences
            1. Definition: Cues that define the differences between pairs of audio channels with respect to pressure level and time.
            2. Types
                1. Interchannel level difference (ICLD) Array of frequencies and associated level differences (NxM(M-1)/2)
                M= #channels
                2. Interchannel time difference (ICTD) Array of frequencies and associated time differences (NxM(M-1)/2)
                M= #channels

4. Device
    1. Definition: characteristics of the device that captured the Audio instance.
    2. Features
        1. Device ID Definition: an identifier of the device that captured the Speech instance, typically a string.
        2. Sensor Geometry
            1. Definition: the type of description of the the spatial arrangement of audio sensors in an audio device.

2. Types
    1. Microphone Array Geometry
3. Device Geometry
    1. Definition: the set of positions and orientations of the devices that captured an Audio instance, grouped according the their Microphone Array Geometries, in a real or virtual space.
    2. Types
        1. Device Scene Geometry
4. Sensor characteristics
    1. Definition: features of a single microphone sensor having an impact on the captured Audio Data Type instance, specifically directivity pattern and frequency response
    2. Directivity pattern
        1. Cardioid
        2. Supercardioid
        3. Hypercardioid
        4. Omnidirectional
        5. Parametric
            1. Definition: a directivity pattern which can be represented as coefficients of its trigonometric polynomial.
            2. Features:
                1. Degree
                2. Coefficients
    3. Frequency response
        1. Definition: the sensitivity of a microphone sensor expressed as an array of complex numbers at a discrete number of frequencies.

5.3 Audio-Visual Qualifier

5.3.1 Definition

Audio-Visual Qualifier is a set of Data providing additional information on Audio-Visual Data for potential use by a machine.
The combination of Audio-Visual Data and Audio-Visual Qualifier is called Audio-Visual Object, specified by MPAI-OSD V1.3.

5.3.2 Functional Requirements

Asset Qualifier must allow the expression of the following Elements:

1. Formats
    1. Content
        1. Speech Qualifiers with their Time information.
        2. Audio Qualifiers with their Time information.
        3. Visual Qualifiers with their Time information.
    2. Transport

Users needing additional entries in the Audio-Visual Qualifier or support of new Qualifiers should make a documented request to the MPAI Secretariat. Requests will be considered by the appropriate MPAI committee.

5.3.3 Syntax

https://schemas.mpai.community/TFA/V1.3/data/AudioVisualQualifier.json

5.3.4 Semantics

1. **Formats**
    1. **Content**
        1. Speech Components
            1. Times
            2. Speech Qualifiers
        2. Audio Components
            1. Times
            2. Audio Qualifiers
        3. Visual Components
            1. Times
            2. Visual Qualifiers
    2. **Transport**
        1. Definition: the types of data arrangement used to transport a Visual instance.
        2. Methods
            1. File
                1. AVI
                2. EXIF
                3. MP4 (ISO/IEC 14496-12:2022)
            2. Stream
                1. DASH (ISO/EC 23009-1:2022)
                2. HTTP Live Streaming
                3. WebRTC
                4. MPEG-2 TS (ISO/IEC 13818-1:2023)

5.4 Certificate Qualifier

5.4.1 Definition

Certificate Qualifier is a set of Data providing additional information on Certificate Data for potential use by a machine.
The combination of Certificate Data and Certificate Qualifier is called Certificate Object, specified by MMM-TEC V2.0.

5.4.2 Functional Requirements

Certificate Qualifier must allow the expression of the following Elements:
1. Sub-Types
2. Formats

Users needing additional entries in the Certificate Qualifier or support of new Qualifiers should make a documented request to the MPAI Secretariat. Requests will be considered by the appropriate MPAI committee.

5.4.3 Syntax

https://schemas.mpai.community/TFA/V1.3/data/CertificateQualifier.json

5.4.4 Semantics

1. **Sub-Types**
    1. Non-BlockChain specific

2. BlockChain specific

2. Formats

1. Content

3. Attributes

5.5 Contract Qualifier

5.5.1 Definition

Contract Qualifier is a set of Data providing additional information on Contract Data for potential use by a machine.
The combination of Contract Data and Contract Qualifier is called Contract Object, specified by MMM-TEC V2.0.

5.5.2 Functional Requirements

Asset Qualifier must allow the expression of the following Elements:

1. Sub-Types
2. Formats

Users needing additional entries in the Contract Qualifier or support of new Qualifiers should make a documented request to the MPAI Secretariat. Requests will be considered by the appropriate MPAI committee.

5.5.3 Syntax

https://schemas.mpai.community/TFA/V1.3/data/ContractQualifier.json

5.5.4 Semantics

1. Sub-Types

1. Non-BlockChain specific
2. BlockChain specific

2. Formats

1. Content
    1. Non-executable
        1. JSON
        2. RDF
        3. XML
    2. Executable
        1. Non-Blockchain
            1. C
            2. C++
            3. Java
        2. Blockhain
            1. Bitcoin
            2. Michelson
            3. Solana
            4. Solidity

5.6 Control Qualifier

5.6.1 Definition

Control Qualifier is a set of Data providing additional information on Control Data for potential use by a machine.

The combination of Control Data and Control Qualifier is called Control Object, specified by XRV-LTP V1.0,

5.6.2 Functional Requirements

Location Qualifier must allow the expression of the following Elements:

1. Formats

Users needing additional entries in the Time Qualifier or support of new Qualifiers should make a documented request to the MPAI Secretariat. Requests will be considered by the appropriate MPAI committee.

5.6.3 Syntax

https://schemas.mpai.community/TFA/V1.3/data/ControlQualifier.json

5.6.4 Semantics

1. **Sub-Types**
2. **Formats**
    1. ANSI E1.20-2010
    2. ANSI E1.37-1-2012
    3. Midi
3. **Attributes**

5.7 Currency Qualifier

5.7.1 Definition

Currency Qualifier is a set of Data providing additional information on Currency Data for potential use by a machine.
The combination of Currency Data and Currency Qualifier is called Currency Object, specified by MMM-TEC V2.0

5.7.2 Functional Requirements

Discovery Qualifier allows the representation of the following Elements:

1. SubTypes
    1. Real
    2. Virtual
2. Formats
    1. Real
    2. Virtual

Users needing additional entries in the Currency Qualifier or support of new Qualifiers should make a documented request to the MPAI Secretariat. Requests will be considered by the appropriate MPAI committee.

5.7.3 Syntax

https://schemas.mpai.community/TFA/V1.3/data/CurrencyQualifier.json

5.7.4 Semantics

1. **Sub-Types**
    1. Real
    2. Virtual
2. **Formats**
    1. Real Currency

2. Virtual Currency

5.8 Discovery Qualifier

5.8.1 Definition

Discovery Qualifier is a set of Data providing additional information on Discovery Data for potential use by a machine.
The combination of Discovery Data and Discovery Qualifier is called Discovery Object, specified by MMM-TEC V2.0.

5.8.2 Functional Requirements

Discovery Qualifier allows the representation of the following Elements:
1. Formats

Users needing additional entries in the Discovery Qualifier or support of new Qualifiers should make a documented request to the MPAI Secretariat. Requests will be considered by the appropriate MPAI committee.

5.8.3 Syntax

https://schemas.mpai.community/TFA/V1.3/data/DiscoveryQualifier.json

5.8.4 Semantics

1. **Formats**
    1. Basic Discovery

5.9 ECG Qualifier

5.9.1 Definition

ECG Qualifier is a set of Data providing additional information on ECG Data for potential use by a machine.
The combination of ECG Data and ECG Qualifier is called ECG Object, specified by AIH-HSP V1.o.

5.9.2 Functional Requirements

ECG Qualifier must allow the expression of the following Elements:
1. Sub-Type
2. Format

Users needing additional entries in the ECG Qualifier or support of new Qualifiers should make a documented request to the MPAI Secretariat. Requests will be considered by the appropriate MPAI committee.

5.9.3 Syntax

https://schemas.mpai.community/TFA/V1.3/data/ECGQualifier.json

5.9.4 Semantics

1. **Sub-Types**
    1. CPET (Cardiopulmonary exercise test)
    2. EKG-stress test (Exercise)
    3. EKG-12-lead (Resting)
    4. SAE (Signal-averaged electrocardiogram)
    5. HRV (Heart Rate Variability)

6. PPG (Photoplethosysmography)
7. SCG (Seismocardioscopy)

2. Formats

1. ECG
    1. HL7 (Health Level Seven)
    2. SCP-ECG (Standard Communications Protocol for Computer-Assisted Electrocardiography)
    3. DICOM-ECG (Digital Imaging and Communication in Medicine)
    4. aECG (Annotated Electrocardiogram)
    5. ecgML (a markup language for electrocardiogram data acquisition and analysis)
    6. MFER (Medical Waveform Format Encoding Rules)
    7. Philips XML (eXtensible Markup Language),
    8. ML-ECG
    9. mECGML (mobile Electrocardiography Markup Language)
    10. ecgAware (an ECG markup language for ambulatory telemonitoring and decision-making support).
2. HRV
    1. HRV score
    2. ln(RMSSD)
    3. pNN50
    4. RMSSD
    5. SDNN

5.10 EEG Qualifier

5.10.1 Definition

EEG Qualifier is a set of Data providing additional information on EEG Data for potential use by a machine.
The combination of EEG Data and EEG Qualifier is called EEG Object, specified by AIH-HSP V1.3.

5.10.2 Functional Requirements

EEG Qualifier should allow the expression of the following Elements:

1. Sub-Type
2. Format

Users needing additional entries in the EEG Qualifier or support of new Qualifiers should make a documented request to the MPAI Secretariat. Requests will be considered by the appropriate MPAI committee.

5.10.3 Syntax

https://schemas.mpai.community/TFA/V1.3/data/EEGQualifier.json

5.10.4 Semantics

1. Sub-Types

1. Electroencephalography (EEG)
2. Magnetoencephalography (MEG)
    1. Yokogawa MEG
    2. Biosemi EEG
    3. NeuroMag MEG

2. **Formats**
    1. EEG
        1. Minimum EEG-MAT
        2. Standard EEG-MAT format
    2. MEG
        1. Minimum MEG-MAT
        2. Standard MEG-MAT format

5.10.5 5 References

1. Standard data format MEG/EEG; https://vbmeg.atr.jp/docs/v22/attachFile/vbmeg2_job_functions/Standard-format-MEG_EEG_2_0_0_en.pdf

5.11 EHR Qualifier

5.11.1 Definition

EHR Qualifier is a set of Data providing additional information on EHR Data for potential use by a machine.
The combination of EHR Data and EHR Qualifier is called EHR Object, specified by AIH-HSP V1.0.

5.11.2 Functional Requirements

ECG Qualifier must allow the expression of the following Elements:

1. Sub-Type
2. Format

Users needing support of other entries in MPAI-TFA should make a documented request to the MPAI Secretariat to consider addition of such entries.

5.11.3 Syntax

https://schemas.mpai.community/TFA/V1.3/data/EHRQualifier.json

5.11.4 Semantics

1. **Sub-Types**
    1. Inpatient
    2. Outpatient
2. **Formats**
    1. EHRxF

5.12 Genomics Qualifier

5.12.1 Definition

Genomics Qualifier is a set of Data providing additional information on Genomics Data for potential use by a machine.
The combination of Genomics Data and Genomics Qualifier is called Genomics Object, specified by AIH-HSP V1.0.

5.12.2 Functional Requirements

Genomics Qualifier must allow the expression of the following Elements:

1. Sub-Type
2. Format

Users needing additional entries in the Genomics Qualifier or support of new Qualifiers should make a documented request to the MPAI Secretariat. Requests will be considered by the appropriate MPAI committee.

5.12.3 Syntax

https://schemas.mpai.community/TFA/V1.3/data/GenomicsQualifier.json

5.12.4 Semantics

1. **Sub-Types**
    1. DNA
    2. RNA
2. **Formats**
    1. Raw Data
        1. FASTA
        2. FASTQ
        3. SAM
        4. BED
        5. WIGGLE
        6. TSV
    2. Compressed
        1. BAM
        2. CRAM
        3. MPEG-G

5.13 Information Qualifier

5.13.1 Definition

Information Qualifier is a set of Data providing additional information on Information Data for potential use by a machine.
The combination of Information Data and Information Qualifier is called Information Object, specified by MMM-TEC V2.0.

5.13.2 Functional Requirements

Information Qualifier must allow the expression of the following elements:
1. Formats

Users needing additional entries in the Information Qualifier or support of new Qualifiers should make a documented request to the MPAI Secretariat. Requests will be considered by the appropriate MPAI committee.

5.13.3 Syntax

https://schemas.mpai.community/TFA/V1.3/data/InformationQualifier.json

5.13.4 Semantics

1. **Formats**
    1. Basic Information

5.14 Interpretation Qualifier

5.14.1 Definition

Interpretation Qualifier is a set of Data providing additional information on Interpretation Data for potential use by a machine.
The combination of Interpretation Data and Interpretation Qualifier is called Interpretation Object, specified by MMM-TEC V2.0.

5.14.2 Functional Requirements

Interpretation Qualifier must allow the expression of the following Elements:
1. Formats

Users needing additional entries in the Interpretation Qualifier or support of new Qualifiers should make a documented request to the MPAI Secretariat. Requests will be considered by the appropriate MPAI committee

5.14.3 Syntax

https://schemas.mpai.community/TFA/V1.3/data/InterpretationQualifier.json

5.14.4 Semantics

1. Formats
    1. Basic Interpretation

5.15 GNSS Qualifier

5.15.1 Definition

GNSS Qualifier is a set of Data providing additional information on GNSS Data for potential use by a machine.
The combination of GNSS Data and GNSS Qualifier is called GNSS Object specified by CAV-TEC V1.0.

5.15.2 Functional Requirements

GNSS Qualifier should allow the expression of the following GNSS Qualifier elements:
1. Format

Users needing additional entries in the GNSS Qualifier or support of new Qualifiers should make a documented request to the MPAI Secretariat. Requests will be considered by the appropriate MPAI committee.

5.15.3 Syntax

https://schemas.mpai.community/TFA/V1.3/data/GNSSQualifier.json

5.15.4 Semantics

1. Sub-Types
2. Formats
    1. BeiDou
    2. Galileo
    3. GLONASS
    4. GPS
    5. QZSS
3. Attributes

5.16 LiDAR Qualifier

5.16.1 Definition

LiDAR Qualifier is a set of Data providing additional information on LiDAR Data for potential use by a machine.
The combination of LiDAR Data and LiDAR Qualifier is called LiDAR Object, specified by MPAI-OSD V1.3.

5.16.2 Functional Requirements

LiDAR Qualifier should allow the expression of the following Elements:

1. Format

Users needing additional entries in the LiDAR Qualifier or support of new Qualifiers should make a documented request to the MPAI Secretariat. Requests will be considered by the appropriate MPAI committee.

5.16.3 Syntax

https://schemas.mpai.community/TFA/V1.3/data/LiDARQualifier.json

5.16.4 Semantics

1. **Formats**
    1. LAS (LASer) from American Society for Photogrammetry and Remote Sensing (ASPRS) by Canadian Well Logging Society (CWLS) http://www.cwls.org/las/ and the American Society for Photogrammetry and Remote Sensing
    2. LAZ from American Society for Photogrammetry and Remote Sensing (ASPRS)
    3. Ifsar Digital Surface Model (DSM)
    4. Isar Digital Terrain Model (DTM)

5.17 Location Qualifier

5.17.1 Definition

Location Qualifier is a set of Data providing additional information on Location Data for potential use by a machine.
The combination of Location Data and Location Qualifier is called Location Object, specified by MPAI-OSD V1.3.

5.17.2 Functional Requirements

Location Qualifier must allow the expression of the following Elements:

1. Sub-Types
2. Formats

Users needing support of other entries in MPAI-TFA should make a documented request to the MPAI Secretariat to consider addition of such entries.

5.17.3 Syntax

https://schemas.mpai.community/TFA/V1.3/data/LocationQualifier.json

5.17.4 Semantics

1. **Sub-Types**
    1. Real
    2. Virtual
2. **Formats**

1. MPAI-OSD V1.2 Data Types Location
2. Other Location Formats

5.18 Medical Image Qualifier

5.18.1 Definition

Medical Images Qualifier is a set of Data providing additional information on Medical Images Data for potential use by a machine.
The combination of Medical Images Data and Medical Images Qualifier is called Medical Images Object, specified by AIH-HSP V1.0.

5.18.2 Functional Requirements

Medical Images Qualifier must allow the expression of the following Elements:

1. Sub-Type
2. Format
3. Attributes

Users needing additional entries in the Genomics Qualifier or support of new Qualifiers should make a documented request to the MPAI Secretariat. Requests will be considered by the appropriate MPAI committee.

5.18.3 Syntax

https://schemas.mpai.community/TFA/V1.3/data/MedicalImagesQualifier.json

5.18.4 Semantics

1. Sub-Types

1. Scanning Technology
    1. Computerised Tomography (CT)
    2. Magnetic Resonance Imaging (MRI)
    3. Positron Emission Tomography (PET)
    4. Single Photon Emission Computed Tomography (SPECT)
    5. X-Rays
2. Channels
    1. Definition: The number of values provided for each pixel of an image/
    2. Alpha-channel
        1. Definition: a number that represents the degree of transparency of a colour of a Visual instance.
        2. Number: between 0 and 1.

2. Formats

1. Pixels
    1. Integer
        1. Little Endian
        2. Big Endian
    2. Real
    3. Complex
2. Static
    1. 2D
        1. Analyze
        2. DICOM (Digital Imaging and Communication in Medicine)
        3. Minc
        4. Nifti (Neuroimaging Informatics Technology Initiative)

1.
2. Surface-based
    1. Gifti
        1. Definition: Geometry Informatics Technology Initiative
        2. Data Types
            1. Surface geometry files (.surf.gii)
            2. metric files (.func.gii, .shape.gii)
            3. label files (.label.gii)
    2. Cifti
        1. Definition: Connectivity format of the Geometry Informatics Technology Initiative
        2. Data Types:
            - timeseries (dtseries.nii)
            - parcellation (dlabel.nii)
            - scalars (dscalar.nii)
            - connectivity (dconn.nii)
3. 3D
    1. Nifti
        1. Definition: Neuroimaging Informatics Technology Initiative
        2. Compression
            1. Raw Data (nii)
            2. Compressed data (nii.gz)
    2. Dicom
        1. Definition: Digital Imaging and Communications in Medicine
        2. Compression
            1. Raw data (no extension of dcm)
    3. mgh
        1. Definition: Massachusetts General Hospital
        2. Compression
            1. Raw data (mgh)
            2. Compressed mgz (iwith ZLib)
    4. minc
        1. Definition: Medical Image NetCDF
        2. Sub-formats:
            1. MINC1
            2. MINC2
3. Dynamic
    1. 2D
    2. 3D

1. Attributes

1. Colour Map
2. Metadata

5.19 Metaverse API Qualifier

5.19.1 Definition

Metaverse Qualifier is a set of Data providing additional information on Metaverse API for potential use by a machine.
The combination of Metaverse API and Metaverse API Qualifier is called Metaverse API Object, specified by MMM-TEC V2.0.

5.19.2 Functional Requirements

1. Metaverse API Qualifier allows the expression of the following Elements:
    1. Sub-Types
    2. Formats

Users needing additional entries in the Metaverse API Qualifier or support of new Qualifiers should make a documented request to the MPAI Secretariat. Requests will be considered by the appropriate MPAI committee.

5.19.3 Syntax

https://schemas.mpai.community/TFA/V1.3/data/MataverseAPIQualifier.json

5.19.4 Semantics

1. **Sub-Types**
    1. Non-BlockChain specific
    2. BlockChain specific
2. **Formats**
    1. MMM-TEC V2.0
    2. Axie Infinity
    3. Decentraland
    4. Roblox
    5. Second Life
    6. Upland
    7. Voxels
    8. VRChat

5.20 ML Model Qualifier

5.20.1 Definition

Machine Learning Model Qualifier is a set of Data providing additional information on Machine Learning Model Data for potential use by a machine.
The combination of Machine Learning Model Data and Machine Learning Model Qualifier is called Machine Learning Model Object. Machine Learning Model is specified by MMM-AIF V2.1.

5.20.2 Functional Requirements

Machine Learning Model Qualifier has the following functional requirements:

1. Sub-Type
    1. MLModel Types
    2. NNModel Types
2. Format
    1. Extension
    2. Framework
    3. Exchange
3. Attributes
    1. Regulation
    2. Certification Type
    3. Validity

Users needing support of other entries in MPAI-TFA should make a documented request to the MPAI Secretariat to consider addition of such entries.

5.20.3 Syntax

https://schemas.mpai.community/TFA/V1.3/data/MLModelQualifier.json

5.20.4 Semantics

1. **Sub-Type**
    1. Bayesian Classifier
    2. Neural Network
        1. Convolutional with residuals
        2. Convolutional without residuals
        3. Deconvolutional
        4. Eco-State Neural Network
        5. Feed Forward
        6. Modular
        7. Recurrent
        8. Transformer
    3. Random Forest
    4. Support Vector Machine
    5. XG-Boost
2. **Format**
    1. **Extension**
        1. Engine
        2. H5
        3. Keras
        4. Mlmodel
        5. Onnx
        6. Pd
        7. Pkl
        8. Pt
        9. Pth
        10. Tflite
    2. **Framework**
        1. ai
        2. Caffe
        3. CNTK
        4. Keras
        5. MxNet
        6. PyTorch
        7. Scikit-Learn
        8. TensorFlow
    3. **Exchange**
        1. ONNX
        2. NNEF
3. **Attributes**
    1. **Regulations**
        1. AI Act
        2. CAIO
        3. Data Act
        4. Data Governance Act
        5. EBSI
        6. GDPR

2. **Certification Type**
    1. Bylaw
    2. Sandbox
3. **Validity (Time)**

5.21 MoCap Qualifier

5.21.1 Definition

MoCap Qualifier is a set of Data providing additional information on MoCap Data for potential use by a machine.
The combination of MoCap Data and MoCap Qualifier is called MoCap Object, specified by MPAI-PAF V1.4.

5.21.2 Functional Requirements

MoCap Qualifier must allow the expression of the following Elements:

1. Format
2. Attributes

Users needing support of additional entries in MPAI-TFA should make a documented request to the MPAI Secretariat. An appropriate committee will consider the addition of such entries.

5.21.3 Syntax

https://schemas.mpai.community/TFA/V1.3/data/MoCapQualifier.json

5.21.4 Semantics

1. **Formats**
    1. AMC
    2. AOA
    3. ASF
    4. ASK
    5. BRD
    6. BVA
    7. BVH
    8. C3D
    9. CSM
    10. FBX
    11. GMS
    12. GRC
    13. GTR
    14. HDF
    15. HTR
    16. MBX
    17. MNM
    18. MVNX
    19. PZ2
    20. SDL
    21. TAK
    22. TRC
    23. V
    24. VSK

5.22 Offline Map Qualifier

5.22.1 Definition

Offline Map Qualifier is a set of Data providing additional information on Offline Map Data for potential use by a machine.
The combination of Offline Map Data and Offline Map Qualifier is called Offline Map Object, specified by MPAI-OSD V1.3.

5.22.2 Functional Requirements

Offline Map Qualifier must allow the expression of the following Elements:

1. Format

Users needing additional entries in the Offline Map Qualifier or support of new Qualifiers should make a documented request to the MPAI Secretariat. Requests will be considered by the appropriate MPAI committee.

5.22.3 Syntax

https://schemas.mpai.community/TFA/V1.3/data/OfflineMapQualifier.json

5.22.4 Semantics

1. **Formats**
    1. GeoJSON
    2. GML (Geography Markup Language)
    3. GPX (GPS eXchange Format)
    4. KML (Google Keyhole Markup Language)
    5. KMZ (Google Keyhole Markup Language)
    6. MMPK (Mobile map package)
    7. OSM (Open Street Map
    8. SHP (Shapefile)
    9. TPK (Tile package)
    10. VTPK (Vector tile package)

5.23 Program Qualifier

5.23.1 Definition

Program Qualifier is a set of Data providing additional information on Program Data for potential use by a machine.
The combination of Program Data and Program Qualifier is called Program Object, specified by MMM-TEC V2.0.

5.23.2 Functional Requirements

1. The Data of a Program has a format enabling it to be executed in the target M-Instance.
2. A Program may be subject to certification before it can be imported into an M-Instance.
3. Program Qualifier must allow the expression of the following Elements:
    1. Sub-Types
    2. Formats
    3. Attributes

Users needing additional entries in the Program Qualifier or support of new Qualifiers should make a documented request to the MPAI Secretariat. Requests will be considered by the appropriate MPAI committee.

5.23.3 Syntax

https://schemas.mpai.community/TFA/V1.3/data/ProgramQualifier.json

5.23.4 Semantics

1. **Sub-Types**
    1. Non-BlockChain specific
    2. BlockChain specific
    3. Autonomous
2. **Formats**
    1. Content
        1. Non-Blockchain
            1. C
            2. C++
            3. Java
        2. Blocchain
            1. Michelson
            2. Solidity

5.24 Radar Qualifier

5.24.1 Definition

RADAR Qualifier is a set of Data providing additional information on RADAR Data for potential use by a machine.
The combination of RADAR Data and RADAR Qualifier is called RADAR Object, specified by MPAI-OSD V1.3.

5.24.2 Functional Requirements

RADAR Qualifier must allow the expression of the following Elements:

1. Format

Users needing additional entries in the RADAR Qualifier or support of new Qualifiers should make a documented request to the MPAI Secretariat. Requests will be considered by the appropriate MPAI committee.

5.24.3 Syntax

https://schemas.mpai.community/TFA/V1.3/data/RADARQualifier.json

5.24.4 Semantics

1. **Formats**
    1. DX format
    2. Furuno SCN
    3. Furuno SCNX
    4. NetCDF
    5. OPERA BUFR
    6. OPERA HDF5
    7. RADOLAN
    8. Digital Terrain Model (DTM)

5.25 Speech Qualifier

5.25.1 Definition

Speech Qualifier is a set of Data providing additional information on Speech Data for potential use by a machine.
The combination of Speech Data and Speech Qualifier is called Speech Object, specified by MPAI-OSD V1.3.

5.25.2 Functional Requirements

A Speech Qualifier must allow the expression of the following Elements:

1. Formats
    1. Content
    2. Transport
2. Attributes
    1. Source
    2. Metadata
    3. Spatial Attributes
    4. Device

Users needing additional entries in the Speech Qualifier or support of new Qualifiers should make a documented request to the MPAI Secretariat. Requests will be considered by the appropriate MPAI committee.

5.25.3 Syntax

https://schemas.mpai.community/TFA/V1.3/formats/SpeechQualifiers.json

5.25.4 Semantics

1. Formats

1. Content
    1. Definition: the type of data arrangement used to digitally represent speech.
    2. Types:
        1. Raw Speech
            1. Definition: the type of data arrangement used to digitally represent samples.
            2. Types:
                1. Sampling Frequency: Number expressing kHz.
                2. Sample Precision: Number expressing bits/sample.
        2. Speech Compression Formats
            1. Definition: the type of data arrangement used to reduce the number of bits for speech.
            2. Types:
                1. G711A
                2. G711mu
                3. MP3 (ISO/IEC 11172-3:1993)
                4. AAC (ISO/IEC 14496-3:2019)
2. Transport
    1. Definition: the type of data arrangement used to transport Speech.
    2. Types:
        1. File
            1. Definition: the type of data arrangement used to statically transport Speech by files.

2. Types:
    1. WAV
    2. MP4 (ISO/IEC 14496-12:2022)
2. Stream
    1. Definition: the type of data arrangement used to dynamically transport Speech by stream.
    2. Types:
        1. DASH (ISO/IEC 23009-1:2022)
        2. HTTP Live Streaming

2. Attributes

1. Source Type
    1. Definition: the types of the Speech instance
    2. Types:
        1. Real
        2. Synthetic
2. Metadata
    1. Definition: the type of data arrangement used to attach information to a Speech instance.
    2. Types:
        1. Language
            1. Definition: the type of data arrangement used to indicate the Language used by a Speech instance.
            2. Type:
                1. ISO 639-1
                2. ISO 639-2
                3. ISO 639-3
        2. Speaker Identity
            1. Definition: the type of data arrangement used to identify a speaker.
            2. Type:
                1. MPAI Instance Identifier
        3. Content Description
            1. Definition: the type of data arrangement used to describe the content of a Speech instance.
            2. Types:
                1. ASCII
                2. UTF-8,
                3. UTF-16,
                4. UTF-32
        4. Entity Internal Status D
            1. Definition: the type of data arrangement used to describe the internal status such as cognitive state, emotion, and social attitude.
            2. Type:
                1. MPAI Personal Status
    3. Device
        1. Definition: Characteristics of the device that captured the speech.
        2. Characteristics:
            1. Device ID
                1. Definition: an identifier of the device

2. Identifier:
    1. String
2. Device Location
    1. Definition: the position and orientation of the device in a real or virtual space.
    2. Types:
        1. MPAI Point of View
3. Sensor Characteristics
    1. Definition: sensor features having an impact on the captured speech.
    2. Sensor features
        1. Omnidirectional
        2. Figure of eight
        3. Cardioid
        4. Supercardioid
        5. Hypercardioid

5.26 Text Qualifier

5.26.1 Definition

Text Qualifier is a set of Data providing additional information on Text Data for potential use by a machine.
The combination of Text Data and Text Qualifier is called Text Object, specified by MPAI-OSD V1.3.

5.26.2 Functional Requirements

Text Qualifier allow the expression of the following Qualifier elements:

1. Formats
    1. Static
    2. Dynamic
2. Attributes
    1. Object Identity
    2. Intention
    3. Language
    4. Meaning

Users needing additional entries in the Text Qualifier or support of new Qualifiers should make a documented request to the MPAI Secretariat. Requests will be considered by the appropriate MPAI committee.

5.26.3 Syntax

https://schemas.mpai.community/TFA/V1.3/data/TextQualifier.json

5.26.4 Semantics

1. **Formats**
    1. **Static**
        1. Definition: the format of Text that does not change in time
        2. Formats:
            1. ASCII
            2. ISO/IEC 646,
            3. ISO/IEC 8859-1:1998,

4. ISO/IEC 8859-2:1999,
5. ISO/IEC 8859-3:1999,
6. ISO/IEC 8859-4:1998,
7. ISO/IEC 8859-5:1999,
8. ISO/IEC 8859-6:1999,
9. ISO/IEC 8859-7:2003,
10. ISO/IEC 8859-8:1999,
11. ISO/IEC 8859-9:1999,
12. ISO/IEC 8859-10:1998,
13. ISO/IEC 8859-11:2001,
14. ISO/IEC 8859-12,
15. ISO/IEC 8859-13:1998,
16. ISO/IEC 8859-14:1998,
17. ISO/IEC 8859-15:1999,
18. ISO/IEC 8859-16:2001,
19. UTF-8 (ISO 10646:2017),
20. UTF-16 (ISO 10646:2017),
21. UTF-32 (ISO 10646:2017),

2. **Dynamic**
    1. Definition: the format of Text whose characteristics change in time.
    2. Formats:
        1. TimedTextML
        2. WebVTT

2. **Attributes**
    1. **Intention**
        1. Definition: Data Type expressing the result of analysis of the goal of a question.
        2. Format:
            1. Intention
    2. **Object Identity**
        1. Definition: the identifier of an object referenced in a Text instance.
        2. Format:
            1. Instance Identifier
    3. **Meaning**
        1. Definition: data representing the syntactic and semantic information of Text.
        2. Format:
            1. Meaning
    4. **Language**
        1. Definition: the standard of the language code used by the text
        2. Standards:
            1. ISO 639-1
            2. ISO 639-2
            3. ISO 639-3

5.27 Time Qualifier

5.27.1 Definition

Time Qualifier is a set of Data providing additional information on Time Data for potential use by a machine.

The combination of Time Data and Time Qualifier is called Time Object, specified by MPAI-OSD V1.3, Time is specified by SMPTE 12M-1, SMPTE 12M-2, and MIDI/MTC.

5.27.2 Functional Requirements

Location Qualifier must allow the expression of the following Elements:

1. Sub-Types
2. Formats
3. Attributes

Users needing additional entries in the Time Qualifier or support of new Qualifiers should make a documented request to the MPAI Secretariat. Requests will be considered by the appropriate MPAI committee.

5.27.3 Syntax

https://schemas.mpai.community/TFA/V1.3/data/TimeQualifier.json

5.27.4 Semantics

1. **Sub-Types**
2. **Formats**
    1. MPAI-OSD V132 Data Types Time
    2. SMPTE 12M-1, SMPTE 12M-2, and MIDI/MTC
3. **Attributes**

5.28 Ultrasound Qualifier

5.28.1 Definition

Ultrasound Qualifier is a set of Data providing additional information on Ultrasound Data for potential use by a machine.
The combination of Ultrasound Data and Ultrasound Qualifier is called Ultrasound Object, specified by MPAI-OSD V1.3.

5.28.2 Functional Requirements

Ultrasound Qualifier must allow the expression of the following Elements:

1. Format

Users needing additional entries in the Ultrasound Qualifier or support of new Qualifiers should make a documented request to the MPAI Secretariat. Requests will be considered by the appropriate MPAI committee.

5.28.3 Syntax

https://schemas.mpai.community/TFA/V1.3/data/UltrasoundQualifier.json

5.28.4 Semantics

1. **Formats**
    1. CUDF (Common Ultrasonic Data File) Format
    2. UFF (Ultrasound File Format)

5.29 Visual Qualifier

5.29.1 Definition

Visual Qualifier is a set of Data providing additional information on Visual Data for potential use by a machine.

The combination of Visual Data and Visual Qualifier is called Visual Object, specified by MPAI-OSD V1.3.

5.29.2 Functional Requirements

Visual Qualifier must allow the expression of the following Qualifier elements:

1. Sub-Types
    1. Colour
    2. Transparency
    3. Brightmess
2. Formats
    1. Content
        1. Sampling
            1. Time
            2. Space
        2. SD
            1. Static
            2. Dynamic
        3. 3D
            1. Static
            2. Dynamic
    2. Transport
3. Attributes
    1. Source
        1. Real
        2. Synthetic
    2. Metadata
        1. Visual Metadata Formats
        2. Object Identity
        3. Content Description
    3. Device
        1. Device ID
        2. Device Location
    4. Sensor Characteristics

Users needing additional entries in the Visual Qualifier or support of new Qualifiers should make a documented request to the MPAI Secretariat. Requests will be considered by the appropriate MPAI committee.

5.29.3 Syntax

https://schemas.mpai.community/TFA/V1.3/data/VisualQualifier.json

5.29.4 Semantics

1. Sub-Types

1. Colour

1. Definition: the parameters that characterise the digital representation of the colour information of a Visual instance.
2. Parameters
    1. Colour Formats
        1. Definition: the specific mapping of the colour space
        2. Mappings
            1. Rec. ITU-R BT. 709

        2. Rec. ITU-R BT. 2020
        3. SMPTE ST 2036-1
    2. Alpha-channel
        1. Definition: a number that represents the degree of transparency of a colour of a Visual instance.
        2. Number
            1. A number between 0 and 1.
    3. Brightness
        1. Definition: the expression of the maximum value of intensity than a Visual instance can take
        2. Units of measure
            1. Nit (candelas/sqm)
    4. YUV
        1. Definition; The specific types of YUV transformation of the three colour axes.
        2. Types
            1. Y'UV
            2. Y'PbPr
            3. Y'CbCr
            4. YDbDr
            5. Y'IQ
    5. Colour Subsampling
        1. Definition: The specific method of subsampling the colour information
        2. Methods
            1. 4:4:4
            2. 4:2:2
            3. 4:1:1
    6. YMCK
        1. Definition: the specific colour axis rotation used by the printing industry with the addition of the Black channel.

2. Formats

1. Content

1. Sampling
    1. Definitions: The characteristics of the transformation from a Visual instance in a real space to a Visual entity in the Virtual Space.
    2. Characteristics
        1. Time
            1. Definition: method to define the period between digital representations of snapshots of a Visual instance.
            2. Methods
                1. Time between snapshots.
        2. Space
            1. Definitions: method to represent the density of visual samples in the Virtual Space.
            2. Methods
                1. Dots per inch (dpi)
        3. Sample Precision:
            1. Definition: Integer representing the number of bits/pixel

2. 2D
    1. Definition: the digital representation of a time-independent or time-dependent Visual instance as 2D information
    2. Methods
        1. Static
            1. BMP
            2. Bounding Box
            3. JPEG (ISO/IEC 10918-1:1994)
            4. JPEG 2000 (ISO/IEC 15444-1:2019)
            5. JPEG XS (ISO/IEC 21122-1:2024)
            6. PNG
            7. RAW
            8. SVG
            9. TIFF
        2. Dynamic
            1. AVC (ISO/IEC 14496-10:2022)
            2. AV1
            3. EVC (ISO/IEC 23094-1:2020)
            4. HEVC (ISO/IEC 23008-2:2023)
            5. LCEVC (ISO/IEC 23094-2:2021)
            6. VVC (ISO/IEC 23090-2:2023)
3. 3D
    1. Definition: digital representation of a time-independent or time-dependent Visual instance as 3D information
    2. Methods
        1. Static
            1. Bounding Box
            2. G-PCC (ISO/IEC 23090-9:2023)
            3. OBJ
            4. V-PCC (ISO/IEC 23090-5:20230)
        2. Dynamic
            1. FBX
            2. G-PCC (ISO/IEC 23090-9:2023)
            3. OpenVDB 12.0.0
            4. V-PCC (ISO/IEC 23090-5:20230)

2. Transport

1. Definition: the type of data arrangement used to transport a Visual instance
2. Methods
    1. File
        1. AVI
        2. EXIF
        3. JPEG XS (ISO/IEC 21122-3:2022)
        4. MP4 (ISO/IEC 14496-12:2022)
    2. Stream
        1. DASH (ISO/EC 23009-1:2022)
        2. HTTP Live Streaming
        3. WebRTC
        4. MPEG-2 TS (ISO/IEC 13818-1:2023)

3. Attributes

1. Source Type

1. Definition: the types of a Visual instance.
2. Types:
    1. Real
        1. Raster
    2. Synthetic
        1. Raster
        2. Vector

2. Metadata

1. Definition: the types of data formats attached to a Visual instance.
2. Methods
    1. Visual Metadata Formats
        1. Dublin Core (ISO 15836-1:2017)
        2. IPTC Photo Metadata
        3. XMP
    2. Object IDs
        1. Instance Identifier
    3. Entity Internal Status
        1. Personal Status

3. Device

1. Definition: elements of the device that captured the Visual instance.
2. Elements
    1. Device ID
        1. Definition: an identifier of the device that captured the Speech instance
        2. Types
            1. A string.
    2. Device Location
        1. Definition: the position and orientation of the device that captured a Visual instance in a real or virtual space.
            1. Position and orientation
                1. Point of View
    3. Sensor characteristics
        1. Definition: sensor features having an impact on the captured Visual instance
        2. Features