

## 2.3.5 Rights Expression Languages

*Susanne Guth*<sup>239</sup>

**Abstract:** This chapter provides an overview of the field of rights expression languages (RELS). It justifies the need for rights expression languages in today's DRM systems and addresses the requirements which have to be met by these languages. An REL is basically a means of expressing the rights of a party to certain assets. Therefore, all rights languages have a similar basic language concept, which is also introduced in this chapter. Standardization is a critical success factor for RELS, thus all important standards and other initiatives are briefly described as well. The chapter also deals with current and potential fields of application for RELS, after which two practical examples (XML instances) of rights languages are presented. Finally, the chapter gives an overview of the current market situation and trends in the field of DRM middleware and implementations using RELS.

### I Introduction

The number of online marketplaces has grown steadily in recent years<sup>240</sup> and will continue to expand in the future. Wherever commercial goods are exchanged electronically, there is a need for contracts to specify the terms and conditions of the transaction. Most of the resulting contracts are stored in digital format. Digital contracts are exchanged among different information systems for various reasons: to fulfill the contract (i.e., to exercise the rights granted), to pay the amount agreed upon, to rescind the contract and so on. Digitally signed contracts are legally binding<sup>241</sup>. They are also of public interest and have to be readable for third parties.

However, in other non-commercial fields of application for digital contracts, a monetary consideration might not be part of the agreement for a digital good, for example in education. Authors of learning materials might be more interested in a good reputation than in revenues. Nonetheless, they may still wish to restrict access and usage rights to their materials in order to prevent modification or re-distribution. The two cases mentioned describe situations in which rights information is specified in the form of contracts. The contracts state the rights and relationships of the contracting parties to the subject matter of the contract.

The need to express rights is not solely desired for the purpose of formulating contracts. In the private domain, Internet users demand discreet handling of their personal data. They wish to have a guarantee that their personal information is accessible only in compliance with data privacy laws or in accordance with additional rights which they grant personally.

A number of organizations and companies have recognized the need for a standard rights expression language (REL) which has the power to express usage

<sup>239</sup> Vienna University of Economics and Business Administration.

<sup>240</sup> See: Johnson (2002).

<sup>241</sup> See: E-SIGN. Directive (1999).

and access rights and supports the applications mentioned above. Accordingly, a rights expression language has to support the implementation of frameworks which enable the interoperability of DRM systems and agents on the basis of digital contracts (or digital documents).

## II Requirements for Rights Expression Languages

A rights expression language provides a means of expressing use and access rights to assets. It should be sufficiently rich to formulate business models and to express terms and conditions for digital publications, audio and video files, images, games, software, and other digital assets, regardless of whether a monetary consideration is part of the transaction. The application of a standardized REL facilitates interoperability and consistency among DRM systems, which manage the creation, controlled distribution and consumption of digital or physical goods and services.

In order to provide the above-mentioned functionality, an REL must fulfill a number of technical and conceptual requirements. One substantial technical requirement for RELs is machine readability. Therefore, all of today's RELs have chosen serialization in XML. XML documents are machine readable and interpretable and thus qualify as an exchange format for digital documents. Stating rights information in an XML-based language allows flexible expressions, as the expression elements are not restricted to the columns of a relational database table.

The following activities might be involved in managing the consumption of digital goods: the authentication of the consumer, verifying the consumer's rights on the basis of his/her role or identity, granting or denying access, decrypting and decompressing digital goods, rendering the digital goods according to the permissions granted, notifying the content provider of the consumption, calculating royalties for the provider or other involved parties, and processing payments.

A number of REL requirements can be derived from the example given. In order to provide the relevant metadata, the REL should support the articulation of roles, standard identification systems (such as DOI<sup>242</sup>, ISBN, ISSN etc.), the definition of usage permissions and their restrictions (or prerequisites), the expression of revenue and payment details, security information, details on technical handling (decryption algorithms, viewers, media format) as well as workflow data.

This informal enumeration does not represent a complete list of requirements for an REL. The Moving Pictures Expert Group (MPEG) (see page 106) has formally specified the requirements for a rights expression language and its rights data dictionary for the multimedia domain<sup>243</sup>. The document defines additional requirements such as concepts for content aggregation, permissions and parties,

<sup>242</sup> See: *Paskin* within this book on page 26.

<sup>243</sup> See: MPEG-21 Requirements (2002).

the sequencing of elements, etc. The requirements of a rights language vary depending on their field of application and scope, thus the REL should be open and extensible.

### III Components of a Rights Expression Language

The two constitutive factors in a language are its syntax and semantics. The term ‘syntax’ refers to the grammar rules which apply to the language’s vocabulary, whereas the term ‘semantics’ refers to the meaning of valid “sentences” in the language. For the purposes of this chapter, the grammar of RELs is referred to as the *rights language concept*, and the semantics of rights vocabulary are defined by the *rights data dictionary (RDD)*. A valid sentence in an REL is called a rights expression or an REL instance. Rights expression languages have the power to express the rights of parties to particular assets. Thus RELs have the power to formulate simple stand-alone rights expressions as well as complex digital contracts.

#### III.1 Rights Language Concept

The most basic elements in every rights language concept are rights, assets and parties<sup>244</sup>; the names of these three basic elements vary in each REL.

- *Rights* are understood as expressions which grant certain usage or access permissions to digital goods or services. Permissions can be specified in more detail as prerequisites or restrictions. Prerequisites describe terms or duties that have to be fulfilled before a right is granted. Restrictions serve to narrow the right granted, for example by time, location, individual etc.
- The *asset* represents the digital good or service to which the rights apply. The asset has to be described by a non-ambiguous identifier such as a DOI<sup>245</sup>).
- The *party* element represents any kind of party, be it a legal entity or physical person, which has a relationship to a digital product or service. In contracts, the party elements predominantly represent the people who enter into the contract. Examples of parties include the rights holder, author, creator, content provider, consumer, administrator and the like.

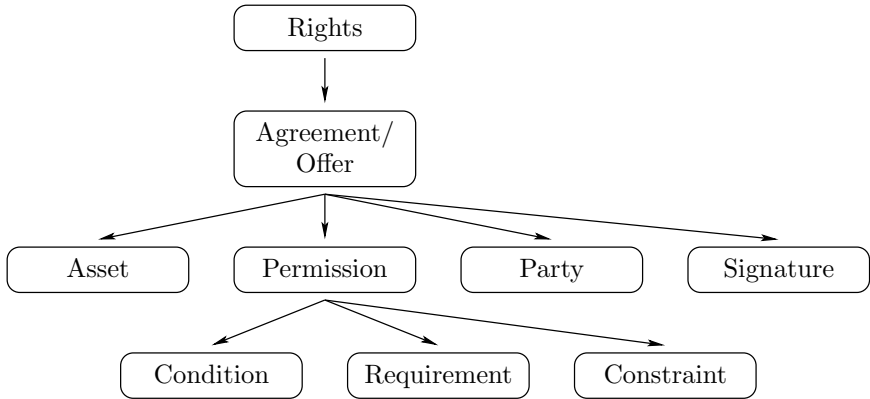
Starting from this basic model, each REL contains additional concepts for the purpose of expressing rights relationships in more detail, for example by means of prerequisites and restrictions on permissions. The paragraphs that follow present an example of a language concept: the straightforward concept of the Open Digital Rights Language (ODRL) (see page 105).

The root element in ODRL is the *rights* element, which represents one rights expression (e.g., a license, contract, etc.). The rights element may contain the rights expression itself with the *party*, *asset* and *permissions* elements or, alternatively, it may use the *offer/agreement* element to indicate semantically that

<sup>244</sup> See: Iannella (2001).

<sup>245</sup> See: Paskin within this book on page 26.

a given rights expression is an offer or agreement. In ODRL, prerequisites are called *requirements*, and restrictions are called *constraints*. ODRL also provides for *conditions*. Once a condition is fulfilled, the right is revoked.



**Fig. 1.** A Subset of the ODRL Language Concept

If the ODRL rights expression includes a digital signature, the corresponding information can be expressed by means of the *signature* element. The ODRL language concept allows the addition of XML elements compliant with the XML Signature<sup>246</sup> namespace. Figure 1 illustrates the elements discussed, which are merely a subset of the ODRL language concept. For a full description of the concept, please refer to Iannella<sup>247</sup>.

All ODRL elements can be further described by means of an ID, name, etc. with the help of the *context* element (not shown in Figure 1).

A rights expression can specify multiple parties, multiple or bundled assets as well as multiple permissions. Each permission can have prerequisites and constraints. In the next section, we will look at the rights vocabulary provided in order to create instances of this language concept.

### III.2 Rights Data Dictionary (RDD)

Each rights expression language includes a rights vocabulary, which defines the vocabulary permitted and its semantics in REL instances (i.e., valid rights expressions). For example, in an REL instance the print, play or view vocabulary items may be used as granted permissions; the time, location and individual vocabulary items may be used to restrict the permissions granted; or the payment vocabulary item may be used to express a requirement to obtain a permission. The table below shows an extract from the ODRL rights data dictionary in which several permission elements are defined.

<sup>246</sup> See: Bartel (2002).

<sup>247</sup> See: Iannella (2002).

Name	Identifier	Description	Comment
Play	play	The act of rendering the asset in audio/video form.	...
Print	print	The act of rendering the asset on paper or hard copy form.	...
Execute	execute	The act of executing the asset.	...
...			

Similar vocabulary definitions exist for requirements, constraints and the context element. The condition element can be expressed by means of the requirements and constraints vocabulary. A valid instance in the language concept and vocabulary introduced here can be found on page 109.

The rights data dictionary of the indecs 2rdd project (see page 106) aims to provide a more sophisticated RDD than one that simply defines vocabulary. The project has also provided an approach to a rights ontology which supports the interoperability of various rights metadata models.

## IV Standards and Initiatives

In this chapter, we introduce the relevant standards in the field of rights expression languages. The field is still evolving, but the standards mentioned below have managed to prevail.

### IV.1 ODRL

The Open Digital Rights Language (ODRL)<sup>248</sup> is being developed by the ODRL initiative<sup>249</sup>. The ODRL initiative is an international effort which aims to develop an open REL standard for the DRM sector. In the spirit of the open source community, ODRL is freely available. It was recently accepted by the Open Mobile Alliance (OMA)<sup>250</sup> as the standard REL for mobile content. The latest version of the ODRL specification (Version 1.1) was co-published by W3C (as a W3C Note). The OpenIPMP Open Source Rights Management Project<sup>251</sup> have just released the first version of their DRM software that utilises ODRL as the Rights Expression Language.

<sup>248</sup> See: Iannella (2002).

<sup>249</sup> See: <http://www.odrl.net>.

<sup>250</sup> See: <http://www.openmobilealliance.org>.

<sup>251</sup> See: <http://www.openipmp.com>.

## IV.2 XrML

The eXtensible rights markup language<sup>252</sup> is an REL specification developed by ContentGuard, a joint venture set up by Xerox and Microsoft. Like ODRL, XrML has also been accepted by standards bodies. XrML Version 2.0 was selected as the basis for development of the MPEG 21 Part 5 standard for an REL (see page 106) and for the Open eBook Forum<sup>253</sup> (OeBF) standard REL. The REL standard of the Organization for the Advancement of Structured Information Standards<sup>254</sup> (OASIS) will be based on XrML Version 2.1. ContentGuard has discontinued further development of XrML and transferred this responsibility to the OASIS *Rights Committee* and the MPEG initiative. However, the rights for industrial use of XrML functionality still need to be licensed with ContentGuard.

## IV.3 The <indec> 2rdd Project

The <indec > 2rdd project is based on the <indec > project, which defined a framework for interoperable metadata in content-based e-commerce and is now hosted by the DRM consulting company Rightscom<sup>255</sup>. In contrast to ODRL and XrML, the project focuses exclusively on defining a rights data dictionary, and its objective is to complete the MPEG 21 Part 6 standard for an RDD.

## IV.4 MPEG 21

The Moving Pictures Expert Group (MPEG) is the ISO/IEC working group in charge of developing standards for the coded representation of digital audio and video. Among other standards, MPEG is working on Standard 21 with a view to developing a standardized multimedia framework. Parts 5<sup>256</sup> and 6<sup>257</sup> of Standard 21 specify an REL and RDD suitable for such a framework. After defining the *requirements for RELs and RDDs*<sup>258</sup>, MPEG issued a call for contributions to select one REL and one RDD as a basis for future development. XrML Version 2.0 was accepted as the future MPEG 21 rights language, and the data dictionary from the <indec > initiative was accepted as the basis for Part 6 of the MPEG 21 standard.

## IV.5 Other Initiatives

XrML and ODRL are the leading initiatives in the field of rights expression languages. There have been other approaches which have been partly merged into one of the two languages or have not seen further development, while other

<sup>252</sup> See: ContentGuard (2000).

<sup>253</sup> See: <http://www.openebook.org>.

<sup>254</sup> See: <http://www.oasis-open.org>.

<sup>255</sup> See: <http://www.rightscom.com>.

<sup>256</sup> See: DeMartini, Wang, Wragg (2002).

<sup>257</sup> See: MPEG-21 RDD (2002).

<sup>258</sup> See: MPEG-21 Requirementants (2002).

newer initiatives are not yet established. This subsection briefly addresses these approaches and other appreciable initiatives as well as their status.

- RealNetworks, Inc. has put effort into its eXtensible Media Commerce Language (XMCL). An earlier version of XMCL was merged with ODRL in November 2001, but the language is still being developed independently.
- A relatively new initiative is the DREL (Digital Rights Expression Language) project founded in 2002 by the IEEE Learning Technology Standards Committee (LTSC)<sup>259</sup>. This committee addresses the need to express digital rights in the context of education.
- Xerox has done pioneering work in developing the Digital Property Rights Language (DPRL). DPRL was the precursor of XrML and is not being developed further.
- OASIS has just released Version 1.0 of the eXtensible Access Control Markup Language (XACML). XACML focuses on expressing access control policies rather than high-level usage rights for digital goods or services.
- The eBook industry has just started working on their “Rights Grammar” specification in order to develop a standard that provides interoperability among DRM systems in the eBook community.
- The Custom Digital Rights Language (CDRL)<sup>260</sup> is being developed by Octalis. Octalis<sup>261</sup> is a spin-off of a Belgian University and of no importance in the current DRM industry or standards bodies.
- The Creative Commons initiative, founded in 2001, aims at defining licenses to support rightsholders to assign the public domain specific rights to their creative works<sup>262</sup>. The initiative is developing a metadata format to express these licenses.

All of the major standards bodies as well as the publishing industry are aware of the need for a rights expression language and thus involved in some kind of REL development projects.

## V Application Fields

The fields of application for rights expression languages are numerous and have not yet been exhausted. This section introduces a number of current and potential application fields for RELs, starting with an enumeration of typical use scenarios.

1. Rights expressions can be used in secure digital containers. A secure container is a transport format for digital goods.<sup>263</sup> Its minimum components are the digital good in encrypted format and the corresponding rights information. The secure container grants access rights to authorized users only.

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<sup>259</sup> See: <http://ltsc.ieee.org>.

<sup>260</sup> See: Octalis (2002).

<sup>261</sup> See: <http://www.octalis.com/>.

<sup>262</sup> See: Creative Commons (2002).

<sup>263</sup> See: *Spenger* within this book on page 62.

The rights expressions are interpreted and processed by the appropriate secure viewer, i.e., the software designated to handle the secure container and render the content appropriately. For example, EMMS, which is IBM's DRM system (see page 111), uses this technique to package and distribute content (formerly *Cryptolope* technology). Microsoft's WMA format is another implementation of secure container technology.<sup>264</sup>

2. As an alternative to 1., access rights and digital goods/services can also be distributed separately. For example, the encrypted digital good or service can be distributed by means of superdistribution (e.g., peer-to-peer technology). Prior to accessing the product, the user has to receive the appropriate rights, which are sent separately in the form of a ticket (also called a voucher). Nokia is currently developing such technology<sup>265</sup> for the mobile communications sector.
3. In general, rights expression languages have the power to express offers and contracts (or agreements). Digital offers and contracts become legally binding with the digital signatures of the contracting parties. Digital contracts are a driving technology and a critical success factor in electronic business, regardless of whether the subject matter of the contract is a tangible/intangible or digital/physical product.

Hybrids and alternatives of the variants above are also conceivable in the technical application of rights expressions, depending on the system architecture and the information flow designed in the DRM system (see page 154). Generally speaking, the main field of application for rights expressions formulated with an REL will be the exchange of rights information between interoperating systems, independent of the logical construct they represent (contract, offer, etc.).

In order to integrate an REL into an information system, at least two components have to be added<sup>266</sup>:

- *License phrasing component.* The license phrasing component supports the user in writing rights expressions. This component could be, for example, a web-based user interface that helps content providers create offers. An REL instance is generated by the license phrasing component according to the specifications of the content provider.
- *REL interpreter.* A detailed REL instance is useless without an XML interpreter which is able to read and process the REL. For example, a secure viewer in charge of handling a secure container must be able to interpret the rights expressions which accompany the content in order to grant access to and render the content accordingly.

The interpretation of a rights expression forms the basis for its enforcement. The enforcement of a rights expression refers to the execution of the rights granted

<sup>264</sup> To learn more about secure containers see: *Spenger* within this book on page 62.

<sup>265</sup> See: Nokia (2001).

<sup>266</sup> See: Guth, Simon, Zdun (2003).

in accordance with the intentions of the rights holder. Further reading on rights enforcement can be found in Guth and Koeppen<sup>267</sup>.

RELs are often more powerful than the DRM system requires. Therefore, the rights expression language is usually adapted to the specific implementation and domain, and adaptation policies are developed to specify the restrictions or subset used. Examples of policies include defining the vocabulary used, naming the identification schemes allowed in instances (e.g., DOI, ISSN) or restricting the depth of nested rights expressions. The license phrasing component and the REL interpreter have to implement these policies.

The main focus of this section was to introduce ways to assign rights expressions to digital goods or services and to control usage and access. However, the machine-readable information in rights expressions or contracts has more potential than simply supporting access control. For example, electronic contracts can be used as an information base for customer relationship management services, contract-based workflow management, financial controlling or intellectual property rights discovery and protection.

## VI Practical Examples

All current RELs are defined using XML technology<sup>268</sup>, which means that the language concept and the data dictionary are defined using XML schemas or data type definition (DTD) documents. Consequently, valid rights expressions are instances of the REL schemas or DTDs.

### VI.1 ODRL Example

ODRL Version 1.1 comprises two XML schemas: one which defines the language concept and a second that defines the ODRL rights data dictionary. The following code is a simple example of ODRL showing a contract for a video (disregarding XML namespace labels). ODRL uses XML attributes to assign additional information to the vocabulary (cf. “currency” of the amount tag).

The sample license shows a recording of a marketing lecture sold to the *Université Libre de Bruxelles* for the price of €10 with the right to *play* the video *five times*. The video stream’s rights holder is the *Department of Information Systems at the Vienna University Economics and BA*. In this example, we used proprietary IDs from the Universal Project<sup>269</sup>.

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<sup>267</sup> See: Guth, Koeppen (2002).

<sup>268</sup> See: Fallside (2001).

<sup>269</sup> See: <http://www.ist-universal.org>.

```

<rights>
  <agreement>
    <party>
      <context>
        <uid>urn:univ:us-wuw-deptIS </uid>
        <name>Department of IS, Vienna University of Economics and BA</name>
      </context>
      <rightsholder/>
    </party>
    <asset>
      <context>
        <uid>urn:univ:lr-wuw-vid-1</uid>
        <name>Marketing strategies for Universal</name>
      </context>
    </asset>
    <party>
      <context>
        <uid>urn:univ:us-wuw-uniBrux</uid>
        <name>Université Libre de Bruxelles</name>
      </context>
    </party>
    <permission>
      <play>
        <requirement>
          <prepay>
            <amount currency=EUR>10.00</amount>
          </prepay>
        </requirement>
        <constraint>
          <count> 5 </count>
        </constraint>
      </play>
    </permission>
  </agreement>
</rights>

```

## VI.2 XrML Example

The XrML Language is defined by three XML schemas: the XrML core schema, the XrML standard extension (sx) schema and the XrML content extension (cx) schema. This example includes XML namespace information, which is necessary for the validation of XML instances. XrML envisages the use of XML Signature specifications to describe the identity of the contracting parties. The example below shows an XrML instance which reuses elements of the XML Signature namespace.

The “license”-tag is the root element of an XrML instances, asset and party are referred to as the “resource” and “principal” in the basic language concept of XrML. “Grant” comprises the actual rights expression. Rights are expressed as

“rights” plus “conditions”. The XrML-compliant representations of the resource and principal are “digital work” and “keyHolder.” The XrML vocabulary contains “print” and “validityInterval” as a right and condition. The XrML license below grants the owner of the x509 certificate the use of *someResource.xxx* until the *end of year 2005*.

```
<?xml version="1.0" encoding="UTF-8"?>
<license xmlns="http://www.xrml.org/schema/2001/11/xrml2core"
         xmlns:sx="http://www.xrml.org/schema/2001/11/xrml2sx"
         xmlns:dsig="http://www.w3.org/2000/09/xmldsig#"
         xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
         xmlns:cx="http://www.xrml.org/schema/2001/11/xrml2cx"
         xsi:schemaLocation="http://www.xrml.org/schema/2001/11/xrml2cx
                             ..\schemas\xrml2cx.xsd">

  <grant>
    <keyHolder>
      <info>
        <dsig:x509Data>
          <dsig:X509IssuerSerial>
            <dsig:X509IssuerName>CN=Guth Susanne,
              OU=Dept. of Information Systems,
              O=Vienna University of BA, L=Vienna,
              ST=Vienna, C=Austria
            </dsig:X509IssuerName>
            <dsig:X509SerialNumber>12345678</dsig:X509SerialNumber>
          </dsig:X509IssuerSerial>
          <dsig:X509Certificate>MIIEDCCA6GgAwIBAgIBEDANBgkqhki...
            ...Zos6NAm8m6UQBA== </dsig:X509Certificate>
        </dsig:x509Data>
      </info>
    </keyHolder>
    <cx:print/>
    <cx:digitalWork>
      <cx:locator>
        <nonSecureIndirect URI="http://www.wu-wien.ac.at/someResource"/>
      </cx:locator>
    </cx:digitalWork>
    <validityInterval>
      <notAfter>2005-12-24T23:59:59</notAfter>
    </validityInterval>
  </grant>
</license>
```

## VII Current Market Situation and Trends

This section examines the application of rights expression languages in the current DRM systems market. The leading developers of DRM middleware include IBM, Adobe, Real Networks and Microsoft, although Real Networks is currently not using an REL in their products.

- IBM has developed a product called the Electronic Media Management System (EMMS)<sup>270</sup>, which currently deploys a proprietary rights expression language influenced by ODRL. EMMS supports a variety of media formats. IBM is working in close cooperation with Nokia to develop solutions for the mobile communications sector<sup>271</sup>. Nokia has just released a new version of their content publishing toolkit, that provides for content creation in the OMA format (based on ODRL) and enables deployment of content and rights to mobile handsets.
- Microsoft has implemented XrML in its Windows Media<sup>TM</sup> Rights Manager. This software provides a means of packaging content and specifying usage and access rights formulated in XrML. The output of this tool is a file in Windows Media format (WMA), and the rights can be interpreted and processed by the Windows Media Player.
- Adobe offers DRM solutions for the exchange of documents in pdf format, including e-Books. The documents are created with the Adobe Content Server software and can be interpreted and enforced with the corresponding reader, which offers the functionality of a secure viewer. Adobe is a supporter of the ODRL initiative and a DRM player which will potentially use ODRL in future products.

Based on this middleware, some implementations have already appeared on the Internet. One of the first music subscription services, PressPlay<sup>272</sup>, uses the Microsoft solution and thus works with XrML. MusicNet<sup>273</sup> is a digital music service based on Real Networks' technology. The M-Stage Mobile Music Service<sup>274</sup> is a product on the Japanese mobile-commerce market hosted by NTT DoCoMo, based on IBM's EMMS technology. Besides the market leaders, there are also other projects which have implemented rights languages, such as the COLIS<sup>275</sup> project, which uses ODRL.

InterTrust, one of the pioneers in the development of specifications for DRM systems, does not provide a DRM middleware implementation. However, InterTrust has recently had success in licensing its DRM specifications.

All REL developers publish up-to-date information on implementations of their languages as well as their supporters on their web sites. One reliable online source of information on RELs is OASIS' *The XML Coverpages*<sup>276</sup>

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<sup>270</sup> See: <http://www.ibm.com/software/data/emms/>.

<sup>271</sup> See: Nokia (2001).

<sup>272</sup> See: <http://www.pressplay.com/>.

<sup>273</sup> See: <http://www.musicnet.com/>.

<sup>274</sup> See: [http://www.nttdocomo.co.jp/p\\_s/mstage/music/](http://www.nttdocomo.co.jp/p_s/mstage/music/).

<sup>275</sup> See: <http://www.colis.mq.edu.au/>.

<sup>276</sup> See: <http://xml.coverpages.com/drm.html>.