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Information technology — Coding of multimedia and hypermedia information —

Part 1:
MHEG object representation — Base notation (ASN.1)

Technologies de l'information — Codage de l'information multimédia et hypermédia —

Partie 1: Représentation d'objet MHEG — Notation de base (ASN.1)

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Foreword

ISO (the International Organization for Standardization) and IEC (the International Electrotechnical Commission) form the specialized system for worldwide standardization. National bodies that are members of ISO or IEC participate in the development of International Standards through technical committees established by the respective organization to deal with particular fields of technical activity. ISO and IEC technical committees collaborate in fields of mutual interest. Other international organizations, governmental and non-governmental, in liaison with ISO and IEC, also take part in the work.

In the field of information technology, ISO and IEC have established a joint technical committee, ISO/IEC JTC 1. Draft International Standards adopted by the joint technical committee are circulated to national bodies for voting. Publication as an International Standard requires approval by at least 75 % of the national bodies casting a vote.

International Standard ISO/IEC 13522-1 was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 29, *Coding of audio picture, multimedia and hypermedia information.*

This part of ISO/IEC 13522 is also published by ITU-T as ITU-T Recommendation T.171, but not as identical text.

ISO/IEC 13522 consists of the following parts, under the general title *Information technology — Coding of multimedia and hypermedia information*:

— *Part 1: MHEG object representation — Base notation (ASN.1)*

— *Part 3: MHEG script interchange representation*

— *Part 4: MHEG registration procedure*

— *Part 5: Support for base-level interactive applications*

— *Part 6: Support for enhanced interactive applications*

Annex A forms an integral part of this part of ISO/IEC 13522. Annexes B to G are for information only.

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0 Introduction

This part of ISO/IEC 13522 provides an encoding for multimedia/hypermedia information to be used and interchanged by applications in a wide range of domains.

The design of this part of ISO/IEC 13522 has been driven by an analysis of application requirements to identify the generic aspects of these applications and incorporate them in a simple encoding.

0.1 Application domains for requirements analysis

In recent years, an explosion of multimedia applications and services has been apparent in many domains. This subclause illustrates the very wide range of audiovisual computer-based applications on which the requirements analysis has been made.

- **Training and education (also known as teletraining)**: The extension of data processing and telematics to support audiovisuals makes it a more attractive tool to educators because it improves the interface with the students. There is also a need to exchange audiovisuals between tools and to reuse audiovisuals in other applications. The audiovisuals need be structured in such a way that they can be updated, modified and personalised easily.
- **Simulation and games**: These can be made much more realistic by the use of multiple media in computer-based systems. Examples are flight and maritime simulators; these applications are highly interactive.
- **Sales and advertising**: The association of attractive audiovisuals, showing the products to best advantage, with the stock control and ordering process is a natural commercial evolution.
- **Office information systems, engineering documentation**: There is a long-standing need to be able to integrate drawings, images, audio and video into all types of office documentation. Integrated documents would also provide an attractive means of internal enterprise communication.
- **Culture**: The computer processing of audiovisual information makes it possible to extend the audience for theatres, museums and cultural events. It also opens the possibility of new art forms.
- **Electronic publishing and electronic books**: Much material that is currently published on paper could be enhanced by the integration of audiovisuals and by being available in a hypertext manner over a telecommunication network, for example, tourist guides and yellow pages, which could be a mixed sales and advertising application.
- **Public information**: The use of audiovisual interfaces makes it possible for the public to use computer-based, real-time information systems, for example, a kiosk at which information is accessed through videotex or locally from CD.
- **Computer-supported multimedia co-operative work**: There is a need to form effective teams of people who are geographically separated but have to share text, graphics, image, audio and other information, for example for remote maintenance, joint authorship or multimedia electronic mail.
- **Medical applications**: There is a need for a timely retrieval of audiovisual information, including medical images, medical data and case history, in an integrated way from a remote site. This could be a mixed co-operative work application with different medical experts.
- **Interactive television applications**: The emergence of digital television systems on terrestrial, satellite or cable networks, as well as the availability of new modulation and transmission techniques on the telephone network, creates favourable conditions for a new offer of interactive multimedia services based on the merging of television and telematics technologies, providing the users with interactive access to video documents.

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- **New classes of applications**: The widespread availability of remote access to audiovisual data processing systems open the way to new classes of applications such as interactive television, customised news programmes and archive materials.

In the following paragraphs, the specific needs of communicating multimedia/hypermedia applications from these domains are examined, leading to a list of application requirements. This set of requirements constitutes the global framework of this part of ISO/IEC 13522.

0.2 Multimedia/Hypermedia application requirements

In the various domains presented above, interactive multimedia systems are perceived to have increased impact on users through their use of image, video and audio, in addition to traditional text information.

The development of these systems is based upon support for multimedia information in the following areas:

- **Platforms**: Emerging compression standards, such as JPEG (ISO/IEC 10918) or MPEG (ISO/IEC 11172, ISO/IEC 13818), have enabled the development of dedicated hardware, which will soon be provided as a standard system resource.
- **Storage**: The increasing capacity of magnetic and optical disks, combined with compression techniques, enables the storage of increasing amounts of high bandwidth information.
- **Communication**: The increasing availability and bandwidth of digital transmission media, such as ISDN and other broadband telecommunication and broadcasting networks, enables the appropriate exchange of large amounts of data.

Using these facilities, multimedia applications are anticipated to be designed to run on heterogeneous platforms and to be interconnected to offer multimedia services.

These multimedia applications and services will use large quantities of structured multimedia objects resident in workstations, stored on digital interchange media and retrieved or distributed from remote sources through networks. These multimedia data will represent a significant investment and it is vital that the information should be applicable in a world of rapidly evolving systems and technologies. In particular, it is important that information should be interchangeable between the data structures supported by different applications.

The following application requirements can be identified:

a) multimedia database retrieval;

b) frequent updates of multimedia data;

c) manipulation of a set of data elements;

d) creation of multimedia documents on a range of workstations;

e) composition of multimedia data in time and space;

f) ability to link part of a document with some other part of the same or another document in an open hyperdocument environment;

g) synchronisation:

   1) elementary synchronisation: two objects are synchronised with regard to the same reference origin time (parallel mode) or one with regard to the other (sequential mode);

   2) chained synchronisation: a set of objects are presented one after another in the form of a chain;

   3) cyclic synchronisation: one or more objects are repetitively presented;

   4) conditional synchronisation: the presentation of an object is linked to the fulfilment of a condition;

h) reuse of multimedia data by integration in different documents;

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i) exchange of multimedia data between heterogeneous systems;

j) space wide range of users, including closed user groups;

k) real-time interactivity, including acquisition of multimedia data;

l) telecommunication of multimedia data;

m) broadcast of multimedia data;

n) wide range of data volumes and transfer rates;

o) access control, security;

p) tariffing;

q) copyright, licensing;

r) wide range of support materials;

s) use of a wide range of terminals and workstations, including devices with minimal resources;

t) minimal resources: facilities that the interchange form must provide in order for a given set of objects, running in limited resources environments, to meet their functional specification as determined by the designer:

   1) ease of specification: for specifying the minimum recommended resources needed by an MHEG application;

   2) ease of application: minimum requirements of an application should be easily recognised by the negotiation process;

   3) flexibility: the mechanism should be reliable across a broad range of system configurations and media formats;

   4) informative rather than restrictive: the using application should have the final determination as to whether a given set of objects can be interpreted;

   5) extensible/open: the representation should function correctly as new formats, classes, and application-dependent parameters are added;

   6) scalability: trade-off among different application platform capabilities, for example, resolution enhancement relative to presentation time;

   7) composition: the minimum resource requirements for a given MHEG application should be combinable in some consistent and predictable manner when applications are combined;

   8) graceful degradation: the primary concern of minimal resource systems is the manner in which degradation can be handled; an application should be able to express its policy with regard to this issue, for example, by using scalability and related mechanisms;

u) real-time interchange and presentation:

   1) object placement optimisation: objects that are likely to be accessed simultaneously are adjacent from the standpoint of the access mechanism;

   2) progressive access of objects: images may be retrieved and presented in increasing resolution for systems with significant presentation delay; scalable versions of objects may be represented and retrieved for systems with insufficient resources for full fidelity presentation;

   3) partial object retrieval: large objects may be retrieved in several portions, since the entire content is not presented at one time;

   4) object sequencing: the order in which objects are expected to be presented should be used by the access mechanism when insufficient throughput would lead to unacceptable delays for the whole object to be interchanged;

   5) separate retrieval of object description and object content: the object description should be retrieved without necessarily retrieving the content so that the system can use information about a set of objects to optimise the access for this set and resources needed for the access can be prepared;

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6) global object index: a table of all objects and their position in an object set should be provided to support fast lookup of objects;

7) object interleaving: objects that are to be retrieved simultaneously may be interleaved so that large objects do not cause delays for other objects;

8) resource requirements: that for retrieval and presentation by the target system should be available by lookup rather than by derivation;

9) aggregate retrieval: a collection of objects can be aggregated so that they can be retrieved by one step rather than through a series of requests;

v) ability to reference individual media objects internally and externally;

w) ability to navigate in a hypermedia fashion;

x) ability to support arbitrary hyperlink transversal schemes.

These requirements can be summarised in a set of generic needs:

- Application designers and vendors require application portability in a multi-vendor environment.
- Applications need handle multimedia information structured in such a way that real-time interactivity (including acquisition of multimedia data), as well as real-time interchange of multimedia data can be ensured.
- Applications need compose and synchronise multimedia data in space and time.
- Applications need be able to define links between multimedia data elements.
- Applications need be able to reuse multimedia data by integration in different contexts.
- Applications need be able to frequently update the multimedia data, as well as to manipulate a set of data elements.
- Applications need be able to be interpreted on different systems, from minimal resources to non-limited resources systems.
- Applications need be interchanged and presented in real-time.

These requirements have been taken into account in defining the standard for multimedia and hypermedia information.

0.3 Rationale for standardisation of multimedia and hypermedia information

The rationale for a standard defining multimedia and hypermedia information structures is based on the following considerations.

- Standardisation only at the level of monomedia information is not sufficient to guarantee application portability. Applications do not use the monomedia data separately but must define an associated set of parameters that are necessary for presentation. (Such parameters may include identification of the encoding algorithm applied to the data, decoding parameters relevant to the data, optional attributes to be used for presentation).
- Standardisation only at the level of monomedia information is not sufficient for the design and interchange of multimedia and hypermedia information. Multimedia and hypermedia applications rely on abstractions or data structures that provide features such as synchronisation links and logical links between monomedia data.
- The design and management of multimedia and hypermedia applications in distributed environments is eased if the internal details of the information presentation are masked from the application by the use of appropriate abstractions. The application should deal only with functions such as management of information distribution, scheduling of presentation, management of the user dialogue, and other high-level activities.

This part of ISO/IEC 13522 aims to provide generic multimedia/hypermedia information structures that fulfil these requirements and additionally are suited to:

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0.4.3 Minimal resources

This part of ISO/IEC 13522 supports the specification of the minimal resources required to present the encoded data and provides facilities for the interchange of information relating to these resources, which is provided by the information source.

0.4.4 Real time

This part of ISO/IEC 13522 eases the real-time interchange of multimedia information and provides facilities to assist a using system to achieve an adequate information flow.

0.5 Concepts of this part of ISO/IEC 13522

This subclause provides a general introduction to the concepts of this part of ISO/IEC 13522. The following concepts are presented:

- **MHEG classes, MHEG objects**: this part of ISO/IEC 13522 defines object classes. From these classes, MHEG objects may be instantiated by the object designer (e.g. a computer program) and interchanged between using applications. Any number of MHEG objects may be instantiated from a given MHEG class.
- **Run time objects (rt-objects)**: The MHEG model class is an MHEG abstract class, which provides the following MHEG classes: script, content, multiplexed content, and composite classes. From these model classes, model objects may be instantiated by the object designer and interchanged. In order to reuse the data interchanged in the model objects in different contexts, the object designer can to create run-time objects, also called rt-objects, from a given model object: for example, the same data in a content object may be presented twice at the same time with different sizes using two rt-content objects, but the content object is interchanged only once. Any number of rt-objects may be created from a given model object by the object designer.
- **Channels**: this part of ISO/IEC 13522 defines logical spaces in which the rt-objects are presented and perceived by the user.

0.5.1 Object orientation

This part of ISO/IEC 13522 defines a classification of structures corresponding to units of multimedia/hypermedia information to be interchanged. This classification is based on an analysis of the common behaviour and properties of multimedia/hypermedia information and takes the form of an object-oriented approach to the specification. This approach results in autonomous and reusable information structures that are generic to multimedia/hypermedia applications.

In the context of this part of ISO/IEC 13522, the term "class" denotes a structure of interchangeable multimedia/hypermedia information from which MHEG objects can be instantiated. This part of ISO/IEC 13522 uses the object-oriented mechanism of deriving subclasses from existing ones, together with the associated concept of inheritance.

The use of an object-oriented approach for the definition of MHEG structures does not imply that a system interpreting these structures must be based upon this approach. While this part of ISO/IEC 13522 defines an interchange format for multimedia/hypermedia information, it makes no assumptions about the internal representation of MHEG structures or the design of systems, engines, interpreters, tools, or using applications.

The MHEG classes contain a level of complexity that is appropriate for use as generic structures in a wide range of using applications and domains. It is assumed that the semantics associated with the use of MHEG classes are defined at the application level and not at the level of this part of ISO/IEC 13522. When using applications interchange multimedia/hypermedia information, they usually rely on interchange services, which provide the appropriate support for the interchange of data. There are various levels of complexity of data interchange, as shown in Figure 0.2.

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- real-time presentation, i.e. using multimedia presentation and synchronisation facilities available on the application platform;
- real-time interchange, i.e. using communication facilities available on the application platform;
- final-form representation, i.e. in which the information is represented and coded for direct presentation without requiring additional processing of its structure.

0.4 Objectives of this part of ISO/IEC 13522

0.4.1 Interchange

This part of ISO/IEC 13522 provides interchange facilities for various media types. The media data may be encoded according to other international standards, e.g. JPEG for still image, MPEG for video, or may be encapsulated using private or proprietary coding techniques. The interchange units defined by this part of ISO/IEC 13522 are handled by the MHEG engine under the control of a using application.

In order to support multimedia interchange, as opposed to the interchange of multiple media, this part of ISO/IEC 13522 provides structures for the composition of different media types within a single unit of interchange.

0.4.2 Presentation

This part of ISO/IEC 13522 supports final-form presentation of multiple media types. This part of ISO/IEC 13522 provides facilities for the identification of the coding technique to enable the use of the appropriate presentation resources on a specific platform.

In order to support multimedia presentation, as opposed to the presentation of multiple media, this part of ISO/IEC 13522 provides structures for the composition of different media types in a presentation. This composition takes the form of time sequencing, spatial positioning, and logical interaction among the media.

In addition, this part of ISO/IEC 13522 supports interaction with and modification of media data and its associated presentation attributes, e.g. size, position and volume.

Figure 0.1 illustrate the use of this part of ISO/IEC 13522 as an interchange unit and as an identifier of multimedia information encoded according to several International Standards.

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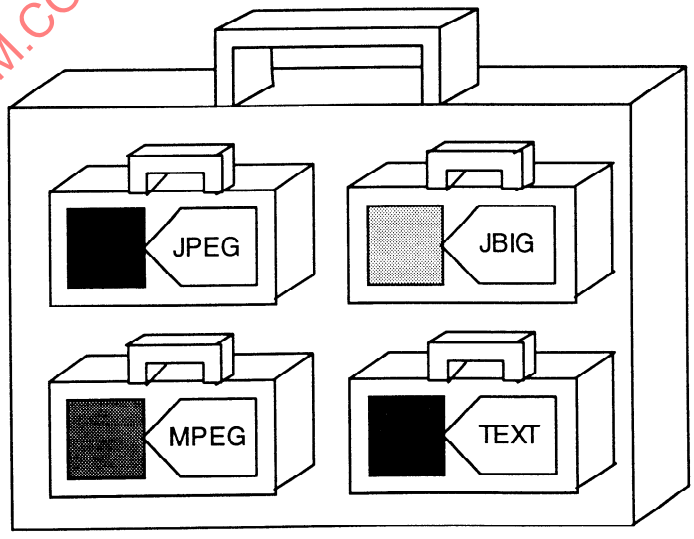

Figure 0.1 - This part of ISO/IEC 13522 for interchange and identification of multimedia information

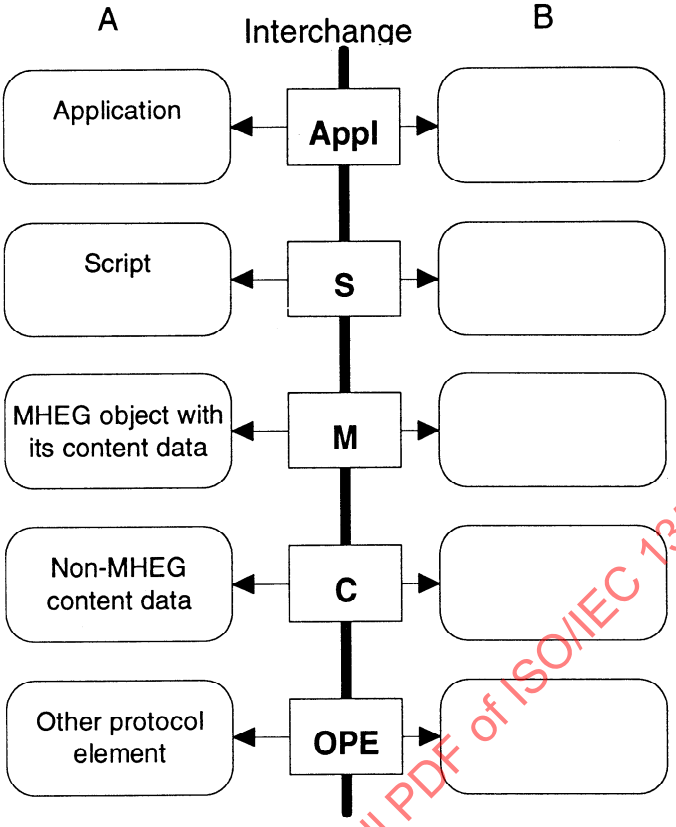

Figure 0.2 - Multimedia/hypermedia interchange model

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In Figure 0.2, applications A and B may be see clausen as a single application by the user.

Figure 0.2 shows interchange between using applications A and B and identifies the levels at which this interchange takes place.

- Application level: This exchange (Appl) is not covered by this part of ISO/IEC 13522. The using application may make use of a script interchange standard at the next lower layer.
- Script level: This exchange (S) is covered by ISO/IEC 13522-3 and other standards for hyperdocument and scriptware interchange and may make use of the MHEG object interchange Standard at the next lower layer.
- MHEG object level: This exchange (M) is the subject of this part of ISO/IEC 13522. It makes use of recommendations and standards for the interchange of content data.
- Non-MHEG content or script data level: This exchange (C) is covered by this part of ISO/IEC 13522-3 for script data and is addressed by individual monomedia recommendations and standards for other content or script data.
- Other protocol element level: This exchange (OPE) of elements such as messages and acknowledgements is required by the application but is not addressed by this part of ISO/IEC 13522.

This model also shows the need to address the binding of the application to the MHEG objects and of MHEG objects to the content and script data.

0.5.2 Encoding

This part of ISO/IEC 13522 provides a coded representation of each MHEG class. Instances of these coded representations are MHEG objects and represent the data interchanged and presented by multimedia/hypermedia applications.

The base coded representation makes use of ISO/IEC 8824 "Specification of Abstract Syntax Notation One" (ASN.1) and ISO/IEC 8825 "Specification of Basic Encoding Rules for ASN.1" and is described in this part of this part of ISO/IEC 13522.

Alternative coded representations may be provided. Their coded representation should be isomorphic to the base-coded representation. These different notations and encoding schemes are alternatives used to express the same and unique representation of the MHEG objects.

0.5.3 Overview of the MHEG classes

The classes defined in this part of ISO/IEC 13522 can be used to specify:

- objects containing media information;
- relationship between objects;
- dynamic behaviour of objects;
- information to optimise the real-time handling of objects.

The instantiable classes described in the next subclauses are defined by this part of ISO/IEC 13522:

0.5.3.1 Content class

The content class is a model class; it encapsulates or refers to the coded representation of media information together with a parameter set containing information required for content presentation. This parameter set includes an identification of the coding method and a field for the specification of application-oriented parameters (e.g. fonts and colour table). The content class also specifies the original size, duration and volume of the data. These values are expressed using generic space and temporal units. From the content class, the multiplexed content object is derived; content objects that are not multiplexed are called pure content objects or non-mux content objects.

0.5.3.2 Multiplexed content class

The multiplexed content class is a model class that is a sub-class of the content class. It encapsulates or refers to the coded representation of multiplexed media data together with a description of each multiplexed stream.

0.5.3.3 Composite class

The composite class is a model class; it provides support for associating multimedia and hypermedia objects. This mechanism provides a consistent approach to the linking and synchronisation in time and space, of a set of objects. This class also provides a logical structure to describe the list of possible interactions offered to the user, but does not define the interaction facilities provided by the user interface. Such interaction may be achieved in a variety of ways, e.g. graphical user interface and keyboard. This part of ISO/IEC 13522 does not define the look and feel of multimedia interactive presentations, nor does it propose to change or add concepts to those existing in typical graphical user interfaces. As this part of ISO/IEC 13522 is generic and independent of platform and implementation, it describes interaction at a virtual level. It is up to a using application to apply these mechanisms using its specific look and feel.

0.5.3.4 Action class

This part of ISO/IEC 13522 provides an initial behaviour for each MHEG object, run-time object (rt-object), and channel, e.g. default position of an rt-content. It provides also a means to modify the initial behaviour of each object by defining a list of elementary actions to be applied to the objects. The modification of the behaviour is achieved by interchanging the corresponding elementary actions within action objects. The action objects are used within a link object to describe the link effect.

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The action class defines a structure that specifies a synchronised set of elementary actions to be applied to one or more targets.

0.5.3.5 Elementary actions

This part of ISO/IEC 13522 defines elementary actions that can affect the following behaviours of an MHEG object, an rt-object or a channel.

- **Preparation:** Actions are provided to control the availability of MHEG object in the system. For example, the Prepare and Destroy actions may be applied to add and remove an MHEG object from the system.
- **Creation of run-time objects (rt-objects):** The New action is provided to create rt-objects (rt-script, rt-component) from a model object (script, component); the Delete action is provided to destroy rt_objectc.
- **Presentation:** Actions are provided to control the progress of rt-components in the system. For example, the Run and Stop actions may be applied to control the progression of a time-based rt-component.
- **Rendition:** Actions are provided to control the projection of an rt-component on to the system. These actions vary according to the media type. For example, the Set GTF action changes the presentation speed for time-based media and Set OVS action changes the presentation size for visible media.
- **Interaction:** Actions are provided to control the results of interaction with an rt-component in the system. For example, Set Interaction Ability action specifies the selectability and the modifiability of an rt-component.
- **Activation:** Actions are provided to control the activation of rt-scripts in the system. For example, the Run and Stop actions.

0.5.3.6 Get actions

This part of ISO/IEC 13522 also defines a means to retrieve the behaviour of an MHEG object, an rt-object or a channel. Actions are provided to get the behaviour attribute or status value of MHEG objects, rt-objects and channels. These actions are called "get actions". The result of a get action is either a generic value or the value "undefined" when an error condition occurs. The get actions are used to express the source and the comparison value of the link condition in a link object or as any parameter of an elementary action.

0.5.3.7 Link class

The link class defines a structure that specifies a set of relationships. Each relationship is defined between one or more sources and one or more targets. The relationship is composed of conditions associated with the sources (link condition) and actions to be applied to the targets (link effect). The actions, which are described in action objects, are to be applied to the targets when the conditions are satisfied.

The source and targets can be instances of any MHEG class, including link class and action class. The source and targets can also be any run-time objects.

Instances of the link class are used to specify the time sequencing, spatial positioning, or logical interaction between MHEG objects and run-time objects.

0.5.3.8 Script class

The script class is a model class. It defines a container for complex relationships between MHEG objects, run-time objects and channels, specified in a script representation. This part of ISO/IEC 13522 does not define the script representation itself but provides the script class to encapsulate a script and an indication of the representation used.

It is assumed that the script representation used in a script object is able to reference MHEG objects, rt-objects, and channels, and also to access their attributes. This part of ISO/IEC 13522-3 defines an interface to MHEG entities for this purpose and defines a script interchange format.

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0.5.3.9 Descriptor class

The descriptor class defines a structure for the interchange of resource information about one or several other interchanged objects. The described objects are called "related" objects. The information can be used to facilitate matching between the resources required to present the objects and the resources available to the system, or to perform a negotiation between the source of the MHEG objects and the presentation site.

0.5.3.10 Container class

The container class provides a means to group multimedia and hypermedia data in order to interchange them as a whole set.

0.5.4 Run-time objects (rt-objects)

For the purpose of reusing model objects (script, component objects) in different presentations or activations, a clear separation is made between the interchanged model object, which contains the reusable data or composition, and the rt-object corresponding to a specific view of the model data or composition.

The rt-objects (rt-script, rt-content, rt-multiplexed content, and rt-composite objects) are created by the object designer using the MHEG action New. The presentation or activation of an rt-object does not affect the model object; this allows reuse of same model object in different rt-objects.

0.5.5 Channels

A channel is a logical space in which the rt-components (rt-content and rt-composite objects) are presented and perceived by the user. The channels are created by the object designer using an MHEG action. The object designer may provide information in the descriptor object to help the MHEG engine map of the logical channels to the real world.

0.6 The MHEG application interface

This part of ISO/IEC 13522 does not define an Application Programming Interface (API) for the handling of objects in a system. However, it is assumed that the MHEG engine provides the using application with the way to use the actions defined in ISO/IEC 13522-1.

0.7 Extensibility of this part of ISO/IEC 13522

The scope of the classes defined in this part of ISO/IEC 13522 is compatible with their use in a wide range of applications and domains. It is recognised that certain applications may require specific functionality not directly provided by the classes, e.g. a using application may require the use of specialised resources available on a given platform. In this case, additional resources, which are not provided directly by this part of ISO/IEC 13522, may be associated with the MHEG objects. This association is defined using one of the following techniques, whose use does not impact the coded representation of the facilities defined by this part of ISO/IEC 13522.

The following provisions may be extended (see clause 15):

- extension of elementary actions;
- extension of attributes of an MHEG object, an rt-object or a channel;
- extension of data types, classifications, styles, events, channel media types;
- addition of new object classes.

NOTE: This facility may be used for example to create and manipulate new attributes such as payment or colour, or to vary some speech modulation parameter in an audio object.

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For 1) through 3), a registration procedure and catalogues are provided by the part 4 of this part of ISO/IEC 13522. This may be used to define extensions without significant reduction of portability. This extension allows users to use proprietary or registered catalogues (see clause 14 and 15.1). An MHEG engine may take any catalogue entry into account and thereby introduces the new extension process; another MHEG engine with no extensions may ignore the extension.

The addition of new object classes implies an appropriate adaptation of MHEG engine for interpretation of the new classes, which limits the usage of MHEG objects of these classes to that MHEG adapted engine.

0.8 Liaisons

This part of ISO/IEC 13522 interfaces with a variety of multimedia applications and is consistent with other International Standards and recommendations developed in ISO and ITU-T.

ISO/IEC JTC1/SC29/WG12 maintains active liaison with those working groups of ISO and ITU-T who are engaged in multimedia/hypermedia standardisation. See the foreword for further details.

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Information technology - Coding of multimedia and hypermedia information -

Part 1:
MHEG object representation - Base notation (ASN.1)

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1 Scope

This part of ISO/IEC 13522 specifies the coded representation of final-form multimedia and hypermedia information objects that are interchanged as units within or across services and applications, by any means of interchange (e.g. storage, local area network, wide area telecommunication, broadcast telecommunications or broadcast networks). These objects, called MHEG objects, define the structure of a multimedia presentation.

These objects provide the following functionalities:

- final-form representation,
- systems with minimal resources,
- interactivity and multimedia synchronisation,
- real-time presentation,
- real-time interchange,

as a common base for many multimedia and hypermedia applications.

This part of ISO/IEC 13522 defines:

- the specifications of the MHEG objects without regard for the underlying representation coded representation,
- the base-coded representation, using the ASN-1 representation.

(Other types of coded representation may be specified in other parts of ISO/IEC 13522.)

1.1 Specificity of the scope

Since it is expected that a wide range of recommendations, standards, and using applications will be users of this part of ISO/IEC 13522, the scope focuses on the generic structuring aspects. This part of ISO/IEC 13522 recognises the semantics implied by the specification of the MHEG objects but does not enforce any semantic interpretation by the using application.

1.2 Issues outside the scope of this part of ISO/IEC 13522

The scope excludes any standardisation of models, services, systems, protocols or applications that make use of MHEG objects. Integration of MHEG objects within these models, services, systems, protocols or applications, or interworking, may be defined by other standards.

The coded representation of content data is not in the scope of this part of ISO/IEC 13522.

2 Conformance

The conformance is evaluated on interchanged objects. There is no consideration of conformance for a system, an engine or a process.

An interchanged object is conformant if it can be correctly interpreted. This means that:

- its ASN.1 encoding is correct (conformance of the concrete syntax);
- its ASN.1 notation is conformant to the grammar specified in this part of ISO/IEC 13522 (conformance of the abstract syntax).

A conforming MHEG decoder shall recognise and decode all MHEG objects as defined in this part of ISO/IEC 13522.

2.1 Profiles

Profiles may be provided by other parts of ISO/IEC 13522 or the using applications.

2.2 Syntax

Conformance is on the base representation. An MHEG object instance shall be represented using the ASN.1 notation defined by this part of ISO/IEC 13522.

Conformance at the level of the coded representation is ensured by the use of ISO/IEC 8825-1 for the encoding of the syntax.

2.3 Semantics

This part of ISO/IEC 13522 provides an encoded representation for expressing an expected behaviour of objects, such as relationship in time and space, but does not define techniques to handle such relationships among the objects.

3 Normative References

The following standards contain provisions which, through reference in this text, constitute provisions of this part of ISO/IEC 13522. At the time of publication, the editions indicated are valid. All standards are subject to revision, and parties to agreements based on this part of ISO/IEC 13522 are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

- ISO/IEC 8824-1:1994, *Information technology - Abstract Syntax Notation One (ASN.1): Specification of basic notation.* (Corresponds to ITU-T Rec. X.680.)
- ISO/IEC 8824-1:1995 Amd.1:1996, *Information technology - Abstract Syntax Notation One (ASN.1): Specification of basic notation - Amendment 1: Rules of extensibility.* (Corresponds to ITU-T Rec. X.680/Amd.1.)
- ISO/IEC 8824-2:1995, *Information technology - Abstract Syntax Notation One (ASN.1): Information object specification.* (Corresponds to ITU-T Rec. X.681.)

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- ISO/IEC 8824-2:1995 Amd.1:1996, *Information technology - Abstract Syntax Notation One (ASN.1): Information object specification - Amendment 1: Rules of extensibility.* (Corresponds to ITU-T Rec. X.681/Amd.1.)
- ISO/IEC 8825-1:1995, *Information technology - ASN.1 encoding rules: Specification of Basic Encoding Rules (BER), Canonical Encoding Rules (CER) and Distinguished Encoding Rules (DER).* (Corresponds to ITU-T Rec. X.690.)
- ISO 8879:1986, *Information processing - Text and office systems - Standard Generalized Markup Language (SGML).*
- ISO/IEC 9070:1991, *Information technology - SGML support facilities - Registration procedures for public text owner identifiers.*
- ISO/IEC TR 9573:1988, *Information processing - SGML support facilities - Techniques for using SGML.*

4 Definitions

For the purposes of this part of ISO/IEC 13522 the following definitions apply:

- The definitions of ISO/IEC 8824:1995 and ISO/IEC 8825:1995,
- The definitions of ISO 8879:1986,
- The definitions of ISO/IEC 9070:1991,
- The definitions in this clause.

4.1 abstract class: An MHEG class that cannot be instanciated, i.e. has no interchanged objects. An abstract classe encapsulates information and provides inheritance of attributes in its sub-classes, and also acts as a mechanism for specifying which MHEG actions may be applied to which MHEG classes.

4.2 action: An elementary action or a get action.

4.3 action effect: Concatenation of the MHEG effect and the user effect for all elementary actions. For get actions, it is equal to the MHEG effect.

4.4 action object: An instance of an MHEG class that defines an organised set of elementary actions.

4.5 activate, (active): An elementary action that causes a link object to become active, i.e. only an active link can be fired.

4.6 alias: An attribute that may be associated to an MHEG entity, data or stream. It is used as an alternative identification.

4.7 anchor: A content object containing anchor information rather than media data. Anchor information is used to position an anchor against a hub document.

4.8 attribute: A typed value representing some characteristics of an interchanged MHEG object, an rt-object or a channel.

4.9 author, object designer: A computer program or other devices used to generate objects by mechanical or electronic means.

4.10 channel: A logical device in which rt-components are positioned for final presentation. Channels are mapped by an MHEG engine to physical devices like screen windows or loudspeakers for making the rt-objects within them perceivable by the user.

4.11 coded representation: The binary representation of the structure and data within an object instance.

4.12 component object: An instance of an MHEG class that represents a content object, a multiplexed content object, or a composite object.

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4.13 composite object: An instance of an MHEG class that defines a list of composition elements grouped for presentation. The presentation of a composite object consists of the presentation of its composition elements.

4.14 composition elements: An attribute of the MHEG composite class that defines the presentation and the subhierarchy of the composite object.

4.15 constraint condition: A part of a link condition describing an attribute and a status value. It is referred to an additional condition if trigger conditions within a same link are satisfied.

4.16 container object: An instance of an MHEG class that defines a list of objects grouped for interchange. It provides a means to group objects without specifying any specific relationship.

4.17 content object: An instance of an MHEG class that provides a consistent structure for the interchange of encoded generic value or any presentation data. It may be either a non-mux-content or a multiplexed content.

4.18 data: An attribute of the content and script classes.

4.19 default channel: A channel that is always available to the MHEG engine using a reserved identifier (that is; "Default-Channel"). The elementary actions "New channel" and "Delete channel" are ignored for the default channel. When a root rt-component is not assigned to a specific channel, it is implicitly assigned to the default channel.

4.20 delete, delete channel, (not available): An elementary action that removes an rt-object or a channel from the MHEG engine. The rt-object or the channel is said to be not available.

4.21 demultiplex: A means to extract two or more streams of information from a single combined encoding scheme to achieve separate presentation or exchange.

4.22 descendant: Any MHEG entity contained in the subhierarchy whode root is the initial object.

NOTE 1: A graph of descendancy may contain loops. An entity may be a descendant of itself.

4.23 descriptor object: An instance of an MHEG class that defines the associated information associated to any object. A using application may use this object to negotiate characteristics of MHEG engines.

4.24 destroy, (not ready), (not available): An elementary action that removes an MHEG object from an MHEG engine. The object is said to be not ready or not available.

4.25 elementary action: Used to modify the behaviour of an MHEG entity within the MHEG engine. Elementary actions are interchanged within action objects. An elementary action is typically composed of a target set, specific parameters defined for each elementary action, and an optional transition duration.

NOTE 2: Examples of elementary actions: Prepare (target set), Run (target set, number of performances).

4.26 empty socket: A socket into which no rt-component has been plugged.

4.27 event: A signal generated by some system components or the MHEG engine, e.g. key stroke, mouse movement.

4.28 final form: An interchange form intended for presentation without requiring change of the structure of the objects.

4.29 fire a link: Each time a link condition of an active link is satisfied, the link is fired, i.e. its link effect is processed.

4.30 generation: A composite object has several sockets where component objects are attached. These component objects have the sibling relationship. Therefore, a composite object is said to define one generation of component objects. Several generations may be made if other composite objects are attached in the sockets. As an rt-composite is created from a composite object, an rt-composite also defines some generations.

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4.31 generic value: One of generic boolean, generic numeric, generic integer, generic ratio, generic string, generic reference, or generic list. It may be a constant or an evaluated value.

4.32 get action: Targeted to an MHEG entity and specifies the requested attribute or status value to be evaluated. The effect of a get action is to provide a generic value. This generic value is used in the context of the evaluation and is a local value. If the same get action is processed in two different links in parallel, there are two generic values resulting from these two evaluations. These two generic values may be different. A get action can be used and interchanged when a value is allowed, for example, as a parameter of an elementary action or a get action, as a source value or comparison value in a link object.

NOTE 3: Examples of get actions: Get Preparation Status (target) and Get Running Status (target).

4.33 hook: An attribute of the content class and script class that contains encoding and decoding information enabling the use of data. The semantics of these parameters are not defined by ISO/IEC 13522-1 but are given by the semantics of the data encoding standard or recommendation.

4.34 hypermedia: Featuring the ability to access monomedia and multimedia information by navigating across links.

4.35 interchange attribute: An attribute of an interchanged MHEG object.

4.36 interchange medium: The medium used to interchange data: it may be a storage medium, a transmission medium, or a combination.

4.37 interchange value: The value of an interchanged attribute.

4.38 label: A generic string that is associated with an element of a composite. When an rt-composite is created from the composite object, an rt-content is created from this label and automatically plugged into a corresponding socket.

4.39 link condition: Conditions to be satisfied in order to fire a link. It is composed of some trigger conditions, some constraint conditions and some logical operators between them.

4.40 link effect: Effects of a link when it is fired. It is composed of some elementary actions and/or some action objects.

4.41 link object: An instance of an MHEG class that defines spatio-temporal or conditional relationship among MHEG entities. A link object is composed of a link condition and a link effect.

4.42 macro action: An action object that offers the facility to replace the parameters in frequently used action objects.

4.43 macro link: A link object that offers the facility to replace the parameters in frequently used conditional actions.

4.44 macro parameter: A parameter of an action or an attribute of the action class that is replaced by the following information: a macro definition identifier and a default macro usage value.

4.45 macro usage value: Within the link effect of a link object, a usage value may be provided for each macro parameter used within the link effect. This assignment is processed when the link is fired.

4.46 medium (plural media): A means by which information is perceived, expressed, stored, or transmitted.

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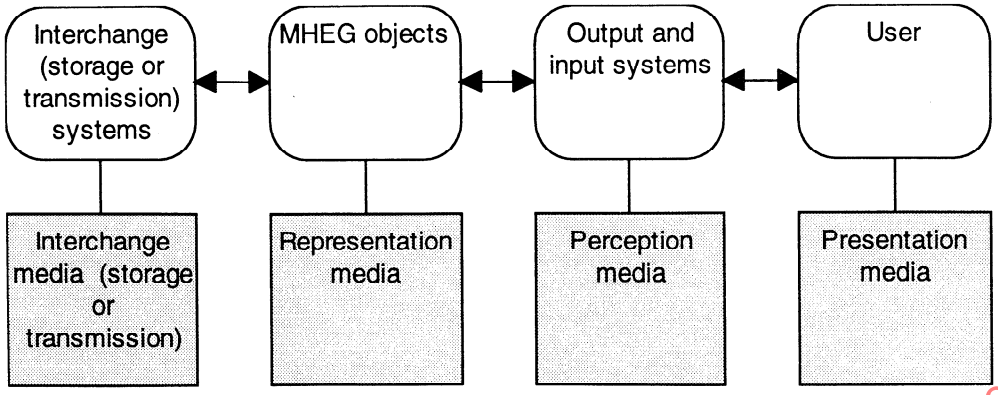

Figure 1 - Relationships between the different meanings of media

NOTES

4: Figure 1 is intended to clarify the relationship between the different meanings of the term "media". Representation and presentation media are to be differentiated for virtuality and portability (device independence) purposes. A given character string (coded representation) can be presented using different means (screen, paper, loudspeaker after text-to-speech synthesis). The same command can be input by the user through different equivalent means (for example, selection in a list with a mouse, a touch screen, with digits + validation key, with a keyboard to input the corresponding character string, or even through a microphone with a voice recognition system allowing recognition of a limited vocabulary including the name of the above-mentioned command.).

5: This is a weak definition because this term has different meanings depending on the context. Thus, the term should be avoided in its stand-alone form. To be unambiguous, it should be only used in expressions such as perception medium, representation medium, presentation medium, storage medium, transmission medium.

4.47 mh object class: An MHEG object class that is the root of MHEG class hierarchy. It defines attributes common to all other MHEG classes.

4.48 mheg class: An MHEG object class defined by ISO/IEC 13522-1.

4.49 mheg effect: The effect caused by the processing of an elementary action or a get action, which changes or retrieves some internal state.

4.50 mheg engine: A virtual entity that processes and interprets MHEG objects encoded according to the encoding specifications of ISO/IEC 13522-1.

NOTE 6: How to implement the MHEG engine is outside the scope of ISO/IEC 13522-1. ISO/IEC 13522-1 does not define any ingredients inside the MHEG engine.

4.51 mheg entity, entity: Any MHEG object, rt-object or channel.

4.52 mheg object: A coded representation of a multimedia and/or hypermedia object that conforms to ISO/IEC 13522-1.

4.53 minimal resources: A system with minimal buffering capacity, minimal throughput of communication channels, limited computational power.

4.54 model object: An instance of an MHEG class that represents a script object or a component object.

4.55 multimedia representation: The property of handling several types of representation media.

NOTES

7: The term multimedia is an adjective; it should be used attached to a noun that provides the context (e.g. multimedia service or application, multimedia terminal, multimedia network, multimedia presentation).

8: In ISO/IEC 13522-1, multimedia is used in the sense of multiple representation media. Hence, a remote processing service or videotex, using a keyboard and a textual display, is not multimedia, as the interaction involves only one medium (text).

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9: An MHEG object within a multimedia service or application need not contain several representation media.

4.56 multiplex: A means to combine two or more streams of information into a single encoding scheme to achieve simultaneous presentation or exchange.

4.57 multiplexed content object: An instance of an MHEG class that provides a single consistent structure for the interchange of any multiplexed presentation data.

4.58 new, new channel, (available): An elementary action which causes an rt-object or a channel to become available to the MHEG engine for further processing (e.g. presentation). The rt-object or the channel is said to be available.

4.59 non-mux content object: A pure content object, i.e. a content object that is not a multiplexed content object.

4.60 null: A specific value indicating nothing

4.61 null data: Null data are generated by the MHEG engine when referenced by the use of a reserved identifier: "Null-Data". Null data may replace any kind of data. Actions performed on an rt-script/rt-content made from a script object/content object with null data are not ignored. The user effect of such an action is defined by the hook and classification information provided in the model object.

4.62 null mheg object: A null object is generated by the MHEG engine when referenced by the use of a reserved identifier: "Null-Mh". The null object may replace any object of any MHEG class. An action performed on a null MHEG object causes a null effect.

4.63 null root rt-object: A null root rt-object is generated by the MHEG engine when referenced by the use of a reserved identifier: "Null-Root-Rt". The null root rt-object may replace any root rt-object. An action performed on a null root rt-object causes a null effect.

4.64 object: A finite, independent, self-defining piece of information that is manipulated as a whole by MHEG engines and interchanged as one unit.

NOTES

10: Within the context of ISO/IEC 13522-1, the object can be of multiple types (e.g. action, link, script, content, composite, descriptor, or container object).

11: "Self-defining" implies that the object contains or refers to the information necessary for its handling.

12: The definition is not restricted to digitally-coded objects, but may also be applied to analogue objects (e.g. a videodisk sequence).

4.65 object class: Any category of objects that have a specific and homogeneous template (i.e. characteristics and behaviour as relevant to the contained information and to their actions modifying their behaviour).

4.66 parent-child relationship: A relationship that exists when the parent object is a composite object that contains or refers to a child object.

4.67 perception medium: The nature of the information as perceived by a human being (e.g. speech, noise, music, text, drawings, moving, scenes).

4.68 plug: An elementary action that attaches an rt-component into a socket.

4.69 prepare, prepared, (ready): An elementary action that causes an object to become available to the MHEG engine for further processing (e.g. presentation). The object is said to be prepared or ready.

4.70 presentation: The rendition of an rt-component to be perceived by a user.

4.71 presentation media: The means used to reproduce information to a user using an output device (e.g. screen, paper, printer, loudspeaker) or to acquire information from a user using an input device (e.g. keyboard, mouse, microphone, camera).

4.72 presentation space: The space used to present rt-components to the user. It consists of a temporal axis, three dimensional spatial axes and an audible volume range.

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4.73 projection: A presentation space of a socket may be mapped into the presentation space of its parent or a channel presentation space, changing its temporal position, size or volume. The mapping is called projection. A root rt-component is always projected into a channel presentation space. A number of elementary actions are used to achieve such projection.

4.74 real-time interchange: The interchange of objects among systems within deadlines needed to satisfy the presentation schedule. This implies a constant limited delay. Specifically, time-based media and time-synchronised objects have presentation requirements that are not necessary satisfied by buffering.

4.75 real-time presentation and interaction: The ability to present objects within a limited dead-line. Intrinsically time-based (e.g. audio, video) objects or objects that have time-behaviour or time-constraints (e.g. synchronisation) are concerned.

4.76 real-time system: In the context of certain media (e.g. audio, video), real time implies a presentation that meets the original time base requirements.

4.77 render: Tto show a certain object in a specific way to the user. A number of elementary actions are used to achieve specific rendering.

4.78 representation medium: The type of the interchanged data that defines the nature of the information as described by its coded form.

EXAMPLE: representation media information and their possible coded forms:

Characters or text: Telex, ASCII, EBCDIC.

Graphics: CEPT, NAPLPS or CAPTAIN videotex, CGM.

Audio: ITU-T G711, MIDI, MPEG Audio.

Still picture: Fax group 3, JBIG, JPEG.

Audio visual sequence: MPEG, CCIR Rec. 601 plus associated audio.

NOTE 13: The representation medium is defined independently of the direction of interchange (i.e. to or from the user or between equipments). Each representation medium may be used for both input or output, e.g. character-type representation may be used for both text display and text input from a keyboard; graphics-type representation may be used for both graphic display and graphic input (location) from a mouse. Audio-type or picture-type representations may be used both for display and capture.

4.79 representation of an object: A description of the object structure and its contents.

4.80 root rt-component: A non plugged rt-component. A root rt-component addresses either a root rt-composite or a root rt-content.

4.81 root rt-composite: An rt-composite that is not plugged.

4.82 root rt-content: An rt-content that is not plugged. A root rt-content addresses either a root rt-non-mux or a root rt-mux.

4.83 root rt-mux: An rt-mux that is not plugged.

4.84 root rt-non-mux: An rt-non-mux that is not plugged.

4.85 rt-component: An rt-component in an rt-objects created from a component object.

4.86 rt-component socket: A socket in which an rt-component is plugged. An rt-component socket addresses either an rt-composite socket or an rt-content socket.

4.87 rt-composite: A run-time object created from a model composite object. The elements of an rt-composite are called sockets. An rt-composite addresses either a root rt-composite or an rt-composite socket.

4.88 rt-composite socket: An rt-composite that is plugged.

4.89 rt-content: A run-time object created from a model content object. An rt-content addresses either a root rt-content or an rt-content socket.

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4.90 rt-content socket: An rt-content that is plugged. An rt-content socket addresses either an rt-non-mux socket or an rt-mux socket.

4.91 rt-mux: A run-time content created from a model multiplexed content object. An rt-mux addresses either a root rt-mux or an rt-mux socket.

4.92 rt-mux socket: An rt-mux that is plugged.

4.93 rt-non-mux: A run-time content created from a pure model content object, i.e. not from a multiplexed content object. An rt-non-mux addresses either a root rt-non-mux or an rt-non-mux socket.

4.94 rt-non-mux socket: An rt-non-mux that is plugged.

4.95 rt-object, run-time object: A run-time object created from a model object. For the purpose of reusing model objects in different contexts, a clear separation has been made between the MHEG model interchange object that contains the original definition and the rt-object corresponding to a specific usage of the model. The use of an rt-object does not affect the model object. This allows the reuse of the same model object in different rt-objects. A model object is considered a template. Any number of rt-objects may be created based on instructions given by the author, i.e. the New action. ISO/IEC 13522-1 defines an initial behaviour of each rt-object and actions that will modify and retrieve this behaviour. The internal representation of the rt-objects is not defined by ISO/IEC 13522-1. Each MHEG engine may have its own internal representation technique. However, ISO/IEC 13522-1 defines the identification techniques to reference an rt-object in order to modify or to retrieve its behaviour.
An rt-object addresses either an rt-script or an rt-component.

4.96 rt-script: A run-time object created from a model script object.

4.97 script object: An instance of an MHEG class defining a structure to interchange script data in a specified encoded form.

4.98 sequencing: The ordering of the preparation of objects, as specified by the object designer, that makes best use of the available resources to produce an acceptable presentation.

4.99 sibling relationship: Relationship between sockets of a given generation within an rt-composite.

4.100 socket: The elements of an rt-composite in that rt-components are plugged are called sockets. Therefore, a socket is equivalent to an rt-component that is plugged. Once an rt-component is plugged, it can be referenced only via its socket identification. Different types of sockets are defined depending on the rt-component plugged into the socket: empty socket, rt-content socket (an rt-non-mux socket or an rt-mux socket) and rt-composite socket

4.101 status: A value representing the current state of an object within the MHEG engine.

NOTE 14: The processes composing the MHEG engine are outside the scope of ISO/IEC 13522-1. However, ISO/IEC 13522-1 requires a mechanism for evaluating the different statuses of objects within the MHEG engine.

4.102 storage media: A means used to store information (e.g. electronic memory, floppy disk, hard disk, optical disk, magnetic tape).

4.103 structure of an object, mheg object structure: A description of how the information in an object is organised.

4.104 synchronisation: The presentation of rt-components in time and space according to constraints and relationship defined among those objects. The constraints and relationship may be defined explicitly, within link objects, composite objects, script objects, or implicitly through the nature of the application.

4.105 temporal position: A specified position on the temporal axis of an rt-component or a channel.

4.106 timestone: An identified marker for a temporal position. This marker may be used to trigger links.

4.107 transition duration: An optional parameter that may be provided for certain elementary actions, e.g. Set Current Volume (target set, audible volume, transition duration). A transition duration is expressed in GTU. When a transition duration is specified, the corresponding elementary action is to be processed

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during the specified duration, e.g. the audible volume value changes gradually from its previous value to the specified value within the specified transition duration.

4.108 **transmission media:** A means used to transmit information (e.g. twisted pair, coaxial cable, optical fibre, radio links).

4.109 **trigger condition:** A part of a link condition describing a change of an attribute or status value. As the described change happens, the trigger condition is said to be satisfied.

4.110 **user effect:** The effect caused by the processing of an elementary action that is perceived by a user.

4.111 **using application:** An part of ISO/IEC 13522, Recommendation or other specification that makes us eof provisions of ISO/IEC 13522-1.

5 Symbols and Abbreviations

The following symbols and abbreviations are used in ISO/IEC 13522-1.

AP Attachment Point

ASN.1 Abstract Syntax Notation One

AVR Audible Volume Range

BER Basic Encoding Rules

CC Current Condition (within a link condition)

CGSU Channel original Generic Spatial Unit

CPS Channel Presentation Space

CRPS Channel Relative Presentation Space

CTP Current Temporal Position

CV Current audible Volume

EA Elementary Action

GF Generic Factor

GSF Generic Spatial Factor

GSU Generic Spatial Unit

GTF Generic Temporal Factor

GTU Generic Temporal Unit

GU Generic Unit

GUI Graphical User Interface

GVF Generic Audible Volume Factor

ID Identifier

JBIG Bi-Level Image Encoding Standard provided by ISO 11544: Information Technology - Digital Compression and Coding of Bi-level Images.

JPEG Photographic Image Encoding Standard provided by ISO 10918: Information Technology - Digital Compression and Coding of Continuous-tone Still Images.

LAN Local Area Network

LC Link Condition (within a link object)

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LE Link Effect (within a link object)

MH Multimedia Hypermedia

MHEG Adjective meaning of multimedia and hypermedia Information coding scheme provided by ISO/IEC JTC1/SC29/WG12 - Multimedia Hypermedia Experts Group.

NOTE: If MHEG is used without any combination of nouns, it means the working group in JTC1. Otherwise, it should be used as an adjective followed by a noun to be unambiguous in its meaning, e.g. MHEG objects, MHEG actions, MHEG classes.

MPEG Audiovisual encoding standards provided by ISO/IEC 11172, Information Technology - Coding of Moving Pictures And Associated Audio for Digital Storage Media up to about 1.5 Mbit/S And ISO/IEC 13818, Information Technology - Generic Coding Of Moving Pictures And Associated Audio.

mux Multiplexed

OAP Original visible size Attachment Point

OD Original Duration

OGSU Original Generic Spatial Unit

OGTU Original Generic Temporal Unit

OGU Original Generic Unit

OGVU Original Generic Audible Volume Unit

OPS Original Presentation Space

OS Original Size

OV Original audible Volume

OVD Original Visible Duration

OVS Original Visible Size

PAP Projected visible size Attachment Point

PC Previous Condition (within a link condition)

PCV Projected Current audible Volume

POD Projected Original Duration

POS Projected Original Size

PRPS Parent Relative Presentation Space

PS Presentation Space

PTU Physical Temporal Unit

PU Physical Unit

PVD Projected Visible Duration

PVS Projected Visible Size

PVU Physical audible Volume Unit

RGSU Relative Generic Spatial Unit

RGTU Relative Generic Temporal Unit

RGU Relative Generic Unit

RGVU Relative Generic audible Volume Unit

RPS Relative Presentation Space

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rt	Run-Time
TC	Trigger Condition (within a link condition)
TD	Transition Duration
WAN	Wide Area Network

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Section 1: Overview

6 Main Features of this part of ISO/IEC 13522

6.1 Interchanging multimedia objects

A multimedia object has little use on its own. It becomes useful in a multimedia application. A multimedia application needs a means to describ multimedia objects and represent them in an application-independent way for interchange them with other applications. To fulfil this need ISO/IEC 13522-1 defines MHEG objects as the solution to.

6.2 The object-oriented approach

ISO/IEC 13522-1 uses some object-oriented techniques like object classes and inheritance. This subclause describes the specific usage of object-oriented concepts within ISO/IEC 13522-1.

6.2.1 Object classes

ISO/IEC 13522-1 uses "object class" term for denoting structures of interchangeable multimedia/hypermedia objects. As such, MHEG classes specify the structure of MHEG objects, not their interfaces. Especially, ISO/IEC 13522-1 does not specify methods as part of classes (or their interfaces, respectively).

MHEG objects are considered as information entities that are interpreted by an appropriate process, i.e. an MHEG engine, to realise behaviour.

6.2.2 Subclasses and inheritance

ISO/IEC 13522-1 uses the class derivation concept. Subclasses inherit all structure from their superclass (i.e. the class they are subclass of) and add new attributes to add new behaviours or override inherited attributes so as to adapt existing behaviours.

6.2.3 Polymorphism

The MHEG engine may perform certain actions on MHEG objects, e.g. prepare them for further use or set some attribute values. Polymorphism applies to these actions. Polymorphism means that if the application of an action is valid for objects of a certain class, it is also valid for objects of all their subclasses, but the effect may be different for different classes. Polymorphism is a way to represent the base class has a generic (common) behaviour while each of the derived classes may have a specific behaviour.

For example, the implementation of a Run action targeted to a run-time content object representing a text is different from the implementation of this actions targeted to a run-time multiplexed content object representing MPEG bitstream. The generic common behaviour is the presentation (run) of the instance, and the specific part for the video is to present video.

6.2.4 Objects and object life cycles

Three forms of MHEG objects are distinguished in ISO/IEC 13522 as shown in Figure 2:

– The interchangeable multimedia/hypermedia-information, encoded according to annex A of ISO/IEC 13522-1.

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- The representation within the MHEG engine, used for internal purposes (e.g. MHEG object stored in its native internal representation, computation of link conditions).
- Copies of 2), usable for presentation by the user. These are called rt-objects.

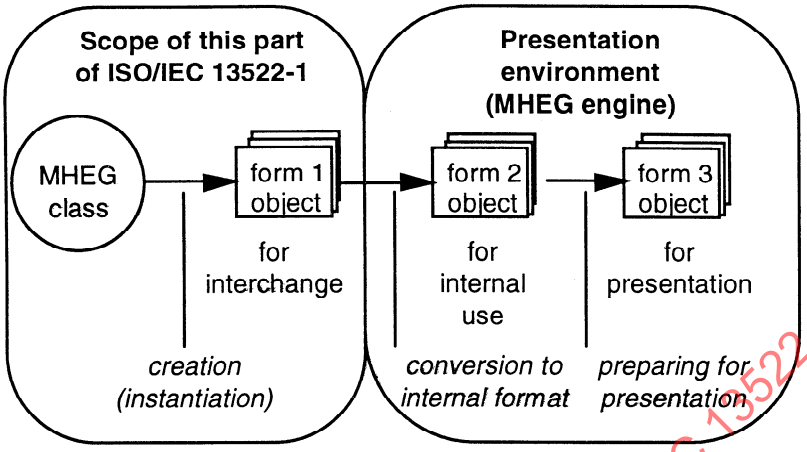

Figure 2 - The different forms of MHEG objects

The life cycle of form 1) objects is out of the scope of ISO/IEC 13522-1. Once they have been created by some encoding mechanism as instances of concrete MHEG classes, they remain, for instance in a repository until destroyed by means out of the scope of ISO/IEC 13522-1. However, if a form 1 MHEG object, which may be a copy of some original object, is received by an MHEG engine, it is converted into form 2). The form 2) remains until a Destroy action is applied to it. The form 3) comes into existence whenever a New action is applied to an appropriate form 2) object (i.e. a model object), resulting in a form 3) copy of this object, which can be presented and may have its attribute values changed. Form 3) objects are deleted by use of a Delete action.

Form 2) and 3) objects live within a presentation environment, i.e. the MHEG engine. This implies that they should not exist no longer the presentation environment vanishes.

6.3 Technical features

(In this subclause, some technical features achieved by ISO/IEC 13522 are described.)

Because of the generic nature of ISO/IEC 13522-1, a user may combine the following facilities. However, a using application may impose rules to implement a more restrictive architecture.

6.3.1 Object composition for interchange and presentation

Two techniques for object composition are used and provided by ISO/IEC 13522-1. One is the container concept provided by the container class which is used as an information packing tool to convey multimedia and hypermedia information. The other is the presentation composition provided by the composite class which is used as an information presentation tool under the control of a multimedia and hypermedia script.

The container class is used to combine a set of multimedia and hypermedia objects to be interchanged between storage systems and presentation systems. The container class groups a set of objects to be interchanged as a whole, taking into account the needs of minimal resource systems. Using this mechanism, the efficient exchange of multimedia data between heterogeneous systems may be achieved according to the needs of minimal resources systems. When objects in a container are used in a presentation, a certain number of preparation actions are required before the object can participate in this presentation.

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Figure 3 illustrates the use of ISO/IEC 13522-1 as an interchange unit and as an identifier of multimedia information encoded according to other International Standards.

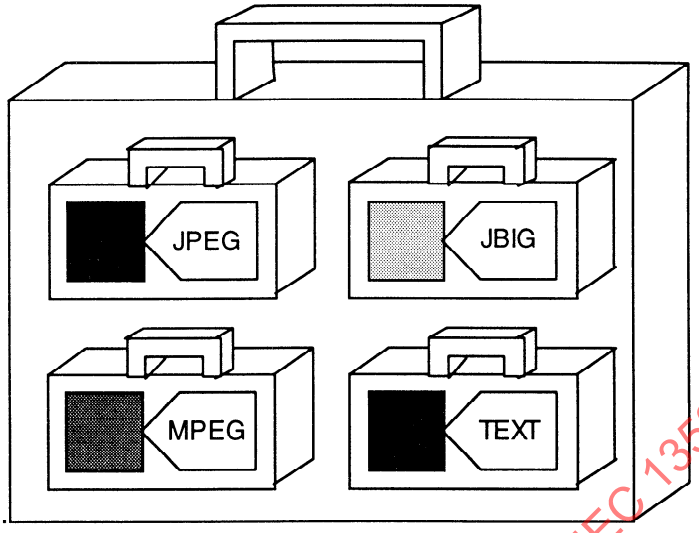

Figure 3 - Interchange and identification of multimedia information

The composite class is used to combine a set of multimedia and hypermedia objects to be presented. It provides a common presentation facility for those objects included in it, and describes presentations varying from the simplest monomedia object to complex multimedia and hypermedia interactions.

6.3.2 Run-time objects

For the purpose of reusing objects in different contexts, a clear separation is to be made between an interchange object, called **model object,** and a run-time object, called **rt-object**. The model object corresponds to original reusable information. It is an instance of an MHEG object class containing script data, monomedia, multimedia and/or hypermedia information. An rt-object represents one specific use of the model object. It is used for presentation. Any number of rt-objects may be created from a single model object.

The internal representation of rt-objects is not defined by ISO/IEC 13522. Each MHEG engine may have its own internal representation technique. The activation and attribute modification of an rt-object do not affect the original model object. This allows the reuse of the same original model object in different contexts.

NOTE: For example, in a hockey game, two content objects are needed: B (blue team) and R (red team). Content B contains the original drawing of a blue team hockey player and content R contains the original drawing of a red team hockey player. Several rt-contents can be made from these model content objects as follows:

- Rt-contents 1 to 10, corresponding to the 10 hockey players from the blue team, are created from the content B.
- Rt-contents 11 to 20, corresponding to the 10 hockey players from the red team, are created from the content R.

All the information related to the presentation is described for each rt-content. For example, rt-contents 1 to 6 (blue team) and 11 to 16 (red team) have different positions on the rink. Rt-contents 7 to 10 have positions on the blue team bench, and rt-contents 17 to 20 have positions on the red team bench.

The presented size of each rt-content may be different. And the presentation attributes may be evaluated on each rt-content, in order to know at a precise moment if a player (i.e. an rt-content) is in a hospital (not running) or on the ice (running).

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6.3.3 Individual behaviour common to all rt-objects created from a given model object

ISO/IEC 13522 offers a mechanism to describe individual behaviour common to all the rt-objects, that may be created from a given model object. The advantages of this facility are the following:

- the behaviour is described only once and applies to all the rt-objects;
- the object designer can describe a common individual behaviour without knowing the number of rt-objects to be created from the given model object;
- once prepared, the link applies to all rt-objects already created as well as future made rt-objects.

This facility is provided by the "?" tail reference techniques (see clause 11.3).

6.3.4 Synchronisation

There are four kinds of multimedia objetct synchronization mechanisms:

a) Elementary synchronisation: two objects are synchronised either
   1) both with regard to the same reference origin time (parallel mode); or
   2) one with regard to the other (sequential mode).
b) Chained synchronisation: a set of objects are presented one after another in the form of a chain;
c) Cyclic synchronisation: one or more objects are repetitively presented;
d) Conditional synchronisation: the presentation of an object is linked to the satisfaction of a condition.

In ISO/IEC 13522-1, these four kinds of synchronisation are defined in a single describing manner, which is the conditional synchronisation.

There is four levels of Multimedia object synchronisation:

- **Script**: a script may contain complex synchronisation taking into account user replies, calculated values, and the state of system resources, for example.

  NOTE 1: Script synchronisation is not defined by ISO/IEC 13522-1.
- **Conditional**: the current state of the presented object may trigger a reflex action to another object, e.g. "when the audio has finished, ask the question".
- **Spatio-temporal**: the position in time and space of an object may be relative to another, e.g. "show the product name 2 cm above the image, 2 seconds after the presentation of the image".
- **Intermedia**: close synchronisation within a multiplexed content object, e.g. "lip sync" for movies.

NOTE 2: Intermedia synchronisation is provided by other standards such as MPEG.

6.3.5 Links

MHEG links are associative, dynamic, and event-driven. There are many types of links; however, they may be categorised into two types as follows:

- Object Synchronisation Link: describes the synchronisation among multimedia objects.
- Hyperlink: describes an object relationship to context related hypermedia objects.

ISO/IEC 13522-1 uses a single mechanism to both types of link of object linking within a link object.

The set of MHEG links is highly dynamic. Links may be added and removed at any time and may depend on user activity and previous performance in order to adapt the behaviour during the life of the presentations.

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The MHEG links are driven by a change of MHEG entity behaviour, e.g. an object becomes ready, or the volume of an rt-content increases. Each link describes a change that may trigger it and the effect in which it results.

MHEG links are fully resolved and require no further processing other than their direct execution.

6.3.6 Input

To support interactive multimedia/hypermedia systems, some mechanism is needed for user input. In ISO/IEC 13522-1, the list of possible interactions offered to the user is described using composite objects. Input is considered a behaviour and is based on selection and modification behaviours of rt-components.

ISO/IEC 13522-1 provides facilities to describe the results of the user interaction but does not provide the interaction facilities. Such interaction may be achieved in a variety of ways, e.g. GUIs (graphical user interface) and keyboards. ISO/IEC 13522-1 does not define the look-and-feel of multimedia interactive presentations, nor does it propose to change or add concepts to those that exist in typical GUIs. As ISO/IEC 13522-1 is generic and independent of platform and implementation, it describes interaction at a virtual level.

6.3.7 Event handling

MHEG objects interact with events through event handling mechanisms. An event is generated by either the outer system or the MHEG engine itself.

When an event is generated, the MHEG engine sets the corresponding catalogued event identification to the event attribute and, if needed, associated information to the event data attribute of the rt-object or channel that should receive this event. For example, a mouse click event on a button generated by the GUI can be sent to an rt-object as event number 10 with associated x-y position information.

Event handling mechanisms may be used for general purpose synchronisation and interaction mechanism.

6.3.8 Anchor

To support hypertext and hypermedia, ISO/IEC 13522-1 provides an anchor mechanism. An anchor is a content object that holds anchor information rather than media data. This anchor information defines an area within another content object data. This area is to be presented on the other data by the GUI using either the rendering specified within the objects or a specified style. As the anchor is interchanged within a content object, an rt-content can be created from the content object and all the behaviours of rt-content apply, e.g. running, selection.

6.3.9 Real time

ISO/IEC 13522-1 does not specify and makes no assumptions about the quality or capability of the underlying networks through which using applications may interchange MHEG objects. There may already exist some LANs that meet all the capacity requirements for real-time interchange of applications, and future standards may specify some WANs with appropriate capabilities. ISO/IEC 13522-1 deals with these uncertain circumstances in two ways:

a) ISO/IEC 13522-1 allows the author to define a set of specifications that would necessarily have to be satisfied to ensure real-time applications regardless of the interchange media capabilities. In addition, the MHEG object specification provides mechanisms that ease real-time interchange regardless ing network capabilities.

b) An MHEG descriptor object provides the following:

   1) a description of objects to be supported by the system;

   2) a description of media encoding;

   3) a system-readable material and a read-me mechanism by which communicating applications can negotiate an optimum interchange session. In this regard, the descriptor object provides a placeholder for references to other standards that are needed for allocation of network resources among complementary and competing applications;

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4) offset information of objects.

Requirements for real-time capability are satisfied as follows:

- Object placement optimisation and progressive access to ects should be handled by the using application. Object offset information may be used to achieve quick retrieval of a certain object embedded in another object.
- Partial object retrieval, object sequencing, and separate retrieval of object description and object content are features of the Prepare and Destroy actions usage and process.
- Resource requirements are described by the MHEG descriptor object.
- Object interleaving is supported by the MHEG multiplexed content object.

  NOTE: ISO/IEC 13522-1 does not provide interleaving facilities but supports the indication of interleaved objects.

- Aggregate retrieval is supported by the MHEG container object.

6.3.10 Object management

6.3.10.1 Object identification

General object identification is needed for copyright, owner identification, and unique identification. ISO/IEC 13522-1 provides a description mechanism for this information in an MHEG object. Within this description mechanism, the unique identification mechanism is a key for the processing of MHEG objects inside the MHEG engine.

An internal identifier and an external identifier are provided in order to support unique identification. These identifiers are used to reference objects. The internal identifier is an encoded identifier within an MHEG object and consists of an identifier or an index. The external identifier acts as a connector between the MHEG and non-MHEG entities and consists of a public identifier and a system identifier.

ISO/IEC 13522-1 also provides symbolic identification using aliases. This identification may replace any other identification.

6.3.10.2 Object reference

Reference to local and remote objects, as an alternative to physical inclusion is needed. ISO/IEC 13522-1 provides a generic reference mechanism to any entity defined by ISO/IEC 13522-1.

6.3.10.3 Object content

A uniform interface to content data is needed. ISO/IEC 13522-1 provides this mechanism in the description of content class.

6.3.10.4 Uniform objects

A uniform view of objects by using applications is needed. ISO/IEC 13522-1 provides this uniform view using the MHEG object hierarchy.

6.3.11 Minimal resources

Extraction of relevant component data on a timely basis for minimal resource systems is considered in ISO/IEC 13522-1. There are several aspects:

- **Inter-object interleaving**: This is outside the scope of ISO/IEC 13522-1 because it is a system issue.

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NOTE: ISO/IEC 13522-1 does not provide interleaving facilities but supports the indication of interleaved objects by the use of the multiplexed content object.

- **Sequencing**: This is defined in ISO/IEC 13522-1 by a specific use of the Prepare action.
- **Degradation and negotiation of required resources**: The descriptor objects provide complementary information about a set of interchanged objects useful for the degradation of some presentation and the negotiation of minimal resources requirements.

6.3.12 Presentation and structuring dynamism

When an rt-composite is created from an original composite object, the rt-components attached to the sockets may be removed or replaced using the plug action. This allows dynamism in the presentation if the plugged rt-contents are changed and dynamism in the structure of the rt-composite if the plugged rt-composites are changed.

6.3.13 Macro action and link

The macro facility provides a general technique for producing efficient coding of frequently used action objects in which only a few values change from one link to another. The same applies on frequent link conditions in which only a few values change from one link to another. This allows to share and reuse complex behaviours. An author may create a catalogue of predefined action object and link object templates.

6.3.14 Static and dynamic assignment of generic value

A generic value may be specified as a constant or as an evaluated result of a get action. Generic values are values processed inside an MHEG Engine. Generic values can be stored and retrieved from content object data. An evaluated value may be stored after its evaluation, i.e. a constant is stored, e.g. content data = "hello". An evaluated value may also be stored without any processing, i.e. the get action is stored, e.g. content data = Get Preparation Status (target), in which case, the evaluation is performed dynamically each time this generic value is retrieved.

7 MHEG Engine Assumptions

7.1 Handling and Interchange of objects

ISO/IEC 13522-1 does not define the way in which an MHEG Engine should handle interchanged MHEG objects or rt-objects. But it makes some assumptions about the features of MHEG Engines to define further actions on the objects.

a) ISO/IEC 13522-1 assumes that an MHEG object, once it has been interchanged, is used by so as using application and handled by an MHEG Engine.

b) ISO/IEC 13522-1 makes no assumptions on the internal structure or organisation of the MHEG Engine, except that:

   1) An MHEG Engine should correctly interpret MHEG effect of MHEG action.

   2) An MHEG Engine should be able to evaluate status and attribute values of MHEG entities which are under its control. The changes that occur on the status or attribute value may be used to express conditions in links.

   3) When an MHEG Engine uses an entry of a catalogue, this engine should correctly interpret this entry as described in the catalogue.

   4) The MHEG Engine should be able to work with a user interface support system, when it exists, and to get from this user interface system the results of the interaction with the user. These results are formalised by the MHEG Engine in order to modify the corresponding interaction statuses.

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NOTE 1: For example, the user interface support system indicates to the MHEG Engine that a specific element of a given object has been selected, and thus the MHEG Engine is able to modify the corresponding interaction and selection status. This change of status may fire a link and carry on an action as specified in a given MHEG object.

To facilitate understanding of the role played by ISO/IEC 13522-1, this subclause details the role of MHEG objects in the interchange between two systems, as shown in Figure 4.

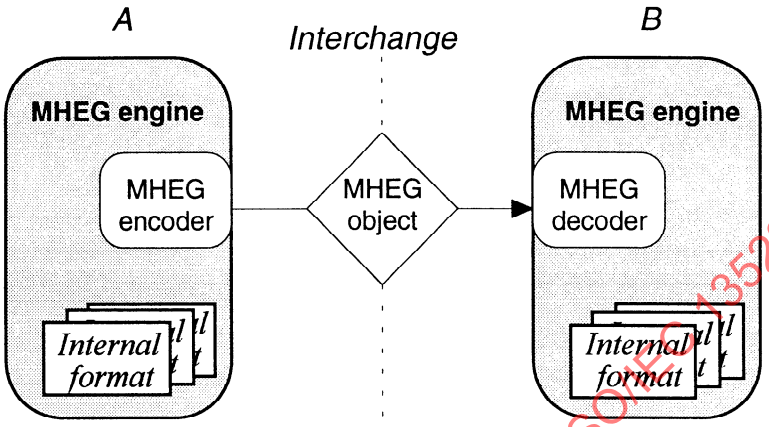

Figure 4 - Interchange of MHEG objects

An MHEG object is defined only at the interchange point between the applications A and B. When system A wishes to send an MHEG object to B, it calls an MHEG **encoder**, which converts the internal format used by A to the format defined by ISO/IEC 13522-1.

When B receives an MHEG object, the object is decoded by an MHEG **decoder**. The values within the object are passed by the decoder, which may convert them to the internal format used by B.

NOTE 2: The internal formats in the using applications A and B may be the same as the MHEG format.

NOTE 3: If the exchange between A and B is in both directions, both systems may have an encoder and decoder

7.2 The MHEG application interface

The MHEG Engine is assumed to provide an interface to the using application. This interface provides the application with facilities for control of the MHEG Engine and is the only access point to MHEG objects within the MHEG Engine. ISO/IEC 13522-1 does not define the scope or the form of the MHEG Engine interface, nor does it define the structure of data passing across this interface.

7.3 Exception handling

ISO/IEC 13522-1 recommends the reactions of an MHEG Engine when abnormal or exceptional situations are encountered during run time. These reactions are neither minimal nor complete, so an MHEG Engine may do more (e.g. write to a log file or inform the application) or less (e.g. stop processing). The described behaviour is recommended but not required for conformance.

NOTE: Specific reactions on error conditions are given for each specific situation throughout the behaviour section.

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8 Methodology

This clause describes the methodology used to specify ISO/IEC 13522-1 and is provided as a help to the user in understanding ISO/IEC 13522-1.

NOTE: It does not imply that a conforming system or product should use this methodology for either analysis or implementation. This is the case for the general object orientation that is chosen for the design of ISO/IEC 13522.

In the context of ISO/IEC 13522-1, an object class denotes a structure of interchangeable multimedia/hypermedia information, from which MHEG objects can be instanciated. ISO/IEC 13522-1 restricts the usage of object-oriented concepts to specialisation, inheritance and polymorphism.

8.1 Modularity

To allow a using application to use only some of the objects provided for by ISO/IEC 13522-1, the representation itself is secribed as a set of modules organised as follows:

- One module per interchanged object class.
- One module containing all the useful definitions and the abstract classes.
- One module containing all the elementary actions.

NOTE: In this way, an application process is likely to incur the minimum overhead due to the objects not used.

8.2 Methodology of representation of MHEG objects

ISO/IEC 13522-1 provides a description of an MHEG object, a precise definition of the structure of the object, and a base-coded representation for the object. The base coded representation defined in ISO/IEC 13522-1 uses ASN.1.

Alternative structure representations may be provided. They are intended to be isomorphic and equivalent for the purposes of ISO/IEC 13522-1 (see Figure 5).

NOTE: It is intended that the base transfer syntax provided by ISO/IEC 13522-1 and alternative syntaxes provided by other parts of ISO/IEC 13522 is consistent and that it is possible to convert an MHEG object instance from one to another. However, this process is not defined by ISO/IEC 13522.

The representation of an MHEG object is specified through four levels: description of representation, object-oriented definition (structure and semantics), notation for the structure of the representation; and the coded representation defined by applying encoding rules to the representation (see Figure 5).

The description of the representation provided by ISO/IEC 13522-1 includes the structure of the representation and sufficient semantics to enable a concrete understanding of the meaning of an MHEG object. ISO/IEC 13522-1 does not provide semantics for an application process that make use of this object.

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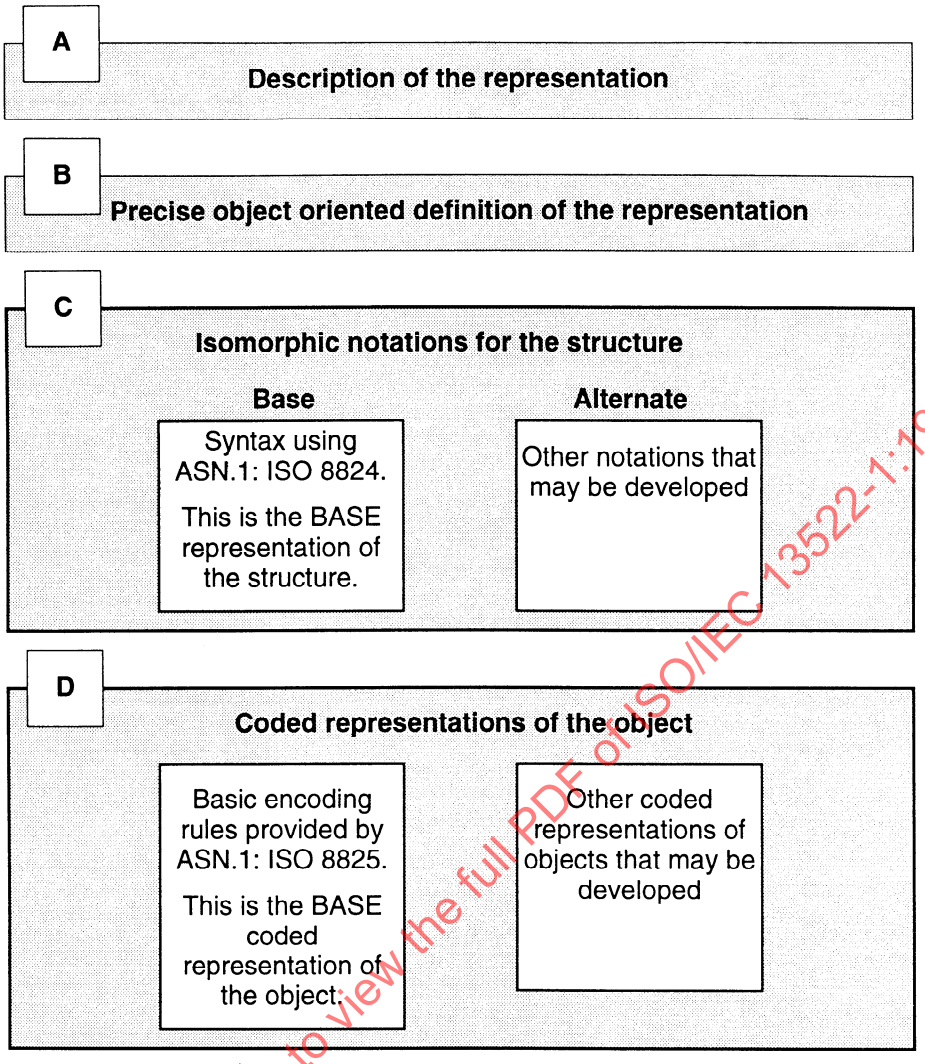

Figure 5 - Levels of the methodology used by ISO/IEC 13522-1

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8.2.1 Level A: Description of representation

Level A provides the description of representation for each useful definition (see section 2), each MHEG object (see section 3), and each MHEG entity behaviour (see sections 4, 5, 6, 7 and 8).

8.2.2 Level B: Precise object-oriented definition

For each MHEG object class, the precise object-oriented definition is given by the following:

- Class hierarchy: from which class it inherits and by which class(es) it is inherited.
- Usage: which class(es) it uses and by which class(es) it is used.
- Structure: attributes it contains, in addition to the inherited attributes.
- Textual description: a short explanation of semantics and behaviour.

The structure of classes is described using a context-free grammar in which the following conventions described apply:

- **X::= I, J, K** X is defined as a sequence of attributes I followed by J followed by K.

- **X?** None or one instance of X may occur.
- **X+** One or more instances of X may occur.
- **X*** Any number of instances of X may occur.
- **(I | J | K)** Exactly one of the set is to occur.
- **(I , J , K)?** None or the entire sequence may occur.
- **(I , J , K)+** One or more instances of the entire sequence may occur.
- **(I , J , K)*** None or more instances of the entire sequence may occur.

The structure and semantics of each representation attribute of the object (see B in Figure 5) are described in the next subclauses with the structure shown in Figure 6.

Attribute name
- *semantics*
- *type OR*
  structure of subattributes OR
  choice between attributes OR
  subattribute list

Figure 6 - Structure of attribute subclause

NOTE 1: Each subattribute is described as an attribute.

NOTE 2: Structure (A, B): means that subattribute A is followed by subattribute B.

NOTE 3: List of (A, B): means that one or more instances of the entire sequence (A, B) may occur.

8.2.3 Level C: Isomorphic notations for the structure of MHEG objects

There may be a set of equivalent notations for the level B description of the structure of an MHEG object. The notations are equivalent in that they are isomorphic with respect to the MHEG object structure described in level B. However, one of the notations is the base notation, which is to be referred to as regard of conformance.

The base notation for the representation of MHEG objects uses ASN.1. This is known as the base representation (C in Figure 5).

8.2.3.1 ASN.1 techniques used in level C

The ASN.1 notation for the structure of each MHEG class is typically as presented in Figure 7.

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```
- MHEG OBJECT CLASS MODULE

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granted for use with conforming MHEG Engines and applications as defined in ISO/IEC 13522-1,
provided this notice is included in all copies.

ISOMHEG-cl {joint-iso-itu-t(2) mheg (19), version (1), class-identifier (xx)},

DEFINITIONS ::= BEGIN

EXPORTS
     MHEG-Object-Class;

IMPORTS
     Mh-Object-Class FROM ISOMHEG-mh {joint-iso-itu-t(2) mheg (19), version (1), mh-object
(1000)};

MHEG-Object-Class:= SEQUENCE

{

class-identification OBJECT IDENTIFIER {    joint-iso-itu-t(2),  - root
                                            mheg (19),           - arc1
                                            version (1),         - arc2
                                            class-identifier(xx) - arc3
                                            },

COMPONENTS OF Mh-object,

- object class attributes

}

END
```

Figure 7 - Example of an ASN.1 module used for MHEG object representation

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The following ASN.1 techniques are used to represent the MHEG objects:

a) ASN.1 OBJECT IDENTIFIER. The object identifiers defined in ISO/IEC 13522-1 are summarised in annex (see Annex A). The semantics of the object identifier are defined by reference to the following object identifier tree:

   1) **root**: Origin of the standard. It shall be joint-iso-itu-t(**2**).

   2) **arc1:** ISO/IEC 13522 identification. It shall be **19**. The identification of ISO/IEC 13522 has been provided by the joint naming authority.

   3) **arc2**: MHEG Standard version. It is set to **1** for this version of ISO/IEC 13522-1.

      NOTE 1: Revisions of this part of ISO/IEC 13522-1 will have other arc2 values.

   1) **arc3:** Class identifier. It is a number assigned to each MHEG class.

b) The ASN.1 modules are used in ISO/IEC 13522-1 to represent the MHEG object classes and superclasses, and also to describe the useful definitions. Each module has an identification, which is expressed using an ASN.1 OBJECT IDENTIFIER. This identification is attached to the definition of the module and is not part of the definition of the MHEG class.

   NOTE 2: This module OBJECT IDENTIFIER is not encoded within an MHEG object. It is used by another module within the IMPORT/EXPORT facilities in order to identify a module formally.

c) The ASN.1 IMPORT/EXPORT and the COMPONENTS OF facilities are used to represent the inheritance of attributes of MHEG object classes. Each superclass defines a SEQUENCE of attributes that are exported. This SEQUENCE is imported by the subclasses and COMPONENTS OF is used to derive these attributes.

d) The ASN.1 IMPORT/EXPORT facilities are also used to represent the MHEG useful definition and the elementary actions. The useful definition module exports the definitions and the abstract classes. The elementary action module exports the elementary actions. Each MHEG object class module imports the corresponding definitions when needed.

e) Each MHEG object is represented as a sequence of attributes using the ASN.1 SEQUENCE facilities.

f) The technique of an ASN.1 OBJECT IDENTIFIER is also used to uniquely identify each MHEG object class. This MHEG object class OBJECT IDENTIFIER is part of the definition of the class and shall be encoded in each object instance.

8.2.3.2 Copyright protection

The formal ASN.1 definition is part of the text of ISO/IEC 13522-1 and is protected by copyright. In order to facilitate conformance to MHEG, the formal ASN.1 definition in the body and annex A of ISO/IEC 13522-1 may be copied as specified in the following copyright notice:

© International Organisation for Standardisation, 1996. Permission to copy in any form is granted for use with conforming MHEG Engines and applications as defined in ISO/IEC 13522-1, provided this notice is included in all copies.

The permission to copy does not apply to any other material in ISO/IEC 13522-1.

NOTE: An attribute is defined by ISO/IEC 13522-1 for specifying the copyright notice attached to an MHEG object.

8.2.4 Level D: Coded representation of MHEG objects

ISO/IEC 13522 provides a set of equivalent coded representations of MHEG objects. The coded representations are equivalent in that they are isomorphic with respect to the level B. However, one of the coded representations is the base-coded representation.

The base coded representation is provided by ASN.1 BER.

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Section 2: Generic Utility and Useful Definition Mechanisms

This part of ISO/IEC 13522 provides the following mechanisms:

- Presentation mechanism (see clause 9),
- Generic Identification Mechanism (see clause 10),
- Generic Reference Mechanism (see clause 11),
- Generic Value (see clause 11),
- Macro mechanism (see clause 13),
- Hooks (see clause 14),
- Extensibility (see clause 15).

These generic mechanisms or definitions are used throughout ISO/IEC 13522-1.

Their coded representation is grouped in a separate ASN.1 module called "useful definitions module".

When an MHEG object requires a specific definition, the ASN.1 class representation of the object imports the definition from the useful definitions module.

9 Presentation Mechanism

This clause describes the general mechanism used by a PS (Presentation Space) (see clause 9.1) to present the rt-components to the user. The PS is composed of a generic coordinate system in time and space, and it also contains an AVR (Audible Volume Range) for audio expression.

The values used to define the spatial, temporal and audible behaviour of rt-components are expressed in GU (Generic Units) , e.g. position, size, duration and volume. This mechanism is used to the interpret of the units with respect to an associated PS.

NOTE: This make it possible co-exists possible for data coming from different creation tools with different coordinate systems and audible volume ranges.

A PS is associated with each rt-component. It is called OPS (Original PS) (see clause 9.2).

A PS is also associated with each channel. It is called CPS (Channel PS) (see clause 9.3).

To allow placement of children relative to their parent, each rt-component may be projected into a parent PS. For a child, its parent PS is called an RPS (Relative PS) (see clause 9.4). This parent may also be a child of another parent. So, there is a chain of mapping that ends at CPS: OPS to RPS to RPS...to CPS. For each projection a scaling factor, called GF (Generic Factor), is applied. This GF is defined as a ratio and specifies number of RGU (Relative GU) to be mapped to one OGU (Original GU). Lastly, for its perception by a user, each CPS is mapped by the MHEG Engine onto a physical space (see clause 11.1).

Figure 8 summarises the presentation techniques.

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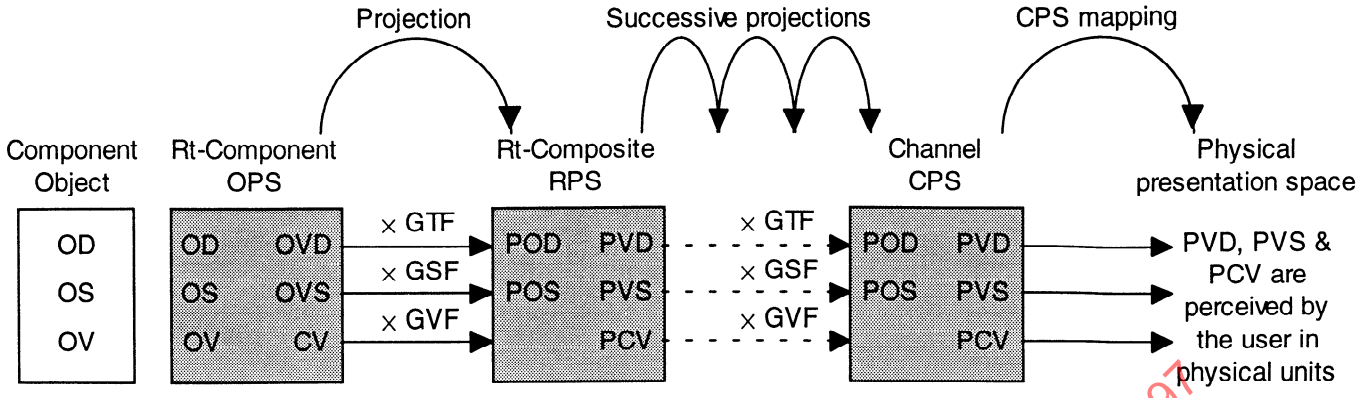

Figure 8 - Overview of presentation techniques

9.1 Presentation space (PS)

A PS shall be defined as follows:

- A temporal axis T,
- Three spatial axes, X, Y, and Z,
- An AVR.

9.1.1 Temporal axis

A PS shall have one temporal axis: T

The temporal axis shall be an interval [0, TEndPoint], where the TEndPoint is positive. The TEndPoint may be specified as infinite. The point 0 is defined as the origin of the temporal axis.

The number of addressable points within a temporal axis is (TEndPoint + 1).

The GU used along this axis is called GTU (Generic Temporal Unit).

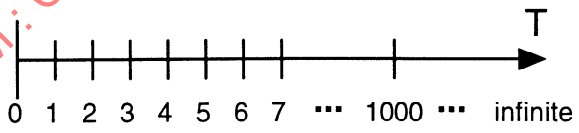

Figure 9 - The T axis.

The rt-component temporal behaviour uses temporal positions and temporal durations, which are expressed in GTU within the PS:

a) A temporal position shall be defined as:
   1) A point on the T axis;
   2) Always defined within the interval [0, TEndPoint] on the corresponding T axis.

b) A duration shall be defined as:
   1) A distance between two temporal positions.
   2) Defined as the length of an interval [StartPoint, EndPoint];
   3) Always defined within the interval [0, TEndPoint] on the corresponding T axis;

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4) Equal to (EndPoint – StartPoint). EndPoint shall be greater than or equal to StartPoint;

5) The number of addressable points within a duration is (EndPoint – StartPoint + 1).

Figure 10 illustrates temporal position and duration attributes.

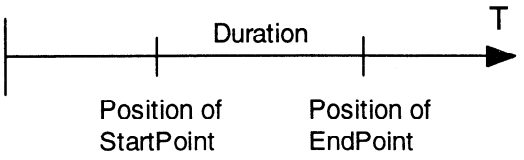

Figure 10 - Temporal position and duration

The temporal scaling factor is called GTF (Generic Temporal Factor). Its value n specifies that one OGTU (Original GTU) is to be mapped to n RGTU (Relative GTU) i.e. 1 OGTU / 1 RGTU = GTF.

9.1.2 Spatial axes

A PS shall have three spatial axes — X, Y and Z — that span a right-handed orthogonal coordinate system.

Each spatial axis is to be perceived by the user in the direction defined by Figure 11: X from left to right, Y from bottom to top, and Z from display towards the user.

NOTE: Extensions may be provided to allow views from alternative directions, e.g. through additional channel attributes.

All instances of such a PS shall be colinear with respect to each other, i.e. all X axes are parallel, all Y axes are parallel and all Z axes are parallel.

Each spatial axis shall have a finite length and shall be an interval [0, SEndPoint], where SEndPoint is always greater than or equal to 0. The default value SEndPoint is +65535. The point 0 is defined as the origin of each spatial axis. The point (0, 0, 0) is called the spatial origin.

The number of addressable points within a spatial axis is (SEndPoint + 1).

The GU used along each spatial axis is called GSU (Generic Spatial Unit)

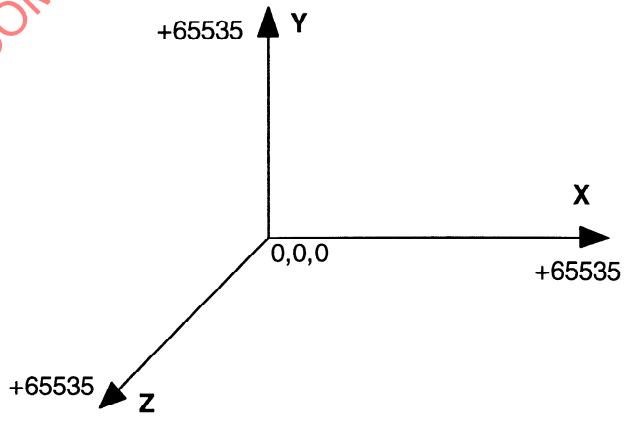

Figure 11 - The X, Y and Z axes of the presentation space

The rt-component spatial behaviour uses spatial positions and sizes, which are expressed in GSU within the PS:

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a) A spatial position shall be defined as:

   1) A triple of points (x, y, z), one point on each spatial axis;

   2) Always defined within the interval [0, SEndPoint] of the corresponding spatial axis.

b) A size shall be defined as:

   1) A triple of distances (lx, ly, lz), one on each spatial axis, giving the length along each axis in the given order;

   2) Each distance is defined as the length of an interval [StartPoint, EndPoint] on the corresponding axis;

   3) Each distance shall be defined within the interval [0, SEndPoint] of the corresponding spatial axis;

   4) Each distance is equal to (EndPoint – StartPoint). EndPoint shall be greater than or equal to StartPoint;

   5) The number of addressable points within each distance is (EndPoint – StartPoint + 1).

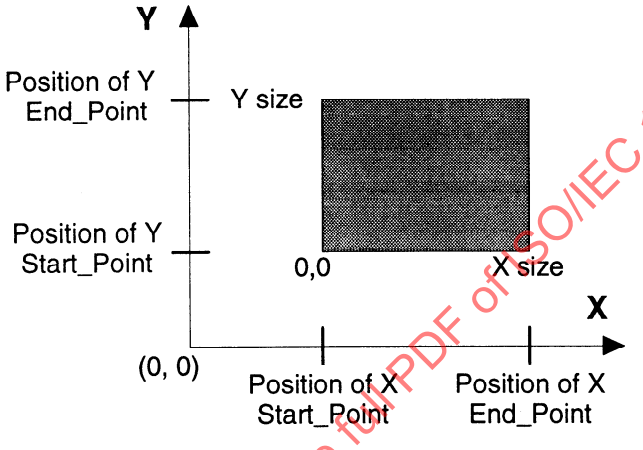

Figure 12 - Spatial Position and Size

Figure 12 illustrates spatial position and size attributes.

NOTE: In this figure, the Z axis is omitted for clarity.

A spatial scaling factor is defined for each spatial axis, and is called GSF (Generic Spatial Factor). Its value n specifies that one OGSU (Original GSU) is to be mapped to n RGSU (Relative GSU), i.e. 1 OGSU / 1 RGSU = GSF.

The GSF may be different for each spatial axis of a PS.

9.1.3 Audible volume range (AVR)

ISO/IEC 13522-1 defines one unique AVR. Every audible expression shall be described within the AVR. The AVR is defined as the interval [0, +255].

The number of addressable points within the AVR is 256.

The unit used along the axis is GVU (Generic audible Volume Unit).

The rt-component audible behaviour uses audible volumes, which are expressed in GVU within the PS. An audible volume shall be a point defined within the AVR.

The audible volume scaling factor is called GVF (Generic audible Volume Factor). Its value n specifies that one OGVU (Original GVU) is to be mapped in n RGVU (Relative GVU) i.e. 1 OGVU / 1 RGVU = GVF.

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9.2 Original presentation space (OPS)

9.2.1 Initialisation of OS and OD

When an rt-component becomes available, a PS is associated with it, and it is called OPS. The temporal and spatial axes shall be initialised as follows:

a) The TEndPoint shall be initialised with the Original Duration (OD) value retrieved as follows:

1) If the OD is encoded within the component object, this value shall be used;

2) For an rt-content, if the OD is not encoded within the content object, the OD value may be retrieved from information contained in the hook or in the data itself;

3) Otherwise, the OD value shall be set to infinite.

b) Each SEndPoint shall be initialised with the Original Size (OS) length value on the corresponding axis, which is retrieved as follows:

1) If the OS is encoded within the component object:

i) If the length of the OS is provided on an axis, this value shall be used for this spatial axis.

ii) otherwise, the length of the OS on this axis shall be set to 0.

2) For an rt-content, if the OS is not encoded within the content object, the OS value may be retrieved from information contained in the hook or in the data itself.

NOTE: For a multiplexed content object, the OS of the global multiplexed data is used. The OS may be encoded individually in each stream within a multiplexed content object. This information should not be used to set theOS of the rt-mux. It is just a help for an MHEG Engine to manipulate and present a stream.

3) Otherwise, the OS length value shall be set to 0 on each axis.

The following OGU along each OPS axis are defined:

- The GTU along the OPS temporal axis is called OGTU (Original GTU);
- The GSU along each OPS spatial axis is called OGSU (Original GSU);
- The GVU along the OPS AVR is called OGVU (Original GVU).

9.2.2 Initialisation of GF

The scaling factors associated with the OPS axes shall be initialised as follows:

- The GTF shall be initialised to 1. It may be changed by the use of the Set GTF action;

NOTE 1: For example, if the GTF changes from 1 to 10, 1 unit of RGTU lasts 10 times longer than before the change. If the GTF changes from 1 to 1/10, 1 unit of RGTU lasts 10 times shorter than before the change. A GTF value of 0 has the effect of reducing the rt-component duration to an infinitesimal small duration in the RPS, because the whole rt-component duration is perceived within 0 RGTU.

- The GSF on each OPS spatial axis shall be initialised to 1. It may be changed by the use of the Set GSF action;

NOTE 2: For example, if the GSF changes from 1 to 2 on an axis, 1 OGSU is to be mapped on 2 RGSU on this axis. So the rt-component is perceived twice as large on this axis. A GSF value of 0 on all axes has the effect of reducing the rt-component perception to an infinitesimal small size in the RPS, because the whole rt-component is being perceived within 0 RGSU.

- The GVF shall be initialised to 1. It can be changed by the use of the Set GVF action.

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NOTE 3: For example, if the GVF changes from 1 to 2, 1 OGVU is to be mapped on 2 RGVU. So the rt-component is perceived twice as loud. A GSF value of 0 has the effect reducing the rt-component perception to an infinitesimal small volume in the RPS, because the rt-component volume is being perceived in 0 RGVU.

9.2.3 Initialisation of attributes for rt-components

For each rt-component the following attributes are defined when the OPS is created:

- OD: Defines the initial duration of the rt-component. Its value is retrieved as explained above.
- OVD (Original Visible Duration): It is a subset of the OD. It defines the part of the OD which is perceived by the user. It shall be initialised to the OD value and may be changed by the use of the Set OVD action.
- OS: Defines the initial size of the rt-component. Its value is retrieved as explained above.
- OVS (Original Visible Size): It is defined as a size and then positioned within the OS. The portion of the OS which fits within the OVS is perceived by the user. The portion of the OS that is outside the OVS is clipped. If the OVS exceeds the limits of the OS, the exceeding portion of the OVS is filled by the background of the rt-component. The OVS shall be initialised to the OS value and positioned at the origin of the OS. The size may be changed by the use of a Set OVS action. The position may be changed by the use of the Set OVS Position action.

NOTE: The background of the rt-component is not defined by ISO/IEC 13522-1. The background may be either retrieved from the hook or the data of the component object. A Set Style action can also be used by the author to set a catalogued background style.

9.2.4 Initialisation of attributes for rt-contents

For each rt-content the following attributes shall be defined when the OPS is created:

a) OV: Defines the initial volume of the rt-content. Its value is retrieved as follows:
   1) If the OV is encoded within the content object, this value is used;
   2) If not, the OV value may be retrieved from information contained in the hook or in the data itself;
   3) Otherwise, the OV value is set to the minimum value of the AVR.

b) CV (Current Volume): It corresponds to the volume which will be perceived by the user. It is initialised to the OV value and may be changed by the use of the Set CV action.

NOTE: When an rt-mux is responsible for the presentation of several streams, it is up to the demultiplexing process and the GUI to keep the coherence between the duration, size and volume of the rt-mux itself and the duration, size and volume of each stream selected for this rt-mux.

To ensure the final presentation, the duration and the volume that are encoded within each rt-content shall be expressed in 1 ms (PTU) and 1 dB (PVU), respectively. If the duration and the volume are retrieved from the hook, these values are translated and expressed in 1 ms (PTU) and 1 dB (PVU), respectively.

9.3 Channel presentation space (CPS)

The CPS shall be initialised as follows:

a) The TEndPoint shall be initialised with the CPS Duration value retrieved as follows:
   1) If the action Set CPS is targeted to this channel and contains a CPS Duration parameter, this value shall be used.
   2) Otherwise, the CPS Duration value shall be set to infinite.

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b) Each SEndPoint shall be initialised with the CPS Size length value on the corresponding axis, which is retrieved as follows:

   1) If the action Set CPS is targeted to this channel and contains a CPS Size parameter:

      i) if the length of the CPS Size is provided on an axis, this value shall be used for this spatial axis.

      ii) otherwise, the length of the CPS Size on this axis shall be set to 0.

   2) Otherwise, the CPS Size length value on each axis shall be set to the default SEndPoint value.

   NOTE: When different MHEG objects are generated by different authors and are used in the same application, if each of these authors uses the default channel, it is recommended that all the authors should be aware of the current CPS definition of the default channel, if it has been changed.

   3) Otherwise, the OS length value is set to 0 on each axis.

c) The AVR shall be set as defined by ISO/IEC 13522-1.

There is no scaling factor associated with the CPS axes.

9.4 Relative presentation space (RPS)

The Relative PS of an rt-component is the PS into which the rt-component is assigned and projected. Each rt-component is assigned to only one RPS at a given time. The following RPS are defined:

a) PRPS (Parent RPS): A socket may be projected within the OPS of its rt-composite parent, in order to describe a composition in time, space or audio. This may be repeated recursively, if the rt-composite parent is itself an rt-composite socket.

b) CRPS (Channel RPS):

   1) A socket may also be projected directly within a CPS when this socket does not participate to the composition in time, space or audio described by its parent.

   2) Each root rt-composite is projected into a CPS.

Initially, each root rt-component is assigned to the default channel, and each socket is assigned to its parent rt-composite PS. This RPS assignment may be changed by the use of the Set RPS Assignment action.

The following RGU along each RPS axis are defined:

- The GTU along the RPS temporal axis is called RGTU (Relative GTU).
- The GSU along each RPS spatial axis is called RGSU (Relative GSU).
- The GVU along the RPS AVR is called RGVU (Relative GVU).

The attributes defined for each rt-component within the OPS are projected into the assigned RPS as follows:

- POD (Projected OD): projection of the OD in the RPS and shall be computed as follows: OD x GTF = POD.
- PVD (Projected Visible Duration): projection of the VD shall be computed as follows: OVD x GTF = PVD.
- POS (Projected OS): projection of the OS in the RPS and shall be computed as follows: OS x GSF = POS.
- PVS (Projected Visible Size): projection of the OVS and shall be computed as follows: OVS x GSF = PVS. The PVS value may also be set directly by the use of the Set OVS action with the OVS Proj Strategy attribute as "calculated".

The attribute defined for each rt-content within the OPS is projected into the assigned RPS as follows: PCV (Projected Current Volume): Projection of the CV in the RPS and shall be computed as follows: CV x GVF = PCV.

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9.5 CPS mapping

Each CPS is a virtual space. It is up to the MHEG Engine to assign a physical PS to a virtual space, and to convert virtual coordinates (GU) to physical coordinates.

Each CPS is assigned to a physical PS by the MHEG Engine. The descriptor object may provide information to facilitate this mapping such as the followings:

- expected media type mapping may be provided to facilitate the assignment to a physical PS;

  NOTE 1: The MHEG Engine may associate the CPS with physical devices such as TV sets, workstations, cameras, windows, loudspeakers and microphones.

- recommended resolution for the physical PS axes may be provided for satisfactory rendition: x-resolution, y-resolution, z-resolution and t-resolution.

  NOTE 2: Authors should take into account the limited possibilities of minimum resource equipment, and should not require unduly fine resolutions.

- recommended audio dynamic range and a recommended minimum and maximum frequency for playback may be provided to present audible data with an appropriate amplitude.

The virtual coordinates shall be converted to physical coordinates as follows:

- The CPS temporal axis is mapped to a physical temporal axis. The physical temporal units are expressed in milliseconds. 1 CGTU is mapped to 1 PTU.
- The CPS spatial axes are mapped to physical spatial axes. The physical spatial units depend on each physical PS, e.g. a pixel, 1 millimetre. 1 CGSU is mapped to 1 PSU.

  NOTE 3: In performing the mapping of each spatial axis onto the physical space, the MHEG Engine is responsible that the direction of each spatial axis (see Figure 11) si correctly perceived by the user. Therefore, considering a CPS Y axis defined as [0, 65535] in the upward direction, it might be required that this Y axis be mapped onto a physical range [0, 479] in the downward direction for a computer display.

- The CPS AVR is mapped to a physical AVR. The physical audible volume units are expressed in decibels [dB] with respect to the physical AVR's limit. 1 CGVU is mapped to 1 PVU.

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10 Generic Identification Mechanism

MHEG provides generic mechanisms to identify any MHEG entity, data or stream.

There are three types of identification mechanisms:

- External identification: This identification is not encoded within an MHEG object. The external identifications can be decoded for reference purposes without having to decode the MHEG object (see clause 10.1).
- Internal identification: This identification is encoded within the MHEG object. The internal identification cannot be discovered until an MHEG object is decoded (see clause 10.2).
- Symbolic identification: This identification may replace any other external or internal identification (see clause 10.3).

  NOTE: External and internal identification should not be confused with remote and local objects. A local or remote object may have an external or an internal identification.

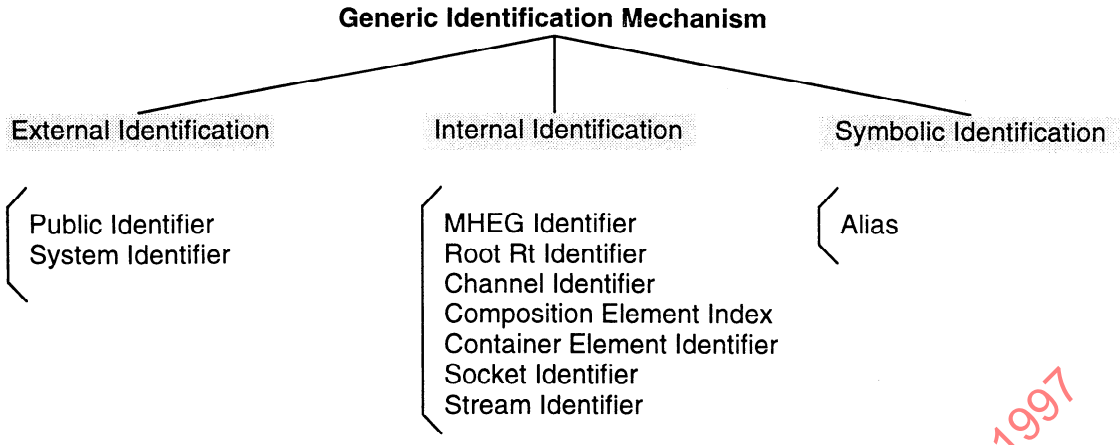

Figure 13 - Overview of the generic identification mechanism

10.1 External identification

The external identification mechanism is not defined by ISO/IEC 13522-1. External identifiers are not encoded within the MHEG object to which they refer.

NOTE: Identification and references should be distinguished. The external identification is not encoded within the MHEG object, whereas reference to an MHEG object is encoded within an MHEG object, even if it uses an external reference.

The external identification mechanism may be used to identify any MHEG object or data not included in a content or a script object.

This technique is defined in ISO 8879 "Formal Public Identifiers", and ISO 9070 "Registration procedures for public text owner identifiers" that specifies both ASN.1 and SGML notations for the representation of registered owner identifiers. The external identifier consists of;

– a public identifier (see clause 10.1.1),

– a system identifier (see clause 10.1.2).

10.1.1 Public identifier

A public identifier is a character string whose syntax is given by subclause 10.2 of ISO 8879:1986. A public identifier shall be encoded as an ASN.1 PrintableString.

NOTE: The encoding method for public identifiers of ISO/IEC 13522-1 simplifies that of ISO 9070 defined in informative annex D in order to ease implementation.

EXAMPLE: The example of a public identifier in Figure 14 identifies the image of Lena, the lady with the hat, as it is stored in the system. The example of a public identifier in Figure 15 identifies a remote object requiring telecommunication access. A complete example of a public identifier is given in Figure 16.

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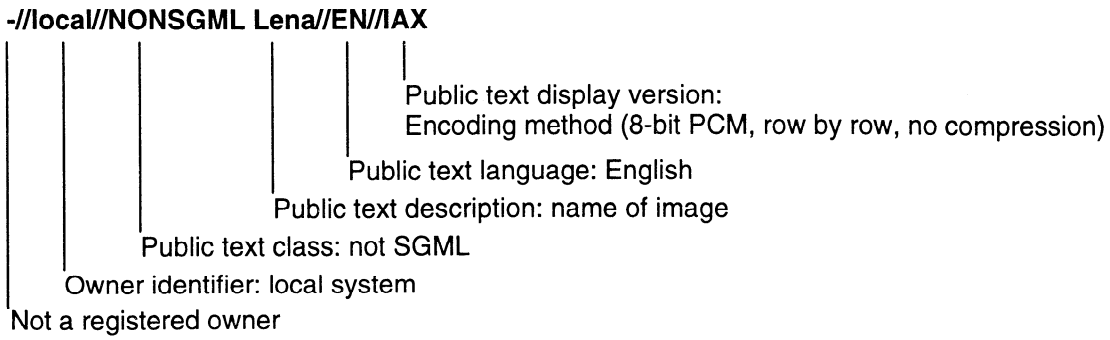

Figure 14 - Example of a public identifier for a non-registered owner

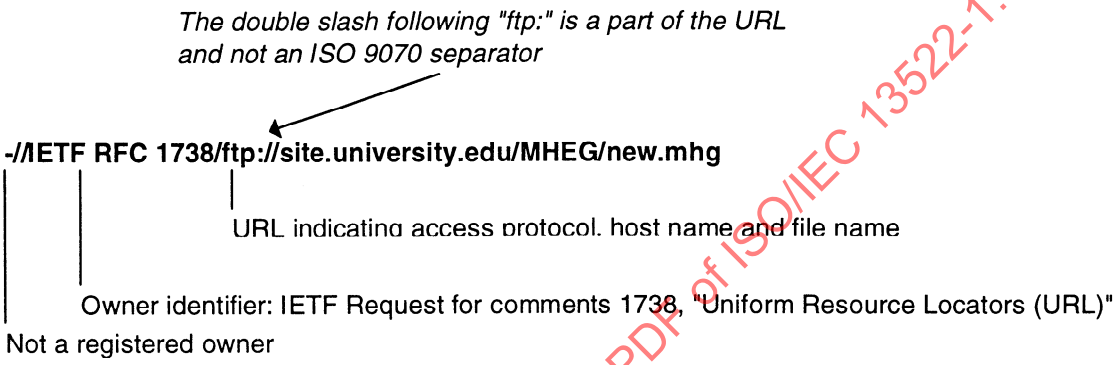

Figure 15 - Example of a public identifier for a URL (Uniform Resource Locator)

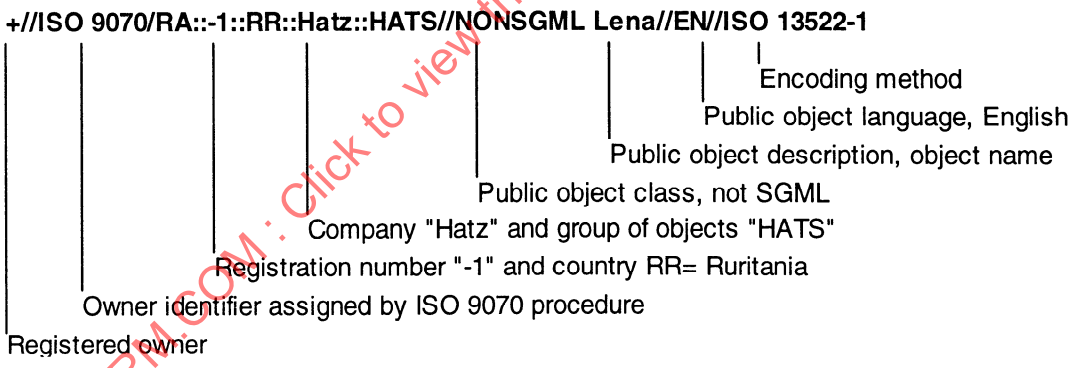

Figure 16 - Example of a public identifier for a registered owner

In Figure 16, imagine a Ruritanian hat manufacturer called Hatz who applies to the ISO 9070 Registration Authority and is issued the registration number -1. The company follows the recommended conventions and decides to begin the owner-name components with: "/RR:Hatz".

The Hatz company decides to set up a group of public MHEG objects containing description of the hats. The additional owner-name component is HATS thus making the full owner name: ISO 9070/RA::-1::RR::Hatz::HATS.

10.1.2 System identifier

A system identifier provides a system-dependent means of identifying a particular piece of information within the system. It may also be used to indicate the system that supplies the information. The character set and the syntax of the system identifier is not defined by ISO/IEC 13522-1 and depend on the system. The system identifier shall be encoded as an ASN.1 OctetString.

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NOTE: The system identifier may be used to describe a database or telecommunications request for an object.

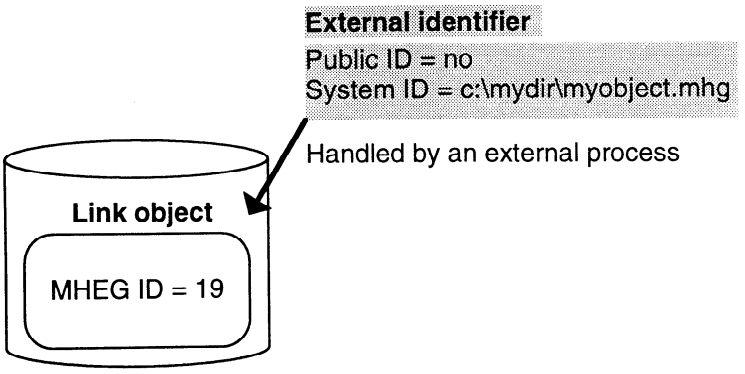

Figure 17 - Example of a system identifier without public identifier

Figure 17 shows that identification mechanisms may be combined. This link object has an internal identification encoded internally using an MHEG identifier, and an external identification external to the object, that uses an external identifier.

10.2 Internal identification

The internal identification mechanism is encoded within MHEG objects.

The following internal identifications are provided by ISO 13522-1 to identify entities not included in other MHEG entities:

- MHEG Identifier: Identify an MHEG object (see clause 10.2.1),
- Root Rt-Identifier: Identify a root rt-object (see clause 10.2.2),
- Channel Identifier: Identify a channel (see clause 10.2.3).

The internal identification is also used to identify an element within a constructed entity:

- An index provides an identification for an element of a given generation within a constructed entity. Each element is indexed within a generation by sequential integers starting from one. The following notation is used to express index: outer_object_identification.i, where "i" indicates the index within the outer object, e.g. the third element of container object with MHEG ID 1000 is expressed by 1000.3.
- A tail provides an identification of an element within a hierarchy of constructed entities. A tail is a list of indexes and it describes a path from an outer entity through an element. Each index corresponds to an index of an element within the constructed entity. Successive indexes correspond to nested elements. The last index in the list is the index of the element to be identified. The following notation is used to express tail: outer_object_identification.i1.i2.i3....in, where "i1.i2.i3....in" is a list of indexes indicating the path from the outer object through the element.

The following internal identifications are also provided in ISO 13522-1 to identify an element:

- **Composition Element Index**: Identify any element of a composite (see clause 10.2.4),
- **Container Element Identification**: Identify any element of a container (see clause 10.2.5),
- **Socket ID**: Identify any socket (see clause 10.2.6),
- **Stream ID**: Identify any stream within a multiplexed content object (see clause 10.2.7).

10.2.1 MHEG Identifier

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An MHEG identifier may be assigned to each MHEG object. When used the MHEG Identifier shall be encoded within the MHEG object and shall be composed of the following:

- an optional **application identifier**, which is provided by the application designer. It shall be encoded in ISO/IEC 13522-1 as an ASN.1 octet string.
- an **MH number**, which uniquely identifies an MHEG object within an application. The mh number shall be encoded as an integer. When the MHEG identifier is present, it is mandatory.

A reserved MHEG identifier is provided to identify a null MHEG object: "Null-Mh".

It is the object designer's responsibility to ensure that MHEG identifiers are unique among the MHEG objects.

The following notation is used to express MHEG identifiers: a1.a2.a3...an-m, where "a1.a2.a3...an" represents the application identifier and m represents the mh number. When the application identifier is omitted, the MHEG identifiers are expressed using the following notation m.

EXAMPLE: A content object may have the following MHEG identifier: 129.63.24.2-49, and another composite object may have the following MHEG identifier: 700, which means that this composite has no application identifier.

10.2.2 Root Rt-ID

A root rt-identifier shall be assigned to each root rt-object. This identifier shall be composed of the following:

- The **model object identification**, which identifies the model object. Any one of the identifications of an MHEG object may be used to identify this model object, e.g. MHEG identifier, Container Element Index, External ID, Alias.
- an **rt-number**, which is an integer that identifies the root rt-object with regard to a modef object.

A reserved root rt-identifier is provided to identify a null rt-object: "Null-Root-Rt".

It is the object designer's responsibility to ensure that root rt-identifiers are unique.

The unicity of an rt-numbers with regard to a model object is required at a given instant. An rt-number may be reused once this number is again available, i.e. once the rt-object that was using it is deleted. At a precise instant, there shall not be two rt-objects with the same rt-number.

The following notation is used to express root rt-identifiers: model_object_identification:r, where model_object_identification may be any one of the identifications of an MHEG object and "r" is the rt-number.

EXAMPLE: The first rt-composite object created from the composite object identified by MHEG identifier: 700 has as root rt-identifier: 700:1. The third rt-content object created from the content object identified by MHEG identifier: 129.63.24.2-49 has as rt-identifier 129.63.24.2-49:3.

10.2.3 Channel identifier

A channel identifier shall be assigned to each channel. This identifier is an integer.

A reserved channel identifier is provided to identify the default channel: "Default-Channel".

It is the object designer's responsibility to ensure that channel identifiers are unique.

10.2.4 Composition element index

The index facility is used in a composite object to identify each element within the composition.

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Each composite object defines one generation. The indexes of elements whose associated models are included within the composite object with non-empty associated models are provided by the author. The missing indexes, which represent referenced model objects, are automatically provided by the MHEG Engine; these elements are considered as elements with an empty associated model.

EXAMPLE:

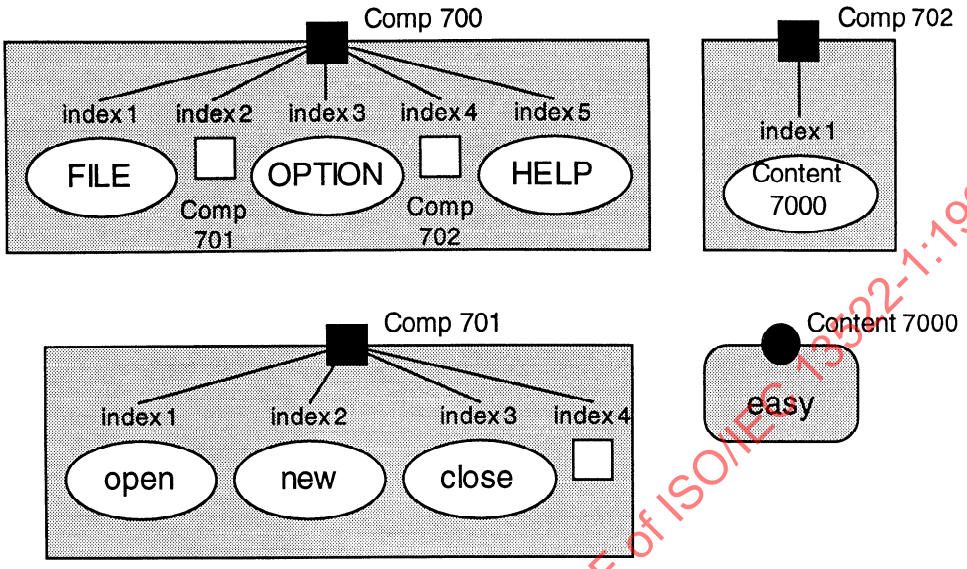

Figure 18 - Indexing of elements in a composite object

In Figure 18, the five elements in composite object 700 are identified with indexes 1, 2, 3, 4 and 5. The four elements in composite object 701 are identified with indexes 1, 2, 3 and 4. The single element in composite object 702 is identified by index 1. Comp 701 and Comp 702 that are associated models of Comp 700, and Content 7000 that is an associated model of Comp 702, are referenced rather than included. They are identified by using either their own identifier or the index of the composite elements with which they are associated.

NOTE: The element index is typically used at the: time of construction of the rt-composite.

10.2.5 Container element identification

The index facility is used in a container object to identify each element within the container. When a container object contains a hierarchy of embedded container objects, the tail facility is used to identify the embedded elements in the hierarchy of container objects.

Each container object defines one generation. The indexes of elements are automatically provided by the MHEG Engine and are indexed in each generation from one, sequentially.

An element in a container object is always an MHEG object. A container element, which is an MHEG object, may already be assigned another identifier, e.g. an external identifier or an MHEG identifier. In this case this element has two different identifications, either as an element of a container or as an MHEG object directly.

NOTE: The index or tail within a container is typically used to obtain rapid access to elements of a container. When a Prepare action is targeted to an MHEG object using its identification within a container, e.g. 1000.3, element 3 of container 1000, the object may be picked out of the container with minimal processing by the MHEG Engine. If an MHEG identifier is encoded within this object, this identifier is available to the MHEG Engine as soon as the object is prepared. It is recommended that further actions on this object typically use the MHEG identifier rather than the container indexing.

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EXAMPLE:

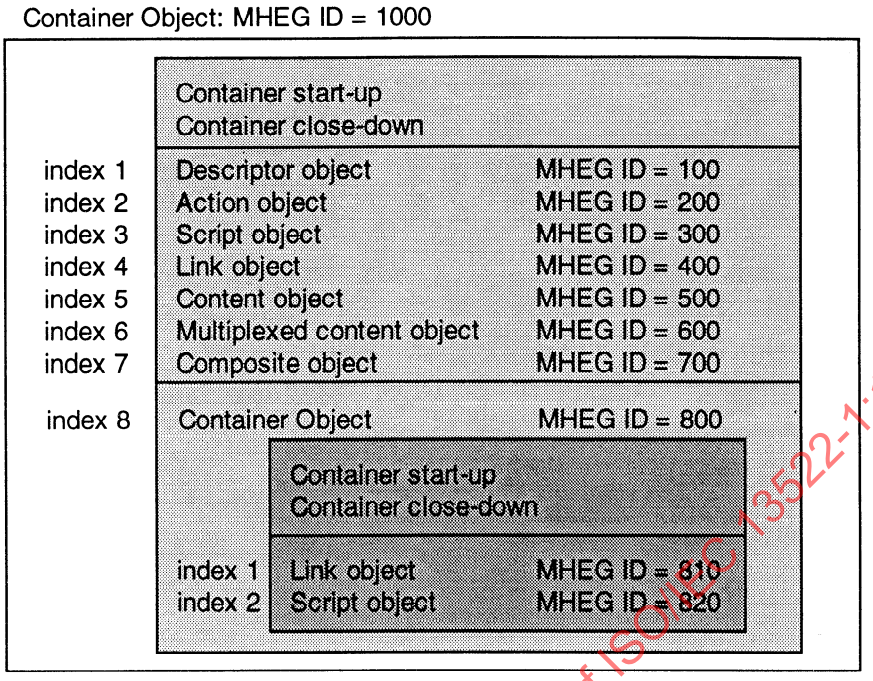

Figure 19 - Indexing of elements in a container object

In Figure 19, the elements defined in the container object are MHEG objects; they are identified by an index or a tail within the container, e.g. index 1 of container 800 or tail 1000.8.1.or tail 800.1 identifies the link object with MHEG ID 810. An MHEG identifier and an external identifier may be also provided for each object.

10.2.6 Socket identifier

The index facility is used to identify each element of a given generation of an rt-composite. The tail facility is used in a root rt-composite object to identify each element within the rt-composite.

Each root rt-composite defines a complete hierarchy. In each generation of an rt-composite, the sockets are indexed from one, sequentially and deduced from the composite object model. The tail is used to identify each socket indicating the path from the root rt-composite through the socket.

EXAMPLE:

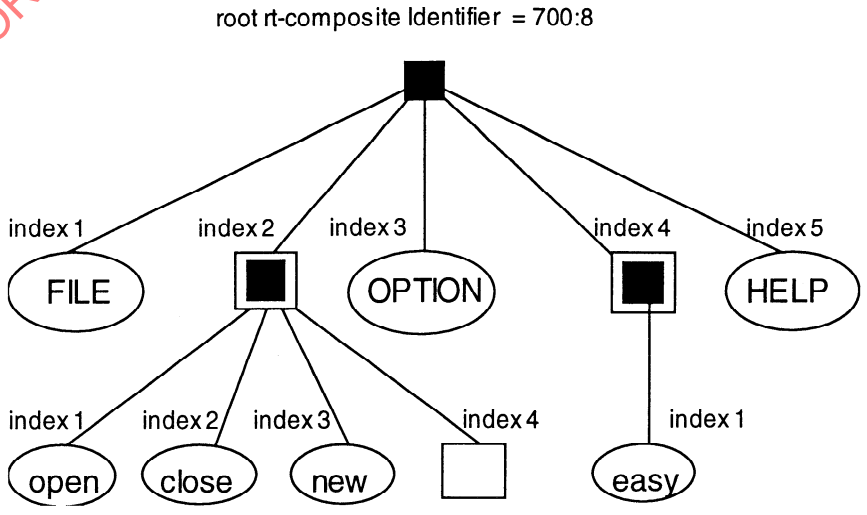

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Figure 20 - Indexing of sockets

Figure 20 shows an rt-composite that is a result of a New action applied on an rt-composite made from the model composite object 700 shown in Figure 18. The rt-number is 8. This rt-composite is made either directly from the composite object 700 or from the same object considered as element 7 in container 1000.

The sockets in the first generation are identified by indexes 1, 2, 3, 4 and 5 like the elements in the composite 700 or as tails 700:8.1, 700:8.2, 700:8.3, 700:8.4 and 700:8.5.

NOTE: These objects can also be identified by tails: 1000.7:8.1, 1000.7:8.2, 1000.7:8.3, 1000.7:8.4 and 1000.7:8.5, because 700:8 can be identified by 1000.7:8 (see clause 10.2.5 and also its note).

The three sockets in the second generation below index 2 of first generation are identified with indexes 1, 2, 3, 4 like the elements in the composite 701 or as tails: 700:8.2.1, 700:8.2.2, 700:8.2.3.

The socket in the second generation below index 4 of first generation is identified with index 1 as is the element in the composite 702 or as tail: 700:8.4.1.

10.2.7 Stream identifier

A stream identifier is used to identify each stream within a multiplexed content object. This identifier is expressed as a tail and designs a path from an outer stream to an inner stream within the multiplexed data.

It is the object designer's responsibility to ensure that stream identifiers are unique within a given multiplex.

10.3 Symbolic identification

ISO/IEC 13522-1 provides a means of assigning a symbolic identification that may be used to replace any other internal or external identification. This symbolic identification is called alias.

The alias mechanism features:

- addressing entities using an another name.
- regrouping entities to which the same actions are to be applied at the same time. In this case, the alias mechanism provides a group reference rather than a symbolic identification;
- Multivaluation of objects using a delayed assignment of alias; A complete application may be described by an author using an alias. The real assignment of the entity may be done later dynamically.

NOTE 1: This can be especialy useful for multilingual/internationalisation, multiresolution media format, multiversion of objects and multiencoded media format. For example, an author provides one object for the different languages and the actions are described by using aliases. Then Set Alias actions are used to assign the correct language when needed.

An alias is a string that is used as a convenient alternative for an other identification format. An alias is assigned using the Set Alias action.

NOTE 2: The alias is different from the object name in the MH-object class.

NOTE 3: For example, Set Alias(START, "e:\appli\start-up.mhg"). This alias is an alternative identification for the external ID identified as "e:\appli\start-up.mhg".

NOTE 4: For example, Set Alias(OPTION, 700:8.2). This alias is an alternative identification for the socket 2 of root rt-composite number 8 created from composite model 700 (see Figure 20).

A given entity may have several aliases assigned at the same time. A given alias may be assigned to several entities at the same time.

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11 Generic Reference Mechanism

MHEG entities, data and streams need to be referenced either from another MHEG object or as a parameter of an action. Targets of an action also address the MHEG entities using their reference.

11.1 Generic reference using generic identification

The following references mechanisms are defined:

a) **External ID Reference**: reference to an MHEG object or a data using its External ID (see clause 10.1).

b) **MHEG ID Reference**: reference to an MHEG object using its MHEG ID (see clause 10.2.1).

NOTE 1: The reference to an MHEG identifier cannot be resolved until the referenced MHEG object is decoded. A using application may provide a mechanism to resolve this reference without decoding the object, e.g. using a map of the location of an MHEG object to its MHEG identifier.

c) **Root Rt-ID Reference**: used to reference a root rt-object. It is specified as a reference to the model object followed by a reference to an rt-number. The model object is referenced using one of the references defined for an MHEG object. The reference to an rt-number is one of the following:

1) an rt-number: used to reference a root rt-object.

2) the constant *****: used to reference, all the root rt-objects created from the specified model object when this reference is resolved.

3) the constant **?**: used to reference a single dynamically determined rt-number (see clause 11.3).

EXAMPLE: For example, taking into account the composite object defined in Figure 18 and

Figure 19:

- 700:* represents a reference to all the root rt-composite objects created from this composite object model upon the resolution of this reference.

- 700:? represents a reference to a dynamically determined root rt-composite object created from this composite object model.

d) **Channel ID Reference**: reference to a channel using its Channel ID (see clause 10.2.3).

e) **Tail Reference**: This reference cannot be used directly by the author; it is part of the Container Element Reference and of the Socket ID Reference. It is defined as one of the following:

1) tail: used to reference a given element using its tail identification (see clause 11.1).

2) tail complement: defined as either **children** or **descendants**. When used alone, it references the child elements, i.e. one generation or all generations (the descendant elements of the outer entity itself).

3) tail followed by a tail complement: the tail complement, in that case, applies to the element referenced using the tail identification. This element shall be itself a constructed entity, i.e. another container object or an rt-composite socket.

f) **Container Element Reference**: reference to an MHEG object using its Container Element. It is specified as a reference to the container object followed by a **Tail Reference**. The container object is referenced using one of the references defined for an MHEG object. The tail reference is used to reference:

1) a single MHEG object, or an element of the container;

2) the children of the outer container object;

3) the children of a container object which is an element of the outer container object;

4) the descendants of the outer container object;

5) the descendants of a container object that is an element of the outer container object;

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NOTE 2: In Figure 19, 1000.8.children or 800.children represents a reference to the two elements within this embedded container, i.e. link object 810 and multiplexed content object 820.

NOTE 3: 1000.descendants represents a reference to all the elements within container 1000 and within the embedded container 800.

NOTE 4: The reference to a container element cannot be resolved until the referenced container object is decoded. However, if the author has provided an offset information within the descriptor (see clause 0.5.3.9) for a container element, an MHEG Engine may use this offset information to decode only the specified container element without decoding the rest of the container object.

NOTE 5: If an author has provided additional identification to a container element, e.g. an MHEG identifier, this container element may be also referenced using one of the references defined for an MHEG object.

g) **Socket ID Reference**: used to reference a socket. It is specified as a reference to the root rt-composite followed by a **Socket Tail Reference**. The root rt-composite is referenced using a Root Rt-ID Reference. The socket tail reference allows an author to reference

1) a single socket;

2) the children of the root rt-composite;

3) the children of an rt-composite socket within the root rt-composite;

4) the descendants of the root rt-composite;

5) the descendants of an rt-composite socket within the root rt-composite.

h) **Socket Tail Reference**: this reference cannot be used directly by the author; it is part of the Socket ID Reference. It is defined as one of the following:

1) a tail: used to reference a given socket using its tail identification (see clause above).

2) a socket tail complement: It is defined as one of the following:

i) the constants provided by a tail complement, i.e. children or descendants (see clause above). Used alone, the tail complement applies to the root rt-composite itself;

ii) the constant **?child** used to reference a single dynamically determined socket within the root rt-composite itself;

iii) the constant **?descendant** used to reference a single dynamically determined socket within the descendant sockets of the root rt-composite itself. When ?child or ?descendant is used, the technique to determine the socket is the same as for ? (see clause 11.3). The individualisation phase, in this case, is made on each child or descendant socket of the specified root rt-composite.

NOTE 6: The ?child and ?descendant facilities may be used as follows: for example, a root rt-composite describes a menu; each socket is an item. When one of the items is selected, the same behaviour is specified. This behaviour is processed individually each time one of the items is selected. This is described in a single link using the ?descendant or ?child facilities. The number of sockets children or descendants may be changed during the life of the menu; the link always applies.

3) a tail followed by a socket tail complement: the tail complement, in thid case, applies to the socket referenced using the tail identification. This socket shall be an rt-composite socket.

NOTE 7: In Figure 20, 700:8.children represents a reference to all the child elements of the root rt-composite (indexes 1 to 5, first generation).

NOTE 8: 700:8.2.children represents a reference to all the child sockets of the rt-composite socket 700:8.2 (indexes 1 to 4, 2nd generation).

NOTE 9: 700:8.descendants represents a reference to all the descendant sockets of the root rt-composite (all generations).

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NOTE 10: 700:?.1 represents a reference to rt-content socket (FILE) of a dynamically determined root rt-composite created from composite object model 700.

NOTE 11: 700:?.descendants represents a reference to all descendant sockets of a dynamically determined root rt-composite created from composite object model 700.

NOTE 12: 700:*.1 represents a reference to the rt-content socket 1 (FILE) of all the root rt-composite objects created from this composite object model at the moment of the resolution of this reference.

NOTE 13: 700:?descendant represents a reference to a single dynamically determined socket between the descendant socket (all generations) of the root rt-composite.

NOTE 14: 700:?child represents a reference to a single dynamically determined socket between the child socket (open, close, new, index) of the rt-composite socket 700:8.2.

NOTE 15: 700:?.?child represents a reference to a single dynamically determined socket between the child socket (one generation) of a dynamically determined root rt-composite created from composite object model 700.

i) **Stream ID Reference**: reference to a stream using its Stream ID (see clause 10.2.7).

j) **Alias Reference**: reference to an MHEG entity or a data or a stream using one of its assigned aliases (see clause 10.3). The reference to an alias cannot be resolved until the alias has been assigned.

11.2 Predefined references

The following predefined reference constants value are also defined:

a) **Null-Data**: reference to a null data.

b) **Null-Mh**: reference to a null MHEG object.

c) **Null-Root-Rt**: reference to a null root rt-object.

d) **Default-Channel**: reference to the default channel.

e) **"This"**: reference to a composite or a container within its dynamic scope. A composite or a container object may be referenced using any one of the referencing techniques defined for an MHEG object (e.g. MHEG ID reference, container element reference, alias reference, external identifier reference) or by using the "this" facility provided for local referencing purposes within the scope of composite or the container object itself. "This" shall be used only within a link or an action object; it shall not be used either within a container element reference or within a component object reference of a composition element. The following applies:

   1) When a composite or a container object is prepared, "this" shall take the value of the composite or the container object identification. When the start-up link, rt-start-up and container start-up are activated, the value of "this" is propagated to them.

   2) The propagation of the value of "this" to a link object shall have the effect of replacing each occurrence of "this" within the link condition by the value of "this"

   3) When such a link is fired, the value of "this" shall be propagated to its link effect. The following applies:

      i) Each occurrence of "this" within the usage value of the macro resolution and within the action object shall be replaced by the value of "this". If the action object is a nested action object, any occurrence of "this" within all embedded action objects shall also be replaced by the value of "this".

      ii) If the link is a nested link object, the value of "this" shall also be propagated to the embedded link objects.

NOTE 1: "This" is a local variable within the dynamic scope of the composite or the container.

NOTE 2: In Figure 18, the availability start-up of the composite object has the following link effect: New this:1, Activate link L1. The link object L1 is defined as follows: TC = this:1.3 becomes selected, LE = Run (this:1.5). When the

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composite 700 is prepared, the start-up is activated, the root rt-composite number 1 is created and the value this = 700 is propagated to link object L1.

11.3 ? reference

? is used in link and action objects to describe an individual behaviour common to all root rt-objects created from a given model object. The advantages of this facility are:

- the behaviour is described only once and applied to all the root rt-objects created from a same model object;
- the object designer is able to describe an individual behaviour for each root rt-object without knowing the number of root rt-objects that will be created from the given model object;
- once activated, the link applies to all root rt-objects already created as well as future created root rt-objects.
- this facility allows a complete independence between all the root rt-objects created from the same model, i.e. they may be presented independently, the behaviour is an individual behaviour attached to each root rt-object.

The reference "model_object_identification:?" can be used in a link or in an action object wherever an rt-object reference is allowed. However, the following applies:

- If the link object is not an embedded link, the reference "model_object_identification:?" shall be used in the source value of at least one trigger condition in order to assign a usage value to ?.

  NOTE 1: The composite rt-availability start-up link answers this requirement, its link condition is "this:? becomes available". All embedded links activated from the rt-availability start-up are active for each new created root rt-composite.

- In an embedded link object, the ? can be used for different model objects, e.g. the following references "model_object_identification1:?", "model_object_identification2:?" can be used in the same embedded link object.

  NOTE 2: It is deprecated to use ? with different model object identifications in a non-embedded link object. Because the ? value is resolved when a trigger condition becomes true and only one trigger condition becomes true at a given time. So, in that case only one ? is resolved and all other references are considered as "undefined" references.

The determination of the rt-number to be taken into account in the place of each ? is highly dynamic. When a non-embedded link object is activated, the following phases applies:

a) Each link object containing a trigger condition with a source value encoded as "model_object_identification:?" is to be evaluated in parallel for each root rt-object created from the indicated model_object_identification. For that purpose, all instances of ? with the same model_object_identification within the link condition are replaced by a given instance of a root rt-object rt-number in each parallel evaluation.

   NOTE 3: During the activation of such a link object, the root rt-objects created from the indicated "model_object_identification" may vary, i.e. additional root rt-objects may be created or some of them may be destroyed.

b) If a trigger condition becomes true for a given root rt-object and if the link condition is satisfied, its rt-number becomes the "? usage value". Each instance of ? with the same model_object_identification is replaced by the "? usage value" in the following places:

   1) Within the link effect. If the action object defining the link effect is a nested action object, the "? usage value" is also propagated to each instance of the ? with the same model_object_identification within the embedded action objects.

   2) When an embedded link object is activated from this link object, the following applies:

      i) a specific instance of the embedded link object handles this "? usage value".

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ii) the "? usage value" is propagated to each instance of the ? with the same model_object_identification within this instance of embedded link.

iii) If this instance of the embedded link object contains some ? not resolved within a trigger condition, the same phases, i.e. 1) and 2) apply.

iv) If some ? remains unresolved after all phases 1) and 2), the corresponding references are to be considered as "undefined".

c) Phase 1 is processed in parallel on all root rt-objects created from the model object. If the link condition of a nested link object becomes true for two root rt-objects in parallel in phase 1, e.g. 700:3 and 700:4, the phase 2 is to be processed for each ? usage value in parallel. That is, if the link effect activates an embedded link, two instances of this embedded link are handled in parallel for both ? usage values of 700:3 and 700:4

NOTE 4: If the link is deactivated, this link cannot be fired for any "? usage value".

EXAMPLE 1: This example takes into account composite object defined in Figure 18:

Its start-up may have the following link effect: new 700:3, new 700:9

Its rt-availability start-up link effect is: activate link object L1.

Link L1 is an embedded link object, it is defined as follows: TC = 700:?.3 becomes selected, LE = run 700:?.5. This link is used to describe an individual behaviour common to all root rt-composites which may be created from model object 700, i.e. for 700:3, 700:9 but also for any future root rt-composite created from the model 700.

The following applies:

- When the rt-availability start-up is activated, i.e. each time a new root rt-composite is created, an instance of L1 handles this new root rt-composite. The rt-number of this new made root rt-composite is considered as the "? usage value" and is transmitted to this instance of L1.
- In fact, there is one instance of link L1 per root rt-composite already created from 700. So we can consider that link L1 is active for all root rt-composite created from 700 and that its trigger is evaluated each time the selection status of the socket 3 of any root rt-composite created from 700 changes.
- When the trigger of an instance of link L1 becomes true for a root rt-composite, e.g. 700:2, the link condition becomes true and the value of this root rt-composite rt-number is considered as the "? usage value". This value is transmitted to the link effect of this instance of link L1. So the fifth socket of 700:2 becomes running.
- When both 700:2.3 and 700:3.3 are selected in parallel, two instances of the link L1 are satisfied in parallel, their link effect is to be performed in parallel. That is, socket 5 of 700:2 and socket 5 of 700:3 becomes running in parallel.

EXAMPLE 2:

Link object L1 is defined as follows: TC = 700:?.3 becomes selected, LE = run (700:?.5), activate (link object L2, link object L3).

Link L2 is an embedded link object defined as follows: LC: 900:3.1 becomes selected AND 700:?.2 is running, LE: stop 700:?.5 run 700:?.2.

Link L3 is a more complex embedded link object, it is defined as follows: LC: 999:?.1 becomes selected AND (700:?.5) is running, LE: stop (999:?.1, 700:?.5) run (999:?.2, 700:?.2)

The following applies:

- Instances of Link L1 are handled as explained in the previous example.
- Consider now that an instance of L1 link condition is satisfied for 700:7, 7 becomes the "? usage value" for composite 700. This value is transmitted to the link effect of this instance of L1. That is, the socket 5 of 700:7 becomes running as in the previous example, but additionally links L2 and L3 are activated.

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- When L2 is activated, an instance of L2 handles the "? usage value" and all appearances of 700:? are replaced by 700:7 in the link effect of this instance. When this instance of link L2 is handled and when its link condition becomes true, i.e. 900:3.1 is selected and 700:7.2 is running, then 700:7.5 is stopped and 700:7.2 becomes running.
- When L3 is activated, and instance of L3 handles the "? usage value" and all appearances of 700:? are replaced by 700:7 in the link effect of this instance. As one ? is remaining in a trigger condition, the instance of link L3 is evaluated in parallel for all root rt-composites created from 999. If the trigger condition of this instance of L3 is valid for 999.9, the "? usage value" 9 is replaced in this instance and so 999:9.1 and 700:7.5 are stopped and 999:7.2 and 700:7.2 becomes running.

12 Generic Value

This clause describes the mechanisms provided by ISO/IEC 13522-1 for specifying values in a generic way. The generic values may be used to express:

- elementary action parameters,
- get action parameters,
- conditions,
- MHEG object attributes.

A generic value may be defined as follows:

- **constant**: a specific constant is also provided to identify an unspecified value: "unspecified".

  NOTE 1: The "unspecified" value is used in link condition as a comparison value.

- **evaluated values**: an evaluated value is the result of the process of a get action by the MHEG Engine. When the MHEG Engine cannot process a get action, this get action is evaluated as the constant value "undefined".

  NOTE 2: The generic values shall be stored in and retrieved from the data field of a content object.

The type of a generic value is one of the following:

- Generic Boolean (see clause 12.1),
- Generic Numeric (see clause 12.2),
- Generic Integer (see clause 12.3),
- Generic Ratio (see clause 12.4),
- Generic String (see clause 12.5),
- Generic Reference (see clause 12.6),
- Generic List (see clause 12.7).

It is the object designer's responsibility to ensure that the generic values given as parameters of actions conform in type and number to the specification of the parameters as specified in ISO/IEC 13522-1. If the actual parameters do not conform in type or number to what is expected, it is an error and the action shall be ignored.

The type of a generic value determines the following:

- The set of values that it can possibly take;
- The common semantics of these values.

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12.1 Generic boolean

A generic boolean value shall be either one of the following values: TRUE, FALSE.

The generic boolean value may be specified as follows:

- a boolean constant;
- a result of the evaluation of a get action;
- a result of a logical operation within a link condition;
- a result of a comparison operation within a link condition.

12.2 Generic numeric

A generic numeric value shall be a numeric. Numerical values are not restricted in any way. Numeric values may be integer, real or complex; however, the coded representation may impose reductions. The ASN.1 syntax supports only integer values.

NOTE: It is recommended that authors assume this limitation.

A generic numeric value may be used as follows:

- a numeric constant;
- a result of the evaluation of a get action.

12.3 Generic integer

A generic integer value shall be an integer.

The generic integer value may be used as follows:

- an integer constant;
- a result of the evaluation of a get action.

12.4 Generic ratio

A generic ratio value shall be a pair of integers (m, n) with m being the numerator and n the denominator of a fraction. If n is omitted, it is assumed to be 100, interpreting m as a percentage. n shall be greater or equal than 1.

A generic ratio value may be used as follows:

- a ratio constant;
- a result of the evaluation of a get action.

12.5 Generic string

A generic string value shall be a string of any number of characters. The coding scheme of string values is not restricted in any way. The values may be represented in any code sets. However, the coded representations may impose limitations. The ASN.1 syntax supports only GraphicString.

NOTE 1: It is recommended that the authors assume this limitation.

GraphicString contains all G sets + SPACE as defined in ASN.1. Such specification allows for international string.

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The string is considered as a whole, i.e. the component characters cannot be addressed individually.

NOTE 2: Typically, the character string is used as a label, e.g. "Help".

The generic string value may be specified as follows:

– a string constant;

– a result of the evaluation of a get action.

NOTE 3: Lowercase and uppercase characters are dictinct from each other.

12.6 Generic reference

A generic reference shall be one of the references defined by ISO/IEC 13522-1 (see clause 10).

A generic reference value may be used as follows:

– a reference constant;

– a result of the evaluation of a get action.

12.7 Generic list

A generic list value shall be an ordered set, possibly empty, of generic values of any type. Each element of a generic list value may have a distinct type from the other elements of the list. Each element of a generic list is implicitly indexed.

NOTE 1: An element of a list may be another generic list.

NOTE 2: Each element, within a list or a sublist, may be retrieved separately using the Get Data action facility.

NOTE 3: The generic list type may be used to construct vectors (same type for all elements of the list) and compound sets (sets of elements of various types).

A generic list value may be used as:

– a list of constants;

– a result of the evaluation of a get action.

13 Macro Mechanism

The macro mechanism is a general way of producing efficient coding of frequently used action and link objects in which only a few values are changed from one to another. This allows the sharing and reuse of complex behaviours. An author may create a catalogue of predefined action and link object templates, that are also called macro action object and macro link object (see clause 19.5). In a macro action object or a macro link object, at least one attribute is encoded as a macro parameter value.

A macro parameter value shall be composed of:

– a Macro Def ID: It shall be either a string or an integer. It is used as a symbol representing the macro parameter. A given Macro Def ID may be used by many macro parameter values.

– a Default usage value: It shall be a value to be assigned to the attribute encoded as a macro parameter value when the macro usage value assignment is omitted.

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Each link object contains an optional set of attributes called "macro parameter resolution" and which is used to resolve the macro parameter value contained in its link effect. Each macro parameter resolution is composed of a Macro Def ID and the corresponding macro usage value to be assigned to the Macro Def ID.

When a link object is fired, the link effect is to be processed. The first step of this process is called the macro resolution phase and is limited to this link effect process.

NOTE 1: As the same link may be fired several times in parallel, therefore, the macro resolution phase is limited to a given link effect process.

The aim of this phase is to assign a macro usage value to each macro parameter value contained in the link effect. Each macro parameter resolution is propagated to the action object describing the link effect. The following applies:

- If this action is a nested action object, the macro parameter resolution is also propagated to the embedded action object.
- If an embedded link object is activated from this link effect, the macro parameter resolution is propagated to this embedded link object except if this embedded link object itself contains a macro parameter resolution which uses the same Macro Def ID.

During the propagation phase, for each macro parameter value,

- The Macro Def ID of the macro parameter value shall be retrieved from one of the propagated macro parameter resolution: This macro parameter value shall be replaced by the corresponding macro usage value of this propagated macro parameter resolution.

  NOTE 2: Even if the usage value is not compatible with the expected type of the attribute encoded as macro parameter value, the MHEG Engine shall assign it. It is for the object designer to ensure compatibility.

  NOTE 3: If the usage value is an evaluated value, the macro parameter value shall be replaced by this Get action without processing it.

- Otherwise, this macro parameter value is replaced by the corresponding default usage value encoded within this macro parameter value. If no default usage value is provided, this macro parameter value shall be replaced by the value "undefined".

NOTE 4: These abbreviations are used for the following examples:

MPR: Macro Parameter Resolution

MDI: Macro Def ID

MUV: Macro Usage Value

DUV: Default Usage Value (When DUV is omitted, no default usage value is provided.)

ALE: Action in Link Effect

EXAMPLE 1: Simple link effect

L1 has following specifications:

- LC1: button1 becomes selected
- MPR1: (MDI = TARGET1, MUV = 700:1), (MDI = TARGET2, MUV = 700:2)
- ALE1: New(MDI = TARGET1), New(MDI = TARGET2), Run(MDI=TARGET1), Run(MDI=TARGET2)

If LC1 is satisfied, the macro resolution phase is processed and ALE1 is processed as follows:

- ALE1: New(700:1), New(700:2), Run(700:1), Run(700:2)

EXAMPLE 2: Embedded action within link effect

L2 has following specifications:

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– LC2: button1 becomes selected

– MPR2: (MDI = SYNC, MUV = serial), (MDI = TARGET1, MUV = 700:1), (MDI = TARGET2, MUV = 700:2)

– ALE2: ActionObject1

And ActionObject1 is as follows:

– Synchro indicator: SYNC

– Action set: New(TARGET1), Run(TARGET1), Stop(TARGET2)

If LC2 is satisfied, the macro resolution phase is processed and each MUV is propagated to ActionObject1. And ActionObject1 is processed as follows:

– Synchro indicator: serial

– Action set: New(700:1), Run(700:1), Stop(700:2)

if synchro indicator is resolved as "undefined", the action is not processed

Example 3, embedded links within link effect

L3 has following specifications:

– LC3: button1 becomes selected.

– MPR3: (MDI = TARGET1, MUV = 700:1)

– ALE3: New(TARGET1), Activate(L10), Activate(L20)

L10 is as follows:

– LC10: if TARGET1 is "not running"

– MPR10: none

– LE10: Run(TARGET1)

And L20 is as follows:

– LC20: if TARGET1 is "not running"

– MPR20: (MDI = TARGET1, MUV = 999:1)

– ALE20: New(TARGET1), Run(TARGET1)

If LC3 is satisfied, MPR3 is propagated to ALE3, L10 and L20. And L10 is processed as follows:

– LC10: if 700:1 is "not running"

– LE10: Run(700:1)

However, L20 is processed as follows:

– LC20: if 700:1 is "not running"

– ALE20: New(999:1), Run(999:1)

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14 Hooks

This clause describes handling of hooks, which are used in content, script and descriptor objects. Hooks provide the information for the type identification of the encoded data. A hook consists of the encoding information that identifies the encoding method and an optional encoding description that may be used to specify parameters of the encoding method.

Two kinds of hooks are provided, one for the content data and another for the script data.

a) **Content hook**: Composed of an identification field for the data encoding standard and a descriptive field:

1) The content encoding information contains an identification of the content encoding standard. A wide range of existing encoding standards such as MPEG, G711 or JPEG are maintained in the registered catalogue using the procedure described by ISO/IEC 13522-4. Private encoding formats can also be provided using a proprietary catalogue.

2) The content encoding description gives a more precise description of the characteristics needed to decode the content. The semantics of these parameters are not defined by ISO/IEC 15522-1 but are given by the semantics of the data encoding standard or recommendation with respect to the using application. Such information may also be provided within the content encoding catalogues.

b) **Script hook:** Composed of an identification field for script representation and a descriptive field:

1) Scripting encoding information contains an identification of the script encoding standard. A wide range of existing encoding standards are maintained in the registered catalogue using the procedure described in ISO/IEC 13522-4. Private encoding formats can also be provided using a proprietary catalogue.

2) Script representation description gives a more precise description of the characteristics needed to decode the script. The semantics of these parameters are not defined by ISO/IEC 15522-1 but are given by the semantics of the data encoding standard or recommendation with respect to the using application. Such information may also be provided within the script encoding catalogues.

15 Extensibility

The following extensibility mechanisms is provided:

– catalogues (see clause 15.1),

– incorporation of new MHEG object classes (see clause 15.2),

– extensibility provision (see clause 15.3).

15.1 Catalogues

A set of catalogues may be used to maintain compatibility between MHEG Engines and to allow extensibility. New concepts may be made available to all MHEG systems by registering a reference to a format identifier in a registered catalogue or only to one group of applications by registering it in a proprietary catalogue.

– The registered catalogues are maintained according to ISO/IEC-13522-4. Standardised, well-known concepts are listed in the registered catalogue. It is permitted to register new concepts in this catalogue.

– Application-specific concepts reside in the proprietary catalogue, which is private to only one set of applications. These catalogues may only be referenced by special MHEG Engines. The maintenance of the proprietary catalogue is assured by the using application.

Within each catalogue, an optional description may be associated with each entry to clarify its usage.

An MHEG Engine may take any catalogue entry into account, thereby, introducing the concept of this entry within its process. When an author provides an MHEG object or an action using such an entry, this MHEG Engine should be able to process this object or this action. If the author uses an entry unknown to the MHEG Engine, the MHEG object or the action sahll be ignored by this engine.

For each of the following attributes used by ISO/IEC 13522-1, a registered catalogue is provided, and a using application may also maintain a proprietary catalogue for private use:

– **Content encoding** contains a precise description of the content encoding methods that may be used in the content hook, e.g. ISO 13818-1. A content encoding description may be associated with each entry of this catalogue.

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- **Content classification** is provided as an optional assistance in determining the type of content data. It provides information on the type of data. For media data it is used to indicate the perception media, e.g. text, graphics, audio. This information may be used in a negotiation process, a database, or by an MHEG Engine to choose a decoder.
- **Script encoding** contains the script representations that may be used in the script hook (e.g. JAVA, Lingo, ISO 13522-3). A script encoding description may be associated with each entry of this catalogue
- **Script classification** is provided as an optional assistance in determining the type of script representation. This information may be used in a negotiation process, a database, or by an MHEG Engine to choose a script interpreter.
- **Media type** contains the medium type that may be used in the descriptor object in order to help the mapping of a channel to a physical device, e.g. text, still image or video.
- **Style** contains the styles that may be used in the set style action, e.g. for user interaction: button, slider, entry field. The styles may depend on the GUI on the platform and on user personalisation. Additional information may be associated with each entry of this catalogue in order to define the style more precisely, e.g. a value range for a slider, an orientation for a menu.
- **Event** contains a list of catalogued event identifiers (e.g. mouse click, keyboard key pressed, remote control command) that may be used in the descriptor object to indicate the expected mapping of event identifiers provided by the author to the catalogued event identifiers. Additional information may be associated with each entry of this catalogue in order to define the event more precisely, e.g. the position of the click.
- **Extended elementary action** contains a list of catalogued elementary actions used in the "catalogued elementary action" action. These catalogued elementary actions are used to extend the number of elementary actions defined by ISO/IEC 13522-1, e.g. draw a line, arithmetic operation. Additional information may be associated with each entry of this catalogue in order to define the behaviour of an action more precisely, e.g. the parameters, the MHEG effect, the allowed periods, additional error conditions.
- **Extended attribute** contains a list of catalogued attributes used in the "set catalogued attribute" action. These catalogued attributes are used to extend the number of attributes of MHEG entities defined in ISO/IEC 13522-1, e.g. colour, text fonts. Additional information may be associated with each entry of this catalogue in order to define the attribute more precisely, e.g. the type.

15.2 Incorporation of New MHEG object classes

ISO/IEC 13522-1 reserves numbers 0 to 9999 of ASN.1 OBJECT IDENTIFIER arc3. The numbers from 0 to 9999 shall not be used privately. However, a using application may use other numbers to create new object classes, that may be complete new object classes or modifications of existing object classes.

15.3 Provision for extensibility

To enable extension of attributes, "Extensibility is provided for throught used of ASN-1 extension markers. "Extensibility Provision" is added to the following places in the ASN.1 grammar:

- the "elementary action" attribute;
- the "evaluated value" attribute;
- the "description" attribute of the MH-object class;
- every leaf classes of MHEG object.

For each "Extensibility Provision" attribute, a list of tags numbered from 0 to 9999 is reserved for use in other parts of ISO/IEC 13522. Reserved tags shall not be used privately.

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Section 3: Overview of MHEG classes

The following clauses present the structure provided by ISO/IEC 13522-1 to interchange multimedia and hypermedia information. An MHEG Engine shall be able to parse this structure.

16 MHEG Object Classes Overview

The object-oriented approach is used because it fits the requirements of active, autonomous and reusable objects. The interchanged object classes are classified as shown in Figure 21. Every interchanged object belongs to one of the **emphasised** classes. Abstract classes are used to describe common attributes or to group classes dealing with similar topics. ISO/IEC 13522-1 does not define methods in its classes. Thus, the use of the object-oriented paradigm is limited to attribute inheritance.

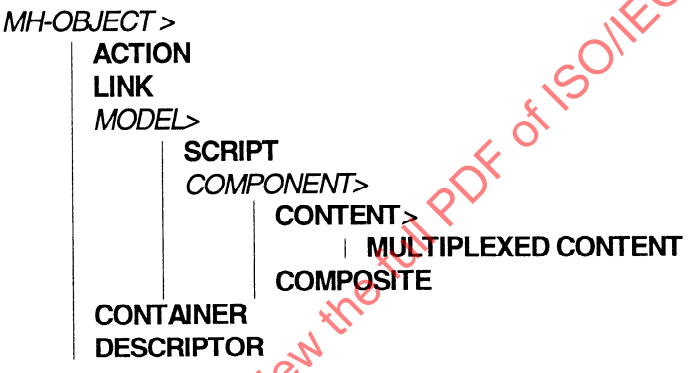

Figure 21 - MHEG Inheritance Tree

In Figure 21, the greater-than sign (>) means "has the following subclasses". Only the instances of classes that are emphasised may be interchanged. The useful definitions are not considered to be a separate class. They are merely a convenient grouping of utility attributes.

17 Structure of Mh-Object Class

This clause describes the common structure for the interchange of MHEG objects, i.e. the instances of MHEG classes, defined by ISO/IEC 13522-1. This mechanism provides a consistent approach to the identification and interchange of MHEG objects.

The MH-Object class provides the information in the next subclauses for the identification of MHEG objects.

17.1 Class identification

The class identification is composed of the identification of the standard, the standard version and a specific identifier unique for each MHEG object class. The class identification attribute is encoded at level C using the ASN.1 technique of OBJECT IDENTIFIER (see clause 8.2.3.1). To ease encoding, this attribute is not encoded within MH-Object class at level C. This attribute is encoded individually for each interchanged class in order to assign a unique number for each class instead of inherited directly from Mh-object class.

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17.2 MHEG ID

An MHEG ID may be provided to identify an interchanged object within the scope of an application.

17.3 General object information

The MH-Object class gives supplementary information for an MHEG object as follows:

a) Name of the MHEG object

b) Owner of the MHEG object

c) Version of the MHEG object

d) Last modification date of the MHEG object

e) List of keywords describing the MHEG object

f) Readable copyright information relative to the MHEG object

g) Copyright identifier used by an authorised organisation to identify the copyright work type of the MHEG object. For example:

   1) ISBN (part of ISO/IEC 13522 Book Number) for a book;

   2) ISSN (part of ISO/IEC 13522 Serial Number) for a periodical publications;

   3) ISRC (part of ISO/IEC 13522 Record Code) for a sound recording;

   4) ISAN (part of ISO/IEC 13522 for Audiovisual Number) for an audiovisual application.

h) Copyright number used by certain authorised organisation to identify the copyright information assigned to the MHEG object within a copyright identifier scope, e.g. 2-11072557-5 is an ISBN copyright number.

i) Readable licence information relative to the usage of the MHEG object

j) Cache priority, which may be used by the MHEG Engine as a hint of how to manage the MHEG objects. This is an integer in the range from 0 to 255. The value 0 means that the MHEG Engine should delete the object from its memory space entirely if it receives a Destroy action. The value 255 means that the MHEG Engine is should cache the MHEG object within its memory space at the time of a Destroy action. Other values may be interpreted by each MHEG Engine independently taking the range into account. However, the MHEG Engine is not required to follow this instruction. This is only provided as a hint information for the MHEG Engine.

k) Readable comments relative to the MHEG object

l) Extensibility provision used by other standards which describe an extension of ISO/IEC 13522-1

18 Structure of Action Class

The action class defines a reusable arrangement of elementary actions. Action objects that are instances of the action class are used in link objects in order to describe their link effects. A given action object may be addressed by many link objects. Several link conditions in different links may be satisfied at the same instant and are assumed to be fired and processed in parallel. Therefore, the processing of actions describing the link effect has a local effect limited to the link itself.

The MHEG action class consists of following attributes:

– A synchro indicator specifies the type of processing of the synchronised actions. Two values are defined: "parallel" and "serial". When it is set to "serial", all the actions within the "synchronised action set" should be processed in sequence. When it is set to parallel, all these actions should be processed in parallel (see clause

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31.3). Since synchronised actions may be processed in parallel, it is the author's responsibility to take into account any side effects due to the parallelism. Specification of contradictory actions is deprecated.

NOTE 1: An action object that calls for a parallel run and stop of an rt-content is ambiguous since the final state is not defined.

NOTE 2: An action object that calls in the same serial group for an rt-content to run and stop after a delay of one second is not ambiguous. The rt-content is to be presented for one second.

NOTE 3: An MHEG Engine is not required to perform true parallel processing, but authors must organise the group as if they were to be processed in parallel.

– A synchronised action set is a set of elementary actions and/or other embedded action objects.

Using this structure, an author is able to describe the following action objects:

– Basic action object (see clause 18.2),

– Nested action object (see clause 18.3),

– Macro action object (see clause 18.4).

18.1 Elementary actions

ISO/IEC 13522-1 defines a list of elementary actions that may be included in an action object to modify the behaviour of MHEG entities (see section 4), e.g. Prepare, Run. The structure of each elementary action is as follows:

– A target set is defined as a list of generic references or only one generic reference. Each elementary action is to be processed on the specified target set. If more than one target is specified in the target set, whatever the value of the synchro indicator is, the elementary action should be processed in parallel on all the targets specified in the target set. Authors should assume that the MHEG Engine applies the elementary action to the multiple targets in parallel.

NOTE: A common target set may be specified for several elementary actions by using the alias mechanism (see clause 10.3) or macro parameter mechanism (see clause 13).

– An optional transition duration may be provided for some elementary actions. A transition duration shall be expressed in GTU. When a transition duration is specified, the corresponding elementary action should be processed during this transition duration. When no transition duration is specified, a null duration should be used.

– The specific action parameters are defined for each elementary action (see sections 4, 5, 6, 7 and 8).

18.2 Basic action object

A basic action object contains only elementary actions. It does not contain macro parameters or embedded action objects within its synchronised action set.

NOTE: The using application is responsible for determining the appropriate number of elementary actions.

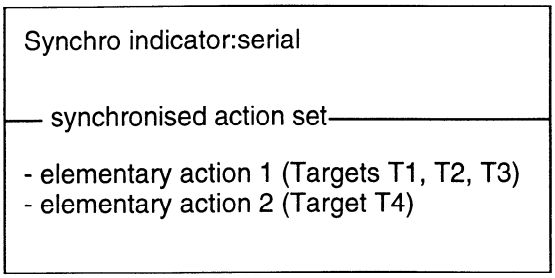

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Figure 22 - Example of a basic action object

In Figure 22, the MHEG Engine completes the parallel processing of the MHEG effect of elementary action 1 on targets T1, T2 and T3. When completed, the MHEG effect of elementary action 2 is processed on T4.

18.3 Nested action object

To describe more complex behaviours, an embedded action object may be contained in the synchronised action set. The embedded action object maybe itself a nested action object. A complete hierarchy of action objects may be designed using this mechanism.

NOTE: The using application is responsible for determining the appropriate depth of nesting.

EXAMPLE:

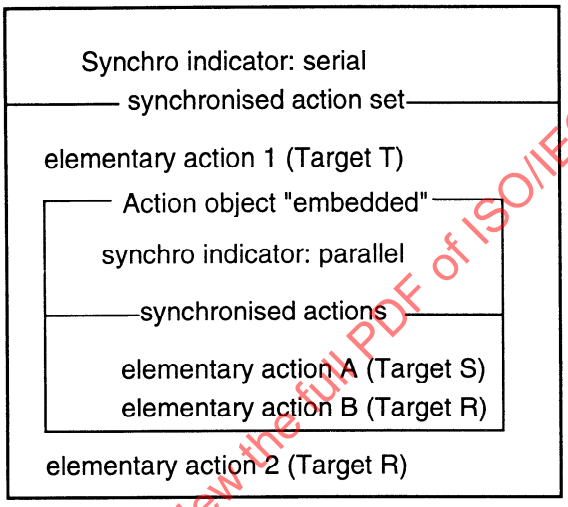

Figure 23 - Example of a nested action object

In the example of Figure 23, the MHEG Engine processes the MHEG effect of elementary action 1 on target T. When completed, the MHEG Engine processes, in parallel, the MHEG effect of elementary action A on target S and the MHEG effect of elementary action B on target R. When completed, the MHEG effect of elementary action 2 is processed on target R.

18.4 Macro action object

To produce efficient coding of frequently used action objects in which only a few values change from one link to another, the synchro indicator attribute of an action object and each parameter of an elementary action may be specified as a macro parameter value. A macro action object shall contain at least one macro parameter value.

Each macro parameter value should be resolved when the link object which uses this action is fired (see clause 19.3).

19 Structure of Link Class

An MHEG link class is used to specify spatial, temporal and conditional relations between, and actions upon, MHEG entities. The link contains a condition, evaluates to true which when satisfied or provokes the processing of actions on targets that produce the required effect. The link is said to be fired.

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Only those link objects that have been activated may be fired (see clause 29.2). Several link conditions in different links may be satisfied at the same instant and are assumed to be fired and processed in parallel by the MHEG Engine.

The link object is separated from the objects that produce the triggering contexts. The basic behaviour of each MHEG entity (e.g. volume, channel on/off) is part of the entity itself. During the life of the entities, change in the behaviour may be used to trigger a separate link object that calls for the actions to be processed. These actions, in turn, modify the basic behaviour of any other MHEG entity, for example, to increase a volume. This may in turn generate further changes in behaviour and trigger further links.

Every instance of a link class shall contain a link condition and a link effect.

Using this structure, an author can describe the following types of link objects:

- Basic link object (see clause 19.3),
- Nested link object (see clause 19.4),
- Macro link object (see clause 19.5).

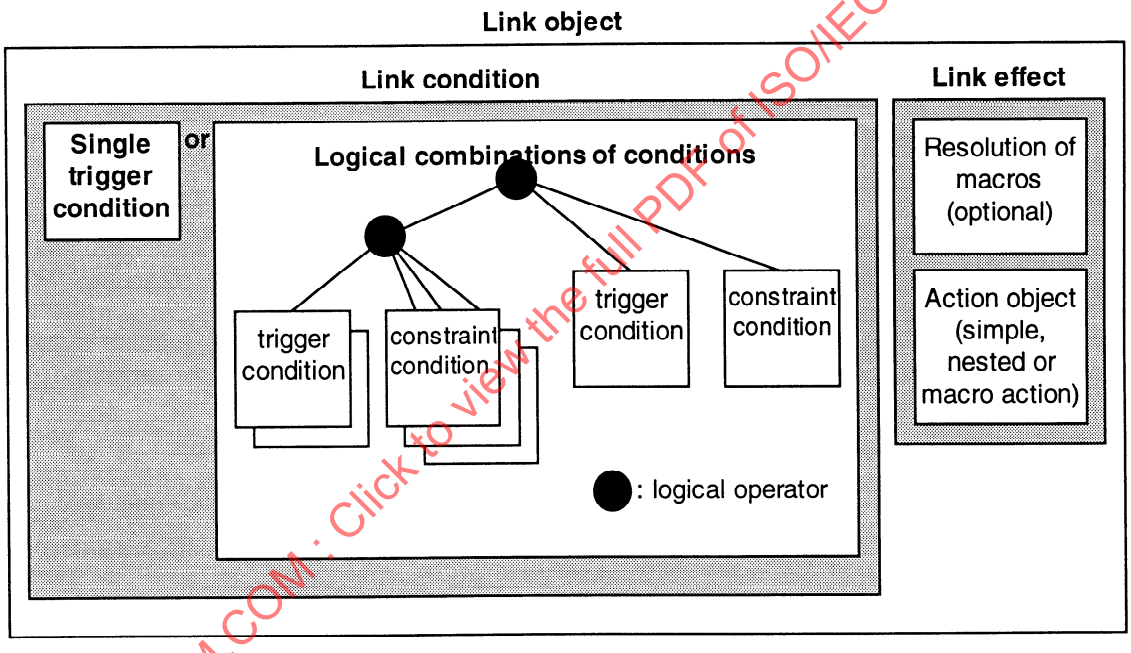

Figure 24 - Link object structure

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19.1 Link Condition

The link condition shall be either a trigger condition (see clause 19.1.1) or a logical combination of trigger and constraint conditions (see clause 19.1.8).

The link condition shall be evaluated as follows:

- When a link object becomes active, the link condition is evaluated to false.

  If the link condition is a single trigger condition, the link condition evaluates the value of the trigger condition. If the link condition is a logical combination of conditions, the link condition evaluates the value of the top node of the logical tree combining the conditions (see

  Figure 25).

– If the link condition is evaluated to true, the link is fired, i.e. its link effect is processed by the MHEG Engine (see clause 31.2). If the link condition is evaluated to false or "undefined", the link is not fired, i.e. its link effect is not processed.

A link may be fired several times during its activation, i.e. every time its link condition becomes true.

19.1.1 Trigger condition

A trigger condition describes the occurrence of a change in MHEG entities, that triggers the link. The trigger is described as a change of attribute or status value of an MHEG entity. The following behaviour changes may be triggered:

– Temporal changes: raised by timestones or delay;

– Action changes: consequences of any elementary action;

– Interaction changes: occur, for example, when the user selects a menu or clicks on a button;

– Any catalogued event changes: occur, for example, when a system event happens.

The trigger condition is expressed as a transition, i.e. as a double condition on the same source. It is composed of:

– a source value;

– a previous condition, which expresses the condition to be satisfied before the transition occurs;

– a current condition, which expresses the expected condition to satisfy after the transition occurs.

A trigger condition evaluates to either a boolean value or "undefined". The following applies:

a) When a link object becomes active, each trigger condition is evaluated to false.

b) The previous condition of each trigger condition shall be evaluated.

c) The source value of each trigger condition shall be an evaluated value on a target attribute or a status, e.g. get preparation status(target). When the value of this attribute or status changes, the following steps shall be applied to the corresponding trigger condition:

   1) Assign this value to the current comparison value and evaluates the current condition.

   2) Evaluate the trigger condition as the logical operation: "previous condition" AND "current condition".

      i) If the result is true and if the link condition is defined as a single trigger condition, the link condition shall be evaluated to true.

      ii) If the result is true and if this trigger condition is part of a logical combination of conditions, this logical combination of conditions shall be evaluated (see clause 19.1.8).

   3) The trigger condition shall be evaluated to false.

   4) Go to b).

   NOTE: Steps c1 to c4 should be considered as an atomic operation for link, i.e. if a value tested by a trigger condition changes while the MHEG Engine is processing steps c1 to c4, the processing of such a change is delayed until the current processing enters in step c.

EXAMPLE: Table 1 shows some examples of trigger conditions. In the example, Get CV(rt-content N) means Get CV action targeted to the rt-content N in order to retrieve the current audible volume (CV), Get Event(rt-content N) means Get Event action targeted to the rt-content N in order to retrieve the number of most recently happened event, and Get Data(content A) means Get Data action targeted to the content object A in order to retrieve the contained generic value contained.

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Table 1 - Examples of trigger conditions

Trigger source value	Previous condition		Current condition		Semantics	Nature of the Change
	Operator	Previous value	Operator	Current value		
Get CV (rt-content N)	==	10	<	5	rt-content N had CV equal to 10, and decreases to less than five.	Change from a specified previous value to a specified current value.
Get CV (rt-content N)	==	Get Data (content A)	<	Get Data (content B)	rt-content N had CV equal to the value specified in the data of content object A, and changes to a value less than that of the value in content object B.	
Get CV (rt-content N)	any	"unspecified"	any	"unspecified"	The CV of rt-content N has changed. The value is not significant.	Change from an "unspecified" value to an "unspecified" value. The trigger is on a change of the source value without regard for its previous and current values.
Get CV (rt-content N)	==	10	any	"unspecified"	The CV of rt-content N was 10 and has changed. The new value is not significant.	Change from a specified value to an "unspecified" value. The trigger is on a change of the source value without regard for its current value.
Get CV (rt-content N)	any	"unspecified"	>	10	The CV of rt-content N becomes greater than 10. The previous value is not significant. NOTE that the previous value may have been greater than 10.	Change from any previous value to a specified current value range.
Get CV (rt-content N)	any	"unspecified"	==	10	The CV of rt-content N becomes equal to 10. The previous value is not significant. NOTE that the previous value may have been equal to 10.	Change from an "unspecified" value to a specified current value. The trigger is on a change of the source value whatever its previous value.
Get CV (rt-content N)	<	Get CV (rt-content P)	>	Get CV (rt-content P)	The CV of rt-content N was less than the CV of rt-content P and has become greater.	Change with respect to other rt-contents.
Get Event (rt-content N)	any	"unspecified"	==	10	The event 10 has occurred on rt-content N. The previous event value is not significant.	Becomes true any time event 10 is raised.
Get Event (rt-content N)	==	10	==	10	The previous event occurred to rt-content N was 10. The same event occurs again.	Becomes true for each successive rising of the event 10.
Get CV (rt-content N)	Previous condition is omitted, i.e. it is the negation of the current condition		>=	5	The CV of rt-content N was less than 5 and increases greater than or equal to 5. The previous condition is interpreted as CV<5. The previous value range is (-∞, 4), the current value range is (5, +∞). These two value ranges do not overlap and their union is the whole range of integer numbers.	Change from a previous value range to a current value range where the two value ranges do not overlap and where the union of the value ranges is the largest possible value range. In that case, the previous condition is omitted, and so interpreted as the negation of the current condition.

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19.1.2 Constraint condition

A constraint condition may be provided within a logical combination of conditions. It expresses a required contextual state as one of the trigger conditions is satisfied. A constraint condition is used to specify more precisely the context in which the link condition is satisfied.

A constraint condition is composed of a source value and a current condition which expresses the expected condition to satisfy.

NOTE: Constraints do not require a previous condition because they express contextual states as the trigger is satisfied.

A constraint condition evaluates a boolean value or "undefined". It is satisfied when the specified current condition is satisfied for the source value. Constraint conditions are to be evaluated as one of the trigger condition becomes true.

Table 2 shows some examples of constraint conditions.

Table 2 - Examples of constraint conditions

Source Value	Current condition		Semantics
	Operator	Current value	
Get CV (rt-content N)	<	5	rt-content N has CV value less than five.
Get CV (rt-content N)	<	Get Data (content A)	rt-content N has CV value less than that of the value in content object A.
Get CV (rt-content N)	==	5	rt-content N has CV value equal to five.

19.1.3 Source value

The source value is used as the base of the comparison described in the previous condition and the current condition. The presence of the source value in a condition is mandatory.

The source value shall be provided by an evaluated value, i.e. it is expressed as a result of a get action.

19.1.4 Comparison value

The comparison value is to be compared to the source value using the comparison operator in the previous and the current conditions. The presence of the comparison value in the condition is mandatory.

The comparison value is specified as one of the following:

a) An evaluated value, result of a get action.

b) A constant value.

c) One of the comparison value constants defined by ISO/IEC 13522-1, e.g. "ready", "not ready" for the preparation status.

d) "Unspecified" value to indicate that the value to be compared with the source is not significant; what is significant is that the value has changed. The following applies:

1) within a trigger condition:

i) within the previous condition: it means that the trigger condition is on a change of the source value whatever its previous value was.

ii) within the current condition: it means that it is a condition on a change of the source value whatever its current value becomes.

iii) within both the previous and the current condition: it means that it is a condition on a change of value whatever its previous value was and whatever its current value becomes.

NOTE: The current value may be the same as the previous value, but the engine as wilfully set the same value to an attribute or a status. This is particularly useful for successive raising of the same event (see clause 6.3.7) or timestone (see clause 72.16.14), i.e. the same event may occur several times, each time the event identifier is set to the corresponding value.

2) Within a constraint condition: it means that the constraint condition is always evaluated to true.

19.1.5 Previous condition

The previous condition is used in a trigger condition only. It is composed of a comparison operator and a previous comparison value.

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The previous comparison value is a generic value (see clause 12).

When the previous condition is omitted, the previous condition is to be interpreted as the negation of the indicated current condition, and the following applies:

- The comparison operator of the previous condition shall be the negation of the comparison operator of the current condition.
- The comparison value of the previous condition shall be the same as the comparison value of the current condition.

The previous condition shall be satisfied when the result of the comparison operation between the source value and the previous comparison value using the specified comparison operator is evaluated to true.

19.1.6 Current condition

The current condition is mandatory in a generic condition, and it is composed of a comparison operator and the current comparison value.

The current comparison value is a generic value (see clause 12).

The current condition shall be satisfied when the result of the comparison operation between the source value and the current comparison value using the specified comparison operator is evaluated to true.

19.1.7 Comparison operator

The comparison operator used in the previous and the current condition shall be one of the following:

- == equal,
- != not equal,
- < less than,
- <= less or equal,
- > greater than,
- >= greater or equal.

NOTE 1: A using application may provide other comparison operators.

A comparison operation is a comparison between the source and a comparison value.

The result of the comparison is as defined in Table 3.

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Table 3 - Comparison operations

Comparison operator	Source value (SV)	Comparison value (CV)	Result value (Boolean or "undefined")	Remarks
==	Generic boolean Generic numeric Generic integer Generic ratio Generic string Generic reference Generic list	Generic boolean Generic numeric Generic integer Generic ratio Generic string Generic reference Generic list	True: if SV == CV False: otherwise	 see a) see b) see c) see d)
!=	Generic boolean Generic numeric Generic integer Generic ratio Generic string Generic reference Generic list	Generic boolean Generic numeric Generic integer Generic ratio Generic string Generic reference Generic list	True: if SV != CV False: otherwise	 see a) see b) see c) see d)
<	Generic numeric Generic integer Generic ratio Generic list of generic numeric / generic integer / generic ratio	Generic numeric Generic integer Generic ratio Generic list of generic numeric/ generic integer/ generic ratio	True: if SV<CV False: otherwise	 see a) see d)
<=	Generic numeric Generic integer Generic ratio Generic list of generic numeric / generic integer / generic ratio	Generic numeric Generic integer Generic ratio Generic list of generic numeric / generic integer / generic ratio	True: if SV<=CV False: otherwise	 see a) see d)
>	Generic numeric Generic integer Generic ratio Generic list of generic numeric / generic integer / generic ratio	Generic numeric Generic integer Generic ratio Generic list of generic numeric / generic integer / generic ratio	True: if SV>CV False: otherwise	 see a) see d)
>=	Generic numeric Generic integer Generic ratio Generic list of generic numeric / generic integer / generic ratio	Generic numeric Generic integer Generic ratio Generic list of generic numeric / generic integer / generic ratio	True: if SV>=CV False: otherwise	 see a) see d)
any	any	CV type is not the same as SV type	False	see e)
any	any SV type "undefined" "undefined" "undefined"	"undefined" any CV type "unspecified" "undefined"	"undefined"	see f)
any	any SV type	"unspecified"	True	see g)

ISO/IEC 13522-1 does not define the semantics of operations on types of values different from those presented in Table 3. If such an operation is to be processed by the MHEG Engine and if no semantics has been provided by the using application, this operation is evaluated to the value "undefined".

True > False and "Hello" <= "Bye!" are evaluated to "undefined".

In order to evaluate a result of some operations, the following applies:

a) Two generic ratios shall be compared as follows:

1) If the denominator is omitted, it shall be assumed to be 100.

NOTE 2: For example: (10/100) == (10/omitted) is true.

2) A generic ratio is reduced if it is not irreducible. This reduction should be done only for comparison purposes. The value of the generic ratio still remains as it was before reduction.

NOTE 3: For example: (10/100) becomes (1/10) for comparison.

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b) Strings shall be compared character by character. Uppercase characters are distinguished from the lowercase characters.

NOTE 4: A string comparison is similar to a comparison between two lists (see clause below). To be equal two strings need to have the same size, and each character needs to be identical.

NOTE 5: For example, comparison of strings: "HELLO" == "HELLO" is true. "hello" == "HELLO" is false. "Hello" != "Hello" is false.

c) Two references shall be compared on the addressed entities. Two different references may address the same entity. In that case, the comparison for equality is evaluated to true. A comparison may be made between references addressing groups of entities. In that case, the comparison is made on level of the addressed entities. The comparison for equality between two groups with different numbers of entities shall be evaluated to false. When the MHEG Engine cannot compare two references, the result of the comparison shall be evaluated to "undefined".

NOTE 6: This situation may occur when references are not yet resolved by the MHEG Engine or when a reference addresses an unknown object.

NOTE 7: For example: A content object has MHEG ID 1000 and its external ID is "e:\mydir\content.mhg". 1000 == "e:\mydir\content.mhg" is true. If an alias, e.g. ContentA, is assigned to this content, ContentA == 1000 is true, ContentA != "e:\mydir\content.mhg" is false.

d) Two lists shall be compared as follows:

1) If the two lists have different lengths (i.e. not the same number of elements) the result of the comparison is evaluated to false.

2) If the two lists have the same length (i.e. the same number of elements) the comparison is realised on each element. Two elements in the same position of the two lists are compared using the comparison operator.

i) If one of the comparisons at the level of elements is evaluated to false, the comparison at the level of the list is evaluated to false.

ii) If one of the comparisons at the level of elements is evaluated to "undefined", the comparison at the level of the list is evaluated to "undefined".

iii) Otherwise the comparison at the list level is evaluated to true.

NOTE 8: A logical AND operation is processed between the result of each compared elements.

3) Two lists of length zero are considered to be strictly equal.

NOTE 9: For example: comparison of generic list of generic numeric: (2, 3, 5) == (2, 3) is false, (2, 3, 5) == (2, 3, 5) is true, (2, 3, 5) == (2, 4, 5) is false, (2, 3, 5) > (0, 1, 6) is false because 6 > 5, () <= () is true

e) The result of a comparison between non-compatible types is always evaluated to the value false.

NOTE 10: For example: comparison of non-compatible values: 3 != true is false, 5 != "a" is false.

f) The comparison of two values is always "undefined" if one of the values is an "undefined" value.

NOTE 11: For example: (2, 3, 5) == (2, undefined, 5) is "undefined", (2, 3, 5) > (0, 1, undefined) is "undefined", "undefined" == "undefined" is "undefined", "undefined" == "unspecified" is "undefined"

g) A given comparison value may be specified by the author as "unspecified" instead of any comparison value. The comparison of a value with an "unspecified" value is always gives true except if the value to be compared is "undefined".

NOTE 12: For example: (2, 5, 7) <= (2, unspecified, unspecified) is true, (2, 5, 7) >= (2, unspecified, unspecified) is true, "Hello" == unspecified is true, "undefined" <= "unspecified" is "undefined".

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NOTE 13: Distinguish clearly between "undefined" and "unspecified" values. The value "undefined" is not provided by an author. It is always a result of a get action with an error or a result of a comparison operation containing a source value or a comparison value evaluated to "undefined". The value "unspecified" is a intentional omission by the author.

19.1.8 Logical combination

A logical combination of conditions consists of:

- A logical operator is to be applied to the list of conditions.
- A list of conditions, each of which may be a trigger condition, a constraint condition, or another logical combination of conditions. It is a recursive structure. If the operator NOT is used, the list of conditions shall contain only one condition. Otherwise the list of conditions shall contain at least two conditions.

A logical combination of conditions may be represented asa logical tree. The leaves of the logical tree may be trigger or constraint conditions. A logical operator is attached to each node.

EXAMPLE:

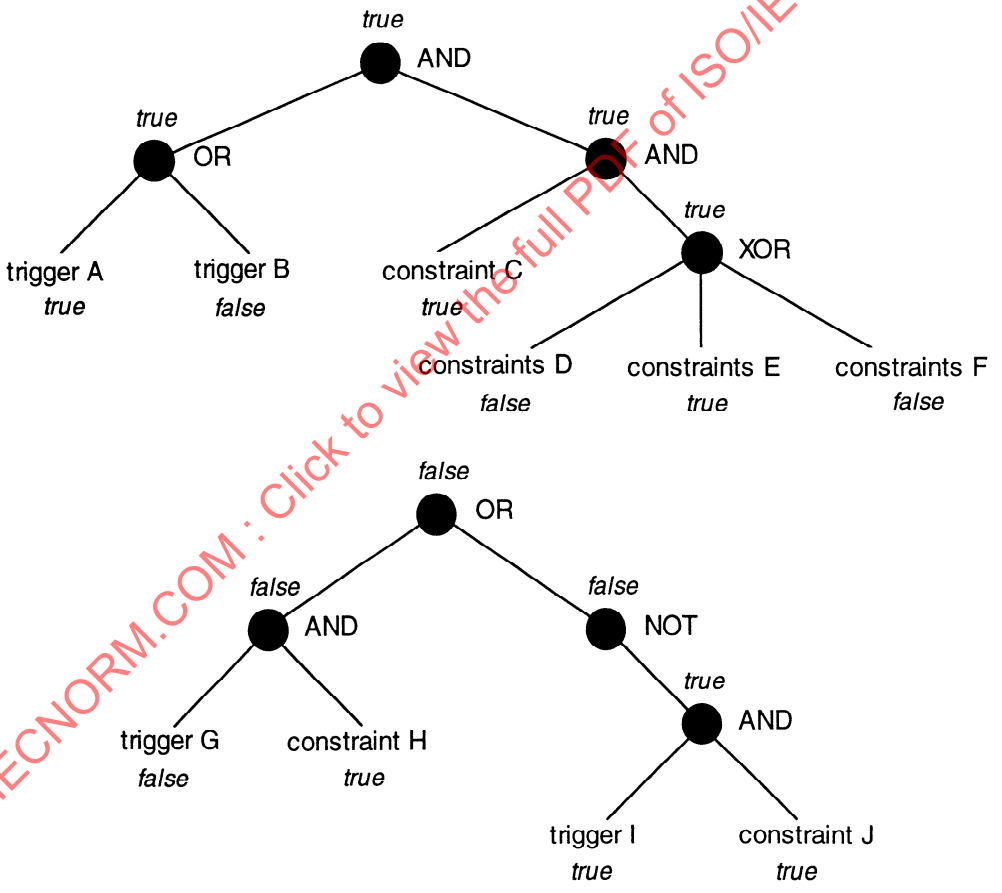

Figure 25 - Examples of logical tree describing a logical combination of conditions

The two trees described in Figure 25 show different combinations of conditions. Any other types of combinations may be provided. Some combinations may be meaningless, for example OR (Trigger Condition K, Trigger Condition L, Constraint Condition M). In that case, the constraint condition is useless.

The evaluation of a logical combination of conditions is as follows:

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a) Each trigger condition shall be evaluated as specified in 19.1.1.

b) Each time one of the trigger condition becomes true, the following applies:

   1) Each constraint condition shall be evaluated as specified in 0

   2) Then each node shall be evaluated as follows in a bottom up manner:

      i) The logical operator attached to the node shall be applied on the evaluated conditions attached to this node, as specified in 19.1.9

      ii) Each node shall evaluate the result of the previous logical operation, i.e. a boolean value or "undefined".

c) The link condition shall evaluate the value of the top node, i.e. the root of the logical tree as in Figure 25.

19.1.9 Logical operator

The logical operator is used within a logical operation. The following logical operators are defined:

- AND: logical and,
- OR: logical or,
- XOR: logical exclusive or,
- NOT: logical negation.

A logical operation is composed of a logical operator and a list of operands. The result of a logical operation shall be evaluated as follows:

- If the operator NOT is used with one operand, the result is as follows:
  - NOT True evaluates: False,
  - NOT False evaluates: True,
  - NOT "undefined" evaluates: "undefined",
- if the operator NOT is defined with several operands, the result shall "undefined"
- If the operator AND, OR or XOR is used with n operands, n being greater than 2, the logical operation is decomposed in n - 1 operations, that are evaluated from left to right.

  NOTE: For example, AND (c1, c2, c3, ..., cn-1, cn) is decomposed as AND(...AND(AND(AND(c1, c2), c3), ...), cn)

- If the operator AND is used on two operands, the result is as follows:
  - True AND True evaluates: True,
  - False AND False evaluates: False,
  - "undefined" AND "undefined" evaluates: "undefined",
  - True AND False evaluates: False,
  - True AND "undefined" evaluates: "undefined",
  - False AND "undefined" evaluates: "undefined",
- If the operator OR is used on two operands, the result is as follows:
  - True OR True evaluates: True,
  - False OR False evaluates: False,
  - "undefined" OR "undefined" evaluates: "undefined",
  - True OR False evaluates: True,
  - True OR "undefined" evaluates: True,

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  - False OR "undefined" evaluates: False,
- If the operator XOR is used on two operands, the result is as follows:
  - True XOR True evaluates: False,
  - False XOR False evaluates: False,
  - "undefined" XOR "undefined" evaluates: "undefined",
  - True XOR False evaluates: True,
  - True XOR "undefined" evaluates: "undefined",
  - False XOR "undefined" evaluates: "undefined",
- If the operator AND, OR or XOR is used on one operand, the result is "undefined".

19.2 Link Effect

The link effect shall consist of:

a) an optional macro resolution used to assign a usage value to each macro parameter. The macro resolution shall be defined as a list of macro parameter resolutions. Each macro parameter resolution in a macro resolution shall consist of:
   1) a macro Def ID identifies one of the macro parameters.
   2) a macro usage value specified as a generic value.

b) An action, which may be a Basic action object (see clause 18.2), a nested action object (see clause 18.3) or a macro action object (see clause 18.4).

The link effect is processed as specified in 31.2 as the link condition becomes satisfied, i.e. as it is evaluated to true.

19.3 Basic link object

A basic link object shall be as a combination of a basic link condition and a basic link effect. The allowed combinations may form a simple link object or a more complex one.

A basic link condition shall not contain any macro parameter. The following basic link conditions may be defined:

- TC
- Simple logical combination of conditions, e.g. TC AND CC, TC1 OR TC2
- Complex logical combination of TC and CC, e.g. NOT (((TC1 AND CC1) OR (TC2 AND NOT (CC3) AND CC4 AND CC5)) XOR (TC3 AND CC6))

A basic link effect shall not contain any Activate action. The following basic link effects may be defined:

- No macro parameter resolution and a basic action object,
- No macro parameter resolution and a nested action object,
- A set of macro parameter resolution and a macro action.

19.4 Nested link object

Nested links may be used to describe more complex behaviour, a nested link object may be provided by an author. A nested link object contains an Activate elementary action within its link effect. The target of this Activate

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elementary action is called embedded link object. As the nested link object is fired, the embedded link object is activated.

The embedded link object may be itself a nested link object. A complete hierarchy of link objects may be designed using this mechanism.

EXAMPLE: Considering the link objects L1, L2 and L3 as follows:

L1 has LE1 as (run Image1, activate L2);

L2 has LE2 as (run Image2, activate L3);

L3 has LE3 as (run Content6);

As the link condition of L1 is satisfied, presentation of Image1 begins and embedded L2 is activated each time due to the LE1. As the link condition of L2 is satisfied after this activation of L2, presentation of Image2 begins and embedded L3 is activated due to the LE2. And so on;

The links L2 and L3 are called embedded links from the point of view of L1. The link L3 is called embedded link from the L2 point of view of L2.

19.5 Macro link object

A macro link object may be used to produce efficient coding of frequently used link objects in which only a few values change from one link condition to another. A macro link object is an embedded link object which contains at least one macro parameter value within its link condition. Each macro parameter value is resolved when it is activated from a nested link object (see clause 6.3.13).

NOTE: The macro link object needs to be an embedded link object, otherwise the macro parameter value would never be resolved, so the link condition described would never be satisfied.

20 Structure of Model Class

The model objects, instances of model classes, may be interchanged within or across using applications. A model object is considered as a template object. From this model, rt-objects may be created according to the instructions given by the author.

The model class is an abstract class inherited by the script class and the component class.

Any number of rt-objects may be created from a given model object. The activation of an rt-object shall not affect the model object. This allows the reuse of the same model object in different contexts, i.e. different rt-objects.

The internal representation of the rt-objects is not specified by ISO/IEC 13522-1. Each MHEG Engine may have its own internal representation technique.

NOTE: The model class contains no interchange attribute.

21 Structure of Script Class

An MHEG script class is used to specify complex conditional actions on MHEG entities. The script objects, instances of script class, may be interchanged within or across applications. A script object is a model object. From this model, rt-scripts may be created according to be instructions given by the author.

The MHEG script class provides the following information for the interchange of scripts:

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- Optional script classification (see clause 14) provided as an assistance in determining the type of the script data.
- Script hook (see clause 14) identifies the script representation and describes the encoding and decoding information enabling the use of the script data. It is composed of an identification and a description of the script representation.
- Script data. Inclusion or reference of the encoded script itself or to a "Null-Data".

22 Structure of Component Class

The component class is an abstract class inherited by content class and composite class.

The component objects, instances of component classes, may be interchanged within or across using applications.

A component object is a model object. From this model, rt-components may be created according to the instructions given by the author.

In addition to the attributes inherited from model class, the component class defines an optional "OPS initialisation" attribute, which is composed of an OD and an OS. This attribute is used to initialise the OPS of each rt-component created from this component object. The OD and OS are used to initialise the lengths of the OPS T axis and X, Y, Z axes. The OD and OS are provided as an optional assistance to the MHEG Engine. It is up to the object designer should ensure that this information is compatible with similar information that may be contained in the hook or in the data.

23 Structure of Content Class

This clause describes the handling of encoded data. This mechanism is common to all types of encoded data and provides a consistent approach to the identification of the type and the interchange of the following:

- Data that may be presented to, and perceived by, the user, e.g. graphics, audio data.
- Data that cannot be presented to the user in an immediate way, e.g. an executable, a HyperODA document (ISO/IEC 8613), a HyTime (ISO/IEC 10744) based document.
- Null data that may or may not be presented to the user depending on information given in hook or classification attributes or depending on the styles applied, e.g. a transparent area with a rectangle around the area.
- Generic value stored in the data. This value may be presented to the user depending on information given in hook or classification attributes or depending on the styles applied, e.g. a numeric may be presented as a pure numeric or as a slider, a string as a pure string or as a button. This value may be also used to store a value to be retrieved later, e.g. for a comparison in a link condition or for another attribute assignment. Specific get data and set data actions allow to retrieve and to modify this value, e.g. Set CV (target set, Get Data (content target)).

A content object is a model object. From this model, rt-contents may be created according to instructions given by the author.

The MHEG content class provides the following information for the type identification and interchange of encoded data:

- Optional data classification provided as an assistance in determining the type of the data. The classification is either proprietary or registered, e.g. generic value, graphics or video (see clause 14).
- Content Hook describes the encoding and decoding information enabling the use of the encoded data (see clause 14).

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- Optional OV provided as an assistance in determining the current audible volume encoded within the data. When provided, this OV shall be defined within the AVR (see clause 9.1.3).
- Content Data. Inclusion or reference to a generic value, an encoded data provided by ISO/IEC 13522-1 or other recommendations or standards and by or a "Null-Data". The generic value in shall be encoded using the syntax defined for Generic Value in the Useful Definitions module.

24 Structure of Multiplexed Content Class

This clause describes the handling of multiplexed data. This mechanism extends the mechanism provided by the content class.

An MHEG multiplexed content class provides a list of ordered streams in addition to the information provided by the content class. It describes the streams contained in the multiplexed data.

Each stream is composed of the following:

- Stream identifier. Each stream has an unique identification within a multiplex.
- Optional catalogued content classification. It is provided as an assistance in determining the type of this stream (see clause 14).
- Content hook. It describes the encoding and decoding information required for the use of this stream (see clause 14).

EXAMPLE: multiplexed content object:

Data Hook:

MPEG-2 TS

Data:

Multiplexed data

Streams:

Stream identifier: 2.1, stream hook: MPEG2-Video

Stream identifier: 2.4, stream hook: MPEG2-Audio

Stream identifier: 2.5, stream hook: MPEG2-Audio

25 Structure of Composite Class

The composite class is used to associate multimedia and hypermedia objects with each other. This mechanism provides a consistent approach to the synchronisation in time and space and linking of a set of objects.

NOTE 1: This class provides also the logical structure to describe the list of possible interactions offered to the user, but does not define the interaction facilities provided by the user interface, which may be achieved in a variety of ways, e.g. Graphical User Interfaces, keyboard, etc. ISO/IEC 13522-1 does not define the look and feel of multimedia interactive presentations, nor does it propose to change or add concepts to those that exist in typical Graphical User Interfaces. As ISO/IEC 13522-1 is generic and independent of platform and implementation, it describes interaction at a virtual level. It is up to a using application to apply these mechanisms using its specific look and feel.

NOTE 2: In this way, ISO/IEC 13522-1 achieves a consistent interface between an MHEG Engine and the user interaction services or other applications, while still allowing the author to maintain the local look and feel.

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A composite object provides means to describe one generation of information and its behaviour. Each generation is made up of a list of elements. The element is the basic building block of the composite class. Each element provides also a means to point to another generation defined by another composite object. Thus a recursive structure may be built up with the repetitive use of composite object and references in their elements.

Each generation represents a unit in the presentation logic intended by the author.

There are typically intrinsic relationship among sibling elements of a same generation.

There are also typical intrinsic relationships propagation among generations.

NOTE 2: A typical use of a composite object is to define one element for each choice to be offered to the user in the main menu. A second composite is used to describe the choices of the submenu.

NOTE 3: Another typical use of a composite object is to define elements that are to be presented simultaneously.

The MHEG composite class provides the following information in addition to a generic identification of the composition:

a) Composition behaviour: This set of behaviours may be used to describe the sequencing and interrelationships between the elements of this composite and the hyperlinking between different kinds of information. The composition behaviour contains the following information:

   1) Predefined behaviour for specifying initial behaviours. The following start-up and close-down are defined:

      i) availability start-up: when the composite object is prepared.

      ii) availability close-down: when the composite object is destroyed.

      iii) rt-availability start-up: when one rt-composite is created from the composite object.

      iv) rt-availability close-down: when one rt-composite is deleted.

   2) A set of links for specifying conditional actions.

   3) A set of actions. Actions and links are used to describe the behaviour of each element and the interrelationships between parent and siblings.

b) The number of elements contained in the composition defined by this composite.

c) Composition elements. Each composite defines one generation. One generation is composed of the list of all the sibling elements.

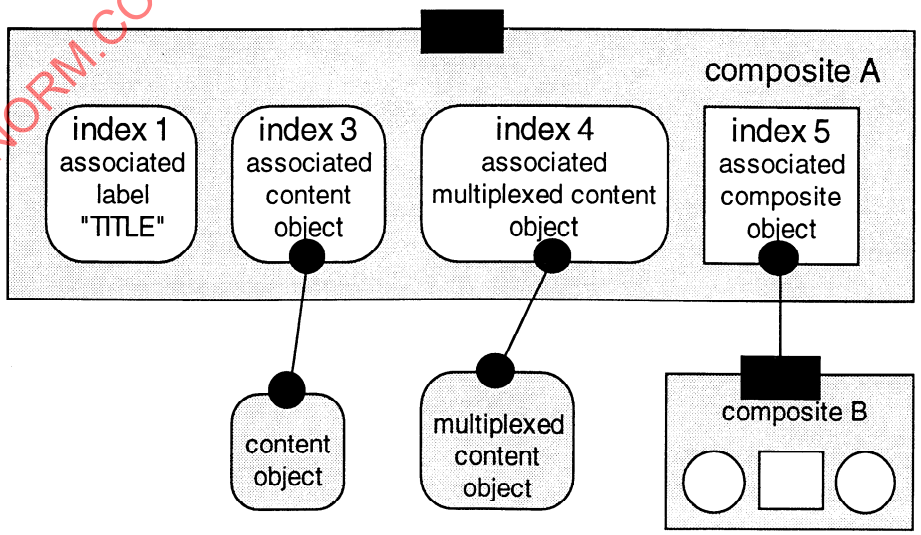

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Figure 26 - Example of a composite object structure.

Empty elements are not represented in Figure 26.

25.1 Availability Start-up

The availability start-up is a link object that shall have the same link condition, when the preparation status of the composite object becomes ready, i.e. Get Preparation Status("this") becomes ready. The link effect may be used for additional preparation effect of the composite. It is either a personalised link effect provided by the author or one of the following default link effects:

- Automatic start-up 1: Activate all the included or referenced links within the specific behaviour.
- Automatic start-up 2: Prepare all the referenced associated model objects.
- Automatic start-up 3: Prepare all the referenced action and link objects within the specific behaviour.
- Automatic start-up 4: Activate all the included or referenced links within the specific behaviour, and prepare all the referenced associated model objects.
- Automatic start-up 5: Prepare all the referenced associated model objects, and prepare all the referenced action and link objects within the specific behaviour.

When the availability start-up is omitted, there is no start-up effect.

NOTE: The availability start-up is a link. It is processed only when the composite object's preparation status becomes "ready".

25.2 Availability Close-down

The availability close-down is a link object that shall have the same link condition: when the preparation status of the composite object becomes not ready, i.e. Get Preparation Status("this") becomes not ready. The link effect may be used for additional destruction effect of the composite. It is either a personalised link effect provided by the author or one of the following default link effects:

a) Automatic Close-down 1:
   1) Destruction of referenced link and action objects in the specific behaviour.
   2) Destruction of referenced action objects describing link effect in one of the link objects.
   3) Destruction of nested action objects referenced in action objects included or referenced in the composition behaviour.
   4) When completed, destruction of the availability close-down link itself.

b) Automatic Close-down 2:
   1) Destruction of referenced associated components within the composition elements.
   2) When completed, destruction of the availability close-down link itself.

c) Automatic Close-down 3:
   1) Destruction of referenced link and action objects in the specific behaviour.
   2) Destruction of referenced action objects describing link effect in one of the link objects.
   3) Destruction of nested action objects referenced in action objects included or referenced in the composition behaviour.
   4) Destruction of referenced associated components within the composition elements.

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5) When completed, destruction of the availability close-down link itself.

When the availability close-down is omitted, there is no close-down effect.

NOTE: The availability close-down is a link. It is processed only when the composite object's preparation status becomes "not ready".

25.3 Rt-Availability Start-up

The rt-availability start-up is a link object that shall have the same link condition: when an rt-composite is created from this composite, i.e. Get Rt-Availability Status("this":?) becomes available. The link effect may be used for additional preparation effect of the rt-composite. It is either a personalised link effect provided by the author or the following default link effect:

– Automatic Rt-Start-up: Run action is targeted to this rt-composite.

When the rt-availability start-up is omitted, there is no start-up effect.

NOTE: The availability start-up is a link. It is processed only when the rt-composite object's rt-availability status becomes "available" to each rt-composite created from this composite object.

25.4 Rt-Availability Close-down

The rt-availability close-down is a link object that always has the same link condition: when an rt-composite created from this composite becomes deleted, i.e. Get Rt-Availability Status("this":?) becomes not available. The link effect may be used for additional destruction effect of the rt-composite. It is always a personalised link effect provided by the author. When the rt-availability close-down is omitted, there is no close-down effect, i.e. the rt-availability close-down is inhibited.

NOTE: The availability close-down is a link. It is processed only when the rt-composite object's rt-availability status becomes "not available" for an rt-composite created from this composite object.

25.5 Composition Element

Each element oa a composition is composed of the following:

a) A composition **element index**. Each element has an unique identification within a composite object.

b) An **associated model**. The associated model may be used to associate information to be presented to the user. The model is either a label, a content, a composite, or an empty model:

   1) a label is a generic string. A label may be presented to the user as an interaction item following the style applied to the rt-composite. For example, a label may correspond to a title of a menu or push button.

   2) a content represents a terminal element that is either a content object or a multiplexed content object.

   3) a composite allows the build-up of a parent-child relationship through successive generations.

      NOTE: It is the author's responsibility to avoid the appearance of cycles in the composite object, i.e. an element addressing an ascendant.

   4) An empty model. No model is associated with the element.

When an rt-composite is created from the composite object, the MHEG Engine creates rt-objects from the associated models described in the composition (an rt-content from an associated label or an associated content, an rt-composite from an associated composite, a "Null-Root-Rt" from an empty associated model). These rt-objects are plugged into the corresponding sockets within the rt-composite.

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25.6 Composition example

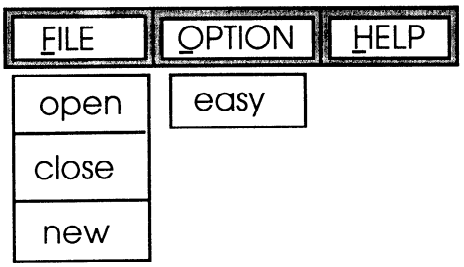

Figure 27 - Example of menu structure with submenus.

Figure 27 shows an example of a menu using the root rt-composite 700:8 in Figure 20 created from composite 700 in Figure 18. Composite 700 defines a logical structure of composition without regard of its presentation. In this example, a style menu is applied to 700:8 in order to represent different generations of menus and sub-menus:

- The rt-content sockets: "FILE", "OPTION", "HELP" are presented in the principal menu.
- The rt-composite sockets 700:8.2 and 700:8.4 represent the submenus.
- The rt-content sockets: "open", "close" and "new" are presented when the first menu is activated.
- The rt-content socket: "easy" is presented when the second menu is activated.

The presentation of this menu is not specified; it is part of the look and feel of the presentation system.

26 Structure of Container Class

This clause describes grouping of MHEG objects. This grouping is intended to facilitate the interchange to obtain a single set of interchange. It ensures that all the included objects are interchanged at the same time.

This may also be used by the object designer to group information participating to a ginev application.

Container object consist of:

- An optional predefined behaviour composed of a Container Start-up (see clause 26.1) and Container Close-down (see clause 26.2).
- A list of Container Elements (see clause 26.3).

26.1 Container Start-up

The container start-up is a link object that shall have the same link condition: when the preparation status of the container object becomes ready, i.e. Get Preparation Status("this") becomes ready. The link effect may be used for additional preparation effect of the container. It is either a personalised link effect provided by the author or one the following default link effects:

- Automatic Container Start-up 1: Prepare action is targeted to the included objects.
- Automatic Container Start-up 2: Prepare action is targeted to the included and referenced objects.
- Automatic Container Start-up 3: Activate included link objects.
- Automatic Container Start-up 4: Activate included and referenced link objects.
- Automatic Container Start-up 5: Prepare action is targeted to the included objects; Activate included link objects.

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- Automatic Container Start-up 6: Prepare action is targeted to the included objects; Activate included and referenced link objects.
- Automatic Container Start-up 7: Prepare action is targeted to the included and referenced objects; Activate included link objects.
- Automatic Container Start-up 8: Prepare action is targeted to the included and referenced objects; Activate included and referenced link objects.

When the container start-up is omitted, there is no start-up effect.

NOTE: The container start-up is a link. It is processed only when the container object's preparation status becomes ready.

26.2 Container Close-down

The container close-down is a link object that shall have the same link condition: when the preparation status of the container object becomes not ready, i.e. Get Preparation Status("this") = not ready. The link effect may be used for additional destruction effect of the container. It is either a personalised link effect provided by the author or one the following default link effects:

- Automatic Container Close-down:
  - Destruction of referenced objects.
  - When completed, destruction of the availability close-down link itself.

When the container close-down is omitted, there is no close-down effect.

NOTE: The availability close-down is a link. It is processed only when the container object's preparation status becomes not ready.

26.3 Container Element

A container shall contain an ordered list of container elements. Each container element shall be an instance of any other MHEG class that may be included or referenced. It shall be one of the following:

- action object
- link object
- script object
- content object
- multiplexed content object
- composite object
- container object
- descriptor object

A container element index shall be assigned to each container element by the MHEG Engine. Each element has an unique identification within a container: the elements are all indexed from 1 to n by the MHEG Engine.

27 Structure of Descriptor Class

The descriptor class is used to describe other objects that are interchanged. This description is intended to facilitate the negotiation, installation, operation and management of applications that use MHEG objects.

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It is recognised that different presentation systems may have widely differing capabilities. By interchanging and interpreting descriptor objects, it is possible to adapt the resources of the presentation system to the requirements of the described objects. The descriptor objects allow MHEG Engines to determine whether they can proceed to a presentation; They allow using applications to determine the resources that would be needed for a presentation of a set of objects.

All objects that are interchanged need not be described using a descriptor object. If no descriptor is associated with an object; it is for the using application to define the description of the object. It is the responsibility of the author to ensure consistency between the descriptor objects and the described objects. ISO/IEC 13522-1 does not provide mechanisms to handle errors or inconsistencies in descriptor objects.

A number of facilities ranging from the informal to the formal may be provided by the descriptor object:

- set of related objects (see clause 27.1),
- other descriptors other (see clause 27.2),
- readme (see clause 27.3),
- system readable material (see clause 27.4),
- set of channel informations (see clause 27.5),
- set of catalogued style informations (see clause 27.6),
- set of catalogued extended elementary action informations (see clause 27.7),
- set of catalogued extended attribute informations (see clause 27.8).

27.1 Related Object

A set of related objects may be provided in order to specify the scope of the descriptor object. If this set is omitted, the scope of the descriptor object is defined by the using application. In this case, in general, the scope should include all objects belonging to the application. Each related object attribute provides information about a single related object; it is specified as a list of the following attributes:

a) Object reference: identifies the related object to which this object information applies.

b) Object information: optional, defines more precisely the related object with the following attributes:

   1) Object Size: indicates the size of the encoded related object in octets (optional);

   2) Class ID: identifies the class of the related object;

   3) A set of class-specific attributes: choice of attribute sets, which carry object specific information on the related object:

      i) Specific attributes on a related script object (see clause 27.1.1);

      ii) Specific attributes on a related content object (see clause 27.1.2);

      iii) Specific attributes on a related multiplexed content object (see clause 27.1.3);

   4) Offset: It provides a relative position in octets of an encoded object that is included in another encoded object (see clause 27.1.5).

ISO/IEC 13522-1 does not define how to handle contradictory descriptions, if a given related object is described more than once.

27.1.1 Script Class Information

The script class information is a set of attributes describing the related script object. The following information may be provided:

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- Script classification: Informs the executing system about the classification of the related script object. (see clause 15.1);
- Script hook: Informs the MHEG Engine about the script representation used by the related script object. The run-time engine may use this information to prepare the corresponding script interpreter or to reject this script object if this script interpreter is not available. (see clause 14).

27.1.2 Content Class Information

The content class information is a set of attributes describing the related content object. The following information may be provided:

- Content classification: Informs the MHEG Engine about the classification of the related content object. (see clause 15.1);
- Content hook: Informs the MHEG Engine about the encoding used for the data of the related content. The MHEG Engine may use this information to prepare the corresponding decoder. (see clause 14);
- Alternative objects: Provides a facility to indicate alternative content objects that may be used instead of this related content (see clause 27.1.4).

27.1.3 Mux Content Class Info

The mux content class info provides a set of attributes describing the related multiplexed content object. The following information may be provided:

a) Content class information: Informs the MHEG Engine about the whole multiplexed data of the related multiplexed content object, i.e. classification, hook, alternative objects (see clause 27.1.2);

b) Number of streams: Reflects the number of streams contained within the multiplexed data of the related object;

c) Set of stream information: Each stream information is composed of the following attributes:

   1) Stream identifier: Identifies a stream within the related multiplexed content object;

   2) Content class information: A single stream can be regarded as a single content object; therefore, the attribute set that describes a related content is used, i.e. classification, hook, alternative objects (see clause 27.1.2).

27.1.4 Alternative Object

The alternative object provides information about alternative content objects that may replace the related object.

Alternative content objects may differ in the encoding or in any other attributes from the related object. The using application may use this facility to adapt the data to be presented to the local environment. It is up to the author of the descriptor to ensure the integrity of alternative objects in the context of the related object.

The alternative objects are described as a list of alternative objects. Each alternative object is composed of the following attributes:

- A reference to an alternative content object;
- An alternative hook: specifying the hook of the alternative object;
- An alternative descriptor object: reference to the descriptor object describing the alternative object. It is optional;
- An alternative readme: optional and specified as a free format string. It may be used by the using application to identify the nature of the alternative object. For example, in a multi-language application, the readme may carry an identification of the language of the alternative object. It is up to the using application to interpret the pragmatics of the readme.

27.1.5 Offset

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An encoded MHEG object may be included within an another encoded MHEG object. To help retrieve this included MHEG object without decoding from the beginning, offset information may be provided. The offset indicates the first octet of the included MHEG object in level D representation.

27.2 Other Descriptor

A set of references to other descriptor objects may be used by an author to connect different descriptor objects. The connected descriptor objects may describe different objects, and the scope of the descriptors may differ. Handling of contradictory descriptions, if the scope of two or more descriptors overlap, is not specified.

This facility provides a mechanism to create a structured set of descriptors. Allowed structures are linked lists or trees. It is up to the author to define an useful structure.

27.3 Readme

This informal text provides a human user with the information needed to proceed with the installation and operation of the set of related MHEG objects. The choice of words is left to the author, who may use the readme to point to further sources of information and support.

27.4 System Readable Material

A using application may place information in the descriptor object which it finds useful. ISO/IEC 13522-1 does not define either this information or the encoding used by the application. An author or a using application may include information in the descriptor intended for the MHEG Engine. However (the author should be aware that this information need not be portable to other MHEG systems).

27.5 Channel Information

A set of channel information may be used by an author, so that MHEG Engine may map more easily each channel on to the real environment. Each channel may be described as follows:

- Channel ID: Identifies the channel to be described.
- x-min, x-max, y-min, y-max, z-min, z-max: Describe for each spatial axis the minimum and maximum values required for the device associated with this channel.
- x-resolution, y-resolution, z-resolution: Describe for each spatial axis the resolution for the device associated with this channel. This is the number of addressable spatial physical units.
- t-resolution: Describes the temporal resolution for the device associated with this channel. This is the number of addressable temporal physical units within one second.
- f-min, f-max: Define the minimum and maximum presentable frequency required for that channel if audible media are presented on this channel. The unit is "hertz".
- Audio-dynamic: Defines the audio dynamic required for that channel if audible media are presented on this channel. The unit is "dB".
- Media types: Specifies the types of the media of the rt-components assigned on this channel. This allows the MHEG Engine to assign channels to physical devices. It is one of the catalogued values that can be either registered or proprietary. However, if the presentation system does not support the requested device, the engine may ignore the media type.
- Events mapping: Specifies the expected events that may occur on this channel or on the rt-components assigned to this channel. A catalogued event may be assigned to each event. This allows an MHEG Engine to map an event defined by the author to a real event that occurs in its environment. The catalogued event may be either registered or proprietary. If no mapping on a catalogued event is provided, it is considered that the event

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identifier provided by the author directly map on catalogued event identifier. Otherwise it is up to the using application to define how to map the event identifier to a real event. Handling of contradictory descriptions, if a given event identifier is mapped more than once, is not specified.

Handle contradictory descriptions if a given channel is described more than once is not specified.

27.6 Catalogued Style Information

A set of catalogued styles may be used to inform the MHEG Engine about the catalogued styles used in the Set Style actions interchanged in related action objects. The catalogued style can be either registered or proprietary.

27.7 Catalogued extended elementary action informations

A set of catalogued extended elementary actions may be used to inform the MHEG Engine about the catalogued extended elementary actions used in the catalogued elementary action interchanged in related action objects. The catalogued extended elementary actions may be either registered or proprietary.

27.8 Catalogued extended attribute informations

A set of catalogued extended attributes may be used to inform the executing system about the catalogued extended attributes used in the Set Catalogued Attribute actions interchanged in related action and link objects. The catalogued extended attributes may be either registered or proprietary.

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Section 4: Common Behaviour of MHEG Entities

ISO/IEC 13522-1 defines the expected behaviour and the initial expected behaviour of the MHEG objects, rt-objects and channels through behaviour attributes and their status values. ISO/IEC 13522-1 also defines actions to change and retrieve each expected behaviour. The processing effects of these actions that are perceptible to the user are called "user effects", and the processing effects whose results are only available to the MHEG Engine are called "MHEG effect". Only the MHEG effect is defined by ISO/IEC 13522-1. The user effect is perceived by the user via a certain GUI that determines the look and feel of MHEG entities.

28 MHEG Entity Behaviour

The initial behaviour of each MHEG entity may be changed by interchanging the following instances of MHEG classes:

- Action class used to interchange a set of actions with target references to MHEG objects, rt-objects or channels;
- Link class used to interchange a set of actions and to specify conditions for those set of actions;
- Script class used to interchange scripts which describe complex behaviours.

29 MHEG Entity State Definition

The complete life of an MHEG object, an rt-object or a channel is defined by the following diagrams. As some actions are only valid for a certain period of an MHEG entity, the MHEG entity life definition is used to assert the validity of an action. Two description methods are used:

- Time line diagrams describe the principal behaviour along time as shown in Figure 28. This figure shows a status change of an MHEG entity. First, it is in period i. After targeting a certain action to this entity, there is some MHEG effect caused by an MHEG Engine or a GUI, however the entity remains in period i. This means that a Get action targeted to the entity during the processing of an MHEG effect always retrieves the value that was attached to the period (the value in period i). After finishing the processing of the MHEG effect, the entity enters period j. If the period j has some user effect, the appearance of the entity is changed and perceived by a user. The duration of MHEG effect and possible user effect are shown in Figure 28.
- Finite state diagrams describe the allowed state transitions depending on actions as shown in Figure 29. In this figure, two ellipses (State1, State2) represent states, and 3 boxes (action x, action y, action z) stand for actions that may modify states. The initial status is State1. If action x is targeted, the state remains State1. If action y is targeted after that, the state is changed to State2. The action z causes a transition back to State1. Action x and y are not valid and ignored if the state is State2, and action z is not valid and ignored if the state is State1.

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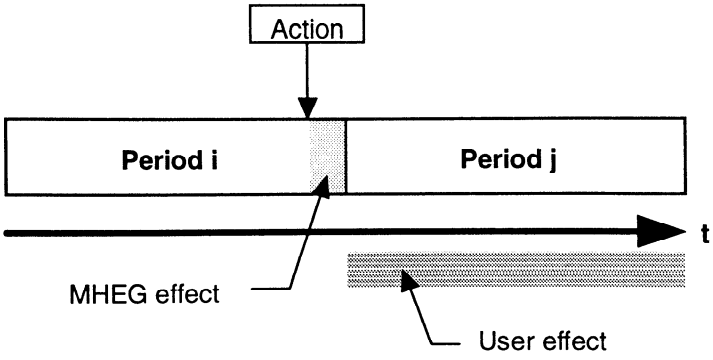

Figure 28 - Example of a time line diagram

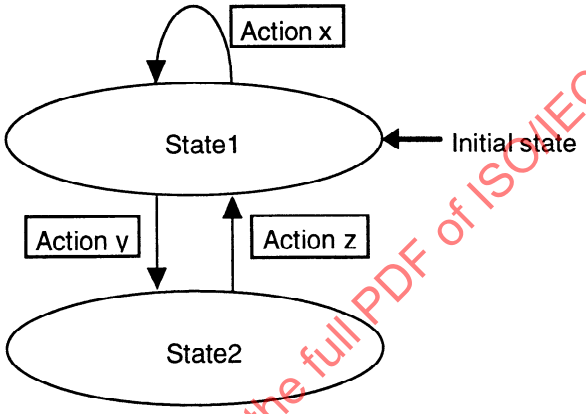

Figure 29 Example of a finite state diagram

Several MHEG entities periods are defined for the following behaviours:

- MHEG object availability (see clause 29.1);
- Link object activation (see clause 29.2);
- Channel availability (see clause 29.3);
- Rt-object availability (see clause 29.4);
- Rt-Component running behaviour (see clause 29.5);
- Rt-Component presentation behaviour (see clause 29.6).

29.1 MHEG object availability

Figure 30 and Figure 31 show MHEG object availability. Two states are defined as follows:

- **O1**: The MHEG object is not known to the MHEG Engine. Even if it is not created, the MHEG object is said to be in period O1. During O1, all MHEG objects except link objects have only one attribute: preparation status which is equal to "not ready". Link objects additionally have the activation status equal to "inactive". Any other object attributes described in ISO/IEC 13522-1 do not exist. Any Get actions evaluate "undefined" to these non existing attributes.

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– **O2**: The MHEG object is available to the MHEG Engine. The preparation status of the MHEG object is "ready". The object has been decoded. All other object attributes have been created and set to their corresponding interchanged values.

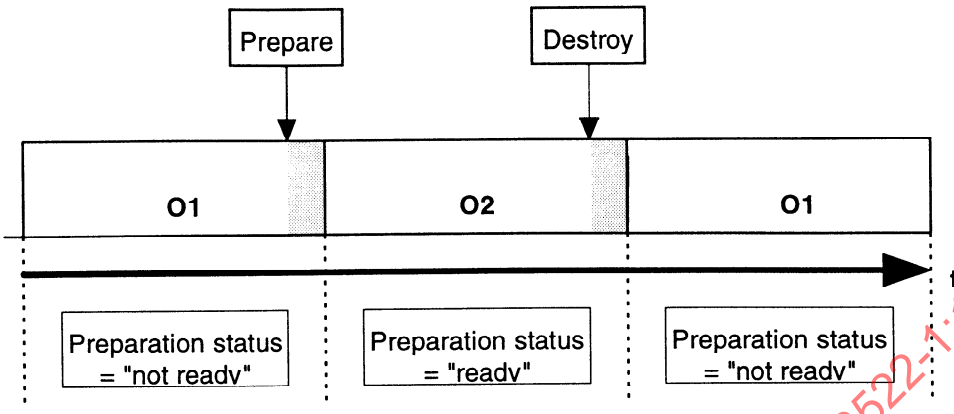

Figure 30 - Time line diagram of MHEG object availability

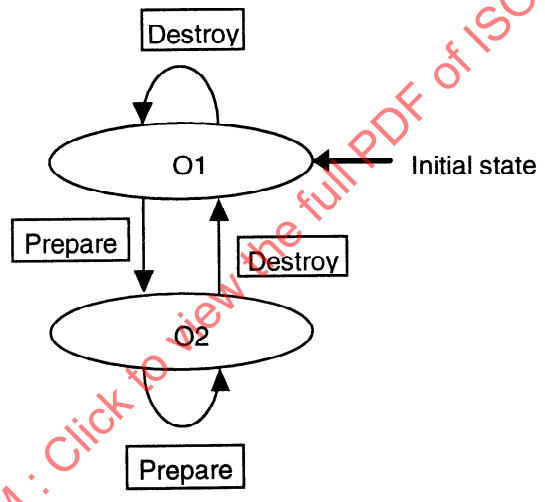

Figure 31 - Finite state diagram of MHEG object availability

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29.2 Link activation

Figure 32 and Figure 33 show link activation beside the specific activation states. Link objects have additionally MHEG object availability states because they are also MHEG objects. The two figures also show the relationship between MHEG object availability and link activation. Two states are defined for link activation as follows

– **L1**: The activation status of the link object is "inactive". This link cannot be fired.

– **L2**: The activation status of the link object is "active". The link object has been activated. During L2, each time the link condition becomes true, the link is fired.

NOTE: The Link Abort action does not affect these states.

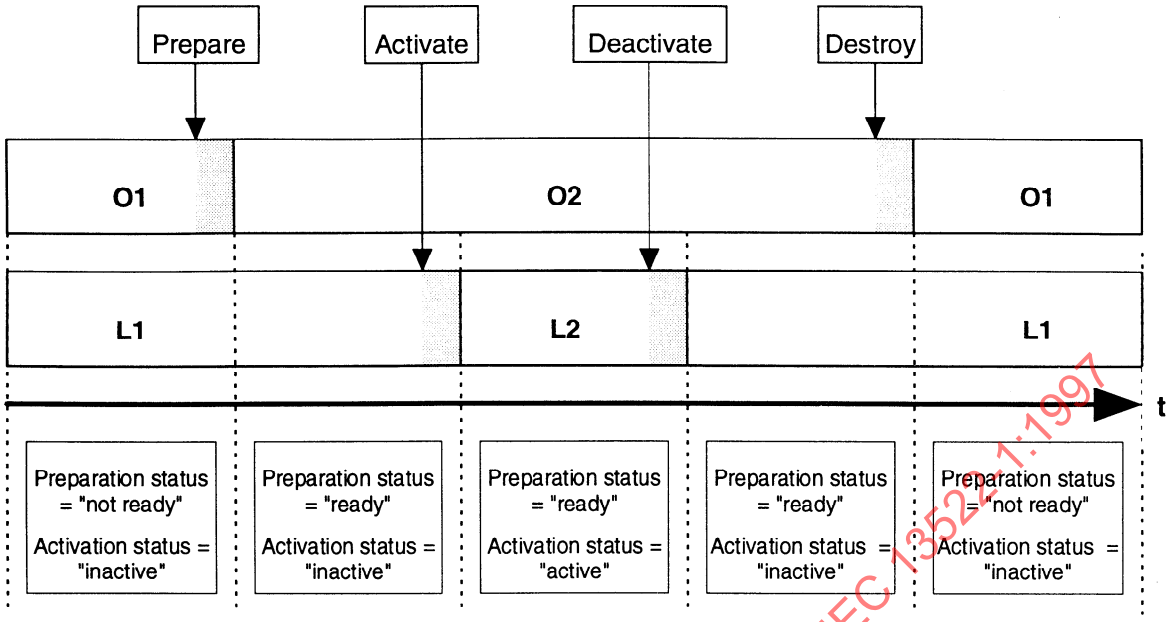

Figure 32 - Time line diagram of link object availability and activation

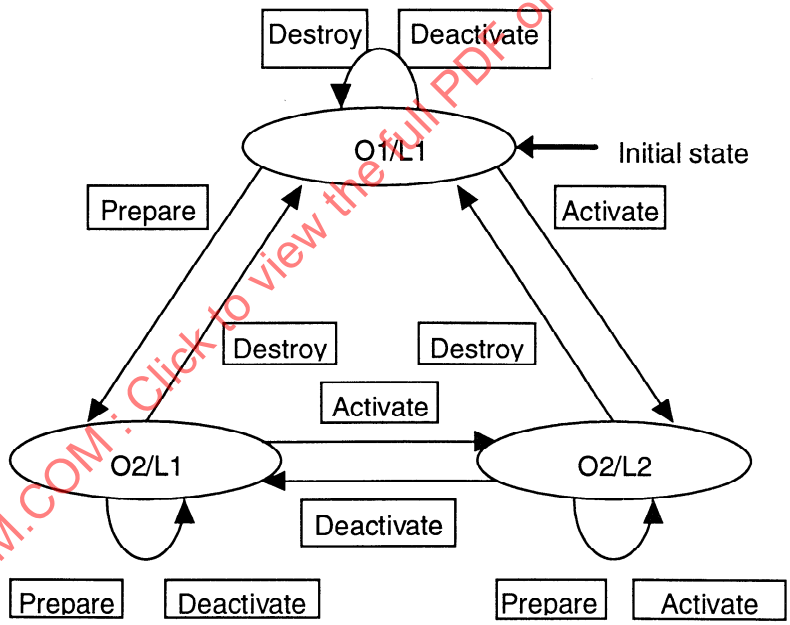

Figure 33 - Finite state diagram of link object availability and activation

An Activate action targeted to a link whose preparation status is "not ready" implicitly executes a Prepare action.

A Destroy action may also be targeted in L2. Then the link object enters directly in period L1/O1.

29.3 Channel availability

Figure 34 and Figure 35 show channel availability. Two states are defined as follows:

– **C1**: The channel is not yet created, and not available to the MHEG Engine.

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– **C2**: The channel is available to the MHEG Engine.

The default channel may neither be created nor be deleted. It shall always be available to the MHEG Engine (i.e. the default channel is always in state C2.). Both New channel and Delete channel shall be ignored for the default channel.

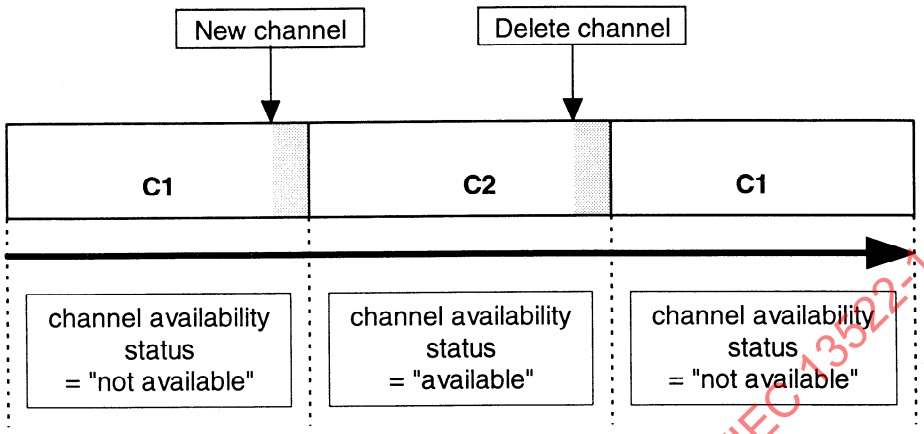

Figure 34 - Timing diagram of channel availability

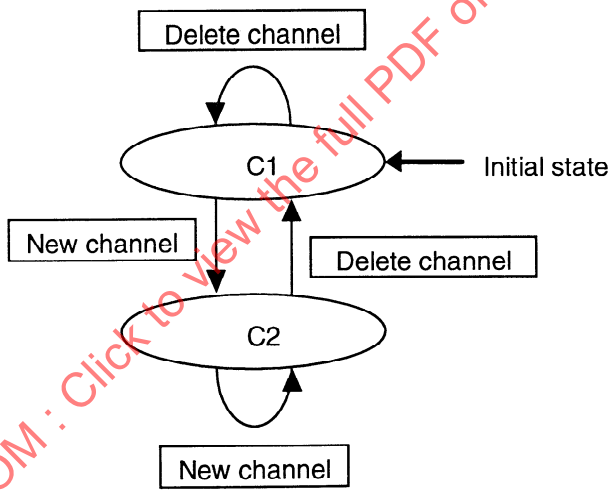

Figure 35 - Finite state diagram of channel availability

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29.4 Rt-object availability

Figure 36 and Figure 37 show rt-object availability. They also show the relationship between rt-object availability status and MHEG object availability status belonging to the model object from which the rt-object is derived. Two states are defined as follows:

– **R1**: The model object is prepared (O2), the rt-object is not created, it is not available.

– **R2**: The rt-object is available to the MHEG Engine. During this period the rt-object may be presented, using a Run action.

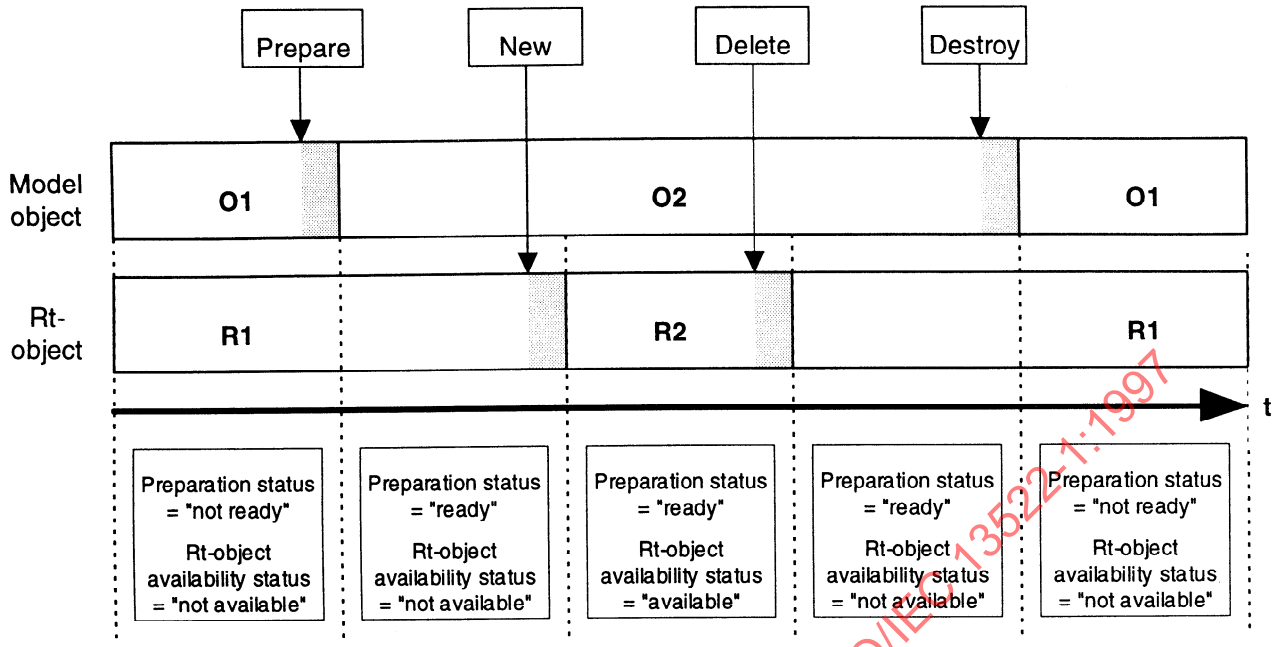

Figure 36 - Timing diagram of rt-object availability

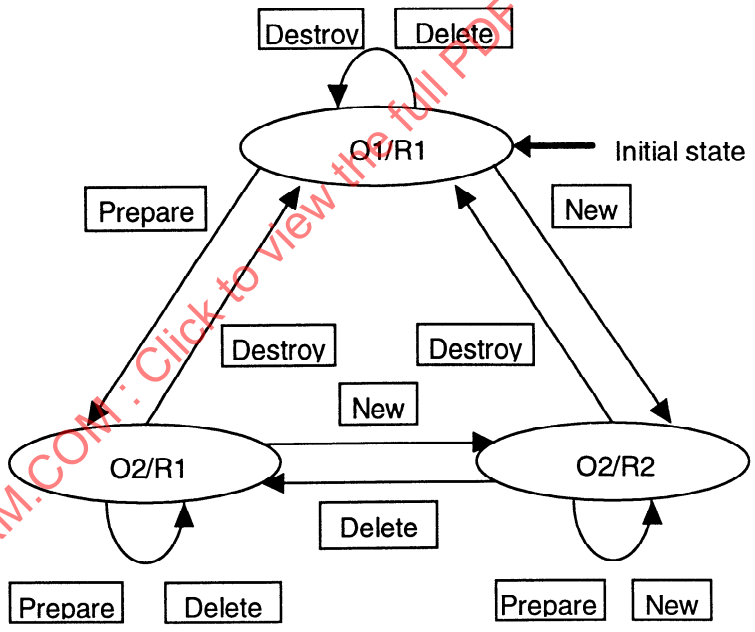

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Figure 37 - Time line diagram of rt-object availability

A New action in O1/R1 prepares the model object implicitly. And a Destroy action in O2/R2 deletes all rt-objects created from this model implicitly.

29.5 Rt-Component running behaviour

Figure 38 and Figure 39 show rt-component running behaviour. Once an rt-component is "available" (i.e. in R2), it is ready for presentation. Two states are defined as follows:

- **R2**: The rt-component is not running. It is not presented to the user.
- **R3**: The rt-component is running. It may be presented to the user. During this period, there may be a user effect, which is the result of presenting the rt-component with the specified behaviour attributes. The user effect may depend on each MHEG Engine and GUI.

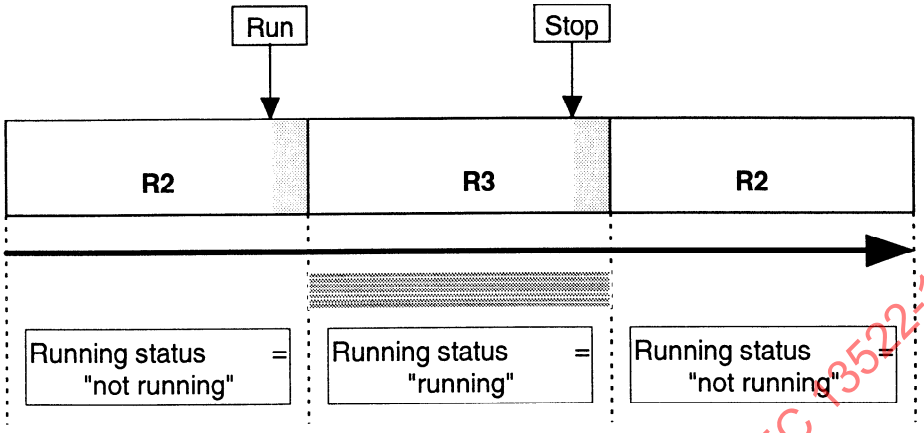

Figure 38 - Time line diagram of rt-component that is "running"

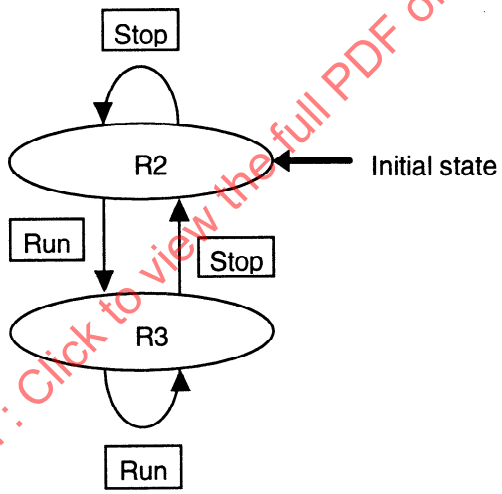

Figure 39 - Running behaviour finite state diagram

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If a Run action is targeted to a non-existing rt-component (i.e. the rt-object is in R1), an implicit New action is targeted to this rt-component before processing the Run action.

29.6 Rt-Component presentation behaviour

While an rt-component is running (i.e. the rt-component is in R3), presentation behaviour attributes may be changed by targeting certain Set actions.

Figure 40 shows a typical example of a presentation behaviour attribute. In this Figure, a presentation behaviour attribute called "A" associated with an rt-component is changed from value V0 to V1 during R3 of the rt-component. A user effect may be associated with this attribute value change. After stopping the rt-component, the attribute A remains as V1 independent of the running status and any other attributes.

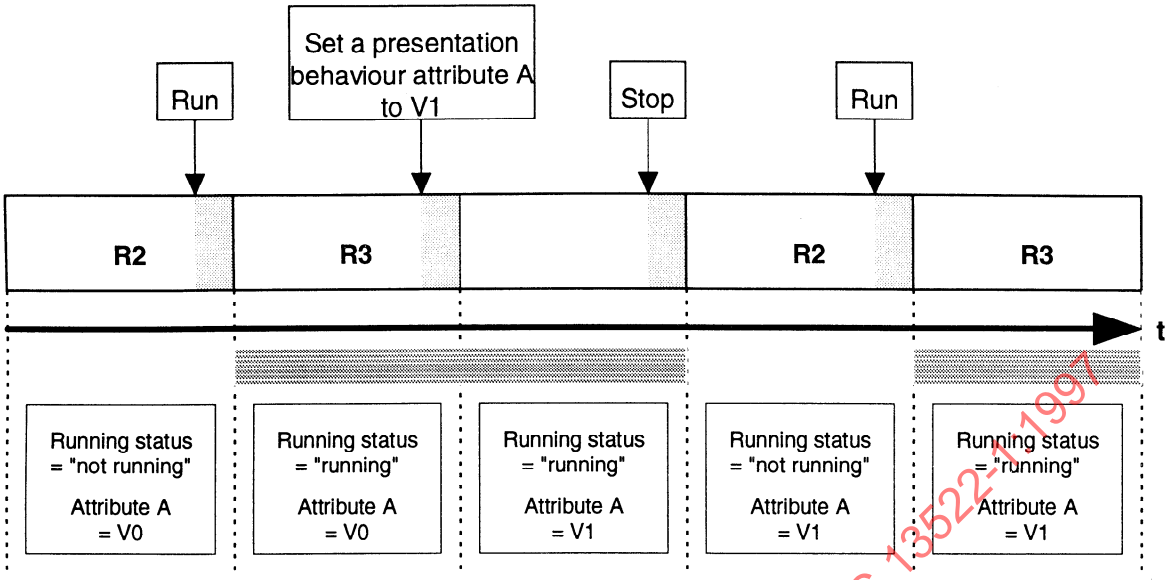

Figure 40 - Presentation behaviour attributes changing

Figure 41 shows a presentation behaviour attribute change with a certain transition duration. When an rt-component is running, a certain Set action is targeted to it in order to change the presentation behaviour attribute A gradually. In this case, one additional state period R3.TD is defined as follows:

– **R3.TD**: The rt-component running status is "running". The MHEG Engine is processing the attribute changing with the transition duration caused by a certain Set action. The duration of R3.TD is equal to the transition duration specified in the Set action. During R3.TD, the value of the specified attribute changes gradually. When such an action is in a serial synchronised group of actions, the following action in the list is to be processed after the completion of R3.TD. A user effect may be associated with R3.TD. It shows the impact of the transition duration on the attribute value perception. The user may gradually perceive the change of the presentation behaviour attribute value from the previous value to the specified value. The user effect may depend on each MHEG Engine and GUI.

The MHEG effect of a Set action with some transition duration is composed of two parts: the initial processing of the Set action in R3, and the consecutive processing of the gradual attribute changing gradually in R3.TD.

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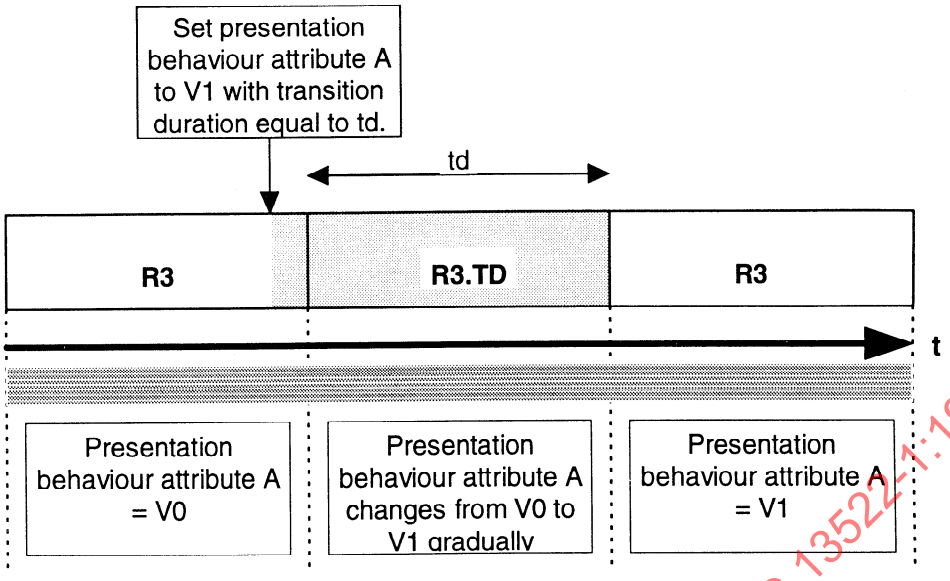

Figure 41 - Time line diagram of Set actions with transition duration

When an MHEG effect of a transition duration is under process and a Stop action is trageted at this rt-component, the MHEG effect of the transition duration shall be terminated once the MHEG effect of the Stop action is completed. The presentation behaviour attribute value takes the specified value in the Set action as if no transition duration has been specified. Figure 42 shows this situation.

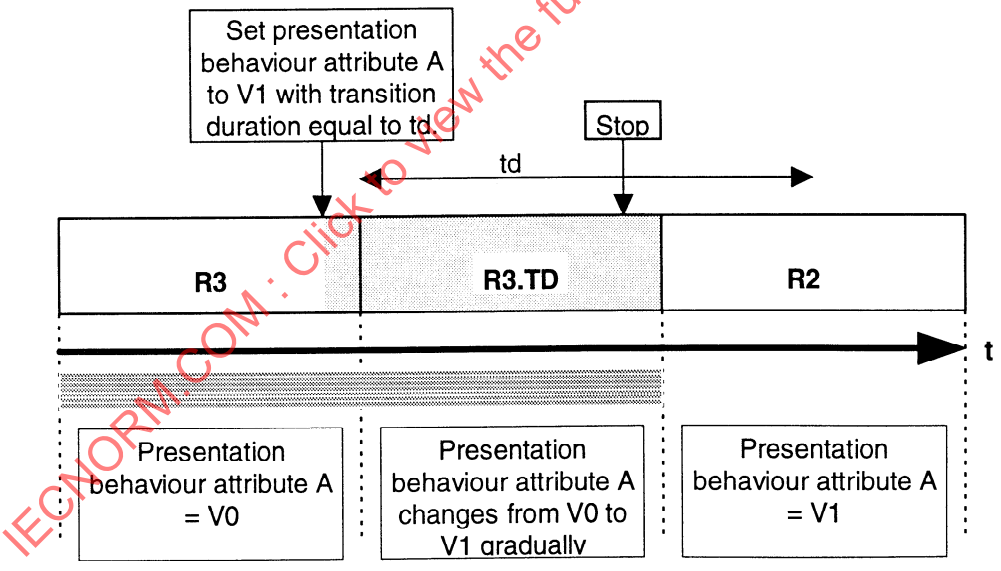

Figure 42 - Time line diagram of a Set action with transition duration when a Stop action occurs

When the MHEG effect of a transition duration is under process and a Set action is targeted at the same attribute, the MHEG effect of the transition duration shall be terminated. The presentation behaviour attribute value takes the value specified by the last Set action. If the last Set action has no transition duration, the MHEG effect is processed as described in Figure 40. If it has transition duration, the MHEG effect is processed as described in Figure 41. Figure 43 shows an example of the former case.

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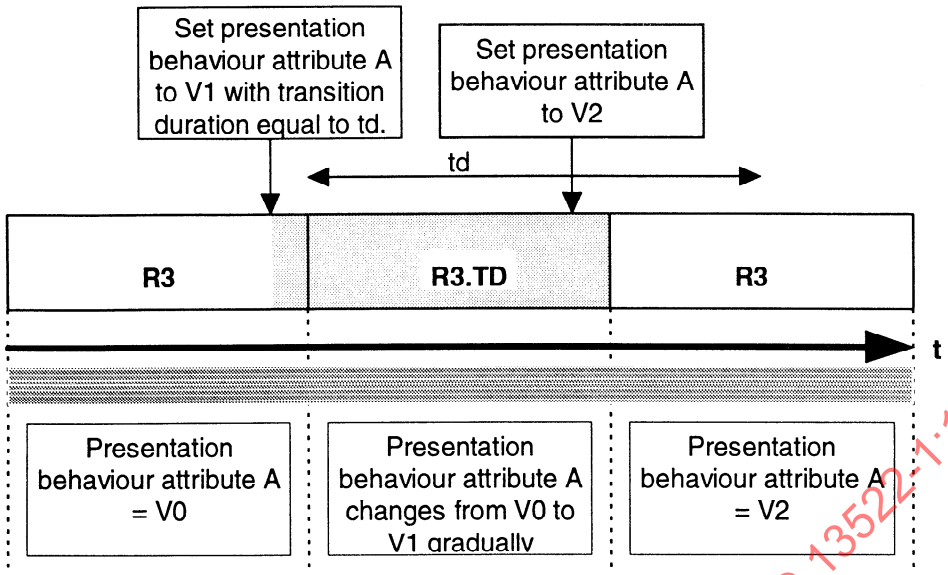

Figure 43 - Time line diagram of a interrupted Set action with transition duration

Figure 44 shows presentation behaviour attribute change while an rt-component is "not running". The rt-component has a presentation behaviour attribute A equal to V0 while it is in R2. When a Set action to change the presentation behaviour attribute A is targeted at this rt-component, the MHEG Engine processes the MHEG effect of this Set action. If a transition duration is specified, it is set to 0 meaning that the transition duration shall be ignored. After processing the MHEG effect, the presentation behaviour attribute A is equal to V1. If a Run action targeted after that, the rt-component is presented with the presentation behaviour attribute A equal to V1.

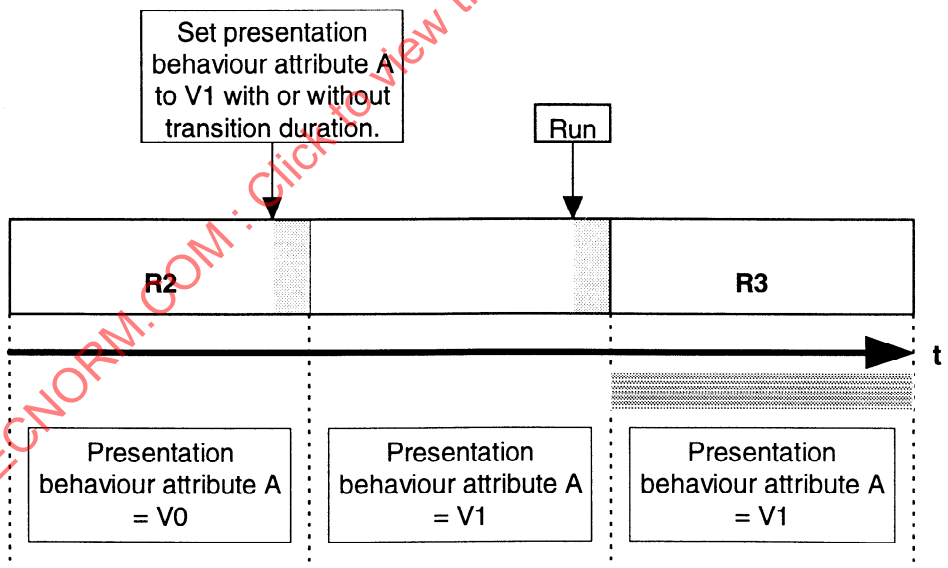

Figure 44 Time line diagram of set actions on an rt-component that is "not running"

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30 Life Cycle of MHEG Entities

MHEG entities are created and destroyed using elementary actions. The period between creation and destruction makes the life of an MHEG entity. During its life, some attributes associated with the MHEG entity are used.

The principal rules between the life the an MHEG entity and its associated attributes are as follows:

- When if such an MHEG entity does not exist, its preparation status (see clause 29.1), rt-availability status (see clause 29.4) or channel availability status (see clause 29.3) shalll be always defined. The preparation status shall be set to "not ready", the rt-availability status to "not ready" or the channel availability status to "not available".
- If a Prepare action (see clause 29.1), a New action (see clause 29.4) or a New Channel action (see clause 29.3) is targeted, the MHEG Engine is required to instantiate the specified MHEG entity with its corresponding attributes which are described in different behaviours. The preparation status is set to "ready", the rt-availability status to "ready" or the channel availability status to "available".
- If a Destroy action (see clause 29.1), a Delete action (see clause 29.4) or a Delete Channel action (see clause 29.3) is targeted, the MHEG Engine is required to remove the specified MHEG entity with its corresponding associated attributes except for the preparation status, rt-availability status and channel availability status that are set to "not ready", "not ready" and "not available", respectively.

Therefore, if an MHEG entity is destroyed or deleted, only the preparation status, the rt-availability status or the channel availability status is changed. And if there is a link whose condition is "when the preparation status becomes "not ready"", "when the rt-availability status becomes "not ready"" or "when the channel availability status becomes "not available"", it shall be triggered.

On the other hand, other associated attributes with the destroyed or deleted MHEG entity are completely removed without changing their status values. For example, if there is an rt-component whose running status is "running", its running status is removed without changing value. That means the rt-component has been deleted while it was "running". The running status is no longer available after deletion. If there is a link whose condition is "when the running status becomes "not running"", it shall not be triggered at the time of the deletion.

31 General Action Mechanisms

This clause summarises the general action mechanisms and their handling by an MHEG Engine. The mechanism apply to the processing of comman behavior as well as other behaviors.

31.1 Action handling

Actions shall be processed according to the following conditions:

- If an MHEG effect of an action contains a list of sub-effects, these sub-effects are to be performed by the MHEG Engine as if they were a single non-interruptable and indivisible operation.
- The effect of processing an action on a set of two or more targets is to propagate the action to each target within the set of targets. These actions are processed in parallel. The MHEG effect of the action shall end when the MHEG effects of all propagated actions end.
- In certain cases, in order to process an action, a preceeding action is implicitly executed. This preceeding action may produce a change of status. A link triggered on this change of status is fired before the processing of the specified action ends.

EXAMPLE: When an rt-object is made from a model object which is not prepared, an implicit Prepare action should be targeted to the model object before the New action. A link whose condition is "when a

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preparation status of the model object becomes ready" should be triggered when the model object enters O2, and not when the rt-object enters R2.

31.2 Processing of link effect

When a link is fired, i.e. as the link is activated and the link condition is satisfied, the MHEG Engine shall processe the link effect. Each time the link is fired the link effect is processed in two phases as follows:

- The macro resolution phase: if there are macros in this link (see clause 13).
- The action process phase. It consists in processing the action object included or referenced in the link effect. This action object may be a basic action, a nested action or macro action.

NOTE: The link effect is processed as summarised in Figure 45.

The action process begins when the link condition is satisfied when the macro resolution is accomplished, if the action is a macro action. Each action object is a recursive construction containing a group of synchronised actions together with a synchro indicator.

The synchro indicator specifies if the synchronised actions in the group are to be processed in parallel or in serial. The action group process depends on the synchro indicator. If a synchro indicator attribute is specified as a macro and if this macro is resolved as the value "undefined", the entire synchronised action set is not processed.

```
BEGIN ACTION PROCESS of action object within the link effect
    IF synchro indicator == serial
        FOR J = 1 TO number_of_synchronised_actions
        DO
            IF synchronised_action J == elementary_action
                PERFORM target resolution of elementary_action J
                PERFORM the action effect of elementary_action J on the target set
            ELSE IF synchronised_action J == action_object
                PERFORM RECURSIVE ACTION PROCESS of action_object J
            ENDIF
            WAIT FOR the end of MHEG effect of synchronised_action J
    ELSE IF synchro_indicator == parallel
        FOR J = 1 TO number_of_synchronised_actions
        DO IN PARALLEL
            IF synchronised_action J == elementary_action
                PERFORM target resolution of elementary_action J
                PERFORM the action effect of elementary_action J on the target set
            ELSE IF synchronised_action J == action_object
                PERFORM RECURSIVE ACTION PROCESS on action_object J
            ENDIF
    ENDIF
    WAIT FOR the end of MHEG effect of each actions in each of the "synchronised actions"
    WAIT FOR the end of user effect of each action 'run' in each of the "synchronised actions"
        DURING that time IF a target is "running" AND
            IF its current temporal position == its terminal temporal position
                PERFORM a Stop action on this target
```

Figure 45 - Action process phase

31.2.1 Serial action processing

If all the elementary actions contained in a serial action group are specified to be processed, each elementary action is processed sequentially after the MHEG effect of the previous elementary action has been completed.

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EXAMPLE: Figure 46 shows an example. In this Figure, 2 elementary actions are included in a link effect. After finishing the MHEG effect of elementary action 1, elementary action 2 is processed.

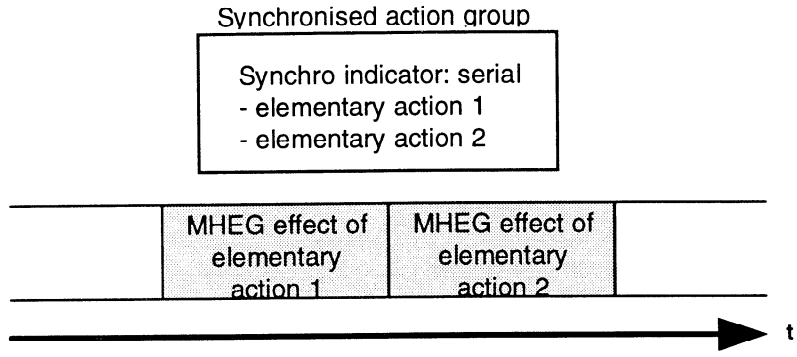

Figure 46 Example of processing of serial actions

The duration of the MHEG effect for a serial action list is the sum of duration of the MHEG effects for the serial actions.

NOTE: If a Run action is contained within the group, the user effect of the Run action continues even after the MHEG effects of the group have been completed, except if a Stop action is performed.

31.2.2 Parallel action processing

If all the elementary actions contained in a parallel action group are specified to be processed, they are processed in parallel. The MHEG effect of the parallel action group ends when the MHEG effects of all the parallel actions end.

NOTE: When a parallel group is imbricated in a serial group, the MHEG Engine should wait for the end of the MHEG effect of the set of parallel actions before processing the next action in the serial group.

EXAMPLE: Figure 47 shows an example of parallel processing. Before processing the elementary action 4, the MHEG Engine waits for the end of the MHEG effect of the action group, i.e. the end of the MHEG effect of elementary action 2.

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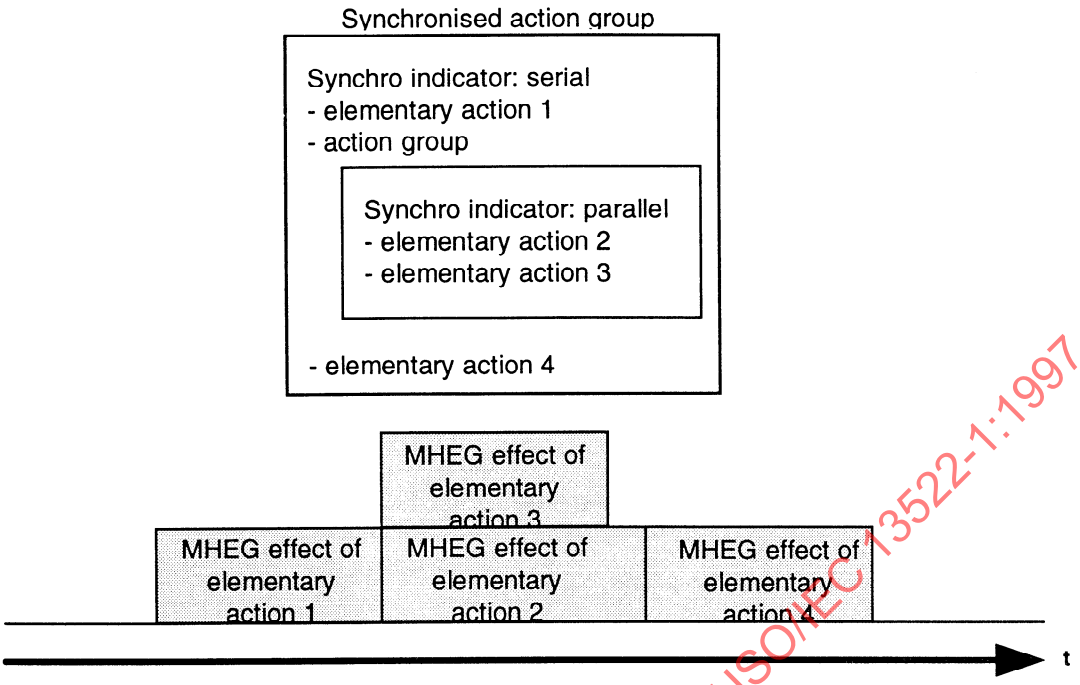

Figure 47 Example of processing parallel actions

The duration of the MHEG effect for a set of parallel actions is the longest of the MHEG effects among the parallel actions.

31.3 Basic processing of an elementary action

When an MHEG Engine processes an elementary action on a single target, it chall produce the following effects:

- **MHEG effect without transition duration**: This begins as the action is targeted, and ends once the action has been processed by the MHEG Engine. The MHEG effect typically results in a change of status or behaviour attribute value (see some examples in Figure 30, Figure 32, Figure 34, Figure 36, Figure 38, Figure 40 and Figure 44).
- **User effect without transition duration**: This effect may exist only if the running status is "running". The user effect begins as the MHEG effect of the Run action ends. This user effect lasts until the MHEG effect of the Stop action ends. The user effect is perceptible by the user during the "running". Each time a presentation attribute of the target is changed, if the target is "running", the user effect immediately reflects this change (see some examples in Figure 38 and Figure 40).
- **MHEG Effect with transition duration**: This begins as an action specifying a non null transition duration is targeted to an entity. It ends when the action has been processed by the MHEG Engine. If the target is not running, the transition duration is set to zero and ignored (see some examples in Figure 41, Figure 42 and Figure 43).
- **User Effect with transition duration**. This effect may exists only when a target is running and a set action with a non null transition duration is targeted to it. The user effect begins as the MHEG effect of the transition duration begins. The effect of the action is perceptible to the user gradually from the previous value to the specified value. As the MHEG effect of the transition duration ends, the user effect with transition duration ends (see some examples in Figure 41, Figure 42 and Figure 43).

31.4 Resolution of target set

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A single target (e.g. an MHEG object, a container element, an rt-object, a socket element, a channel) or multiple targets (e.g. some targets, an alias addressing several entities, all the rt-objects made from a model object, all the children of a specified entity) may be specified for each elementary action. Multiple targets are specified as a list of targets. The action effects for each target of a list should be processed in parallel.

NOTE 1: Authors should not rely on the order in which parallel actions are executed.

NOTE 2: An MHEG Engine is not required to perform true parallel processing.

Processing an action on an undefined target should have no effect.

31.5 Arithmetic precision

Percentage and ratio may be specified in some of elementary actions' parameters, for example, Set GTF, Set OVD. Ratio is also used in mapping OPS to RPS.

The general rule to calculate percentage and ratio is that full precision operation should be taken up to the final presentation of objects. Rounding should be done only for the final presentation of objects, i.e. in the final chain of OPS to CPS at channels.

NOTE 1: If an rt-object with CV 17 is connected to rt-composite A with GVF 1/3 that is connected to rt-composite B with GTF 3 and rt-composite B is connected to a channel, the final volume to be mapped to a physical device is 17 (Round(17 x 1/3 x 3)) and not 18 (Round(Round(17 x 1/3) x 3)).

NOTE 2: In above example with changing GTF of rt-composite B to 2, the final volume is 11 (Round(17 x 1/3 × 2)).

NOTE 3: A using application may define another arithmetic precision and rounding policies.

32 Common Action Effects and Handling

This clause describes common action effects and handling of all elementary actions and get actions for all behaviours throughout ISO/IEC 13522-1. The actual processing of elementary actions and get actions is outside the scope of ISO/IEC 13522-1, and should be provided by the MHEG Engine.

32.1 Elementary actions

Common action effects and handling of all elementary actions are as follows:

- If the MHEG Engine is unable to produce the required MHEG effect of an elementary action, the MHEG Engine should notify the using application of it.
- If the effect of targeting an elementary action to an MHEG object, an rt-object or a channel is not described in ISO/IEC 13522-1, this action is ignored by the MHEG Engine.
- If the whole set of targets becomes no longer available during the processing of an elementary action (i.e. all the targets within the set are destroyed or deleted), the process of this action is aborted.
- If a reference to a target of an elementary action except for Prepare, Activate, New and New Channel actions is invalid, the elementary action is ignored (i.e. with a null effect and completed immediately).
- If a target within a set of targets for an elementary action does not exist, this action is ignored only for that target.
- If the reference specification defines an empty set of MHEG objects, rt-objects or channels, the reference is ignored.

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- If the reference is ignored, the MHEG Engine behaves as if no entity were addressed.
- If a Prepare, New or New Channel action is applied to an MHEG entity which has an identifier already assigned to an MHEG entity currently available to the MHEG Engine, this action is ignored.
- If an elementary action is targeted to an rt-object in period R2 with a transition duration parameter, the specified transition parameter value is ignored and the elementary action is performed as if the transition duration were set to 0.
- If an elementary action is targeted to an rt-object in period R3 with a transition duration parameter, the specified transition parameter value is interpreted by the GTU assigned for the target. The presentation of the target is being gradually changed depending on the elementary action and changing presentation attribute.
- If a transition duration parameter is specified as a negative value, it is set to 0.
- The behaviour of an MHEG Engine that is executing a sequential synchronised actions group while one or more actions fail is not specified.

User effects associated with an elementary action are described in the corresponding clause of the elementary action. If the clause is silent in this respect, no user effect is associated with the elementary action.

32.2 Get actions

Common action effects and handling of all get actions are as follows:

- If a reference to a target of a get action except for Get Preparation Status, Get Activation Status, Get Rt-availability Status and Get Channel Availability actions is invalid, the result is to be evaluated to "undefined".
- If an MHEG Engine is unable to evaluate a get action, this action is evaluated to "undefined".
- If a reference to multiple entities (e.g. children tail, descendant tail) is specified, this reference is ignored. The target of a get action should address a single entity.
- If the reference is ignored, the MHEG Engine behaves as if no entity were addressed.

32.3 Recommended exception handling

Exception handling within the MHEG Engine is not specified., however the following is recommended:

a) upon being provided with an object whose encoding does not conform to ISO/IEC 13522-1,an MHEG Engine should ignore the whole objec.

b) If non-existing entities are referenced, except for targets of elementary actions and get actions:

   1) In a link condition, respective conditions should be evaluated to "undefined";

   2) Otherwise (e.g. in a composition element), they should be replaced by null objects.

   NOTE: These replacement behaviours should be withdrawn as soon as the referenced object is created.

a) If an object receives an action for which the corresponding behaviour is not defined by ISO/IEC 13522-1, the MHEG engione ignores this action. For example, Delete action targeted to a content object, a Set action with an unsupported value targeted to an rt-object.

   NOTE: The behaviour may be defined in an extension to ISO/IEC 13522-1 defined by another standard or a using application.

b) If other exceptions occur, e.g. request for a presentation aspect not supported by the presentation environment, or runtime failures like out of memory, graceful degradation and sensible falls back are encouraged.

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33 Postpone Behaviour

This behaviour is used to postpone the processing of any actions. As a rule , each action is processed immediately. However, any action may be postponed using this facility.

33.1 Behaviour attributes and statuses

There are no postpone behaviour attributes or statuses.

33.2 Actions to change the behaviour

ISO/IEC 13522 defines means to modify this behaviour by the use of the following actions:

– Delay action (see clause 33.2.1).

33.2.1 Delay action

This action is used to insert a delay between two actions of a serial synchronised action set within an action object.

This action has the following parameters:

– Temporal Unit Ref Param,

– Duration Param.

This action may be targeted during any period.

33.2.1.1 Delay action effect

The MHEG effect is as follows:

– If the temporal unit reference is specified as an rt-component, the duration of the delay is expressed in OGTU belonging to the rt-component.

NOTE: When the temporal unit reference indicates an rt-content, the delay is interpreted following the rules of the OPS-RPS-CPS chain exactly like any other temporal attributes.

– Otherwise (the temporal unit reference is specified as default GF), the duration of the delay is expressed in PTU.

– If the Delay action is in serial synchronised actions, the MHEG Engine waits during the specified duration before processing the next action.

– The MHEG effect ends when the duration of the delay expires.

33.2.1.2 Delay additional error conditions

– If the Duration Parameter parameter value is a negative value, it shall be set to the value 0.

– If the specified rt-component does not exist, the retrieved GTF is interpreted as the default-GF.

34 Returnability Behaviour

This behaviour is used to return information to an application or to entities outside the MHEG Engine, e.g. a script engine, a GUI, a server.

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34.1 Behaviour attributes and statuses

There are no returnability behaviour attributes or statuses.

34.2 Actions to change the behaviour

ISO/IEC 13522 defines means to modify this behaviour by the use of the following actions:

– Return action (see clause 34.2.1).

34.2.1 Return action

This action is used to return information to a application or to entities outside the MHEG Engine. Generic values or information contained in content objects may be passed.

This action has the following parameters:

– Set of Return Target Param,

– Return Indicator Param,

– Set of Returned Generic Value Param,

– Set of Content Object Ref Param.

This action may be targeted during any period.

34.2.1.1 Return action effect

The MHEG effect of the Return action is as follows:

– Return Indicator Param, Returned Generic Value Param and Content Object Ref Param are passed to the entity specified by the Return Target Parameters. The encoding format of the returned information is not specified by ISO/IEC 13522-1.

34.2.1.2 Return additional error conditions

There are no additional error conditions.

35 Alias Behaviour

This behaviour provides a symbolic identification to any generic references. Initially, no alias is given to any references.

35.1 Behaviour attributes and statuses

There are no alias behaviour attributes or statuses.

35.2 Actions to change the behaviour

ISO/IEC 13522 defines means to modify this behaviour by the use of the following actions:

– Set Alias action (see clause 35.2.1).

35.2.1 Set Alias action

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This action is used to assign aliases to generic references.

This action has the following parameters:

- Set of Target Param,
- Set of Alias Spec Param.

This action may be targeted during any period.

35.2.1.1 Set Alias action effect

The effect of this action shall be as follows:

- According to the Update Command, one or several aliases are added, removed or replaced to a target.
- If a target is not accessible when this action is processed, the alias is assigned to the reference as if the target were accessible.

35.2.1.2 Set Alias additional error conditions

There are no additional error conditions.

36 Extensibility Behaviour

This behaviour is used to the process of a catalogued elementary action, or the modification or retrieval of a catalogued attribute value (see clause 15).

The main purpose of the catalogued elementary actions is to provide behaviour that cannot be reasonably controlled like attributes, e.g. draw line, perform arithmetic operations or stop the MHEG Engine.

However the main purpose of the catalogued attributes deal with information that is expressed using attributes, e.g. presentation attributes such as font size or channel attributes such as current number of assigned rt-components.

NOTE: Style behaviour (see clause 55) is also a kind of extension which is devoted for presentation and interaction. For example, content format (encoding data) conversion is a feature of catalogued elementary actions, while presenting a content in different ways is a feature of the style behaviour (a music code playing in a graphical way or audible way).

36.1 Behaviour attributes and statuses

This behaviour is expressed using the following attributes or statuses:

- Catalogued Attribute (see clause 36.2).

36.2 Catalogued Attribute

A Catalogued Attribute is a catalogue entry which represents a list of data that may be such as presentation attributes, font size or channel attributes... The catalogued attribute may be used as a kind of tail to navigate along the hierarchy of catalogues.

36.3 Actions to change the behaviour

ISO/IEC 13522 defines means to modify this behaviour by the use of the following actions:

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- Catalogued Elementary Action action (see clause 36.3.1),
- Set Catalogued Attribute action (see clause 36.3.2).

36.3.1 Catalogued Elementary Action action

This action enables to use an extended elementary action which is registered or proprietary.

This action has the following parameters:

- Set of Target Param,
- Catalogued Extended Elementary Action Param,
- Set of Elementary Action Param.

This period is described in the catalogue where the extended EA is retrieved.

36.3.1.1 Catalogued Elementary action effect

The effect of this action is described in the catalogue where the extended elementary action is retrieved.

36.3.1.2 Catalogued Elementary Action additional error conditions

- The additional errors are also described in the catalogue where the extended elementary action is retrieved.

36.3.2 Set Catalogued Attribute action

This action enables to set a value of a catalogued attributes for the target.

This action has the following parameters:

- Set of Target Param,
- Cat Ext Attribute Param,
- Ext Attribute Value Param: a generic value to be assigned to a Cat Ext Attribute,
- Transition Duration Param.

This period is described in the catalogue where the extended EA is retrieved.

36.3.2.1 Set Catalogued Attribute action effect

The action effect depends on the chosen attributes and is described in the corresponding catalogue.

36.3.2.2 Set Catalogued Attribute additional error conditions

- The additional errors are also described in the catalogue where the extended elementary action is retrieved.

36.4 Actions to retrieve the behaviour

ISO/IEC 13522 defines means to get this behaviour by the use of the following actions:

- Get Catalogued Attribute action (see clause 36.4.1).

36.4.1 Get Catalogued Attribute action

This action enables to retrieve a value of a catalogued attribute for the target.

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This action has the following parameters:

- Target Param,
- Cat Ext Attribute Param: a generic value to be assigned to a Cat Ext Attribute.

This period is described in the catalogue where the extended EA is retrieved.

36.4.1.1 Get Catalogued Attribute action effect

The value of the catalogued attribute is retrieved.

36.4.1.2 Get Catalogued Attribute additional error conditions

- The additional errors are also described in the catalogue where the extended elementary action is retrieved.

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Section 5: Behaviour of MHEG Objects

37 Availability Behaviour of Mheg Objects

The behaviour is used to express the avaibility of an MHEG object to the MHEG Engine. All MHEG objects shall have a availability behaviour.

37.1 Behaviour attributes and statuses

This behaviour is expressed using the following attribute or status:

– Preparation Status (see clause 37.2).

37.2 Preparation Status

The availability of any MHEG object to the MHEG Engine may be evaluated. The result of this evaluation is set in the preparation status. The following applies (see Figure 31):

When an MHEG object is not available to the MHEG Engine, its preparation status is evaluated to "not ready", i.e. the MHEG object is in period O1. Initially an MHEG object is in this state.

NOTE 1: For example, in this state, the object has not been interchanged to the receiving system, some pre-processing is needed to prepare an object for presentation, etc.

Otherwise, its preparation status is evaluated to "ready", i.e. the MHEG object is in period O2.

NOTE 2: An MHEG Engine may offer more detailed diagnostic and informations messages to the using application, for example, to explain that an object cannot be located, or to indicate error conditions. These messages are not specified by ISO/IEC 13522-1.

37.3 Actions to change the behaviour

ISO/IEC 13522 defines means to modify this behaviour by the use of the following actions:

– Prepare action (see clause 37.3.1),

– Destroy action (see clause 37.3.2).

37.3.1 Prepare action

This action is used to make the MHEG object available to the MHEG Engine.

NOTE 1: For example, retrieval of an audiovisual sequence from a disk may require so much time that it may be efficient to start loading it before it is needed.

NOTE 2: A using application or a specific profile may define one concrete behaviour of this action. For example, considering a content object which has large data may be loaded either within the Prepare MHEG effect of the Prepare action or outside of it, depending on the appropriate strategy.

This action has the following parameter:

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– Set of Mh-Target Param.

This action may be targeted during the period: O1.

37.3.1.1 Prepare action effect

If the preparation status of the target is "not ready", the effect of the Prepare action shall be as follow::

a) The target shall be made available to the MHEG Engine.

b) Process the specific effects of the Prepare action on the following targets:

1) Action object: Implicit Prepare actions are targeted to the embedded (included or referenced) action objects in a nested action object.

2) Link object: Implicit Prepare actions are targeted to the action objects (included or referenced) describing the link effect.

NOTE 1: The preparation of a link object need not trigger the preparation of any targets of the get actions and elementary actions contained in this link.

3) Script object: The script data (included or referenced) is made available to the MHEG Engine.

NOTE 2: Object availability to an MHEG Engine is not specified by ISO/IEC 13522-1. For example, the script data may

be compiled into executable code and linked to the MHEG Engine or it may be in an interpreted form requiring a separate process.

4) Content object: The content data (included or referenced) is made available to the MHEG Engine.

NOTE 3: Object availability to an MHEG Engine is not defined by ISO/IEC 13522-1. For example, the content data may

be in the memory of the MHEG Engine or made available when required via a telecommunication or broadcast network.

5) Composite object:

i) Implicit Prepare actions are targeted to the links and action objects included in the specific behaviour.

ii) Implicit Prepare actions are targeted to the associated model objects included in the composition elements.

iii) Implicit Activate actions are targeted to the "availability start-up", "rt-availability start-up", "availability close-down" and "rt-availability close-down" links.

NOTE 4: The object designer may specify an explicit preparation and activation of the link and action objects only when there is a need to include that behaviour in the MHEG Engine, or in order to take into account the needs of minimal resource systems.

NOTE 5: The object designer may specify an explicit preparation of the referenced associated model objects only when there is a need to create an rt-composite. This takes the needs of minimal resource systems into account.

6) Container object: Implicit Activate actions are targeted to the "container start-up" and "container close-down" links.

NOTE 6: The object designer may specify, within these links, an explicit sequencing of preparation of the objects, and so make these objects available to the MHEG Engine when needed, in order to take the needs of minimal resource systems into account.

7) Descriptor object: The descriptor information (included or referenced) is made available to the MHEG Engine.

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NOTE 7: It is expected that the MHEG Engine evaluates the information provided by the descriptor during the execution of the Prepare action. how the information is handled depends on the implementation of the engine and the execution context .

c) Set the preparation status of the target to "ready". The target enters in period O2. These additional effects are to be processed on the following targets:

1) Content object: The following behaviours are available:

i) Generic value storage behaviour;

ii) Copy behaviour.

2) Composite object: "Availability start-up" is fired, i.e. its link effect is processed.

3) Container object: "Container start-up" is fired, i.e. its link effect is processed.

37.3.1.2 Prepare additional error conditions

– If one of the targets is an indexed element within a container object, the outer container object needs to be prepared. If it is not prepared, the action is ignored for this target.

– If one of the targets is not an MHEG object in O1, this action is ignored for that target.

37.3.2 Destroy action

This action removes an MHEG object from the MHEG Engine in order to release resources (e.g. memory, bandwidth, processing power) in the MHEG Engine.

This action has the following parameter:

– Set of Mh-Target Param.

This action may be targeted during the period: O2.

37.3.2.1 Destroy action effect

If the preparation status of the target is "ready"; the Destroy action shall have the following effect:

a) The specified effects of the Destroy action shall be processed on the following targets:

1) Action object:

i) Implicit Destroy actions are targeted to the embedded (included or referenced) action objects in a nested action object.

NOTE 1: Object designers should be aware of side effects that may occur if these objects are referenced in other objects.

ii) If an action object to be destroyed is under processing, the processing is interrupted.

NOTE 2: The way in which the processing is interrupted is not defined by ISO/IEC 13522-1. It is the responsibility of the MHEG Engine.

iii) If a nested action object is destroyed in an action object, this nested action object is replaced by a null object.

NOTE 3: Processing a null object has a null effect.

2) Link object:

i) If the link effect of the target is under process, an implicit Link Abort action is targeted to the link.

NOTE 4: As a link may be fired several times during its life, several link effects may be under process at the same time. All of these link effects are concerned.

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ii) An implicit Destroy action is targeted to each included or referenced action object.

NOTE 5: Object designers should be aware of side effects that may occur if this action object is referenced in other objects.

NOTE 6: The destruction of a link does not imply the destruction of any target for that link.

3) Model object: an Implicit Delete action is targeted to all the existing rt-objects created from this model object. The rt-availability status for each rt-object is changed to "not available". Other behaviours are destroyed.

NOTE 7: Object designers should be aware that the rt-objects disappear if the original model object is destroyed.

NOTE 8: handling of the disappearance of the rt-objects is not specified.

4) Script object: The script data (included or referenced) is destroyed.

NOTE 9: Object designer should be aware of side effects that may occur if this script data is referenced in another script object.

5) Content object: The content data (included or referenced) is destroyed.

NOTE 10: Object designers should be aware of side effects that may occur if this content object data is referenced in another content object.

6) Composite object:

i) Implicit Destroy actions are targeted to the "availability start-up", "rt-availability start-up" and "rt-availability close-down".

ii) Implicit Destroy actions are targeted to the link and action objects included in the specific behaviour.

iii) Implicit Destroy actions are targeted to the included component objects associated with the composition elements.

iv) Associated model objects and labels are also destroyed.

7) Container object: An implicit Destroy action is targeted to the "availability start-up" link.

b) The preparation status of the target is set to "not ready". The target enters in period O1. These additional effects are to be processed on the following targets:

1) Link object: The activation behaviour is changed to "inactivate".

2) Model object: The rt-availability behaviour is changed to "not available".

3) Composite object: availability close-down link is fired, i.e. its link effect is processed. After the link effect, availability close-down link is destroyed.

4) Container object: availability close-down link is fired, i.e. its link effect is processed. After the link effect, availability close-down link is destroyed.

c) Destroy the target.

37.3.2.2 Destroy additional error conditions

– If one of the targets is not an MHEG object in O2, this action is ignored for that target.

37.4 Actions to retrieve the behaviour

ISO/IEC 13522 defines means to get this behaviour by the use of the following actions:

– Get Preparation Status action (see clause 37.4.1).

37.4.1 Get Preparation Status action

This action is used to retrieve the preparation status of each MHEG object.

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This action has the following parameter:

– Mh-Target Param.

This action may be targeted during the periods: O1 and O2.

37.4.1.1 MHEG effect

This action evaluates the preparation status of the target. The following applies:

– If the target is in period O1, the preparation status is evaluated to "not ready".

– Otherwise (i.e. the target is in period O2), the preparation status is evaluated to "ready".

37.4.1.2 Get Preparation Status additional error conditions

There are no additional error conditions.

38 Link Object Activation Behaviour

The Link object behaviour is used to control the processing of a link object in the MHEG Engine. All link objects have this behaviour. Active link objects are monitored by the MHEG Engine. Whenever a link condition becomes true, the corresponding link effect is performed.

38.1 Behaviour attributes and statuses

This behaviour is expressed using the following attribute or status:

– Activation Status (see clause 38.2).

38.2 Activation Status

Once the link object is prepared, its activity may be evaluated. The result of this evaluation is set in the activation status. The following applies:

– When a link object may to be fired, its activation status is set to "activate", i.e. the link object is in period L2.

– Otherwise, its activation status is set to "inactive", i.e. the link object is in period L1.

38.3 Actions to change the behaviour

ISO/IEC 13522 defines means to modify this behaviour by the use of the following actions:

– Activate action (see clause 38.3.1),

– Deactivate action (see clause 38.3.2).

38.3.1 Activate action

This action activates link objects, i.e. allows them to be fired.

This action has the following parameter:

– Set of Link Target Param.

This action may be targeted during the period: L1.

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38.3.1.1 Activate action targeted to a single link object

The MHEG effect of this action is as follows:

- If the target is in period O2/L1, the activation status of the target is set to "active".
- If the target is in period O1, an implicit Prepare action is targeted to this target. Once the target is prepared, its activation status is set to "active".

A link object may be fired only if its preparation status is "ready" and its activation status is "active", i.e. the link object is in period O2/L2. Once active, the link effect may be processed several times (i.e. each time the link condition becomes true) until the link object is set to "inactive".

38.3.1.2 Activate additional error conditions

- If one of the targets is not a link object in O1 O2/L1, this action is ignored for that target.

38.3.2 Deactivate action

This action deactivates link objects, i.e. they cannot be fired.

This action has the following parameter:

- Set of Link Target Param.

This action may be targeted during the period: L2.

38.3.2.1 Deactivate action effect

The MHEG effect of this action is as follows:

- If the target is in period L2, the activation status of the target is set to "inactive".

38.3.2.2 Deactivate additional error conditions

- If one of the targets is not a link object in L2, this action is ignored for that target.

38.4 Actions to retrieve the behaviour

ISO/IEC 13522 defines means to get this behaviour by the use of the following actions:

- Get Activation Status action (see clause 38.4.1).

38.4.1 Get Activation Status action

This action is used to retrieve the activation status value of a link object.

This action has the following parameter:

- Link Target Param.

This action may be targeted during the periods: L1 and L2.

38.4.1.1 Get activation status targeted to a link object

The MHEG effect of this action is to retrieve the activation status of the target. The following applies:

- If the target is in period L1, the activation status evaluates to "inactive".
- If the target is in period L2, the activation status evaluates to "active".

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38.4.1.2 Get Activation Status additional error conditions

- If the target addresses multiple entities, e.g. Use of an alias which addresses a list of targets, or use of the "*" wildcard instead of a given rt-component number, or use of children or descendant tails, the action shall be ignored for this target.
- If the target is not a link object, this action is ignored for this target.
- If the target is not accessible, e.g. The reference cannot be resolved, the action is ignored for this target.

39 Link Object Abort Behaviour

This behaviour aborts the processing of all the actions that are contained in a link object.

39.1 Behaviour attributes and statuses

There are no link object abort behaviour attributes or statuses.

39.2 Actions to change the behaviour

ISO/IEC 13522 defines means to modify this behaviour by the use of the following actions:

- Link Abort action (see clause 39.2.1).

39.2.1 Link Abort action

This action is used to abort the processing of all the actions contained in a link object.

This action has the following parameter:

- Set of Link Target Param.

This action may be targeted during the period: L2.

39.2.1.1 Link Abort action effect

The effect of the action is as follows:

a) The elementary actions currently processed within the link effect of the target are aborted. These elementary actions are directly contained in the link effect or in a nested action object. The rest of the elementary actions contained within the link effect or some nested action objects are not processed.

b) MHEG effect of the aborted elementary action was to change an attribute value:

   1) If it is without a transition duration, the value is not changed;

   2) Otherwise (with a transition duration), the value becomes the current value.

      NOTE 1: What is aborted is the process of the transition duration. This is why the presentation attribute value on which the change with transition duration is under processing stops its change at its current value. This is a different effect from a Stop action targeted during that time (see Figure 42).

c) If the aborted elementary action is a Run action, an implicit Stop action is targeted to the target of the Run action.

If the aborted elementary action has a set of targets, the effect depends on the processing state of this elementary action on each target.

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NOTE 2: Suppose one Prepare action is targeted at both Object A and Object B within the link L1, and the MHEG effect of the Prepare action for Object A is already terminated (i.e. Object A is in period O2), but the MHEG effect of this action for Object B is still under processing (i.e. Object B is in period O1). In this case, if a Link Abort action is targeted to L1, the preparation status of Object A is evaluated to "ready", however, the preparation status of Object B is evaluated to "not ready".

NOTE 3: An Link Abort action does not affect a link activation status. A link may be fire even if a Link Abort action targeted at it is being processed. Only the actions that are originated by a link before the Link Abort action is targeted to such as link should be affected by the Link Abort action.

NOTE 4: The use of Link Abort actions as much should be avoided as possible. Their main role is to terminate the processing of actions that are performing MHEG effects with transition durations in R3.TD.

39.2.1.2 Link Abort additional error conditions

– If one of the targets is not a link object in L2, this action is ignored for that target.

40 Content Class Generic Value Storage Behaviour

This behaviour is used to store and retrieve of a generic value within the data of a content object.

40.1 Behaviour attributes and statuses

This behaviour is expressed using the following attribute or status:

– Data (see clause 40.2).

40.2 Data

A generic value may be stored in a content object and may be retrieved from a content object for further processing. Using the generic value storage behaviour, a content object may be used as a variable holder.

40.3 Actions to change the behaviour

ISO/IEC 13522 defines means to modify this behaviour by the use of the following actions:

– Set Data action (see clause 40.3.1),

– Add action (see clause 40.3.2),

– Substract action (see clause 40.3.3).

40.3.1 Set Data action

This action is used to store or to modify a generic value in the data field of a content object.

This action has the following parameters:

– Set of Content Target Param,

– Substitution Indicator Param,

– Set of Data Element Param.

This action may be targeted during the period: O2.

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40.3.1.1 Set Data targeted to a single content object

If a set of data element parameters is provided, the elements in this set are interpreted sequentially. For each data element parameter, the following effect shall apply:

a) If the generic list element ID parameter is omitted:

1) if the substitution indicator parameter is equal to "substitution", the previously stored generic value is replaced by the specified generic value (see Figure 48).

2) Otherwise (substitution indicator parameter is "no substitution"):

i) If the target contains a generic list, the specified generic value is added as a new element of the generic list in the target. If the target contains n elements, the new value is indexed as n+1th element (see Figure 49).

ii) Otherwise, this action is ignored.

b) Otherwise (generic list element ID parameter is specified):

1) If the target does not store a generic list:

i) If the substitution indicator parameter is "substitution", the previously stored value is discarded and new generic list is to be created. The specified generic value is stored in the specified generic list element ID, and other elements until the last numeric in the specified generic list element ID shall be filled with "unspecified" (see Figure 50).

ii) Otherwise, this action is ignored.

2) Otherwise (the target is a generic list):

i) If the specified generic list element ID exists in the target:

– If the substitution indicator is "substitution" the specified generic value is stored in the specified element ID, overwriting the previous value (see Figure 51).

– Otherwise (the substitution indicator is "no substitution"), this action is ignored.

ii) If the specified generic list element ID does not exist in the target and it is possible to extend generic list element ID as specified, the generic list of the target is extended in order to store the specified generic value. Empty elements created by this extension are filled with "unspecified". In this case, the substitution indicator is ignored (see Figure 52).

iii) Otherwise (the specified generic list element ID does not exist and it cannot be extended), this action is ignored (see Figure 53).

NOTE: The order of the data element parameters is significant, especially if no generic list element ID is specified for the generic value with "no substitution" and the target has a generic list.

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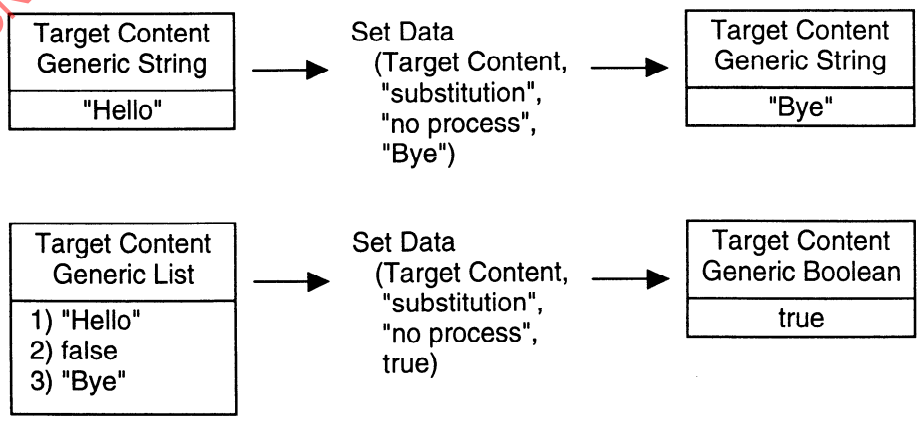

Figure 48 - Generic value substitution

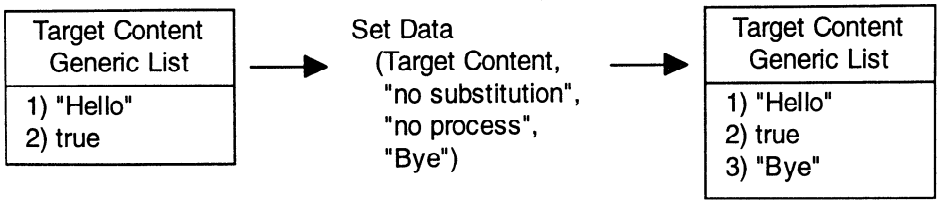

Figure 49 - Addition of an element to generic list

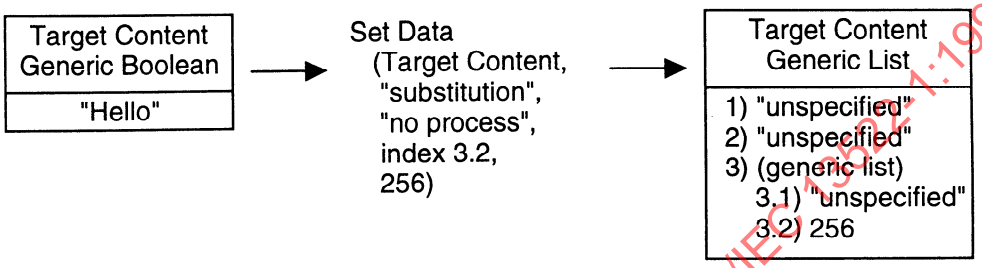

Figure 50 - Creation of list

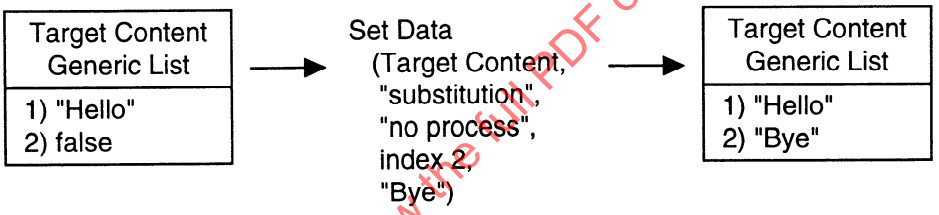

Figure 51 - Substitute of an element in a generic list

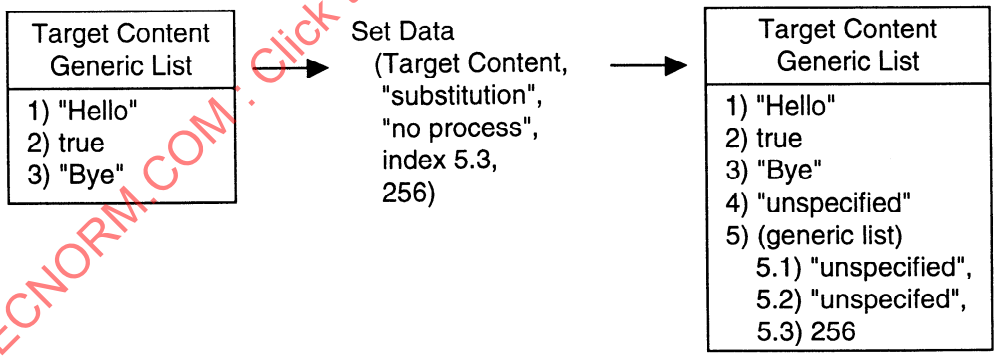

Figure 52 - Extension of a list

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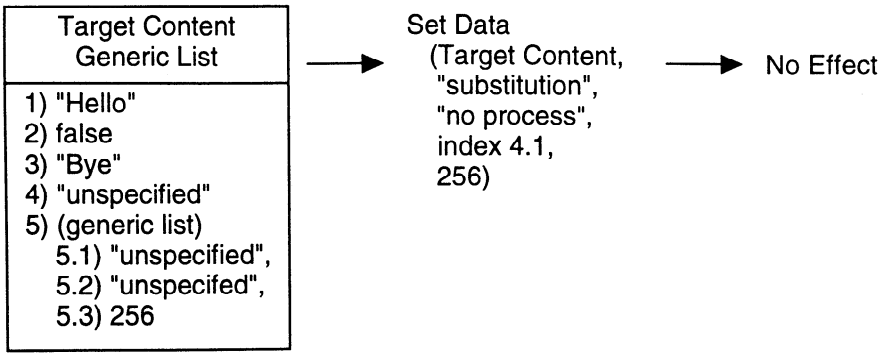

Figure 53 - Imcompatible generic list element ID

40.3.1.2 Set Data additional error conditions

- If one of the targets is not a content object in O2, this action is ignored for that target.
- If the hook of the targeted content object does not specify generic value this action is ignored.
- If a set data contains an element value which is specified as a Get Data action applied to the same target content object, this element value is replaced by an "unspecified" value.
- If the target is not a non-mux content, this action is ignored for this target.

40.3.2 Add action

This action provides an arithmetic operation that adds generic numeric, generic integer or generic ratio to the generic value contained in the data field of the target.

This action has the following parameters:

- Set of Content Target Param,
- Generic List Elt ID Param,
- Generic Value Param.

This action may be targeted during the period: O2.

40.3.2.1 Add action effect

If the generic list element ID parameter is omitted, this action should be targeted to a content object which does not contain a generic list. Otherwise, this action should be targeted to a content object which contains a generic list and the specified generic list element ID should exist.

The generic value type of the target content data and the specified generic value should be the same, and they are either generic numerics, generic integers or generic ratios.

This action shall have the following effect:

- If the generic value parameter is provided, the content data or the element data specified by the generic list element ID parameter is incremented by the generic value parameter.
- Otherwise, the content data or the element data specified by the generic list element ID parameter is incremented by 1 (generic numeric 1, generic integer 1 or generic ratio 1 depending on the generic value type in the target content object).

40.3.2.2 Add additional error conditions

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- If one of the targets is not a content object in O2, this action is ignored for that target.
- If the generic list element ID parameter is omitted and the target has a generic list, this action shall be ignored.
- If the generic list element ID parameter is provided and the target does not have a generic list, this action shall be ignored.
- If the generic list element ID parameter is provided and the target does not have a specified element, this action shall be ignored.
- If the generic value type of the target content data and the specified generic value are different, this action shall be ignored.
- If the generic value type of the target content data is neither generic numerics, generic integers nor generic ratio, this action shall be ignored.
- If the target is not a non-mux content, this action is ignored for this target.

40.3.3 Substract action

This action provides an arithmetic operation that subtracts a generic numeric, generic integer or generic ratio from the generic value contained in the data field of the target.

This action has the following parameters:

- Set of Content Target Param,
- Generic List Elt ID Param,
- Generic Value Param.

This action may be targeted during the period: O2.

40.3.3.1 Subtract targeted to a single content object

If the generic list element ID parameter is omitted, this action should be targeted to a content object which does not contain a generic list. Otherwise, this action should be targeted to a content object which contains a generic list and the specified generic list element ID should exist.

The generic value type of the target content data and the specified generic value should be of the same type, and they should be either generic numerics, generic integers or generic ratios.

This action shall have the following effects:

- If the generic value parameter is provided, the content data or the element data specified by the generic list element ID parameter is decremented by the generic value parameter.
- Otherwise, the content data or the element data specified by the generic list element ID parameter is decremented by 1 (Generic numeric 1, generic integer 1 or generic ratio 1 depending on the generic value type in the target content object).

40.3.3.2 Substract additional error conditions

- If one of the targets is not a content object in O2, this action is ignored for that target.
- If the generic list element ID parameter is omitted and the target has a generic list, this action is ignored.
- If the generic list element ID parameter is provided and the target does not have a generic list, this action is ignored.
- If the generic list element ID parameter is provided and the target does not have a specified element, this action is ignored.

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- If the generic value type of the target content data and the specified generic value are different, this action is ignored.
- If the generic value type of the target content data is neither generic numerics, generic integers nor generic ratio, this action is ignored.
- If the target is not a non-mux content, this action is ignored for this target.

40.4 Actions to retrieve the behaviour

ISO/IEC 13522 defines means to get this behaviour by the use of the following actions:

- Get Data action (see clause 40.4.1).

40.4.1 Get Data action

This action is used to retrieve a generic value or an element of a generic list stored in a content object.

This action has the following parameters:

- Content Target Param,
- Generic List Elt ID Param.

This action may be targeted during the period: O2.

40.4.1.1 Get Data targeted to a content object

The MHEG effect of this action is to retrieve a generic value or an element of a generic list stored in a content object. This action is evaluated to a generic value as follows:

- If generic list element ID parameter is not specified, this action is evaluated to the whole generic value stored in the target content object.
- Otherwise, this action is evaluated to the generic value stored at the place specified by the generic list element ID parameter within the target content object.

40.4.1.2 Get Data additional error conditions

- If the target addresses multiple entities, e.g. Use of an alias which addresses a list of targets, or use of the "*" wildcard instead of a given rt-component number, or use of children or descendant tails, the action shall be ignored for this target.
- If one of the targets is not a content object in O2, this action is ignored for that target.
- If the target is not a content object which does not contain a generic value, e.g. A still picture, a video, this action is ignored for this target.
- If the target is not accessible, e.g. The reference cannot be resolved, the action is ignored for this target.
- If the element list index is an incompatible element list index, i.e. It indicates a non existent path within the data, this action returns "undefined".
- If the target is not a non-mux content, this action returns "undefined".

41 Content Class Copy Behaviour

The Content class copy behaviour is used to generate new content objects from an existing one.

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This behaviour is used to copy a model content object to other independent content objects. The copied content objects have independent identifications provided by the object designer. They are completely independent of the original content object, i.e. any modification to the original does not affect the copied content objects.

41.1 Behaviour attributes and statuses

There are no content class copy behaviour attributes or statuses.

41.2 Actions to change the behaviour

ISO/IEC 13522 defines means to modify this behaviour by the use of the following actions:

– Copy action (see clause 41.2.1).

41.2.1 Copy action

This action specifies a target content object as a source of the copy operation and a set of content objects as destinations of the copy operation.

This action has the following parameters:

– Content Target Param,

– Set of Destination Param.

This action may be targeted during the period: O2.

41.2.1.1 Copy action effect

The effect of this action is as follows:

– If the content object specified as a destination parameter does not exist, the specified content object is created. If the destination is specified by an MHEG identifier, a content object containing the MHEG identifier is created.

– All attributes of the target content object except the MHEG identifier attribute are copied in every destination content object.

A target content object may be specified by a container element which is the content object. However, a destination content object shall not be specified by a container element even if it is a content object.

No rt-contents shall exist for a destination content object at the time of a Copy action.

41.2.1.2 Copy additional error conditions

– If one of the targets is not a content object in O2, this action is ignored for that target.

– If rt-contents are created from a content object referenced in a destination parameter, this action is ignored for that destination.

– If a content object referenced in a destination parameter is specified as a container element reference, this action is ignored for that destination.

– If the target is not a non-mux content, this action is ignored for this target.

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Section 6: Rt-Objects Behaviour

42 Rt-Objects Availability Behaviour

This behaviour is used to describe the availability of rt-objects within the MHEG Engine. All rt-objects shall have a Rt-objects availability behaviour.

42.1 Behaviour attributes and statuses

This behaviour is expressed using the following attribute or status:

– Rt-Availability Status (see clause 42.2).

42.2 Rt-Availability Status

The rt-availability status value of each rt-object should be evaluated to "available" if the rt-object is available for running for the MHEG Engine, i.e. the rt-object is created from a model object and in period R2. The rt-availability status value of each rt-object should be evaluated to "not-available" if the rt-object is not created or deleted, i.e. the rt-object is in period R1.

Initially, the rt-availability status of each rt-object shall be "not available".

42.3 Actions to change the behaviour

ISO/IEC 13522 defines means to modify this behaviour by the use of the following actions:

– New action (see clause 42.3.1),

– Delete action (see clause 42.3.2).

42.3.1 New action

The New action is used to create rt-objects from model objects. A view of the model object is created for for running and for perception by users. The rt-object creation process provided by the MHEG Engine is not specified.

This action has the following parameter:

– Set of Rt-Target Param.

This action may be targeted during the period: R1.

42.3.1.1 New action effect

The MHEG effect is processed immediately. There is no associated user effect. The MHEG effect of this action is as follows:

a) Construct the targeted rt-object.

NOTE 1: It is up to the MHEG Engine to decide wether the data of the model object should be copied.

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b) Assign the rt-object identifier. This is the target of the New action.

c) Perform specific effects of the New action on ths following objects:

1) Rt-script:

i) Passing parameter behaviour is initialised.

ii) Rt-script termination behaviour is set to "not terminated".

2) Rt-Component:

i) Presentation behaviours are initialised.

ii) Interaction behaviour is initialised.

3) Rt-Composite:

i) Construct each component within the rt-composite.

NOTE 2: Each composite object represents one generation. The construction is recursive when a composite object is associated with a composition element. Using this facility, the MHEG Engine combines all the generations to construct a complete rt-composite.

ii) Target a Plug action to each socket in the rt-composite. The data to be plugged is the data found in the associated model of the corresponding element. When an empty model is associated, a null rt-object is to be plugged in the corresponding socket.

NOTE 3: The Plug action is targeted automatically by the MHEG Engine. The author need not to specify this action. This is a feature of the associated model facility in the composite object.

NOTE 4: Strictly speaking, a label or a component object cannot be plugged directly into a socket. When a label is associated, the MHEG Engine is expected to create a content object with the label as data and then create an rt-content from this content. When a component is associated, the MHEG Engine processes an implicit New action to create an rt-component from that component, and then plugs that rt-component into the socket.

NOTE 5: The New action is propagated to the next generation in the rt-composite through the effect of the Plug action.

iii) Sockets presentation and structural dynamism behaviour is initialised.

iv) Presentation behaviours are initialised.

d) The running behaviour is initialised to "not running".

e) Set the rt-availability status of the targeted rt-object to "available". The created rt-object enters in period R2.

f) The rt-availability start-up link in a composite object is fired.

When the original model object is in O1, an implicit Prepare action is targeted to the model object, and then the New action is applied as above.

42.3.1.2 New additional error conditions

- If in one of the targets, the original object identification addresses an object which is not a model object, this action shall be ignored for this target.
- If one of the targets does not address an rt-object, this action shall be ignored for this target.
- If one of the targets is not an rt-object in R1, this action is ignored for that target.

42.3.2 Delete action

This action removes rt-objects from the MHEG Engine. This may be used to release resources in the MHEG Engine. This action does not affect model objects from which rt-objects are created.

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This action has the following parameter:

– Set of Rt-Target Param.

This action may be targeted during the periods: R2, R3 and R3.TD.

42.3.2.1 Delete action effect

There is no direct user effect associated, however, there may be an indirect user effect in certain cases. The MHEG effect of this action shall be as follows:

a) Perform the specific effects of this action on the following targets:
   1) Rt-script:
      i) Passing parameters behaviour is destroyed.
      ii) Termination behaviour is destroyed.
   2) Rt-Component:
      i) Presentation behaviours are destroyed.
      ii) Interaction behaviour is destroyed.
   3) Rt-Composite:
      i) Sockets presentation and structural dynamism behaviour is destroyed.

         NOTE: The Plug action defined in this behaviour is no longer applied to sockets. This behaviour is no longer possible.

      ii) Presentation behaviour is destroyed.
      iii) The Delete action shall be propagated to each rt-component plugged in each socket of this rt-composite. It shall destroys the complete rt-composite when the propagation is completed.
      iv) If a label is plugged in a socket, the dynamically created content object used for the Plug action process shall be destroyed.

b) Destroys the running behaviour.

c) Destroys the targeted rt-object.

d) Set the rt-availability status of the targeted rt-object to "not available". The rt-object enters period R1.

e) Rt-availability close-down link of the corresponding composite object is fired.

42.3.2.2 Delete additional error conditions

– If in one of the targets, the original object identification addresses an object which is not a model object, this action shall be ignored for this target.

– If in one of the targets, the original object identification addresses a model object which is not in period 02, this action is ignored for that target because the model object is not yet available.

– If one of the targets is not an rt-object in R2, R3, and R3.TD, this action is ignored for that target.

42.4 Actions to retrieve the behaviour

ISO/IEC 13522 defines means to get this behaviour by the use of the following actions:

– Get Rt-Availability Status action (see clause 42.4.1).

42.4.1 Get Rt-Availability Status action

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This action is used to retrieve the availability status of each rt-object for the MHEG Engine.

This action has the following parameter:

– Rt-Target Param.

This action may be targeted during the periods: R1, R2, R3 and R3.TD.

42.4.1.1 Get Rt-availability Status targeted to rt-object

The MHEG effect of this action is as follows:

– If the targeted rt-object is in period R1, the rt-availability status is evaluated to "not available".

– Otherwise, it is evaluated to "available".

42.4.1.2 Get Rt-Availability Status additional error conditions

– If the target addresses multiple entities, e.g. Use of an alias which addresses a list of targets, or use of the "*" wildcard instead of a given rt-component number, or use of children or descendant tails, the action shall be ignored for this target.

– If the target is not an rt-object, this action is ignored for this target.

– If the target is not accessible, e.g. The reference cannot be resolved, the action is ignored for this target.

– If in one of the targets, the original object identification addresses a model object which is not in period 02, this action is ignored for that target because the model object is not yet available.

43 Rt-Objects Running Behaviour

This behaviour is used to run and stop rt-objects.

43.1 Behaviour attributes and statuses

This behaviour is expressed using the following attribute or status:

– Running Status (see clause 43.2).

43.2 Running Status

An rt-object may be run by the MHEG Engine at different times. When an rt-component is running, it may be presented to the user. When an rt-script is running, the script itself is being processed.

The running of each rt-object for the MHEG Engine may be evaluated.

Initially, the running status of each rt-object is evaluated to "not running" and the rt-object is in period R2. The running status of each rt-object is evaluated to "running" if the rt-object is running and its presentation or processing is controlled by the MHEG Engine.

43.3 Actions to change the behaviour

ISO/IEC 13522 defines means to modify this behaviour by the use of the following actions:

– Run action (see clause 43.3.1),

– Stop action (see clause 43.3.2).

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43.3.1 Run action

This action is used to present and process of rt-object for the MHEG Engine.

This action has the following parameters:

- Set of Rt-Target Param,
- Number Of Performances Param.

This action may be targeted during the periods: R1 and R2.

43.3.1.1 MHEG effect of Run targeted to a single rt-object

If the rt-availability status of the target is "not available", an implicit New action is targeted at this rt-object. If the target is in period R2, the MHEG effect is processed immediately as follows:

a) Place the target under the control of the presentation or processing system.

b) Set number of completed performances to 0.

c) Perform specific effects as follows:

1) Rt-Component: The current temporal position is positioned at the current temporal position of its RPS.

NOTE 1: By default, when an rt-component is created, its current temporal position is set to the start point of its OVD, i.e. its initial temporal position.

NOTE 2: The Run action starts the presentation of the rt-component at the current temporal position of the target where it has been left by a previous Run action, i.e. the current temporal position is not reset by the Run action.

d) Set the running status to "running". The rt-object enters period R3.

e) If the current temporal position reaches the terminal temporal position, the number of completed performances is increased by 1.

f) If the specified number of performances is not equal to the number of completed performances, the current temporal position is set to the initial temporal position and presentation continues from the beginning of the OVD.

g) The temporal termination of the target is affected when if the specified number of performances is equal to the number of completed performances.

43.3.1.2 User effect of Run targeted to a single rt-object

The user effect of this action shall be as follows:

a) Rt-script: The user effect is described within the script data. At the end of the processing of an rt-script, an implicit stop action is targeted at the rt-script by the MHEG Engine.

NOTE 1: In that case, the termination status is set to "terminated". The processing of the rt-script has been performed up to the end of the script.

b) Rt-Component:

1) The current temporal position of the target progresses within the OVD of the target taking into account the current GTF value. All presentation behaviour attributes may affect the user effect (e.g. position, size, audible volume).

2) When the terminal temporal position (i.e. the end of OVD) of the target is crossed after the specified number of performances, the following applies:

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i) If the temporal termination of the target is equal to "freeze", the current GTF value is memorised and the GTF value is temporarily set to 0 by the MHEG Engine. The GTF of the target becomes 0. The current temporal position remains constant at the terminal temporal position value. The rt-component is still "running".

NOTE 2: If the information presented is a video, the last frame may be displayed. If it is an audio, no sound may be perceived. If it is a still picture, it may remain presented.

NOTE 3: If the current temporal position is changed to another position, the memorised GTF values is resumed.

ii) Otherwise (the temporal termination of the target is equal to "stop"), an implicit Stop action should be targeted to the rt-component.

NOTE 4: By default, the terminal temporal position is set to the rt-component original duration. If this duration is infinite, an explicit Stop action should be targeted to that rt-component to stop the user effect of the Run action.

NOTE 5: If a timestone is positioned on the terminal temporal position, it is crossed as many times as the specified number of performance just when the current temporal position of rt-component crosses it. If an rt-component is set to "freeze" and there is such a timestone, the timestone is crossed just at the time the current temporal position arrives on the terminal temporal position every time.

c) Rt-Composite:

1) All the user effects for rt-component applies.

2) Each time the current temporal position of an rt-composite crosses a temporal position where a child socket is attached, an implicit Run action shall be targeted at that socket.

NOTE 6: A socket may be positioned on a temporal position on its parent T axis (PRPS) using a Set PVD Position action.

3) If the terminal temporal position of an rt-composite is crossed, a Set CTP action is targeted at each socket that is still running to set it to its terminal temporal position.

NOTE 7: The VD of the sockets that are running and not at their terminal temporal position are effectively shortened when the terminal temporal position of the parent is crossed. Whatever their positions, if the parent is terminated, they are terminated too.

NOTE 8: They are positioned at their terminal temporal position so that they restart at their initial temporal position when they become running again.

43.3.1.3 Run additional error conditions

- If the target is not a socket whose parent is not in period R3 or R3.TD, this action is ignored for this target. The parent needs to be running to set the children or descendants running.
- If one of the targets is not an rt-object in R1 R2, this action is ignored for that target.
- If the number of performances is less than 1, this action shall be ignored for the whole target set.

43.3.2 Stop action

This action sets the running status to "not running" and stops ongoing user effects.

This action has the following parameter:

- Set of Rt-Target Param.

This action may be targeted during the periods: R3 and R3.TD.

43.3.2.1 Stop targeted to a single rt-object

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The action effect of this action is as follows:

a) Perform specific effects on the following objects:

1) Rt-Component: The progression of the current temporal position is stopped and it remains at its current value.

2) Rt-Composite: The Stop action is propagated to all child sockets, i.e. to all descendant sockets recursively.

NOTE 1: A socket cannot be running if its parent is not running.

NOTE 2: All sockets, that are assigned to this composition space and that are directly assigned to a channel, are stopped.

b) Stop ongoing user effects of the target

c) Set the running status to "not running". The rt-object enters period R2, and all the user effects are stopped.

43.3.2.2 Stop additional error conditions

– If one of the targets is not an rt-object in R3 or R3.TD, this action is ignored for that target.

– If the target is not a socket whose parent is not in period R3 or R3.TD, this action is ignored for this target. The children or descendants should not be running when the parent is not running. The Stop action is useless in this case.

43.4 Actions to retrieve the behaviour

ISO/IEC 13522 defines means to get this behaviour by the use of the following actions:

– Get Running Status action (see clause 43.4.1).

43.4.1 Get Running Status action

This action is used to retrieve the running status of each rt-object.

This action has the following parameter:

– Rt-Target Param.

This action may be targeted during the periods: R2, R3 and R3.TD.

43.4.1.1 MHEG effect

This action evaluates the running status as follows:

– If the target is in period R3 or R3.TD, the running status shall be evaluated to "running".

– Otherwise, it shall be evaluated to "not running".

43.4.1.2 Get Running Status additional error conditions

– If the target addresses multiple entities, e.g. Use of an alias which addresses a list of targets, or use of the "*" wildcard instead of a given rt-component number, or use of children or descendant tails, the action shall be ignored for this target.

– If one of the targets is not an rt-object in R2, R3 or R3.TD, this action is ignored for that target.

– If the target is not accessible, e.g. The reference cannot be resolved, the action is ignored for this target.

– If in one of the targets, the original object identification addresses a model object which is not in period 02, this action is ignored for that target because the model object is not yet available.

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44 Rt-Script Passing Parameter Behaviour

This behaviour is used to pass parameters to rt-script.

44.1 Behaviour attributes and statuses

There are no rt-script passing parameter behaviour attributes or statuses.

44.2 Actions to change the behaviour

ISO/IEC 13522 defines means to modify this behaviour by the use of the following actions:

– Set Parameters action (see clause 44.2.1).

44.2.1 Set Parameters action

This action is used to pass parameters to rt-scripts and to return information back from the rt-script processing. Any number of rt-script parameters may be defined for a given rt-script.

Each rt-script parameter is specified as a generic value or a content object. Since a generic value is a result of a Get action or a constant, using a generic value is similar to a "call by value". However, using a content object is similar to a "call by reference" since a content object may contain or refer to a generic value, image, video and so on.

This action may be targeted at any time during the life of an rt-script even when an rt-script is under processing of a script engine, and may also be targeted several times during the life of the rt-script.

The semantics, the parameter order, the type (input, output or input/output) and any usage of each parameter should be defined by the object designer and shall be supported by a using application and a script engine.

NOTE: No passing parameter may be specified. It may be used to signal or to notify the script engine or the MHEG Engine. The semantics of this usage depends on the using application.

This action has the following parameters:

– Set of Rt-Script Target Param,

– Set of Passing Param.

This action may be targeted during the periods: R2, R3 and R3.TD.

44.2.1.1 Set Parameter action effect

There is no direct user effect associated with this action. However, there may be an indirect user effect in certain cases.

The MHEG effect of this action is to pass the specified passing parameters to the target.

Content objects in passing parameters may be used to return information from a script engine to the MHEG Engine. Therefore, if a content object is used as a parameter from which rt-contents are created and running, there may be indirect user effects by an rt-script due to the data modification within the content object. The presentation of such rt-content may be modified.

EXAMPLE: Suppose an rt-script is in charge of the access to a database to retrieve information and the results are set into a content object. The result may be used to complete a form, for example, as follows:

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An rt-script RS1 is created from a model script object MS1: New (RS1).

An content object CO1 and two generic values of integers are passed to RS1 as parameters: Set Parameters (RS1, CO1, 13, 15).

RS1 is executed: Run (RS1)

The execution of RS1 uses the parameters set by the Set Parameters action during the process. After finishing the script, the execution result is stored in CO1.

The value in CO1 may be retrieved by using a link condition for further processing in the MHEG Engine: "When the running status of RS1 becomes "not running"", Get Data (CO1).

44.2.1.2 Set Parameters additional error conditions

- If one of the targets is not an rt-script in R2, R3 or R3.TD, this action is ignored for that target.
- If the reference to a content object used to pass parameters is not accessible or does not address a content object, this parameter is replaced by the value "undefined".

45 Rt-Scripts Termination Behaviour

This behaviour is used to evaluate the complete termination of an rt-script process inside a script engine for the MHEG Engine.

45.1 Behaviour attributes and statuses

This behaviour is expressed using the following attribute or status:

- Termination Status (see clause 45.2).

45.2 Termination Status

The Termination Status specifies the execution status of an rt-script. It is either "terminated" or "not terminated". If the execution of an rt-script is completed, the termination status is evaluated to "terminated". Otherwise, it is evaluated to "not terminated".

After the creation of an rt-script, the termination status is initialised to "not terminated". After receiving a Run action, the rt-script is executed by a script engine. When it is terminated (i.e. its termination status is changed from "not terminated" to "terminated"), an implicit Stop action is targeted at the rt-script. If a Stop action is targeted during the execution of the rt-script, it becomes "not running" and "not terminated". Only the rt-objects that are "not terminated" may be run again. If the same script is to be executed, two rt-scripts should be created and run. There is no direct relationship between the running status and the termination status.

45.3 Actions to retrieve the behaviour

ISO/IEC 13522 defines means to get this behaviour by the use of the following actions:

- Get Termination Status action (see clause 45.3.1).

45.3.1 Get Termination Status action

This action is used to retrieve the termination status of the target.

This action has the following parameter:

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– Rt-Script Target Param.

This action may be targeted during the periods: R2, R3 and R3.TD.

45.3.1.1 Get Termination Status action effect

The effect of this action is follows:

– If the process of the target rt-script is not terminated, the termination status shall be evaluated to "not terminated".

– Otherwise, it shall be evaluated to "terminated".

45.3.1.2 Get Termination Status additional error conditions

– If the target addresses multiple entities, e.g. Use of an alias which addresses a list of targets, or use of the "*" wildcard instead of a given rt-component number, or use of children or descendant tails, the action shall be ignored for this target.

– If one of the targets is not an rt-script in R2, R3 or R3.TD, this action is ignored for that target.

– If the target is not accessible, e.g. The reference cannot be resolved, the action is ignored for this target.

46 Sockets Presentation and Structural Dynamism Behaviour

This behaviour is used to attach or detach an rt-component to a socket. This may be done at any time during the life of the rt-composite once the rt-composite is created.

This behaviour has the following particularities:

– Attachment of an rt-content to a socket. This socket becomes an rt-content socket, and the rt-content is perceived through the socket.

– Attachment of an rt-composite to a socket. This socket becomes an rt-composite socket. A new set of generations is attached to the socket. If each generation contains a set of rt-content sockets, a new depth of presentation may be perceived .

– Replacement of an rt-content in an rt-content socket. A new rt-content may be perceived.

– Replacement of an rt-composite in an rt-composite socket. A generation and all its descendants are replaced by a new set of generations. A new generation may be perceived.

– Detachment of an rt-component from a socket. The socket becomes an empty socket. No presentation is perceived.

Initially, each socket has an rt-component plugged into it. This is a null rt-object or an rt-component created from the associated model information exchanged within the composite.

46.1 Behaviour attributes and statuses

There are no sockets presentation and structural dynamism behaviour attributes or statuses.

46.2 Actions to change the behaviour

ISO/IEC 13522 defines means to modify this behaviour by the use of the following actions:

– Plug action (see clause 46.2.1).

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46.2.1 Plug action

This action specifies the information to be plugged into a socket. This action is used to make a different presentation from the same composite object model.

The parent of the target should be in period R2, R3 or R3.TD

This action has the following parameters:

- Set of Socket Target Param,
- Plug In Param.

This action may be targeted during any period.

46.2.1.1 Plug action effect

The MHEG effect of this action is as follows:

a) If the specified socket exists, the following applies:

1) If a null rt-object is to be plugged in:

i) An implicit Delete action is targeted to the rt-component currently plugged into the targeted socket.

ii) A null rt-object is attached to the targeted socket. The socket becomes an empty socket.

iii) If the running status of a previous plugged-in socket was "running", an implicit Run action is targeted to the socket.

iv) Any previous user effects may cease.

2) If an rt-component is to be plugged in:

i) A copy of the specified rt-component to be plugged in is made. This new rt-component shall have no explicit identification and shall be referenced only via the socket addressing in which it is to be plugged.

NOTE 1: It is up to the MHEG Engine to assign this identification and ensure that it is unique. An author should not use the same value.

NOTE 2: For an rt-content, a New action may be performed on the model object and then a transfer of behaviour may be performed from the targeted rt-content to this newly created rt-content.

NOTE 3: For an rt-composite, it is not permitted to perform an New action on the model composite object in order to make a copy. The created one is not always the same as the targeted rt-composite due to the structural and presentation dynamism behaviour of sockets that may be applied to the rt-composite.

ii) If the running status of the new made rt-component is "running", it is set to "not running".

iii) An implicit Delete action is targeted to the rt-component currently plugged into the targeted socket.

iv) The newly created rt-content is attached to the targeted socket with its currently associated behaviours.

v) If the running status of previous plugged in socket was "running", an implicit Run action is targeted to the socket.

vi) Any previous user effects may be modified as result of the Plug action.

3) If a component object is to be plugged in:

i) An rt-component is created from this model component object. This rt-component has no explicit identification and is referenced only via the socket addressing in which it is to be plugged.

ii) This newly created rt-component is attached to the targeted socket with its currently associated behaviours.

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iii) If the running status of previous plugged in socket was "running", an implicit Run action is targeted to the socket.

iv) Any previous user effects may be modified as the result of the Plug action.

4) If a label is to be plugged in:

i) A content object is dynamically created. This content object has no explicit identification and is referenced only via the socket in which an rt-content created from this content object is to be plugged.

ii) Apply all steps in the case as a component object is to be plugged in.

b) Otherwise (the specified socket does not exist), the specified socket is to be created, and the following applies:

1) If the first index of the socket address does not exist, the children sockets are completed with empty sockets until this socket index. For example, if the number of sockets is n and the first index of the targeted socket address is m (n < m) , new sockets should be indexed from n+1 to m.

2) If the second index of the socket address is provided:

i) If the first index indicates an rt-composite and the second index does not exist, the children sockets of this second generation are completed with empty sockets as described in the first index case.

ii) If the first index does not indicate an rt-composite:

– An implicit Delete action is targeted to the rt-content currently plugged-in there;

– A new rt-composite is created with a number of sockets equal to the second index. Each socket within this rt-composite is created as an empty socket. This new rt-composite has no explicit identification and is referenced only via the socket addressing in which it is to be plugged;

– This new rt-composite is plugged into the socket addressed by the first index.

3) Above steps are repeated up to the last index of the adress of the targeted socket.

4) Once socket creations are completed, the target addresses an empty socket and the steps for existing socket address is applied as described above.

46.2.1.2 Plug additional error conditions

– If one of the targets does not address a socket that exists or does not exist, this action shall be ignored for that target.

– If one of the targets is a socket with its parent in period R1, this action is ignored for that target.

47 Rt-Composite Navigation Behaviour

This behaviour is used to navigate along the trees formed by rt-composites.

47.1 Behaviour attributes and statuses

This behaviour is expressed using the following attributes or statuses:

– Rt-Composite Address (see clause 47.2),

– Navigation Command (see clause 47.3),

– Child (see clause 47.4),

– EmptyChild (see clause 47.5),

– Sibling (see clause 47.6),

– Ancestor (see clause 47.7).

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47.2 Rt-Composite Address

The Rt-Composite Address is used to describe an address referencing an rt-composite.

47.3 Navigation Command

The Navigation Command describes a navigation path. It is a choice among "Child", "EmptyChild", "Sibling" or "Ancestor".

47.4 Child

Navigation path is used to reach a child. It is expressed as an integer N > 0 for N-th child, "last" which specifies the last indexed child or "random" which specifies randomly indexed child.

47.5 EmptyChild

Navigation path is used to reach an empty socket. It is expressed as an integer N > 0 for N-th empty socket or "last" which specifies the last empty socket in a composite.

47.6 Sibling

Navigation path is used to reach a relative sibling. It is expressed as an integer for relative sibling, e.g. (1 = previous, +1 = next, 0 = current.

47.7 Ancestor

Navigation path is used to reach an ancestor. It is expressed as an integer N >= 0 for N-th previous generation or "root" which specifies the root. Any ancestor of root is a root.

47.8 Actions to retrieve the behaviour

ISO/IEC 13522 defines means to get this behaviour by the use of the following actions:

– Get Rt-Composite Address action (see clause 47.8.1).

47.8.1 Get Rt-Composite Address action

This action is udes to go up to the root, down to the leaves and to explore the intermediate levels (nodes) in a composition tree.

This action has the following parameters:

– Rt-Composite Target Param,

– Navigation Command Param.

This action may be targeted during the periods: R2, R3 and R3.TD.

47.8.1.1 Get Rt-Composite Address effect

The result of the action is a generic reference addressing an rt-composite specified by the navigation command parameter.

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NOTE 1: Clearly this reference is suitable for use as a target of other actions.

NOTE 2: It may be stored in a content object with Set Data action (see clause 72.8.1) for later use.

This action may be recursively used.

47.8.1.2 Get Rt-Composite Address additional error conditions

- If one of the targets is not an rt-component in R2, R3 or R3.TD, this action is ignored for that target.
- If the target is not an rt-component, the action shall be ignored for that target.
- If the target is not accessible, e.g. the reference cannot be resolved, the action is ignored for this target.
- If in one of the targets, the original object identification addresses an object which is not a model object, this action shall be ignored for this target.
- Navigating to a non-existent socket shall return "undefined".
- If the specified navigation command parameter is invalid, "undefined" shall be returned.

48 Rt-Components Rps Assignment Behaviour

This behaviour is used to assign rt-components to an RPS, i.e. a composition space or a channel.

48.1 Behaviour attributes and statuses

This behaviour is expressed using the following attribute or status:

- RPS Assignment (see clause 48.2).

48.2 RPS Assignment

An RPS is a composition space or a channel.

48.3 Actions to change the behaviour

ISO/IEC 13522 defines means to modify this behaviour by the use of the following actions:

- Set RPS Assignment action (see clause 48.3.1).

48.3.1 Set RPS Assignment action

This action is used to assign an rt-component to an RPS.

This action has the following parameters:

- Set of Rt-Component Target Param,
- RPS Assignment Param.

This action may be targeted during the periods: R2, R3 and R3.TD.

48.3.1.1 Set RPS Assignment action effect

The MHEG effect of this action is as follows:

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- If the RPS parameter is specified as a reference to a channel, the current RPS assignment of this target is changed to the specified channel;
- Otherwise, the current RPS assignment of this target is changed to the PRPS for an rt-component target and to the default channel for a root rt-component target.

After this action, the old OPS-RPS relationship is destroyed and a new one is established. Therefore, the previous PVD position mapping and the previous PVS mapping of the target are completely destroyed and reinitialised.

48.3.1.2 Set RPS Assignment additional error conditions

- If one of the targets is not an rt-component in R2, R3 or R3.TD, this action is ignored for that target.
- If the previous RPS assignment and the specified RPS assignment are the same, this action is ignored for that target.
- If the specified reference to a channel does not address an available channel (i.e. The channel is not in period C2), this reference is replaced by the default channel reference and the action should be applied for the default channel.

48.4 Actions to retrieve the behaviour

ISO/IEC 13522 defines means to get this behaviour by the use of the following actions:

- Get RPS Assignment action (see clause 48.4.1).

48.4.1 Get RPS Assignment action

This action is used to retrieve the RPS assignment to an rt-component and a root rt-component.

This action has the following parameter:

- Rt-Component Target Param.

This action may be targeted during the periods: R2, R3 and R3.TD.

48.4.1.1 Get RPS Assignment action effect

The MHEG effect of this action is to retrieve the RPS assigned to the target. The following applies:

- If the target is assigned to a channel, this channel identifier is retrieved.
- If the target is assigned to PRPS, the value "prps" is retrieved.

48.4.1.2 Get RPS Assignment additional error conditions

- If the target addresses multiple entities, e.g. Use of an alias which addresses a list of targets, or use of the "*" wildcard instead of a given rt-component number, or use of children or descendant tails, the action shall be ignored for this target.
- If the target is not an rt-component, the action shall be ignored for that target.
- If the target is not accessible, e.g. the reference cannot be resolved, the action is ignored for this target.

49 Rt-Components Perceptability Behaviour

This behaviour is used to represent perceptability of rt-components and root rt-components for the MHEG Engine.

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NOTE: Rt-Components and root rt-components concerned by this behaviour may be either "visible" or "audible".

49.1 Behaviour attributes and statuses

This behaviour is expressed using the following attributes or statuses:

- Perceptability (see clause 49.2),
- Presentation Priority (see clause 49.3).

49.2 Perceptability

The perceptability value is defined within the interval between 0% to 100%. The perceptability value is represented by a generic ratio.

Each rt-content or root rt-content has a perceptability. How an rt-content or a root rt-content is perceived is influenced by this value. If the perceptability value is set to zero, an rt-content or a root rt-content is not be perceptible. If the perceptability value is set to 100%, the original perception of an rt-content or a root rt-content is perceived. How an rt-content or a root rt-content is perceived when other perceptability values are specified depends on the MHEG Engine.

NOTE: The opacity of a picture may be controlled from 0% to 100%.

Each rt-composite or root rt-composite also has a perceptability. How its descendants are perceived is influenced by this value. If the perceptability value is set to zero, all descendants are not perceived. If the perceptability value is set to 100 %, the original perception of all descendants taking into account their own perceptability values is perceived. How all descendants on other perceptability values are perceived depends on the MHEG Engine.

Initially, all rt-objects shall have perceptability values as 100 %.

49.3 Presentation Priority

All rt-components assigned to a same channel have priorities relative to each other. The presentation order is determined in one RPS. If this RPS is of an rt-composite, this may have also a presentation priority relative to other rt-components presented in a same RPS.

A presentation priority is defined by a integer from 0 to 255, where 0 represents the highest priority in the presentation stacking order and 255 represents the lowest priority.

If two rt-components have the same presentation priority values in the same RPS, the stacking order is defined by Run actions targeted at these rt-components. This means that the rt-component at which a Run action has been targeted the most recently has higher presentation priority. If the Run actions are targeted in parallel at such rt-components, the stacking order depends on implementation. However, there are no assignments of their presentation priority values.

Initially, all rt-components have 0 as presentation priority value.

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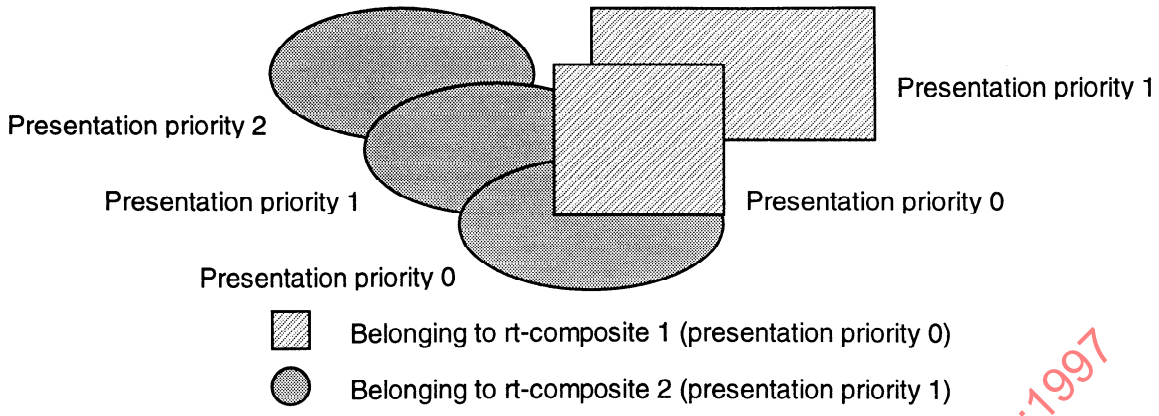

Figure 54 - Level of presentation priority

Figure 55 shows the rendering of rt-composite 1 and rt-composite 2. Within rt-composite 1, the presentation stacking is determined by the presentation priority values of the two rectangles. Within rt-composite 2, the presentation stacking is determined by the presentation priority values of the three ovals. The presentation stacking between rectangles and ovals is determined by the presentation priority values of rt-composite 1 and rt-composite 2, and it does not applied for each rectangles and ovals individually.

The presentation priority also affects the actual perceptability of rt-contents. Figure 56 shows a typical situation of rendering. Three rectangles have 50 % as their perceptability, and have a presentation priority as described in Figure 56. In this case, the actual perceptabilities of some parts of rectangles to be perceived by the user are affected due to object overlapping. However, there are no affection for the perceptability attributes of the three rectangles.

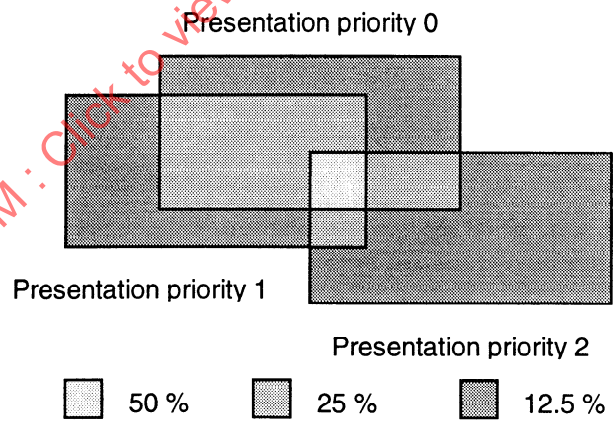

Figure 55 - Perceptability with presentation priority

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49.4 Actions to change the behaviour

ISO/IEC 13522 defines means to modify this behaviour by the use of the following actions:

– Set Perceptability action (see clause 49.4.1),

– Set Presentation Priority action (see clause 49.4.2).

49.4.1 Set Perceptability action

This action is used to change the perceptability of an rt-component or a root rt-component.

This action has the following parameters:

- Set of Rt-Component Target Param,
- Perceptability Param: specifies the perceptability to be assigned to an rt-component,
- Transition Duration Param.

This action may be targeted during the periods: R2, R3 and R3.TD.

49.4.1.1 Set Perceptability action effect

The Set Perceptability action effect is as follows:

- Set the perceptability of the targeted rt-component as specified.

If the target is running, there may be a user effect associated with this action.

If the transition duration parameter is specified, the perceptability is changed gradually.

49.4.1.2 Set Perceptability additional error conditions

- If one of the targets is not an rt-component in R2, R3 or R3.TD, this action is ignored for that target.
- If the presentation priority parameter value is not in interval [0 %, 100 %], it shall be set to the value 0.
- If the transition duration is negative, it is set to zero.

49.4.2 Set Presentation Priority action

This action enables to change the presentation priority of an rt-component or a root rt-component.

This action has the following parameters:

- Set of Rt-Component Target Param,
- Presentation Priority Param,
- Transition Duration Param.

This action may be targeted during the periods: R2, R3 and R3.TD.

49.4.2.1 Set Presentation Priority action effect

The effect of Set Presentation Priority action is as follows:

- The presentation priority of the targeted rt-component is set as specified.
- If the specified presentation priority is an integer, the presentation priority of the target is set to this value.
- If the specified presentation priority is "up-priority", the presentation priority of the target is decreased by 1. If the value is 0, the value remains 0.
- Otherwise (the specified presentation priority is "down-priority"), the presentation priority of the target is increased by 1. If the value is 255, the value remains 255.

If the target is running, there may be a user effect associated with this action.

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If the presentation priority is equal to "up-priority" or "down-priority", the transition parameter is ignored.

NOTE: The use of a transition duration parameter allows an rt-component to appear with a gradual presentation priority. Typically, this goes with a special effect such as a progressive change in the stacking order of the presentation.

49.4.2.2 Set Presentation Priority additional error conditions

- If one of the targets is not an rt-component in R2, R3 or R3.TD, this action is ignored for that target.
- If the presentation priority parameter value is not in interval [0, 255], it shall be set to the value 0.
- If the transition duration is negative, it is set to zero.

49.5 Actions to retrieve the behaviour

ISO/IEC 13522 defines means to get this behaviour by the use of the following actions:

- Get Perceptability action (see clause 49.5.1),
- Get Presentation Priority action (see clause 49.5.2).

49.5.1 Get Perceptability action

This action is used to retrieve the perceptability value of an rt-component.

This action has the following parameter:

- Rt-Component Target Param.

This action may be targeted during the periods: R2, R3 and R3.TD.

49.5.1.1 Get Perceptability action effect

This action is used to evaluates a generic ratio within the interval [0, 1]. The ratio represents the current value of the perceptability.

49.5.1.2 Get Perceptability additional error conditions

- If the target addresses multiple entities, e.g. Use of an alias which addresses a list of targets, or use of the "*" wildcard instead of a given rt-component number, or use of children or descendant tails, the action shall be ignored for this target.
- If the target is not an rt-component, the action shall be ignored for that target.
- If the target is not accessible, e.g. The reference cannot be resolved, the action is ignored for this target.

49.5.2 Get Presentation Priority action

This action is used to retrieve the presentation priority value of an rt-component.

This action has the following parameter:

- Rt-Component Target Param.

This action may be targeted during the periods: R2, R3 and R3.TD.

49.5.2.1 Get Presentation Priority action effect

This action is used to evaluate a generic integer within the interval [0, 255] The integer value represents the current value of the presentation priority.

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49.5.2.2 Get Presentation Priority additional error conditions

- If the target addresses multiple entities, e.g. use of an alias which addresses a list of targets, or use of the "*" wildcard instead of a given rt-component number, or use of children or descendant tails, the action shall be ignored for this target.
- If the target is not an rt-component, the action shall be ignored for that target.
- If the target is not accessible, e.g. the reference cannot be resolved, the action is ignored for this target.

50 Rt-Components Temporal Behaviour

This behaviour is used to express the presentation of rt-components in time.

50.1 Behaviour attributes and statuses

This behaviour is expressed using the following attributes or statuses:

- OD (see clause 50.2),
- POD (see clause 50.3),
- OVD (see clause 50.4),
- PVD (see clause 50.5),
- Temporal Termination (see clause 50.6),
- PVD Position (see clause 50.7),
- CTP (see clause 50.8),
- GTF (see clause 50.9),
- Timestone Status (see clause 50.10),
- Timestone ID (see clause 50.11),
- Expected OVD Result (see clause 50.12),
- Expected PVD Result (see clause 50.13).

50.2 OD

Each rt-component and channel has an OD initialised by the process described in the original presentation space . Each OD for an rt-component is set only once at the time of creation and shall not be changed.

50.3 POD

Each OD is projected to its RPS. The projection is POD. The POD of an rt-component is calculated by the GTF assigned to the rt-component as POD = OD x GTF.

50.4 OVD

Each rt-component has an OVD which is defined as a subset of the OD. Only the part specified as the OVD is perceived by the user. The portion of the OD that is outside the OVD is clipped. The OVD is specified by the initial temporal position and the terminal temporal position that are positions within the OD. Both points are specified by the OGTU in the OPS.

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By default, the initial temporal position of the OVD is initialised to 0 (i.e. the origin of the OD), and the terminal temporal position of the OVD is initialised to the length of the OD (i.e. the end point of the OD).

The terminal temporal position may be specified smaller than the initial temporal position (see Figure 59). The length of the OVD is always defined starting from the initial temporal position to the terminal temporal position taking into account the direction of the T axis.

If the terminal temporal position is smaller than the initial temporal position, the VD length is as following:

(OD end point - OVD initial temporal position) + (OVD terminal temporal position - OD start point (0))

Otherwise, the VD length shall be:

OVD terminal temporal position - OVD initial temporal position.

50.5 PVD

The projection of each OVD in its RPS results is the PVD. The PVD of an rt-component is calculated using the GTF assigned to the rt-component as PVD = OVD x GTF.

50.6 Temporal Termination

The temporal termination allows an rt-component to indicate the termination process to choose when the presentation of the rt-composite ends.

This attribute is evaluated either "freeze" or "stop". Initially, the temporal termination is set to "freeze".

50.7 PVD Position

The OVD of an rt-component is projected to its RPS as a PVD. The length of the PVD is controlled by the GTF value of the rt-component, and the position of the PVD is controlled implicitly or explicitly by an elementary action as follows:

The PVD position of a root rt-component is implicitly determined by a Run action targeted to the root rt-component.

After the Run action, the CTP of the target is positioned to its current RPS temporal position in the temporal life of the RPS. The PVD of the target is positioned to the RPS taking into account the CTP.

The CTP of the target progresses taking into account its GTF value.

The PVD position of an rt-component is determined as follows:

Initially, the PVD of an rt-component is not positioned to its RPS OD. If a Run action is targeted to such an rt-component, the CTP of the target is implicitly positioned to its current RPS temporal position in the temporal life of the RPS.

Once an rt-component is positioned to its RPS OD by using a Set PVD Position action, the following applies (see Figure 57):

The PVD of the rt-component is attached to the RPS OD tightly. Therefore, the CTP of the rt-component is calculated from the CTP of its RPS automatically and shall not be changed by a Set CTP action.

If the parent CTP exists outside the child PVD, the CTP of an rt-component is "undefined".

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If the parent of the rt-composite is running and the parent CTP enters in an rt-component PVD, the running status of the rt-component is set to "running" and presentation begins taking into account the playing direction of the parent (forward or reverse). The CTPs of children progress synchronously with the parent CTP.

If the parent of the rt-composite is running and the parent CTP gets out of an rt-component PVD, the running status of the rt-component is set to "not running" and its presentation ends.

If a part of the PVD outbounds the OVD of its RPS, this part is clipped and shall not be assigned to the RPS. The presentation of this PVD may begin or end at the middle of the PVD corresponding to the edge of parent OVD.

The binding of the PVD of the rt-component to its RPS is effective until it is explicitly removed.

NOTE: PVD position are used to perform temporal composition. As the position is set to the rt-composite object of the RPS, the rt-component is automatically started each time the rt-composite becomes "running".

EXAMPLE:

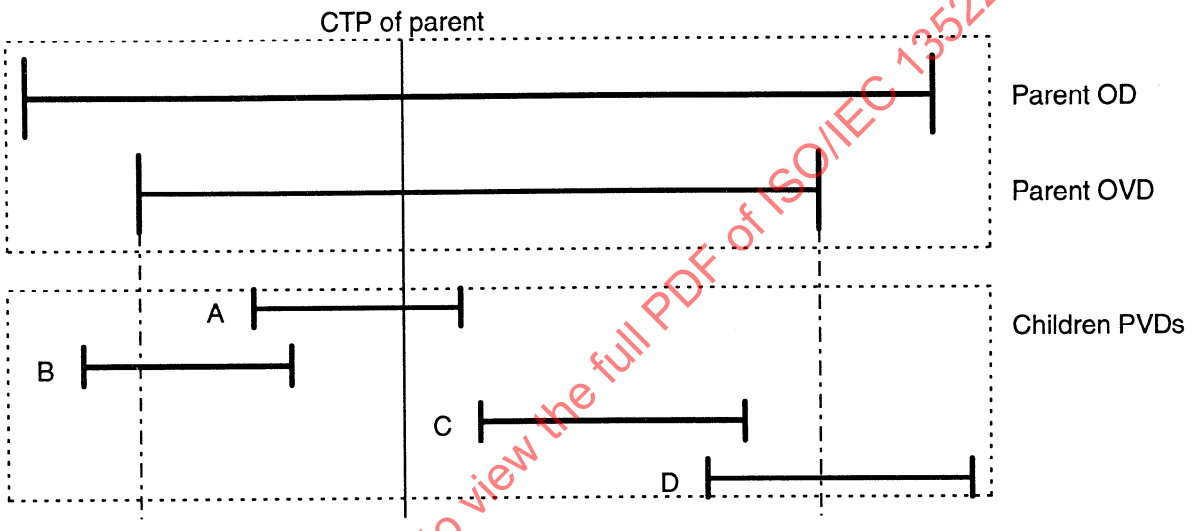

Figure 56 - Parent OVD and children PVDs

Figure 56 shows the PVD positioning of several rt-components with regard to their parent rt-composite. The CTP is automatically calculated from the parent CTP. For Child A, the CTP is within the PVD of Child A. For Child C and D, the CTPs are "undefined". A part of Child B outside the parent PVD is never presented and a part of Child D outside the parent OVD is also never presented.

50.8 CTP

Each rt-component has a CTP within its OVD interval. Initially, the CTP is set to the initial temporal position of the OVD.

The CTP is affected by a Run action and Stop action as follows:

After a Run action, the CTP progresses at the current GTF (see clause 50.9) in the PVD of final OPS-RPS chains until the terminal temporal position of the PVD is reached or a Stop action is performed.

NOTE 1: If the GTF is equal to 0, the CTP remains at its current position.

NOTE 2: "Progress" means "increment" if the GTF is positive. It means "decrement" if the GTF is negative.

After a Run action, if the CTP passes the end point of the OD, the CTP is set to zero, i.e. the start point of OD (see Figure 58).

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After a Run action, if the CTP passes the zero point (i.e. the start point of OD), the CTP is set to the end point of the OD (see Figure 59).

After a Stop action, the CTP remains at its current value.

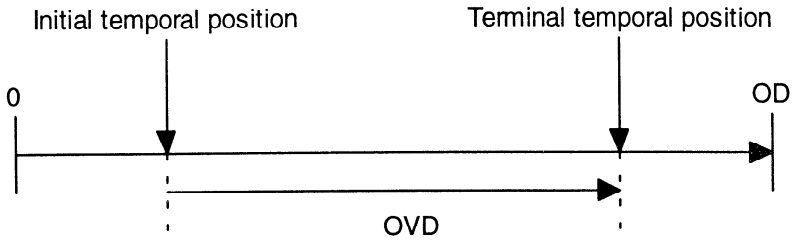

Figure 57 - Forward presentation

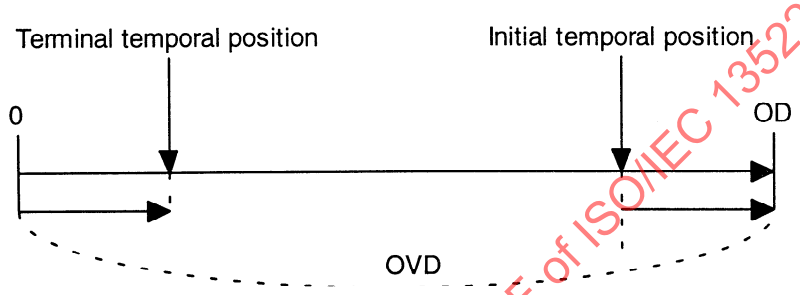

Figure 58 - Forward presentation with wrap-around

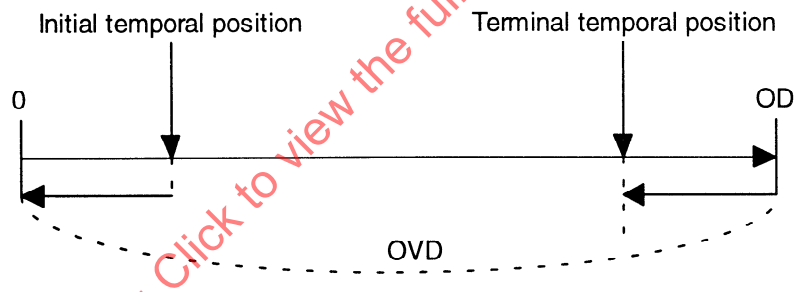

Figure 59 - Backward presentation with wrap-around

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50.9 GTF

The presentation speed of an rt-component is controlled by its current GTF. The GTF defines the number of RGTU corresponding to one OGTU. A GTF value may be negative to express that the playback direction is reverse. In this case, the CTP of an rt-component is progressed reversibly if it is running.

NOTE: Channels do not have GTFs. No temporal factors are available for the mapping to CPS.

50.10 Timestone Status

An rt-component may have any number of timestones defined along its OD. A timestone is composed of

- A timestone identifier: An generic integer that value is provided by the author. The value 0 is reserved to express that no timestone has ever encountered for the target.
- A temporal position: Expressed in OGTU within the interval of the OD.

– As a timestone contains a temporal position and is defined in the OPS, the perception of this point may differ on the RPS T axis.

NOTE: For example, if the GTF value is doubled, the PVD in the RPS is halved and the CTP progresses at double speed. In this case, the temporal position of OPS looks closer in the RPS.

Timestones are crossed by the CTP when an rt-component is running. The timestone status is defined as a last timestone identifier crossed by the CTP.

Initially, the timestone status is 0, and no timestone is provided on an rt-component. Timestones are specified by the author using a Set Timestones action.

50.11 Timestone ID

The Timestone ID shall be a generic integer. The value 0 is reserved.

50.12 Expected OVD Result

Expected OVD Result should be a value among "initial-temporal-position", "terminal-temporal-position" or "duration".

50.13 Expected PVD Result

Expected PVD Result should be a value among "initial-temporal-position", "terminal-temporal-position" or "duration".

50.14 Actions to change the behaviour

ISO/IEC 13522 defines means to modify this behaviour by the use of the following actions:

– Set OVD action (see clause 50.14.1),
– Set CTP action (see clause 50.14.2),
– Set Temporal Termination action (see clause 50.14.3),
– Set PVD Position action (see clause 50.14.4),
– Set GTF action (see clause 50.14.5),
– Set Timestones action (see clause 50.14.6).

50.14.1 Set OVD action

This action specifies an OVD within an OD.

This action has the following parameters:

– Set of Rt-Component Target Param,
– Initial Point Spec Param,
– Terminal Point Spec Param.

This action may be targeted during the periods: R2, R3 and R3.TD.

50.14.1.1 Set OVD effect

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The initial temporal position and the terminal temporal position may be specified as follows:

- by a absolute value in the OGTU of the target.
- by a relative value with regard to the OD. The value is interpreted as OD × (specified value). If the calculated value is outside the OD, the value is set to 0 (if negative) or OD (if greater than OD). If the specified value does not indicate an addressable point, this value shall be rounded.

If the target is running, there may be an associated user effect, i.e. the perception duration may be shortened or extended.

50.14.1.2 Set OVD additional error conditions

- If one of the targets is not an rt-component in R2, R3 or R3.TD, this action is ignored for that target.
- If one of the temporal position parameters specified as an absolute point is not in the interval [0, OD], this action is ignored for the whole target set.

50.14.2 Set CTP action

This action is used to specify the CTP within the OVD.

This action has the following parameters:

- Set of Rt-Component Target Param,
- Current Point Spec Param.

This action may be targeted during the periods: R2, R3 and R3.TD.

50.14.2.1 Set CTP effect

The CTP may be specified as follows:

- If the position is specified as an absolute value, the CTP is set to this value.
- If the position is specified as a relative value, this value is interpreted as a relative value to the OVD of the target. The CTP is set to OVD × (specified value).
- If the position is specified as an original point factor, the CTP is set to (initial temporal position) × (specified value).
- Otherwise (the position is specified as a current point factor), the CTP is set to CTP × (specified value).
- In above cases, if the calculated value is outside the OVD, the value is set to the nearest point within the OVD.
- If the specified point does not indicate an addressable point, this value shall be rounded.

If the target is running, there may be a user effect associated. If the playback is forward and the CTP is set to a smaller value, this has the effect of replaying a part of the target. If the playback is forward and the CTP is set to a greater value, this has the effect of skipping a part of the target.

A Set CTP action does not affect any timestone status. If the target is replayed, a previously passed timestone may be crossed again. If the target is skipped forward, timestones within this skipped part are not crossed.

50.14.2.2 Set CTP additional error conditions

- If one of the targets is not an rt-component in R2, R3 or R3.TD, this action is ignored for that target.
- If the temporal position parameter specified as an absolute point is not in the interval of OVD, this action is ignored for the whole target set.

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– If one of the targets is assigned to its RPS by a Set PVD Position action, this action is ignored for that target.

50.14.3 Set Temporal Termination action

This action is used to specify the type of temporal termination if the CTP reaches the end of presentation.

This action has the following parameters:

– Set of Rt-Target Param,

– Temporal Termination Param.

This action may be targeted during the periods: R2, R3 and R3.TD.

50.14.3.1 Set Temporal Termination effect

This action sets the temporal termination of the target. If the target is at the end of the presentation and the running status is "running", there may be a user effect changing the previous temporal termination presentation to the specified new one.

50.14.3.2 Set Temporal Termination additional error conditions

– If one of the targets is not an rt-component in R2, R3 or R3.TD, this action is ignored for that target.

50.14.4 Set PVD Position action

This action is used to specify the position within the OD of the parent where to attach the PVD of a socket.

This action has the following parameters:

– Set of Socket Target Param,

– Temporal Position Param: the Temporal Position Param is used to specify temporal position either by an absolute value along a temporal axis or a relative value against a temporal duration.

This action may be targeted during the period: R2.

50.14.4.1 Set PVD Position effect

The PVD position may be specified as follows:

– by an absolute value in the RGTU of the target

– by a relative value relatively to the OD of the parent. The value is interpreted as OD × (specified value). If the calculated value is outside the OD of the parent, the value is set to 0 (if negative) or OD (if greater than OD). If the specified point does not indicate an addressable point, this value shall be rounded.

If the parent of the target is running, there may be a user effect associated. After performing this action, if the CTP of the parent enters the PVD of the target, this target is to be played.

50.14.4.2 Set PVD Position additional error conditions

– If one of the targets is not an rt-component in R2, this action is ignored for that target.

– If the temporal position parameter specified as an absolute point is not within the interval of the parent OD, this action shall be ignored for the whole target set.

– If the temporal position parameter specified as a relative point is not within the interval of the parent OD, this action shall be ignored for the whole target set.

– If the target does not have a PRPS, this action shall be ignored.

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50.14.5 Set GTF action

This action is used to specify the presentation speed of an rt-component.

This action has the following parameters:

- Set of Rt-Component Target Param,
- GTF Param: Generic ratio or default-GF.

This action may be targeted during the periods: R2, R3 and R3.TD.

50.14.5.1 Set GTF effect

The GTF value of the target is set to the specified value.

If the target is running, there may be a user effect associated with this action. That is the change of the target presentation speed.

50.14.5.2 Set GTF additional error conditions

- If one of the targets is not rt-component in R2 R3 R3.TD, this action is ignored for that target.

50.14.6 Set Timestones action

This action is used to specifies a set of timestones to be set within the OD of the target.

This action has the following parameters:

- Set of Rt-Component Target Param,
- Set of Timestone Spec Param.

This action may be targeted during the periods: R2, R3 and R3.TD.

50.14.6.1 Set Timestones action effect

The effect of this action is as follows:

- According to the update command within the timestone specification parameter, specified timestones are added, removed or replaced.
- If an absolute value is specified as a timestone position, the value is interpreted as the position in the OD.
- If an relative value is specified as a timestone position, the value, OD × (specified value), is calculated and used.
- A same timestone may be repeated several times or infinitely. This is specified by the "number of repetitions". Number of repetitions is valid only for the "add" command and ignored for other commands. If the specified number of repetitions is greater than 1, the corresponding timestones shall be repeated every specified time position as many as specified. For example, Set Timestones (target, ((1, 5, 10), add)) action repeats 10 times to add timestone 1 every 5 GTUs from the beginning of the OD.

50.14.6.2 Set Timestones additional error conditions

- If one of the targets is not rt-component in R2, R3 or R3.TD, this action is ignored for that target.
- If the timestone position parameter is not within the interval of the OD, this timestone shall be ignored. All other timestones are applied.

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– If the number of repetitions is less than 1 with the "add" command, this timestone shall be ignored. All other timestones are applied.

50.15 Actions to retrieve the behaviour

ISO/IEC 13522 defines means to get this behaviour by the use of the following actions:

– Get OD action (see clause 50.15.1),
– Get POD action (see clause 50.15.2),
– Get OVD action (see clause 50.15.3),
– Get PVD action (see clause 50.15.4),
– Get CTP action (see clause 50.15.5),
– Get Temporal Termination action (see clause 50.15.6),
– Get PVD Position action (see clause 50.15.7),
– Get GTF action (see clause 50.15.8),
– Get Timestone Status action (see clause 50.15.9).

50.15.1 Get OD action

This action is used to retrieve the OD of the target expressed in OGTU.

This action has the following parameter:

– Rt-Component Target Param.

This action may be targeted during the periods: R2, R3 and R3.TD.

50.15.1.1 Get OD action effect

The MHEG effect of this action is to retrieve the OD value of the target expressed in OGTU.

50.15.1.2 Get OD additional error conditions

– If the target addresses multiple entities, e.g. Use of an alias which addresses a list of targets, or use of the "*" wildcard instead of a given rt-component number, or use of children or descendant tails, the action shall be ignored for this target.
– If the target is not an rt-component, the action shall be ignored for that target.
– If the target is not accessible, e.g. The reference cannot be resolved, the action is ignored for this target.
– If one of the targets is not an rt-component in R2 R3 R3.TD, this action is ignored for that target.

50.15.2 Get POD action

This action is used to retrieve the POD of the target expressed in RGTU.

This action has the following parameter:

– Rt-Component Target Param.

This action may be targeted during the periods: R2, R3 and R3.TD.

50.15.2.1 Get POD action effect

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The MHEG effect of this action is to retrieve the POD value of the target expressed in RGTU.

50.15.2.2 Get POD additional error conditions

- If the target addresses multiple entities, e.g. Use of an alias which addresses a list of targets, or use of the "*" wildcard instead of a given rt-component number, or use of children or descendant tails, the action shall be ignored for this target.
- If the target is not an rt-component, the action shall be ignored for that target.
- If the target is not accessible, e.g. The reference cannot be resolved, the action is ignored for this target.
- If one of the targets is not an rt-component in R2 R3 R3.TD, this action is ignored for that target.

50.15.3 Get OVD action

This action is used to retrieve the OVD of the target expressed in OGTU.

This action has the following parameters:

- Rt-Component Target Param,
- Expected OVD Result Param.

This action may be targeted during the periods: R2, R3 and R3.TD.

50.15.3.1 Get OVD action effect

The MHEG effect of this action is to retrieve the OVD value of the target expressed in OGTU as follows:

- If the expected OVD result parameter is "initial-temporal position", this action retrieves the initial temporal position of the OVD.
- If the expected OVD result parameter is "terminal temporal position", this action retrieves the terminal temporal position of the OVD.
- Otherwise (the expected OVD result parameter is "duration"), this action retrieves the duration of the OVD.

50.15.3.2 Get OVD additional error conditions

- If the target addresses multiple entities, e.g. Use of an alias which addresses a list of targets, or use of the "*" wildcard instead of a given rt-component number, or use of children or descendant tails, the action shall be ignored for this target.
- If the target is not an rt-component, the action shall be ignored for that target.
- If the target is not accessible, e.g. The reference cannot be resolved, the action is ignored for this target.
- If one of the targets is not an rt-component in R2 R3 R3.TD, this action is ignored for that target.

50.15.4 Get PVD action

This action is used to retrieve the PVD of the target expressed in RGTU.

This action has the following parameters:

- Rt-Component Target Param,
- Expected PVD Result Param.

This action may be targeted during the periods: R2, R3 and R3.TD.

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50.15.4.1 Get PVD action effect

The MHEG effect of this action is to retrieve the PVD value of the target expressed in RGTU as follows:

- If the expected PVD result parameter is "initial-temporal position", this action retrieves the initial temporal position of the PVD.
- If the expected PVD result parameter is "terminal temporal position", this action retrieves the terminal temporal position of the PVD.
- Otherwise (the expected PVD result parameter is "duration"), this action retrieves the duration of the PVD.

50.15.4.2 Get PVD additional error conditions

- If the target addresses multiple entities, e.g. use of an alias which addresses a list of targets, or use of the "*" wildcard instead of a given rt-component number, or use of children or descendant tails, the action shall be ignored for this target.
- If the target is not an rt-component, the action shall be ignored for that target.
- If the target is not accessible, e.g. the reference cannot be resolved, the action is ignored for this target.

50.15.5 Get CTP action

This action is used to retrieves the CTP value of the target.

This action has the following parameter:

- Rt-Component Target Param.

This action may be targeted during the periods: R2, R3 and R3.TD.

50.15.5.1 Get CTP action effect

The MHEG effect of this action is to retrieve the CTP value of the target. This action evaluates a temporal position expressed in OGTU.

50.15.5.2 Get CTP additional error conditions

- If the target addresses multiple entities, e.g. use of an alias which addresses a list of targets, or use of the "*" wildcard instead of a given rt-component number, or use of children or descendant tails, the action shall be ignored for this target.
- If the target is not an rt-component, the action shall be ignored for that target.
- If the target is not accessible, e.g. the reference cannot be resolved, the action is ignored for this target.
- If one of the targets is not an rt-component in R2, R3 or R3.TD, this action is ignored for that target.
- If a targets is positioned to its PRPS by a Set PVD Position action, this action returns "undefined" for that target.

50.15.6 Get Temporal Termination action

This action is used to retrieve the temporal termination value of the target.

This action has the following parameter:

- Rt-Component Target Param.

This action may be targeted during the periods: R2, R3 and R3.TD.

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50.15.6.1 Get Temporal Termination action effect

The MHEG effect of this action is to retrieve the temporal termination value of the target, i.e. "freeze" or "stop".

50.15.6.2 Get Temporal Termination additional error conditions

- If the target addresses multiple entities, e.g. use of an alias which addresses a list of targets, or use of the "*" wildcard instead of a given rt-component number, or use of children or descendant tails, the action shall be ignored for this target.
- If the target is not an rt-component, the action shall be ignored for that target.
- If the target is not accessible, e.g. the reference cannot be resolved, the action is ignored for this target.
- If one of the targets is not an rt-component in R2, R3 or R3.TD, this action is ignored for that target.

50.15.7 Get PVD Position action

This action is used to retrieve the PVD position value of the target within its PRPS.

This action has the following parameter:

- Rt-Component Target Param.

This action may be targeted during the periods: R2, R3 and R3.TD.

50.15.7.1 Get PVD Position action effect

The MHEG effect of this action is to retrieve the PVD position value of the target within its PRPS. This action evaluates a temporal position expressed in RGTU.

50.15.7.2 Get PVD Position additional error conditions

- If the target addresses multiple entities, e.g. use of an alias which addresses a list of targets, or use of the "*" wildcard instead of a given rt-component number, or use of children or descendant tails, the action shall be ignored for this target.
- If the target is not an rt-component, the action shall be ignored for that target.
- If the target is not accessible, e.g. the reference cannot be resolved, the action is ignored for this target.
- If one of the targets is not an rt-component in R2, R3 or R3.TD, this action is ignored for that target.
- If the target is not positioned to its PRPS, this action returns "undefined".

50.15.8 Get GTF action

This action is used to retrieve the GTF value of the target.

This action has the following parameter:

- Rt-Component Target Param.

This action may be targeted during the periods: R2, R3 and R3.TD.

50.15.8.1 Get GTF action effect

The MHEG effect of this action is to retrieve the GTF value of the target. This action evaluates a generic ratio.

50.15.8.2 Get GTF additional error conditions

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- If the target addresses multiple entities, e.g. use of an alias which addresses a list of targets, or use of the "*" wildcard instead of a given rt-component number, or use of children or descendant tails, the action shall be ignored for this target.
- If the target is not an rt-component, the action shall be ignored for that target.
- If the target is not accessible, e.g. the reference cannot be resolved, the action is ignored for this target.
- If one of the targets is not an rt-component in R2, R3 or R3.TD, this action is ignored for that target.

50.15.9 Get Timestone Status action

This action is used to retrieve the timestone status value of the target.

This action has the following parameter:

- Rt-Component Target Param.

This action may be targeted during the periods: R2, R3 and R3.TD.

50.15.9.1 Get Timestone Status action effect

The MHEG effect of this action is to retrieve the timestone status value of the target. This action evaluates an integer corresponding to the timestone identifier of the last timestone crossed by the CTP. If no timestones have ever been crossed, 0 is returned.

50.15.9.2 Get Timestone Status additional error conditions

- If the target addresses multiple entities, e.g. Use of an alias which addresses a list of targets, or use of the "*" wildcard instead of a given rt-component number, or use of children or descendant tails, the action shall be ignored for this target.
- If the target is not an rt-component, the action shall be ignored for that target.
- If the target is not accessible, e.g. the reference cannot be resolved, the action is ignored for this target.
- If one of the targets is not an rt-component in R2 R3 R3.TD, this action is ignored for that target.

51 Rt-Components Spatial Behaviour

The behaviour describes presentability in space of rt-components for the MHEG Engine.

51.1 Behaviour attributes and statuses

This behaviour is expressed using the following attributes or statuses:

- OS (see clause 51.2),
- POS (see clause 51.3),
- Aspect Ratio (see clause 51.4),
- Resizing Strategy (see clause 51.5),
- OVS (see clause 51.6),
- OAP (see clause 51.7),
- OVS Position (see clause 51.8),
- PVS (see clause 51.9),

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- OVS Proj Strategy (see clause 51.10),
- PAP (see clause 51.11),
- PVS Position (see clause 51.12),
- GSF (see clause 51.13),
- Spatial Control (see clause 51.14),
- User Spatial Control (see clause 51.15),
- Expected Axis Result Param (see clause 51.16),
- Point Type Param (see clause 51.17).

51.2 OS

Each rt-component and each channel has an assigned OS that is defined in its OPS. Therefore, the OS is measured in the OGSU (see clause 9.2).

Each OS for an rt-content is set only once and shall not be changed. However, the OS of an rt-composite may be changed resizing strategy (see clause 51.5).

51.3 POS

Each OS of an rt-component is projected to its RPS. The projection is called POS. The POS is measured in the RGSU. It is calculated as POS = OS x GSF on each axis.

51.4 Aspect Ratio

The aspect ratio is three ratio associated to the width, the height and the depth along the spatial axes.

The projection of the OS is controlled by GSF and the relationship, POS = OS x GSF, is always respected. However, in order to preserve the aspect ratio of an rt-component, how to fill the POS is specified independently of the GSF. The value of the aspect ratio attribute is either "preserved" or "not-preserved". This attribute controls the aspect ratio preserving only for one OS-POS mapping. If the rt-component is to be presented in a channel preserving the aspect ratio, every aspect ratio attribute through the OPS-RPS chains from the rt-component to the channel should be set to "preserved".

For preserving the aspect ratio, the following shall apply:

- "Preserved": The rt-component is scaled preserving the aspect ratio. This scaling is independent of the assigned GSF and the rt-component is scaled so that at least one of the width, height or depth fit the POS. Then, the POS is filled with this scaled rt-component. The scaled rt-component may not entirely fit the POS, i.e. some portion of the POS may not be filled by the scaled rt-component. If on a given axis, the scaled rt-component is smaller that the size of the POS, the scaled rt-component is centred on the interval of this axis. How the portions of POS that are not covered by the scaled rt-component are filled may be either defined by a (registered) presentation style or implementation dependent.
- "Not preserved": The POS should be filled entirely with the rt-component taking into account the GSF on each axis.

Initially, the aspect ratio attribute value is set to "preserved".

NOTE 1: The POS are not affected by the aspect ratio attribute value, i.e. the aspect ratio of the OS and the aspect ratio of the POS may be different on each axis even if the aspect ratio attribute value is "preserved".

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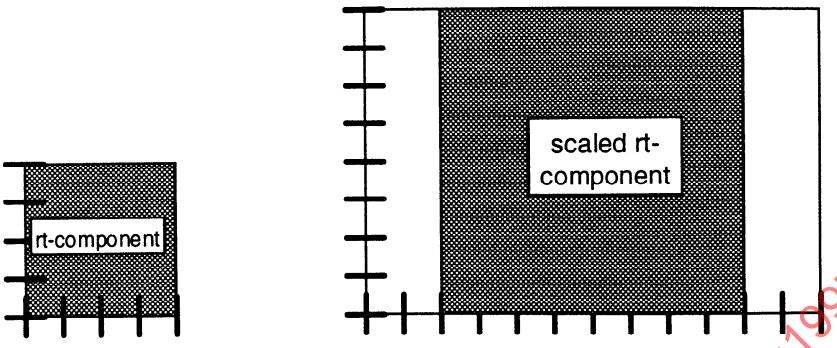
NOTE 2: If an axis has a zero value in the OS, this axis is not taken into account in the scaling of the rt-component.



OS (in OPS): x = 4, y = 4, z = 0 POS (in RPS): x = 12, y = 8, z = 0

Figure 60 - Aspect ratio preserved

In Figure 60, the aspect ratio attribute is set to "preserved". Therefore, the rt-component should be scaled independently of the GSF and a part of the POS is filled it. The scaled rt-component should be centred in the POS.

51.5 Resizing Strategy

The resizing strategy shall only be used if the rt-component is an rt-ciomposite.

The OS for each rt-composite may be modified in order to accommodate the modification in size and position of the PVSs of the child rt-components. This is controlled by a resizing strategy attribute. One of the following three attribute values may be set to an rt-composite:

- "Fixed": The OS of an rt-composite should remain as the initial size of the OS. The OS shall not be changed until an another attribute value is assigned. If this attribute is changed from an another value to "fixed" and the previous OS is different from the initial size due to the resizing at that time, the OS should be reset to the initial size.
- "Minimum": The OS of an rt-composite should have a minimum size that is enough to contain all the PVSs of the child rt-components and greater than or equal to the initial OS of the target on each axis.
- "Grows only": The OS of an rt-composite should not be reduced. If a part of an rt-component PVS is positioned outside the OS, the OS becomes the minimum size on each axis that is big enough to include every PVS. However, it is never reduced if the OS is bigger than the actual minimum size enough for every PVS.

The initial value is "fixed".

The portions of PVSs that outbound the OS of an rt-composite should be clipped. However, the values of such PVSs does not be changed. This situation occurs only if the value is "fixed".

If some portions of a PVS outbound the OS of an rt-composite and its resizing strategy is "minimum" or "grows only", the PAP position of the PVS may be changed due to the resizing. The MHEG Engine should take into account this change.

NOTE 1: The values of the such PVSs remain the same because these rt-component may be assigned later to another RPS or may become completely perceivable due to the change of the parent OS.

NOTE 2: The size considerations described above should be done independently on each axis. For example, in the case of "minimum", if the initial value of the rt-composite OS is x = 10 and y = 10, and the rt-composite has one rt-component whose PVS is x = 5 and y = 20, the OS of the rt-composite becomes x = 10 and y = 20.

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If the aspect ratio attribute is set to "preserved" for an rt-composite, the size of the data information may be a subset of the OS in order to preserve the aspect ratio.

51.6 OVS

The OVS is a subset of the OS for an rt-component, and is positioned relatively to the OS. The portion of the OS that fits within the OVS shall be presented to the user. The portion of the OS that is outside of the OVS shall be clipped. If the OVS exceeds the limits of the OS, the exceeding portion of the OVS should be filled with a background which depends on the implementation or is specified by an extensibility facility.

The OVS may be specified by one of the following methods:

- Directly defined in the OPS: The OVS is defined within the OPS by a Set OVS action with OVS Proj Strategy attribute as "calculated". In this case, a change of the rt-component GSF affects the PVS because the OVS is a constant (PVS = OVS (constant) x GSF). However, this change does not affect the PAP and the PVS position.
- Indirectly defined in the RPS: The PVS is defined within the RPS rather than the OVS, by a Set OVS action with the OVS Proj Strategy attribute set to "fixed". The OVS is automatically calculated by OVS = PVS / GSF on each axis. In this case, the OVS may change dynamically depending on the GSF value. A change of the rt-component GSF does not affect the PVS because the PVS is a constant (PVS (constant) = OVS x GSF). This GSF change does not affect the OAP (see clause 51.7) and the OVS position (see clause 51.8) with regard to the OVS, but does affect the OVS.

NOTE 1: However, it affects some part of the OS becoming visible.

The OVS is initialised to the size of the corresponding OS in the OPS using OGSU.

NOTE 2: Typically, the OVS directly defined in the OPS is used to perform real scaling of an rt-component. Therefore, the PVS and the POS are varied depending on the GTF of the rt-component.

NOTE 3: Typically, the OVS indirectly defined in the RPS is used to scale only the OS of an rt-component that is projected and perceived through the constant PVS.

Figure 61 shows the relationship among OS, OVS, OAP, OVS position, PVS, PAP and PVS position.

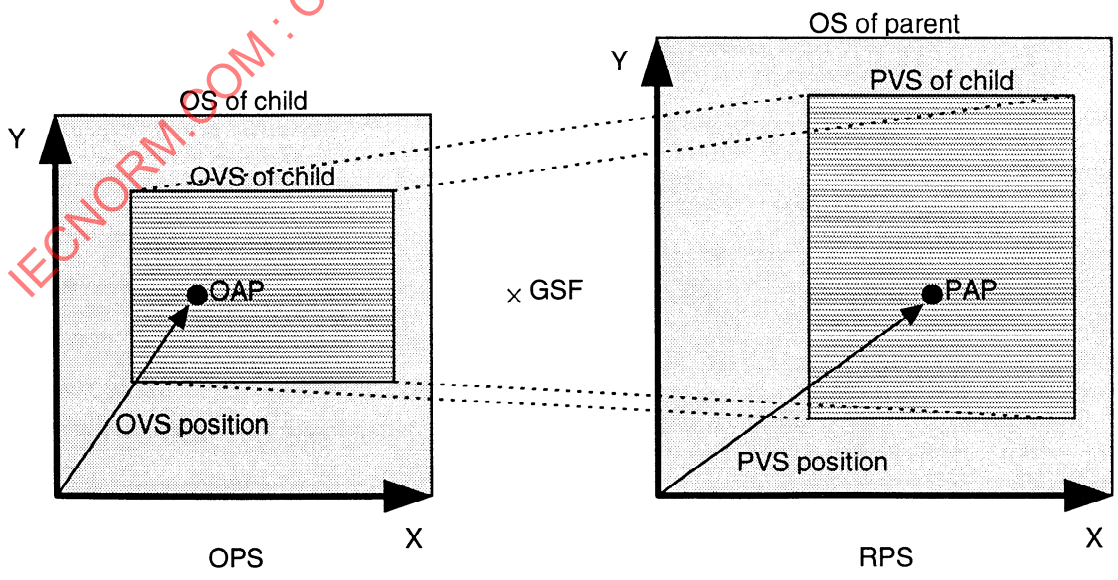

Figure 61 - Relationship among OS, OVS, OAP, OVS position, PVS, PAP and PVS position

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51.7 OAP

An OAP defines an attachment position within the OVS. This attachment position with the OVS position is used to position the OVS within its OS. Initially, the OAP is set to the origin of the OVS, i.e. (0, 0, 0).

The OAP may be specified by an absolute position within the OVS, or a relative position relatively to the OVS origin expressed by a generic ratio.

If an OVS is specified indirectly by a Set OVS action with OVS Proj Strategy attribute as "fixed", the OVS may be dynamically changed depending on the corresponding GSF value. In this case, the OAP shall not be affected by the changing OVS. It shall keep the current value. If the value is specified by an absolute one, It should be kept. If the value is specified by a relative one, the relative value shall be kept.

51.8 OVS Position

An OVS position is used to specifiy a position relatively to the origin of the OS where the corresponding OAP should be positioned. The OVS position with the OAP is used to position the OVS within its OS. Initially, the OVS position is set to the origin of the OS, i.e. (0, 0, 0).

The OVS may be specified by an absolute position within the OS, or a relative position relatively to the OS expressed by a generic ratio.

If an OVS is specified indirectly by a Set OVS action with OVS Proj Strategy as "fixed" attribute, the OVS may be dynamically changed depending on the corresponding GSF value. In this case, the OVS position should not be affected by the changing OVS. It should keep the current value. If the value is specified by an absolute value, it should be kept. If the value is specified by a relative one, it should be kept.

51.9 PVS

The PVS is a projection of the OVS of an rt-component to its RPS, and is positioned relatively to the OS of the PRS.

The PVS may be specified by one of the following methods:

- Directly defined in the RPS: The PVS is defined within the RPS by a Set OVS action with OVS Proj Strategy as "fixed" attribute. In this case, the PVS is constant and the corresponding OVS is automatically calculated.
- Indirectly defined in the OPS: The OVS is defined within the OPS by a Set OVS action with OVS Proj Strategy as "calculated" attribute, a Set OAP action and a Set OVS Position action. In this case, the PVS is calculated according to the GSF value and the corresponding OVS is constant.

The PVS is initialised by the OVS initial value and the GSF initial value.

51.10 OVS Proj Strategy

Each rt-component has an OVS Proj Strategy attribute. This attribute defines how to project an OVS to the corresponding PVS. The relationship between the OVS and the PVS, PVS = OVS x GSF on each axis, shall be respected.

This attribute has either "fixed" or "calculated". The following applies:

a) If the OVS Proj Strategy is equal to "fixed", the PVS is always fixed.
   1) If the OVS changes, the GSF shall be recalculated.
   2) If the GSF changes, the OVS shall be recalculated.

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b) Otherwise ("calculated"), the PVS shall be always calculated.

1) If the OVS changes, the PVS shall be recalculated.

2) If the GSF changes, the PVS shall be recalculated.

51.11 PAP

A PAP defines an attachment position within the PVS. This attachment position with the PVS position is used to position the PVS within the OS of the RPS. Initially, the PAP is set to the origin of the PVS, i.e. (0, 0, 0).

The PAP may be specified as an absolute position within the PVS, or a relative position with regard to the PVS origin expressed by a generic ratio.

51.12 PVS Position

A PVS position defines a position relatively to the origin of the OS of the RPS or to another PVS within the same RPS, where the corresponding PAP should be positioned. The PVS position with the PAP is used to position the PVS within the OS of the RPS. Initially, the PVS position is set to the origin of the OS of RPS, i.e. (0, 0, 0).

The PVS position may be specified by an absolute position within the OS, or a relative position with regard to the OS expressed by a generic ratio.

51.13 GSF

The projection of the OPS to RPS is controlled by its GSF value. The GSF defines the number of RGSU corresponding to one OGSU for each axis.

51.14 Spatial Control

Moving, resizing, scaling and scrolling an rt-component may be allowed to a user independently of the elementary action controls. This attribute indicates wether those functions may be used or not with the combination of the user spatial control attribute value. The spatial control attribute has one of the following values:

- "moving": Indicating the move of the PVS,
- "resizing": indicating the resize of the PVS,
- "scaling": indicating the scale of the OS,
- "scrolling": indicating the scroll of the OS.

NOTE 1: Scrolling may be allowed for each rt-component and for the parent of the rt-components independently. Scrolling always refers to the PS of the rt-component.

Initially, the user controls are "not allowed".

It is the responsibility of the MHEG Engine with the user interface to notify the user of its permission to perform a given control and to provide the necessary supports (e.g. scroll bars, resizing handles).

For example, if the scrolling is allowed to the rt-component, a mechanism is to be offered by the MHEG Engine to operate a scrolling of the OS as perceived through the PVS. It is the responsibility of the MHEG Engine to decide which look-and-feel has to be adopted for the scroll mechanism and to decide whether such a mechanism has to be attached to the rt-component.

If the user control is not allowed, it is the responsibility of the MHEG Engine to notify to it the usert (e.g. scroll bars are not displayed, or pressing scroll keys produce a beep).

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NOTE 2: for example, a scroll mechanism attached to an rt-component may be implemented through a couple of scroll bars.

NOTE 3: for example, a scroll mechanism not attached to an rt-component may be implemented with keys or arrows.

51.15 User Spatial Control

This attribute is used with the spatial control attributes to indicate wether a certain user spatial control may be used.

51.16 Expected Axis Result Param

The Expected Axis Result Param is defined by a value among "x", "y", "z" or "xyz".

51.17 Point Type Param

The Point Type Param is defined by a value among between "absolute" and "relative".

51.18 Actions to change the behaviour

ISO/IEC 13522 defines means to modify this behaviour by the use of the following actions:

- Set Aspect Ratio action (see clause 51.18.1),
- Set Resizing Strategy action (see clause 51.18.2),
- Set OVS Proj Strategy action (see clause 51.18.3),
- Set OVS action (see clause 51.18.4),
- Set OAP action (see clause 51.18.5),
- Set OVS Position action (see clause 51.18.6),
- Set PAP action (see clause 51.18.7),
- Set PVS Position action (see clause 51.18.8),
- Set GSF action (see clause 51.18.9),
- Set User Spatial Control action (see clause 51.18.10).

51.18.1 Set Aspect Ratio action

This action is used to specify whether the ratio between the OS in the OGSU and the scaled rt-component in the POS of the RGSU is to be preserved for each axis in projecting an rt-component OS to the POS.

This action has the following parameters:

- Set of Rt-Component Target Param,
- Aspect Ratio Param.

This action may be targeted during the periods: R2, R3 and R3.TD.

51.18.1.1 Set Aspect Ratio action effect

The MHEG action effect of this action is as follows:

- If the aspect ratio parameter is "preserved", the aspect ratio of the scaled rt-component should be preserved.
- Otherwise, the rt-component should fit the POS entirely.

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This effect continues until the target is destroyed or this action is targeted again with a different value. The continuous effect means that the scaled rt-component within the POS should be calculated each time the POS is changed in order to maintain the aspect ratio preserved or in order to fit the POS.

If the target is running, there is a user effect associated, i.e. the area in which the data information is presented may be stretched to fit the entire POS or squeezed to a subset of it.

51.18.1.2 Set Aspect Ratio additional error conditions

– If one of the targets is not an rt-component in R2, R3 or R3.TD, this action is ignored for that target.

51.18.2 Set Resizing Strategy action

This action is used to specify the OS resizing strategy of an rt-composite regarding the modification of the PVSs of the child rt-components positioned in the OS of the rt-composite.

This action has the following parameters:

– Set of Rt-Composite Target Param,

– Resizing Strategy Param.

This action may be targeted during the periods: R2, R3 and R3.TD.

51.18.2.1 Set Resizing Strategy effect

The action effect is as follows:

– Depending on the resizing strategy parameter value ("fixed", "minimum" or "grows only"), the OS of the target rt-composite may change.

– If "minimum" or "grows only", the OS of the rt-composite shall be computed again each time the child PVSs are modified and each time the OS does not fit the specified strategy.

This effect shall continue until the target is destroyed or this action is targeted again with a different Resizing Strategy parameter value.

51.18.2.2 Set Resizing Strategy additional error conditions

– If one of the targets is not an rt-component in R2, R3 or R3.TD, this action is ignored for that target.

51.18.3 Set OVS Proj Strategy action

This action is used to set the OVS Proj Strategy to an rt-component.

This action has the following parameters:

– Set of Rt-Component Target Param,

– OVS Proj Strategy Param.

This action may be targeted during the periods: R2, R3 and R3.TD.

51.18.3.1 Set OVS Proj Strategy effect

The effect of this action is as follows:

– Set the OVS Proj Strategy attribute to the value of the OVS Proj strategy parameter.

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- If the OVS Proj Strategy attribute is set to "fixed", the size specification parameter in Set OVS action is interpreted as RGSU and the Set OVS action sets the PVS.
- Otherwise, the size specification parameter in Set OVS action is interpreted as OGSU and the Set OVS action sets the OVS directly.

51.18.3.2 Set OVS Proj Strategy additional error conditions

- If one of the targets is not an rt-component in R2, R3 or R3.TD, this action is ignored for that target.

51.18.4 Set OVS action

This action is used to set the OVS directly or indirectly depending on the OVS Proj Strategy attribute of the target.

This action has the following parameters:

- Set of Rt-Component Target Param,
- Size Spec Param,
- Transition Duration Param.

This action may be targeted during the periods: R2, R3 and R3.TD.

51.18.4.1 Set OVS action effect

The effect of this action is follows:

a) The size specification parameter may be specified by an absolute value expressed in GSU or an relative value expressed in generic ratio.

b) If the OVS Proj Strategy attribute of the target is equal to "fixed":

   1) The specified values in the size specification parameter is interpreted as in the RPS of the target. Absolute values are considered as expressed in RGSU. Relative values are considered as expressed relatively to the POS of the target.

   2) The PVS of the target is directly defined by the interpreted values.

   3) The OVS is automatically calculated by the current GSF of the target.

   4) If the OVS or the GSU is changed after applying this action, the new GSU or the new OVS is computed again and is set so that PVS = OVS x GSU on each axis.

c) Otherwise:

   1) The specified values in the size specification parameter is interpreted as in the OPS of the target. Absolute values are considered as expressed in OGSU. Relative values are considered as expressed relatively to the OS of the target.

   2) The OVS of the target is directly defined by the interpreted values.

   3) The PVS is automatically calculated by the current GSF of the target.

   4) If the OVS or the GSU is changed after applying this action, the new PVS is calculated again in order to hold PVS = OVS x GSU on each axis.

If a size specification on an axis is omitted, 100 % is applied.

If a non zero transition duration is specified, the OVS or the PVS is gradually changed depending on the OVS Proj Strategy attribute. There is a user effect associated with this action, i.e. the presented content within the PVS is changed gradually or the PVS is changed gradually. The change of the OVS or the PVS does not affect the OAP, the OVS position, the PAP and the PVS position.

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51.18.4.2 Set OVS additional error conditions

- If one of the targets is not an rt-component in R2, R3 or R3.TD, this action is ignored for that target.
- If a size specification on an axis is omitted, 100 % is applied.
- If the a size specification parameter value is a negative value, this action shall be ignored for the whole target set.
- If the transition duration is negative, it is set to zero.
- If an original point factor or a current point factor is used, this action is ignored for all its targets.

51.18.5 Set OAP action

This action is used to set the OAP of an rt-component. The OAP shall be specified within the OVS.

This action has the following parameters:

- Set of Rt-Component Target Param,
- OAP Param: This parameter may be specified as an absolute value or a relative value.

This action may be targeted during the periods: R2, R3 and R3.TD.

51.18.5.1 Set OAP action effect

The OAP may be set to absolute values or relative values with regard to to the OVS depending on the OAP parameter.

There may be a user effect changing the presented portion of the OS.

51.18.5.2 Set OAP additional error conditions

- If one of the targets is not an rt-component in R2, R3 or R3.TD, this action is ignored for that target.
- If one of the OAP parameters is specified as an absolute value and it is not in the interval [0, OVS] on an axis, this parameter is set to 0.
- If one of the OAP parameters is specified as a relative value and it is not in the interval [0, 100 %] on an axis, this parameter is set to 0 %.

51.18.6 Set OVS Position action

This action is used to specify the position of the OVS relatively to the OS.

This action has the following parameters:

- Set of Rt-Component Target Param,
- OVS Position Param: the OVS Position Param is used to specify a macro parameter instead of a specified position value for the OVS relatively to the OS,
- Transition Duration Param.

This action may be targeted during the periods: R2, R3 and R3.TD.

51.18.6.1 Set OVS Position action effect

The OVS position may be set to absolute values in the OPS or relative values with regard to the OS depending on the OAP parameter. The effect of this action is as follows:

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– Set the OVS position of the target.

There may be a user effect changing the presented portion of the OS.

If a non zero transition duration is specified, the OVS position is gradually changed. There is a user effect associated with this action, i.e. the presenting part of the OS is gradually changed. The change of the OVS position does not affect the OAP.

NOTE 1: The OVS position parameter may have any absolute values and relative values.

NOTE 2: If some portions of the OS are not within the OVS, they are not perceived by the user. NOTE that the OVS position may position the OVS completely outside the OS. In this case, the entire OS is not perceived.

51.18.6.2 Set OVS Position additional error conditions

– If one of the targets is not an rt-component in R2, R3 or R3.TD, this action is ignored for that target.

– If the transition duration is negative, it is set to zero.

51.18.7 Set PAP action

This action is used to set the PAP of an rt-component. The PAP shall be specified within the PVS.

This action has the following parameters:

– Set of Rt-Component Target Param,

– PAP Param: may be specified as an absolute value or a relative value.

This action may be targeted during the periods: R2, R3 and R3.TD.

51.18.7.1 Set PAP action effect

The PAP may be set to absolute values or relative values with regard to the PVS depending on the PAP parameter. The effect of this action is the PAP of the target.

There may be a user effect changing the presented position within the RPS.

51.18.7.2 Set PAP additional error conditions

– If one of the targets is not an rt-component in R2, R3 or R3.TD, this action is ignored for that target.

– If one of the PAP parameter is specified as an absolute value and it is not in the interval [0, PVS] on an axis, this parameter is set to 0.

– If one of the PAP parameter is specified as a relative value and it is not in the interval [0, 100 %] on an axis, this parameter is set to 0 %.

51.18.8 Set PVS Position action

This action is used to specify the position of the PVS relatively to the OS of the RPS.

This action has the following parameters:

– Set of Rt-Component Target Param,

– PVS Position Param: the PVS Position Param may be specified as an absolute value or a relative value,

– Transition Duration Param.

This action may be targeted during the periods: R2, R3 and R3.TD.

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51.18.8.1 Set PVS Position action effect

The PVS position may be set to absolute values in the RPS or relative values with regard to the OS of the RPS depending on the PAP parameter. The effect of this action is the PVS position of the target.

There may be a user effect changing the presenting position within the RPS.

If a non zero transition duration is specified, the PVS position is gradually changed. There is a user effect associated with this action, i.e. the presented position of the PVS is gradually changed. The change of the PVS position does not affect the PAP.

NOTE: Any values are allowed for the PVS position parameter in absolute values and relative values.

51.18.8.2 Set PVS Position additional error conditions

- If one of the targets is not an rt-component in R2, R3 or R3.TD, this action is ignored for that target.
- If the transition duration is negative, it is set to zero.

51.18.9 Set GSF action

This action is used to set the GSF of the target.

This action has the following parameters:

- Set of Rt-Component Target Param,
- GSF Param: a generic ratio,
- Transition Duration Param.

This action may be targeted during the periods: R2, R3 and R3.TD.

51.18.9.1 Set GSF action effect

If the target is running, there may be a user effect. The presenting rt-component may be changed in its size.

If a non zero transition duration is specified, the size of the target is gradually changing up to the specified GSF

51.18.9.2 Set GSF additional error conditions

- If one of the targets is not an rt-component in R2, R3 or R3.TD, this action is ignored for that target.
- If the GSF parameter parameter value is a negative value, it shall be set to the value 0.
- If the transition duration is negative, it is set to zero.

51.18.10 Set User Spatial Control action

This action is used to specify whether the user is able to control some rt-component objects according to the specified functions (see clause 11.3).

This action has the following parameters:

- Set of Rt-Component Target Param,
- Set of Spatial Control Param,
- User Spatial Control Param.

This action may be targeted during the periods: R2, R3 and R3.TD.

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51.18.10.1 Set User Spatial Control action effect

The effect of this action is to set specified spatial control parameters to "allowed" or "not allowed" according to the user spatial control parameter.

If one of the spatial control functions is allowed, the user may interact with the rt-component to perform the function.

51.18.10.2 Set User Spatial Control additional error conditions

- If one of the targets is not an rt-component in R2, R3 or R3.TD, this action is ignored for that target.
- If the target is not an rt-component, the action shall be ignored for that target.

51.19 Actions to retrieve the behaviour

ISO/IEC 13522 defines means to get this behaviour by the use of the following actions:

- Get OS action (see clause 51.19.1),
- Get POS action (see clause 51.19.2),
- Get Aspect Ratio action (see clause 51.19.3),
- Get Resizing Strategy action (see clause 51.19.4),
- Get OVS Proj Strategy action (see clause 51.19.5),
- Get OVS action (see clause 51.19.6),
- Get OAP action (see clause 51.19.7),
- Get OVS Position action (see clause 51.19.8),
- Get PVS action (see clause 51.19.9),
- Get PAP action (see clause 51.19.10),
- Get PVS Position action (see clause 51.19.11),
- Get GSF action (see clause 51.19.12),
- Get User Spatial Control action (see clause 51.19.13).

51.19.1 Get OS action

This action is used to retrieve the OS of the target.

This action has the following parameters:

- Rt-Component Target Param,
- Expected Axis Result Param.

This action may be targeted during the periods: R2, R3 and R3.TD.

51.19.1.1 Get OS action effect

The effect of this action is as follows:

- If the expected axis result parameter is "x", "y" or "z", the corresponding size of the OS on this axis is returned as a generic integer.
- Otherwise ("xyz"), all the sizes of the OS are returned as a generic list containing three generic integers.

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The return value is measured in the OGSU of the target.

51.19.1.2 Get OS additional error conditions

- If the target addresses multiple entities, e.g. use of an alias which addresses a list of targets, or use of the "*" wildcard instead of a given rt-component number, or use of children or descendant tails, the action shall be ignored for this target.
- If the target is not accessible, e.g. the reference cannot be resolved, the action is ignored for this target.
- If the transition duration is negative, it is set to zero.

51.19.2 Get POS action

This action is used to retrieve the POS of the target.

This action has the following parameters:

- Rt-Component Target Param,
- Expected Axis Result Param.

This action may be targeted during the periods: R2, R3 and R3.TD.

51.19.2.1 Get POS action effect

The effect of this action is as follows:

- If the expected axis result parameter is "x", "y" or "z", the corresponding size of the POS on this axis is returned as a generic integer.
- Otherwise ("xyz"), all the sizes of the POS are returned as a generic list containing three generic integers.

The return value is measured in the RGSU of the target.

51.19.2.2 Get POS additional error conditions

- If the target addresses multiple entities, e.g. use of an alias which addresses a list of targets, or use of the "*" wildcard instead of a given rt-component number, or use of children or descendant tails, the action shall be ignored for this target.
- If the target is not accessible, e.g. the reference cannot be resolved, the action is ignored for this target.
- If the transition duration is negative, it is set to zero.

51.19.3 Get Aspect Ratio action

This action is used to retrieve the aspect ratio attribute of the target.

This action has the following parameter:

- Rt-Component Target Param.

This action may be targeted during the periods: R2, R3 and R3.TD.

51.19.3.1 Get Aspect Ratio action effect

This action evaluates the aspect ratio attribute of the target and returns it.

51.19.3.2 Get Aspect Ratio additional error conditions

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- If the target addresses multiple entities, e.g. use of an alias which addresses a list of targets, or use of the "*" wildcard instead of a given rt-component number, or use of children or descendant tails, the action shall be ignored for this target.
- If the target is not accessible, e.g. the reference cannot be resolved, the action is ignored for this target.
- If the transition duration is negative, it is set to zero.

51.19.4 Get Resizing Strategy action

This action is used to retrieve the resizing strategy attribute of the target.

This action has the following parameter:

- Rt-Composite Target Param.

This action may be targeted during the periods: R2, R3 and R3.TD.

51.19.4.1 Get Resizing Strategy action effect

This action evaluates the resizing strategy attribute of the target and returns it.

51.19.4.2 Get Resizing Strategy additional error conditions

- If the target addresses multiple entities, e.g. use of an alias which addresses a list of targets, or use of the "*" wildcard instead of a given rt-component number, or use of children or descendant tails, the action shall be ignored for this target.
- If the target is not accessible, e.g. the reference cannot be resolved, the action is ignored for this target.
- If the transition duration is negative, it is set to zero.

51.19.5 Get OVS Proj Strategy action

This action is used to retrieve the OVS Proj Strategy attribute of the target.

This action has the following parameter:

- Rt-Component Target Param.

This action may be targeted during the periods: R2, R3 and R3.TD.

51.19.5.1 Get OVS Proj Strategy action effect

This action evaluates the OVS Proj Strategy attribute of the target and returns it.

51.19.5.2 Get OVS Proj Strategy additional error conditions

- If the target addresses multiple entities, e.g. use of an alias which addresses a list of targets, or use of the "*" wildcard instead of a given rt-component number, or use of children or descendant tails, the action shall be ignored for this target.
- If the target is not accessible, e.g. the reference cannot be resolved, the action is ignored for this target.
- If the transition duration is negative, it is set to zero.

51.19.6 Get OVS action

This action is used to retrieve the OVS of the target.

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This action has the following parameters:

- Rt-Component Target Param,
- Point Type Param,
- Expected Axis Result Param.

This action may be targeted during the periods: R2, R3 and R3.TD.

51.19.6.1 Get OVS action effect

The effect of this action is as follows:

- If the point type parameter is "absolute", this action evaluates the OVS as absolute values in the OGSU, and returns generic integers.
- Otherwise ("relative"), this action evaluates the OVS as relative values with regard to the corresponding OS, and returns generic ratios.
- If the expected axis result parameter is "x", "y" or "z", the corresponding size of the OVS on that axis is returned.
- Otherwise ("xyz"), all the sizes of the OVS are returned as a generic list of three elements.

51.19.6.2 Get OVS additional error conditions

- If the target addresses multiple entities, e.g. use of an alias which addresses a list of targets, or use of the "*" wildcard instead of a given rt-component number, or use of children or descendant tails, the action shall be ignored for this target.
- If the target is not accessible, e.g. the reference cannot be resolved, the action is ignored for this target.
- If the transition duration is negative, it is set to zero.

51.19.7 Get OAP action

This action is used to retrieve the OAP of the target.

This action has the following parameters:

- Rt-Component Target Param,
- Point Type Param,
- Expected Axis Result Param.

This action may be targeted during the periods: R2, R3 and R3.TD.

51.19.7.1 Get OAP action effect

The effect of this action is as follows:

- If the point type parameter is "absolute", this action evaluates the OAP as absolute values in the OGSU within the OVS and returns generic integers.
- Otherwise ("relative"), this action evaluates the OAP as relative values with regard to the corresponding OVS and returns generic ratios.
- If the expected axis result parameter is "x", "y" or "z", the corresponding point of the OAP on that axis is returned.
- Otherwise ("xyz"), all the points of the OAP are returned as a list of three elements.

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51.19.7.2 Get OAP additional error conditions

- If the target addresses multiple entities, e.g. use of an alias which addresses a list of targets, or use of the "*" wildcard instead of a given rt-component number, or use of children or descendant tails, the action shall be ignored for this target.
- If the target is not accessible, e.g. the reference cannot be resolved, the action is ignored for this target.
- If the transition duration is negative, it is set to zero.

51.19.8 Get OVS Position action

This action is used to retrieve the OVS position of the target.

This action has the following parameters:

- Rt-Component Target Param,
- Point Type Param,
- Expected Axis Result Param.

This action may be targeted during the periods: R2, R3 and R3.TD.

51.19.8.1 Get OVS Position action effect

The effect of this action is as follows:

- If the point type parameter is "absolute", this action evaluates the OVS position as an absolute values in the OGSU and returns generic integers.
- Otherwise ("relative"), this action evaluates the OVS position as relative values with regard to the corresponding OS and returns generic ratios.
- If the expected axis result parameter is "x", "y" or "z", the corresponding length of the OVS position on that axis is returned.
- Otherwise ("xyz"), all the lengths of the OVS position are returned as a list of three elements.

51.19.8.2 Get OVS Position additional error conditions

- If the target addresses multiple entities, e.g. use of an alias which addresses a list of targets, or use of the "*" wildcard instead of a given rt-component number, or use of children or descendant tails, the action shall be ignored for this target.
- If the target is not accessible, e.g. the reference cannot be resolved, the action is ignored for this target.
- If the transition duration is negative, it is set to zero.

51.19.9 Get PVS action

This action is used to retrieve the PVS of the target.

This action has the following parameters:

- Rt-Component Target Param,
- Point Type Param,
- Expected Axis Result Param.

This action may be targeted during the periods: R2, R3 and R3.TD.

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51.19.9.1 Get PVS action effect

The effect of this action is as follows:

- If the point type parameter is "absolute", this action evaluates the PVS as absolute values in the RGSU of the target and returns generic integers.
- Otherwise ("relative"), this action evaluates the PVS as relative values with regard to the OS of the parent and returns generic ratios.
- If the expected axis result parameter is "x", "y" or "z", the corresponding size of the PVS on that axis is returned.
- Otherwise ("xyz"), all the sizes of the PVS are returned as a list of three elements.

51.19.9.2 Get PVS additional error conditions

- If the target addresses multiple entities, e.g. use of an alias which addresses a list of targets, or use of the "*" wildcard instead of a given rt-component number, or use of children or descendant tails, the action shall be ignored for this target.
- If the target is not accessible, e.g. the reference cannot be resolved, the action is ignored for this target.
- If the transition duration is negative, it is set to zero.

51.19.10 Get PAP action

This action is used to retrieve the PAP of the target.

This action has the following parameters:

- Rt-Component Target Param,
- Point Type Param,
- Expected Axis Result Param.

This action may be targeted during the periods: R2, R3 and R3.TD.

51.19.10.1 Get PAP action effect

The effect of this action is as follows:

- If the point type parameter is "absolute", this action evaluates the PAP as absolute values in the RGSU of the target within the PVS and returns generic integers.
- Otherwise ("relative"), this action evaluates the PAP as relative values with regard to the corresponding PVS and returns generic ratios.
- If the expected axis result parameter is "x", "y" or "z", the corresponding point of the PAP on that axis is returned.
- Otherwise ("xyz"), all the points of the PAP are returned as a list of three elements.

51.19.10.2 Get PAP additional error conditions

- If the target addresses multiple entities, e.g. use of an alias which addresses a list of targets, or use of the "*" wildcard instead of a given rt-component number, or use of children or descendant tails, the action shall be ignored for this target.
- If the target is not accessible, e.g. the reference cannot be resolved, the action is ignored for this target.
- If the transition duration is negative, it is set to zero.

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51.19.11 Get PVS Position action

This action is used to retrieve the PVS position of the target.

This action has the following parameters:

- Rt-Component Target Param,
- Point Type Param,
- Expected Axis Result Param.

This action may be targeted during the periods: R2, R3 and R3.TD.

51.19.11.1 Get PVS Position action effect

The effect of this action is as follows:

- If the point type parameter is "absolute", this action evaluates the PVS position as absolute values in the RGSU of the target and returns generic integers.
- Otherwise ("relative"), this action evaluates the PVS position as relative values with regard to the OS of the parent and returns generic ratios.
- If the expected axis result parameter is "x", "y" or "z", the corresponding length of the PVS position on that axis is returned.
- Otherwise ("xyz"), all the lengths of the PVS position are returned as a list of three elements.

51.19.11.2 Get PVS Position additional error conditions

- If the target addresses multiple entities, e.g. use of an alias which addresses a list of targets, or use of the "*" wildcard instead of a given rt-component number, or use of children or descendant tails, the action shall be ignored for this target.
- If the target is not accessible, e.g. the reference cannot be resolved, the action is ignored for this target.
- If the transition duration is negative, it is set to zero.

51.19.12 Get GSF action

This action is used to retrieve the GSF of the target.

This action has the following parameters:

- Rt-Component Target Param,
- Expected Axis Result Param.

This action may be targeted during the periods: R2, R3 and R3.TD.

51.19.12.1 Get GSF action effect

The effect of this action is as follows:

- If the expected axis result parameter is "x", "y" or "z", the corresponding GSF of the target on that axis is returned as a generic integer.
- Otherwise ("xyz"), all the GSFs of the target are returned as a list of three generic integers.

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51.19.12.2 Get GSF additional error conditions

- If the target addresses multiple entities, e.g. use of an alias which addresses a list of targets, or use of the "*" wildcard instead of a given rt-component number, or use of children or descendant tails, the action shall be ignored for this target.
- If the target is not accessible, e.g. the reference cannot be resolved, the action is ignored for this target.
- If the transition duration is negative, it is set to zero.

51.19.13 Get User Spatial Control action

This action is used to retrieve the user spatial control attribute value.

This action has the following parameters:

- Rt-Component Target Param,
- Spatial Control Param.

This action may be targeted during the periods: R2, R3 and R3.TD.

51.19.13.1 Get User Spatial Control effect

The effect of this action is to return "allowed" or "not allowed" according to the specified spatial control parameter ("moving", "resizing", "scaling" or "scrolling"), this action.

51.19.13.2 Get User Spatial Control additional error conditions

- If the target addresses multiple entities, e.g. use of an alias which addresses a list of targets, or use of the "*" wildcard instead of a given rt-component number, or use of children or descendant tails, the action shall be ignored for this target.
- If the target is not accessible, e.g. the reference cannot be resolved, the action is ignored for this target.
- If the transition duration is negative, it is set to zero.

52 Rt-Components Audible Behaviour

The behaviour is used to describe the audible presentation of rt-components. ISO/IEC 13522-1 defines an initial value for this behaviour and actions to modify it and to retrieve it.

52.1 Behaviour attributes and statuses

This behaviour is expressed using the following attributes or statuses:

- OV (see clause 52.2),
- CV (see clause 52.3),
- PCV (see clause 52.4),
- GVF (see clause 52.5).

52.2 OV

Each rt-content has an OV that is defined within the AVR. However, there is no OV for an rt-composite. The OV is always measured in the GVU, and shall be in this range.

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The OV of an rt-content shall not be changed once set.

52.3 CV

Each rt-content has a CV that is initialised as the OV. The CV may be changed using the Set CV action, however, the CV shall be within the AVR.

52.4 PCV

The PCV, i.e. the projection of the CV in its RPS is calculated using the GVF belonging to its RPS (PRPS or CPS) as CV x GVF.

NOTE: Every rt-component (rt-content and rt-composite) has a GTF and a GSF. However, rt-contents have no GVF. Rt-Composites and channels have GVF. Instead of having a GVF, an rt-content has a CV that may be changed.

52.5 GVF

The projection of the CV in the OPS onto the PCV in the RPS is controlled by the GVF belonging to the RPS. The GVF defines the number of RGVU corresponding to one OGVU Original presentation space.

52.6 Actions to change the behaviour

ISO/IEC 13522 defines means to modify this behaviour by the use of the following actions:

- Set CV action (see clause 52.6.1),
- Set GVF action (see clause 52.6.2).

52.6.1 Set CV action

This action is used to set the CV of the target as specified value.

This action has the following parameters:

- Set of Rt-Content Target Param,
- CV Param: specified as an absolute value, a relative value, an original point factor or a current point factor,
- Transition Duration Param.

This action may be targeted during the periods: R2, R3 and R3.TD.

52.6.1.1 Set CV action effect

This effect of this action is as follows:

- If the CV is specified as an absolute value, this value is set to the CV of the target.
- If the CV is specified as a relative value, this value is interpreted as a relative value to the AVR ([0, 255]) and the audible volume is calculated by 255 × (specified value). The calculated value is set to the CV of the target.
- If the CV is specified as an original point factor, the value, OV × (specified value), is calculated and set to the CV of the target.
- Otherwise (the CV is specified as a current point factor), the value, (current CV) × (specified value) , is calculated and set to the CV.

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– The above case, if the calculated value is outside the AVR, the value is set to 0 (if negative) or 255 (if greater than 255).

If a non zero transition duration is specified, the CV is gradually changed to the specified value.

52.6.1.2 Set CV additional error conditions

– If one of the targets is not an rt-content in R2, R3 or R3.TD, this action is ignored for that target.

– If the CV parameter defined as an absolute parameter value is not in interval of the AVR, this action shall be ignored for the whole target set.

– If the transition duration is negative, it is set to zero.

52.6.2 Set GVF action

This action is used to specify the GVF of an rt-composite or a channel.

This action has the following parameters:

– GVF Target,

– GVF Param: GVF value to be assigned,

– Transition Duration Param.

This action may be targeted during the periods: R2, R3, R3.TD and C2.

52.6.2.1 Set GVF action effect

The effect of this action is as follows:

– The GVF of the target is set to the specified value.

– If the target is an rt-composite, all the PCVs of descendants are calculated again by this value.

– Otherwise (the target is a channel), all the PCVs of rt-components assigned to this channel are calculated again by this value.

If a non zero transition duration is specified, the PCVs of the targets are gradually changed.

52.6.2.2 Set GVF additional error conditions

– If one of the targets is not an rt-composite or a channel in R2, R3, R3.TD or C2, this action is ignored for that target.

– If the transition duration is negative, it is set to zero.

52.7 Actions to retrieve the behaviour

ISO/IEC 13522 defines means to get this behaviour by the use of the following actions:

– Get OV action (see clause 52.7.1),

– Get CV action (see clause 52.7.2),

– Get PCV action (see clause 52.7.3),

– Get GVF action (see clause 52.7.4).

52.7.1 Get OV action

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This action is used to retrieve the OV of the target.

This action has the following parameter:

– Rt-Content Target Param.

This action may be targeted during the periods: R2, R3 and R3.TD.

52.7.1.1 Get OV action effect

The effect of this action is to retrieve the OV of the target expressed in the OGVU.

52.7.1.2 Get OV additional error conditions

– If the target addresses multiple entities, e.g. use of an alias which addresses a list of targets, or use of the "*" wildcard instead of a given rt-component number, or use of children or descendant tails, the action shall be ignored for this target.

– If one of the targets is not an rt-content in R2, R3, R3.TD, this action is ignored for that target.

52.7.2 Get CV action

This action is used to retrieve the CV of the target.

This action has the following parameter:

– Rt-Content Target Param.

This action may be targeted during the periods: R2, R3 and R3.TD.

52.7.2.1 Get CV action effect

– The effect of this action is to retrieve the CV of the target expressed in the OGVU.

52.7.2.2 Get CV additional error conditions

– If the target addresses multiple entities, e.g. use of an alias which addresses a list of targets, or use of the "*" wildcard instead of a given rt-component number, or use of children or descendant tails, the action shall be ignored for this target.

– If one of the targets is not an rt-content in R2, R3, R3.TD, this action is ignored for that target.

52.7.3 Get PCV action

This action is used to retrieve the PCV of the target.

This action has the following parameter:

– Rt-Content Target Param.

This action may be targeted during the periods: R2, R3 and R3.TD.

52.7.3.1 Get PCV action effect

– The effect of this action is to retrieve the PCV of the target expressed in the RGVU.

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52.7.3.2 Get PCV additional error conditions

- If the target addresses multiple entities, e.g. use of an alias which addresses a list of targets, or use of the "*" wildcard instead of a given rt-component number, or use of children or descendant tails, the action shall be ignored for this target.
- If one of the targets is not an rt-content in R2, R3, R3.TD, this action is ignored for that target.

52.7.4 Get GVF action

This action is used to retrieve the GVF of the target.

This action has the following parameters:

- Rt-Composite Target Param,
- Channel Target Param.

This action may be targeted during the periods: R2, R3, R3.TD and C2.

52.7.4.1 Get GVF action effect

- The effect of this action is to retrieve the GVF of the target as a generic ratio.

52.7.4.2 Get GVF additional error conditions

- If the target addresses multiple entities, e.g. use of an alias which addresses a list of targets, or use of the "*" wildcard instead of a given rt-component number, or use of children or descendant tails, the action shall be ignored for this target.
- If one of the targets is not an rt-component or a channel in R2, R3, R3.TD or C2, this action is ignored for that target.

53 Rt-Mux Stream Choice Behaviour

This behaviour is used to describe the choices of the stream within an rt-mux. Once streams have been chosen, the rt-mux is responsible for the chosen streams and ensure their presentation.

53.1 Behaviour attributes and statuses

This behaviour is expressed using the following attributes or statuses:

- Stream Choice (see clause 53.2),
- Stream Chosen State (see clause 53.3),
- Stream Identification (see clause 53.4).

53.2 Stream Choice

An rt-mux is responsible for the presentation of either complete multiplexed data or some specified streams individually chosen within the multiplexed data.

The stream choice attribute holds a list of the chosen stream IDs as a list.

Initially, all streams are chosen for an rt-mux, i.e. the rt-mux is responsible for the presentation of the complete multiplexed data. Thus, this attribute holds every stream ID.

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Once several streams have been chosen for an rt-mux, the rt-mux is responsible for the presentation of the chosen streams when it becomes "running". In this case, the demultiplexing process may be pipelined with the presentation process, and therefore no new data is generated from the demultiplexing.

EXAMPLE:

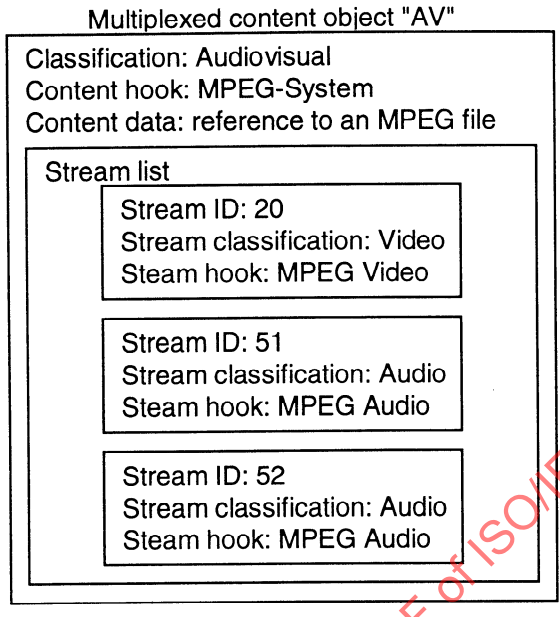

Figure 62 - Example of stream chosen

Figure 62 shows an example of a multiplexed content object. This model object contains one video stream and two audio streams. Two audio streams are recorded in different languages associated with the video stream, for example bilingual audio for a movie, language A for the stream 51 and language B for the stream 52. From this model object, the rt-mux AV is created using a New action. Initially, all streams in this AV are chosen for the presentation.

Before the actual presentation, an appropriate audio stream is to be chosen using the Set Stream Choice action. Stream 51 is the choice: Set Stream Choice(AV, (52, "remove")). Then, a Run action is targeted to the rt-mux AV. This has the effect of presenting the video with the audio stream 51.

This presentation may go with two buttons and the following behaviour may be associated with the buttons:

For button 1: If button 1 is selected, Set Stream Choice(AV, (51, "remove")), (52, add))

For button 2: If button 2 is selected, Set Stream Choice(AV, (52, "remove")), (51, add))

There may be also the single toggle button like:

If the button is selected, check the current selection of the audio by Get Stream Chosen State(AV, 51)

If the result is "chosen", Set Stream Choice((AV, (51, "remove")), (52, add))

Otherwise ("not chosen"), Set Stream Choice(AV, (52, "remove")), (51, add))

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53.3 Stream Chosen State

Each stream in an rt-mux has a stream chosen state. If it is chosen, the state is "chosen". Otherwise, the state is "not chosen".

Each rt-mux also has a stream chosen state. If all its streams are chosen, the state is "chosen". If some of its are chosen, the state is "partially chosen". Otherwise (no streams are chosen), the state is "not chosen".

53.4 Stream Identification

Choice between a stream identifier or "all streams".

53.5 Actions to change the behaviour

ISO/IEC 13522 defines means to modify this behaviour by the use of the following actions:

– Set Stream Choice action (see clause 53.5.1).

53.5.1 Set Stream Choice action

The action is used chooses the streams that are to be presented within a target rt-mux.

This action has the following parameters:

– Set of Rt-Mux Target Param,

– Set of Stream Spec Param.

This action may be targeted during the periods: R2, R3 and R3.TD.

53.5.1.1 Set Stream Choice action effect

The effect of this action is as follows:

– According to the specified update command, streams are add, removed or replaced with a new set.

– If a "remove" command is used and no streams are specified, all streams currently chosen are changed to "not chosen".

The result of this action is to change stream chosen states of some streams and the rt-mux. There may be a user effect if the target is running.

53.5.1.2 Set Stream Choice additional error conditions

– If one of the targets is not an rt-mux in <validperiod>, this action is ignored for that target.

53.6 Actions to retrieve the behaviour

ISO/IEC 13522 defines means to get this behaviour by the use of the following actions:

– Get Stream Choice action (see clause 53.6.1),

– Get Stream Chosen State action (see clause 53.6.2).

53.6.1 Get Stream Choice action

This action is used to retrieve a list of chosen stream IDs of the target.

This action has the following parameter:

– Rt-Mux Target Param.

This action may be targeted during the periods: R2, R3 and R3.TD.

53.6.1.1 Get Stream Choice action effect

The effect of this action is to retrieve a list of chosen stream IDs as a generic list.

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53.6.1.2 Get Stream Choice additional error conditions

- If the target addresses multiple entities, e.g. use of an alias which addresses a list of targets, or use of the "*" wildcard instead of a given rt-component number, or use of children or descendant tails, the action shall be ignored for this target.
- If one of the targets is not an rt-mux in R2, R3 or R3.TD, this action is ignored for that target.
- If the target is not accessible, e.g. the reference cannot be resolved, the action is ignored for this target.

53.6.2 Get Stream Chosen State action

This action is used to retrieve the stream state of the target.

This action has the following parameters:

- Rt-Mux Target Param,
- Stream Identification Param.

This action may be targeted during the periods: R2, R3 and R3.TD.

53.6.2.1 Get Stream Chosen State action effect

The effect of this action is as follows:

- If a stream ID is specified as a value of the stream identifier parameter, the stream chosen state of the stream is retrieved.
- Otherwise (i.e. "all streams" is specified as a value of the stream identifier parameter), the stream state of the target rt-mux is retrieved.

53.6.2.2 Get Stream Chosen State additional error conditions

- If the target addresses multiple entities, e.g. use of an alias which addresses a list of targets, or use of the "*" wildcard instead of a given rt-component number, or use of children or descendant tails, the action shall be ignored for this target.
- If one of the targets is not an rt-mux in R2, R3 or R3.TD, this action is ignored for that target.
- If the target is not accessible, e.g. the reference cannot be resolved, the action is ignored for this target.

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54 Interaction Behaviour

The behaviour is used to describe the interaction between rt-components and the user. Through this behaviour, the MHEG Engine and MHEG entities interact with to the user. All rt-components may be interactive. Initially, each rt-component is not interactive.

NOTE: Through the event behaviour, the MHEG Engine and the MHEG entities are also interact with the user. However, this interaction behaviour is dedicated to especially user selection and modification which are frequently used.

54.1 Behaviour attributes and statuses

This behaviour is expressed using the following attributes or statuses:

- Interaction Type (see clause 54.2),
- Interaction Status (see clause 54.3),
- Selection Status (see clause 54.4),

- Modification Status (see clause 54.5),
- Interaction Ability (see clause 54.6),
- Selectability (see clause 54.7),
- Modifiability (see clause 54.8),
- Min Interact Required (see clause 54.9),
- Max Interact Required (see clause 54.10),
- Number Of Interacted Sockets (see clause 54.11).

54.2 Interaction Type

There are two interaction types for rt-components:

- "selection";
- "modification".

The two selection types are independent of each other so that one rt-component may have one of the interaction types or both at the same time.

The MHEG Engine is assumed to manage the selection and the modification of rt-components with the help of the user interface. Using the value of the following interaction attributes, the MHEG Engine is informed of the user interactions with rt-components.

The user may interact with rt-components only if they are running. If an rt-component is not running, the user is not allowed to interact with it and no states concerning the interaction behaviour shall be changed.

The two types of interactions are controlled and retrieved by the same set of elementary actions and get actions specifying the interaction type as a parameter.

54.3 Interaction Status

Each rt-component may have a selection status indicating the user selection on it, and each rt-component may also have the modification status indicating the user modification to it.

The interaction status of an rt-component may be set only if the component is "running" on. The interaction status may be set explicitly by a Set Interaction Status action or implicitly by the user interaction.

How to interact to rt-components is up to the MHEG Engine.

NOTE 1: Rt-contents may be selected by a mouse positioning and click, and may be modified by a mouse positioning and keyboard input.

NOTE 2: Not only the visible rt-contents but also some audible rt-contents and multiplexed contents may be selected or modified. How to do that depends on the MHEG Engine implementation.

The interaction status may be perceptible (visibly or audibly) to show the current status of an rt-component to the user. However, this is an MHEG Engine feature which is not specified.

54.4 Selection Status

The selection status shall be either "selected" or "not selected". It indicates the results of the user selection.

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Initially, each rt-component is "not selected".

54.5 Modification Status

The modification status is "modified", "not modified" or "modifying". It indicates the results of the user modification.

Initially, each rt-component is "not modified".

54.6 Interaction Ability

The selectability of an rt-component is used to tell the MHEG Engine whether this rt-component may be selected by a user. The modifiability of an rt-component is used to tell the MHEG Engine whether this rt-component is modified by a user.

The interaction allowance may be perceptible (visibly or audibly) to show what interaction are allowed with an rt-component to the user. However, This is an MHEG Engine feature which is not specified.

54.7 Selectability

Each rt-component has a selectability that may be either "selectable" or "not selectable". This attribute is indirectly specified by the value of the maximum interaction required attribute for the selection. If the maximum interaction required attribute for the selection is 0 , the selectability value is "not selectable" otherwise, it is "selectable".

If an rt-component is "selectable", the user may interact to it and may select it. Otherwise, the user selection is inhibited.

54.8 Modifiability

Each rt-component has a modifiability that may be "modifiable" or "not modifiable". This attribute is indirectly specified by the value of the maximum interaction required attribute value for the modification. If the maximum interaction required attribute for the modification is 0, the modifiability value is "not modifiable" otherwise, it is "modifiable".

If an rt-component is "modifiable", the user may interact to it and may modify it. Otherwise, the user modification is inhibited.

54.9 Min Interact Required

The selection and modification statuses for an rt-content is directly determined by a user interaction because the user may directly select and modify the rt-content. However, the selection and modification statuses for an rt-composite are not directly determined by a user interaction. The selection and modification statuses for an rt-composite are dynamically determined as follows:

If a Set Interaction Status action is targeted to a rt-composite, the rt-composite is set to the specified status regardless of the min interact required attribute, the max interact required attribute and some possible "modifying" child rt-components.

NOTE 1: It is up to the author to keep consistency among those attribute values if an explicit Set Interaction Status action is used.

If one of the rt-components in a rt-composite is "modifying", the rt-composite is determined as "modifying".

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If a number of selected or modified rt-components in this rt-composite is greater than or equal to the min interact required attribute value, and if it is less than or equal to the max interact required attribute value, and if the user interaction process has been done, then the rt-composite is determined as "selected" or "modified".

NOTE 2: The MHEG Engine should provide some mechanism that checks the end of user interaction process. the interaction status is not determined automatically. The user interaction may continue until the number of selected or modified rt-components becomes the value of the max interact required attribute even if the number is greater than the min interact required attribute value.

Otherwise, the rt-composite is "not selected" or "not modified".

Therefore, the min interact required and max interact required attributes are provided to the MHEG Engine as a hint to determine the interaction status of rt-composite.

The number of interacted rt-components in an rt-composite may be changed dynamically using a Plug action. It is the MHEG Engine's responsibility to keep the consistency among the children statuses, the parent status, the min interact required and the max interact required attributes for the parent.

NOTE 4: For example, if a selected rt-component is plugged into an rt-composite that has the max interact required attribute 5 and the number of selected sockets 5, the MHEG Engine should start the user interaction process and ask the user to deselect one among the selected 6 sockets in order to satisfy the max interact required condition.

NOTE 5: For example, if the min interact required attribute is 2 and one of the selected sockets is deplugged, the MHEG Engine should start the user interaction process and ask the user to select sockets at least one more.

NOTE 6: For example, if the min interact required attribute is 5 and there are 4 sockets plugged into an rt-composite, the MHEG Engine should continue the user interaction process until some other rt-components are plugged in and at least 5 sockets are selected.

NOTE 7: If an rt-composite is not running, there may be some inconsistency among those attribute. Because the user may interact only if the rt-composite is running, the MHEG Engine may ask the user later again to interact for this rt-composite if an another Run action is targeted. Suppose that an rt-composite with 1 minute duration and "stop" for the temporal termination attribute is running and its min interact required is set to 1. In this case, if the user does not interact to the sockets of the rt-composite while it is running, the number of interacted sockets are less than the min interact required. If it is set to "running" again, the user interaction process begins again. This may be considered as a timer mechanism of the user interaction.

The min interact required attribute is valid only for rt-composites. The value for an rt-content is always ignored and has no meaning.

If the value of the min interact required attribute of an rt-composite is greater than or equal to 1, it means at least one interacted child is needed to change the interaction status of the parent rt-composite.

Initially, the attribute is set to 0.

54.10 Max Interact Required

The max interact required attribute is used to determine the interaction ability of an rt-component.

The attribute for an rt-composite also gives a hint to the MHEG Engine to control the number of interacted children. If the value of the max interact required attribute is greater than or equal to one, it means that one interacted child is the maximum number of interacted children allowed for the rt-composite.

The value of the max interact required shall be greater than or equal to the value of the min interact required for each interaction type.

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The MHEG Engine shall prevent a number of interacted rt-components that is greater than the specified value of the max interact required.

Initially, the attribute is set to 0.

54.11 Number Of Interacted Sockets

The number of interacted children may be evaluated. The number of interacted sockets attribute stores the value, and it may be retrieved by a Get Number Of Interacted Sockets action.

Initially, no sockets are interacted. Therefore, the attribute is set to 0.

54.12 Actions to change the behaviour

ISO/IEC 13522 defines means to modify this behaviour by the use of the following actions:

- Set Interaction Ability action (see clause 54.12.1),
- Set Interaction Status action (see clause 54.12.2).

54.12.1 Set Interaction Ability action

This action sets the interaction ability to the target.

This action has the following parameters:

- Set of Rt-Component Target Param,
- Interaction Type Param,
- Min Interact Required Param,
- Max Interact Required Param.

This action may be targeted during the periods: R2, R3 and R3.TD.

54.12.1.1 Set Interaction Ability action effect

According to the specified interaction type, the selection or the modification of the target is set. The effect of this action is as follows:

- The min interact required attribute is set to the specified value.
- The max interact required attribute is set to the specified value.

The min interact required attribute value has no meaning for rt-contents.

54.12.1.2 Set Interaction Ability additional error conditions

- If one of the targets is not an rt-component in R2, R3 or R3.TD, this action is ignored for that target.
- If the min interact required parameter value is a negative value, it shall be set to the value 0.
- If the max interact required parameter value is a negative value, it shall be set to the value 0.
- If the min interact required is greater than the max interact required, this action shall be ignored for the whole target set.
- If the min interact required parameter value is not in interval [0, number of child sockets of the target], this action shall be ignored for the whole target set.

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- If the max interact required parameter value is not in interval [0, number of child sockets of the target], this action shall be ignored for the whole target set.
- If the current number of interacted sockets are greater than the specified max interact required, this action shall be ignored for that target

54.12.2 Set Interaction Status action

This action is used to set the interaction status of the target.

This action has the following parameters:

- Set of Rt-Component Target Param,
- Interaction Type Param,
- Interaction Status Param.

This action may be targeted during the periods: R3 and R3.TD.

54.12.2.1 Set Interaction Status action effect

The effect of this action is to set the interaction status according to the specified interaction type as follows:

- If the specified interaction type is "selection", the interaction status of the target is set to either "selected" or "not selected".
- Otherwise (the specified interaction type is "modification"), the interaction status of the target is set to either "modified", "not modified" or "modifying".

This action sets the interaction status regardless of any other related attribute values. It is up to the author to decide whether to keep consistency among attribute value.

54.12.2.2 Set Interaction Status additional error conditions

- If one of the targets is not an rt-component in R3 or R3.TD, this action is ignored for that target.

54.13 Actions to retrieve the behaviour

ISO/IEC 13522 defines means to get this behaviour by the use of the following actions:

- Get Interaction Ability action (see clause 54.13.1),
- Get Min Interact Required action (see clause 54.13.2),
- Get Max Interact Required action (see clause 54.13.3),
- Get Interaction Status action (see clause 54.13.4),
- Get Number Of Interacted Sockets action (see clause 54.13.5).

54.13.1 Get Interaction Ability action

This action is used to retrieves the interaction ability of the target.

This action has the following parameters:

- Rt-Component Target Param,
- Interaction Type Param: Interaction value to be returned.

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This action may be targeted during the periods: R2, R3 and R3.TD.

54.13.1.1 Get Interaction Ability action effect

According to the specified interaction type, the effect of this action is as follows:

- If the interaction type is "selection", this action returns "selectable" or "not selectable".
- Otherwise (the interaction type is "modification"), this action returns "modifiable" or "not modifiable".

54.13.1.2 Get Interaction Ability additional error conditions

- If the target addresses multiple entities, e.g. use of an alias which addresses a list of targets, or use of the "*" wildcard instead of a given rt-component number, or use of children or descendant tails, the action shall be ignored for this target.
- If the target is not an rt-component, the action shall be ignored for that target.
- If the target is not accessible, e.g. the reference cannot be resolved, the action is ignored for this target.
- If one of the targets is not rt-component in R2, R3, R3.TD, this action is ignored for that target.

54.13.2 Get Min Interact Required action

This action is used to retrieve the min interact required of the target.

This action has the following parameters:

- Rt-Component Target Param,
- Interaction Type Param.

This action may be targeted during the periods: R2, R3 and R3.TD.

54.13.2.1 Get Min Interact Required action effect

According to the specified interaction type, the value of the min interact required attribute for the selection or the modification is retrieved.

54.13.2.2 Get Min Interact Required additional error conditions

- If the target addresses multiple entities, e.g. use of an alias which addresses a list of targets, or use of the "*" wildcard instead of a given rt-component number, or use of children or descendant tails, the action shall be ignored for this target.
- If the target is not an rt-component, the action shall be ignored for that target.
- If the target is not accessible, e.g. the reference cannot be resolved, the action is ignored for this target.
- If one of the targets is not rt-component in R2, R3, R3.TD, this action is ignored for that target.

54.13.3 Get Max Interact Required action

This action is used to retrieve the max interact required of the target.

This action has the following parameters:

- Rt-Component Target Param,
- Interaction Type Param.

This action may be targeted during the periods: R2, R3 and R3.TD.

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54.13.3.1 Get Max Interact Required action effect

According to the specified interaction type, the value of the max interact required attribute for the selection or the modification is retrieved.

54.13.3.2 Get Max Interact Required additional error conditions

- If the target addresses multiple entities, e.g. use of an alias which addresses a list of targets, or use of the "*" wildcard instead of a given rt-component number, or use of children or descendant tails, the action shall be ignored for this target.
- If the target is not an rt-component, the action shall be ignored for that target.
- If the target is not accessible, e.g. the reference cannot be resolved, the action is ignored for this target.
- If one of the targets is not rt-component in R2, R3, R3.TD, this action is ignored for that target.

54.13.4 Get Interaction Status action

This action is used to retrieve the interaction status of the target.

This action has the following parameters:

- Rt-Component Target Param,
- Interaction Type Param.

This action may be targeted during the periods: R2, R3 and R3.TD.

54.13.4.1 Get Interaction Status action effect

According to the specified interaction type, the effect of this action is as follows:

- If the interaction type is "selection", the selection status of the target is returned.
- Otherwise (the interaction type is "modification"), the modification status of the target is returned.

54.13.4.2 Get Interaction Status additional error conditions

- If the target addresses multiple entities, e.g. use of an alias which addresses a list of targets, or use of the "*" wildcard instead of a given rt-component number, or use of children or descendant tails, the action shall be ignored for this target.
- If the target is not an rt-component, the action shall be ignored for that target.
- If the target is not accessible, e.g. the reference cannot be resolved, the action is ignored for this target.
- If one of the targets is not rt-component in R2, R3, R3.TD, this action is ignored for that target.

54.13.5 Get Number Of Interacted Sockets action

This action is used to retrieve the number of interacted sockets of the target.

This action has the following parameters:

- Rt-Composite Target Param,
- Interaction Type Param.

This action may be targeted during the periods: R2, R3 and R3.TD.

54.13.5.1 Get Number Of Interacted Sockets action effect

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According to the specified interaction type, the number of selected or modified sockets is retrieved.

54.13.5.2 Get Number Of Interacted Sockets additional error conditions

- If the target addresses multiple entities, e.g. use of an alias which addresses a list of targets, or use of the "*" wildcard instead of a given rt-component number, or use of children or descendant tails, the action shall be ignored for this target.
- If the target is not an rt-component, the action shall be ignored for that target.
- If the target is not accessible, e.g. the reference cannot be resolved, the action is ignored for this target.
- If one of the targets is not rt-composite in R2, R3, R3.TD, this action is ignored for that target.

55 Rt-Components Style Behaviour

This behaviour is used to describe the style of rt-component. Each rt-component may have a style. A style may change the user perception of rt-contents.

A style is a way of presentation, and may be compared to a predefined behaviour or style of presentation. Applying a style to a target allows the author to avoid describing this behaviour or presentation. The MHEG Engine uses the information described in the style to directly map a style to a facility provided by the user interface if possible. If the user interface does not provide such a facility, the MHEG Engine may interpret the style with the description of the predefined behaviour provided for each style.

EXAMPLE:

An rt-non-mux containing a generic integer may be displayed as a graphical slider with the "slider" style.

An rt-non-mux containing audio may be listened to using a speaker as audio, or may be displayed as wave form in a graphical way.

55.1 Behaviour attributes and statuses

This behaviour is expressed using the following attribute or status:

- Style (see clause 55.2).

55.2 Style

A style is a catalogued entry, either registered or proprietary. This attribute is used to assign a logical style to the rt-component. How the style is perceived by the user is not specified .

55.3 Actions to change the behaviour

ISO/IEC 13522 defines means to modify this behaviour by the use of the following actions:

- Set Style action (see clause 55.3.1).

55.3.1 Set Style action

This action is used to assign a style to the target.

This action has the following parameters:

- Set of Rt-Component Target Param,

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- Catalogued Style Param,
- Additional Information Param: It may be used by a specific style to interchange some additional information to be associated with. For example, a value range for a slider style. How many generic values are required and the semantics of those generic values depends on a style.

This action may be targeted during the periods: R2, R3 and R3.TD.

55.3.1.1 Set Style action effect

The effect of this action is as follows:

- Depending on the specified style param and the additional information parameter, a style is assigned to the target
- The previous style applied to the target is removed.

If a Run action is targeted to the target after applying this action, the target is presented with the current specified style. If the target is running at the time of applying this action, there may be a user effect associated with this action.

NOTE: The MHEG Engine may directly map the target on a style facility provided by its user interface. However, certain attributes and statuses may be used in link objects, e.g. the selection status of the target, the position and size of the target. They should be updated by the MHEG Engine according to the style and coherently with the current user interaction.

55.3.1.2 Set Style additional error conditions

- If one of the targets is not an rt-component in R2, R3 or R3.TD, this action is ignored for that target.

55.4 Actions to change the behaviour

ISO/IEC 13522 defines means to modify this behaviour by the use of the following actions:

- Get Style action (see clause 55.4.1).

55.4.1 Get Style action

This action is used to retrieve the current style associated with the target.

This action has the following parameter:

- Rt-Component Target Param.

This action may be targeted during the periods: R2, R3 and R3.TD.

55.4.1.1 Get Style action effect

The effect of this action is to evaluate a list corresponding to the catalogued style that are applied to the target.

55.4.1.2 Get Style additional error conditions

- If one of the targets is not an rt-component in R2, R3 or R3.TD, this action is ignored for that target.

56 Rt-Contents Anchor Behaviour

This behaviour is used to describe the anchor function of an rt-content.

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An anchor is characterised as follows:

- An anchor is distinguished from a normal rt-content by the optional data classification attribute of the content object. If this classification attribute is "Anchor", then this content object contains anchor information, and rt-contents created from this content object may be used as anchors.
- An anchor may be used to create a hotspot on another rt-component. The content data contained in an anchor is used to attach the anchor to other rt-content, e.g. starting point and end point, rectangular area, polygon area. This content data is called anchor information. If an rt-content to which an anchor is attached is modified in its presentation (e.g. resize, move), the anchor should follow its modification and change its position or shape automatically. The semantics of this anchor information is not defined by ISO/IEC 13522-1. It depends on rt-contents to which the anchors are attached on the MHEG Engine or the application.
- The hook in an anchor is used to indicate the semantics of anchor information. It provides an encoding format which is used to describe the rendering of the anchor, the attachment points in the rt-content to which the anchor is attached and the semantics of the anchor. Since the encoding format is registered, the hook is used to provide a generic implementation of anchor mechanism.
- The anchor information is used by the GUI or some other system that supports the rendering of rt-contents, and is expected to perform the appropriate rendering of an anchor.
- As an anchor is an rt-content, its selection status tells the MHEG Engine that the hotspot specified by this anchor is selected by a user action. A Run action or a Stop action may make an anchor active or inactive. A Set Interaction Ability action may also make an anchor active or inactive.
- An anchor has preparation behaviour, rt-availability behaviour, running behaviour, Interaction behaviour and rt-contents anchor behaviour. Behaviors not applicable to an anchor are ignored by the MHEG Engine. If behaviours that should not be applied to an anchor are applied, these behaviours are ignored by the anchor.

EXAMPLE:

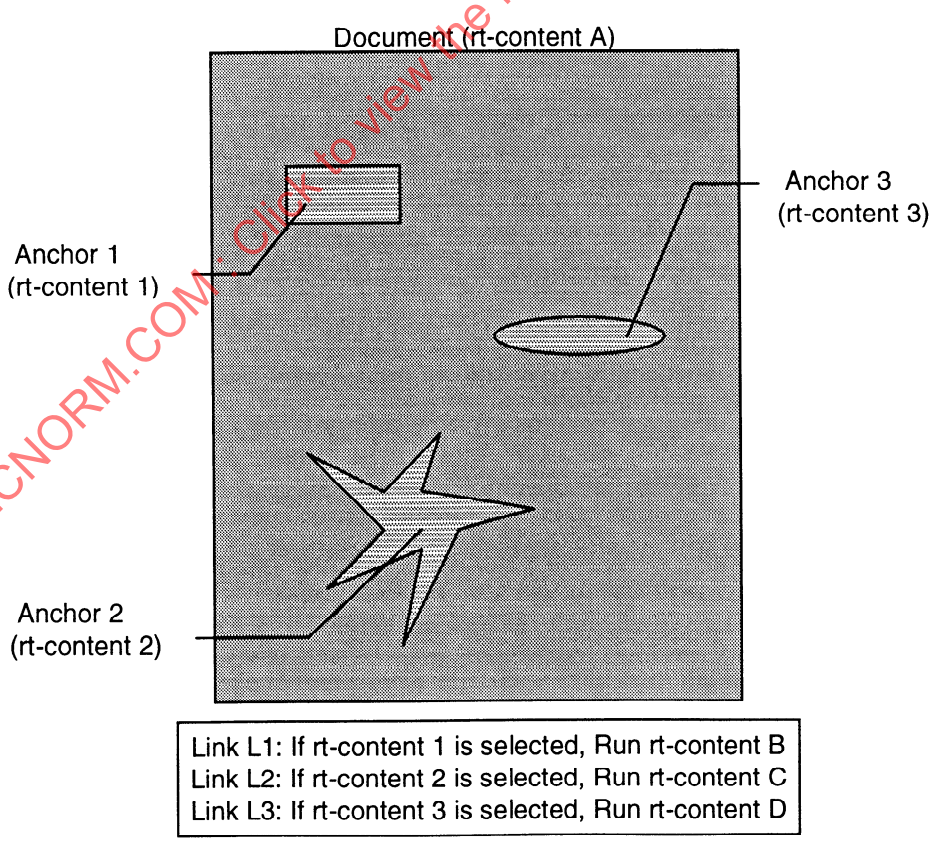

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Figure 63 - Example of anchors

Figure 63 shows an example of using anchors. In this figure, three anchors (rt-content 1, rt-content 2, rt-content 3) are attached to the hub document (rt-content A). Depending on the anchor information, each anchor specifies the shape and the position of the hotspot within the hub document. A rendering system displays anchors in an appropriate way. If the user selects one of the anchors, the link objects associated with these anchors are fired and lead the user to an another presentation.

56.1 Behaviour attributes and statuses

There are no rt-contents anchor behaviour attributes or statuses.

56.2 Actions to change the behaviour

ISO/IEC 13522 defines means to modify this behaviour by the use of the following actions:

– Attach Anchor action (see clause 56.2.1).

56.2.1 Attach Anchor action

This action is used attaches anchors to the target.

This action has the following parameters:

– Set of Rt-Content Target Param,

– Set of Anchor Spec Param.

This action may be targeted during the periods: R2, R3 and R3.TD.

56.2.1.1 Attach Anchor action effect

The effect of this action depends on the specified update command, specified anchors are added, removed or replaced.

56.2.1.2 Attach Anchor additional error conditions

– If one of the targets is not an rt-content in R2, R3 or R3.TD, this action is ignored for that target.

– If one of the anchors is not an anchor (i.e. Contains no classification attribute catalogued as "Anchor"), this action is ignored for that anchor.

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Section 7: Channels Behaviour

57 Channel Availability Behaviour

This behaviour is used to describe the availability of channels. Each channel has this behaviour.

57.1 Behaviour attributes and statuses

This behaviour is expressed using the following attribute or status:

– Channel Availability Status (see clause 57.2).

57.2 Channel Availability Status

The availability of each channel to the MHEG Engine may be evaluated. The channel availability status indicates whether a channel is available. This status shall be either "available" or "not available".

The channel availability status should be evaluated to "not available" if the channel cannot be activated by the MHEG Engine, i.e. the channel is in period C1 (see clause 29.3).

NOTE 1: This means that the channel has not been formally created or has been deleted.

NOTE 2: For example, the channel may not yet have been created by the MHEG Engine, i.e. a New action has not yet been targeted.

The channel availability status should be evaluated to "available" if the channel has been activated by the MHEG Engine, i.e. the channel has been created by the MHEG Engine and is in period C2.

NOTE 3: The MHEG Engine may provide to the application more detailed diagnostic and information message. For example, to explain that a channel cannot be created, or to indicate error conditions. These messages are not specified by ISO/IEC 13522-1.

Initially, each channel is "not available", except for the "default channel".

57.3 Actions to change the behaviour

ISO/IEC 13522 defines means to modify this behaviour by the use of the following actions:

– New Channel action (see clause 57.3.1),

– Delete Channel action (see clause 57.3.2).

57.3.1 New Channel action

This action is used to create channels. i.e. a logical perception space through which the assigned rt-components are perceived.

The channel creation process is not specified and is provided by the MHEG Engine.

This action has the following parameter:

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– Set of Channel Target Param.

This action may be targeted during the period: C1.

57.3.1.1 New Channel action effect

The MHEG effect of this action is as follows:

– Construct the target channel (see clause 9.3).

– Assign a channel identifier (target of this action) to the constructed channel.

– Set the channel perceptability behaviour as "off".

– Set the channel availability status of the target to "available". The created channel enters period C2.

57.3.1.2 New Channel additional error conditions

– If one of the targets is not a channel in C1, this action is ignored for that target.

– If an existing channel identifier is used in one of the targets, this action shall be ignored for that target.

– If one of the target is the default channel, this action shall be ignored for that target.

57.3.2 Delete Channel action

This action is used to remove channels from the MHEG Engine. This may be used to release resources in the MHEG Engine.

This action has the following parameter:

– Set of Channel Target Param.

This action may be targeted during the period: C2.

57.3.2.1 Delete Channel action effect

The effect of this action is as follows:

– Destroy the channel perceptability behaviour.

NOTE 1: The object designer should be aware that if the channel is "on", this action makes the channel and all associated rt-components disappear. How to handle the disappearance is not specified.

– Implicit Stop actions are targeted to all rt-components assigned to the targets.

– All rt-components assigned to the target are deassigned, and a Set Channel Assignment action targeted to the default channel is implicitly targeted to those rt-components.

NOTE 2: The behaviours of these rt-components remain identical after the deassignment.

NOTE 3: Destroy the target and its CPS.

– Set the channel availability status of the target to "not available". The channel enters in period C1.

57.3.2.2 Delete Channel additional error conditions

– If one of the targets is not a channel in C2, this action is ignored for that target.

– If one of the target is the default channel, this action shall be ignored for that target.

57.4 Actions to retrieve the behaviour

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ISO/IEC 13522 defines means to get this behaviour by the use of the following actions:

– Get Channel Availability Status action (see clause 57.4.1).

57.4.1 Get Channel Availability Status action

This action is used to retrieve the channel availability status of the target.

This action has the following parameter:

– Channel Target Param.

This action may be targeted during the periods: C1 and C2.

57.4.1.1 Get Channel action effect

The effect of this action is as follows:

– If the target is in period C1, this action returns "not available".

– Otherwise (the target is in period C2), this action returns "available".

57.4.1.2 Get Channel Availability Status additional error conditions

– If the target addresses multiple entities, e.g. use of an alias which addresses a list of targets, or use of the "*" wildcard instead of a given rt-component number, or use of children or descendant tails, the action shall be ignored for this target.

– If the target is not a channel, this action is ignored for this target.

– If the target is not accessible, e.g. the reference cannot be resolved, the action is ignored for this target.

58 Channel Perceptability Behaviour

This behaviour is used to describe the perceptability of channels. All channels shall have a channel perceptability behaviour.

58.1 Behaviour attributes and statuses

This behaviour is expressed using the following attribute or status:

– Channel Perceptability (see clause 58.2).

58.2 Channel Perceptability

Each channel may be turned on and off. If a channel is turned on, all the rt-components assigned to this channel are perceived by the user. If a channel is turned off, all the rt-components assigned to this channel are no longer perceived by the user.

NOTE: Rt-Components may be assigned and positioned to a non perceptible channel. If the channel is turned on, all the assigned rt-components appear as specified previously.

The channel perceptability shall be either "on" or "off".

Initially, the default channel is turned on. So its channel perceptability is "on".

However, all other channels are turned off. So their channel perceptability is "off".

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58.3 Actions to change the behaviour

ISO/IEC 13522 defines means to modify this behaviour by the use of the following actions:

– Set Channel Perceptability action (see clause 58.3.1).

58.3.1 Set Channel Perceptability action

This action is used to change the channel perceptability of a target.

This action has the following parameters:

– Set of Channel Target Param,

– Channel Perceptability Param.

This action may be targeted during the period: C2.

58.3.1.1 Set Channel Perceptability action effect

The effect of this action is to set the channel perceptability of the target as specified:

– If the target is set to "off", the target is turned off.

– otherwise (the target is set to "on"), the target is turned on.

There is no effect if the specified value is the same as the current value.

58.3.1.2 Set Channel Perceptability additional error conditions

– If one of the targets is not a channel in C2, this action is ignored for that target.

58.4 Actions to retrieve the behaviour

ISO/IEC 13522 defines means to get this behaviour by the use of the following actions:

– Get Channel Perceptability action (see clause 58.4.1).

58.4.1 Get Channel Perceptability action

This action is used to retrieve the channel perceptability of the target.

This action has the following parameter:

– Channel Target Param.

This action may be targeted during the period: C2.

58.4.1.1 Get Channel Perceptability action effect.

This action evaluates the value of the channel perceptability attribute, and returns "on" or "off" depending on the state.

58.4.1.2 Get Channel Perceptability additional error conditions

– If the target addresses multiple entities, e.g. use of an alias which addresses a list of targets, or use of the "*" wildcard instead of a given rt-component number, or use of children or descendant tails, the action shall be ignored for this target.

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- If one of the targets is not a channel in C2, this action is ignored for that target.
- If the target is not accessible, e.g. the reference cannot be resolved, the action is ignored for this target.

59 Channel Presentation Space Behaviour

This behaviour is used to describe the channel presentation space. Upon creation of channels, each presentation space of a channel is initialised to the default values. These values may be changed after creation.

59.1 Behaviour attributes and statuses

There are no channel presentation space behaviour attributes or statuses.

59.2 Actions to change the behaviour

ISO/IEC 13522 defines means to modify this behaviour by the use of the following actions:

- Set CPS action (see clause 59.2.1).

59.2.1 Set CPS action

This action is used to specify the CPS of the target channel.

This action has the following parameters:

- Set of Channel Target Param,
- CPS Initialisation Param.

This action may be targeted during the period: C2.

59.2.1.1 Set CPS action effect

The effect of this action is as follows:

- The temporal axis of the target CPS is set to the specified CPS duration. If it is omitted, the temporal axis is set to infinite.
- The spatial axis of the target CPS is set to the specified CPS size. If it is omitted on a certain axis, this spatial axis is set to 0.

There may be a user effect. If the spatial axes of the CPS are shrunk, some rt-components projected on to this CPS may become invisible.

59.2.1.2 Set CPS additional error conditions

- If one of the targets is not a channel in C2, this action is ignored for that target.

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Section 8: Channels & Rt-Components Behaviour

60 Channels and Rt-Components Events Behaviour

This behaviour is used to describe the events that may occur on channels and rt-components.

The behaviour is used to allow the MHEG Engine to get events that may be triggered not only by the MHEG Engine but also by some systems or system components outside of the MHEG Engine.

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60.1 Behaviour attributes and statuses

This behaviour is expressed using the following attributes or statuses:

- Event (see clause 60.2),
- Event Data (see clause 60.3).

60.2 Event

An event is identified by a catalogued entry which is a list. An event identifier 0 is reserved to indicate that no event has occurred.

The event attribute holds the identifier of the event that has occurred most recently on a channel or an rt-component. Initially, each event attribute is set to 0. This attribute may be changed by the occurrence of an event.

60.3 Event Data

An event data attribute stores the information associated with the event most recently received by a channel or rt-component if the event requests to store additional information. The value stored in an event data attribute is a generic value. Its valid structure and allowed values are catalogued; they depends on the event.

Initially, the value of an event data attribute is set to a null value.

60.4 Actions to change the behaviour

ISO/IEC 13522 defines means to modify this behaviour by the use of the following actions:

- Set Event action (see clause 60.4.1).

60.4.1 Set Event action

This action is used to send an event to the target. This action may be implicitly targeted if the MHEG Engine or some systems generate an event and if this event is catalogued.

This action has the following parameters:

- Set of Rt-Component Channel Tg Param,
- Event Param: specifies an event.,

– Event Data Param: specifies the data associated with an event.

This action may be targeted during the periods: R2, R3, R3.TD and C2.

60.4.1.1 Set Event action effect

The effect of this action is as follows:

– Set the event attribute of the target as specified.

– If the event data is associated with the event, the event data attribute is set to this data.

– Otherwise (the event data is omitted), the event data attribute is set to NULL.

It is an author's responsibility to keep the consistency between the event attribute and the event data attribute if this action is explicitly used.

It is the MHEG Engine or the application's responsibility to keep this consistency if this action is implicitly used.

60.4.1.2 Set Event additional error conditions

– If one of the targets is not an rt-component or a channel in R2, R3, R3.TD or C2, this action is ignored for that target.

60.5 Actions to retrieve the behaviour

ISO/IEC 13522 defines means to get this behaviour by the use of the following actions:

– Get Event action (see clause 60.5.1),

– Get Event Data action (see clause 60.5.2).

60.5.1 Get Event action

This action is used to retrieve the event that has happened to the target.

This action has the following parameter:

– Rt-Component Channel Tg Param: Specifies the data associated with an event.

This action may be targeted during the periods: R2, R3, R3.TD and C2.

60.5.1.1 Get Event action effect

The effect of this action is to evaluate the event attribute and to return the stored value.

60.5.1.2 Get Event additional error conditions

– If one of the targets is not an rt-component or a channel in R2, R3, R3.TD nor C2, this action is ignored for that target.

60.5.2 Get Event Data action

This action retrieves the event data of the target that is associated with the most recently happened event.

This action has the following parameter:

– Rt-Component Channel Tg Param: Specifies the data associated with an event.

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This action may be targeted during the periods: R2, R3, R3.TD and C2.

60.5.2.1 Get Event Data action effect

The effect of this action is to evaluate the event data attribute and to return the stored value.

60.5.2.2 Get Event Data additional error conditions

- If one of the targets is not an rt-component or a channel in R2, R3, R3.TD nor C2, this action is ignored for that target.

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Section 9: Detailed Representation Of MHEG Objects

61 Mh-Object class representation attributes

Table 4: Overview of Mh-object Class representation attributes

Mh-object Class ::= Class Identification, Mheg ID?, Description?

Class Identification ::= *joint-iso-itu-t, mheg, version,* Class ID

Class ID ::=
action-class-ID | *link-class-ID* | *script-class-ID* | *content-class-ID* | *multiplexed-content-class-ID* | *composite-class-ID* | *container-class-ID* | *descriptor-class-ID* | Extensibility Provision

Description ::=
Name?, Owner?, Version?, Date?, Keywords?, Copyright?, Copyright ID?, Copyright Number?, Licence?, Cache Priority?, Comments?, Extensibility Provision

Name ::= String

Owner ::= String

Version ::= String

Date ::= *UTCTime*

Keywords ::= String*

Copyright ::= String

Copyright ID ::= *OCTET STRING*

Copyright Number ::= *OCTET STRING*

Licence ::= String

Cache Priori ty ::= Integer

Comments ::= String

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61.1 Mh-object Class

- The Mh-object abstract class provides the common structure for the identification and interchange of all MHEG objects. It provides also the generic addressing mechanism.
- Inherits from: NONE.
- Addresses: NONE
- Inherited by: Action, Link, Model, Container and Descriptor classes.
- Addressed by: NONE.
- Sequence of (Class Identification, Mheg ID?, Description?).

61.2 Class Identification

- Identification of the class by:

– MHEG Standard: joint-iso-itu-t (2) mheg (19);

– MHEG Standard version: (1).

- Class identifier corresponding to the interchanged object.

- Sequence of (joint-iso-itu-t, mheg, version, Class ID).

61.3 Class ID

- Identification of the MHEG object class of the interchanged object

- Choice between (action-class-ID, link-class-ID, script-class-ID, content-class-ID, multiplexed-content-class-ID, composite-class-ID, container-class-ID, descriptor-class-ID, Extensibility Provision).

61.4 Description

- More precise description of an MHEG interchanged object.

- Sequence of (Name?, Owner?, Version?, Date?, Keywords?, Copyright?, Copyright ID?, Copyright Number?, Licence?, Cache Priority?, Comments?, Extensibility Provision).

61.5 Name

- Name of the MHEG object.

- String.

61.6 Owner

- Identification of the owner of the MHEG object.

- String.

61.7 Version

- Identification of the version of the MHEG object.

- String.

61.8 Date

- Latest modification date of the MHEG object. In the base notation (ASN.1) ISO format Universal Time (UTC) is used.

- UTCTime.

61.9 Keywords

- List of keywords qualifying the MHEG object.

- List of (String).

61.10 Copyright

- Content of the copyright attached to the MHEG object.

- String.

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61.11 Copyright ID

- Identification code for the type of work.
- OCTET STRING.

61.12 Copyright Number

- Identification code for the work.
- OCTET STRING.

61.13 Licence

- Information concerning the licence attached to the MHEG object.
- String.

61.14 Cache Priority

- This attribute provides a facility for memory management and may be used by the MHEG Engine for optimisation of Prepare and Destroy actions. the value shall be within the range [0, 255].
- Integer.

61.15 Comments

- Free format comments attached to the MHEG object.
- String.

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62 Action class representation attributes

Table 5: Overview of Action Class representation attributes

Action Class ::= Mh-object Class, Synchro Indicator Param, Synchronised Action+, Extensibility Provision
Synchro Indicator Param ::= Synchro Indicator | Synchro Indicator Macro
Synchro Indicator Macro ::= Macro Def ID, Synchro Indicator?
Synchro Indicator ::= *serial* | *parallel*
Synchronised Action ::= Elementary Action | Action Object
Action Object ::= Action Object Reference | Action Class

62.1 Action Class

- The action class provides a consistent structure for the interchange of sets of actions, basic action objects and nested action objects. Action objects, instances of action class, are used to interchange an organised set of elementary actions.
- Inherits from: Mh-object Class.
- Addresses: Action Class.
- Inherited by: NONE
- Addressed by: Link Class, Composite Class, Container Class.

- Sequence of (Mh-object Class, Synchro Indicator Param, Synchronised Action+, Extensibility Provision).

62.2 Synchro Indicator Param

- Parameter of Synchro Indicator.
- Choice between (Synchro Indicator, Synchro Indicator Macro).

62.3 Synchro Indicator Macro

- Allows the specification of a macro parameter instead of a specified synchro indicator value.
- Sequence of (Macro Def ID, Synchro Indicator?).

62.4 Synchro Indicator

- This parameter specifies if the following group of synchronised actions are to be performed in parallel or in sequence.
- Choice between (serial, parallel).

62.5 Synchronised Action

- Defines a recursive structure to express combination of actions. Each synchronised action within this group is either a single elementary action or another nested action object.
- Choice between (Elementary Action, Action Object).

62.6 Action Object

- The action object may be either referenced or included in the object.
- Choice between (Action Object Reference, Action Class).

63 Link class representation attributes

Table 6: Overview of Link Class representation attributes

Link Class ::= Mh-object Class, Link Condition, Link Effect, Extensibility Provision
Link Condition ::= Trigger Condition I Logical Combination
Trigger Condition ::= Source Value, Previous Condition?, Current Condition
Constraint Condition ::= Source Value, Current Condition
Source Value ::= Evaluated Value
Comparison Operation ::= Comparison Operator, Comparison Value
Comparison Value ::= Generic Value I Comparison Value Constant I *unspecified*
Previous Condition ::= Comparison Operation
Current Condition ::= Comparison Operation
Comparison Operator ::= *equal I not-equal I greater I greater-equal I less I less-equal*
Logical Combination::= Logical Operator, Condition+
Logical Operator ::= *and I or I xor I not*

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Condition ::= Trigger Condition | Constraint Condition | Logical Combination

Link Effect ::= Macro Parameter Resolution*, Action Object

Macro Parameter Resolution ::= Macro Def ID, Usage Value

Usage Value ::= Generic Value

63.1 Link Class

- The Link class provides a consistent structure for the interchange of conditional actions targeted to MHEG objects, run-time objects or channels. MHEG link objects, instances of link class, may be interchanged. A link object is directional and connects one or more sources with one or more targets. The actions defined within the link are processed on the indicated targets only if the conditions are satisfied.

- Inherits from: Mh-object class.

- Addresses: Action class.

- Inherited by: NONE

- Addressed by: Composite class, Container Class.

- Sequence of (Mh-object Class, Link Condition, Link Effect, Extensibility Provision).

63.2 Link Condition

- Defines the condition of the link. The link effect is to be performed each time the value of the link condition change to true.

- Choice between (Trigger Condition, Logical Combination).

63.3 Trigger Condition

- Defines a trigger condition which is described as a change of an attribute or status value.

- Sequence of (Source Value, Previous Condition?, Current Condition).

63.4 Constraint Condition

- Defines a constraint condition which tests a current state of a value.

- Sequence of (Source Value, Current Condition).

63.5 Source Value

- Identifies the status or attribute of an object which is to be tested in a previous or a current condition. The evaluated value is the result of a get action targeted on a single object. Otherwise the source value is "undefined".

- Evaluated Value.

63.6 Comparison Operation

- Describes a comparison operation to be performed on source value in order to fulfil a condition.

- Sequence of (Comparison Operator, Comparison Value).

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63.7 Comparison Value

- Specification of the value to be compared to the source value using the comparison operator. It is up to the object designer to ensure that the type of the current comparison value is compatible with the source value.

- Choice between (Generic Value, Comparison Value Constant, unspecified).

63.8 Previous Condition

- Defines the previous condition on the source value. If the previous condition is omitted it means that the previous condition is evaluated as: "NOT Current Condition".

- Comparison Operation.

63.9 Current Condition

- Defines the current condition on the source value.

- Comparison Operation.

63.10 Comparison Operator

- Specifies the operation to be performed to compare the source value with the comparison value.

- Choice between (equal, not-equal, greater, greater-equal, less, less-equal).

63.11 Logical Combination

- Defines a tree structure to express combination of conditions. The logical operator constitutes a node of the logical tree of conditions. The set of conditions constitutes the leaves of this tree. When the logical operator is NOT, only one condition is allowed. Any other operator shall have at least two conditions.

- Sequence of (Logical Operator, Condition+).

63.12 Logical Operator

- Defines the logical operation to be applied to compare the conditions of the node.

- Choice between (and, or, xor, not).

63.13 Condition

- Defines the conditions to which the logical operations are to be applied.

- Choice between (Trigger Condition, Constraint Condition, Logical Combination).

63.14 Link Effect

- Defines the macro resolution providing a usage value to each macro parameter and the action object to be triggered when the result of the link is fired.

- Sequence of (Macro Parameter Resolution*, Action Object).

63.15 Macro Parameter Resolution

- Associates a usage value to a Macro Def ID.

- Sequence of (Macro Def ID, Usage Value).

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63.16 Usage Value

- Assigns a usage value to a Macro Def ID. It is up to the object designer to ensure that the usage value is compatible with the parameter which has been specified using a Macro Def ID.

- Generic Value.

64 Model class representation attributes

Table 7: Overview of Model Class representation attributes

Model Class ::= Mh-object Class

64.1 Model Class

- The Model Class is an abstract class. The script class and the component class inherit this class.

- Inherits from: Mh-object class

- Addresses: NONE

- Inherited by: Script Class, Component Class

- Addressed by: NONE

- Mh-object Class.

65 Script class representation attributes

Table 8: Overview of Script Class representation attributes

Script Class::= Model Class, Script Classification?, Script Hook, Script Data, Extensibility Provision
Script Classification ::= Catalogued Script Classification
Script Data ::= Script Inclusion | Data Reference
Script Inclusion ::= *BIT STRING* | *OCTET STRING* | InterchangedScript
InterchangedScript::= *Imported from ISO/IEC 13522 sir*

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65.1 Script Class

- The Script class provides a consistent structure for the interchange of complex actions on MHEG entities. MHEG script objects, instances of script class, may be interchanged. A script object contains an indication of the script representation used and the encoded script itself. It is assumed that the script representation used in a script object is able to reference MHEG entities and access their attributes.

- Inherits from: Model class

- Addresses: NONE

- Inherited by: NONE

- Addressed by: Container class

- Sequence of (Model Class, Script Classification?, Script Hook, Script Data, Extensibility Provision).

65.2 Script Classification

- One of the catalogued script classification, it may be a registered one or a proprietary one.
- Catalogued Script Classification.

65.3 Script Data

- Encoded script according to the script representation identified by the script hook. This script data may be included in the script object itself or referenced using the external identifier or alias mechanism. A null script data may be also used.
- Choice between (Script Inclusion, Data Reference).

65.4 Script Inclusion

- The script data is included in the interchanged script object.
- Choice between (BIT STRING, OCTET STRING, InterchangedScript).

65.5 InterchangedScript

- The Interchanged Script syntax is provided by ISO/IEC 13522-3.
- Imported from ISO/IEC 13522 sir.

66 Component class representation attributes

Table 9: Overview of Component Class representation attributes

Component Class ::= Model Class, OPS Initialisation?

66.1 Component Class

- Component Class is an abstract class. The content class and the composite class inherit this class.
- Inherits from: Model class
- Addresses: NONE
- Inherited by: Content Class, Composite Class
- Addressed by: NONE
- Sequence of (Model Class, OPS Initialisation?).

67 Content class representation attributes

Table 10: Overview of Content class representation attributes

Content Class ::= Component Class, Cat Content Classification?, Content Hook, OV?, Content Data, Extensibility Provision
Content Data ::= Data Inclusion I Data Reference
Data Inclusion ::= *BIT STRING I OCTET STRING* I Generic Value

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67.1 Content Class

- The content class provides a consistent structure for the interchange of encoded data. MHEG content objects, instances of content class, may be interchanged. A content object provides the identification of the type and the interchange of data.

- Inherits from: Component Class.

- Addresses: NONE.

- Inherited by: Multiplexed Content Class.

- Addressed by: Composite Class, Container Class.

- Sequence of (Component Class, Cat Content Classification?, Content Hook, OV?, Content Data, Extensibility Provision).

67.2 Content Data

- Data encoded according to other recommendations and standards or proprietary formats. This data is included in the content object itself or referenced using alias or external identifier mechanism offered. A Null-Data may also be specified.

- The content data need not use the encoding schemes provided by International standards. The reference to content data facility allows to reference any content data encoding format.

- Choice between (Data Inclusion, Data Reference).

67.3 Data Inclusion

- The data is included in the interchanged content object.

- Choice between (BIT STRING, OCTET STRING, Generic Value).

68 Multiplexed content class representation attributes

Table 11: Overview of Multiplexed Content Class representation attributes

Multiplexed Content Class	::= Content Class, Multiplexed Stream+, Extensibility Provision
Multiplexed Stream	::= Stream ID, Cat Content Classification?, Content Hook?

68.1 Multiplexed Content Class

- The multiplexed content class provides a consistent structure for the exchange of multiplexed media data. The multiplexed content class is a model class which is a subclass of the content class. It contains or refers to the coded representation of a multiplexed media data together with a description of each multiplexed stream. A multiplexed content class represents association between a content class and an ordered list of streams describing the streams contained in the multiplexed data.

- Inherits from: Content class.

- Addresses: NONE.

- Inherited by: NONE

- Addressed by: Composite, Container classes.

- Sequence of (Content Class, Multiplexed Stream+, Extensibility Provision).

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68.2 Multiplexed Stream

- Defines a stream of the multiplexed data and specific information.
- Sequence of (Stream ID, Cat Content Classification?, Content Hook?).

69 Composite class representation attributes

Table 12: Overview of Composite Class representation attributes

Composite Class ::=
Component Class, Availability Start-up?, Availability Close-down?, Rt-Availability Start-up?, Rt-Availability Close-down?, Action Object*, Link Object*, Nb Of Elements, Composition Element*, Extensibility Provision

Availability Start-up ::=
Link Effect | *automatic-start-up-1* | *automatic-start-up-2* | *automatic start-up-3* | *automatic-start-up-4* | *automatic-start-up-5*

Availability Close-down ::=
Link Effect | *automatic-close-down-1* | *automatic-close-down-2* | *automatic-close-down-3*

Rt-Availability Start-up::= Link Effect | *automatic-rt-start-up*

Rt-Availability Close-down ::= Link Effect

Link Object ::= Link Class | Link Object Reference

Nb Of Elements::= Integer

Composition Element ::= Index, Associated Model

Element Index ::= Index

Associated Model ::=
Component Object Reference | Content Class | Multiplexed Content Class | Composite Class | Label

Label ::= String

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69.1 Composite Class

- The composite class provides a consistent approach to the synchronisation in time and space, linking, encapsulation of a set of objects and interchange of these objects. MHEG composite objects, instances of composite class, may be interchanged. A composite object addresses actions, links to describe the initial and dynamic behaviour of the component objects and the rt-objects created from these composite objects.
- Inherits from: Component class.
- Addresses: Link, Action, Content, Multiplexed Content and Composite classes.
- Inherited by: NONE.
- Addressed by: Composite class.
- Sequence of (Component Class, Availability Start-up?, Availability Close-down?, Rt-Availability Start-up?, Rt-Availability Close-down?, Action Object*, Link Object*, Nb Of Elements, Composition Element*, Extensibility Provision).

69.2 Availability Start-up

- The composite availability start-up may be used for additional preparation effect of the composite. It shall be either a personalised link effect provided by the author or one of the default link effects provided by ISO/IEC 13522-1.

- Choice between (Link Effect, automatic-start-up-1, automatic-start-up-2, automatic start-up-3, automatic-start-up-4, automatic-start-up-5).

69.3 Availability Close-down

- The composite close-down start-up may be used for additional destruction effect of the composite. It is either a personalised link effect provided by the author or one of the default link effects provided by ISO/IEC 13522-1.

- Choice between (Link Effect, automatic-close-down-1, automatic-close-down-2, automatic-close-down-3).

69.4 Rt-Availability Start-up

- The rt-availability start-up may be used for additional creation effect of the rt-composite. It is either a personalised link effect provided by the author or the default link effect provided by ISO/IEC 13522-1.

- Choice between (Link Effect, automatic-rt-start-up).

69.5 Rt-Availability Close-down

- The rt-availability close-down may be used for additional destruction effect of the rt-composite. It is always a personalised link effect provided by the author.

- Link Effect.

69.6 Link Object

- Link object used to describe the behaviour of each element and the interrelationships among parent and siblings. The link object may be either referenced or included in the composite object.

- Choice between (Link Class, Link Object Reference).

69.7 Nb Of Elements

- Indicates the number of elements within the composition.

- Integer.

69.8 Composition Element

- Defines the internal structure of the composite. This structure provides a support for created rt-composites. If no elements are included, the MHEG Engine should consider that the composite has "Nb Of Elements" empty elements. If the last element has an index lower than "Nb Of Elements", the MHEG Engine should consider that empty elements are repeated from the last element until the "Nb Of Element" element. Each element has an index and refers a model component object or a label. The component object may be interchanged included in this composite object or externally. The label shall be included. Empty elements are not encoded but are implicitly generated by the MHEG Engine.

- Sequence of (Index, Associated Model).

69.9 Element Index

- Index of the associated model unique within a composite.

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- Index.

69.10 Associated Model

- The element addresses or includes a component object or a label.

- Choice between (Component Object Reference, Content Class, Multiplexed Content Class, Composite Class, Label).

69.11 Label

- A label is a string which represent a reference on a component.

- String.

70 Container class representation attributes

Table 13: Overview of Container Class representation attributes

Container Class ::= Mh-object Class, Container Start-up?, Container Close-down?, Container Element+, Extensibility Provision
Container Start-up ::= Link Effect | *automatic-container-start-up-1* | *automatic-container-start-up-2* | *automatic-container-start-up-3* | *automatic-container-start-up-4* | *automatic-container-start-up-5* | *automatic-container-start-up-6* | *automatic-container-start-up-7* | *automatic-container-start-up-8*
Container Close-down ::= Link Effect | *automatic-container-close-down*
Container Element ::= Mh-Reference | Action Class | Link Class | Script Class | Content Class | Multiplexed Content Class | Composite Class | Container Class | Descriptor Class | Extensibility Provision

70.1 Container Class

- The container class provides a consistent structure for the handling of multimedia and hypermedia information. This grouping is intended to facilitate the interchange in order to obtain a unit set of interchange. Defines the elements of the container to be exchanged. The indexes of the components need not be encoded because the elements are numbered from 1 to n by the MHEG Engine.

- Inherits from: MH Object class.

- Addresses: Link, Action, Script, Content, Multiplexed Content, Composite, Descriptor and Container classes.

- Inherited by: NONE

- Addressed by: NONE.

- Sequence of (Mh-object Class, Container Start-up?, Container Close-down?, Container Element+, Extensibility Provision).

70.2 Container Start-up

- The container start-up may be used for additional preparation effect of the container. It is either a personalised link effect provided by the author or one of the default link effects provided by ISO/IEC 13522-1.

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- Choice between (Link Effect, automatic-container-start-up-1, automatic-container-start-up-2, automatic-container-start-up-3, automatic-container-start-up-4, automatic-container-start-up-5, automatic-container-start-up-6, automatic-container-start-up-7, automatic-container-start-up-8).

70.3 Container Close-down

- The container availability close-down may be used for additional destruction effect of the container. It is either a personalised link effect provided by the author or the default link effect provided by ISO/IEC 13522-1.

- Choice between (Link Effect, automatic-container-close-down).

70.4 Container Element

- A container element is an included objet that may be included or referenced in the container in order to be interchanged.

- Choice between (Mh-Reference, Action Class, Link Class, Script Class, Content Class, Multiplexed Content Class, Composite Class, Container Class, Descriptor Class, Extensibility Provision).

71 Descriptor class representation attributes

Table 14: Overview of Descriptor Class representation attributes

Descriptor Class ::=
Mh-object Class, Related Object*, Other Descriptor*, Readme?, System Readable Material?, Channel Information*, Catalogued Style Information*, Cat Ext elementary action Info*, Cat Ext Attribute Info*, Extensibility Provision

Related Object ::= Mh-Reference, Object Information?

Object Information ::= Object Size?, Class ID, Class Specific Information?, Offset?

Object Size ::= Integer

Class Specific Information ::= Script Class Information | Content Class Information | Mux Content Class Info

Script Class Information ::= Script Classification?, Script Hook?

Content Class Information ::= Cat Content Classification?, Content Hook?, Alternative Object*

Mux Content Class Info ::= Content Class Information, Number Of Streams?, Stream Information*

Number Of Streams ::= Integer

Stream Information ::= Stream ID, Content Class Information

Alternative Object ::= Content Object Ref, Content Hook?, Alternative Descriptor Object?, Alternative Readme?

Alternative Descriptor Object ::= Descriptor Object Reference

Alternative Readme ::= String

Offset ::= Integer

Other Descriptor ::= Descriptor Object Reference

Readme ::= String

System Readable Material ::= *BIT STRING | OCTET STRING*

Channel Information ::=
Channel ID, X min?, X max?, Y min?, Y max?, Z min?, Z max?, X Resolution?, Y Resolution?, Z Resolution?, T Resolution?, F min?, F max?, Audio Dynamic?, Channel Media Type*, Event Mapping*

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X min ::= Integer

X max ::= Integer

Y min ::= Integer

Y max ::= Integer

Z min ::= Integer

Z max ::= Integer

X Resolution ::= Integer

Y Resolution ::= Integer

Z Resolution ::= Integer

T Resolution ::= Integer

F min ::= Integer

F max ::= Integer

Audio Dynamic ::= Integer

Channel Media Type ::= Catalogued Media Type

Event Mapping ::= Event, Catalogued Event?

Catalogued Style Information ::= Catalogued Style

Cat Ext elementary action Info ::= Catalogued Extended Elementary Action

Cat Ext Attribute Info ::= Cat Ext Attribute

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71.1 Descriptor Class

- The descriptor class is used to describe a description of objects that are to be interchanged. It provide support information for the negotiation, installation, operation and management of applications that interchange MHEG objects. MHEG descriptor objects, instances of descriptor class, may be interchanged.

- Sequence of (Mh-object Class, Related Object*, Other Descriptor*, Readme?, System Readable Material?, Channel Information*, Catalogued Style Information*, Cat Ext elementary action Info*, Cat Ext Attribute Info*, Extensibility Provision).

71.2 Related Object

- Specifies the scope of the descriptor, i.e. the list of MHEG objects concerned by this descriptor.

- Sequence of (Mh-Reference, Object Information?).

71.3 Object Information

- Provides additional information on a related object.

- Sequence of (Object Size?, Class ID, Class Specific Information?, Offset?).

71.4 Object Size

- Size of the related encoded object in octets.

- Integer.

71.5 Class Specific Information

- Provides additional specific information on the class.
- Choice between (Script Class Information, Content Class Information, Mux Content Class Info).

71.6 Script Class Information

- Carries information specific to the script class.
- Sequence of (Script Classification?, Script Hook?).

71.7 Content Class Information

- Carries information specific to the content class
- Sequence of (Cat Content Classification?, Content Hook?, Alternative Object*).

71.8 Mux Content Class Info

- Carries information specific to the multiplexed content class.
- Sequence of (Content Class Information, Number Of Streams?, Stream Information*).

71.9 Number Of Streams

- Indicates the number of sub-streams.
- Integer.

71.10 Stream Information

- Further information regarding a stream.
- Sequence of (Stream ID, Content Class Information).

71.11 Alternative Object

- Provides information about alternative objects that an MHEG Engine may use instead of the related object.
- Sequence of (Content Object Ref, Content Hook?, Alternative Descriptor Object?, Alternative Readme?).

71.12 Alternative Descriptor Object

- References the alternative descriptor where the alternative objects are described.
- Descriptor Object Reference.

71.13 Alternative Readme

- Identifies the nature of the alternative object.
- String.

71.14 Offset

- Provides a relative position in octets of an encoded object that is included in another encoded object.
- Integer.

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71.15 Other Descriptor

- Specifies a reference to another descriptor object.
- Descriptor Object Reference.

71.16 Readme

- Provides readable text for human users.
- String.

71.17 System Readable Material

- Provides information used by application or system software.
- Choice between (BIT STRING, OCTET STRING).

71.18 Channel Information

- Contains information to handle a channel.
- Sequence of (Channel ID, X min?, X max?, Y min?, Y max?, Z min?, Z max?, X Resolution?, Y Resolution?, Z Resolution?, T Resolution?, F min?, F max?, Audio Dynamic?, Channel Media Type*, Event Mapping*).

71.19 X min

- Defines the minimum X axis value for the device on which this channel is to be mapped.
- Integer.

71.20 X max

- Defines the maximum X axis value for the device on which this channel is to be mapped.
- Integer.

71.21 Y min

- Defines the minimum Y axis value for the device on which this channel is to be mapped.
- Integer.

71.22 Y max

- Defines the maximum Y axis value for the device on which this channel is to be mapped.
- Integer.

71.23 Z min

- Defines the minimum Z axis value for the device on which this channel is to be mapped.
- Integer.

71.24 Z max

- Defines the maximum Z axis value for the device on which this channel is to be mapped.

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- Integer.

71.25 X Resolution

- Number of addressable spatial physical units on the X axis.
- Integer.

71.26 Y Resolution

- Number of addressable spatial physical units on the Y axis.
- Integer.

71.27 Z Resolution

- Number of addressable spatial physical units on the Z axis.
- Integer.

71.28 T Resolution

- Number of addressable spatial physical units in one second on the T axis.
- Integer.

71.29 F min

- Defines the minimum presentable frequency for the device to which this channel is to be mapped.
- Integer.

71.30 F max

- Defines the maximum presentable frequency for the device to which this channel is to be mapped.
- Integer.

71.31 Audio Dynamic

- Defines the dynamics for the audio device to which the channel is to be mapped. The units are dB.
- Integer.

71.32 Channel Media Type

- Specifies the type of media of the channel, it is one of the catalogued value which may be either registered or proprietary.
- Catalogued Media Type.

71.33 Event Mapping

- Specifies the expected events and their mapping on a catalogued event.
- Sequence of (Event, Catalogued Event?).

71.34 Catalogued Style Information

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- Specifies which style is used by the related objects.
- Catalogued Style.

71.35 Cat Ext Elementary Action Info

- Specifies which catalogued elementary action is used by the related objects.
- Catalogued Extended Elementary Action.

71.36 Cat Ext Attribute Info

- Specifies which extended attribute is used by the related objects.
- Cat Ext Attribute.

72 Behaviours

72.1 Postpone behaviour

Table 15: Overview of Postpone behaviour

Delay ::= Temporal Unit Ref Param, Duration Param
Temporal Unit Ref Param ::= Temporal Unit Ref I Temporal Unit Ref Macro
Temporal Unit Ref Macro ::= Macro Def ID, Temporal Unit Ref?
Temporal Unit Ref ::= Rt-Component Reference I default-GF
Duration Param::= Generic Integer Param

72.1.1 Delay

- This action is used to request the MHEG Engine to delay the processing of further actions.
- Sequence of (Temporal Unit Ref Param, Duration Param).

72.1.2 Temporal Unit Ref Param

- Parameter of Temporal Unit Ref.
- Choice between (Temporal Unit Ref, Temporal Unit Ref Macro).

72.1.3 Temporal Unit Ref Macro

- Allows the specification of a macro parameter instead of a specified Temporal Unit Ref value.
- Sequence of (Macro Def ID, Temporal Unit Ref?).

72.1.4 Temporal Unit Ref

- Defines how to retrieve the GTF in order to interpret the delay.
- Choice between (Rt-Component Reference, default-GF).

72.1.5 Duration Param

- The duration of the delay expressed in GTU.
- Generic Integer Param.

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72.2 Returnability behaviour

Table 16: Overview of Returnability behaviour

Return ::= Return Target Param+, Return Indicator Param, Returned Generic Value Param*, Content Object Ref Param*
Return Indicator Param ::= Generic Numeric Param
Returned Generic Value Param ::= Generic Value Param
Content Object Ref Param ::= Content Object Ref | Content Object Ref Macro
Content Object Ref Macro ::= Macro Def ID, Content Object Ref?

72.2.1 Return

- This action is used to request the MHEG Engine to return information to a using application or to entities outside the MHEG Engine.

- Sequence of (Return Target Param+, Return Indicator Param, Returned Generic Value Param*, Content Object Ref Param*).

72.2.2 Return Indicator Param

- Generic numeric used by an application or other entities outside of the MHEG Engine to distinguish the returned information.

- Generic Numeric Param.

72.2.3 Returned Generic Value Param

- A list of generic values to be returned.

- Generic Value Param.

72.2.4 Content Object Ref Param

- A list of content objects to be returned.

- Choice between (Content Object Ref, Content Object Ref Macro).

72.2.5 Content Object Ref Macro

- Allows the specification of a macro parameter instead of a specified Content Object Ref value.

- Sequence of (Macro Def ID, Content Object Ref?).

72.3 Alias behaviour

Table 17: Overview of Alias behaviour

Set Alias ::= Target Param+, Alias Spec Param+
Alias Spec Param ::= Alias Spec | Alias Spec Macro
Alias Spec Macro ::= Macro Def ID, Alias Spec?
Alias Spec ::= Alias+, Update Command

72.3.1 Set Alias

- This action is used to assign aliases to any generic references.

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- Sequence of (Target Param+, Alias Spec Param+).

72.3.2 Alias Spec Param

- Parameter of Alias Spec.
- Choice between (Alias Spec, Alias Spec Macro).

72.3.3 Alias Spec Macro

- Allows the specification of a macro parameter instead of a specified alias spec value.
- Sequence of (Macro Def ID, Alias Spec?).

72.3.4 Alias Spec

- Aliases and specification of the update command to be applied.
- Sequence of (Alias+, Update Command).

72.4 Extensibility behaviour

Table 18: Overview of Extensibility behaviour

Catalogued Elementary Action ::= Target Param+, Catalogued Extended Elementary Action Param, Elementary Action Param*
Catalogued Extended Elementary Action Param ::= Catalogued Extended Elementary Action | Catalogued Extended Elementary Action Macro
Catalogued Extended Elementary Action Macro ::= Macro Def ID, Catalogued Extended Elementary Action?
Elementary Action Param ::= Generic Value Param
Set Catalogued Attribute ::= Target Param+, Cat Ext Attribute Param, Ext Attribute Value Param, Transition Duration Param?
Ext Attribute Value Param ::= Generic Value Param

72.4.1 Catalogued Elementary Action

- This action enables to use an extended elementary action which is registered or proprietary.
- Sequence of (Target Param+, Catalogued Extended Elementary Action Param, Elementary Action Param*).

72.4.2 Catalogued Extended Elementary Action Param

- Parameter of catalogued extended elementary action.
- Choice between (Catalogued Extended Elementary Action, Catalogued Extended Elementary Action Macro).

72.4.3 Catalogued Extended Elementary Action Macro

- Allows the specification of a macro parameter instead of a specified catalogued extended elementary action value.
- Sequence of (Macro Def ID, Catalogued Extended Elementary Action?).

72.4.4 Elementary Action Param

- Used to interchange the specific parameters of the catalogued extended elementary action.
- Generic Value Param.

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72.4.5 Set Catalogued Attribute

- This action is used to set a value of a catalogued attributes for the target.
- Sequence of (Target Param+, Cat Ext Attribute Param, Ext Attribute Value Param, Transition Duration Param?).

72.4.6 Ext Attribute Value Param

- A generic value to be assigned to a cat ext attribute.
- Generic Value Param.

72.5 Availability behaviour of MHEG objects

Table 19: Overview of Availability behaviour of MHEG objects

Prepare ::= Mh-Target Param+
Destroy ::= Mh-Target Param+

72.5.1 Prepare

- This action is used to make the target MHEG objects available to the MHEG Engine.
- List of (Mh-Target Param).

72.5.2 Destroy

- This action is used to removes the target MHEG objects from the MHEG Engine.
- List of (Mh-Target Param).

72.6 Link object activation behaviour

Table 20: Overview of Link object activation behaviour

Activate ::= Link Target Param+
Deactivate::= Link Target Param+

72.6.1 Activate

- This action is used to make the targert link objects active.
- List of (Link Target Param).

72.6.2 Deactivate

- This action is used to make the target link objects inactive.
- List of (Link Target Param).

72.7 Link object abort behaviour

Table 21: Overview of link object abort behaviour

Link Abort ::= Link Target Param+

72.7.1 Link Abort

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- This action is used to abort processing of the target links specified in the target set.

- List of (Link Target Param).

72.8 Content class generic value storage behaviour

Table 22: Overview of Content Class generic value storage behaviour

Set Data ::= Content Target Param+, Substitution Indicator Param, Data Element Param*
Substitution Indicator Param ::= Substitution Indicator | Substitution Indicator Macro
Substitution Indicator Macro ::= Macro Def ID, Substitution Indicator?
Substitution Indicator ::= *substitution / no-substitution*
Data Element Param ::= Data Element | Data Element Macro
Data Element Macro ::= Macro Def ID, Data Element?
Data Element ::= Process Indicator, Generic List Elt ID?, Generic Value
Process Indicator ::= *process / no-process*
Add ::= Content Target Param+, Generic List Elt ID Param?, Generic Value Param?
Substract ::= Content Target Param+, Generic List Elt ID Param?, Generic Value Param?

72.8.1 Set Data

- Stores or to modify the generic value of the target content objects.
- Sequence of (Content Target Param+, Substitution Indicator Param, Data Element Param*).

72.8.2 Substitution Indicator Param

- Parameter of substitution indicator.
- Choice between (Substitution Indicator, Substitution Indicator Macro).

72.8.3 Substitution Indicator Macro

- Allows the specification of a macro parameter instead of a specified substitution indicator value.
- Sequence of (Macro Def ID, Substitution Indicator?).

72.8.4 Substitution Indicator

- Indicates wether the provided data is to be substituted to the existing data.
- Choice between (substitution, no-substitution).

72.8.5 Data Element Param

- Parameter of data element.
- Choice between (Data Element, Data Element Macro).

72.8.6 Data Element Macro

- Allows the specification of a macro parameter instead of a specified data element value.
- Sequence of (Macro Def ID, Data Element?).

72.8.7 Data Element

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- Indicates a data to be stored.
- Sequence of (Process Indicator, Generic List Elt ID?, Generic Value).

72.8.8 Process Indicator

- Indicates whether the data is to be processed before being store.
- Choice between (process, no-process).

72.8.9 Add

- This action is used to add a generic numeric, generic integer or generic ratio to a content data.
- Sequence of (Content Target Param+, Generic List Elt ID Param?, Generic Value Param?).

72.8.10 Substract

- This action is used to substract a generic numeric, generic integer or generic ratio from a content data.
- Sequence of (Content Target Param+, Generic List Elt ID Param?, Generic Value Param?).

72.9 Content class copy behaviour

Table 23: Overview of Content Class copy behaviour

Copy ::= Content Target Param, Destination Param+
Destination Param ::= Content Target Param

72.9.1 Copy

- This action is used to copy a target content object to a set of content object described in destination parameter.
- Sequence of (Content Target Param, Destination Param+).

72.9.2 Destination Param

- Content objects to which the target data are to be copied.
- Content Target Param.

72.10 Rt-objects availability behaviour

Table 24: Overview of Rt-objects availability behaviour

New ::= Rt-Target Param+
Delete ::= Rt-Target Param+

72.10.1 New

- This action is used to request creation of the target rt-objects from model objects by the MHEG Engine.
- List of (Rt-Target Param).

72.10.2 Delete

- This action is used to request removing of the target rt-objects from the MHEG Engine. This may be used to release resources.
- List of (Rt-Target Param).

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72.11 Rt-objects running behaviour

Table 25: Overview of Rt-objects running behaviour

Run ::= Rt-Target Param+, Number Of Performances Param?
Number Of Performances Param ::= Number Of Performances | Number Of Performances Macro
Number Of Performances Macro ::= Macro Def ID, Number Of Performances?
Number Of Performances ::= Generic Integer | *infinite*
Stop ::= Rt-Target Param+

72.11.1 Run

- This action is used to request the presentation of the target rt-objects by the presentation process.
- Sequence of (Rt-Target Param+, Number Of Performances Param?).

72.11.2 Number Of Performances Param

- Parameter of number of performances.
- Choice between (Number Of Performances, Number Of Performances Macro).

72.11.3 Number Of Performances Macro

- Allows the specification of a macro parameter instead of a specified number of performances value.
- Sequence of (Macro Def ID, Number Of Performances?).

72.11.4 Number Of Performances

- Specifies the number of performances.
- Choice between (Generic Integer, infinite).

72.11.5 Stop

- This action is used to set the running status to "not running" and stops possible user effects.
- List of (Rt-Target Param).

72.12 Rt-script passing parameter behaviour

Table 26: Overview of Rt-script passing parameter behaviour

Set Parameters ::= Rt-Script Target Param+, Passing Param*
Passing Param ::= Passing | Passing Macro
Passing Macro ::= Macro Def ID, Passing?
Passing ::= Generic Value | Content Object Ref

72.12.1 Set Parameters

- This action is used to request passing of parameters to the target rt-script.
- Sequence of (Rt-Script Target Param+, Passing Param*).

72.12.2 Passing Param

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- Parameter of passing.
- Choice between (Passing, Passing Macro).

72.12.3 Passing Macro

- Allows the specification of a macro parameter instead of a specified passing value.
- Sequence of (Macro Def ID, Passing?).

72.12.4 Passing

- Parameters to be passed to an rt-script.
- Choice between (Generic Value, Content Object Ref).

72.13 Sockets presentation and structural dynamism behaviour

Table 27: Overview of Sockets presentation and structural dynamism behaviour

Plug ::= Socket Target Param+, Plug In Param
Plug In Param ::= Plug In | Plug In Macro
Plug In Macro::= Macro Def ID, Plug In?
Plug In ::= Rt-Component Reference | Component Object Reference | Label | Evaluated Reference

72.13.1 Plug

- This action is used to attach an rt-component or a label to the target socket.
- Sequence of (Socket Target Param+, Plug In Param).

72.13.2 Plug In Param

- Parameter of plug in.
- Choice between (Plug In, Plug In Macro).

72.13.3 Plug In Macro

- Allows the specification of a macro parameter instead of a specified plug in value.
- Sequence of (Macro Def ID, Plug In?).

72.13.4 Plug In

- Specifies the information to be plugged into a socket.
- Choice between (Rt-Component Reference, Component Object Reference, Label, Evaluated Reference).

72.14 Rt-components RPS assignment behaviour

Table 28: Overview of Rt-components RPS assignment behaviour

Set RPS Assignment::= Rt-Component Target Param+, RPS Assignment Param
RPS Assignment Param ::= RPS Assignment | RPS Assignment Macro
RPS Assignment Macro ::= Macro Def ID, RPS Assignment?

72.14.1 Set RPS Assignment

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- This action is used to set the RPS assignment of the target rt-components.
- Sequence of (Rt-Component Target Param+, RPS Assignment Param).

72.14.2 RPS Assignment Param

- Parameter of RPS Assignment.
- Choice between (RPS Assignment, RPS Assignment Macro).

72.14.3 RPS Assignment Macro

- Allows the specification of a macro parameter instead of a specified RPS Assignment value.
- Sequence of (Macro Def ID, RPS Assignment?).

72.15 Rt-components perceptability behaviour

Table 29: Overview of Rt-components perceptability behaviour

Set Perceptability ::= Rt-Component Target Param+, Perceptability Param, Transition Duration Param?
Perceptability Param ::= Generic Ratio Param
Set Presentation Priority ::= Rt-Component Target Param+, Presentation Priority Param, Transition Duration Param?
Presentation Priority Param ::= Presentation Priority | Presentation Priority Macro
Presentation Priority Macro ::= Macro Def ID, Presentation Priority?

72.15.1 Set Perceptability

- This action is used to change the perceptability of the target rt-components or root rt-components.
- Sequence of (Rt-Component Target Param+, Perceptability Param, Transition Duration Param?).

72.15.2 Perceptability Param

- Perceptability to be assigned to rt-component.
- Generic Ratio Param.

72.15.3 Set Presentation Priority

- This action is used to change the presentation priority of of the target rt-components or root rt-components.
- Sequence of (Rt-Component Target Param+, Presentation Priority Param, Transition Duration Param?).

72.15.4 Presentation Priority Param

- Parameter of presentation priority.
- Choice between (Presentation Priority, Presentation Priority Macro).

72.15.5 Presentation Priority Macro

- Allows the specification of a macro parameter instead of a specified presentation priority value.
- Sequence of (Macro Def ID, Presentation Priority?).

72.16 Rt-components temporal behaviour

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Table 30: Overview of Rt-components temporal behaviour

Set OVD ::= Rt-Component Target Param+, Initial Point Spec Param, Terminal Point Spec Param
Set CTP ::= Rt-Component Target Param+, Current Point Spec Param
Set Temporal Termination ::= Rt-Target Param+, Temporal Termination Param
Temporal Termination Param ::= Temporal Termination I Temporal Termination Macro
Temporal Termination Macro ::= Macro Def ID, Temporal Termination?
Set PVD Position ::= Socket Target Param+, Temporal Position Param
Temporal Position Param ::= Point Spec Param
Set GTF ::= Rt-Component Target Param+, GTF Param
GTF Param ::= GF Param
Set Timestones ::= Rt-Component Target Param+, Timestone Spec Param+
Timestone Spec Param ::= Timestone Spec I Timestone Spec Macro
Timestone Spec Macro ::= Macro Def ID, Timestone Spec?
Timestone Spec ::= Timestone+, Update Command
Timestone ::= Timestone ID, Timestone Position, Number Of Repetitions
Timestone Position ::= Point Spec
Number Of Repetitions ::= Generic Integer I *infinite*

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72.16.1 Set OVD

- This action is used to specify an OVD within an OD. The first point spec parameter specifies the initial temporal position of the OVD, the second specifies its terminal temporal position.
- Sequence of (Rt-Component Target Param+, Initial Point Spec Param, Terminal Point Spec Param).

72.16.2 Set CTP

- This action is used to specify the CTP within the OVD.
- Sequence of (Rt-Component Target Param+, Current Point Spec Param).

72.16.3 Set Temporal Termination

- This action is used to specify the action to be performed once the terminal temporal position of the rt-component is reached.
- Sequence of (Rt-Target Param+, Temporal Termination Param).

72.16.4 Temporal Termination Param

- Parameter of temporal termination.
- Choice between (Temporal Termination, Temporal Termination Macro).

72.16.5 Temporal Termination Macro

- Allows the specification of a macro parameter instead of a specified temporal termination value.
- Sequence of (Macro Def ID, Temporal Termination?).

72.16.6 Set PVD Position

- This action is used to bind child PVDs to their parent OVD.
- Sequence of (Socket Target Param+, Temporal Position Param).

72.16.7 Temporal Position Param

- The temporal position parameter is used to specify temporal position either by an absolute value along a temporal axis or a relative value against a temporal duration.
- Point Spec Param.

72.16.8 Set GTF

- This action is used to specify the presentation speed of an rt-component.
- Sequence of (Rt-Component Target Param+, GTF Param).

72.16.9 GTF Param

- Generic ratio or default-GF.
- GF Param.

72.16.10 Set Timestones

- This action is used to specifies a set of timestones to be set within the OD of the target
- Sequence of (Rt-Component Target Param+, Timestone Spec Param+).

72.16.11 Timestone Spec Param

- Parameter of timestone spec.
- Choice between (Timestone Spec, Timestone Spec Macro).

72.16.12 Timestone Spec Macro

- Allows the specification of a macro parameter instead of a specified timestone spec value.
- Sequence of (Macro Def ID, Timestone Spec?).

72.16.13 Timestone Spec

- A set of timestones and the update commands to be applied.
- Sequence of (Timestone+, Update Command).

72.16.14 Timestone

- A pair of a timestone identifier and a timestone position and the number of repetitions.
- Sequence of (Timestone ID, Timestone Position, Number Of Repetitions).

72.16.15 Timestone Position

- Specified by point specification.
- Point Spec.

72.16.16 Number Of Repetitions

- Specifies the number of repetitions.
- Choice between (Generic Integer, infinite).

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72.17 Rt-components spatial behaviour

Table 31: Overview of Rt-components spatial behaviour

Set Aspect Ratio ::= Rt-Component Target Param+, Aspect Ratio Param
Aspect Ratio Param ::= Aspect Ratio | Aspect Ratio Macro
Aspect Ratio Macro ::= Macro Def ID, Aspect Ratio?
Set Resizing Strategy ::= Rt-Composite Target Param+, Resizing Strategy Param
Resizing Strategy Param ::= Resizing Strategy | Resizing Strategy Macro
Resizing Strategy Macro ::= Macro Def ID, Resizing Strategy?
Set OVS Proj Strategy ::= Rt-Component Target Param+, OVS Proj Strategy Param
OVS Proj Strategy Param ::= OVS Proj Strategy | OVS Proj Strategy Macro
OVS Proj Strategy Macro ::= Macro Def ID, OVS Proj Strategy?
Set OVS ::= Rt-Component Target Param+, Size Spec Param, Transition Duration Param?
Set OAP ::= Rt-Component Target Param+, OAP Param
OAP Param ::= Spatial Position Spec Param
Set OVS Position ::= Rt-Component Target Param+, OVS Position Param, Transition Duration Param?
OVS Position Param ::= Spatial Position Spec Param
Set PAP ::= Rt-Component Target Param+, PAP Param
PAP Param ::= Spatial Position Spec Param
Set PVS Position ::= Rt-Component Target Param+, PVS Position Param, Transition Duration Param?
PVS Position Param ::= Spatial Position Spec Param
Set GSF ::= Rt-Component Target Param+, GSF Param, Transition Duration Param?
GSF Param ::= GF Param
Set User Spatial Control ::= Rt-Component Target Param+, Spatial Control Param+, User Spatial Control Param
User Spatial Control Param ::= User Spatial Control | User Spatial Control Macro
User Spatial Control Macro ::= Macro Def ID, User Spatial Control?

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72.17.1 Set Aspect Ratio

- This action is used to specify whether the OS is projected with its aspect ratio preserved or not.
- Sequence of (Rt-Component Target Param+, Aspect Ratio Param).

72.17.2 Aspect Ratio Param

- This action is used to specify the aspect ratio preservation.
- Choice between (Aspect Ratio, Aspect Ratio Macro).

72.17.3 Aspect Ratio Macro

- Allows the specification of a macro parameter instead of a specified aspect ratio value.
- Sequence of (Macro Def ID, Aspect Ratio?).

72.17.4 Set Resizing Strategy

- This action is used to specify the OS resizing strategy of an rt-composite.
- Sequence of (Rt-Composite Target Param+, Resizing Strategy Param).

72.17.5 Resizing Strategy Param

- This action is used to specify the resizing strategy.
- Choice between (Resizing Strategy, Resizing Strategy Macro).

72.17.6 Resizing Strategy Macro

- Allows the specification of a macro parameter instead of a specified resizing strategy value.
- Sequence of (Macro Def ID, Resizing Strategy?).

72.17.7 Set OVS Proj Strategy

- This action is used to specify the OVS Proj Strategy.
- Sequence of (Rt-Component Target Param+, OVS Proj Strategy Param).

72.17.8 OVS Proj Strategy Param

- Parameter of OVS Proj Strategy.
- Choice between (OVS Proj Strategy, OVS Proj Strategy Macro).

72.17.9 OVS Proj Strategy Macro

- Allows the specification of a macro parameter instead of a specified OVS Proj Strategy value.
- Sequence of (Macro Def ID, OVS Proj Strategy?).

72.17.10 Set OVS

- This action is used to set the OVS directly or indirectly depending on the OVS Proj Strategy attribute.
- Sequence of (Rt-Component Target Param+, Size Spec Param, Transition Duration Param?).

72.17.11 Set OAP

- This action is used to set the OAP of an rt-component. The OAP shall be specified within the OVS.
- Sequence of (Rt-Component Target Param+, OAP Param).

72.17.12 OAP Param

- May be specified as an absolute value or a relative value.
- Spatial Position Spec Param.

72.17.13 Set OVS Position

- This action is used to specify the position of the OVS relatively to the OS.
- Sequence of (Rt-Component Target Param+, OVS Position Param, Transition Duration Param?).

72.17.14 OVS Position Param

- May be specified as an absolute value or a relative value.
- Spatial Position Spec Param.

72.17.15 Set PAP

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- This action is used to set the PAP of an rt-component. The PAP shall be specified within the PVS.
- Sequence of (Rt-Component Target Param+, PAP Param).

72.17.16 PAP Param

- May be specified as an absolute value or a relative value.
- Spatial Position Spec Param.

72.17.17 Set PVS Position

- This action is used to specify the position of the PVS relatively to the OS of the RPS.
- Sequence of (Rt-Component Target Param+, PVS Position Param, Transition Duration Param?).

72.17.18 PVS Position Param

- May be specified as an absolute value or a relative value.
- Spatial Position Spec Param.

72.17.19 Set GSF

- This action is used to set the GSF of the target.
- Sequence of (Rt-Component Target Param+, GSF Param, Transition Duration Param?).

72.17.20 GSF Param

- A generic ratio
- GF Param.

72.17.21 Set User Spatial Control

- This action is used to set one of the user spatial controls.
- Sequence of (Rt-Component Target Param+, Spatial Control Param+, User Spatial Control Param).

72.17.22 User Spatial Control Param

- Choice between "allowed" and "not allowed".
- Choice between (User Spatial Control, User Spatial Control Macro).

72.17.23 User Spatial Control Macro

- Allows the specification of a macro parameter instead of a specified user spatial control value.
- Sequence of (Macro Def ID, User Spatial Control?).

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72.18 Rt-components audible behaviour

Table 32: Overview of Rt-components audible behaviour

Set CV ::= Rt-Content Target Param+, CV Param, Transition Duration Param?
CV Param ::= Current Point Spec Param
Set GVF ::= GVF Target, GVF Param, Transition Duration Param?
GVF Target ::= Rt-Composite Targets Param I Channel Targets Param
Rt-Composite Targets Param ::= Rt-Composite Target Param+

Channel Targets Param ::= Channel Target Param+
GVF Param ::= GF Param

72.18.1 Set CV

- This action is used to specify the CV of an rt-content.
- Sequence of (Rt-Content Target Param+, CV Param, Transition Duration Param?).

72.18.2 CV Param

- Specified as an absolute value, a relative value, an original point factor or a current point factor.
- Current Point Spec Param.

72.18.3 Set GVF

- This action specifies the GVF of an rt-composite or a channel.
- Sequence of (GVF Target, GVF Param, Transition Duration Param?).

72.18.4 GVF Target

- Targets for GVF.
- Choice between (Rt-Composite Targets Param, Channel Targets Param).

72.18.5 Rt-Composite Targets Param

- Targets for GVF.
- List of (Rt-Composite Target Param).

72.18.6 Channel Targets Param

- Targets for GVF.
- List of (Channel Target Param).

72.18.7 GVF Param

- GVF value to be assigned.
- GF Param.

72.19 Rt-mux stream choice behaviour

Table 33: Overview of Rt-mux stream choice behaviour

Set Stream Choice ::= Rt-Mux Target Param+, Stream Spec Param*
Stream Spec Param ::= Stream Spec | Stream Spec Macro
Stream Spec Macro ::= Macro Def ID, Stream Spec?
Stream Spec ::= Stream ID Reference*, Update Command

72.19.1 Set Stream Choice

- This action specifies a list of streams to be chosen in the multiplexed data and to be assigned to the target.
- Sequence of (Rt-Mux Target Param+, Stream Spec Param*).

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72.19.2 Stream Spec Param

- Parameter of stream spec.
- Choice between (Stream Spec, Stream Spec Macro).

72.19.3 Stream Spec Macro

- Allows the specification of a macro parameter instead of a specified stream spec value.
- Sequence of (Macro Def ID, Stream Spec?).

72.19.4 Stream Spec

- Combination of a list of stream ID and an update command.
- Sequence of (Stream ID Reference*, Update Command).

72.20 Interaction behaviour

Table 34: Overview of Interaction behaviour

Interaction Status Param	::= Interaction Status | Interaction Status Macro
Interaction Status Macro	::= Macro Def ID, Interaction Status?
Min Interact Required Param	::= Min Interact Required | Min Interact Required Macro
Min Interact Required Macro	::= Macro Def ID, Min Interact Required?
Max Interact Required Param	::= Max Interact Required | Max Interact Required Macro
Max Interact Required Macro	::= Macro Def ID, Max Interact Required?
Set Interaction Ability	::= Rt-Component Target Param+, Interaction Type Param, Min Interact Required Param, Max Interact Required Param
Set Interaction Status	::= Rt-Component Target Param+, Interaction Type Param, Interaction Status Param

72.20.1 Interaction Status Param

- Parameter of interaction status.
- Choice between (Interaction Status, Interaction Status Macro).

72.20.2 Interaction Status Macro

- Allows the specification of a macro parameter instead of a specified interaction status value.
- Sequence of (Macro Def ID, Interaction Status?).

72.20.3 Min Interact Required Param

- Parameter of min interact required.
- Choice between (Min Interact Required, Min Interact Required Macro).

72.20.4 Min Interact Required Macro

- Allows the specification of a macro parameter instead of a specified min interact required value.
- Sequence of (Macro Def ID, Min Interact Required?).

72.20.5 Max Interact Required Param

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- An integer greater than or equal to 0 to indicate the minimum interaction required for an rt-component.
- Choice between (Max Interact Required, Max Interact Required Macro).

72.20.6 Max Interact Required Macro

- Allows the specification of a macro parameter instead of a specified max interact required value.
- Sequence of (Macro Def ID, Max Interact Required?).

72.20.7 Set Interaction Ability

- This action may be targeted to rt-components to initialise or modify their interactivity behaviour.
- Sequence of (Rt-Component Target Param+, Interaction Type Param, Min Interact Required Param, Max Interact Required Param).

72.20.8 Set Interaction Status

- This action assigns a value to the selection status of an rt-component.
- Sequence of (Rt-Component Target Param+, Interaction Type Param, Interaction Status Param).

72.21 Rt-components style behaviour

Table 35: Overview of Rt-components style behaviour

Set Style ::= Rt-Component Target Param+, Catalogued Style Param, Additional Information Param?
Catalogued Style Param ::= Catalogued Style | Catalogued Style Macro
Catalogued Style Macro ::= Macro Def ID, Catalogued Style?
Additional Information Param ::= Generic Value Param

72.21.1 Set Style

- This action is used to specifY a style to be applied to a target.
- Sequence of (Rt-Component Target Param+, Catalogued Style Param, Additional Information Param?).

72.21.2 Catalogued Style Param

- Parameter of catalogued style.
- Choice between (Catalogued Style, Catalogued Style Macro).

72.21.3 Catalogued Style Macro

- Allows the specification of a macro parameter instead of a specified catalogued style value.
- Sequence of (Macro Def ID, Catalogued Style?).

72.21.4 Additional Information Param

- Specifies some additional information required for a style.
- Generic Value Param.

72.22 Rt-contents anchor behaviour

Table 36: Overview of Rt-contents anchor behaviour

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Attach Anchor ::= Rt-Content Target Param+, Anchor Spec Param+
Anchor Spec Param ::= Anchor Spec | Anchor Spec Macro
Anchor Spec Macro ::= Macro Def ID, Anchor Spec?
Anchor Spec ::= Anchor+, Update Command
Anchor ::= Rt-Content Reference | Evaluated Reference

72.22.1 Attach Anchor

- Attaches anchors to rt-contents.
- Sequence of (Rt-Content Target Param+, Anchor Spec Param+).

72.22.2 Anchor Spec Param

- Parameter of anchor spec.
- Choice between (Anchor Spec, Anchor Spec Macro).

72.22.3 Anchor Spec Macro

- Allows the specification of a macro parameter instead of a specified anchor spec value.
- Sequence of (Macro Def ID, Anchor Spec?).

72.22.4 Anchor Spec

- A pair of anchors and the update command.
- Sequence of (Anchor+, Update Command).

72.22.5 Anchor

- Specifies an anchor.
- Choice between (Rt-Content Reference, Evaluated Reference).

72.23 Channel availability behaviour

Table 37: Overview of Channel availability behaviour

New Channel ::= Channel Target Param+
Delete Channel ::= Channel Target Param+

72.23.1 New Channel

- This action creates channels.
- List of (Channel Target Param).

72.23.2 Delete Channel

- This action removes channels.
- List of (Channel Target Param).

72.24 Channel perceptability behaviour

Table 38: Overview of Channel perceptability behaviour

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Set Channel Perceptability ::= Channel Target Param+, Channel Perceptability Param
Channel Perceptability Param ::= Channel Perceptability I Channel Perceptability Macro
Channel Perceptability Macro ::= Macro Def ID, Channel Perceptability?

72.24.1 Set Channel Perceptability

- This action changes the channel perceptability of a target.
- Sequence of (Channel Target Param+, Channel Perceptability Param).

72.24.2 Channel Perceptability Param

- Parameter of channel perceptability.
- Choice between (Channel Perceptability, Channel Perceptability Macro).

72.24.3 Channel Perceptability Macro

- Allows the specification of a macro parameter instead of a specified channel perceptability value.
- Sequence of (Macro Def ID, Channel Perceptability?).

72.25 Channel presentation space behaviour

Table 39: Overview of Channel presentation space behaviour

Set CPS ::= Channel Target Param+, CPS Initialisation Param?
CPS Initialisation Param ::= CPS Initialisation I CPS Initialisation Macro
CPS Initialisation Macro ::= Macro Def ID, CPS Initialisation?
CPS Initialisation ::= CPS Duration?, CPS Size?
CPS Duration ::= Integer I *infinite* I Evaluated Integer
CPS Size ::= Size I Evaluated List

72.25.1 Set CPS

- This action specifies an CPS of the target.
- Sequence of (Channel Target Param+, CPS Initialisation Param?).

72.25.2 CPS Initialisation Param

- Parameter of CPS initialisation.
- Choice between (CPS Initialisation, CPS Initialisation Macro).

72.25.3 CPS Initialisation Macro

- Allows the specification of a macro parameter instead of a specified CPS initialisation value.
- Sequence of (Macro Def ID, CPS Initialisation?).

72.25.4 CPS Initialisation

- Specifies the duration and the size of the CPS.
- Sequence of (CPS Duration?, CPS Size?).

72.25.5 CPS Duration

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- Specifies the duration of the CPS.
- Choice between (Integer, infinite, Evaluated Integer).

72.25.6 CPS Size

- Specifies the spatial size of the CPS.
- Choice between (Size, Evaluated List).

72.26 Channels and rt-components events behaviour

Table 40: Overview of Channels and rt-components events behaviour

Set Event ::= Rt-Component Channel Tg Param+, Event Param, Event Data Param?
Event Param ::= Generic List Param
Event Data Param ::= Generic Value Param

72.26.1 Set Event

- This action is used to set the event identifier attribute of the target the specified value.
- Sequence of (Rt-Component Channel Tg Param+, Event Param, Event Data Param?).

72.26.2 Event Param

- Specifies an event.
- Generic List Param.

72.26.3 Event Data Param

- Specifies the data associated with an event.
- Generic Value Param.

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73 Elementary Actions

73.1 List of elementary actions

Table 41: Overview of list of elementary actions

Elementary Action ::=
Set Event I Set CPS I Set Channel Perceptability I New Channel I Delete Channel I Attach Anchor I Get Style I Set Style I Set Interaction Ability I Set Interaction Status I Set Stream Choice I Set CV I Set GVF I Set Aspect Ratio I Set Resizing Strategy I Set OVS I Set OAP I Set OVS Position I Set PAP I Set PVS Position I Set GSF I Set User Spatial Control I Set OVD I Set CTP I Set Temporal Termination I Set PVD Position I Set GTF I Set Timestones I Set Perceptability I Set Presentation Priority I Set RPS Assignment I Plug I Set Parameters I Run I Stop I New I Delete I Copy I Set Data I Add I Substract I Link Abort I Activate I Deactivate I Prepare I Destroy I Catalogued Elementary Action I Set Catalogued Attribute I Set Alias I Return I Delay I Extensibility Provision

73.1.1 Elementary Action

- ISO/IEC 13522-1 defines a list of elementary actions that may be included in an action object to modify the behaviour of MHEG entities.

- Choice between (Set Event, Set CPS, Set Channel Perceptability, New Channel, Delete Channel, Attach Anchor, Get Style, Set Style, Set Interaction Ability, Set Interaction Status, Set Stream Choice, Set CV, Set GVF, Set Aspect Ratio, Set Resizing Strategy, Set OVS, Set OAP, Set OVS Position, Set PAP, Set PVS Position, Set GSF, Set User Spatial Control, Set OVD, Set CTP, Set Temporal Termination, Set PVD Position, Set GTF, Set Timestones, Set Perceptability, Set Presentation Priority, Set RPS Assignment, Plug, Set Parameters, Run, Stop, New, Delete, Copy, Set Data, Add, Substract, Link Abort, Activate, Deactivate, Prepare, Destroy, Catalogued Elementary Action, Set Catalogued Attribute, Set Alias, Return, Delay, Extensibility Provision).

73.2 MHEG entity, data, stream, macro parameter and identification useful definitions

Table 42: Overview of MHEG entity, data, stream, macro parameter and identification useful definitions

Using-Application ::= *NULL*

Alias ::= String

Identifier ::= Integer

Index ::= Integer

Tail Param ::= Tail | Tail Macro

Tail Macro ::= Macro Def ID, Tail?

Tail ::= Index*

External ID ::= Public ID?, System ID?

Public ID ::= *PrintableString*

System ID ::= *OCTET STRING*

Null-Data ::= *NULL*

Mheg ID ::= Application ID?, Mh Number

Application ID ::= *OCTET STRING*

Mh Number ::= Identifier

Null-Mh ::= *NULL*

Stream ID ::= Tail

Rt-Number ::= Identifier

Null-Root-Rt ::= *NULL*

Socket Identification ::= Socket ID | Alias

Socket ID ::= Root Rt-Composite Reference, Tail

Channel ID ::= Identifier

Default-Channel ::= *NULL*

Macro Def ID ::= String | Integer

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73.2.1 Using-Application

- The using application is identified by a reserved identifier: "Using-Application".
- NULL.

73.2.2 Alias

- Identification of an MHEG entity, a data or a stream. It is a sequence of alphanumeric characters which is used as a convenient substitute for the other addressing mechanism. It is for the using application to map this name to a physical address.

- String.

73.2.3 Identifier

- Identification of an MHEG entity.

- Integer.

73.2.4 Index

- Identification of an inner element. The indexes are numbered from 1 to n by default.

- Integer.

73.2.5 Tail Param

- Parameter of Tail.

- Choice between (Tail, Tail Macro).

73.2.6 Tail Macro

- Allows the specification of a macro parameter instead of a specified Tail value.

- Sequence of (Macro Def ID, Tail?).

73.2.7 Tail

- Identification of an inner element within a hierarchy. The list of indexes designs a path from an outer entity to an inner element.

- List of (Index).

73.2.8 External ID

- Identification of an external information (e.g. an MHEG object, a content data) as defined for by ISO 9070 and ISO 8879.

The technique for reference to external information is based on:

The techniques used in ISO 8879 for "formal public identifiers".

International standard ISO 9070 "Registration procedures for public text owner identifier" which provides both ASN.1 and SGML notation for the representation of registered owner identifiers.

The presence of at least one of the two fields is mandatory.

- Sequence of (Public ID?, System ID?).

73.2.9 Public ID

- Character string whose syntax is given by subclause 10.2 of ISO 8879:1986.

ISO/IEC 13522-1 uses a simplification of ISO 9070 Informative Annex D shall be used for the encoding of the public identifier.

- PrintableString.

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73.2.10 System ID

- The system identifier may be used to identify a particular file within the system. It may also be used to indicate the system which supplies the object. This information may be used to describe a database or telecommunications request for an information.

- OCTET STRING.

73.2.11 Null-Data

- The null data is identified by a reserved identifier: "Null-Data".

- NULL.

73.2.12 Mheg ID

- Identification of an MHEG interchanged object.

- Sequence of (Application ID?, Mh Number).

73.2.13 Application ID

- Identification of the application supplying the object. The semantics of the identification are defined by the using application.

- OCTET STRING.

73.2.14 Mh Number

- Unique identification of the object within the application. A reserved mh-number is used to address a null object: "Null-Mh".

- Identifier.

73.2.15 Null-Mh

- The null MHEG object is identified by a reserved identifier: "Null-Mh".

- NULL.

73.2.16 Stream ID

- Unique identification of a stream within a multiplex.

- Tail.

73.2.17 Rt-Number

- Unique identification of a root rt-object created from a given model object.

- Identifier.

73.2.18 Null-Root-Rt

- The null root rt-object is identified by a reserved identifier: "Null-Root-Rt".

- NULL.

73.2.19 Socket Identification

- Identification of a socket.

- Choice between (Socket ID, Alias).

73.2.20 Socket ID

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- Identifier of a socket, i.e. an rt-composite element.
- Sequence of (Root Rt-Composite Reference, Tail).

73.2.21 Channel ID

- Identification of a channel.
- Identifier.

73.2.22 Default-Channel

- The default channel is identified by a reserved identifier: "Default-Channel".
- NULL.

73.2.23 Macro Def ID

- Identification of a macro parameter within an action.
- Choice between (String, Integer).

73.3 References useful definitions

Table 43: Overview of References useful definitions

Reference ::=
Null-Data | Mheg ID Reference | External ID Reference | Container Element Reference | Null-Mh | This | Stream ID Reference | Root Rt-ID Reference | Null-Root-Rt | Socket ID Reference | Channel ID Reference | Default-Channel | Alias Reference

Alias Reference::= Alias

Mheg ID Reference ::= Mheg ID

External ID Reference ::= External ID

Tail Reference ::= Tail?, Tail Complement?

Tail Complement ::= *children | descendants*

Data Reference ::= External ID | Null-Data | Alias Reference

Mh-Reference::=
Mheg ID Reference | External ID Reference | Container Element Reference | Null-Mh | This | Alias Reference

Action Object Reference::= Mh-Reference

Link Object Reference ::= Mh-Reference

Model Object Reference ::= Mh-Reference

Script Object Reference ::= Mh-Reference

Component Object Reference::= Mh-Reference

Content Object Ref::= Mh-Reference

Non-Mux Content Object Ref ::= Mh-Reference

Multiplexed Content Object Ref::= Mh-Reference

Stream ID Reference ::= Stream ID

Composite Object Reference ::= Mh-Reference

Container Object Reference ::= Mh-Reference

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Container Element Reference ::= Container Object Reference, Tail Reference

This ::= *NULL*

Descriptor Object Reference ::= Mh-Reference

Root Rt-Reference ::= Root Rt-ID Reference | Null-Root-Rt | Alias Reference

Root Rt-ID Reference ::= Model Object Reference, Rt-Number Reference

Rt-Number Reference ::= Rt-Number | *question-mark* | *star*

Rt-Reference ::= Root Rt-ID Reference | Null-Root-Rt | Socket ID Reference | Alias Reference

Rt-Script Reference ::= Rt-Script ID Reference | Null-Root-Rt | Alias Reference

Rt-Script ID Reference ::= Script Object Reference, Rt-Number Reference

Root Rt-Component Reference ::= Root Rt-Component ID Ref | Null-Root-Rt | Alias Reference

Root Rt-Component ID Ref ::= Component Object Reference, Rt-Number Reference

Rt-Component Reference ::= Root Rt-Component ID Ref | Null-Root-Rt | Socket ID Reference | Alias Reference

Root Rt-Content Reference ::= Root Rt-Content ID Ref | Null-Root-Rt | Alias Reference

Root Rt-Content ID Ref ::= Content Object Ref, Rt-Number Reference

Rt-Content Reference ::= Root Rt-Content ID Ref | Null-Root-Rt | Socket ID Reference | Alias Reference

Root Rt-Mux Reference ::= Root Rt-Mux ID Reference | Null-Root-Rt | Alias Reference

Root Rt-Mux ID Reference ::= Multiplexed Content Object Ref, Rt-Number Reference

Rt-Mux Reference ::= Root Rt-Mux ID Reference | Null-Root-Rt | Socket ID Reference | Alias Reference

Root Rt-Composite Reference ::= Root Rt-Composite ID Ref | Null-Root-Rt | Alias Reference

Root Rt-Composite ID Ref ::= Composite Object Reference, Rt-Number Reference

Rt-Composite Reference::= Root Rt-Composite ID Ref | Null-Root-Rt | Socket ID Reference | Alias Reference

Socket Reference ::= Socket ID Reference | Alias Reference

Socket ID Reference ::= Root Rt-Composite Reference, Socket Tail Reference

Socket Tail Reference ::= Tail?, Socket Tail Complement?

Socket Tail Complement::= Tail Complement | *question-mark-child* | *question-mark-descendant*

Channel Reference::= Channel ID Reference | Default-Channel | Alias Reference

Channel ID Reference ::= Channel ID

Rt-Component Channel Ref ::= Rt-Component Reference | Channel Reference

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73.3.1 Reference

- A reference is used to address an MHEG entity, a data or a stream.

- Choice between (Null-Data, Mheg ID Reference, External ID Reference, Container Element Reference, Null-Mh, This, Stream ID Reference, Root Rt-ID Reference, Null-Root-Rt, Socket ID Reference, Channel ID Reference, Default-Channel, Alias Reference).

73.3.2 Alias Reference

- Reference to a single or multiple MHEG entity or data or stream using the assigned alias.

- Alias.

73.3.3 Mheg ID Reference

- Reference to an MHEG object using its MHEG identifier.

- Mheg ID.

73.3.4 External ID Reference

- Reference to an MHEG entity or a data using its external identifier.

- External ID.

73.3.5 Tail Reference

- Reference to a given element using its tail identification, a tail complement may be provided. The tail can be omitted, in which case the tail complement is applied to the outer entity itself.

- Sequence of (Tail?, Tail Complement?).

73.3.6 Tail Complement

- The tail complement is used to reference the children (one generation) or the descendants (all generations) of the element referenced using its tail or of the outer entity if the tail is omitted.

- Choice between (children, descendants).

73.3.7 Data Reference

- Reference to a data of a content or a script object using one of its possible identification.

- Choice between (External ID, Null-Data, Alias Reference).

73.3.8 Mh-Reference

- Reference to an MHEG object using one of its possible identifications.

- Choice between (Mheg ID Reference, External ID Reference, Container Element Reference, Null-Mh, This, Alias Reference).

73.3.9 Action Object Reference

- Reference to an action object.

- Mh-Reference.

73.3.10 Link Object Reference

- Reference to a link object.

- Mh-Reference.

73.3.11 Model Object Reference

- Reference to a model object. When the model object to be referenced is a composite object, "this" may be used within link and action objects to express local addressing within the composite or the container object.

- Mh-Reference.

73.3.12 Script Object Reference

- Reference to a script object.

- Mh-Reference.

73.3.13 Component Object Reference

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- Reference to a component object.
- Mh-Reference.

73.3.14 Content Object Ref

- Reference to a content object or a multiplexed content object.
- Mh-Reference.

73.3.15 Non-Mux Content Object Ref

- Reference to a non-mux content object, i.e. a pure content object.
- Mh-Reference.

73.3.16 Multiplexed Content Object Ref

- Reference to a multiplexed content object.
- Mh-Reference.

73.3.17 Stream ID Reference

- Reference to a stream using its stream identifier.
- Stream ID.

73.3.18 Composite Object Reference

- Reference to a composite object, "this" may be used within link and action objects to express local addressing facilities within the composite object.
- Mh-Reference.

73.3.19 Container Object Reference

- Reference to a container object, "this" can be used within link and action objects for local addressing facilities within the composite or the container object.
- Mh-Reference.

73.3.20 Container Element Reference

- Reference to a container element using a reference to the container object defining this element followed by a reference to the element itself.
- Sequence of (Container Object Reference, Tail Reference).

73.3.21 This

- When the MHEG entity to be referenced is a composite or a container object, "this" may be used within link and action objects to express local addressing facilities within the composite or the container object itself.
- NULL.

73.3.22 Descriptor Object Reference

- Reference to a descriptor object.
- Mh-Reference.

73.3.23 Root Rt-Reference

- Reference to a root rt-object using one of its possible identifications.

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- Choice between (Root Rt-ID Reference, Null-Root-Rt, Alias Reference).

73.3.24 Root Rt-ID Reference

- Reference to a root rt-identifier using a reference to the model object from which it is created and a reference to the rt-number assigned to it.

- Sequence of (Model Object Reference, Rt-Number Reference).

73.3.25 Rt-Number Reference

- Reference to a specified root rt-object (rt-number) or to a dynamically determined root rt-object (?) or to all root rt-objects created from a given model object (*).

- Choice between (Rt-Number, question-mark, star).

73.3.26 Rt-Reference

- Reference to an rt-object, i.e. either a root (rt-script, root rt-component) or a socket.

- Choice between (Root Rt-ID Reference, Null-Root-Rt, Socket ID Reference, Alias Reference).

73.3.27 Rt-Script Reference

- Reference to an rt-script using one of its possible identifications.

- Choice between (Rt-Script ID Reference, Null-Root-Rt, Alias Reference).

73.3.28 Rt-Script ID Reference

- Reference to an rt-script identifier using a reference to the model object from which it is created and a reference to the rt-number assigned to it.

- Sequence of (Script Object Reference, Rt-Number Reference).

73.3.29 Root Rt-Component Reference

- Reference to a root rt-component using one of its possible identifications.

- Choice between (Root Rt-Component ID Ref, Null-Root-Rt, Alias Reference).

73.3.30 Root Rt-Component ID Ref

- Reference to a root rt-component identifier using a reference to the model object from which it is created and a reference to the rt-number assigned to it.

- Sequence of (Component Object Reference, Rt-Number Reference).

73.3.31 Rt-Component Reference

- Reference to an rt-component, i.e. either a root or a socket.

- Choice between (Root Rt-Component ID Ref, Null-Root-Rt, Socket ID Reference, Alias Reference).

73.3.32 Root Rt-Content Reference

- Reference to a root rt-content using one of its possible identifications.

- Choice between (Root Rt-Content ID Ref, Null-Root-Rt, Alias Reference).

73.3.33 Root Rt-Content ID Ref

- Reference to a root rt-content identifier using a reference to the model object from which it is created and a reference to the rt-number assigned to it.

- Sequence of (Content Object Ref, Rt-Number Reference).

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73.3.34 Rt-Content Reference

- Reference to an rt-content, i.e. either a root or a socket.
- Choice between (Root Rt-Content ID Ref, Null-Root-Rt, Socket ID Reference, Alias Reference).

73.3.35 Root Rt-Mux Reference

- Reference to a root rt-mux using one of its possible identifications.
- Choice between (Root Rt-Mux ID Reference, Null-Root-Rt, Alias Reference).

73.3.36 Root Rt-Mux ID Reference

- Reference to a root rt-mux identifier using a reference to the model object from which it is created and a reference to the rt-number assigned to it.
- Sequence of (Multiplexed Content Object Ref, Rt-Number Reference).

73.3.37 Rt-Mux Reference

- Reference to an rt-mux, i.e. either a root or a socket.
- Choice between (Root Rt-Mux ID Reference, Null-Root-Rt, Socket ID Reference, Alias Reference).

73.3.38 Root Rt-Composite Reference

- Reference to a root rt-composite using one of its possible identifications.
- Choice between (Root Rt-Composite ID Ref, Null-Root-Rt, Alias Reference).

73.3.39 Root Rt-Composite ID Ref

- Reference to a root rt-composite identifier using a reference to the model object from which it is created and a reference to the rt-number assigned to it.
- Sequence of (Composite Object Reference, Rt-Number Reference).

73.3.40 Rt-Composite Reference

- Reference to an rt-composite, i.e. either a root or a socket.
- Choice between (Root Rt-Composite ID Ref, Null-Root-Rt, Socket ID Reference, Alias Reference).

73.3.41 Socket Reference

- Reference to a socket, using one of its possible identifications. There is no specific reference to a null socket because a null socket, also called an empty socket, is referenced as any other sockets.
- Choice between (Socket ID Reference, Alias Reference).

73.3.42 Socket ID Reference

- Reference to a socket identifier using a reference to the rt-composite defining this socket followed by a reference to the socket itself. A socket is an element of an rt-composite.
- Sequence of (Root Rt-Composite Reference, Socket Tail Reference).

73.3.43 Socket Tail Reference

- Reference to a given socket using its tail identification, a tail complement may be provided. The tail can be omitted, in that case the socket tail complement is applied to the root rt-composite itself.
- Sequence of (Tail?, Socket Tail Complement?).

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73.3.44 Socket Tail Complement

- The socket tail complement is used to reference the children or descendants or a single dynamically determined socket within the children (?child), or a single dynamically determined socket within the descendants (? descendant) of the socket referenced by the tail or of the root rt-composite if the tail is omitted.

- Choice between (Tail Complement, question-mark-child, question-mark-descendant).

73.3.45 Channel Reference

- Reference to a channel identifier using one of its possible identifications.

- Choice between (Channel ID Reference, Default-Channel, Alias Reference).

73.3.46 Channel ID Reference

- Reference to a channel using its channel identifier.

- Channel ID.

73.3.47 Rt-Component Channel Ref

- Reference to an rt-component or to a channel using one of its possible identifications.

- Choice between (Rt-Component Reference, Channel Reference).

73.4 Useful definitions of targets

Table 44: Overview of useful definitions of targets

Target Param ::= Target | Target Macro

Target Macro ::= Macro Def ID, Target?

Target ::= Generic Reference

Mh-Target Param ::= Mh-Target | Mh-Target Macro

Mh-Target Macro ::= Macro Def ID, Mh-Target?

Mh-Target ::= Mh-Reference | Evaluated Reference

Link Target Param ::= Mh-Target Param

Content Target Param ::= Mh-Target Param

Rt-Target Param ::= Rt-Target | Rt-Target Macro

Rt-Target Macro ::= Macro Def ID, Rt-Target?

Rt-Target ::= Rt-Reference | Evaluated Reference

Rt-Script Target Param ::= Rt-Script Target | Rt-Script Target Macro

Rt-Script Target Macro ::= Macro Def ID, Rt-Script Target?

Rt-Script Target ::= Rt-Script Reference | Evaluated Reference

Rt-Component Target Param ::= Rt-Component Target | Rt-Component Target Macro

Rt-Component Target Macro ::= Macro Def ID, Rt-Component Target?

Rt-Component Target ::= Rt-Component Reference | Evaluated Reference

Rt-Content Target Param ::= Rt-Content Target | Rt-Content Target Macro

Rt-Content Target Macro ::= Macro Def ID, Rt-Content Target?

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Rt-Content Target ::= Rt-Content Reference | Evaluated Reference

Rt-Mux Target Param ::= Rt-Mux Target | Rt-Mux Target Macro

Rt-Mux Target Macro ::= Macro Def ID, Rt-Mux Target?

Rt-Mux Target ::= Rt-Mux Reference | Evaluated Reference

Rt-Composite Target Param ::= Rt-Composite Target | Rt-Composite Target Macro

Rt-Composite Target Macro ::= Macro Def ID, Rt-Composite Target?

Rt-Composite Target ::= Rt-Composite Reference | Evaluated Reference

Socket Target Param ::= Socket Target | Socket Target Macro

Socket Target Macro ::= Macro Def ID, Socket Target?

Socket Target ::= Socket Reference | Evaluated Reference

Return Target Param ::= Generic Integer Param | Using-Application

Channel Target Param ::= Channel Target | Channel Target Macro

Channel Target Macro ::= Macro Def ID, Channel Target?

Channel Target ::= Channel Reference | Evaluated Reference

Rt-Component Channel Tg Param ::= Rt-Component Channel Tg | Rt-Component Channel Tg Macro

Rt-Component Channel Tg Macro ::= Macro Def ID, Rt-Component Channel Tg?

Rt-Component Channel Tg ::= Rt-Component Channel Ref | Evaluated Reference

73.4.1 Target Param

- Parameter of Target.
- Choice between (Target, Target Macro).

73.4.2 Target Macro

- Allows the specification of a macro parameter instead of a specified target value.
- Sequence of (Macro Def ID, Target?).

73.4.3 Target

- A target of an action addresses an MHEG entity using its reference.
- Generic Reference.

73.4.4 Mh-Target Param

- Parameter of Mh-Target.
- Choice between (Mh-Target, Mh-Target Macro).

73.4.5 Mh-Target Macro

- Allows the specification of a macro parameter instead of a specified Mh-Target value.
- Sequence of (Macro Def ID, Mh-Target?).

73.4.6 Mh-Target

- An Mh-target of an action addresses an MHEG object using its reference.

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- Choice between (Mh-Reference, Evaluated Reference).

73.4.7 Link Target Param

- A link target of an action addresses a link object using its reference.
- Mh-Target Param.

73.4.8 Content Target Param

- A content target of an action addresses a content object using its reference.
- Mh-Target Param.

73.4.9 Rt-Target Param

- Parameter of Rt-Target.
- Choice between (Rt-Target, Rt-Target Macro).

73.4.10 Rt-Target Macro

- Allows the specification of a macro parameter instead of a specified Rt-Target value.
- Sequence of (Macro Def ID, Rt-Target?).

73.4.11 Rt-Target

- An rt-target of an action addresses an rt-object using its reference.
- Choice between (Rt-Reference, Evaluated Reference).

73.4.12 Rt-Script Target Param

- Parameter of Rt-Script Target.
- Choice between (Rt-Script Target, Rt-Script Target Macro).

73.4.13 Rt-Script Target Macro

- Allows the specification of a macro parameter instead of a specified Rt-Script Target value.
- Sequence of (Macro Def ID, Rt-Script Target?).

73.4.14 Rt-Script Target

- An rt-script target of an action addresses an rt-script object using its reference.
- Choice between (Rt-Script Reference, Evaluated Reference).

73.4.15 Rt-Component Target Param

- Parameter of Rt-Component Target.
- Choice between (Rt-Component Target, Rt-Component Target Macro).

73.4.16 Rt-Component Target Macro

- Allows the specification of a macro parameter instead of a specified Rt-Component Target value.
- Sequence of (Macro Def ID, Rt-Component Target?).

73.4.17 Rt-Component Target

- An rt-component target of an action addresses an rt-component object using its reference.
- Choice between (Rt-Component Reference, Evaluated Reference).

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73.4.18 Rt-Content Target Param

- Parameter of Rt-Content Target.
- Choice between (Rt-Content Target, Rt-Content Target Macro).

73.4.19 Rt-Content Target Macro

- Allows the specification of a macro parameter instead of a specified Rt-Content Target value.
- Sequence of (Macro Def ID, Rt-Content Target?).

73.4.20 Rt-Content Target

- An rt-content target of an action addresses an rt-content object using its reference.
- Choice between (Rt-Content Reference, Evaluated Reference).

73.4.21 Rt-Mux Target Param

- Parameter of Rt-Mux Target.
- Choice between (Rt-Mux Target, Rt-Mux Target Macro).

73.4.22 Rt-Mux Target Macro

- Allows the specification of a macro parameter instead of a specified Rt-Mux Target value.
- Sequence of (Macro Def ID, Rt-Mux Target?).

73.4.23 Rt-Mux Target

- An rt-mux target of an action addresses an rt-mux object using its reference.
- Choice between (Rt-Mux Reference, Evaluated Reference).

73.4.24 Rt-Composite Target Param

- Parameter of Rt-Composite Target.
- Choice between (Rt-Composite Target, Rt-Composite Target Macro).

73.4.25 Rt-Composite Target Macro

- Allows the specification of a macro parameter instead of a specified Rt-Composite Target value.
- Sequence of (Macro Def ID, Rt-Composite Target?).

73.4.26 Rt-Composite Target

- An rt-composite target of an action addresses an rt-composite object using its reference.
- Choice between (Rt-Composite Reference, Evaluated Reference).

73.4.27 Socket Target Param

- Parameter of Socket Target.
- Choice between (Socket Target, Socket Target Macro).

73.4.28 Socket Target Macro

- Allows the specification of a macro parameter instead of a specified Socket Target value.
- Sequence of (Macro Def ID, Socket Target?).

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73.4.29 Socket Target

- A socket target of an action addresses socket using its reference.
- Choice between (Socket Reference, Evaluated Reference).

73.4.30 Return Target Param

- It is up to the implementation to map this parameter to the appropriate recipient.
- Choice between (Generic Integer Param, Using-Application).

73.4.31 Channel Target Param

- Parameter of Channel Target.
- Choice between (Channel Target, Channel Target Macro).

73.4.32 Channel Target Macro

- Allows the specification of a macro parameter instead of a specified Channel Target value.
- Sequence of (Macro Def ID, Channel Target?).

73.4.33 Channel Target

- A channel target of an action addresses a channel using its reference.
- Choice between (Channel Reference, Evaluated Reference).

73.4.34 Rt-Component Channel Tg Param

- Parameter of Rt-Component Channel Tg.
- Choice between (Rt-Component Channel Tg, Rt-Component Channel Tg Macro).

73.4.35 Rt-Component Channel Tg Macro

- Allows the specification of a macro parameter instead of a specified Rt-Component Channel Tg value.
- Sequence of (Macro Def ID, Rt-Component Channel Tg?).

73.4.36 Rt-Component Channel Tg

- An rt-component or channel target of an action addresses an rt-component or a channel using its reference.
- Choice between (Rt-Component Channel Ref, Evaluated Reference).

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73.5 Generic value useful definitions

Table 45: Overview of generic value useful definitions

Generic Value Param ::= Generic Value | Generic Value Macro
Generic Value Macro ::= Macro Def ID, Generic Value?
Generic Value ::= Value | Evaluated Value
Value ::= Boolean | Numeric | Ratio | String | List | Reference
Generic Boolean Param ::= Generic Boolean | Generic Boolean Macro
Generic Boolean Macro ::= Macro Def ID, Generic Boolean?
Generic Boolean ::= Boolean | Evaluated Boolean

Boolean ::= *BOOLEAN*

Generic Numeric Param ::= Generic Numeric | Generic Numeric Macro

Generic Numeric Macro ::= Macro Def ID, Generic Numeric?

Generic Numeric ::= Numeric | Evaluated Numeric

Numeric ::= *INTEGER*

Generic Integer Param ::= Generic Integer | Generic Integer Macro

Generic Integer Macro ::= Macro Def ID, Generic Integer?

Generic Integer ::= Integer | Evaluated Integer

Integer ::= *INTEGER*

Generic Ratio Param ::= Generic Ratio | Generic Ratio Macro

Generic Ratio Macro ::= Macro Def ID, Generic Ratio?

Generic Ratio ::= Ratio | Evaluated Ratio

Ratio ::= Numerator, Denominator?

Numerator ::= Integer

Denominator ::= Integer

Generic String Param ::= Generic String | Generic String Macro

Generic String Macro ::= Macro Def ID, Generic String?

Generic String ::= String | Evaluated String

String ::= *GraphicString*

Generic Reference Param ::= Generic Reference | Generic Reference Macro

Generic Reference Macro ::= Macro Def ID, Generic Reference?

Generic Reference ::= Reference | Evaluated Reference

Generic List Param ::= Generic List | Generic List Macro

Generic List Macro ::= Macro Def ID, Generic List?

Generic List ::= List | Evaluated List

List ::= Value*

Generic List Elt ID Param ::= Generic List Elt ID | Generic List Elt ID Macro

Generic List Elt ID Macro ::= Macro Def ID, Generic List Elt ID?

Generic List Elt ID ::= Tail

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73.5.1 Generic Value Param

- Parameter of Generic Value.
- Choice between (Generic Value, Generic Value Macro).

73.5.2 Generic Value Macro

- Allows the specification of a macro parameter instead of a specified Generic Value value.
- Sequence of (Macro Def ID, Generic Value?).

73.5.3 Generic Value

- Specifies a values of any type, e.g. to express an elementary action parameter, a condition or an MHEG object attribute.
- Choice between (Value, Evaluated Value).

73.5.4 Value

- Specifies a value of any type values supported by ISO/IEC 13522-1.
- Choice between (Boolean, Numeric, Ratio, String, List, Reference).

73.5.5 Generic Boolean Param

- .
- Choice between (Generic Boolean, Generic Boolean Macro).

73.5.6 Generic Boolean Macro

- Allows the specification of a macro parameter instead of a specified Generic Boolean value.
- Sequence of (Macro Def ID, Generic Boolean?).

73.5.7 Generic Boolean

- A generic boolean shall have one of the following values: true false, a result of a get action.
- Choice between (Boolean, Evaluated Boolean).

73.5.8 Boolean

- A boolean is encoded in ISO/IEC 13522-1 as an ASN.1 BOOLEAN.
- BOOLEAN.

73.5.9 Generic Numeric Param

- Parameter of Generic Numeric.
- Choice between (Generic Numeric, Generic Numeric Macro).

73.5.10 Generic Numeric Macro

- Allows the specification of a macro parameter instead of a specified Generic Numeric value.
- Sequence of (Macro Def ID, Generic Numeric?).

73.5.11 Generic Numeric

- A generic numeric has one of the following values: a numeric, a result of a get action.
- Choice between (Numeric, Evaluated Numeric).

73.5.12 Numeric

- Numeric values may be integers, reals or complex. However the coded representation may impose to encode numeric as an ASN.1 INTEGER. Authors should take this restriction into account.
- INTEGER.

73.5.13 Generic Integer Param

- Parameter of Generic Integer.
- Choice between (Generic Integer, Generic Integer Macro).

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73.5.14 Generic Integer Macro

- Allows the specification of a macro parameter instead of a specified Generic Integer value.
- Sequence of (Macro Def ID, Generic Integer?).

73.5.15 Generic Integer

- A generic integer has one of the following values: an integer, a result of a get action.
- Choice between (Integer, Evaluated Integer).

73.5.16 Integer

- An integer is encoded in ISO/IEC 13522-1 as an ASN.1 INTEGER.
- INTEGER.

73.5.17 Generic Ratio Param

- Parameter of Generic Ratio.
- Choice between (Generic Ratio, Generic Ratio Macro).

73.5.18 Generic Ratio Macro

- Allows the specification of a macro parameter instead of a specified Generic Ratio value.
- Sequence of (Macro Def ID, Generic Ratio?).

73.5.19 Generic Ratio

- A generic ratio has one of the following values: a ratio, a result of a get action.
- Choice between (Ratio, Evaluated Ratio).

73.5.20 Ratio

- A ratio value is a pair of integers (m, n) with m the numerator and n the denominator of a fraction. If the denominator is omitted, it is assumed to be 100, thus interpreting the numerator as a percentage.

The numerator shall be greater than 1 and the denominator may be negative.

- Sequence of (Numerator, Denominator?).

73.5.21 Numerator

- Numerator of a fraction
- Integer.

73.5.22 Denominator

- Denominator of a fraction
- Integer.

73.5.23 Generic String Param

- Parameter of Generic String.
- Choice between (Generic String, Generic String Macro).

73.5.24 Generic String Macro

- Allows the specification of a macro parameter instead of a specified Generic String value.

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- Sequence of (Macro Def ID, Generic String?).

73.5.25 Generic String

- A generic string has one of the following values: a string, a result of a get action.
- Choice between (String, Evaluated String).

73.5.26 String

- A string is encoded as an ASN.1 Graphic String.
- GraphicString.

73.5.27 Generic Reference Param

- Parameter of Generic Reference.
- Choice between (Generic Reference, Generic Reference Macro).

73.5.28 Generic Reference Macro

- Allows the specification of a macro parameter instead of a specified Generic Reference value.
- Sequence of (Macro Def ID, Generic Reference?).

73.5.29 Generic Reference

- A generic reference has one of the following values: a reference, a result of a get action.
- Choice between (Reference, Evaluated Reference).

73.5.30 Generic List Param

- Parameter of Generic List.
- Choice between (Generic List, Generic List Macro).

73.5.31 Generic List Macro

- Allows the specification of a macro parameter instead of a specified Generic List value.
- Sequence of (Macro Def ID, Generic List?).

73.5.32 Generic List

- A generic list has one of the following values: a list, a result of a get action.
- Choice between (List, Evaluated List).

73.5.33 List

- A list of values.
- List of (Value).

73.5.34 Generic List Elt ID Param

- Parameter of Generic List Elt ID.
- Choice between (Generic List Elt ID, Generic List Elt ID Macro).

73.5.35 Generic List Elt ID Macro

- Allows the specification of a macro parameter instead of a specified Generic List Elt ID value.
- Sequence of (Macro Def ID, Generic List Elt ID?).

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73.5.36 Generic List Elt ID

- Identification of a generic value which is an element of a generic list.
- Tail.

73.6 Evaluated values useful definitions

Table 46: Overview of evaluated values useful definitions

Get Event Data ::= Rt-Component Channel Tg Param
Get Event ::= Rt-Component Channel Tg Param
Get Channel Perceptability ::= Channel Target Param
Get Channel Availability Status ::= Channel Target Param
Get Style ::= Rt-Component Target Param
Get Number Of Interacted Sockets ::= Rt-Composite Target Param, Interaction Type Param
Get Interaction Status ::= Rt-Component Target Param, Interaction Type Param
Get Max Interact Required ::= Rt-Component Target Param, Interaction Type Param
Get Min Interact Required ::= Rt-Component Target Param, Interaction Type Param
Get Interaction Ability ::= Rt-Component Target Param, Interaction Type Param
Get Stream Chosen State ::= Rt-Mux Target Param, Stream Identification Param
Get Stream Choice ::= Rt-Mux Target Param
Get GVF ::= Rt-Composite Target Param I Channel Target Param
Get PCV ::= Rt-Content Target Param
Get CV ::= Rt-Content Target Param
Get OV ::= Rt-Content Target Param
Get User Spatial Control ::= Rt-Component Target Param, Spatial Control Param
Get GSF ::= Rt-Component Target Param, Expected Axis Result Param
Get PVS Position ::= Rt-Component Target Param, Point Type Param, Expected Axis Result Param
Get PAP ::= Rt-Component Target Param, Point Type Param, Expected Axis Result Param
Get PVS ::= Rt-Component Target Param, Point Type Param, Expected Axis Result Param
Get OVS Position ::= Rt-Component Target Param, Point Type Param, Expected Axis Result Param
Get OAP ::= Rt-Component Target Param, Point Type Param, Expected Axis Result Param
Get OVS ::= Rt-Component Target Param, Point Type Param, Expected Axis Result Param
Get OVS Proj Strategy ::= Rt-Component Target Param
Get Resizing Strategy ::= Rt-Composite Target Param
Get Aspect Ratio ::= Rt-Component Target Param
Get POS ::= Rt-Component Target Param, Expected Axis Result Param
Get OS ::= Rt-Component Target Param, Expected Axis Result Param
Get Timestone Status ::= Rt-Component Target Param

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Get GTF ::= Rt-Component Target Param

Get PVD Position::= Rt-Component Target Param

Get Temporal Termination ::= Rt-Component Target Param

Get CTP ::= Rt-Component Target Param

Get PVD ::= Rt-Component Target Param, Expected PVD Result Param

Get OVD::= Rt-Component Target Param, Expected OVD Result Param

Get POD::= Rt-Component Target Param

Get OD ::= Rt-Component Target Param

Get Presentation Priority ::= Rt-Component Target Param

Get Perceptability ::= Rt-Component Target Param

Get RPS Assignment ::= Rt-Component Target Param

Get Rt-Composite Address ::= Rt-Composite Target Param, Navigation Command Param

Get Termination Status ::= Rt-Script Target Param

Get Running Status ::= Rt-Target Param

Get Rt-Availability Status ::= Rt-Target Param

Get Data::= Content Target Param, Generic List Elt ID Param?

Get Activation Status ::= Link Target Param

Get Preparation Status ::= Mh-Target Param

Get Catalogued Attribute ::= Target Param, Cat Ext Attribute Param

Get Boolean ::= *NULL*

Get Numeric ::= Get Integer

Get Integer ::=
Get Preparation Status | Get Activation Status | Get Rt-Availability Status | Get Running Status | Get Termination Status | Get Presentation Priority | Get OD | Get POD | Get PVD | Get CTP | Get Temporal Termination | Get PVD Position | Get Timestone Status | Get Aspect Ratio | Get Resizing Strategy | Get OVS Proj Strategy | Get User Spatial Control | Get CV | Get PCV | Get Stream Chosen State | Get Min Interact Required | Get Max Interact Required | Get Number Of Interacted Sockets | Get Channel Availability Status | Get Channel Perceptability

Get Ratio ::= Get Perceptability

Get String::= *NULL*

Get Reference ::= Get Rt-Composite Address | Get RPS Assignment

Get List ::= Get Catalogued Attribute | Get Stream Choice | Get Style | Get Event

Get Any ::=
Get Data | Get OVD | Get GTF | Get OS | Get POS | Get OVS | Get OAP | Get OVS Position | Get PVS | Get PAP | Get PVS Position | Get GSF | Get GVF | Get Interaction Ability | Get Interaction Status | Get Event Data

Evaluated Value ::=
Get Boolean | Get Numeric | Get Ratio | Get String | Get Reference | Get List | Get Any | Extensibility Provision

Evaluated Boolean ::= Get Boolean | Get Any

Evaluated Numeric ::= Get Numeric | Get Integer | Get Any

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Evaluated Integer ::= Get Integer I Get Any
Evaluated Ratio ::= Get Ratio I Get Any
Evaluated String ::= Get String I Get Any
Evaluated Reference ::= Get Reference I Get Any
Evaluated List ::= Get List I Get Any

73.6.1 Get Event Data

- Retrieves the event data of the target.
- Rt-Component Channel Tg Param.

73.6.2 Get Event

- Retrieves the event of the target.
- Rt-Component Channel Tg Param.

73.6.3 Get Channel Perceptability

- Retrieves the channel perceptability of the target.
- Channel Target Param.

73.6.4 Get Channel Availability Status

- Retrieves the channel availability status.
- Channel Target Param.

73.6.5 Get Style

- Retrieves the current style associated with the target.
- Rt-Component Target Param.

73.6.6 Get Number Of Interacted Sockets

- Retrieves the number of interacted sockets attribute value of the target.
- Sequence of (Rt-Composite Target Param, Interaction Type Param).

73.6.7 Get Interaction Status

- Retrieves the interaction status value of the target. This action returns "selected" or "not selected" for the selection, and "modified", "modifying" or "not modified" for the modification.
- Sequence of (Rt-Component Target Param, Interaction Type Param).

73.6.8 Get Max Interact Required

- Retrieves the max interact required attribute value of the target.
- Sequence of (Rt-Component Target Param, Interaction Type Param).

73.6.9 Get Min Interact Required

- Retrieves the min interact required attribute value of the target.
- Sequence of (Rt-Component Target Param, Interaction Type Param).

73.6.10 Get Interaction Ability

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- This action is used to retrieve the interaction ability of the target.
- Sequence of (Rt-Component Target Param, Interaction Type Param).

73.6.11 Get Stream Chosen State

- Retrieves the stream state.
- Sequence of (Rt-Mux Target Param, Stream Identification Param).

73.6.12 Get Stream Choice

- This action is used to retrieve a list of stream IDs chosen for the target.
- Rt-Mux Target Param.

73.6.13 Get GVF

- Retrieves the GVF.
- Choice between (Rt-Composite Target Param, Channel Target Param).

73.6.14 Get PCV

- Retrieves the PCV.
- Rt-Content Target Param.

73.6.15 Get CV

- Retrieves the CV.
- Rt-Content Target Param.

73.6.16 Get OV

- Retrieves the OV.
- Rt-Content Target Param.

73.6.17 Get User Spatial Control

- Retrieves the user spatial control attribute value.
- Sequence of (Rt-Component Target Param, Spatial Control Param).

73.6.18 Get GSF

- Retrieves the GSF.
- Sequence of (Rt-Component Target Param, Expected Axis Result Param).

73.6.19 Get PVS Position

- Retrieves the PVS position.
- Sequence of (Rt-Component Target Param, Point Type Param, Expected Axis Result Param).

73.6.20 Get PAP

- Retrieves the PAP.
- Sequence of (Rt-Component Target Param, Point Type Param, Expected Axis Result Param).

73.6.21 Get PVS

- Retrieves the PVS.

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- Sequence of (Rt-Component Target Param, Point Type Param, Expected Axis Result Param).

73.6.22 Get OVS Position

- Retrieves the OVS position.
- Sequence of (Rt-Component Target Param, Point Type Param, Expected Axis Result Param).

73.6.23 Get OAP

- Retrieves the OAP.
- Sequence of (Rt-Component Target Param, Point Type Param, Expected Axis Result Param).

73.6.24 Get OVS

- Retrieves the OVS.
- Sequence of (Rt-Component Target Param, Point Type Param, Expected Axis Result Param).

73.6.25 Get OVS Proj Strategy

- Retrieves the OVS Proj Strategy attribute.
- Rt-Component Target Param.

73.6.26 Get Resizing Strategy

- Retrieves the resizing strategy attribute.
- Rt-Composite Target Param.

73.6.27 Get Aspect Ratio

- Retrieves the aspect ratio attribute.
- Rt-Component Target Param.

73.6.28 Get POS

- Retrieves the POS.
- Sequence of (Rt-Component Target Param, Expected Axis Result Param).

73.6.29 Get OS

- This action is used to retrieve the OS.
- Sequence of (Rt-Component Target Param, Expected Axis Result Param).

73.6.30 Get Timestone Status

- This action is used to retrieve the timestone status value.
- Rt-Component Target Param.

73.6.31 Get GTF

- This action is used to retrieve the GTF of the target.
- Rt-Component Target Param.

73.6.32 Get PVD Position

- This action is used to retrieve the PVD position attached to its PRPS.

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- Rt-Component Target Param.

73.6.33 Get Temporal Termination

- This action is used to retrieve the temporal termination of the target.
- Rt-Component Target Param.

73.6.34 Get CTP

- Retrieves the CTP of the target.
- Rt-Component Target Param.

73.6.35 Get PVD

- Retrieves the PVD, initial temporal position or terminal temporal position of the target.
- Sequence of (Rt-Component Target Param, Expected PVD Result Param).

73.6.36 Get OVD

- This action is used to retrieve the OVD, initial temporal position or terminal temporal position of the target.
- Sequence of (Rt-Component Target Param, Expected OVD Result Param).

73.6.37 Get POD

- Retrieves the POD of the target.
- Rt-Component Target Param.

73.6.38 Get OD

- Retrieves the OD of the target.
- Rt-Component Target Param.

73.6.39 Get Presentation Priority

- Retrieves the presentation priority.
- Rt-Component Target Param.

73.6.40 Get Perceptability

- Retrieves the perceptability.
- Rt-Component Target Param.

73.6.41 Get RPS Assignment

- Retrieves the RPS assignment to an rt-component and a root rt-component.
- Rt-Component Target Param.

73.6.42 Get Rt-Composite Address

- Retrieves the address of an rt-composite which is the parent, descendant or sibling of the target.
- Sequence of (Rt-Composite Target Param, Navigation Command Param).

73.6.43 Get Termination Status

- Retrieves the termination status of an rt-script. The result is "terminated" or "not terminated".
- Rt-Script Target Param.

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73.6.44 Get Running Status

- Retrieves the running status of an rt-object or a socket. The result is "running" or "not running".
- Rt-Target Param.

73.6.45 Get Rt-Availability Status

- Provides means to retrieve the availability status of an rt-object. The result is "available" or "not available".
- Rt-Target Param.

73.6.46 Get Data

- This action is used to retrieve a generic value or an element of a generic list stored in a content object.
- Sequence of (Content Target Param, Generic List Elt ID Param?).

73.6.47 Get Activation Status

- This action is used to retrieve the activation status value of a link object.
- Link Target Param.

73.6.48 Get Preparation Status

- Retrieves the preparation status of an MHEG object. The result is "ready" or "not ready".
- Mh-Target Param.

73.6.49 Get Catalogued Attribute

- This get action is used to retrieve the value of an extended catalogued attribute. The result is a generic value which is described in the corresponding catalogue.
- Sequence of (Target Param, Cat Ext Attribute Param).

73.6.50 Get Boolean

- A get boolean is the result of a get action that returns a boolean.
- NULL.

73.6.51 Get Numeric

- A get numeric is the result of a get action that returns a numeric.
- Get Integer.

73.6.52 Get Integer

- A get integer is the result of a get action that returns an integer.
- Choice between (Get Preparation Status, Get Activation Status, Get Rt-Availability Status, Get Running Status, Get Termination Status, Get Presentation Priority, Get OD, Get POD, Get PVD, Get CTP, Get Temporal Termination, Get PVD Position, Get Timestone Status, Get Aspect Ratio, Get Resizing Strategy, Get OVS Proj Strategy, Get User Spatial Control, Get CV, Get PCV, Get Stream Chosen State, Get Min Interact Required, Get Max Interact Required, Get Number Of Interacted Sockets, Get Channel Availability Status, Get Channel Perceptability).

73.6.53 Get Ratio

- A get ratio is the result of a get action that returns a ratio.
- Get Perceptability.

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73.6.54 Get String

- A get string is the result of a get action that returns a string.
- NULL.

73.6.55 Get Reference

- A get reference is the result of a get action that returns a reference.
- Choice between (Get Rt-Composite Address, Get RPS Assignment).

73.6.56 Get List

- A get list is the result of a get action that returns a list.
- Choice between (Get Catalogued Attribute, Get Stream Choice, Get Style, Get Event).

73.6.57 Get Any

- A get any is the result of a get action that returns any kind of value.
- Choice between (Get Data, Get OVD, Get GTF, Get OS, Get POS, Get OVS, Get OAP, Get OVS Position, Get PVS, Get PAP, Get PVS Position, Get GSF, Get GVF, Get Interaction Ability, Get Interaction Status, Get Event Data).

73.6.58 Evaluated Value

- An evaluated value is the result of a get action.
- Choice between (Get Boolean, Get Numeric, Get Ratio, Get String, Get Reference, Get List, Get Any, Extensibility Provision).

73.6.59 Evaluated Boolean

- An evaluated boolean is one of the result of a get action that results in either a boolean or any.
- Choice between (Get Boolean, Get Any).

73.6.60 Evaluated Numeric

- An evaluated numeric is one of the result of a get action that results in either a numeric, an integer or any.
- Choice between (Get Numeric, Get Integer, Get Any).

73.6.61 Evaluated Integer

- An evaluated integer is one of the result of a get action that results in either an integer or any.
- Choice between (Get Integer, Get Any).

73.6.62 Evaluated Ratio

- An evaluated ratio is one of the result of a get action that results in either a ratio or any.
- Choice between (Get Ratio, Get Any).

73.6.63 Evaluated String

- An evaluated string is one of the result of a get action that results in either a string or any.
- Choice between (Get String, Get Any).

73.6.64 Evaluated Reference

- An evaluated reference is one of the result of a get action that results in either a reference or any.

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- Choice between (Get Reference, Get Any).

73.6.65 Evaluated List

- An evaluated list is one of the result of a get action that results in either a list or any.
- Choice between (Get List, Get Any).

73.7 Hooks

Table 47: Overview of Hooks

Content Hook::= Catalogued Content Encoding?, Content Encoding Description?
Content Encoding Description ::= *OCTET STRING*
Script Hook ::= Catalogued Script Encoding?, Script Encoding Description?
Script Encoding Description ::= *OCTET STRING*

73.7.1 Content Hook

- Encoding and decoding information enabling the use of the encoded media or non media data. This information contains an identification field for the media encoding standard and a field for parameters associated with the encoding. The semantics of these fields is not defined by MHEG but will be under control of MHEG Format Identifier Registration Authority.
- Sequence of (Catalogued Content Encoding?, Content Encoding Description?).

73.7.2 Content Encoding Description

- Additional information associated with reference to specific encoding/decoding techniques. The semantics of this description may be provided by in the content encoding catalogue.
- OCTET STRING.

73.7.3 Script Hook

- Encoding and decoding information enabling the use of the encoded script representation. This information contains an identification field for the script encoding standard and a field for parameters associated with the encoding MHEG Format Identifier Registration Authority.
- Sequence of (Catalogued Script Encoding?, Script Encoding Description?).

73.7.4 Script Encoding Description

- Additional information associated with a reference to specific encoding/decoding techniques. The semantics of this description may be provided by the script encoding catalogue.
- OCTET STRING.

73.8 Extensibility

Table 48: Overview of extensibility

Catalogued Content Encoding ::= Registered Content Encoding | Proprietary Content Encoding
Registered Content Encoding::= *Imported from ISO/IEC 13522 cat*
Proprietary Content Encoding ::= Prop Cat Entry ID
Catalogued Script Encoding ::= Registered Script Encoding | Proprietary Script Encoding

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Registered Script Encoding ::= *Imported from ISO/IEC 13522 cat*

Proprietary Script Encoding ::= Prop Cat Entry ID

Cat Content Classification ::= Registered Content Classification | Prop Content Classification

Registered Content Classification ::= *Imported from ISO/IEC 13522 cat*

Prop Content Classification ::= Prop Cat Entry ID

Catalogued Script Classification ::= Registered Script Classification | Prop Script Classification

Registered Script Classification ::= *Imported from ISO/IEC 13522 cat*

Prop Script Classification ::= Prop Cat Entry ID

Catalogued Media Type ::= Registered Media Type | Proprietary Media Type

Registered Media Type ::= *Imported from ISO/IEC 13522 cat*

Proprietary Media Type ::= Prop Cat Entry ID

Catalogued Style ::= Registered Style | Proprietary Style

Registered Style ::= *Imported from ISO/IEC 13522 cat*

Proprietary Style ::= Prop Cat Entry ID

Catalogued Event ::= Registered Event | Proprietary Event

Registered Event ::= *Imported from ISO/IEC 13522 cat*

Proprietary Event ::= Prop Cat Entry ID

Catalogued Extended Elementary Action ::=
Registered Extended Elementary Action | Proprietary Extended Elementary Action

Registered Extended Elementary Action ::= *Imported from ISO/IEC 13522 cat*

Proprietary Extended Elementary Action ::= Prop Cat Entry ID

Cat Ext Attribute ::= Registered Extended Attribute | Proprietary Extended Attribute

Registered Extended Attribute ::= *Imported from ISO/IEC 13522 cat*

Proprietary Extended Attribute ::= Prop Cat Entry ID

Prop Cat Entry ID ::= Tail | *OCTET STRING*

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73.8.1 Catalogued Content Encoding

- Identification of the encoding of the content data. There are two types of catalogues: a registered catalogue and a proprietary catalogue.

- Choice between (Registered Content Encoding, Proprietary Content Encoding).

73.8.2 Registered Content Encoding

- Identification of the encoding and decoding techniques within a registered content catalogue. The registered content catalogue is under control of MHEG Format Identifier Registration Authority as specified by ISO/IEC 13522-4.

- Imported from ISO/IEC 13522 cat.

73.8.3 Proprietary Content Encoding

- Identification of the encoding and decoding techniques within a proprietary content catalogue. The using application is responsible for the resolution of references to proprietary content catalogue.

- Prop Cat Entry ID.

73.8.4 Catalogued Script Encoding

- Identification of the encoding of the scripting language. There is two types of catalogues: a registered catalogue and a proprietary catalogue.

- Choice between (Registered Script Encoding, Proprietary Script Encoding).

73.8.5 Registered Script Encoding

- Identification of the scripting language within a registered script catalogue. The registered script catalogue is under control of the MHEG Format Identifier Registration Authority as specified by ISO/IEC 13522-4.

- Imported from ISO/IEC 13522 cat.

73.8.6 Proprietary Script Encoding

- Identification of the scripting language within a proprietary script catalogue.

- Prop Cat Entry ID.

73.8.7 Cat Content Classification

- Identification of data type. For media data, the content classification is used to indicate the perception media, e.g. text, graphics, audio. This information may be used by a negotiation process, a database, or by an MHEG Engine to choose a decoder. It is provided as an optional assistance in determining the type of the data. If there is incompatibility between the hook and the classification information, the Hook is to be preferred.

- Choice between (Registered Content Classification, Prop Content Classification).

73.8.8 Registered Content Classification

- Identification of the type of classification within the registered content catalogue. The Mheg Content classification is under the control of the MHEG Format Identifier Registration Authority as specified by ISO/IEC 13522-4.

- Imported from ISO/IEC 13522 cat.

73.8.9 Prop Content Classification

- Identification of the data type within the proprietary content catalogue.

- Prop Cat Entry ID.

73.8.10 Catalogued Script Classification

- Identification of script type.

- Choice between (Registered Script Classification, Prop Script Classification).

73.8.11 Registered Script Classification

- Identification of the type of classification within the registered script catalogue. The registered script classification is under control of the MHEG Format Identifier Registration Authority as specified by ISO/IEC 13522-4.

- Imported from ISO/IEC 13522 cat.

73.8.12 Prop Script Classification

- Identification of the script type within the proprietary script classification catalogue.

- Prop Cat Entry ID.

73.8.13 Catalogued Media Type

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- Identification of media type.
- Choice between (Registered Media Type, Proprietary Media Type).

73.8.14 Registered Media Type

- Identification of the type of classification within the registered media type catalogue. The registered media type classification is under the control of the MHEG Format Identifier Registration Authority as specified by ISO/IEC 13522-4.
- Imported from ISO/IEC 13522 cat.

73.8.15 Proprietary Media Type

- Identification of the media type within the proprietary media type classification catalogue.
- Prop Cat Entry ID.

73.8.16 Catalogued Style

- Identification of style.
- Choice between (Registered Style, Proprietary Style).

73.8.17 Registered Style

- Identification of the type of classification within the registered style catalogue. The registered style classification is under control of the MHEG Format Identifier Registration Authority as specified by ISO/IEC 13522-4.
- Imported from ISO/IEC 13522 cat.

73.8.18 Proprietary Style

- Identification of the style type within the proprietary style classification catalogue.
- Prop Cat Entry ID.

73.8.19 Catalogued Event

- Identification of event.
- Choice between (Registered Event, Proprietary Event).

73.8.20 Registered Event

- Identification of the type of classification within the registered event catalogue. The registered event classification is under the control of the MHEG Format Identifier Registration Authority as specified by ISO/IEC 13522-4.
- Imported from ISO/IEC 13522 cat.

73.8.21 Proprietary Event

- Identification of the event type within the proprietary event classification catalogue.
- Prop Cat Entry ID.

73.8.22 Catalogued Extended Elementary Action

- Identification of catalogued extended elementary action. Either registered one or proprietary one may be used.
- Choice between (Registered Extended Elementary Action, Proprietary Extended Elementary Action).

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73.8.23 Registered Extended Elementary Action

- Identification of the type of classification within the registered catalogued elementary action catalogue. The registered catalogued elementary action classification is under control of the MHEG Format Identifier Registration Authority as specified by ISO/IEC 13522-4.

- Imported from ISO/IEC 13522 cat.

73.8.24 Proprietary Extended Elementary Action

- Identification of the catalogued elementary action type within the proprietary catalogued elementary action classification catalogue.

- Prop Cat Entry ID.

73.8.25 Cat Ext Attribute

- Identification of extended attribute.

- Choice between (Registered Extended Attribute, Proprietary Extended Attribute).

73.8.26 Registered Extended Attribute

- Identification of the type of classification within the registered extended attribute catalogue. The registered extended attribute classification is under the control of the MHEG Format Identifier Registration Authority as specified by ISO/IEC 13522-4.

- Imported from ISO/IEC 13522 cat.

73.8.27 Proprietary Extended Attribute

- Identification of the extended attribute type within the proprietary extended attribute classification catalogue.

- Prop Cat Entry ID.

73.8.28 Prop Cat Entry ID

- Identification of an entry in a catalogue hierarchy.

- Choice between (Tail, OCTET STRING).

73.8.29 Extensibility Provision

- Extensibility marker provided by the syntax for use by other parts of ISO/IEC 13522 or for a using application. Other parts of ISO/IEC 13522 use the corresponding tags reserved by ISO/IEC 13522-1.

73.9 Presentation space useful definitions

Table 49: Overview of Presentation space useful definitions

OPS Initialisation::= OD?, OS?

min-AVR ::= 0

max-AVR ::= 255

GF Param ::= GF | GF Macro

GF Macro ::= Macro Def ID, GF?

GF ::= Generic Ratio | default-GF

default-GF ::= 1

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X GF ::= GF

Y GF ::= GF

Z GF ::= GF

Length ::= Integer

Point ::= Integer | *terminal*

Temporal Position ::= Point

Size ::= X Spatial Length?, Y Spatial Length?, Z Spatial Length?

X Spatial Length ::= Spatial Length

Y Spatial Length ::= Spatial Length

Z Spatial Length ::= Spatial Length

Spatial Length ::= Length | default-spatial-length

default-spatial-length ::= 65536

Size Spec Param ::= Size Spec | Size Spec Macro

Size Spec Macro ::= Macro Def ID, Size Spec?

Size Spec ::= Lengths Spec | Get List | Get Any

Lengths Spec ::= X Length Spec?, Y Length Spec?, Z Length Spec?

X Length Spec ::= Length Spec

Y Length Spec ::= Length Spec

Z Length Spec ::= Length Spec

Length Spec Param ::= Length Spec | Length Spec Macro

Length Spec Macro ::= Macro Def ID, Length Spec?

Length Spec ::= Length | Relative Length | Get Integer | Get Ratio | Get Any

Relative Length ::= Ratio

Spatial Position ::= X Point?, Y Point?, Z Point?

X Point ::= Point

Y Point ::= Point

Z Point ::= Point

Spatial Position Spec Param ::= Spatial Position Spec | Spatial Position Spec Macro

Spatial Position Spec Macro ::= Macro Def ID, Spatial Position Spec?

Spatial Position Spec ::= Points Spec | Get List | Get Any

Points Spec ::= X Point Spec?, Y Point Spec?, Z Point Spec?

X Point Spec ::= Point Spec

Y Point Spec ::= Point Spec

Z Point Spec ::= Point Spec

Point Spec Param ::= Point Spec | Point Spec Macro

Point Spec Macro ::= Macro Def ID, Point Spec?

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Point Spec ::= Point | Relative Point | Get Integer | Get Ratio | Get Any

Current Point Spec Param ::= Current Point Spec | Current Point Spec Macro

Current Point Spec Macro ::= Macro Def ID, Current Point Spec?

Current Point Spec ::=
Point | Relative Point | Original Point Factor | Current Point Factor | Get Integer | Get Ratio | Get Any

Relative Point ::= Ratio

Original Point Factor ::= Ratio

Current Point Factor ::= Ratio

Duration Spec ::= Length Spec

Initial Point Spec Param ::= Initial Point Spec | Initial Point Spec Macro

Initial Point Spec Macro ::= Macro Def ID, Initial Point Spec?

Terminal Point Spec Param ::= Terminal Point Spec | Terminal Point Spec Macro

Terminal Point Spec Macro ::= Macro Def ID, Terminal Point Spec?

Initial Point Spec ::= Point Spec

Terminal Point Spec ::= Point Spec

Transition Duration Param ::= Generic Integer Param

73.9.1 OPS Initialisation

- Provides the information to build an OPS of an rt-component or a channel. It provides an OD and an OS used to determine the OPS temporal and spatial axes lengths. The AVR is set to the range value provided by ISO/IEC 13522-1.

- Sequence of (OD?, OS?).

73.9.2 min-AVR

- Minimum AVR value provided by ISO/IEC 13522-1.

- INTEGER (Default value: 0).

73.9.3 max-AVR

- Maximum AVR value provided by ISO/IEC 13522-1.

- INTEGER (Default value: 255).

73.9.4 GF Param

- Parameter of GF.

- Choice between (GF, GF Macro).

73.9.5 GF Macro

- Allows the specification of a macro parameter instead of a specified GF value.

- Sequence of (Macro Def ID, GF?).

73.9.6 GF

- Specifies the GF of an rt-component or a channel.

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- Choice between (Generic Ratio, default-GF).

73.9.7 default-GF

- Default GF value provided by ISO/IEC 13522-1.
- INTEGER (Default value: 1).

73.9.8 X GF

- Express the GF on the X axis
- GF.

73.9.9 Y GF

- Express the GF on the Y axis
- GF.

73.9.10 Z GF

- Express the GF on the Z axis
- GF.

73.9.11 Length

- Specifies the length of a range [Start Point, EndList Point]. It is equal to EndList-Point - Start-Point + 1.
- Integer.

73.9.12 Point

- Specifies a position within a duration or a size. It is expressed either in GTU or in GSU. The value 0 corresponds to the initial position of the corresponding duration or size. A reserved value "terminal" corresponds to the terminal position of the corresponding duration or size.
- Choice between (Integer, terminal).

73.9.13 Temporal Position

- Specifies a temporal position. It is expressed in GTU. The position is always specified within a duration.
- Point.

73.9.14 Size

- Specifies a size by providing the length on each axis: X, Y, Z.
- Sequence of (X Spatial Length?, Y Spatial Length?, Z Spatial Length?).

73.9.15 X Spatial Length

- Length on the X axis.
- Spatial Length.

73.9.16 Y Spatial Length

- Length on the Y axis.
- Spatial Length.

73.9.17 Z Spatial Length

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- Length on the Z axis.
- Spatial Length.

73.9.18 Spatial Length

- Specifies the length of a spatial axis. It is expressed in GSU.
- Choice between (Length, default-spatial-length).

73.9.19 default-spatial-length

- Default spatial axis length value provided by ISO/IEC 13522-1.
- INTEGER (Default value: 65536).

73.9.20 Size Spec Param

- Parameter of Size Spec.
- Choice between (Size Spec, Size Spec Macro).

73.9.21 Size Spec Macro

- Allows the specification of a macro parameter instead of a specified Size Spec value.
- Sequence of (Macro Def ID, Size Spec?).

73.9.22 Size Spec

- This elementary action parameter is used to specify a size. It is expressed as a length on each axis: X, Y, Z.
- Choice between (Lengths Spec, Get List, Get Any).

73.9.23 Lengths Spec

- Expressed as a length on each axis: x, y, z.
- Sequence of (X Length Spec?, Y Length Spec?, Z Length Spec?).

73.9.24 X Length Spec

- Length on the X axis.
- Length Spec.

73.9.25 Y Length Spec

- Length on the Y axis.
- Length Spec.

73.9.26 Z Length Spec

- Length on the Z axis.
- Length Spec.

73.9.27 Length Spec Param

- Parameter of Length Spec.
- Choice between (Length Spec, Length Spec Macro).

73.9.28 Length Spec Macro

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- Allows the specification of a macro parameter instead of a specified Length Spec value.
- Sequence of (Macro Def ID, Length Spec?).

73.9.29 Length Spec

- Each length may be specified as an absolute length, a relative length or as a result of a get integer, get ratio or get any actions.
- Choice between (Length, Relative Length, Get Integer, Get Ratio, Get Any).

73.9.30 Relative Length

- Length as a ratio of an interval.
- Ratio.

73.9.31 Spatial Position

- Specifies a spatial position by providing a point on each axis: X, Y, Z.
- Sequence of (X Point?, Y Point?, Z Point?).

73.9.32 X Point

- Position on the X axis.
- Point.

73.9.33 Y Point

- Position on the Y axis.
- Point.

73.9.34 Z Point

- Position on the Z axis.
- Point.

73.9.35 Spatial Position Spec Param

- Parameter of Spatial Position Spec.
- Choice between (Spatial Position Spec, Spatial Position Spec Macro).

73.9.36 Spatial Position Spec Macro

- Allows the specification of a macro parameter instead of a specified Spatial Position Spec value.
- Sequence of (Macro Def ID, Spatial Position Spec?).

73.9.37 Spatial Position Spec

- This elementary action parameter is used to specifiy a spatial position. It is expressed as a length on each axis: X, Y, Z.
- Choice between (Points Spec, Get List, Get Any).

73.9.38 Points Spec

- Define a position. It is expressed as a length on each axis: X, Y, Z.
- Sequence of (X Point Spec?, Y Point Spec?, Z Point Spec?).

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73.9.39 X Point Spec

- Length on the X axis
- Point Spec.

73.9.40 Y Point Spec

- Length on the Y axis
- Point Spec.

73.9.41 Z Point Spec

- Length on the Z axis
- Point Spec.

73.9.42 Point Spec Param

- Parameter of Point Spec.
- Choice between (Point Spec, Point Spec Macro).

73.9.43 Point Spec Macro

- Allows the specification of a macro parameter instead of a specified Point Spec value.
- Sequence of (Macro Def ID, Point Spec?).

73.9.44 Point Spec

- Each point may be specified as an absolute point, a relative point within a length or as a result of a get integer, get ratio or get any actions. An integer is interpreted as an absolute value. A ratio is interpreted as a relative value.
- Choice between (Point, Relative Point, Get Integer, Get Ratio, Get Any).

73.9.45 Current Point Spec Param

- Parameter of Current Point Spec.
- Choice between (Current Point Spec, Current Point Spec Macro).

73.9.46 Current Point Spec Macro

- Allows the specification of a macro parameter instead of a specified Current Point Spec value.
- Sequence of (Macro Def ID, Current Point Spec?).

73.9.47 Current Point Spec

- Each current point may be specified as an absolute point, a relative point within a length, a factor of the original point value, a factor of the current point value or as a result of a get integer, get ratio or get any action. An integer is interpreted as an absolute value. A ratio is interpreted as a relative value.
- Choice between (Point, Relative Point, Original Point Factor, Current Point Factor, Get Integer, Get Ratio, Get Any).

73.9.48 Relative Point

- Specified as a ratio to be mapped on an interval.
- Ratio.

73.9.49 Original Point Factor

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- Scaling factor in relation to the original value of this point. It is defined as a positive ratio which is used as a multiplier of the original value of this point.

- Ratio.

73.9.50 Current Point Factor

- Scaling factor in relation to the current value of this point. It is defined as a positive ratio which is used as a multiplier of the current value of this point.

- Ratio.

73.9.51 Duration Spec

- This elementary action parameter is used to specify a duration.

- Length Spec.

73.9.52 Initial Point Spec Param

- Parameter of Initial Point Spec.

- Choice between (Initial Point Spec, Initial Point Spec Macro).

73.9.53 Initial Point Spec Macro

- Allows the specification of a macro parameter instead of a specified Initial Point Spec value.

- Sequence of (Macro Def ID, Initial Point Spec?).

73.9.54 Terminal Point Spec Param

- Parameter of Terminal Point Spec.

- Choice between (Terminal Point Spec, Terminal Point Spec Macro).

73.9.55 Terminal Point Spec Macro

- Allows the specification of a macro parameter instead of a specified Terminal Point Spec value.

- Sequence of (Macro Def ID, Terminal Point Spec?).

73.9.56 Initial Point Spec

- Initial position on the temporal axis

- Point Spec.

73.9.57 Terminal Point Spec

- Terminal position on the temporal axis

- Point Spec.

73.9.58 Transition Duration Param

- An optional parameter which can be provided for certain elementary actions within the presentation behaviour. It is expressed in GTU. When a transition duration is specified, the corresponding elementary action is to be processed during the specified duration, e.g. for set audible volume, the audible volume value changes gradually from its previous value to the specified value within the specified transition duration.

- Generic Integer Param.

73.10 Constants useful definitions

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Table 50: Overview of constants useful definitions

Event Data ::= Value
Event ::= List
Channel Perceptability::= *on / off*
Channel Availability Status ::= *available / not-available*
Style::= List
Max Interact Required ::= Integer
Min Interact Required ::= Integer
Modifiability ::= *modifiable / not-modifiable*
Selectability ::= *selectable / not-selectable*
Modification Status ::= *modified / not-modified / modifying*
Selection Status ::= *selected / not-selected*
Interaction Status ::= Selection Status | Modification Status
Interaction Type ::= *selection / modification*
Interaction Type Macro ::= Macro Def ID, Interaction Type?
Interaction Type Param ::= Interaction Type | Interaction Type Macro
Stream Identification::= Stream ID | *all-streams*
Stream Identification Macro ::= Macro Def ID, Stream Identification?
Stream Identification Param::= Stream Identification | Stream Identification Macro
Stream Chosen State ::= *chosen / not-chosen / partially-chosen*
Stream Choice ::= Generic List
GVF ::= GF
PCV ::= Integer | min-AVR | max-AVR
CV ::= Integer | min-AVR | max-AVR
OV ::= Integer | min-AVR | max-AVR
Point Type Param ::= *absolute / relative*
Spatial Control Macro ::= Macro Def ID, Spatial Control?
Spatial Control Param ::= Spatial Control | Spatial Control Macro
Expected Axis Result Param ::= *x / y / z / xyz*
User Spatial Control ::= *allowed / not-allowed*
Spatial Control ::= *moving / resizing / scaling / scrolling*
GSF ::= X GF?, Y GF?, Z GF?
PVS Position ::= Spatial Position Spec
PAP ::= Spatial Position Spec
OVS Proj Strategy ::= *fixed / calculated*
OVS Position ::= Spatial Position Spec

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OAP ::= Spatial Position Spec

OVS ::= Size Spec

Resizing Strategy ::= *fixed* | *minimum* | *grows-only*

Aspect Ratio ::= *preserved* | *not-preserved*

OS ::= Size

Expected PVD Result ::= *initial-temporal-position* | *terminal-temporal-position* | *duration*

Expected PVD Result Macro ::= Macro Def ID, Expected PVD Result?

Expected PVD Result Param ::= Expected PVD Result | Expected PVD Result Macro

Expected OVD Result ::= *initial-temporal-position* | *terminal-temporal-position* | *duration*

Expected OVD Result Macro ::= Macro Def ID, Expected OVD Result?

Expected OVD Result Param ::= Expected OVD Result | Expected OVD Result Macro

Timestone ID ::= Generic Integer

Temporal Termination ::= *freeze* | *stop*

OD ::= Integer | *infinite*

Presentation Priority ::= Generic Integer | *up-priority* | *down-priority*

Perceptability ::= Generic Ratio

RPS Assignment ::= Channel Reference | Evaluated Reference | *prps*

Ancestor ::= Integer | *root*

Sibling ::= Integer

EmptyChild ::= Integer | *last*

Child ::= Generic Integer | *last* | *random*

Navigation Command ::= Child | EmptyChild | Sibling | Ancestor

Navigation Command Macro ::= Macro Def ID, Navigation Command?

Navigation Command Param ::= Navigation Command | Navigation Command Macro

Termination Status ::= *terminated* | *not-terminated*

Running Status ::= *running* | *not-running*

Rt-Availability Status ::= *available* | *not-available*

Activation Status ::= *active* | *inactive*

Preparation Status ::= *ready* | *not-ready*

Cat Ext Attribute Macro ::= Macro Def ID, Cat Ext Attribute?

Cat Ext Attribute Param ::= Cat Ext Attribute | Cat Ext Attribute Macro

Update Command ::= *add* | *remove* | *replace*

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73.10.1 Event Data

- Specifies an associated data with an event.
- Value.

73.10.2 Event

- Specifies an event.
- List.

73.10.3 Channel Perceptability

- Specifies the channel perceptability. Choice between "on" and "off".
- Choice between (on, off).

73.10.4 Channel Availability Status

- Indicates whether a channel is available.
- Choice between (available, not-available).

73.10.5 Style

- A catalogued entry, either registered or proprietary that gives a logical style to an rt-component.
- List.

73.10.6 Max Interact Required

- An integer greater than or equal to 0 to indicate the maximum interaction required for an rt-component.
- Integer.

73.10.7 Min Interact Required

- A integer greater than or equal to 0 to indicate the minimum interaction required for an rt-component.
- Integer.

73.10.8 Modifiability

- Indicates whether a rt-component is modifiable.
- Choice between (modifiable, not-modifiable).

73.10.9 Selectability

- Specifies a value of the maximum interaction required attribute for the selection of an rt-component.
- Choice between (selectable, not-selectable).

73.10.10 Modification Status

- Indicates the result of the user modification.
- Choice between (modified, not-modified, modifying).

73.10.11 Selection Status

- Indicates the results of the user selection.
- Choice between (selected, not-selected).

73.10.12 Interaction Status

- Indicates if an rt-component may be modified or selected.
- Choice between (Selection Status, Modification Status).

73.10.13 Interaction Type

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- Specifies the interaction type.
- Choice between (selection, modification).

73.10.14 Interaction Type Macro

- Allows the specification of a macro parameter instead of a specified Interaction Type value.
- Sequence of (Macro Def ID, Interaction Type?).

73.10.15 Interaction Type Param

- Parameter of Interaction Type.
- Choice between (Interaction Type, Interaction Type Macro).

73.10.16 Stream Identification

- Choice among a stream identifier or "all streams".
- Choice between (Stream ID, all-streams).

73.10.17 Stream Identification Macro

- Allows the specification of a macro parameter instead of a specified Stream Identification value.
- Sequence of (Macro Def ID, Stream Identification?).

73.10.18 Stream Identification Param

- Parameter of Stream Identification.
- Choice between (Stream Identification, Stream Identification Macro).

73.10.19 Stream Chosen State

- Indicates stream chosen state for each stream within an rt-mux, and for each rt-mux.
- Choice between (chosen, not-chosen, partially-chosen).

73.10.20 Stream Choice

- A list of chosen stream IDs in an rt-mux.
- Generic List.

73.10.21 GVF

- Specifies the GVF to be applied during the mapping of the OPS into its RPS.
- GF.

73.10.22 PCV

- Specifies the PCV of a content object that is a projection of the CV to its parent RPS.
- Choice between (Integer, min-AVR, max-AVR).

73.10.23 CV

- Specifies the CV of a content object. It is initialised by the OV and may be changed by using the Set CV action.
- Choice between (Integer, min-AVR, max-AVR).

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73.10.24 OV

- Specifies the OV of a content object. The OV shall be defined within the AVR. It is used to initialise the CV of each rt-content created from this content.
- Choice between (Integer, min-AVR, max-AVR).

73.10.25 Point Type Param

- Choice between "absolute" and "relative".
- Choice between (absolute, relative).

73.10.26 Spatial Control Macro

- Allows the specification of a macro parameter instead of a specified Spatial Control value.
- Sequence of (Macro Def ID, Spatial Control?).

73.10.27 Spatial Control Param

- Choice among "moving", "resizing", "scaling" and "scrolling".
- Choice between (Spatial Control, Spatial Control Macro).

73.10.28 Expected Axis Result Param

- Choice among "x", "y", "z" or "xyz".
- Choice between (x, y, z, xyz).

73.10.29 User Spatial Control

- Indicates functions of user spatial controls are allowed or not.
- Choice between (allowed, not-allowed).

73.10.30 Spatial Control

- Indicates functions of user spatial controls.
- Choice between (moving, resizing, scaling, scrolling).

73.10.31 GSF

- A set of three GF used for each axis.
- Sequence of (X GF?, Y GF?, Z GF?).

73.10.32 PVS Position

- Specifies the Position of the PVS relatively to the origin of the OS or to another PVS.
- Spatial Position Spec.

73.10.33 PAP

- Specifies the PAP of the PVS. It is used to position the PVS within the RPS.
- Spatial Position Spec.

73.10.34 OVS Proj Strategy

- Specifies the projection strategy of the OVS to the PVS.
- Choice between (fixed, calculated).

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73.10.35 OVS Position

- Specifies the Position of the OVS relatively to the origin of the OS.
- Spatial Position Spec.

73.10.36 OAP

- Specifies the OAP of the OVS. It is used to position the OVS within its OS.
- Spatial Position Spec.

73.10.37 OVS

- Specifies the OVS of an rt-component. It is specified as a subset of the OS.
- Size Spec.

73.10.38 Resizing Strategy

- Defines the resizing strategy of an rt-composite.
- Choice between (fixed, minimum, grows-only).

73.10.39 Aspect Ratio

- Defines if the aspect ratio of an rt-component to be preserved.
- Choice between (preserved, not-preserved).

73.10.40 OS

- Specifies the OS of a component object or a channel. It is used to initialise the OS of an rt-component. It is also used to build the spatial axes of the OPS, of each rt-component created from this component, or the CPS.
- Size.

73.10.41 Expected PVD Result

- Choice among "initial-temporal-position", "terminal-temporal-position" or "duration".
- Choice between (initial-temporal-position, terminal-temporal-position, duration).

73.10.42 Expected PVD Result Macro

- Allows the specification of a macro parameter instead of a specified Expected PVD Result value.
- Sequence of (Macro Def ID, Expected PVD Result?).

73.10.43 Expected PVD Result Param

- Parameter of Expected PVD Result.
- Choice between (Expected PVD Result, Expected PVD Result Macro).

73.10.44 Expected OVD Result

- Choice among "initial-temporal-position", "terminal-temporal-position" or "duration".
- Choice between (initial-temporal-position, terminal-temporal-position, duration).

73.10.45 Expected OVD Result Macro

- Allows the specification of a macro parameter instead of a specified Expected OVD Result value.
- Sequence of (Macro Def ID, Expected OVD Result?).

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73.10.46 Expected OVD Result Param

- Parameter of Expected OVD Result.
- Choice between (Expected OVD Result, Expected OVD Result Macro).

73.10.47 Timestone ID

- A generic integer. The value 0 is reserved.
- Generic Integer.

73.10.48 Temporal Termination

- Determines the presentation when a target reaches to the terminal temporal position.
- Choice between (freeze, stop).

73.10.49 OD

- Specifies the OD of a component object or a channel. It is used to initialise the OD of an rt-component. It is also used to build the temporal axis of the OPS, of each rt-component created from this component, or the CPS.
- Choice between (Integer, infinite).

73.10.50 Presentation Priority

- Determines the presentation stacking order of the rt-components assigned in a same RPS.
- Choice between (Generic Integer, up-priority, down-priority).

73.10.51 Perceptability

- A ratio which defines the perceptability of an rt-component. If Perceptability Status is set to zero rt-content is not perceived. If it is set to 100 the original perception of of the rt-content is perceived.
- Generic Ratio.

73.10.52 RPS Assignment

- RPS is either a channel reference, an evaluated reference or PRPS.
- Choice between (Channel Reference, Evaluated Reference, prps).

73.10.53 Ancestor

- Navigation path to reach an ancestor
- Choice between (Integer, root).

73.10.54 Sibling

- Navigation path to reach a relative sibling
- Integer.

73.10.55 EmptyChild

- Navigation path to reach an empty socket
- Choice between (Integer, last).

73.10.56 Child

- Navigation path to reach a child

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- Choice between (Generic Integer, last, random).

73.10.57 Navigation Command

- It gives a navigation path.
- Choice between (Child, EmptyChild, Sibling, Ancestor).

73.10.58 Navigation Command Macro

- Allows the specification of a macro parameter instead of a specified Navigation Command value.
- Sequence of (Macro Def ID, Navigation Command?).

73.10.59 Navigation Command Param

- Parameter of Navigation Command.
- Choice between (Navigation Command, Navigation Command Macro).

73.10.60 Termination Status

- Represents the process of an rt-script.
- Choice between (terminated, not-terminated).

73.10.61 Running Status

- Indicates if an rt-object is running or not
- Choice between (running, not-running).

73.10.62 Rt-Availability Status

- Indicates if the rt-object has been created from model object or not
- Choice between (available, not-available).

73.10.63 Activation Status

- Indicates if a link object has been activated or not
- Choice between (active, inactive).

73.10.64 Preparation Status

- Indicates the availability of MHEG objects to the MHEG Engine.
- Choice between (ready, not-ready).

73.10.65 Cat Ext Attribute Macro

- Allows the specification of a macro parameter instead of a specified Cat Ext Attribute value.
- Sequence of (Macro Def ID, Cat Ext Attribute?).

73.10.66 Cat Ext Attribute Param

- Parameter of Cat Ext Attribute.
- Choice between (Cat Ext Attribute, Cat Ext Attribute Macro).

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73.10.67 Update Command

- When an attribute of an MHEG entity takes a list of values, this parameter is used to update this list of values. It is used in Set Alias action, Set Timestones action, Set Stream Choice action and Attach Anchor action. It is always used as Attribute Specification = List of (List of attribute value, Update Command)*. The following applies:

– If the update command is equal to "replace", the list of current attribute values of the target is removed and replaced by the list of attribute values provided as parameters of the elementary action.

– If the update command is equal to "add", the list of attribute values provided as parameters of the elementary action is added to the current attribute values list of the target. Attributes that already exists in the current attribute values list are ignored.

– If the update type is equal to "remove", the list of attribute values currently provided as parameter of the elementary action is removed from the current attribute values list of the target. Attribute that does not exist in the current attribute values list are ignored.

Combination of "add" and "remove" update commands may be used within a given attribute specification list. In this case, each command should be evaluated in the order of the list.

A "replace" update command should not be used together with "add" or/and "remove within a given attribute specification list,. If they are used together, the elementary action shall be ignored.

- Choice between (add, remove, replace).

73.11 Comparison value constants

Table 51: Overview of comparison value constants

Comparison Value Constant ::= Preparation Status I Activation Status I Rt-Availability Status I Running Status I Termination Status I *prps* I *infinite* I Temporal Termination I Aspect Ratio I Resizing Strategy I OVS Proj Strategy I User Spatial Control I Stream Chosen State I Selection Status I Modification Status I Channel Availability Status I Channel Perceptability

73.11.1 Comparison Value Constant

- Specifies the constants that may be used as a comparison value within a link condition of a link object.

- Choice between (Preparation Status, Activation Status, Rt-Availability Status, Running Status, Termination Status, prps, infinite, Temporal Termination, Aspect Ratio, Resizing Strategy, OVS Proj Strategy, User Spatial Control, Stream Chosen State, Selection Status, Modification Status, Channel Availability Status, Channel Perceptability).

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Annex A
(normative)
ASN.1 notations (Level C)
Coded representation (Level D)

Useful definitions

```
-- Copyright statement:
--  - - - - - - - - - - - - - - -
-- (c) International Organization for Standardization 1997.
--  Permission to copy in any form is granted for use with conforming MHEG Engines and applications
--  as defined in this part of ISO/IEC 13522 provided this notice is included in all copies.
--

ISOMHEG-ud {joint-iso-itu-t(2) mheg(19) version(1) useful-definitions(9)}
DEFINITIONS
    IMPLICIT TAGS
::= BEGIN

EXPORTS
    Aspect-Ratio,
    Cat-Content-Classification,
    Cat-Ext-Attribute,
    Cat-Ext-Attribute-Param,
    Catalogued-Event,
    Catalogued-Extended-Elementary-Action,
    Catalogued-Media-Type,
    Catalogued-Script-Classification,
    Catalogued-Style,
    Channel-Perceptability,
    Channel-Target-Param,
    Class-ID,
    Comparison-Value-Constant,
    Component-Class,
    Content-Hook,
    Current-Point-Spec-Param,
    Data-Reference,
    Evaluated-Integer,
    Evaluated-List,
    Evaluated-Reference,
    Evaluated-Value,
    Generic-Integer,
    Generic-Integer-Param,
    Generic-List-Elt-ID-Param,
    Generic-List-Param,
    Generic-Numeric-Param,
    Generic-Ratio-Param,
    Generic-Value,
    Generic-Value-Param,
    GF-Param,
    Initial-Point-Spec-Param,
    Interaction-Status,
    Interaction-Type-Param,
    Macro-Def-ID,
    Mh-object-Class,
```

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```
    Mh-Reference,
    Mh-Target-Param,
    Model-Class,
    OVS-Proj-Strategy,
    Point-Spec,
    Point-Spec-Param,
    Presentation-Priority,
    Resizing-Strategy,
    Return-Target-Param,
    RPS-Assignment,
    Rt-Component-Channel-Tg-Param,
    Rt-Component-Reference,
    Rt-Component-Target-Param,
    Rt-Composite-Target-Param,
    Rt-Content-Reference,
    Rt-Content-Target-Param,
    Rt-Mux-Target-Param,
    Rt-Script-Target-Param,
    Rt-Target-Param,
    Script-Hook,
    Size,
    Size-Spec-Param,
    Socket-Target-Param,
    Spatial-Control-Param,
    Spatial-Position-Spec-Param,
    Target-Param,
    Temporal-Termination,
    Terminal-Point-Spec-Param,
    Update-Command,
    User-Spatial-Control,
    Value,
    OV;

IMPORTS
    Registered-Content-Encoding,
    Registered-Script-Encoding,
    Registered-Content-Classification,
    Registered-Script-Classification,
    Registered-Media-Type,
    Registered-Style,
    Registered-Event,
    Registered-Extended-Elementary-Action,
    Registered-Extended-Attribute FROM ISOMHEG-cat {joint-iso-itu-t(2) mheg(19) version(1) catalogues(12)};

Mh-object-Class ::= SEQUENCE {
mheg-id                         Mheg-ID OPTIONAL,
description                     [0] Description OPTIONAL
}
Class-ID ::= CHOICE             {
action-class-id                 [0] INTEGER { action-class-id (1)},
link-class-id                   [1] INTEGER { link-class-id (2)},
script-class-id                 [2] INTEGER { script-class-id (3)},
content-class-id                [3] INTEGER { content-class-id (4)},
multiplexed-content-class-id    [4] INTEGER { multiplexed-content-class-id (5)},
composite-class-id              [5] INTEGER { composite-class-id (6)},
container-class-id              [6] INTEGER { container-class-id (7)},
descriptor-class-id             [7] INTEGER { descriptor-class-id (8)},
```

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```
...
}
Description ::= SEQUENCE        {
name                            GraphicString OPTIONAL,
owner                           [0] GraphicString OPTIONAL,
version                         [1] GraphicString OPTIONAL,
date                            UTCTime OPTIONAL,
keywords                        SEQUENCE OF GraphicString OPTIONAL,
copyright                       [2] GraphicString OPTIONAL,
copyright-id                    OCTET STRING OPTIONAL,
copyright-number                [3] OCTET STRING OPTIONAL,
licence                         [4] GraphicString OPTIONAL,
cache-priority                  INTEGER OPTIONAL,
comments                        [5] GraphicString OPTIONAL,
...
}
Model-Class ::= SEQUENCE        {
COMPONENTS OF Mh-object-Class
}
Component-Class ::= SEQUENCE    {
COMPONENTS OF Model-Class,
ops-initialisation              [1] OPS-Initialisation OPTIONAL
}
Tail-Param ::= CHOICE           {
tail SEQUENCE OF INTEGER,
tail-macro                      [0] Tail-Macro
}
Tail-Macro ::= SEQUENCE         {
macro-def-id                    Macro-Def-ID,
tail SEQUENCE OF INTEGER OPTIONAL
}
External-ID ::= SEQUENCE        {
public-id                       PrintableString OPTIONAL,
system-id                       OCTET STRING OPTIONAL
}
Mheg-ID ::= SEQUENCE            {
application-id                  OCTET STRING OPTIONAL,
mh-number                       INTEGER
}
Socket-Identification ::= CHOICE    {
socket-id                       Socket-ID,
alias                           GraphicString
}
Socket-ID ::= SEQUENCE          {
root-rt-composite-reference     Root-Rt-Composite-Reference,
tail SEQUENCE OF INTEGER
}
Macro-Def-ID ::= CHOICE         {
string                          GraphicString,
integer                         INTEGER
}
Reference ::= CHOICE            {
null-data                       NULL,
mheg-id-reference               Mheg-ID,
external-id-reference           [0] External-ID,
container-element-reference     [1] Container-Element-Reference,
null-mh                         [2] NULL,
this                            [3] NULL,
```

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