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Information technology — Internet of media things —

Part 4: Reference software and conformance

Technologie de l'information — Internet des objets media —

Partie 4: Logiciels de référence et conformité

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of document should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives or www.iec.ch/members_experts/refdocs).

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This document was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 29, *Coding of audio, picture, multimedia and hypermedia information*.

This second edition cancels and replaces the first edition (ISO/IEC 23093-4:2020), which has been technically revised.

The main changes are as follows:

— modification of introduction;

— addition of new APIs;

— addition of binary reference software and its conformance streams.

A list of all parts in the ISO/IEC 23093 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user ’s national standards body. A complete listing of these bodies can be found at www.iso.org/members.html and www.iec.ch/national-committees.

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Introduction

The ISO/IEC 23093 series provides an architecture and specifies APIs and compressed representation of data flowing between media things.

The APIs for the media things facilitate discovering other media things in the network, connecting, and efficiently exchanging data between media things. The APIs also support transaction tokens to access valuable functionalities, resources, and data from media things.

Information related to media things consists of characteristics and discovery data, setup information from a system designer, raw and processed sensed data, and actuation information. The ISO/IEC 23093 series specifies input and output data formats for media things such as media sensors, actuators, storage, and analysers. In addition, media analysers can process sensed data from media sensors to produce analysed data, and the media analysers can be cascaded to extract semantic information.

This document contains the conformance and reference software implementing ISO/IEC 23093-3, which includes the tools to describe data exchanged between media things and their APIs.

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Information technology — Internet of media things —

Part 4:
Reference software and conformance

1 Scope

This document specifies the conformance and reference software implementing ISO/IEC 23093-3. The information provided is applicable for determining the reference software modules available for ISO/IEC 23093-3, understanding the functionality of the available reference software modules, and utilising the available reference software modules.

Furthermore, this document provides means for conformance testing, i.e. bitstreams – XML and binary descriptions – that conform or do not conform to ISO/IEC 23093-3.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO/IEC 23093-1, *Information technology — Internet of media things — Part 1: Architecture*

ISO/IEC 23093-2, *Information technology — Internet of media things — Part 2: Discovery and communication API*

ISO/IEC 23093-3, *Information technology — Internet of media things — Part 3: Media data formats and APIs*

3 Terms, definitions, and abbreviated terms

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO/IEC 23093-1, ISO/IEC 23093-2, and ISO/IEC 23093-3 apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

3.2 Abbreviated terms

API	application programming interface
MACV	media actuator command vocabulary
MAOV	media analyser output vocabulary
MSOV	media sensor output vocabulary
MTDL	media thing description language

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4 Reference software for ISO/IEC 23093-3

4.1 General

This clause specifies the reference software for ISO/IEC 23093-3. The software is available at https://standards.iso.org/iso-iec/23093/-4/ed-2/en. The reference software is written in Java®[1)] and adopts the package structure in Table 1.

Table 1 — The package structure of the IoMT reference software

Name	Definition
`org`	Java package name for reference software provided by organisations such as ISO/IEC, W3C, or similar.
`org.iso`	Java package name for reference software provided by ISO/IEC.
`org.iso.mpeg`	Java package name for reference software.
`org.iso.mpeg.iomt`	Java package name for reference software developing the ISO/IEC 23093 series. - `org.iso.mpeg.iomt.mtdl`, `org.iso.mpeg.iomt.msov`, `org.iso.mpeg.iomt.macv`, and `org.iso.mpeg.iomt.mscv` for ISO/IEC 23093-3. NOTE Code included within these packages can automatically generate tools such as JAXB (Java Architecture for XML Binding)[1].

4.2 ISO/IEC 23093-3 APIs for MTDL

4.2.1 General

This subclause specifies the API to the ISO/IEC 23093-3 reference software. The API is defined in Java® and adopts the package structures in Table 2.

Table 2 — MTDL reference softaware package structures

Name	Definition
`org.iso.mpeg.iomt.mtdl`	Java package name for API to the ISO/IEC 23093-3 reference software.

4.2.2 APIs for MThing

This subclause specifies classes related to the basic information of an `MThing` (Table 3).

Table 3 — Class types of MThing

Name	Definition
`MThingInfo`	Java class containing essential elements and attributes for an MThing.
`MSensorType`	Java class (i.e. superclass) that all media sensors shall extend.
`MActuatorType`	Java class (i.e. superclass) that all media actuators shall extend.
`MAnalyserType`	Java class (i.e. superclass) that all media analysers shall extend.
`MStorageType`	Java class (i.e. superclass) that all media storage shall extend.
`MManagerType`	Java class (i.e. superclass) that all MThing managers shall extend.
`MAggregatorType`	Java class (i.e. superclass) that all MThing aggregators shall extend.

1) Java® is the trademark of a product supplied by Oracle®. This information is given for the convenience of users of this document and does not constitute an endorsement by ISO or IEC of the product named. Equivalent products may be used if they can be shown to lead to the same results.

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4.2.3 APIs for MSensor

This subclause specifies classes that are related to an `MSensor` (Table 4).

Table 4 — Class types of MSensor

Name	Definition
`SensedDataBaseType`	Java class describing sensed data. All of the classes in the `org.iso.mpeg.iomt.msov` shall extend this class.
`SensorCapabilityListEnumType`	Java class specifying the type of sensor capabilities among `allSensorCapabilityList`, `availableSensorCapabilityList`, and `appliedSensorCapabilityList`.
`SensorCapabilityListType`	Java class describing a list of sensor capabilities.
`SensorCapabilityParameterType`	Java class describing a parameter of a sensor capability.
`SensorCapabilityType`	Java class describing a sensor capability.

4.2.4 APIs for MActuator

This subclause specifies classes that are related to a `MActuator` (Table 5).

Table 5 — Class types of MActuator

Name	Definition
`ActuationDataBaseType`	Java class describing actuation data. All of the classes in the `org.iso.mpeg.iomt.macv` shall extend this class.
`ActuatorCapabilityListEnumType`	Java class specifying the type of actuator capabilities among `allActuatorCapabilityList`, `availableActuatorCapabilityList`, and `appliedActuatorCapabilityList`.
`ActuatorCapabilityListType`	Java class describing a list of actuator capabilities.
`ActuatorCapabilityParameterType`	Java class describing a parameter of an actuator capability.
`ActuatorCapabilityType`	Java class describing an actuator capability.

4.2.5 APIs for MAnalyser

This subclause specifies classes that are related to a `MAnalyser` (Table 6).

Table 6 — Class types of MAnalyser

Name	Definition
`AnalysedDataBaseType`	Java class describing the analysed data. All of the classes which are in the `org.iso.mpeg.iomt.maov` shall extend this class.
`AnalyserCapabilityListEnumType`	Java class specifying the type of analyser capabilities among `allAnalyserCapabilityList`, `availableAnalyserCapabilityList`, and `appliedAnalyserCapabilityList`.
`AnalyserCapabilityListType`	Java class describing a list of analyser capabilities.
`AnalyserCapabilityParameterType`	Java class describing a parameter of an analyser capability.
`AnalyserCapabilityType`	Java class describing an analyser capability.

4.2.6 APIs for MStorage

This subclause specifies classes that are related to an `MStorage` (Table 7).

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Table 7 — Class types of MStorage

Name	Definition
StorageCommandBaseType	Java class describing the storage command.
StorageCapabilityListEnumType	Java class specifying the type of storage capabilities among allStorageCapabilityList, availableStorageCapabilityList, and appliedStorageCapabilityList.
StorageCapabilityListType	Java class describing a list of storage capabilities.
StorageCapabilityParameterType	Java class describing a parameter of a storage capability.
StorageCapabilityType	Java class describing a storage capability.

4.2.7 APIs for MManager

This subclause specifies classes that are related to an MManager (Table 8).

Table 8 — Class types of MManager

Name	Definition
ManagerDataBaseType	Java class describing data for managing MThings.
ManagerCapabilityListEnumType	Java class specifying the type of manager capabilities among allManagerCapabilityList, availableManagerCapabilityList, and appliedManagerCapabilityList.
ManagerCapabilityListType	Java class describing a list of manager capabilities.
ManagerCapabilityParameterType	Java class describing a parameter of a manager capability.
ManagerCapabilityType	Java class describing a manager capability.

4.2.8 APIs for MAggregator

This subclause specifies classes that are related to a MAggregator (Table 9).

Table 9 — Class types of MAggregator

Name	Definition
AggregatedMThingListType	Java class describing a list of aggregated MThings.
AggregatorCapabilityListEnumType	Java class specifying the type of aggregator capabilities among allAggregatorCapabilityList, availableAggregatorCapabilityList, and appliedAggregatorCapabilityList.
AggregatorCapabilityListType	Java class describing a list of aggregator capabilities.
AggregatorCapabilityParameterType	Java class describing a parameter of an aggregator capability.
AggregatorCapabilityType	Java class describing an aggregator capability.

4.3 ISO/IEC 23093-3 APIs for MSOV

— CapturedTimeType

4.4 ISO/IEC 23093-3 APIs for MACV

— AudioActuationType

— AudioPlayType

— SetBrightnessType

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— SetCameraOrientationType
— SetCameraResolutionType
— SetCameraZoomType
— SetVolumeType
— VideoActuationType
— VideoPlayType
— SetColourLightType

4.5 ISO/IEC 23093-3 APIs for MAOV

— AnalysedColourLightInfoType
— BezierCurveType
— CommonMediaInfoType
— GroupBezierCurveType
— HandContourType
— HandGestureCommandType
— HandGestureType
— HandPostureType
— HandTrajectoryType
— HealthcareInfoType
— ImageInfoType
— PatientNameType
— PatientType
— SyncedVideoType
— VideoInfoType
— AnalysedColourLightInfoType
— AnalysedMusicFrequencyType
— FaceRegionResultType
— FaceRegionSetType
— FaceRegionType
— FaceVerificationType
— GeneratedSecurityTitleType
— OdourImageOutputListType
— OdourImageOutputType
— OdourImageType

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— QuestionAnalysisType

— SocialEventType

— SpectrogramType

— SpectroPointType

— UserQuestionType

— VideoContentClassType

4.6 ISO/IEC 23093-3 binary representation APIs

4.6.1 General

This subclause specifies the API to the ISO/IEC 23093-3 reference software for binary representation.

4.6.2 Common APIs for binary representation

4.6.2.1 General

This subclause specifies the API to the ISO/IEC 23093-3 reference software for binary representation. The API is defined in Java® and adopts the package structures in Table 10.

Table 10 — Reference software of binary representation

Name	Definition
`org.iso.mpeg.iomt.binary.core`	Java package name for API to the ISO/IEC 23093-3 reference software for binary representation.

4.6.2.2 BinaryIO

The BinaryIO interface defines the methods for operating over data structures defined within ISO/IEC 23093-3. Classes implementing the BinaryIO interface act as factories creating instances of classes performing the following functionalities:

— generate a binary structure from an MXM object tree through the construct binary structure-function;

— generate a binary file from a binary structure using the write-binary function;

— generate a binary structure from a binary file using the read-binary function;

— restore an MXM object tree from a binary structure using the create-MXM-object function.

4.6.2.3 DefaultBinaryIO

DefaultBinaryIO class defines functions "Encode" and "Decode". MThingTypes (e.g. MThingInfo, MSensorType, MAnalyserType, MActuatorType, MStorageType, MManager, MAggregator) can be extended from this DefaultBinaryIO class. DefaultBinaryIO involves the following functions:

— encode: a function defining the methods to create a binary file from an MXM object tree;

— decode: a function defining the methods to restore an MXM object tree from a binary file.

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4.6.3 Binary representation APIs for MTDL

4.6.3.1 General

This subclause specifies the binary representation API to the MTDL of ISO/IEC 23093-3 reference software. The API is defined in Java® and adopts the package structures in Table 11.

Table 11 — MTDL reference software for binary representation

Name	Definition
`org.iso.mpeg.iomt.mtdl.binary`	Java package name for binary representation API to the MTDL of ISO/IEC 23093-3 reference software.

4.6.3.2 Binary representation APIs for MThing

This subclause specifies classes related to the binary representation of an `MThing` (Table 12).

Table 12 — Binary class types of MThing

Name	Definition
`MThingInfo_forBinary`	Java class containing essential elements and attributes for binary representation of an MThing.
`MSensorType_forBinary`	Java class (i.e. superclass) that all binary representation APIs of media sensors shall extend.
`MActuatorType_forBinary`	Java class (i.e. superclass) that all binary representation APIs of media actuators shall extend.
`MAnalyserType_forBinary`	Java class (i.e. superclass) that all binary representation APIs of media analysers shall extend.
`MStorageType_forBinary`	Java class (i.e. superclass) that all binary representation APIs of media storage shall extend.
`MManagerType_forBinary`	Java class (i.e. superclass) that all binary representation APIs of MThing managers shall extend.
`MAggregatorType_forBinary`	Java class (i.e. superclass) that all binary representation APIs of MThing aggregators shall extend.

4.6.3.3 Binary representation APIs for MSensor

This subclause specifies classes related to the binary representation of an `MSensor` (Table 13).

Table 13 — Binary class types of MSensor

Name	Definition
`SensedDataBaseType_forBinary`	Java class describing the binary representation of sensed data. All the classes which are in the `org.iso.mpeg.iomt.msov.binary` shall extend this class.
`SensorCapabilityListType_forBinary`	Java class describing the binary representation of a list of sensor capabilities.
`SensorCapabilityParameterType_forBinary`	Java class describing the binary representation of the parameter of a sensor capability.
`SensorCapabilityType_forBinary`	Java class describing the binary representation of the sensor capability.

4.6.3.4 Binary representation APIs for MActuator

This subclause specifies classes related to the binary representation of a `MActuator` (Table 14).

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Table 14 — Binary class types of MActuator

Name	Definition
`ActuationDataBaseType_forBinary`	Java class describing the binary representation of actuation data. All the classes are in the `org.iso.mpeg.iomt.macv.binary` shall extend this class.
`ActuatorCapabilityListType_forBinary`	Java class describing the binary representation of a list of actuator capabilities.
`ActuatorCapabilityParameterType_forBinary`	Java class describing the binary representation of the parameter of an actuator capability.
`ActuatorCapabilityType_forBinary`	Java class describing the binary representation of the actuator capability.

4.6.3.5 Binary representation APIs for MAnalyser

This subclause specifies classes related to the binary representation of a `MAnalyser` (Table 15).

Table 15 — Binary class types of MAnalyser

Name	Definition
`AnalysedDataBaseType_forBinary`	Java class describing the binary representation of analysed data. All the classes which are in the `org.iso.mpeg.iomt.maov.binary` shall extend this class.
`AnalyserCapabilityListType_forBinary`	Java class describing the binary representation of a list of analyser capabilities.
`AnalyserCapabilityParameterType_forBinary`	Java class describing the binary representation of the parameter of an analyser capability.
`AnalyserCapabilityType_forBinary`	Java class describing the binary representation of the analyser capability.

4.6.3.6 Binary representation APIs for MStorage

This subclause specifies classes related to the binary representation of an `MStorage` (Table 16).

Table 16 — Binary class types of MStorage

Name	Definition
`StorageCommandBaseType_forBinary`	Java class describing the binary representation of a storage command.
`StorageCapabilityListType_forBinary`	Java class describing the binary representation of a list of storage capabilities.
`StorageCapabilityParameterType_forBinary`	Java class describing the binary representation of the parameter of a storage capability.
`StorageCapabilityType_forBinary`	Java class describing the binary representation of the storage capability.

4.6.3.7 Binary representation APIs for MManager

This subclause specifies classes related to the binary representation of an `MManager` (Table 17).

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Table 17 — Binary class types of MManager

Name	Definition
ManagerDataBaseType_forBinary	Java class describing the binary representation of data for managing MThings.
ManagerCapabilityListType_forBinary	Java class describing the binary representation of a list of manager capabilities.
ManagerCapabilityParameterType_forBinary	Java class describing the binary representation of the parameter of a manager capability.
ManagerCapabilityType_forBinary	Java class describing the binary representation of the manager capability.

4.6.3.8 Binary representation APIs for MAggregator

This subclause specifies classes related to the binary representation of a `MAggregator` (Table 18).

Table 18 — Binary class types of MAggregator

Name	Definition
AggregatedMThingListType_forBinary	Java class describing the binary representation of a list of aggregated MThings.
AggregatorCapabilityListType_forBinary	Java class describing the binary representation of a list of aggregator capabilities.
AggregatorCapabilityParameterType_forBinary	Java class describing the binary representation of the parameter of an aggregator capability.
AggregatorCapabilityType_forBinary	Java class describing the binary representation of the aggregator capability.

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5 Conformance for ISO/IEC 23093-3

5.1 General

This clause defines conformance for ISO/IEC 23093-3.

5.2 Schema-based conformance for ISO/IEC 23093-3

5.2.1 General

This subclause specifies the schema-based validation software for ISO/IEC 23093-3. The ISO/IEC 23093-3 validation software is written in Java® and adopts the package structures in Table 19.

Table 19 — Validation software package

Name	Definition
validator	The folder contains a validator for schema-based validation.

For validating an MTDL description, the following arguments should be used:

```
mtdl testmtdl.xml
```

For validating an MSOV description, the following arguments should be used:

```
msov testmsov.xml
```

For validating a MACV description, the following arguments should be used:

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```
macv testmacv.xml
```

For validating a MAOV description, the following arguments should be used:

```
maov testmaov.xml
```

5.2.2 Example of a valid MTDL instance test

```
mtdl testmtdl_valid.xml
```

The following output is shown to indicate that the input XML instance is valid:

```
[Schema-based Validation check] mtdl is valid.
```

5.2.3 Example of an invalid MTDL instance test

```
mtdl testmtdl_invalid.xml
```

The following output is shown to indicate that the input XML instance is invalid:

```
 [Schema-based Validation check] javax.xml.bind.UnmarshalException

  - with linked exception:

[org.xml.sax.SAXParseException; lineNumber: 5; columnNumber: 21; cvc-complex-type.2.4.a:
Inappropriate content starting with 'mtdl: MAnalyser' element found. ": urn: mpeg: mpeg-
IoMT:" urn: mpeg: mpeg-IoMT: 2018: 01-MTDL-NS ": TimeStamp, "Urn: mpeg: mpeg-IoMT: 2018:
01-MTDL-NS" Manalyser, "urn: mpeg: mpeg-IoMT: 2018: 01-MTDL-NS": MStorage, "urn: mpeg:
mpeg-IoMT: 2018: : 2018: 01-MTDL-NS ": MAggregator}'.]
```

The error in line 1 indicates that there can be missing elements of MThing.

5.2.4 Example of a valid MSOV instance test

```
msov testmsov_valid.xml
```

The following output is shown to indicate that the input XML instance is valid:

```
[Schema-based Validation check] msov is valid.
```

5.2.5 Example of an invalid MSOV instance test

```
msov testmsov_invalid.xml
```

The following output is shown to indicate that the input XML instance is invalid:

```
[Schema-based Validation check] javax.xml.bind.UnmarshalException

  - with linked exception:

[org.xml.sax.SAXParseException; lineNumber: 7; columnNumber: 67; The value of 'cvc-pattern-
valid:' 2018-09-07T10: 47 + 3309: 00 'has a value of' \ -? (\ d + (\ - \ d { 2?)?)?)?)?)?)
(F (2)} (? \ {2} \ d +)? ((\ - | \ +) \ d {2}: \ d {2})? 'This is not a good fit for the
pattern.]
```

The error in line 3 indicates that the value of SyncedTimeType is not fit the specified pattern.

5.2.6 Example of a valid MACV instance test

```
macv testmacv_valid.xml
```

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