D1.3 Metadata Framework Requirements

Action	Name	Date	Approbation
Author	D1.3 working group		
Approved by			
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History

Date	Version & Status	Author	Modifications
10/12/2007	1.0.draft	CD	Creation
15/01/2008	1.1 draft	Chabane Djeraba (CNRS)	First version of requirements, including those discussed in Madrid. + Focus on a limited number of concepts
16/01/2008	1.2 draft	Antonio F. Gómez Skarmeta (Facultad de Informática Universidad de Murcia)	Adding scenario applications + structural requirements
18/01/2008	1.3 draft		Phone meetings
22/01/2008	1.3 draft	D. Pakkala, J. Laitakari	Glossary of Daniel Pakkala and J. Laitakari Integration of MPEG-7 methodology, after 18/01/2008 phone meetings
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05/02/08	D1.3.template.draft.5	Juhani Laitakari, Mika Rautiainen	Some polishing actions
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15/02/2008	D1.3.V1.0	Eyal Nitzani	Ad Insertion Scenario
15/02/08	D1.3.V1.0 D1.3.scenario-analysis-Richmediacom	Xavier Madigou	Requirement for Rich media communication scenarios, CamMetadata requirement for the presentation layer, for Cam bundle consummation description on Camclient side.
15/02/08	D.1.3.V1.0	Juhani Laitakari	Requirement analysis of Collaborative and Context-Aware Content Delivery, and Collaborative Content Creation -scenarios
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		Chabane Djeraba, Jean Martinet	
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20/02/08	D1.3.V.1.1 (D1.3.scenario analysis-ATOS-UMU-DracoTIC-scenarios-1)	Eduardo Martínez, Diego Esteban	ATOS-UMU-DracoTIC contribution to the D1.3. requirements specification (version 1)
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18/04/2008	D1.3V1.1_ATOS_UMU_DRACOTIC	Eduardo Martinez Graciá	Examples to Common Operational Requirements on CAM Core Meta-model
18/04/2008	D1.3.V1.1_VTT_elaboration	Juhani Laitakari	Examples on Operational requirements on CAM Core meta-model in CAM Bundle lifecycle steps. Some additional modifications on Operational requirements..... CAM Bundle attributes Relationships between CAM Objects inside....
24/04/2008	D1.3.V1.1-mediateam-examples.doc	Mika Rautiainen	Additional examples on D1.3

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Milestones

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D1.3.template.draft.4	The template draft revisions.	February 01 2008	
D1.3.template.draft.5	Comments from partners	February 05, 2008	
D1.3.template.final		February 08 2008	
D1.3.v1.0	The first public release version	February 15, 2008	
D1.3.v1.1	Future changes/corrections to the first public release. Iterative refinement of contributions from each partner.	February 29, 2008	…….
D1.3.final	Final version of D1.3	30, June 2008	

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1. Executive Summary

This document contains the metadata requirements for CAM4Home. The framework of this metadata is divided into three main sections: Core Metadata, Supplementary Metadata and external Metadata. (See part 5) Each section of Metadata framework has its own requirements that define its type and characteristic. Tables 2 thru 4 describe requirements for Core Metadata. Tables 7 and 8 describe requirements for Supplementary Metadata. This document describes also operations that Metadata should enable and relationships between objects in Core Metadata (tables 5 and 6). There are some Metadata standard that are available but outside the scope of CAM4Home Metadata Framework (external Metadata), these metadata are listed in the table 10. Finally Table 10 lists all requirements for CAM Meta model definition language.

2. Objective

The objective of metadata framework requirement definition is to analyse and specify requirements for the CAM4Home metadata framework based on the identified scenarios and use cases. The requirements will steer the technology choices and platform architecture activities in WP3 and WP4. The role of metadata in CAM content creation, distribution, delivery, interpretation and playback is crucial. The CAM4Home metadata framework will support integration of existing metadata definitions for specific pieces of content that are bundled together to compose CAM content. The metadata framework will be able to describe the information needed for personalized and co-ordinated cross-network and cross-media distribution and delivery of the CAM content in and from digital home environment. The task will produce refined requirements for the metadata framework and CAM content metadata concentrating on following technological challenges:

- Content personalization support
- Content adaptation support
- Content awareness via content analysis algorithms
- Integration of content and content services
- QoS support in delivery and playback of content

3. Glossary

3.1. Definitions

The reference source of the glossary is CAM-Glossary-V1E0, available in Global Technical Area/Technical CAM4HOME glossary of the project website.

Term	Descriptions
Actor	External stakeholder that interacts with the system where stakeholder may refer either to human, organizational or computational entity.
CAM Bundle	A file or stream that represents aggregation of two or more CAM Objects and a description of the aggregation using CAM Metadata.
CAM Meta-model Definition Language	Technology for representing the ontological constraints for CAM Bundle descriptions. An example of definition language is MPEG-7 DDL, which is a modification of XML Schema. For CAM4Home, definition language may conform completely to an already existing technology if allowed by the requirements.
CAM Element	Atomic unit of aggregation in CAM Bundles. May be content or service. (e.g. digital picture, video clip, MMS service, …)
CAM Element Metadata	Existing metadata of a CAM element. (e.g. Metadata of a video clip, digital picture, MMS service, …)
CAM Metadata	Descriptive information about aggregation in a CAM Bundle using the attributes and relations defined by the CAM4Home metadata framework.
CAM Meta-model	a high level specification of structural constraints, requisites and relationships between elements in the description of CAM Bundles
CAM Object	An object combined from a single CAM Element and its CAM Element Metadata.
Content	Is data that is interpretable and bears semantic meaning via human senses. Content may also be interpretable by computational means. Content can be represented by a file or data stream.
Deployment	The process of installing software to host for execution. Deployment may be manual or automatic/dynamic.
Deployment Environment	Collection of execution environments where deployment of software is made for executing the software.
Deployment unit	Self-contained piece of software that can be deployed and executed on a host.
Execution environment	The environment of a host where deployed software is executed.
End User Service	A software application that produces added value to end user(s) and may utilize software services in its operation. (e.g. VoD service)
End User Service Platform	A platform in charge of delivering a service to the end user.
Host	Physical entity of a system where software can be deployed and executed.
IPTV metadata	A descriptive data associated with a content asset package or file. It may vary in depth from merely identifying the content package title or information to populate an EPG to providing a complete index of different scenes in a movie or providing business rules detailing how the content package may be displayed, copied, or sold. Separate uses for metadata have originated from the studios, distribution networks (Cable, Satellite, wire line carriers), down to the IPTV terminal device (e.g. STBs, PVRs).
Linear distribution	Synchronized distribution, receivers view Content simultaneously. Broadcast transmission (push)
Media	An end-to-end mean of communication to deliver or store content for human users. (e.g. Television, Radio)
Metadata	Metadata is data about data. Metadata describes characteristics of information-bearing entities to aid in the identification, discovery, assessment, and management of the described entities. Metadata in CAM4Home must not only to be able to interpret and process by

Term	Descriptions
	computational means but also by human interact and reading (e.g. XML based representation of metadata).
Metadata fragments	A metadata fragment is a self-consistent atomic portion of a metadata instance. In this context, self-consistency means that fragments can be obtained in a random order and each fragment can be transmitted and updated independently.
Metadata instance	A metadata instance is the data instance describing the instance of content or user, etc. A metadata instance has its data-model defined by corresponding metadata schema.
Metadata schema	A metadata schema is the representation format for specifying data-model describing target instance.
Multimedia content	Data that's representation to humans requires use and interpretation of multiple different content types. (e.g. combinations of Audio, Video, Text, Pictures, …)
Non-linear distribution	Receivers are able to view content on-demand: e.g. Video-on-demand (pull-type) services, web downloads
Ontology	Data model that represents a set of concepts within a domain and the relationships between those concepts. It is used to reason about the objects within that domain.
Service	Assistance or benefit afforded to another. In CAM4Home context services are provided by or within the overall hardware and software system either to human users (see End-User Service) or to software entities (see Software Service).
Service Component	Self-contained piece of software that follows a specified service component model and that can be deployed and executed in host specific execution environment. Service component implements software service when executed. Service components can be built from multiple software components.
Service Component model	A set of interface specifications for a service component managing the lifecycle of the service component in its execution environment.
Service Description	Service description is description of software service utilized in the development of software (by software developers) as well as during runtime execution (by software for registering, discovering and binding services via the service framework). Accordingly service description is a sort of Application Programming Interface (API) for utilising and documenting the service described by the description. Multiple software services may have a common service description.
Service Framework	Service framework is the instance of runtime registry of machine interpretable service descriptions and corresponding software services. Service framework provides registration, discovery, binding and unregistering the functionality of software services based on service descriptions.
Service Management	Control of various aspects of a service. In CAM4Home context these aspects maybe e.g. configuration, operation, life-cycle, quality.
Service Registry	A runtime registry of machine interpretable service descriptions.
Service Repository	Service repository is the development time registry of human understandable service descriptions that can be utilized in software development. Service repository may also be machine interpretable.
Service Platform	A collection of software services that can be utilized in development of applications, end user services or software services and is accessible via the execution environment. Service Platform may also specify and provide component model and service framework (e.g. OSGi). Service Platform may be local (executed on a single host) or distributed (executed on multiple networked hosts).
Software Service Platform	A hardware and software that serve as a foundation for developing and deploying one or several software services.
Software Service	Software service is an instance of functionality of software executed in one or more host(s) that can be registered, discovered and invoked by other software executed in the same or another host. Software service is specified by a service description.

Proposed new terms	Descriptions
CAM Core Meta-model	The meta-model that concerns the metadata related to CAM Bundles (CAM Element metadata, CAM Metadata).
CAM Supplementary Meta-model	The meta-model that concerns the metadata that is related to domains outside the CAM Bundle concept (user profiles, environment descriptions, device profiles).

4. CAM4HOME application areas

The following table lists all the CAM4HOME application areas.

Scenario	Scenario analysis responsibilities	Realisation of requirement extraction from scenarios
Collaborative and Context-Aware content Delivery	VTT	Yes
Collaborative content creation	VTT	Yes
Collaborative multimedia creation	Media Team, Oulu University	Yes
Peer-to-peer (Web, downloading, ...)	GET, NDS	No
Web SIP Communication	GET	No
Online Journalism	Murcia and ATOS, DracoTIC	Yes
Online Learning	Murcia, ATOS, DracoTIC	Yes
Game/TV Bundle Scenario		
Rich media communication	Orange – IWEDIA - Thomson	Yes (Thomson)
Mobile device content consumption and creation	Nokia	Yes
Shared Video	Media Team, Oulu University, Thomson	Yes (Oulu University)
Community TV Channel	CNRS	Yes
Ad Insertion	SCOPUS	Yes

To find additional detailed information on any of these scenarios refer to the deliverable in D1.1.

5. Characteristics of CAM4HOME metadata framework

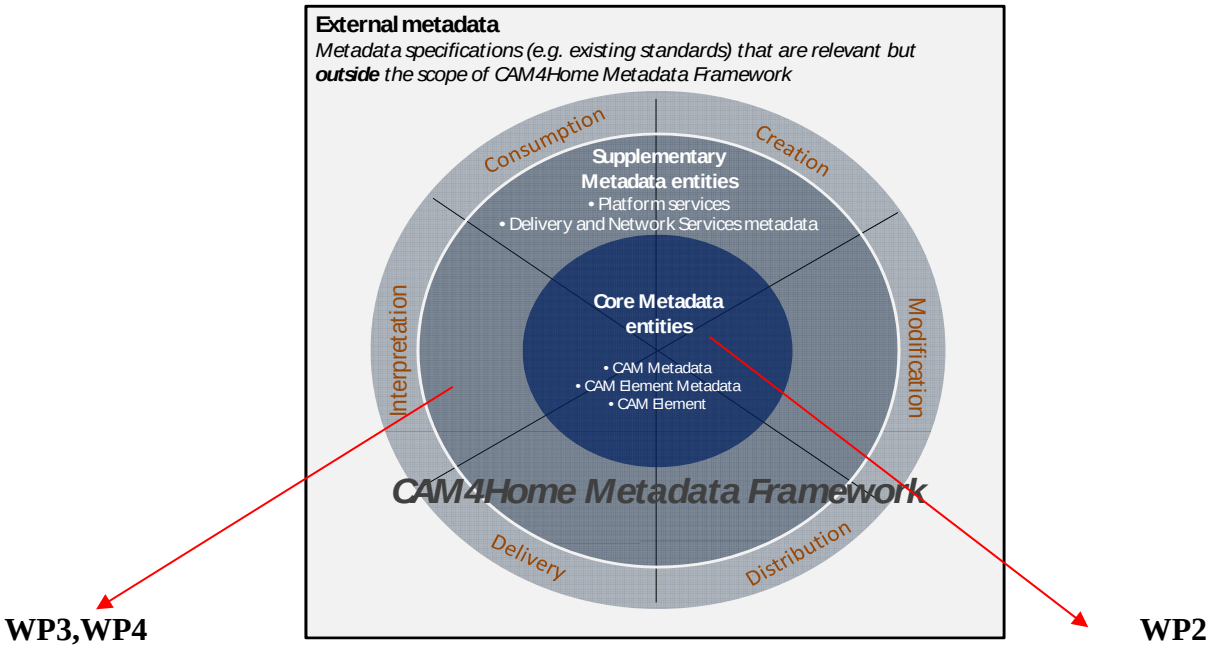

Figure 1. Overview of the CAM4home Metadata Framework structure

As defined in the CAM4Home FPP, the concept of Collaborative Aggregated Multimedia (CAM) refers to aggregation and composition of individual multimedia content and service entities into a content bundle that can be delivered as a semantically coherent composition of content and related services over various communication channels. CAM Bundle contains two or more CAM Elements (video, audio, text etc. Multimedia content). The function of the CAM Element metadata and the CAM metadata are to describe the aggregation of the CAM Elements inside the bundle.

The data model supporting the aforementioned functionality is called **Core Metadata.** It defines the structures of CAM Bundles and Objects and supports their manipulation during their lifecycle phases.

Supplementary Metadata defines the sections of Metadata Framework that are required to enable interoperability of the platform services and supplement the manipulation of Core Metadata. Some examples of Supplementary Metadata are user profiling, community, administrative and system metadata.

This document focuses primarily to define requirements for the Core Metadata, but as a by-product, also produces requirements for Supplementary Metadata. These requirements are further utilized in WP3 and WP4, whereas requirements for the Core Metadata are utilized in WP2.

Figure 1 portrays the CAM4Home Metadata Framework structure. The circle defines the Metadata Framework ecosystem by categorizing Bundles and Objects lifecycle into following six phases:

Creation, Modification, Distribution, Delivery, Interpretation and Consumption.

The metadata framework underlines also “external” meta-data that isn’t related to CAM Bundles or the CAM Elements. This external metadata contains all existing standards and specifications that are somewhat related to the CAM4Home metadata types, but are not contained in the CAM4Home Metadata Framework (i.e. outside the scope of the project).

Figure 2 shows two different instances of data that "flow" through the CAM4Home ecosystem, namely CAM Bundle and CAM Object. CAM Bundle defines the relationship between two or more CAM Objects, whereas CAM Objects define single CAM Element and its descriptive metadata.

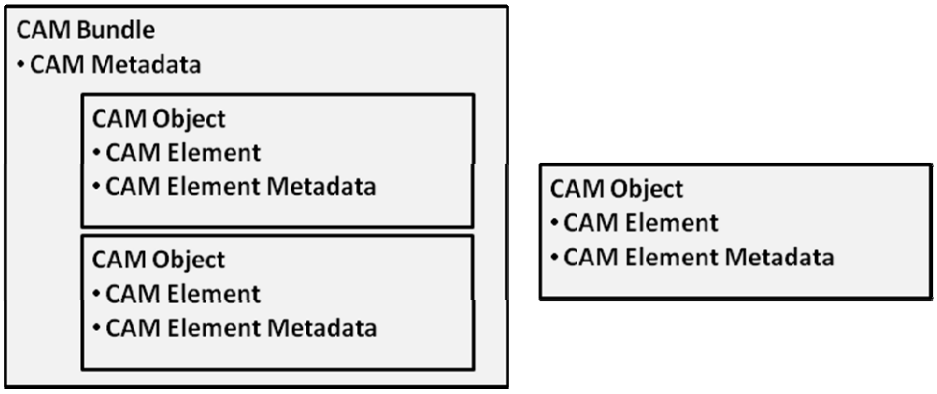

Figure 2. Examples of CAM Bundle and CAM Object

CAM Bundle Definition Language: The language for defining the syntactic metadata scheme will be decided later on when the meta-model is specified according to the gathered requirements.

6. CAM4HOME Metadata Framework requirements

CAM4Home Metadata Framework defines structures for the necessary data entities and supporting operations in the CAM4Home framework in order to enable CAM4Home use scenarios. Metadata framework supports the actor activities focusing on collaboration and aggregation throughout the lifecycle of multimedia distribution and delivery through CAM Bundles. Fundamental elements in the Metadata framework are the instances (CAM descriptions) that define CAM Bundle as an operable data element in the scope of the CAM4Home framework.

This section is divided into requirements for the different facets that constitute CAM4Home metadata framework

Requirements on CAM Core Meta-model

Requirements on Supplementary Meta-model

Requirements on CAM Meta-model Definition Language

6.1. Requirements on CAM Core Meta-model

6.1.1. Common Operational Requirements on CAM Core Meta-model

These generic functional requirements define the necessary support in data structures that will enable platform specific operations on CAM Bundles. In practice, the functional requirements are realized by relevant services in the CAM4Home platform, which conforms to the capabilities set by the metadata framework.

This table lists all the operational requirements related to CAM Core meta-model along with the requirement target and CAM Bundle lifecycle step in which this the requirement appears.

Table 1. Operational requirements on CAM Core meta-model in CAM Bundle lifecycle steps.

Requirement description	Requirement target entities	Lifecycle step(s)
Adaptation requirement: CAM Elements needs to be able to be replaced with more suitable content according to user's environment profile. For example: if user has a mobile terminal which he likes to use for the bundle consumption the CAM Element needs to be replaced with down-scaled element. (Scopus)	CAM Element, CAM Bundle	Delivery
If bundle contents are not suitable for playback by the users' devices the unsuitable content needs to be adapted with a discovered content adaptation service and hen delivered to the user. (VTT)	CAM Element	Delivery
Additional metadata should accomplish the advertisement, such as describing when to put it, where to put it, how long, etc., and thus Cam element may be needed. (Scopus)	CAM Element, CAM Bundle	Creation, Modification, Distribution, Delivery, Interpretation and Consumption
If someone (for example the advertiser or the operator) would need to change the properties of the advertisement, it may need to change the Cam element as well. (Scopus)	CAM Element, CAM Bundle	Creation, Modification, Distribution, Delivery, Interpretation and Consumption
Additional metadata should accomplish the advertisement, such as describing when to put it, where to put it, how long, etc., and thus Cam element may be needed. (Scopus)	CAM Element, CAM Bundle,	Creation, Modification, Distribution, Delivery, Interpretation and Consumption
If someone (for example the advertiser or the operator) would need to change the properties of the advertisement, it may need to change the Cam element as well. (Scopus)	CAM Element, CAM Bundle,	Creation, Modification, Distribution, Delivery, Interpretation and Consumption
After creation, the advertisement should be distributed to advertisement servers along with its accompanied Cam meta data (distribution step). These servers are aware of the content flowing to the user. On avail the server selects the most suitable ad according to client profile, content profile and advertiser agreement. Then, the ad may be sent to user and displayed (Interpretation and consumption steps) according to specifications. At this point a Cam bundle may be needed. (Scopus)	CAM Element, CAM Bundle,	Creation, Modification, Distribution, Delivery, Interpretation and Consumption
A Cam element for advertisement may be created by the advertiser and combine audio / video or combined advertisement. This may be followed by descriptive metadata describing the scenes of the advertisement. The creation may also involve attached web pages, allowing rapid buy. All this metadata need to be encapsulated into a Cam object. (Scopus)	CAM Element, CAM Bundle	Creation, Modification, Distribution, Delivery, Interpretation and Consumption
The metadata in the bundle (CAM Element metadata and CAM Metadata) and the supplementary metadata such as user preference and device profiles needs to be compared in order to extract adaptation requirements CAM Core metadata and CAM Supplementary must be comparable and the	CAM Metadata, CAM Element Metadata	Interpretation

comparison must be doable during the interpretation phase of the bundle lifecycle.(VTT)		
Bundles a researched according to bundle's CAM Metadata and CAM Element metadata of the enclosed content by using query clauses. For example if one searching for a bundle wants to find a bundle with certain theme and including video and picture type content of certain resolution, a query clause stating these requirements is used for the search.(VTT)	CAM Metadata, CAM Element Metadata	Interpretation
Bundle distribution needs to be limited according to privacy statements in the metadata. For example if the bundle belongs to a certain community and it is not wanted be distributed outside the community. (VTT)	CAM Metadata	Distribution
CAM4Home framework must be able to create/enrich CAM Objects by analysing pictorial or auditory type content of CAM Elements and insert automatic CAM Element Metadata to the object.e.g. a content annotation service will analyse media essence and insert detected elements to the description, such as detected people. (Univ. Oulu)	CAM Object, CAM Element, CAM Element Metadata	Creation, Modification
CAM4Home framework must be able to validate automatically generated content-based CAM Element Metadata by the user. E.g. a user client should be able to view detected people information and remove falsely detected objects (Univ. Oulu)	CAM Object, CAM Element Metadata	Creation, Modification
CAM4Home framework must be able to distribute CAM Objects to the community network and index the semi-automatically generated metadata for searching. E.g. framework's indexing service will use automatically generated metadata as another index entry in the database.(Univ. Oulu)	CAM Object, CAM Element Metadata	Distribution, Interpretation
CAM4Home framework must be able to provide CAM Object search capabilities according to the created semi-automatic metadata. e.g. Searching CAM Objects that contain video with people visible should be possible to search through the search interface. (Univ. Oulu)	CAM Object, CAM Element Metadata, CAM Metadata,	Distribution, Interpretation, Consumption
CAM4Home framework must be able to allow storing of CAM Objects and CAM Bundles to users' personal containers or local devices. E.g. user wants to store metadata related to his downloaded video, so he makes a local save of the CAM Object that contains the desired metadata (Univ. Oulu)	CAM Bundle/Object	Delivery, Consumption
CAM4Home framework must be able to allow creation of CAM Bundles by combining two CAM Objects, where one Object is user generated content and other is a promotion of a commercially available media (a short clip, trailer, a reference to the related content service etc.). E.g. User wants to create a CAM Bundle by combining his home made video with a professionally produced video. (Univ. Oulu)	CAM Bundle/Object, CAM Metadata, CAM Element Metadata	Creation, Modification
CAM bundles must be reusable, in order to create new bundles. (ATOS-UMU-DracoTIC). The CAM bundle should allow the disaggregation of the elements inside the bundle to allow the construction of new CAM bundles.	CAM Object, CAM Metadata, CAM Bundles	Creation, Modification, Interpretation

CAM bundles must be self-descriptive. (ATOS-UMU-DracoTIC). The bundle must contain all the necessary information to describe the aggregation of elements inside that particular bundle. The entity that opens the bundle only needs a parser of the CAM4Home metadata definition language and metadata schemas to extract this information. There is no need to access other information source to complete the description of the aggregation. Any information not related to the aggregation could be linked with references to external sources.	CAM Metadata, CAM Bundles	Creation, Modification, Interpretation
CAM bundles must support property rights and creator authentication (ATOS-UMU-DracoTIC). There should be a way to include optionally a declaration of property rights inside the bundle and a digital signature of the creator of the bundle (using, for instance, XML Signature standard). This could help to implement commercial scenarios with the CAM4Home framework.	CAM Metadata, CAM Bundles	Creation, Modification, Interpretation
CAM4Home framework must be able to allow users to promote created CAM Bundles/Objects to the community members. Mobile TV devices (DVB-H), digital TV STB and interactive digital TV STB are required. (CNRS)	CAM Bundle/Object	Creation, Modification, Distribution
The CAM4Home framework must allow conditional access to CAM bundles (ATOS-UMU-DracoTIC). Conditional access is the term that refers to the protection of access to digital contents. The protection could be done by the use of encryption (see XML Encryption) or access control in the server side.	CAM Bundles, CAM Metadata	Delivery, Modification, Consumption
The CAM4Home framework must be extensible through the addition of support for new types of CAM Elements with a plug-in philosophy. The CAM Object structure must permit the identification of the CAM Element Metadata schema used to describe the CAM Element, in order to activate the correct processing for the particular CAM Object. (ATOS-UMU-DracoTIC). The bundle contains references to elements, but it can also contain references to the descriptions of those elements with external metadata. If the reference to the external metadata contains, as an attribute, a string that identifies the schema of the metadata, the entity processing the bundle could decide if it has the ability to parse that metadata. In some cases, it could be interesting to add dynamically the ability to support of a new schema. For instance, an indexer part of a search engine could find a bundle with a reference to an element description whose schema metadata is new. There could be a parser specialized in this new type of metadata, and it could be installed dynamically in the indexer to analyze the new metadata.	CAM Object, CAM Element Metadata, CAM Element	Interpretation, Consumption
CAM4Home framework must be able to provide download of the content to a local client from a community network location. E.g. User has located	CAM Object, CAM Element, CAM Element Metadata	Delivery

community generated video containing people and wants to download it to his local client for offline viewing. (Univ. Oulu)		
The CAM4Home framework must permit the dynamic adaptation of CAM Elements with the support of the CAM Element Metadata and the External Metadata. (ATOS-UMU-DracoTIC). A bundle could contain an element that refers to a video stored in a streaming server. The streaming server could call for the adaptation of the video according to the client device profile, described with external metadata, and to the video metadata itself. This adaptation could consist in reducing the size and temporal frequency of the video if the device is a PDA.	CAM Element Metadata, CAM Element	Distribution, Delivery, Consumption

6.1.2. Requirement on CAM Core Entities

6.1.2.1. Requirements on CAM Element

CAM Element requirements define the types and characteristics of distributed content and services that should be supported in the meta-model. The following table lists all the requirements for possible CAM Element types.

Table 2. Required CAM Element types.

CAM Element Type	Description	Available metadata standards/sources
Service reference	A service reference (URL) to a network service (Scopus)	N/A
Video	video file of an arbitrary format (CNRS, VTT) video stream video live stream (network)	MPEG-7, VIDe, MPEG-21
Audio	An Audio stream (Scopus)	
Reference application	An application that contains data on Multimedia interactive application (Scopus)	
Web pages	Reference to web page in order to allow a rapid buy	
Metadata	Metadata that describes when to put an advertisement, where to put it, for how long, etc.	SCTE-30,35
Picture file	A picture of an arbitrary format (jpeg, tif, png, bmp, etc.) (CNRS, VTT)	EXIF, IPTC-IIM, XMP, DIG35, MPEG-21,
Audio file	An audio file of arbitrary format (mp3, wma, etc.) (VTT)	MPEG-7
AV file	A video file with an audio track. (VTT, CNRS)	MPEG-7, MPEG-21
Text file	A file containing raw or formatted text (.txt file, .rtf file) (VTT)	
Text document	A file containing formatted text and pictures (e.g. Microsoft Word document, Adobe PDF, etc.) (VTT)	
Application	A software application of an arbitrary type. (VTT)	
End-user service	A service reference that points to a remote service	WSDL for the device

reference	located somewhere in the Internet. (e.g. URL or IP –address to a content adaptation service on a remote server) (VTT)	description.
Application reference	An application located on remote server expressed as a URL.	
Referenced multimedia	Separate or combined picture, video, audio and/or text located in a remote server. Reference contains an URL to the multimedia file. Can be downloaded or streamed. (VTT)	All picture, video and audio metadata standards.
Referenced image (Univ. Oulu) (ATOS-UMU-DracoTIC)	Pictorial content that is available for download at the location pointed by the URL.	DIG35 Specification, IPTC, EXIF,JPEG
Referenced web service (Univ. Oulu)	External web service reference that uses delivery mechanism that is not handled by CAM4Home platform. For example a link to an external web page, such as a web discussion forum or a map service	HTTP
Referenced video or audio (ATOS-UMU-DracoTIC) (Univ. Oulu)	A video or audio file that is available for download at the location pointed by the URL.	MPEG-7, MPEG-21, AAF, MXF, TV-Anytime, EBU P/Meta
Referenced Streaming video or audio (ATOS-UMU-DracoTIC) (Univ. Oulu)	A video or audio content that is available for streaming at the location pointed by the URL. (e.g. : reference to a video conference system)	SDP, MPEG-7, MPEG-21, AAF, MXF, TV-Anytime, EBU P/Meta
Referenced web page (ATOS-UMU-DracoTIC)	HTML content that is available for download at the location pointed by the URL.	MPEG-7, MPEG-21, Dublin-Core
Referenced Text (ATOS-UMU-DracoTIC)	A file with formatted text	Dublin-Core, Instructional Management System
Referenced messaging system (ATOS-UMU-DracoTIC)	A reference to a messaging system	SDP

6.1.2.2. Requirements on CAM Element Metadata

CAM Element Metadata requirements define the types and characteristics of element related metadata that should be supported in the CAM Bundle meta-model.

The following table lists all the requirements for attributes that a CAM Element Metadata needs to describe. If an existing metadata standard (such as MPEG-7) is used, don't list its attributes to this table. An alternative would be to just list the attributes that need to be described by the CAM meta-model definition language in order to enable proper execution of the scenario.

Table 3. CAM Element Metadata requirements

CAM Element attributes	Description	Data type and related standards	Applicable CAM Element Type(s)	Originating source
Cuetones	Mark points on the stream, where an advertisement can be allocated (Scopus)	SCTE 35 format, numeric values	Video	Data from the video source provider, or can be added by operators.
Ad position	Points on video where the advertisement can be inserted on (Scopus)	Two numeric values: top and left, for example	Video	Data from the video source provider, or can be added by operators.
resolution	Resolution of a video (Scopus)	Two numeric values: width and height	Video	Data from the video source provider, or can be added by operators.
Content theme	Theme or themes that the content is related to. For example: sports, movie, holiday, football, skiing, TV-series, sunrise, outer space, etc. (VTT Univ. Oulu)	String array	All	Creator or consumer of the content
Appearing objects	Semantically meaningful objects that appear in video, audio or picture. Can be thought as a annotation field to which the user can add semantic statements about the content.(VTT)	String array	Video, Audio, Picture	Creator or consumer of the content.
Appearing person name	Information about the person who appear in a video clip, audio track or picture (VTT)	String array	Video, Audio, Picture	Creator or consumer of the content
Appearing person reference	Reference to a profile of the person appearing in a video clip, audio track or picture. (VTT)	String (URL)	Video, Audio, Picture	Creator or consumer of the content
Appearing person region (picture)	Region (quadrangle) of a picture where a person is located. (VTT)	X/Y pixel values of lower left and upper right corners of the quadrangle.	Picture	Creator of consumer of the picture
Appearing person region (audio)	Region of an audio track where the person's voice is appearing. (VTT)	Two time values.	Audio	Creator of consumer of the audio

Appearing person region (video)	Region and time of a frame to define the person in question and period of time when the person is appearing on the video. (VTT)	Two values of time, and a time and a region of single frame.	Video	Creator of consumer of the video
locator	URL or IP – address where from the content can retrieved or used. (VTT, Scopus))	String	End-user service reference, Application reference, Referenced multimedia	Content distributor
Execution requirements	Hardware and software requirements for executing the application For example platform requirement to be Windows and certain amount of RAM is needed to run the application.(VTT)	String-value or String-String pairs depending on the requirement.	Application	Content creator
Service access method	Description how the service is accessed. For example define that the service in question is Web Service so the binding process to use the service can be identified.(VTT)		End-user service reference	Service provider
Access restriction	Determines the access to the content for users or user groups. For example a list of links to user profiles that have rights to access and display or execute the content.(VTT)	String array	All	Content creator
Title (Univ. Oulu)	A short free-text title for the content	String	All types	Content creator
Free-text description (Univ. Oulu, Scopus,)	A short free text description about the content.	String	All types	Content creator
Element Creator Role	A role of the Element creator regarding her position in the	String enumeration {Community member,	All types	Content creator

	producer/consumer content chain	Advertiser, Professional Producer}		
Appearing Concept [Person Face] and Name (Univ. Oulu)	Quadrilateral region containing a human face, frontal or partially frontal. String contains space for naming the concept	MPEG-7 (Media Time Point or Frame Number; (pointcoord1, pointcoord2); string) array	Video (all types), Image (all types)	Annotation Service with user verification
Appearing Concept [Scene Setting] and Name (Univ. Oulu)	Automatically/Semi-automatically detected scene location from the media contents (outdoor, indoor etc.). String contains space to give name to the concept	MPEG-7 (Media Start/End Time Points or Frame Numbers, string) array	All types	Annotation Service with user verification
Social Tags (Univ. Oulu)	User assigned single keywords that are used for creating a folksonomy. E.g. a keyword describing one entity in the content: people_watching_ T.V.	String array	All types	Content creator or consumer
Comments thread (Univ. Oulu)	User generated comment on the Element contents. Augmented with date and user nickname providing a link to the user profile page. E.g. “I made this video to show how exciting watching TV might be. Enjoy! (john smith 24.4.2008),” “Wow, great video! (Anon 25.4.2008)”	(Date, String, URL String, Comment String) array	All types	Content creator or consumer
Service Presentation (APPLICATION PROFILE) (Orange)	Description how the service is display on user screen (link to user preference skin for the service). Describe only the way to consume the Cam Element	STRING (URL)	End-user service reference	Service provider (Default skin?) User preference otherwise

	associate with			
Person (like subject of the video, plot, actors, etc.) (CNRS)	Metadata inserted by user	String array	All	Mobile phone, TV,
Automatic attribute (CNRS)	Attribute deduced inserted automatically by the system: like date and time, location,	String array	Video, Picture	Mobile phone, TV,
Author (Nokia)	Author of the content	String	All types	Content creator
Location (Nokia)	GPS location. This could be location where for example picture is taken. Or it could be location of what some text describes (like in travel guide)	String	All types	Content creator
Timestamp (Nokia)	Date/time when content was created	Date	All types	Content creator
Content size (Nokia)	Size of the content in bytes. Useful for making decision if content can be downloaded to resource limited device.	Number	All types	Content creator
Content mime-type (Nokia)	Mime type of the content.	String	All types	Content creator
Type (Nokia)	Content type. For example like in DCMI http://dublincore.org/documents/dcmi-type-vocabulary/	URI	All types	Content creator
UID (Nokia)	UID of the element metadata document	String	All types	Content creator or assigned by framework
Content UID (Nokia)	UID of the content that element metadata describes	String	All types	Content creator or assigned by framework
Legal text (Nokia)	Legal text for the content	String	All types	Content creator
Copyright (Nokia)	Copyright text for the content	String	All types	Content creator
Referenced CAM Element metadata (ATOS-UMU-DracoTIC)	A reference to the CAM Element Metadata. It can be internal (inside the bundle) or external (in a web server, for	URI	All types	Content creator

	instance)			
Referenced CAM Element Metadata schema (ATOS-UMU-DracoTIC)	An identifier of the metadata schema used for the CAM Element Metadata (MPEG7, TV-Anytime, etc). A platform unable to interpret the schema could ignore the element or try to download a plug-in able to process the schema.	URI	All types	Content creator
Referenced CAM Element (ATOS-UMU-DracoTIC)	A reference to the actual CAM Element, internal or external.	URI	All types	Content creator

6.1.2.3. Requirements on CAM Metadata

CAM Metadata requirements define the types, attributes and characteristics of Bundle metadata to support and describe the aggregation of two or more CAM Objects. The following table lists all the requirements for CAM Bundle attributes that CAM Metadata needs to describe.

Table 4. CAM Metadata: CAM Bundle attributes requirements

Bundle attribute	Description of the attribute	Attribute data type and related standards	Source of Metadata
ID (Scopus/VTT, Nokia, ATOS-UMU DracoTIC)	Unique ID (URI) for each bundle for distinguishing them from each other.	String	Bundle creator software
Creation date & time (Scopus/VTT, ATOS-UMU DracoTIC)	Date and time when the bundle has been created	Date, Time	Bundle creator software
Name (Scopus/VTT, Nokia)	Descriptive name of the bundle	String	Creator
Theme (Scopus/VTT, Nokia, ATOS-UMU DracoTIC)	A common theme or themes that the content inside the bundle is related to	String array	Bundle creator
Target group (Scopus/VTT)	List of groups that the bundle is mainly targeted to. Can be links to user or community profiles on user and community profiling server.	String array	Bundle creator
Access restriction (Scopus/VTT)	List of groups or users who are allowed to access the bundle Can be links to user or community profiles on user and community profiling server.		
Target domain (Scopus/VTT)	Network domains in which the bundle is feasible to distribute. For example if the contents and applications are applicable for mobile domain as the contents referenced in the bundle are all small sized.	String array	Bundle creator

Content list (Scopus/VTT, ATOS-UMU DracoTIC)	List of content element types in the bundle Video, picture, audio, service, etc.	String array	Bundle creator
Author (Scopus/VTT)	Creator of the bundle who has combined the contents to a bundle. For example link to the author's user profile.	String	Bundle creator
Distributor (Scopus/VTT)	Name of the bundle distributor. For example link to the author's user profile.	String	Distributor
Version history (Scopus/VTT)	Version history of the bundle including author of the new version, version number and creation date. Format: (Author | version | date)	3 columns, n rows String array	Bundle modifier
Previous version references (Scopus/VTT)	List of the references to previous versions if they are available somewhere (reference can be for example URL)	String array	Bundle modifier
Consumers (Scopus/VTT)	List of consumers that the bundle has been delivered to. Includes name of the consumer and a reference to his/her profile. (Name | URL to profile)	String array	Bundle distributor
Aggregation type (Univ. Oulu)	The type of the aggregation process that generated this relationship (e.g. computer generated, community generated, advertiser generated, producer generated)	All	All
Derivative of – relationship (Univ. Oulu)	When a CAM Object Element is a derivative work of another. Derivation description can also be added (e.g. CAM Object #2 is a re-mix of the CAM Object #1)	All	All
Meta-description of –relationship (Univ. Oulu)	When a CAM Object Element content is meant as a descriptive metadata of another Element. (e.g. CAM Object #2 is a review of the film that has the trailer in CAM Object #1)	All	All
Description (Nokia, ATOS-UMU DracoTIC	Short summary of the bundle and objects it encapsulates	String	Bundle creator
Creator (ATOS-UMU DracoTIC)	Entity that has created the bundle	String	Content Creator
Contributors (ATOS-UMU DracoTIC)	Entities that have contributed to the current version of the bundle.	String list	Content Contributor
Last modification Date (ATOS-UMU DracoTIC)	Date of the last modification	Date	Content Contributor
Signatures (ATOS-UMU DracoTIC)	Signature of the author and contributors of the bundle	XML-Signature	Content Creator and Contributor
Rights (ATOS-UMU DracoTIC)	Information about rights over the bundle	DRM statement	Content Creator and Contributor
Subject Vocabulary (ATOS-UMU DracoTIC)	Reference to identify the vocabulary used in the subject	URI	Content Creator

6.1.3. CAM Metadata: Relationships between CAM Objects inside

The table below lists all relationships that CAM Objects might have inside the CAM Bundle.
Example1: if there are two video elements inside the bundle and the first video element is an original movie and the second video element is a parody movie of the original one.
Example2: if the CAM Bundle contains a video element and several picture elements and the video and the pictures have common theme, such as a sport.

Table 5. CAM Metadata: Relationships between CAM Objects inside.

CAM Object relationship description	Relationship attributes	Relationship origin CAM Object	Relationship destination CAM Object
Playback delay between two elements (Scopus/)	Delay between playback	Video	flash game
delivery delay between referenced elements (Scopus/)	Delay between the delivery	all elements	all elements
Thematic relationship between the elements For example video element is about football and the picture element is a picture about football player, thus the thematic relationship being “football” or “sports”(Scopus/VTT)	Theme: (comedy, sports, etc.)	all elements	all elements
Common parameters that regard all Ads (Scopus/)	Common parameters for all the Ads	All Ads elements	All Ads elements
Thematic relationship between two objects. (Scopus/VTT)	Theme of the relationship	All	All
Chronologic sequence relationship between the multimedia objects of a same type. For example time sequence of several pictures. (“This picture was taken right after that one”). (Scopus/VTT)	Time between the creation of the two multimedia objects	Multimedia objects	Multimedia objects
Sequel relationship between two objects. For example a movie or game is a sequel of another. (Scopus/VTT)	Sequel number of the original content and sequel number of the content that is sequel to the other.	All	All
Part of a –relationship. If a picture is a single frame from a video clip. (Scopus/VTT)	Time when the frame appears in the video clip.	Video	Picture
Aggregation type (Univ. Oulu, Nokia)	The type of the aggregation process that generated this relationship (e.g 1 computer generated, community generated, advertiser generated, producer generated) (e.g 2 could be: same event, same location, same date/time, about same person, etc. Or any combination like “same location |same date/time)	All	All
Derivative of –relationship (Univ. Oulu)	When a CAM Object Element is a derivative work of another. Derivation description can also be	All	All

	added (e.g. CAM Object #2 is a re-mix of the CAM Object #1)		
Meta-description of –relationship (Univ. Oulu, Scopus/VTT)	When a CAM Object Element content is meant as a descriptive metadata of another Element. (e.g. CAM Object #2 is a review of the film that has the trailer in CAM Object #1)	All	All
Presentation relationship between all object in the CamBundle. How to present each CamObject on the screen. Which CamObject has to be consume by the CamClient in parallel (example display in // videoconference service and personal video to share) and Where… Which CamObject have to be consume one by one (sequential) as photo display (Orange)		All	All
Play order of the CAMObjects (Nokia, Scopus/VTT)	In which order should CAMObjects be played. Could be that ad is played before any other content	All	All
Alternative: an object is an alternative representation of another object. (ATOS-UMU DracoTIC)	List of features changed: dimensions, language, frame rate, quality	All	All
Rendering relation: an object will render the representation of another object inside itself (a web page with a video rendered in with a plug-in).* (ATOS-UMU DracoTIC)		All	All

6.1.4. Requirements on operations that should be enabled by the metadata

The following table lists all the operations that the CAM Metadata should be able to performed.
Example1: Automatic email sending to a CAM Bundle creator when someone is consuming the bundle he has created.

Table 6. Requirements on operations that should be enabled by the metadata

Description of the operation	Attributes	Operation target	Operation participants
Automatically send an email to the creator of a bundle when someone is consuming it. (Scopus/)	Reference to creator personal profile	Bundle creator	E-mail application
Automatically send a signal to the bundle element creator when someone is consuming it. (Scopus/)	Reference to creator profile	Cam Element creator	Signal application
Send/save statistics on usage (Scopus/)		Bundle creator	Log server application
Sequential playback of two elements in a bundle. For example if a certain video	Delay between the playback of two multimedia objects	Content playback	Media objects that are part of

is wanted to be played after currently played video. The metadata should describe this operation by defining the delay before new video is started, videos that are wanted to be played in sequence and tags of playback order for the videos.(Scopus/VTT)	The objects that are part of the sequence. Sequence numbers for the objects	software	the playback sequence
Distributing the media for searching and indexing. I.e. metadata should be usable by search indexing service (Univ. Oulu)	Search terms, search target metadata (CAM Element Metadata, CAM Metadata)	Search and Indexing service	Search Interface
Automatic detection of concepts by uploading the content data to the Content Annotation service. I.e. Content Annotation service should be able to fill up metadata inside CAM Objects (Univ. Oulu)	CAM Element locator and type	Annotation service	Networking service
User verification of the automatic annotation results. I.e. Users should be able to view the metadata that was automatically created and also be able to make corrections (if necessary) on it (Univ. Oulu)	Appearing Concepts	Annotation Verification Interface	Annotation service, Networking service

Search (ATOS-UMU DracoTIC) Notification of events about CAM Bundle use (ATOS-UMU DracoTIC)	Subject vocabulary and terms Event type (modification, creation, use) and event parameters (CAM Bundle Identification, CAM Bundle Subject filter, CAM Bundle Creator)	CAM Bundle User CAM Bundle Creator and Contributor	Search service CAM Bundle Alert Service

6.2.Requirements on CAM Supplementary Meta-model

Supplementary meta-model is the domain of CAM meta-model that is not involved with the CAM Bundle concept but is still in the scope of the CAM 4Home metadata framework. These include concepts such as:

1. User domain: What user specific information the metadata needs to describe such as preferences, personal information, etc.
2. User environment domain: What environment specific entities or features are required to describe by the metadata in order to enable the execution of the scenario. For example available devices (devices in home, terminal profiles), applications their descriptions, etc.
3. Device description profiles (CC/PP Composite Capabilities and Preference Profiles)

6.2.1. Common requirements on CAM Supplementary Meta-model

The following table list all the metadata domains that should be included in the supplementary meta-model. The domains can consist of e.g. user personal profile, preference profile, device capabilities, user environment profile, user presence information, etc.

Table 7. Supplementary metadata domains.

Metadata domain	Metadata domain description	External metadata standards/sources	Uses platform services (WP3)	Uses delivery and network services (WP4)
User profile (Scopus/)	Profile of the user describing personal information, education , hobbies, etc.	FaceBook	No	No
Device capabilities (Scopus/VTT, Nokia, ATOS-UMU DracoTIC)	Capabilities of a device used to consume the content	CC/PP	No	Yes
User environment profile (Scopus/)	Profile of the user environment information such as Office/Home, Big/small place, etc.		No	Yes
User presence information (Scopus/)	Information about the current presence of the user such as current temperature, light level, noise level, etc.		No	Yes
User preference profile (Scopus/VTT)	User preference profile which describes user's interests towards different types of content where the "content type" refers to theme of the content.	-	Yes	-
User social network (Scopus/VTT)	Description of a users social network expressing his friends, friends of a friend and predetermined social groups such as family, work colleagues, best friends, football team, etc.	Facebook, LinkedIn FOAF	Yes	-
User presence information (Scopus/VTT)	User presence information which describes the user's current state of presence.	-	Yes	Yes
User's environment description (Scopus/VTT)	Describes the hardware and software configuration of the user. What terminals the user has in his/her use, what software has been installed and what platform they are running on, etc.		Yes	Yes
Automated Concepts (Univ. Oulu)	The concepts that the Content Annotation service is able to annotate from a CAM Element. I.e. MPEG-7 provides a set of automatically created descriptions, that could be embedded in the CAM Element Metadata	MPEG-7, Annotation Service	Yes	Yes
Annotation UI Capabilities (Univ. Oulu)	The capabilities of the annotation user interface for enabling manual adjustment and verification of the Automated Concepts (e.g. textual verification, visual verification, visual verification and adjustment etc.)	CAM4Home Client Software	Yes	Yes

User profiles (Nokia)	User profiles that contains information about user, preferences, etc.	FoaF?	No	No
Content Adaptation (ATOS-UMU DracoTIC)	Content Adaptation metadata guide the adaptation process of CAM Elements to conform to the rendering device.	MPEG-21	Yes	Yes
User Preferences (ATOS-UMU DracoTIC)	User preferences about the consumption of CAM4Home bundles. This metadata could support agent based automatic recommending content.	MPEG-7	Yes	Yes
Electronic Programming Guide (ATOS-UMU DracoTIC)	Description of contents distributed through DVB or IPTV	ETSI TS 102 822	Yes	Yes

6.2.2. Requirements for supplementary metadata domain attributes

The following table list all the attributes that a supplementary metadata should describe.

Table 8. Requirements for supplementary metadata domain attributes.

Metadata attribute	Applicable metadata domain(s) [Tbl.7]	Description	Data type	Source of Metadata
Interests (Scopus/VTT)	User preference profiles	Subjects that the user is interested in such as sports, dogs, cats, movies, etc.	String table	Facebook
CAM Bundle interpretation capability (Scopus/	Device capabilities	How large CAM Bundles the terminal can interpret in reasonable time. Is used to make a decision if the interpretation should be moved to server side	Number of kilobytes	CAM4Home terminal analysis software
Environment data (Scopus/VTT)	User environment profile	Static data about the environment of the user.	String table, numbers	User device
Presence data (Scopus/VTT)	User presence information	Data about the presence of the user.	String table, numbers	User device
Interests (Scopus/VTT, Nokia)	User preference profile	User's interests according to content and bundle themes such as sports: golf, football, hobbies: cats, dogs, gardening, etc.	String array	User defined
Preference state (Scopus/VTT)	User preference profile	State that describes user's current willingness to receive content, capability to interact with the system and preference for how much she wants the system to disturb her by three values. Syntax: Name of the state: string	Array of String and 3 values.	User defined

		Willingness: number Interaction: number Disturbance. number		
Personal information (Scopus/VTT)	User social network	Personal information about the user itself and about other users	String, numbers	User defined
Social group (Scopus/VTT)	User social network	Social groups where the user can add persons to belong to	String	User defined
Presence (Scopus/VTT)	User presence information	Describes what the user is currently doing, for example sleeping, working, relaxing or is outside the house. Related to Preference states and determines what devices user is capable of using.	String	User defined
Available devices (Scopus/VTT)	User environment description	List of devices that are available in the user's environment. Includes name of the device and reference to a device capabilities profile	String-string pair	User defined
Available software (Scopus/VTT)	User environment description	List of software that is available in user's devices. Includes the software name and the device in which it is available	String-string pair	User defined
Hardware information (Scopus/VTT)	Device capabilities	Information about the devices hardware. Includes several sub attributes.	-	User defined or available in internet for certain devices
Automated Concept Tags (Univ. Oulu)	Automated Concepts	The names of the concepts that are automatically detectable from the content: Person, Person Face, Scene Setting, etc.	String array	Annotation Service
Annotation Display Type (Univ. Oulu)	Annotation UI Capabilities	Textual, image frame, audio sequence, video sequence, or any combination of these	String enumeration	CAM4Home Client Software
Annotation Modification Capability (Univ. Oulu)	Annotation UI Capabilities	The interaction capabilities for rectifying and adjusting the Automated Concepts. For example: textual, image frame, audio sequence, video sequence, or any combination of these	String enumeration	CAM4Home Client Software

Device screen size (Nokia)	Device profiles	Screen size on the device. For example (320x200)	String	CAM4Home client device
Support file types (Nokia)	Device profiles	List of mime-types that device support	String array	CAM4Home client device
OS Name (Nokia)	Device profiles	Name of the operating system running on the device	String	CAM4Home client device
OS Version (Nokia)	Device profiles	Version of the operating system running on the device	String	CAM4Home client device
Network capabilities (Nokia)	Device profiles	List of supported network capabilities	String array	CAM4Home client device
Name of the	User profiles	Name of the user	String	CAM4Home client

user (Nokia)				software
User web links (Nokia)	User profiles	Links to users homepage or other sites that users want to promote	String array	CAM4Home client software
Home location (Nokia)	User profiles	Geolocation for where user lives. Could be just country, town or even coordinates	String	CAM4Home client software
User birth date (Nokia)	User profiles	Birth date of the user. Could be used for age restricted material	String	CAM4Home client software
Feed preference (Nokia)	User profiles	Indicates user preference if user wants to receive feeds about new cam content. Could have states: “always, only when on Ethernet or wlan, never”	Numeric enumeration	CAM4Home client software
Feed subscriptions (Nokia)	User profiles	Stores information on what CAMFeeds user has subscribed	URL array	CAM4Home client software

6.3.Requirements on CAM Meta model Definition Language

The requirements for the CAM meta-model definition language can focus on the following areas:

- **Requirements on unique identification:**
  Example: A unique identifier/locator should be available for CAM Bundle and CAM Elements
- **Requirements on primitive data types:**
  Example: A set of primitive data types such as integer, real, date, [MORE TYPES?] should be allowed.
- **Requirements on multiple media types:**
  Example: A mechanism to relate metadata to CAM Elements with heterogeneous multimedia types and services should be provided.
- **Requirements on various types of metadata instantiations:**
  Example: Full, partial, full-mandatory and partial-mandatory instantiations should be allowed.
- **Requirements on relationships within and between metadata descriptions**
  Example: Meta data shall be able to express spatial, temporal, structural and conceptual relationships between CAM Element Metadata and CAM Metadata.
- **Requirements on relationships between metadata and elements**
  Example: A rich model for links and references between one or more descriptions and the described data shall be supplied.
- **Requirements on link capability to other ontology**
  Example: A referencing mechanism between a description and external ontology and standards shall be supplied.
- **Requirements on platform independency**
  Example: The platform and application independency should be attained.
- **Requirements on grammar**
  Example: The grammar should be unambiguous and easily parsed
- **Requirements on validation of constraints**
  Example: parser should be able to validate values of properties, structures, related classes and values of properties of related classes.
- **Requirements on intellectual property management**
  Example: A mechanism for the expression of Intellectual Property Management and Protection should be employed.
- **Requirements on human readability : CAM Bundle descriptions should be human readable**
- **Requirements on Synchronization of data and descriptions**
- **Requirements on Binary representation of descriptions to improve efficiency in transport and storage**
- **Requirements on Efficient parsing of descriptions**
- **Requirements on storage and file format**

Table 9. Requirements on CAM meta-model definition language.

Language requirement description	Importance (1-5)
The metadata instance should be represented also in binary format. (Scopus/)	4
The Ads metadata need to be uniquely identified (Scopus/	5
The Ads metadata need to support table, number and strings as inputs metadata (Scopus/)	5
A mechanism to relate metadata to CAM Elements (Scopus/)	3
Ads Meta data shall be able to express spatial, temporal, structural and conceptual relationships between CAM Element Metadata and CAM Metadata, for bundling option of Ads metadata. (Scopus/	3
A referencing mechanism between ads metadata and external standards shall be supplied. (SCTE 35) (ScopusT)	3
The Ads metadata grammar should be unambiguous and easily parsed (Scopus/)	2
Parser should be able to validate values of properties, structures, related classes and values of properties of related classes, especially for billing issues. (Scopus/	3
A mechanism for the expression of Intellectual Property Management and Protection should be employed. (Scopus/)	3
Synchronization of Ads metadata must be implemented (Scopus/)	5
Efficient parsing of description is a benefit. (Scopus/)	2
Metadata should be human interpretable (Scopus/VTT)	3
Metadata should be machine interpretable (Scopus/VTT)	5
Metadata definition language should enable logical reasoning (Scopus/VTT)	2
A Parser for metadata definition language should be freely available (Scopus/VTT)	5
Metadata language should provide unique identification of metadata entities (Scopus/VTT)	5
Metadata language should allow partial instantiation of the metadata schema. (Scopus/VTT)	4
Metadata language should allow metadata entity taxonomies (Scopus/VTT)	5
Metadata language should be adaptable to other existing metadata languages (Media Team)	5
Metadata language should provide easy extendibility with new metadata entities (Media Team)	5
The meta model description language should enable the validation of metadata descriptions (ATOS-UMU DracoTIC)	5
The meta model description language should be platform independent (ATOS-UMU DracoTIC)	4
The meta model description language should have a visual metaphor (ATOS-UMU DracoTIC)	4

Table 10. Relevant metadata standards

Metadata standard	Description
AAF (SMPTE)	Advanced Authoring Format is a professional file interchange format designed for video post-production and authoring environment. AAF was created to help address the problem of multi-vendor, cross-platform interoperability for computer-based digital video production. [http://en.wikipedia.org/wiki/Advanced_Authoring_Format]
DIG35	A standard set of metadata for digital images that will improve the semantic interoperability between devices, services and software. This interoperability will make it easier to organize, print, exchange and otherwise process digital images.
EBU P/Meta	European Broadcasting Union (EBU) P/Meta contains a scheme for metadata exchange, comprising: a flat list of attributes complete with semantic definitions; a list of transaction sets, each of which is built from attributes and other sets; each set has its own definition of purpose and content; a list of reference data (also known as “enumerated values”, “code values” or “controlled value sets”) for appropriate attributes; a syntax and notation for set construction which supports members’ requirements for the assembly of a logical set. P/Meta is designed mainly for B2B metadata exchange, and it collaborates with SMPTE for compatibility. However, some collaboration with TV-Anytime development focuses on B2C scenarios.
EXIF	Exchangeable image file format (Exif) is a specification for the image file format used by digital cameras. The specification uses the existing JPEG, TIFF Rev. 6.0, and RIFF WAV file formats, with the addition of specific metadata tags. It is not supported in JPEG 2000, PNG, or GIF. [http://en.wikipedia.org/wiki/Exif]
IPTC-NAA IIM and Adobe XMP	Information Interchange Model is designed to provide for universal communications embracing all types of data, including text, photos, graphics, etc. on a single network or a single storage medium. A mechanism is provided to use existing formats during transition. This standard is pushed forward by Adobe and its latest development is Extensible Metadata Platform (XMP).
Metadata Dictionary (SMPTE)	Society of Motion Picture and Television Engineers (U.S.) maintains a metadata dictionary that defines a registry of metadata element descriptions for association with essence or other metadata. A full explanation is contained in SMPTE 335M. The metadata dictionary structure defined in SMPTE 335M covers the use of metadata for all types of essence (video, audio, and data in their various forms). The standard specifies that any application must conform both to: (a) the definitions and formats in SMPTE 335M; and (b) The metadata dictionary contents practice.
MPEG-7	A standard for describing the multimedia content data that supports some degree of interpretation of the information meaning, which can be passed onto, or accessed by, a device or a computer code.
MPEG-21	The MPEG-21 standard aims at defining an open framework for multimedia applications. The main objective of the MPEG-21 is to define the technology needed to support users to exchange, access, consume, trade or manipulate Digital Items in an efficient and transparent way.
MXF (SMPTE)	Material eXchange Format is a container format for professional digital video and audio media. It is defined by a set of SMPTE standards.
TV-Anytime	TV-Anytime, is a set of specifications for the controlled delivery of multimedia content to a user’s digital video recorder (DVR). It seeks to exploit the evolution in convenient, high capacity storage of digital information to provide consumers with a highly personalized TV experience. Users in will have access to content from a wide variety of sources, tailored to their needs and personal preferences. TV-Anytime specifications are specified by the TV-Anytime Forum. [http://en.wikipedia.org/wiki/TV-Anytime]
UMID (SMPTE)	The Society of Motion Picture and Television Engineers (U.S.) standard 330M defines Unique Material Identifier as a stand-alone method for generating a unique label designed to be used to attach to media files and streams.

References

[R-1] D. Pakkala, ITEA2-CAM4Home Project Document, “CAM Concept Description”.

[R-2] D. Alliez et al., ITEA2-CAM4Home Project Deliverable D1.2, “Technological Survey”.

[R-3] D. Pakkala, J. Laitakari, ITEA2-CAM4Home Project Document, “Partner Scenario Analysis Guidelines”.

[R-4] M. Rautiainen et al., WP2 Draft Document, “Requirements Gathering for CAM4Home Metadata Framework and CAM bundles”

[R-5] “The New International Webster’s Comprehensive Dictionary of the English Language”

[R-6] ITU-T Recommendation J.98 (2003), Metadata requirements for video-on-demand in cable networks.

Additional comments

Daniel Pakkala, Mika's, Matti's, Damien's: comments on not embedding the content in CAM Metadata/CAM Element Metadata. There are other ways of implementing a tightly coupled metadata-content pairs if they are needed by some scenario/partner.

For example one could think of combining the content (e.g. video clip) and the metadata file (probably XML) with some available or even new file format (bigbundle.c4h ?) for the special cases where it is actually needed (a special use of bundles). In this case the tight coupling of metadata with the content would be done by some external file format of which the CAM Metadata and CAM Element metadata would be completely independent of. The normal use of bundle would be just to process the metadata and consider actual content delivery and distribution separately outside the metadata framework.

1. "A Referenced Element" that is only a reference to the actual content described by the CAM Element Metadata within a CAM Object. For example a URL such as: http://www.oulu.ouka.fi/city/albumi/kesakuvat/torinrannassa.jpg

2. "A Contained Element" that would contain the actual content (e.g. .jpg picture as base 64 encoded string as part of a XML file) described by the CAM Element Metadata within a CAM Object. (If I remember correctly this was agreed as "optional" element type in the Lille meeting.)

Eduardo Martínez Graciá:
In relation with the comment from Mika, I think we should try to use a kind of URI to specify the CAM Element location, be it inside or outside the CAM Bundle. If you take a look at the attached document, I have added these entries to the Table 3. CAM Element Metadata requirements.
That is, the client application takes a look at the URI that identifies the CAM Element Metadata Schema. This could be, for instance, the URI of the XML namespace that identifies the MPEG-7 schema. If the client understands the schema, it can take a look at the CAM Element Metadata using the correct name resolution according to the URI format (if it starts with http it points to a web server, if it starts with, let us say, c4h it points to an internal part of the CAM bundle). Inside the CAM Element Metadata it is supposed that there will be enough metadata to let the client application know if it is able to process the CAM Element. If it is the case, it can access the actual CAM Element with the referenced CAM element URI.

I have included a Manifest attribute in the Table 4. CAM Bundle attributes requirements. The manifest is a URI array pointing to the CAM Objects, and then, to the previous CAM Element Metadata attributes.

Mika Rautiainen:
CAM Object will always be required to encapsulate CAM Element and its description. And CAM Bundle can only encapsulate CAM Objects, not plain CAM Elements (correct me if I'm wrong).

In his mail Juhani clarified that the CAM Object's CAM Element can encapsulate either a reference to the Essence (e.g. a link to a streaming video file) or the actual Essence data (i.e. an entire video file contained within).

I recommend that people who are analyzing a scenario that uses embedded multimedia data inside the CAM Bundle/Object, defines metadata requirements that ensure the access of that contained data in the client applications.
The tricky part is to define the metadata requirements so that the clients where the capabilities cannot handle the contained data won't become exhausted because of receiving it.