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Title:	**Logical Quality Control data model**
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1. Introduction

This document introduces a logical model for the representation of the (meta)data relevant for performing and reporting Quality Control (QC) tests on digital media as well as for the implementation of dedicated QC software.

The core of this document is a Unified Modeling Language (UML) class diagram showing entities, attributes, relations and cardinalities resulting from the studies made by the EBU QC group. Participants in this group (especially broadcasters and QC software vendors) have worked together to gather requirements, both for specifying QC tests and for reporting QC test results.

2. Class diagram

Figure 1 represents the UML 2.0 class diagram of the Quality Control data model. This data model aims at defining the entities relevant for three major areas. These areas as reflected in the coloured boxes shown in Figure 1:

- **Catalogue** (pink box): covers the definition of the quality control tests called QCItems i.e. what to test and which input and output parameters to support. It also includes references to relevant audio and video standards and technical recommendations.
- **Profile** (green box): covers the definition of templates containing all the inputs necessary to perform a complete quality control exercise, which typically includes multiple tests.
- **Report** (cyan box): covers the reporting of quality assessments made on multimedia content by automatic or semi-automatic QC tools, or by manual assessment.

The class diagram also shows the relations between the different entities.

Chapters 3 to 5 describe the main classes and their attributes. Chapter 6 explains the relations between them (including the cardinalities). Chapter 7 describes complex attribute type classes which are also shown in figure 1.

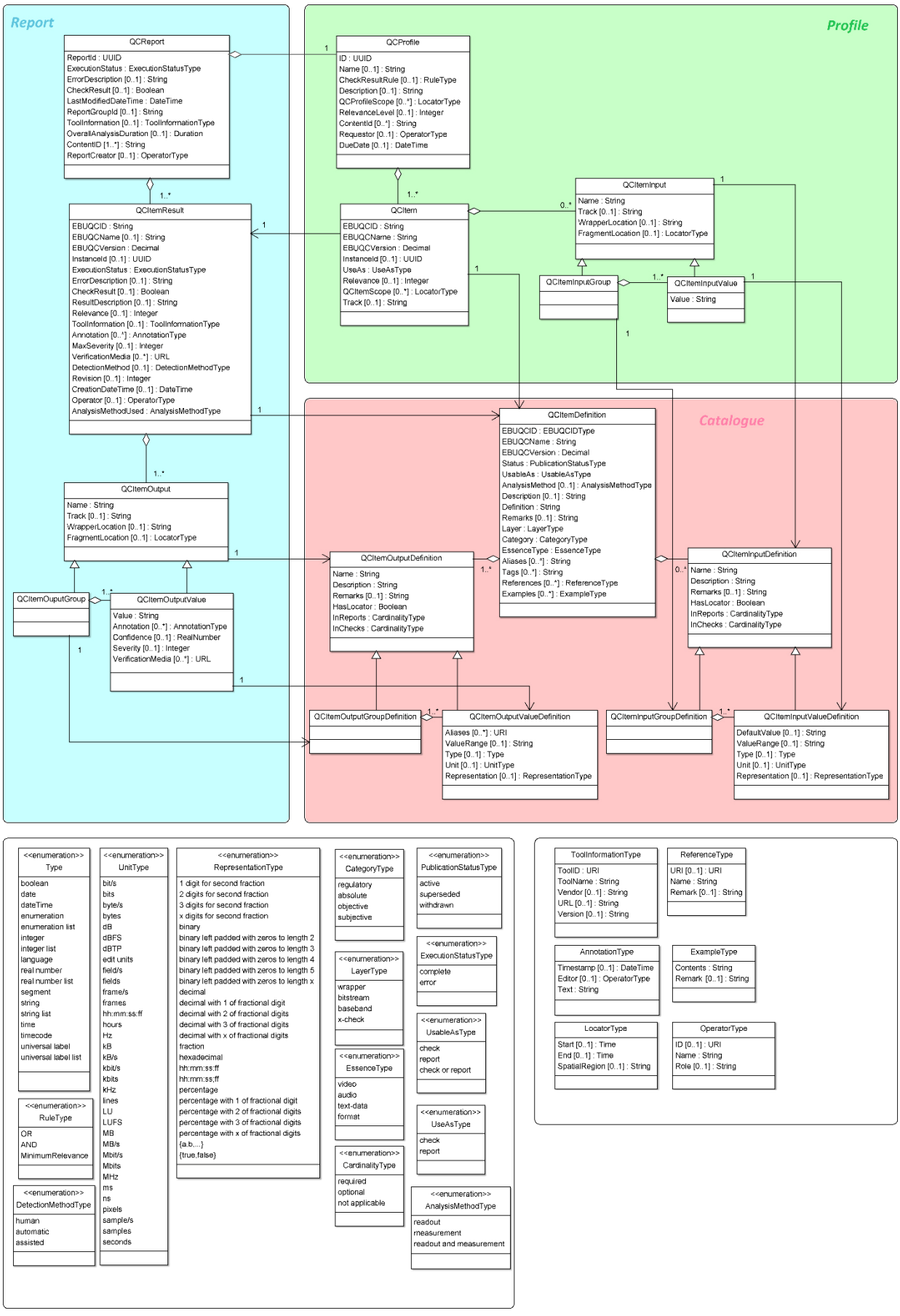

Figure 1 - UML diagram of the QC data model

3. Catalogue

By the term Catalogue we mean the entire collection of QC tests with their definitions i.e. their name and possible aliases, formal definition of what has to be checked or measured, the list of input and output parameters expected to be supported, reference to standards, etc. All this information is collected in and accessible via the EBU.IO/QC Tool at https://ebu.io/qc/

This chapter and its sub-chapters contain the detailed description of the classes used for the QC Test definitions.

3.1. QCItemDefinition

QCItemDefinition defines a single atomic Test that can be instantiated as a QCItem. A QCItemDefinition is a composition of QCInputDefinition(s) and QCOutputDefintion(s).

Depending on the way the Test is implemented and configured, the following Test types can be distinguished:

Readout or **Measurement** (see the AnalysisMethod attribute)**:**
With readout we mean a QCItem where the output is a Readout or a simple inference from a value written within the multimedia file at wrapper or bitstream level (usually a metadata item).

Example: QC Item 0070W, "Stored Frame Size", provides as output the size of the stored video frame which is directly read from the wrapper.

With measurement we mean a QCItem where the output consists of one or more values resulting from a measurement procedure usually carried out by analyzing the audio or video baseband signals. The output can be a signal itself, for example the momentary loudness of an audio channel.

Example: QC Item 0010B "Loudness", analyses the baseband audio and provides as output the Momentary Loudness measurement according to the EBU R 128 specification.

If present, the AnalysisMethod attribute specifies if a Test is to be implemented as a readout, a measurement or both (readout & measurement). There may be cases where no value is defined. Implementers will signal the type of Test performed using the AnalysisMethodUsed attribute in QCItemResult.

Check or **Report** (see UsableAs attribute)
A QCItem implements the check mode when the principal (mandatory) output is a boolean result named CheckResult. This output is intended to be used by a higher workflow level.

Technically a check could be either a simple Readout or a complex measurement, where the result value is compared to a user-specified expected value or threshold. CheckResult is *true* if the check passed (matching value(s), no defect(s), required feature(s) detected) and *false* if the Check failed (value(s) mismatch, defect(s) detected, required feature(s) missing). To prevent ambiguity each QCItem definition shall explicitly define the meaning of CheckResult.

Example: QC Item 0069F, "Display Aspect Ratio", reads the DAR from the wrapper and compares it with the user-specified expected value. The CheckResult output is *true* when the values match, *false* otherwise. Optionally the report may include the value read out.

Conversely a QCItem implements the Report mode when the output does NOT include a CheckResult equivalent, but provides (more verbose) output including the actual values being measured or read out. A QCItem often implements both modalities. Users can then choose to run the Test as a Check or a Report by setting the UseAs attribute on the QCItem (which is the instantion of the QCItemDefinition) to the appropriate value.

Crosscheck (see the Layer attribute)
A QC Item can act on various 'layers' of a file (baseband, bitstream, wrapper), but it can also compare information between the layers. Such a Test is called a Crosscheck. It compares similar information obtained from different file layers, usually the wrapper and the bitstream. The principal (mandatory) output is CheckResult, which is *true* when there is correspondence between the layers, *false* otherwise.

Example: QC Item 0034X, "Video chroma subsampling" verifies if the chroma subsampling declared in the wrapper (QC Item 0034F) equals that declared in the bitstream (QC Item 0034W).

Note: the AnalysisMode for a crosscheck is often "readout and measurement" because it requires both a readout from the wrapper (or bitstream) and a measurement from the baseband.

Attribute	Type	Mand/Opt	Description	Examples
EBUQCID	String	Mand	Unique ID of the QCItem corresponding to the EBU QC Test ID	0010B (Loudness, baseband)
EBUQCName	String	Mand	Brief name of the Test performed by this Item, corresponds to the EBU QC Test name	Aspect Ratio
Aliases	String	Opt	One or more well known aliases of EBUQCName	Display Aspect Ratio
EBUQCVersion	Decimal	Mand	The version number of the EBU QC Item definition. Where the major version is before the decimal point. And the minor version comes after the decimal point.	2.1
Status	enumeration {active,superseded, withdrawn}	Mand	The status signals if the QCItem is the latest version, an earlier (superseded) version or has been withdrawn.	active
UsableAs	enumeration anba	Mand	Specifies whether the QCItem can be used as a check, as a report or both. This attribute is related to the UsedAs attribute of the QCItem entity which specifies the actually used modality.	check or report
Definition	String	Mand	A concise definition of the Test, (without going into implementation details) and a description of the key concepts.	Used in Checks, the system shall report the presence of black bars in the video essence with size and duration beyond the specified input thresholds.
Description	String	Opt	Provides further information on what the Test is about, especially by providing contextual information, such as why the Test is useful in practice.	Images that do not fill the intended screen (e.g. 4:3 or 16:9). A movie designed for a cinema screen will often have black bars at the top and bottom when shown on a 16:9 television.
AnalysisMethod	AnalysisMethodType	Opt	Specifies whether the QC software shall just read out values from the metadata or rather calculate the outputs with direct measurement on essence. Use "readout and measurement" when both methods are required in order to accomplish the task. Often this is the case for QCItems belonging to the x-check Layer. Omit this attribute when it is not known or it is	readout or measurement

			not intended to prescribe how to implement the Test.	
Layer	LayerType	Opt	Defines at which layer a Test is performed. Think of this as an OSI layer type of model. The definitions are provided in Annex A.1.	baseband
Category	CategoryType	Opt	Defines to which category a Test is belongs. This gives an impression of the automatibility of the Test. The definitions are provided in Annex A.2.	absolute
EssenceType	EssenceType	Opt	A categorization of the type of content the Test deals with.	video
References	ReferenceType	Opt	References to a standard or technical specification, where possible with a URI, name and remarks	
Tags	String	Opt	One or more strings recalling specific concepts associated with the QCItem.	video, audio, MXF
Remarks	String	Opt	Free textual notes	
Examples	ExampleType	Opt	One or more examples, each consisting of Content and Remarks (if any).	

Table 1 – List of QCItem Definition attributes

3.2. QCItemInputDefinition

Specifies the nature of an input to the QC Test. This is an abstract class used to define instantiations of single QCItemInputValueDefinition or multiple QCItemInputValueDefinitions grouped by a QCItemInputGroupDefinition.

Attribute	Type	Mand/Opt	Description	Examples
Name	String	Mand	The unique name (in the scope of the QCItem) of the input. Usually the input is an expected value or a threshold.	Audio Duration Expected
Description	String	Mand	Brief description of the input and its meaning.	For BarsMinimumSizeVertical: "Minimum size of the black bar from top and bottom of the frame before an event is generated."
Remarks	String	Opt	Free textual notes	
HasLocator	Boolean	Mand	When set to true the input is related to a time interval or spatial area. When false the input is global to the entire content.	True
InReports	Cardinality Type	Mand	Specifies whether the input is required, optional or not applicable when the QCItem is used as a Report.	required
InChecks	Cardinality Type	Mand	Specifies whether the input is required, optional or not applicable when the QCItem is used as a check.	not applicable

Table 2 – List of QCItemInputDefinition attributes

3.3. QCItemInputGroupDefinition

This is a specialization class of QCItemInputDefinition and has the single purpose to aggregate multiple QCItemInputValueDefinition under the same spatiotemporal interval, wrapper location or track (see QCItemInput class in chapter 4.3).

3.4. QCItemInputValueDefinition

This is a specialization class of QCItemInputDefinition that adds several attributes like the Type (e.g. Integer), Unit (e.g. volts), Representation (e.g. decimal) etc.

Attribute	Type	Mand/Opt	Description	Examples
DefaultValue	String	Opt	A default value to be assumed for the input value when not provided.	1
ValueRange	String or empty	Opt	The range of valid values. This attribute should usually be provided, but in rare cases it may be left out to signal it is not specified. It may be left empty to signal the value does not apply.	[0,1]
Type	Type or empty	Opt	The type of data used to express the specific input. This attribute should usually be provided, but in rare cases it may be left out to signal it is not specified. It may be left empty to signal the value does not apply.	Real number, integer, boolean, date Look at the definition of Type enumeration for the exhaustive list.
Unit	UnitType or empty	Opt	The measurement unit adopted for the specific output value. This attribute should usually be provided, but in rare cases it may be left out to signal it is not specified. It may be left empty to signal the value does not apply.	Bytes Look at the definition of the UnitType enumeration for the exhaustive list.
Representation	RepresentationType or empty	Opt	The representation used when showing the output value e.g. percentage This attribute should usually be provided, but in rare cases it may be left out to signal it is not specified. It may be left empty to signal the value does not apply.	Decimal Look at the definition of RepresentationType enumeration for the exhaustive list

Table 3– List of QCItemInputValueDefinition attributes

3.5. QCItemOutputDefinition

Specifies the nature of an output of the QC Test. It is an abstract class used in practise declined to a single QCItemOutputValueDefinition or to multiple QCItemInputValueDefinitions grouped by a QCItemInputGroupDefinition.

Attribute	Type	Mand/Opt	Description	Examples
Name	String	Mand	The unique name (in the context of the QCItem) of the output. The output is usually a value being read or measured from the analysed content. A special output named “CheckResult” is used to express a pass/fail logic and is mandatory for Tests with a check mode.	CheckResult, VideoCodec
Description	String	Mand	Brief description of the output and its meaning.	For VideoCodec: “Reports the Video Codec detected in the bitstream.”
Remarks	String	Opt	Free textual notes	
HasLocator	Boolean	Mand	When set to true the output is related to a time interval or spatial area. When false the output is global to the entire content.	True
InReports	Cardinality Type	Mand	Specifies whether the output is required, optional or not applicable when the QCItem is used as a Report.	optional

InChecks	Cardinality Type	Mand	Specifies whether the output is required, optional or not applicable when the QCItem is used as a check.	required

Table 4– List of QCItemOutputDefinition attributes

3.6. QCItemOutputGroupDefinition

This is a specialization class of QCItemOutputDefinition and has the single purpose to aggregate multiple QCItemOutputValues under the same spatiotemporal interval, wrapper location or track (see QCItemOutput class in chapter 5.3).

3.7. QCItemOutputValueDefinition

This is a specialization class of QCItemOutputDefinition that adds several attributes, such as the Type (e.g. Integer), Unit (e.g. Volts), and Representation (e.g. decimal).

Attribute	Type	Mand/Opt	Description	Examples
Aliases	URI	Opt	One or more well-known aliases the Output refers to, e.g. a SMPTE universal label or an alternative text.	urn:smpte:ul:060e2b34. 01010105.04010302.09000000
ValueRange	String or empty	Opt	The range of valid values. This attribute should usually be provided, but in rare cases it may be left out to signal it is not specified. It may be left empty to signal the value does not apply.	[0,1]
Type	Type or empty	Opt	The type of data provided by specific output. This attribute should usually be provided, but in rare cases it may be left out to signal it is not specified. It may be left empty to signal the value does not apply.	Real number, integer, boolean, date Look at the definition of the Type enumeration for the exhaustive list.
Unit	UnitType or empty	Opt	The measure unit adopted for the specific output value. This attribute should usually be provided, but in rare cases it may be left out to signal it is not specified. It may be left empty to signal the value does not apply.	Bytes Look at the definition of the UnitType enumeration for the exhaustive list.
Representation	RepresentationType or empty	Opt	The representation used when showing the output value e.g. percentage. This attribute should usually be provided, but in rare cases it may be left out to signal it is not specified. It may be left empty to signal the value does not apply.	Decimal Look at the definition of RepresentationType enumeration for the exaustiuve list

Table 5– List of QCItemOutputValueDefinition attributes

4. Profile

A Profile provides all that is needed as input in order to describe and eventually perform a compound QC Test on media content. A compound Test consists of a set of atomic tests i.e. QCItems with their specific inputs. The following subchapters describe the classes involved in detail.

4.1. QCProfile

QCProfile specifies what content has to be checked and analyzed for. It constitutes the main input to a QC system as it includes all the QCItems to apply, including the associated configurations and inputs.

A QCProfile must include, either directly of via a reference URL, all the associated QCItemDefinitions, which is useful to know important information such as inputs and outputs types, their allowed ranges, measure units and representation.

A QCProfile can optionally include one or more Scopes that restrict all the QC activities to spatiotemporal subregions of the content and a CheckResultRule (logic) for the determination of the overall pass/fail value.

In practice a QCProfile can be implemented with a single XML document, containing all the relevant information. Note that in [1] the name "Template" is used for this entity.

Table 6 provides the list of attributes for the QCProfile with associated descriptions.

Attribute	Type	Mand/Opt	Description	Examples
ID	UUID	Mand	Unique ID of the QCProfile	291381cd-4aec-467a-b7cc-cadb8f870f62
Name	String	Opt	Brief name of the profile	TestProfile
ContentId	String	Opt	The unique ID(s) of the content to be analyzed. It is possible to provide more than one ID but for the identification of the same content. This attribute is optional in order to allow the creation of 'Base Profiles' reusable with any subsequently provided contentID.	b465080a37b74de1addf2c29595c2275 urn:mycompany:myid01
CheckResultRule	enumeration {AND,OR, MinimumRelevance}	Opt	Specifies how the overall Check result in QCReport is calculated from the checks in the profile. If not specified, a default AND logic is used; this means an overall pass is obtained only when all the QCitems have passed.	AND, OR, MinimumRelevance Note: MinimumRelevance in combination with the RelevanceLevel attribute defines the rule for generating the overall pass/fail taking into account the relevance of the QCitems.
Description	String	Opt	Brief description of the profile	
QCProfileScope	LocatorType	Opt	Defines spatiotemporal sub segments of the content to be analysed by all QCItems used within the QCProfile.	Limit the analysis to the intervals: [10:10:00.00, 10:20:00.00] [10:25:00.00, 10:40:00.00]
Requestor	OperatorType	Opt	The company or entity that requested the QC inspections.	ID: urn:companyregister:company1234 Name:Effective Broadcasting Inc. Role: Broadcaster

DueDate	Datetime	Opt	The expected due date for the QCProfile to be applied and the QC report to be returned.	2017-12-10
RelevanceLevel	integer [0,10]	Opt	Setting this RelevanceLevel in combination with the CheckResultRule 'MinimumRelevance' will take into account all check results with a relevance above the specified minimum to generate the overall Check result in QCReport (using AND logic).	5

Table 6 – List of QCProfile attributes

4.2. QCItem

The core of the model is the QCItem. It is related to a specific quality control activity performed on digital multimedia content. A large collection of QCItems has been defined by the EBU QC group. These are described in the publicly available EBU QC Test definitions [1]. The definitions are continuously being updated and refined using the requirements from participating broadcasters and the expertise from participating vendors.

A QCItem can have zero or more inputs to better specify what content to analyse and how. Absence of inputs is allowed and assumes implicit default inputs.

By default all the content (i.e., the entire duration without spatial restrictions) is considered. In order to restrict the analysis to parts of the content QCItemScopes (spatiotemporal subregions) shall be used.

A QCItem always has one single output in the form of a QCItemResult.

Table 7 provides the list of attributes for the QCItem class, with associated descriptions.

Attribute	Type	Mand/Opt	Description	Examples
EBUQCID	String	Mand	Unique ID of the QCItem corresponding to the EBU QC Test ID.	0010B
EBUQCName	String	Mand	Brief name of the Test performed by this Item, corresponds to the EBU QC Test name	Aspect Ratio
EBUQCVersion	Decimal	Mand	The version number of the EBU QC Item definition. Where the major version is before the decimal point. And the minor version comes after the decimal point.	2.1
InstanceId	UUID	Opt	Unique Identifier to distinguish QCItems with the same EBUQCID within one QCProfile. If used, the corresponding QCItemResult must provide the same InstanceID.	791381cd-4aec-467a-b7cc-cadb8f870f62
UseAs	UseAsType	Mand	Specifies if a Test is ran as a Check or a Report.	check
Layer	LayerType	Opt	Corresponds to the QCItemDefinition Layer field.	wrapper
Category	CategoryType	Opt	Corresponds to the QCItemDefinition Category field	human-review only

Relevance	integer [0,10]	Opt	Marks the importance of a QCItem in the context of a profile and of the higher workflow level. It is used in combination with QCProfile/RelevanceLevel and QCProfile/CheckResultRule to determine the overall report checkresult.	3
EssenceType	EssenceType	Opt	Specifies the content type the QCItem focuses on. Corresponds to the QCItemDefinition EssenceType field.	
QCItemScope	LocatorType	Opt	Limits the execution of a QCItem to one or more spatiotemporal segments of the content that are relevant for quality control. If not defined, the QCProfileScope applies to all the QCItems in the profile.	Limit the analysis to the intervals: [10:10:00.00, 10:20:00.00] [10:25:00.00, 10:40:00.00]
Track	String	Opt	Indicates one or more tracks for the QCItem to work on. More than one track can be asked providing a comma separated list of tracks. When this attribute is not provided it is assumed that all the applicable tracks of the source have to be analyzed.	audio track1 audio track1, audio track 2

Table 7 – List of QCItem attributes

4.3. QCItemInput

QCItemInput is input of any kind provided to the QC service implementing the QCItem, both by software and/or users. Those inputs allow specifying what to analyze and how. A QCItemInput can for example be a user provided value to check against (e.g. Expected Display Aspect Ratio 16:9) or a threshold (e.g. the maximum allowed video noise level before reporting). All the relevant inputs including data type, measurement units, ranges, representations, are specified by the EBU QC Tests published on the EBU.IO/QC website [1].

Table 8 provides the list of attributes for the QCItemInput class, with associated descriptions.

Attribute	Type	Mand/Opt	Description	Examples
Name	String	Mand	The unique name of the Input within the scope of the QCItem, as defined in the EBU QC Test Definition.	VideoAspectRatio
Track	String or UUID (if applicable)	Opt	The unique identification of the media track the input refers to. If not specified the input is valid for all the applicable tracks.	-Audio track1 -Video track1
WrapperLocation	String	Opt	Applicable only for QCItems working at wrapper level. The identification of the portion of the file wrapper to be checked/utilised by the QCItem. If not specified it is assumed to use all the locations and also check for their consistency. When the wrapping is MXF the wrapper location is actually the MXF partition with possible values header, footer, body.	-header -footer -body
FragmentLocation	LocatorType	Opt	Indicates the spatiotemporal location that the input refers to. If not provided it means that the complete timeline and spatial region in the scoep of the content has to be considered .	Start:10:10:00.00 End: 10:20:00.00

Table 8 –List of QCItemInput attributes.

Beside the inputs specified by the EBU QC Test Items, tools shall always support the following additional inputs:

- A QCItemInput with Name="ExpectedOutput" to signal optional outputs that are desired to be included. The name of the output is provided as the Value.

Besides the inputs specified by the EBU QC Test Items, tools may need additional vendor specific inputs. A vendor specific input shall be named with the defined prefix: 'custom.', preferably followed by a meaningful vendor prefix and parameter name, separated by dots.

Example : custom.mycompanyname.FrameColorExpected

4.4. QCItemInputGroup

This is a specialization class of QCItemInput and has the solely goal to aggregate multiple QCItemInputValues under the same spatiotemporal interval.

4.5. QCItemInputValue

This is a specialization class of QCItemInput that adds the actual value to be used for the QC process.

Note: additional information about the nature of the input can be gathered from the related QCItemInputValueDefinition which is always included – directly or by reference - in the profile. This information includes the attributes ValueRange, Type, Unit, Representation.

Attribute	Type	Mand/Opt	Description	Examples
Value	as defined in the EBU QC Test Definition	Mand	The actual value of the Input.	16:9

Table 6 – List of QCItemInputValue attributes

5. Report

The Report is the outcome of a QC assessment made according to a specific QCProfile provided as input to the QC system. The report contains all the information obtained as output of the tests performed on the media content. Additionally it also contains the QCProfile, either embedded or in the form of a URL reference.

The following subchapters describe in detail the classes involved.

5.1. QCReport

A QCReport is the aggregation of all the QCItemResults related to a QCProfile. In other words, a QCReport is the complete report of all the QC analyses and inspections made in the context of a specific QCProfile.

QCReport must include, either directly of via a reference URL, the entire associated QCProfile, which is useful to understand which inputs led to the reported results.

A QCReport has an "ExecutionStatus" related to the execution of the quality control activities associated with the QCItems. See Table 4 for details. Possible errors are related to content independent reasons, e.g. network congestion, software bugs etc.

A QCReport has a "CheckResult" when at least one of the QCItems is a Check. The CheckResult represents the overall success or fail of the Check part of the entire analysis.

Table 10 provides the list of attributes for the QCReport class, with associated descriptions.

Attribute	Type	Mand/Opt	Description	Examples
ReportId	UUID	Mand	A unique ID for the report. It is recommended to use a UUID in order to have an ID that is always globally unique.	b465080a37b74de1addf2c29595c2275
ReportCreator	OperatorType	Opt	The service provider or company that ran the QC tests and generated the QCReport.	ID: urn:companyregister:company123 Name: QC Associated Ltd. Role: QC service provider
ExecutionStatus	ExecutionStatus Type	Mand	An overall status for the execution of the QCProfile. Possible statuses are "Complete" to be used when all the QCItems Tests were completed correctly and "Error" to be used when one or more QCItems did not complete correctly. Note: It is assumed that (as a default) a QCReport is generated even if not all the QCItems have executed correctly.	completed
ErrorDescription	String	Opt	When ExecutionStatus ="error", this attribute can be used to provide an overall description of the problems encountered, e.g. how many errors and of which kind were produced for each QCItem.	QCItem 0069F, part of the profile, failed for this reason: file not found
CheckResult	Boolean	Mand when at least one Check is part of the QCProfile	Overall Status of the checks done according to the given QCProfile. This is a logical combination of the statuses of the QCItemResults involved in the QCProfile. This attribute is applicable only if at least one of the QCItems in the profile is a Check, the suggested default	A QCProfile requires to check both AR and AFD at wrapper level (EBU IDs:0069F and 0001F). Status is "true" if both AR and AFD checks passed, is "false" if either one of the two basic checks failed.

			logic is AND i.e. 'true' if all the checks passed.	
ContentId	String	Mand	The unique ID(s) of the content that was analyzed. It is possible to provide more than one ID for the identification of the same content. This attribute must be the same as the ContentID provided with the QCProfile (see Table 2).	b465080a37b74de1addf2c29595c2275
LastModifiedDateTime	Datetime	Mand	Date and time when the report has been last modified (in case of revisions) or initially created	2014-07-29T10:00:00
ReportGroupId	String	Opt	A free label intended to be used by higher level software (e.g. a workflow manager) for grouping reports. It is passed as an input parameter to the QCProfile to be executed.	batchmaterialNbr1
OverallAnalysisDuration	Duration	Opt	The duration of the overall analysis i.e. the difference between the the maximum endtime and the minimum starttime summed over all the QCItems executions.	02:01:00 (hh:mm:ss)
ToolInformation	ToolInformationType	Opt	Indicates which tool has been used to execute the analyses, it makes sense here when all the QCItems belong to the same vendor and tool. When QCItems of the same profile are implemented by different vendors, the ToolInformation of each QCItemResult should be used instead. This same information could be replicated in the QCItemResult (see Table3)	ToolID: uniqueToolID ToolName: QCtool_k Vendor: vendor_xy Version: 1.0 URL: http://vendor_xy/QCtool_k

Table 10 – List of QCReport attributes.

5.2. QCItemResult

QCItemResult contains all the relevant output metadata resulting from the execution of a single QCItem Test. Each specific QCItem will have its own QCItemResult (e.g. the result of a "Display Aspect Ratio" will be different than the result of "Video Frame Count"). The QCItemResult will include the outputs of the quality control operations as specified in detail for each EBU QCItem.

A QCItemResult has an "ExecutionStatus" related to the execution of the quality control activity associated with the QCItem. This status can be one of *complete* and *error*. Possible errors are related to content independent reasons such as network congestion, software bugs etc.

A QCItemResult has a "CheckResult" when the associated QCItem is a Check. The CheckResult represents the *pass* or *fail* of the Check. In general the result will also include a more verbose reporting of the analysis carried out with a potentially long list of time segments and spatial regions with associated measured values.

For example, a blockiness analysis will report the temporal and spatial regions where blockiness occurs with associated severity estimations.

Table 11 provides the list of attributes for the QCItemResult class, with associated descriptions.

Attribute	Type	Mand/Opt	Description	Examples
EBUQCID	String	Mand	Unique ID of the QCItem the result belongs to.	0010B (Loudness, baseband)
EBUQCName	String	Opt	Name of the QCItem the result belongs to.	Loudness

EBUQCVersion	Decimal	Mand	The version number of the EBU QC Item definition. Where the major version is before the decimal point. And the minor version comes after the decimal point.	2.1
InstanceId	UUID	Opt	Unique Identifier to distinguish QCItemResults of the same EBUQCID within one QCReport.	791381cd-4aec-467a-b7cc-cadb8f870f62
AnalysisMethodUsed	AnalysisMethodType	Mand	The actual analysis mode that was used for this QCItem during the test. This shall coincide with the AnalysisMode attribute of QCItemDefinition when the value is one of readout, measure, readout and measure.	readout
ExecutionStatus	ExecutionStatus Type	Mand	Enumeration describing the status of the execution of the associated QCItem. This status either reports proper execution of the QC activity (complete) or an error (erorr), e.g. due to a disk or network error.	complete
ErrorDescription	String	Opt	Is the description of the error encountered. This attribute has a value when “ExecutionStatus” is error.	The QC service timed out.
CheckResult	Boolean	Mand for check, absent otherwise	A boolean variable telling if the Check succeeded or not, applicable only in case the QCItem is a Check. Semantic: **true**, if Check passed (matching value(s), no defect(s), required feature(s) detected) **false**, if Check failed (value(s) mismatch, defect(s) detected, required feature(s) missing)	When a Check of AR at wrapper level against user required values succeeds, then value is "true" and the Check is “passed”.
ResultDescription	String	Opt	A short human readable description of the result. Could be used for both types of QCItems: measurement and check.	- The maximum noise level is -23 dB (measurement) - The maximum noise level is within the limits (check/pass) - The maximum noise level exceeded the limit (check/fail)
ToolInformation	ToolInformationType	Opt	Indicates which tool has been used to execute the QCItem.	ToolID: uniqueToolID ToolName: QCtool_k Vendor: vendor_xy Version: 1.0 URL: http://vendor_xy/QCtool_k
Annotation	AnnotationType	Opt	Additional textual information to comment on the QCItemResult.	Timestamp : 2014-08-07T11:04:22 Editor: QCtool K Text : Test Role: AQC
Relevance	integer [0,10]	Opt	Marks the importance of a QCItemResult for a higher workflow level. The value is provided with the QCItem on the input side.	6
MaxSeverity	integer [0, infinity)	Opt	Sets the upper bound of the scale for severity for all CItemOutputs within this QCItemResult	500
VerificationMedia	URL	Opt	Link to external binary data generated by a tool during analysis, the use of which is for easy checking the results of the QC analyses. To include binary data directly into the report XML, the "data" URL scheme [2] should be used in the form of: data:[<mediatype>][;base64],<data> This attribute shall be used when the verification media refers to the entire	URL to a thumbnail of the video showing a video breakout. URL to a short audio file extracted from the original audiovisual file and containing the defect that was detected.

			ItemResult. When it is specific to a certain Output (whether global or fragment), use instead the attribute with the same name in the class QCItemOutputValue.	
DetectionMethod	DetectionMethodType	Opt	Flags the method used for item processing. Automatic means that the result was obtained with an automatic QC tool. Human means that the result was created by a human operator from scratch. Assisted means that the result is a combination of automatic and human QC.	human
Revision	integer [0, infinity)	Opt	Marks the version of a QCItemResult. Unless otherwise noted, it is assumed that revision N derives from revision N-1 (e.g. revision 1 automatic and revision 2 assisted means that rev2 is a human review of rev1)	2
CreationDateTime	Datetime	Opt	Date and time when the QCItemResult was created.	2014-07-29T11:00:00
Operator	OperatorType	Opt	The user who has performed a Test manually, e.g. eye-ball Check from scratch or a revision of an automatic result.	ID: 123 Name: John Doe Role: Supervisor

Table 11 –List of QCItemResult attributes.

5.3. QCItemOutput

Table 12 provides the list of the attributes for the QCItemOutput class, with associated descriptions.

Attribute	Type	Mand/Opt	Description	Examples
Name	String	Mand	The unique name of the Output within the scope of the QCItem, as defined in the EBU QC Test Definition.	VideoAspectRatio
Track	String or UUID (if applicable)	Opt	The unique identification of the media track to refer to.	-Audio track1 -Video track1
WrapperLocation	String	Opt	Applicable only for reports from QCItems working at wrapper level. The identification of the portion of the file wrapper that has been used when checking/reading-out. For MXF the wrapper location is the 'MXF partition' with possible values header, footer, body.	-header -footer -body
FragmentLocation	LocatorType	Opt	Indicates the spatiotemporal location that the output refers to. If not provided it means that the complete timeline and spatial region for the video in scope has to be considered .	Start:10:12:00.00 End: 10:13:00.00

Table 12 – List of QCItemOutput attributes

Besides the outputs specified by the EBU QC Tests, tools may need additional vendor specific outputs.

A vendor specific output shall be named with the defined prefix 'custom.' and preferably followed by a meaningful vendor prefix and parameter name, separated by dots. Example: custom.mycompanyname.FrameColor

5.4. QCItemOutputGroup

This is a specialization class of QCItemInput and has the single purpose to aggregate multiple QCItemOutputValues referring to the same spatiotemporal interval (FragmentLocation), WrapperLocation and Track.

5.5. QCItemOutputValue

This is a specialization class of QCItemOutputValueDefinition.

Note: additional information about the nature of the input can be gathered from the corresponding QCItemOutputValueDefinition which is always included – directly or by reference - in the profile. This information includes the attributes ValueRange, Type, Unit, Representation.

Attribute	Type	Mand/Opt	Description	
Value	as defined in EBU QC Test Definition	as defined in EBU QC Test Definition	The actual value of the Output. In case the file under test does not provide the required value, the Value should be left out. The value is optional when the QCItemOutput is defined as parent segment in EBU QC Test.	
Annotation	AnnotationType	Opt	Additional textual information to comment	
Verification Media	URL	Opt	Link to external binary data generated by a tool during analysis, to easily check the results of the QC analyses. To include binary data directly into the report XML, the "data" URL scheme [2] should be used in form of: data:[<mediatype>][;base64],<data> This attribute shall be used when the verification media refers to a specific QCOutput (whether global or fragment). When it is global to the ItemResult, use instead the attribute with the same name in class QCItemResult.	http://mycompany/qcresults/verificationmedia/2d34db6a-7c08-445d-aa9e-0613a2cf5b2f.jpg
Confidence	real number [0,1]	Opt	The confidence level with which a tool has found a defect (global or fragment).	0.5
Severity	integer [0, infinity)	Opt	A positive integer indicating the strength of the defect. Severity shall be useful to provide at least a ranking of defects relevance when discovered by the same tool. The model does not impose an upper bound as it is left free to each implementer, if deemed necessary, to use a closed scale. Some QCItems with well documented measurement procedures could require a fixed upper bound.	8

Table 7– List of QCItemOutputValue attributes

6. Description of the relations

QCItem-QCItemResult
Each QCItem produces a specific QCItemResult that is the report of the QC Test Item performed on the content restricted through QCProfileScopes and QCItemScopes. This result includes all the relevant outputs, according to what is specified in the EBU-QC Test's definition.

QCReport-QCItemResult
A QCReport is an aggregation of QCItemResults (at least one) for all the QCItems included in a QCProfile.

QCItemResult-QCItemOutput
A QCItemResult includes at least one and potentially many QCItemOutputs, each of them representing an output of the QC performed.

QCItemOutput- QCItemOutputGroup
QCItemOutputGroup is a specialization of QCItemOutput to group multiple QCItemOutputValues sharing the same spatiotemporal segment (FragmentLocation), Wrapper Location and Track.

QCItemOutput- QCItemOutputvalue
QCItemOutputValue is a specialization of QCItemOutput which adds several attributes among which the actual Value of the output. See the specification of QCItemOutputValue for a complete description of attributes.

QCItemOutputGroup - QCItemOutputvalue
QCItemOutputGroup contains more QCItemOutputValues sharing the same spatiotemporal segment (FragmentLocation), Wrapper Location and Track.

QCProfile-QCItem
A QCProfile aggregates QCItems (at least one). Profiles are created by users to test groups of media files for specific QC compliance.

QCItem-QCItemInput
A QCItem receives zero or more inputs used to configure the QC activity. When no parameters are received the QCItem only applies the implicit defaults.

QCItemInput- QCItemInputGroup
QCItemInputGroup is a specialization of QCItemInput to group multiple QCItemInputValues sharing the same spatiotemporal segment (FragmentLocation), Wrapper Location and Track.

QCItemInnput- QCItemInputvalue
QCItemInputValue is a specialization of QCItemInput which adds the actual Value of the input. See the specification of QCItemInputValue for a complete description.

QCItemInputGroup - QCItemInputvalue
QCItemInputGroup contains more QCItemInputValue sharing the same spatiotemporal segment (FragmentLocation), Wrapper Location and Track.

QCReport-QCProfile
The QCReport mandates the inclusion (can be by reference) of the profile that is used for the quality control activities. This is useful to signal the input configuration that led to the output.

QCItemDefinition-QCItemInputDefinition
A QCItemDefinition includes zero or more input definitions explaining what information will be used to configure the QC analysis.

QCItemInputDefinition- QCItemInputGroupDefinition
QCItemInputGroupDefinition is a specialization of QCItemInputDefinition to group multiple QCItemInputValuesDefinition sharing the same spatiotemporal segment (FragmentLocation), Wrapper Location and Track.

QCItemInputDefinition- QCItemInputValueDefinition
QCItemInputValueDefinition is a specialization of QCItemInputDefinition which adds several attributes among which default value, unit, range etc. See the specification of QCItemInputValueDefinition for a complete description of attributes.

QCItemInputGroupDefinition - QCItemInputValueDefinition
QCItemInputGroupDefinition contains more QCItemInputValueDefinition sharing the same spatiotemporal segment (FragmentLocation), Wrapper Location and Track.

QCItemDefinition-QCItemOutputDefinition
A QCItemDefinition includes zero or more output definitions specifying what will appear in the QC report after the QC analysis.

QCItemOutputDefinition- QCItemOutputGroupDefinition
QCItemInputGroupDefinition is a specialization of QCItemInputDefinition to group multiple QCItemOutputValues sharing the same spatiotemporal segment (FragmentLocation), Wrapper Location and Track.

QCItemOutputDefinition- QCItemOutputValueDefinition
QCItemOutputValue is a specialization of QCItemOutput which adds several attributes. See the specification of QCItemOutputValueDefinition for a complete description of attributes.

QCItemOutputGroupDefinition - QCItemOutputValueDefinition
QCItemOutputGroupDefinition contains more QCItemOutputValueDefinition sharing the same spatiotemporal segment (FragmentLocation), Wrapper Location and Track.

7. Attribute type classes

7.1. ToolInformationType

This attribute class carries the relevant information to indicate which tool has been used to execute the analyses.

Attribute	Type	Mand/Opt	Description	Examples
ToolID	URI	Mand	URI to uniquely identify a tool. Proposed pattern: //<vendor-domain-name>/<name>/<version>	http://vendor.com/tool-x/v2
ToolName	String	Mand	Name of the tool	Video Analyzer 2000
Vendor	String	Opt	Company name of the tool vendor	Vendor Inc.
Version	String	Opt	Version / Release of the tool	Enterprise Edition 2014 r2
URL	String	Opt	The endpoint of the actually used tool. There are maybe multiple instances of a tool running in a qc environment / server farm.	http://qc-domain/tool-x/server-1

7.2. AnnotationType

With the AnnotationType it is possible to add additional time-based textual information to a QCItemResult or QCItemOutput.

Attribute	Type	Mand/Opt	Description	Examples
Text	String	Mand	The actual annotation text	
Editor	OperatorType	Opt	The tool / user / system responsible for the annotation	User X
Timestamp	DateTime	Opt	Time when the annotation was created	2014-04-11T09:22:11

7.3. OperatorType

The OperatorType can be used to define a person, which runs manual tests (e.g. eyeball checks) or adds annotations.

Attribute	Type	Mand/Opt	Description	Examples
Name	String	Mand	Name of the operator or of the company	John Doe
ID	URI	Opt	An identifier for the operator/company	Operator123, urn:mycompany:operator1, urn:companyregister:company10
Role	String	Opt	The role of the operator / company / tool / system in the QC environment	Supervisor, Bradcaster

7.4. LocatorType

The LocatorType can be used to define spatiotemporal sub segments of content. An entire QCProfile or a single QCItem is limited to run the analyses based on the provided scope(s).

QCProfileScope(s), when present, act(s) as default scope(s) for all the involved QCItems. QCItems can have multiple Scopes to be interpreted as further content restrictions of the QCProfileScope(s).

Attribute	Type	Mand/Opt	Description	Examples
Start	Time	Opt	Start of a temporal subsegment of content which has to be / was analysed. Start can be represented in several ways e.g. relative playout time from the beginning, timecode, framecount and is left to implementations.	00:00:05:00
End	Time	Opt	End of a temporal subsegment of a content which has to be / was analysed. End can be represented in several ways e.g. relative playout time from the beginning, timecode, framecount and is left to implementations.	00:10:00:00
SpatialRegion	String	Opt	A string representing a rectangular spatial region of the video track according to the String pattern defined in W3C Media Fragments - 4.2.2 Spatial Dimension [3]	xywh=percent:160,120,320,240

Scope usage:

- Using QCItemScope/QCProfileScope does not require the presence of QCItemOutput to use QCItemOutputGroup, this depends on the actual QCOutputItemValue being part of a QCItemOutputGroup.
- When using QCItemScope/QCProfileScope, QCItemOutputValue refers to the entire time spanned by the scope of the related QCItem.
- In QCItemOutputGroups the time refers to the original time line and is not relative to the QCItemScope/QCProfileScope time.
- QCItemOutputGroupss outside the QCItemScope/QCProfileScope time range(s) or spatial area(s) are considered invalid and may be ignored.

7.5. ExampleType

This attribute class is used to provide an example of a Test and any remark that goes with it.

Attribute	Type	Mand/Opt	Description	Examples
Contents	String	Mand	An Example illustrating how the Test can be used.	Input: None Output: "Video Line Map Field1" = 21 Output: "Video Line Map Field2" = 584
Remark	String	Opt	A remark related to the Example.	Used as a Report.

7.6. ReferenceType

This attribute class carries the relevant information to indicate which tool has been used to execute the analyses.

Attribute	Type	Mand/Opt	Description	Examples
URI	URI	Opt	URI pointing to a specification	http://ieeexplore.ieee.org/document/7292073/
Name	String	Mand	Name of the specification	SMPTE ST 377-1
Remark	String	Opt	Additional clarifying information on this reference	MXF F.4.1 Generic Picture Essence Descriptor

1. References

[1] “EBU QC Test Definitions"
https://ebu.io/qc/items

[2] The "data" URL scheme, IETF RFC 2397
https://www.ietf.org/rfc/rfc2397.txt

[3] W3C Media Fragments - 4.2.2 Spatial Dimension
http://www.w3.org/TR/media-frags/#naming-space

Annex A Layer & Category definitions

A.1 Layers

Wrapper
Tests the structure/integrity of the file wrapper, or of the metadata within the wrapper.

Bitstream
Tests the structure/integrity of the encoded bitstream, or of the metadata within the bitstream.

Baseband
A Test applied to the decoded essence – the video frames or audio samples.

x-check
A verification that the values in other layers agree. For example, if a baseband Test of video frame size has been completed, and the video frame size metadata in the format and wrapper have been examined, the cross-check will verify that the values match.

A.2 Categories

Regulatory
A QC Item specifying a Test that must be performed due to requirements set by a regulator or government. Has a published reference document or standard.

Absolute
Defined in a standards document including a standard scale. May have a defined pass/fail threshold. As a user, I ought to be able to compare the results of different QC devices and see the same result.

Objective
Measurable in a quantitative way against a defined scale, but no standard threshold is agreed. There may be no formal spec or standard, but an agreed method is implied by or exists in the test definition. As a user, I ought to be able to compare the results of different QC devices if I configure the same thresholds.

Subjective
May be measurable but with only a medium degree of confidence. A failure threshold is not defined, or is very vague. May require human interpretation of results. As a user, I cannot expect different QC devices to report identical results.

Human-review only
Tests that can only be carried out by human eyes or ears (Golden Eyes and Golden Ears) or where a human is required to fully interpret the results of an automated QC tool.