

# **SCHEMAS**

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**Forum for Metadata Schema Implementers**

**STANDARDS FRAMEWORK REPORT 1**

**D 32**

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## **Executive Summary**

The Standards Framework Report is an important element of the knowledge base that the SCHEMAS project aims to develop for metadata schema implementers. The main focus is on metadata standardisation initiatives that are web-oriented. This report is the first out of four Standard Framework Reports. The fourth and final version will be released at the end of 2001. In the meantime we will extend the number of initiatives incorporated, and monitor the developments and trends in the area of web-oriented metadata standardisation.

Consulting the MMI Framework of CEN/ISSS as well as other sources has resulted in a list of 89 initiatives. We have sent a questionnaire with questions relevant for schema implementers to the contact persons of 40 of them. A total of 10 contact persons responded. These 10, completed by another 11 initiatives that were analysed through desk research, are the subject of this first Standards Framework Report. Together the 21 initiatives cover 89 standards. Although this population is quiet small compared to the large number of initiatives taking place in this area, we do believe that this report provides a good impression of what is currently happening.

The majority of the 21 initiatives are developing record formats, both domain specific and general. The domains in which most of the initiatives are active are cultural heritage and publishing & rights management. The cultural heritage sector includes libraries, which is where metadata was originally very much used. The general, or none-domain specific, initiatives are also very well represented.

The Dublin Core plays a rather central role in the developments of metadata standardisation. An important number of the 21 initiatives considered are liaised to the Dublin Core. To harmonise the standards and to foster interoperability it is essential that co-operation between the initiatives is further strengthened and expanded.

RDF and web-technologies like XML are relatively new and do not have yet many liaisons with the initiatives covered by this report. It is however expected that RDF and XML will play an important role in facilitating interoperability in the future. Some initiatives already mention that in the near future they will consider using XML.

## 1. Introduction

The SCHEMAS project is setting up a forum for metadata schema implementers. It is especially trying to reach those implementers who are involved in the European Commission's IST programme or in national initiatives within Europe. Implementers in the context of SCHEMAS are pictured as institutions/companies who plan to publish on the Web or who plan to provide information services at a high level of access quality.

SCHEMAS is developing a knowledge base and training material. An important component of the knowledge base is the Standards Framework. The Standards Framework focuses specifically on initiatives for defining or ratifying particular web-oriented metadata schemas as recognised standards. The emphasis here will not only be on standardisation efforts within traditional standards organisations (e.g. CEN and ISO) but also on non-traditional, Internet-based initiatives (e.g. Dublin Core). This present report contains the first version of the Standards Framework. Because of the rapid developments of metadata schemas this framework will be further developed during the coming two years. Since there are many different definitions of metadata we will have to explain how metadata is understood within the SCHEMAS project. In the SCHEMAS project we understand metadata as a broad term covering many types of "structured data about data". This can range from traditional resources such as library catalogues, subject indexes, book reviews and abstracts, to new forms of technical and descriptive data for Web resources like digital signatures, digitised map co-ordinates and online mail order catalogues. Because of the broad diversity of potential applications of metadata, the needs for metadata can best be met by a multiplicity of separate but functionally focused metadata packages that are called schemas.

Metadata schemas are needed in order to be able to organise the content on the web. Metadata schemas have many applications like for example searching and retrieving content, cataloguing content, making content machine understandable or machine-readable, transmitting content, etc. An implementer of metadata can invent a metadata schema him- or herself, but besides running the chance of reinventing the wheel the danger is that it lowers the level of access when the schema is not known to others. A diffused landscape of individual metadata schemas will maybe fulfil the need for localising content but will endanger the accessibility of the content by others. There seems to be a trade-off between localisation and interoperability.

A wide variety of standardisation initiatives have been or are being undertaken. Both within formal standardisation organisations and within other organisations and both at a general level and at a more domain specific level. Standardisation of metadata is a diverse area and the activities are spread over the different application areas and domains of metadata schemas.

As a result, implementers who will need metadata face the challenge of designing schemas that are compatible with both existing and emerging standards. They will need some core elements along with parts of more domain-specific element sets. In some cases they even might find themselves having to invent elements of their own. Since different schemas are needed in different situations, implementers cannot always use schemas "straight from the box".

The Standards Framework is aimed at mapping this wide diversity of metadata standardisation to application areas and to provide information to implementers about what is going on, what they could use and where they can find information about how to use certain standards. This first report describes and analyses 21 initiatives covering a total of 89 separate metadata-related standards. The coming 2 years this Standards Framework will be broadened and deepened. Many standards are still in the development phase and lack good documentation or guidelines.

Again, developments in web-oriented metadata standardisation are going fast. This report will therefore be the first out of 4 and intends to provide after two years a comprehensive and useful Standards Framework for Metadata Schema implementers.

## 2. Methodology

To identify the current metadata standardisation activities we have carried out a desk research with as a starting point the CEN/ISSS Metadata Framework of June 1999. This metadata framework offers a structured classification of activities in the area of metadata for multimedia information. In addition we have consulted the correspondents who are preparing the Metadata Watch. The Metadata Watch is also a main delivery of the SCHEMAS project.

This method has resulted in a list of 89 initiatives in metadata standardisation that are mostly web-oriented. These initiatives include platforms that are maintaining and preparing more than one standards or specification. We have drawn up an overview containing the name of the initiative, name and co-ordinates of the contact person, the institutions responsible for the initiative and the web-address.

From this overview we have selected those initiatives which are the most influential and most relevant to the purposes of SCHEMAS. This in turn resulted in a list of 40 initiatives.

Since we were in need of in-depth information about those standardisation initiatives we have chosen the survey method using a questionnaire that was sent to the contact person of the activity. The questions were of course focused on those topics considered most important for schema implementers. The topics covered by the questionnaire are, besides general details, a short description of the initiative, the objectives, guidelines, the type of material, the domain, the liaison with other initiatives and the future directions. The full results of the survey will be made available through the SCHEMAS Web site<sup>1</sup>.

Through an e-mail message we have asked the correspondents to fill in the questionnaire and send it back. The response rate was quite low because only 10 returned the questionnaire, meaning a response rate of 25%. We selected another 11 initiatives that we considered to be of the highest importance for our audience, and conducted a desk research based on the information on the initiatives' Web sites. This report, therefore, is focused on 21 metadata standardisation initiatives. Although this is a limited number, we believe it will provide a good insight into what is currently happening.

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<sup>1</sup> <http://www.schemas-forum.org/>

### 3. Scope

The metadata standardisation initiatives that are analysed in this Standards Framework Report are summarised in Table 1. Some of these initiatives are actually platforms covering several standardisation initiatives while some are standardisation initiatives that form part of a platform. The 21 initiatives that we have selected cover a total of 89 separate standards and specifications.

**Table 1: Overview of the standardisation initiatives covered by the Standards Framework Report**

	Short name	Full Name	Platform	No. of standards
1	BSR	Basic Semantic Registry	ISO TC 154 WG1	1
2	CEN/ISSS Workshop Learning Technologies	CEN/ISSS Workshop Learning Technologies	CEN/ISSS	1
3	CEN TC 251	Health Informatics	CEN TC 251	1
4	CERIF	Common European Research Information Format	CERIF	1
5	Dublin Core	Dublin Core Metadata Initiative	Dublin Core	2
6	GELOS	Global Environmental Locator System Standard Element Set	GELOS	1
7	GILS	Government Information Locator Service	GILS	1
8	IMS project	IMS Learning Resource Metadata Information Model	IMS Global Learning Consortium.	1
9	ISO TC 46 SC4	Information and Documentation: Computer applications in information and documentation;	ISO TC 46 SC4	26
10	ISO TC 46 SC9	Information and documentation: Presentation, identification and description of documents	ISO TC 46 SC9	30
11	ISO/IEC JTC 1 / SC 32	Data management and Interchange; WG Metadata	ISO/IEC JTC 1 / SC 32	3
12	LOM	Learning Object Metadata	IEEE	1
13	MARC 21 formats	Machine Readable Cataloguing	MARC 21	11
14	MPEG-21	Moving Pictures Expert Group: Digital Audio-visual Framework	MPEG	1
15	MPEG-4	Moving Pictures Expert Group: Coding of audio-visual Objects	MPEG	1
16	MPEG-7	Moving Pictures Expert Group: Multimedia Content Description Interface	MPEG	1
17	NetCDF	Network Common Data Form	NetCDF	1
18	PDS	Planetary Data System	PDS	2
19	RDF	Resource Description Framework	W3C	1
20	SMPTE	Society of Motion Picture and Television Engineers	SMPTE	2
21	VRA	Visual Resources Association Data Standards Committee	VRA	1

The remainder of this report is an analysis of these 21 metadata standardisation initiatives.

## 4. Mapping the initiatives

### 4.1 Introduction

Metadata frameworks provide a general architecture for metadata. The Metadata Framework of CEN/ISSS<sup>2</sup> distinguishes 4 main applications of metadata. These are resource discovery, asset management, interoperability and manipulation. Besides this framework there are also other frameworks. However, we have mapped the current standardisation initiatives of the Standards Framework Report according to the Metadata Framework of CEN/ISSS.

#### *Resource discovery*

Resource discovery is a key aim of many metadata initiatives and can be further sub-divided into record formats, classification, resource location, languages, multimedia content and metadata registries.

#### *Record formats*

Record formats are based on an element set and are designed to be carriers for certain types of information. The most well known record format is the **Dublin Core**. The Dublin Core intends to be a cross-domain element set to describe electronic resources. Most of these elements have a commonly understood semantics and the element set is characterised by simplicity. Two specifications are maintained: the Dublin Core Metadata Element Set and a formally recommended list of Dublin Core Qualifiers.

The **MARC21<sup>3</sup> Formats** initiative comprises 11 standardisation activities that can be sub-divided into 5 record formats and 6 code lists. MARC21 has developed standard formats for bibliographic information, authoritative information, holdings information, classification numbers and non-bibliographic resources. Within the library world MARC record formats are very common. The MARC Code lists contain standardised codes for certain types of information in order to facilitate subject-oriented retrieval of information. MARC21 distinguishes codes lists for languages, geographic areas, countries, organisations, relators and sources. Codes lists are useful for information that is confined to a limited number of values.

The **VRA Core Record** is also a record format but is aimed at creating records specifically for describing works of visual culture as well as images that document them.

Another domain specific record format is **CERIF**. CERIF is developing a standard format for the Research sector within Europe. It contains a set of guidelines for developing record formats meant for everyone dealing with research information systems.

The **IMS Metadata Specification** is developing a standard record format specifically for describing learning resources. In the same domain, i.e. education and training, the

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<sup>2</sup> <http://www.cenorm.be/iss/Workshop/delivered-ws/MMI/Default.htm>

<sup>3</sup> MARC is the abbreviation of MACHine-readable Cataloguing.

**Learning Object Metadata** is being developed. LOM focuses on a set of elements to fully and adequately describe a learning object.

**GELOS** is an element set for environmental information resources.

The **PDS** initiative comprises two standardisation activities under consideration, which are (1) PDS Data element dictionary, and (2), PDS Metadata model. The objective of the dictionary is to define the domain of discourse for the Planetary Science Community by defining data elements to be used in labelling data products and describing enterprise entities. The objective of the Metadata Model is to define the objects that describe the Planetary Science Community's enterprise elements including data objects and catalogue objects. Data objects are used to label data products such as images. Catalogue objects are used to describe entities in the community such as spacecraft, targets and instruments.

Another domain specific record format considered in this first Standards Framework Report is **GILS**, Government Information Locator Service.

This Standards Framework covers 3 metadata standards in the area of *multimedia content*, namely, MPEG 4, MPEG 7 and MPEG 21. **MPEG 4** deals with coding audio-visual objects and is aimed at defining a standard for representing Multimedia objects and to interact with these objects. **MPEG 7** develops a Multimedia Content Description Interface to define a standard for representing Multimedia Objects and interfacing with these objects. **MPEG 21** develops a digital audio-visual framework with the aim to describe the infrastructure for the delivery and consumption of multimedia content.

**ISO/IEC JTC1/SC32** is a platform concerned with *metadata registries* and is responsible for ISO 11179, a standard in 7 parts. Metadata registries are tools to publish the definition of metadata element sets and related information and aim at enabling interoperability. ISO 11179 aims at specifying, standardising and registering data elements to make data understandable and sharable. Two other specifications that are developed under ISO/IEC JTC1/SC32 are ISO/IEC TR15452:2000 and ANSI X3.285:1998.

**ISO TC46** is called "Information and Documentation" and sub-committee 9 is standardising the presentation, identification and description of documents. In total, 30 standards have been or are being developed by this sub-committee.

### *Asset Management*

Asset is a term that is frequently used in multimedia and refers to the ownership of images, video clips, audio clips, etc. The role of metadata herein is to facilitate the capturing, storing and management of assets. Asset management can be further sub-divided into rights management, preservation and auditing.

Currently there are no initiatives in the area of asset management part of the Standards Framework.

### *Interoperability*

Metadata plays an important role in achieving a general level of information sharing between different communities with different types of information and technologies and to create new and more powerful types of information.

**ISO TC 46/SC4** develops technical standards to be used to facilitate *interoperability* of information services such as libraries, information centres, indexing and abstracting services, archives and publishers. Sub-committee 4 is maintaining and developing a total of 26 standards.<sup>4</sup>

Another initiative in the area of interoperability is **NetCDF** (Network Common Data Form). NetCDF is an interface for array-oriented data access and a library that provides an implementation of the interface. The NetCDF library also defines a machine-independent format for representing scientific data. Together, the interface, library, and format support the creation, access, and sharing of scientific data.

**CEN TC251** has produced several standards which are currently transformed into a European Reference Information Model. Besides an Information Model CEN TC 251 also developed a Message development Framework to produce all kinds of messages. The aim is to safely transport medical information.

### *Manipulation*

Metadata can be used to manipulate a set of related multimedia information resources. The function of manipulation encompasses delivery, access and protocols. Delivery can be further subdivided into rendering, client configuration, interchange and network Quality of Service. Interchange can be further specified by distinguishing streaming and formats. Access can be sub-divided into user identification, security and payment/clearance. Protocols can be sub-divided into directory and search & retrieve.

*Streaming* in this context refers to those initiatives that standardise the transmission of multimedia information in real time. The Society for Motion Picture and Television Engineers (**SMPTE**), in collaboration with the European Broadcasting Union (EBU), has set up a task force for harmonised standards for the exchange of programme materials as bit streams.

In the area of *search and retrieval* an important initiative is the Basic Semantic Registry (**BSR**). The goal of BSR is to act as a central reference to assist in the universal and multilingual understanding of data across commerce, industry and administration. The BSR contains data about electronic data interchange message standards.

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<sup>4</sup> The 26 initiatives of ISO TC 46 SC4 are:

**WG 1: Character sets**; ISO 5426, ISO 5426-2, ISO 5427, ISO 5428, ISO 6438, ISO 6630, ISO 6861, ISO 6862, ISO 8957, ISO 10585, ISO 10586, ISO 10754, ISO 11822

**WG 4: Format structures for bibliographic information interchange in machine readable form**  
ISO 2709, ISO 10160, ISO 10161-1, ISO 10161-2, ISO 10162, ISO 10163-1, ISO 23950

**WG 6: Electronic Publishing**; ISO 12083

**WG 7: Data elements** ; ISO 8459-1, ISO 8459-2, ISO 8459-3, ISO 8459-4

**WG 8: Library Codes** ; ISO/DIS 15511 (ISIL)

### *Other Frameworks*

Besides the MMI Framework of CEN/ISSS there are also *other frameworks*. The best known and promising is the Resource Description Framework (**RDF**) which is being developed by the W3 Consortium. RDF offers interoperability between applications that exchange machine-understandable information on the web by providing an infrastructure to support metadata activities.

**The CEN/ISSS Workshop on Learning Technologies** is also another framework. It has delivered a report that identifies the requirements for standards related activities in the area of learning technologies. The workshops are a concept initiated by CEN/ISSS and aim at offering a new mechanism and approach to standardisation, it is a place to bring together the clients' ICT standards and specifications requirements are given the opportunity to find a solution in an environment "tailor-made" for their needs.

### **4.2 Conclusion**

The current Standards Framework is biased towards record formats. The discovery of resources is a key application of metadata and this application has a need for domain-specific as well as multilingual metadata schemas. It is therefore not a surprise that many activities are taking place in this area.

## 5. Synthesis

### 5.1 Domains covered

Following the classification of domains<sup>5</sup> in the Metadata Watch we have categorised the 21 standardisation initiatives as follows:

#### Industry

This domain is characterised by activities with a focus on business information systems for commerce, especially business-to-business commerce on the Web, i.e. the supply chain.

**BSR** can be categorised in this domain.

#### Publishing

**MPEG 21** and **ISO TC46/SC9** can be categorised in this domain.

#### Audio-Visual

This sector deals with staggeringly large amounts of information of which only a portion is textual. In addition, the means by which this content is distributed varies greatly, i.e. terrestrial broadcast, Internet, and CD-ROM and DVD.

Activities in this domain are **MPEG 7** and **MPEG 4** and **SMPTE**.

#### Cultural Heritage

The **VRA Core Record**, **ISO TC46/SC4** and **MARC** fall under this domain.

#### Education and Training

The **IMS project**, **LOM** and the **CEN/ISSS Workshop on Learning Technologies** fall under this domain.

#### Research

This domain includes non-commercial laboratories, corporate research, and professional societies.

**CERIF** can be categorised in this domain.

#### Academia

**NetCDF** can be categorised in this domain.

#### Geographic information

**PDS** falls under this domain.

#### All

**Dublin Core**, **JTC1/SC32/WG2** and **RDF** are all not domain specific.

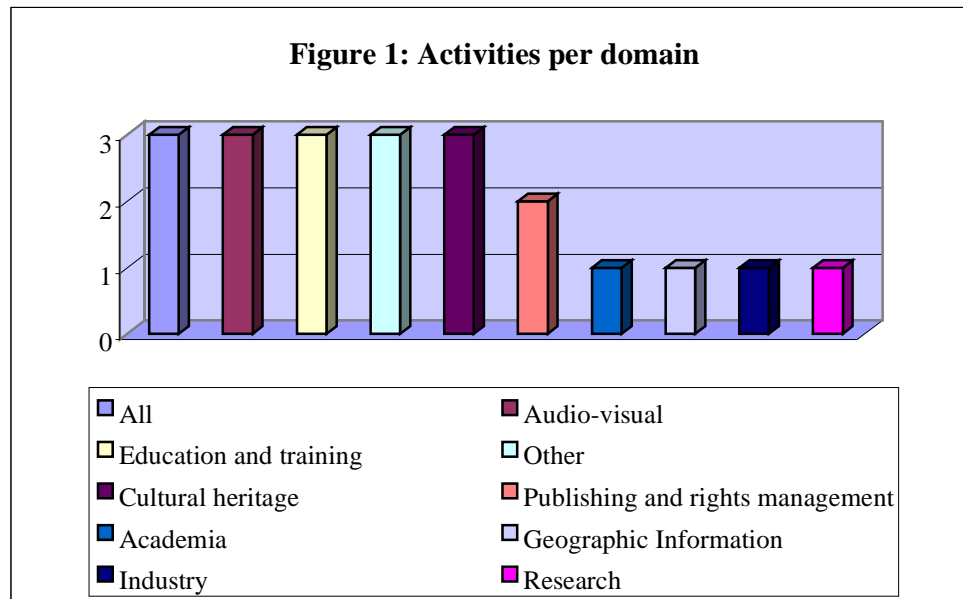
#### Other

This domain includes, but is not limited to, environmental work, government (including military), **GILS**, healthcare (**CEN TC 251**), mail and delivery, and transport and logistics. (**GELoS**)

All the domains are covered. Graphically the categorisation into domains can be pictured as follows:

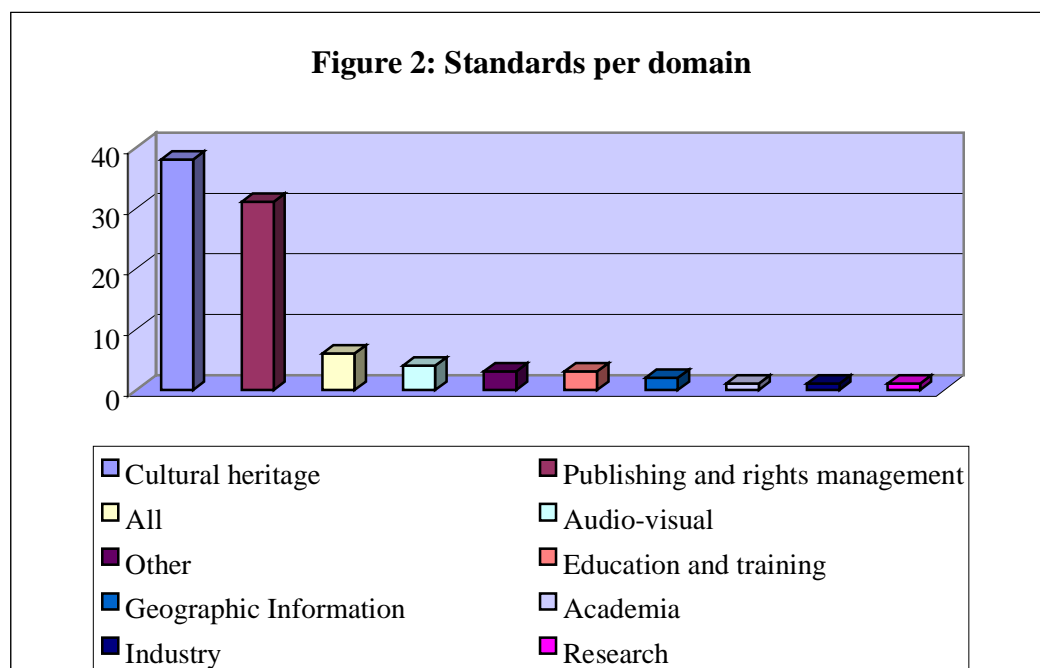
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<sup>5</sup> A further specification of the domains can be found in Annex 1.



Since the population consists of only 21 initiatives, it is hard to draw general conclusions. However, because we have chosen these 21 initiatives based on the criteria of being influential and well-known, we can say that most activities are taking place in the domains all, audio-visual, education and training, other, and cultural heritage. Some domains might be less in need of metadata standardisation and therefore know fewer initiatives. Another reason for low activity in certain domains might be resulting from more co-operation and thus less diffusion of activities.

Of these 21 initiatives 6 are platforms and together they represent a total of 89 standards. Looking at all these 89 standards together we see that most are occurring in the domains of cultural heritage and publishing and rights management.



Once we have include a larger number of the identified metadata standardisation initiatives we will be able to draw more valid conclusions about the domains in which the majority of metadata standardisation activities take place.

## 5.2 Types of material

The types of material on which the standardisation initiatives are focused are shown in table 2. We only looked at those standardisation initiatives for which we have received a filled out questionnaire.

Table 2: Type of material

	Gelos	MPEG 4, 7, 21	PDS Metadata	CEN TC 251	DC	VRA	MARC	Total
All				X	X		X	3
Databases, datasets	X		X					2
Documents, text	X		X					2
Images (film, photograph, slide)						X		1
Map	X							1
Measurement station	X							1
Multimedia resources		X						1
Software	X							1

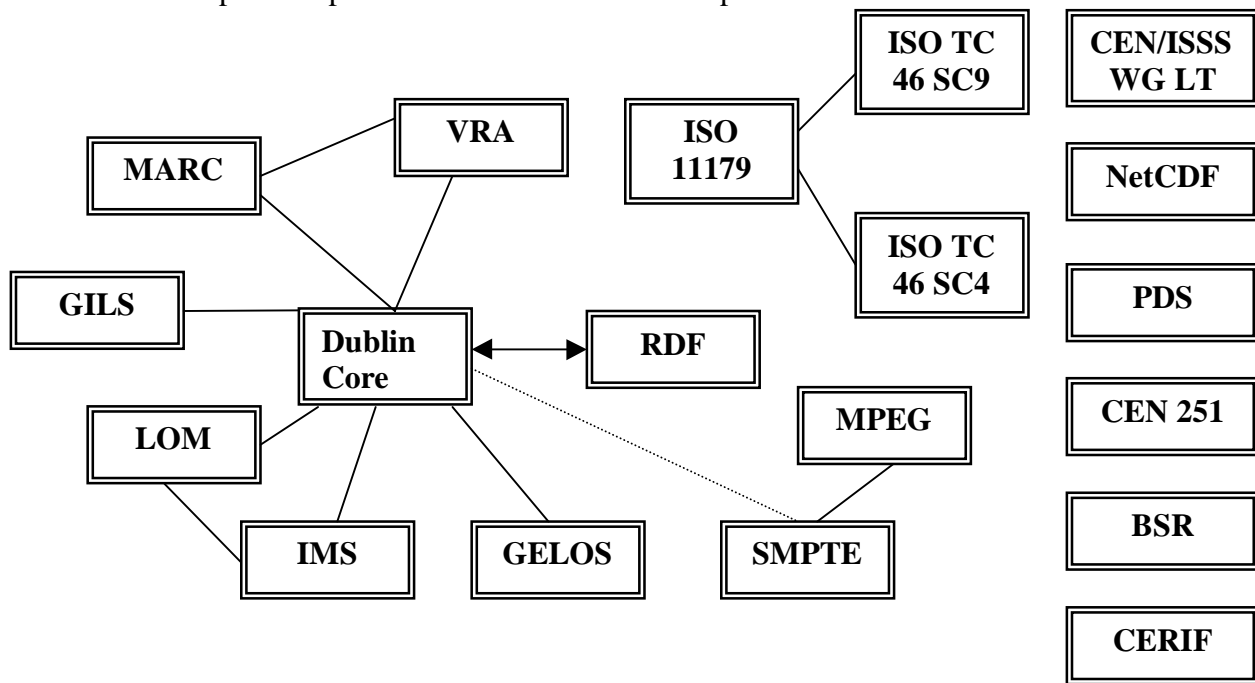
Looking at table 2 we can conclude that a wide range of materials are covered but that there is no clear bias towards one of them.

### 5.3 Interrelationships

The diagram below shows the interrelationship between some of the initiatives, as far as could be traced from answers to the questionnaire and the desk research.

The Dublin Core plays a central role. RDF does not, but that might be because RDF is a much more recent effort than the Dublin Core. Expected is that RDF will in the near future influence the standardisation initiatives that are currently still in the developing phase or those that are newly initiated. Noticeable is also that apparently within the domain education there is co-operation between separate initiatives since LOM and IMS are liaised.

Table 3. Graphical representation of interrelationships



Dublin Core and RDF are strongly related through the fact that there is a substantial overlap in the people who work on those two initiatives.

GELOS claims to be liaised to the Dublin Core while the Dublin Core did not mention to be liaised to GELOS.

The ISO 11179 liaises with many other ISO activities. The ISO standards from Technical Committee 46 are also included in the Standards Framework.

### 5.4 Conclusions

In conclusion, the metadata-related standards considered in this Standards Framework Report are biased towards the domains of Cultural heritage and Publishing and rights management. The general or non-domain specific initiatives are also well represented. The domain Cultural heritage includes library and bibliographic information, which is

the area where metadata was traditionally most needed. Although it is hard to draw general conclusions from this small population, this Standards Framework Report will provide implementers with an insight into the activities taking place within the domains.

There is, fortunately, a tendency visible of standardisation activities to build relationships between them. Ideally, this emerging network of standards should lead to some form of harmonisation or co-operation in the near future. Dublin Core aims to play a central role in this landscape of activities by inviting specific domains to participate in the definition and further development of this standard.

## 6. Trends

### 6.1 Overall perspectives

The fast technological changes and the enormous growth of content on the web require a continuous maintenance and adaptation of recent metadata standards. All the standards of the Standards Framework will in the future have to be maintained and/or adapted. XML is an example of a new technology that has a major impact on current and new metadata standards. XML will become important in many standardisation initiatives in the area of metadata. XML is being developed by the W3 Consortium and is, as they call it, “a method for putting structured data in a text file”. The advantage of a text file in this context is that it allows you to look at the structured data without the program that produced it. XML describes data that than can be stored, analysed, used by applications and exchanged. By using XML for designing text files the problems of for example localisation and platform dependency are circumvented. The main difference between HTML and XML, and what explains the popularity of the latter, is that HTML is a language that does not distinguish form and content while XML does.

The influence of XML is reflected in the current activities and future directions of the 21 standardisation initiatives. For example, RDF is expressed in XML. In March 2000 specification version 1.1 of the RDF has been published as a W3C candidate recommendation.

### 6.2 Future plans of individual activities

For **BSR** we did not receive a questionnaire and there is not much information about this standard available on the web.

Another platform that is considering XML is **CEN TC 251**. CEN TC 251 states that it will soon be published as a XML Schema. Schemas will make it possible to employ ‘Templates’ for local profiling of the standard. All CEN TC 251 standards are at the moment transformed into a European Reference Information Model. Within a few years CEN TC 251 will be an ISO/TC 215 standard.

**GILS** has the ambition to develop from a domain-specific into a more generic standard.

**ISO TC46/SC9** is maintaining current standards and will develop others in the future.

**ISO TC46/SC4** is maintaining current standards and will develop others in the future.

Version 1.1 of the **IMS** Meta-data Specification was published in June 2000. XML is the “first” language in which the IMS metadata will be represented.

**LOM** did not return a questionnaire and there is no information on future directions on the web. Currently the LOM is still in draft version, version 3.6, that is intended to become a document that can be submitted for vote as an IEEE standard.

The record formats and codes list of **MARC** will be maintained and the changes will be published annually. The focus will also be on increasing liaison with other standard bodies.

**MPEG 4** will concentrate its efforts on standardising IPMP, building a textual representation, building a more flexible timing model, and on video coding for both studio applications and digital cinema. This is expected to be completed in 2001 although the video coding for digital cinema still has to start.

**MPEG 7** is still in the developing phase and the standard is expected to be ready by September 2001.

**MPEG 21** is also still under development. A draft technical report is expected to be ready early 2001 and the first specification phase is expected to be ready by the end of 2001.

**NetCDF** refers to the website: <http://www.unidata.ucar.edu/packages/netcdf/itr> where unfortunately information about the plans was not displayed.

The **PDS** is continuously reviewing the state of the art in metadata standards, protocols and supporting technologies. If necessary the PDS will be adapted to make it more effective and efficient. Currently XML is considered as an exchange and internal processing language. The developers of PDS are also participating in the NASA interagency metadata registry development project.

The Task Force installed by EBU and **SMPTE** had as a main task to look forward and to make a number of fundamental decisions that will lead to standards for the exchange of television programme material as bit streams. A final report was ready by 1998. It is now up to both EBU and SMPTE to develop standards.

The VRA Data Standards Committee who is developing the **VRA Core Record** will the coming time be working on guidelines to use the latest version, version 3.

The **Dublin Core** Metadata Initiative, **GELOS**, **ISO/IEC JTC 1/SC32** and **CERIF** did not specify any future directions.

### ***6.3 Conclusions***

XML will play an important role in the future of metadata standardisation. It provides a common language for expressing metadata and could therefore provide a basis for future interoperability between standards.

RDF is being promoted by the World Wide Web Consortium as the basis for metadata interoperability for the Web. Currently the Dublin Core is still the key element set used in the development of other metadata standards.

XML and RDF are both being developed by W3C, however independent of each other. This might cause problems in the future.

It needs to be noted that potentially important activities such as the Dublin Core Metadata Initiative and ISO/IEC JTC1/SC32 do not have published future plans and directions.

## **7. Overall Conclusions**

This first edition of the Standards Framework Report analyses and describes 21 metadata standardisation initiatives. These initiatives cover a wide range of domains and material types.

Many of these 21 initiatives are liaised to each other, with an emerging central role for Dublin Core. To harmonise the standards and to foster interoperability it is essential that co-operation is further strengthened and expanded.

Web-technologies like RDF and XML will play an important role in facilitating interoperability in the future. Many of the 21 initiatives covered by this report are using XML to different degrees.

**Annex 1: Short description of the domains**

<i>Domain</i>	<i>Includes</i>
Industry	<ul style="list-style-type: none"> <li>- manufacturing</li> <li>- software vendors</li> <li>- hardware vendors</li> <li>- telecommunication operators</li> <li>- Internet Service Providers</li> <li>- Search engines services</li> <li>- banking and insurance</li> <li>- advertising</li> <li>- retail</li> </ul>
Publishing	<ul style="list-style-type: none"> <li>- book trade and distribution</li> <li>- music/video/multimedia distribution</li> <li>- music recording industry</li> <li>- scientific journals</li> <li>- news agencies</li> <li>- newspapers</li> <li>- copyright management</li> </ul>
Audio-visual	<ul style="list-style-type: none"> <li>- film industry</li> <li>- broadcast production and archiving</li> <li>- multimedia production</li> </ul>
Cultural Heritage	<ul style="list-style-type: none"> <li>- libraries</li> <li>- library services</li> <li>- museums</li> <li>- museum portals</li> <li>- archives</li> </ul>
Academic	<ul style="list-style-type: none"> <li>- university and higher education projects</li> <li>- subject gateways</li> <li>- W3C initiatives</li> </ul>
Education and training	<ul style="list-style-type: none"> <li>- interactive courseware</li> <li>- life-long learning</li> <li>- distance learning</li> <li>- schools</li> <li>- curricula</li> </ul>
Research	<ul style="list-style-type: none"> <li>- research laboratories</li> <li>- company research</li> <li>- professional societies</li> </ul>
GIS	<ul style="list-style-type: none"> <li>- geospatial information providers</li> </ul>
Other	<ul style="list-style-type: none"> <li>- transport operators</li> <li>- mail and delivery services</li> <li>- health care</li> <li>- government services</li> <li>- environmental information</li> <li>- statistics</li> </ul>