

# Semantically enhanced representation of legal contracts for web applications

## Abstract

The Carneades Contract Format (CC-F) provides a flexible and extensible representation framework for legal contracts, which is capable of representing the text, the document structure and the semantics of legally binding agreements. The paper provides an overview about the CC-F, discusses the underlying design considerations, compares it with other solutions.

Keywords: legal contract, semantics, web applications, xml, Carneades Contract

## 1. Introduction

Contracts are part of everyday life. Nearly all aspects of our activities are regulated by legally binding and legally enforceable agreements, which define what we can or cannot do in different situations. The amount of contractual relationships, which define our rights, duties and responsibilities is tremendous.

Theoretically in most of the cases we can enter into a legally enforceable contractual relationship without any formalities, whereas under certain circumstances it is a statutory requirement to embed our contractual agreements into written documents. Theory and practice however became very distant and we can experience an ever growing and super extensive use of written legal contracts. With the appearance of web applications (web based services and electronic commerce solutions) the use of written legal contracts has multiplied during the last 15 years and led to an extensive use of written contracts in electronic form.

Beside this phenomenon, web based services also created a new contracting practice, which seems to have strong limitations from a legal point of view. Whenever we purchase something in a shop we enter into a sales agreement, but we rarely create a written document about this commercial transaction. In case of most web-shops, once we buy something we immediately enter into at least two contracts: one with the shop service provider and another one with the seller. These contracts are usually written contracts. In most cases these contracts consist of general contract terms provided by the shop owner and the seller, whereas transaction specific pieces of contractual information (e.g. buyer, price, date) are usually stored separately. This contracting practice creates problems, because general contract terms often change, databases which store transaction specific contractual information are often restructured or simply deleted, moreover these databases are under the sole control of one of the contracting parties. This complexity of problems makes the determination of the actual agreement's content rather uncertain in a later legal dispute arising out of the transaction. Due to these deficiencies in later legal disputes or proceedings these types of written contracts cannot fulfil the same role that made the use of paper based written contracts so popular. These types of electronic contracts simply cannot provide the same level of certainty as paper based documentary evidence.

An obvious solution to these problems generated by web applications (like the extensive use of written electronic contracts, separation of transaction specific contractual information) can be the

use of individualized, authentic, written electronic contracts in the domain of web applications. However we do not experience the contracting practice to move towards this direction. There are several reasons, one of them certainly being the lack of a widely used, standard representation format for written electronic contracts, which could help to overcome the above mentioned limitations. The CC-F intends to be such a format.

## **2. Design considerations**

We have formulated two major design requirements concerning the possible use of the CC-F. One was to provide support for the use of the contracts in legal proceedings as documentary evidence, while the other was to support the processing of legal information contained in the contract.

During our work we have come to the conclusion that these two usage goals can be best achieved by creating a compound document format. Additionally the adherence to W3C principles seemed to be a natural requirement because the CC-F intended to be used by web applications.

### **2.1. Usage considerations**

#### **2.1.1. Possibility to use in legal proceedings**

Documentary evidence plays a distinguished role in proving or disproving facts in legal proceedings. The main advantage of paper based documentary evidence over other forms of proof is that documents can be observed easily and they that provide an objective insight into past events. Moreover paper based documents, their content and their authenticity can be observed by anybody who can read the document.

From a practical point of view, paper based documents are advantageous, because all the information about a past event is enclosed into the document and an average person in possession of the document can access this information directly and judge its authenticity without any special help. This is the reason why everyday contracting practice is so much focused on paper based written contracts in spite of the fact that statutory requirements for using written contracts can be considered rare exceptions.

To sum up, the above described paper based documentary evidence is widely used and preferred because of the following reasons:

- a) it encloses all necessary information about past events
- b) the enclosed information can be accessed directly
- c) authenticity of the enclosed information can easily be judged

Despite the fact that written electronic contracts can possess these qualities, the contracting practice that has been developed during the last 15 years in relation to web applications did not make use of them. Although these qualities are important if we would like to use written electronic contracts in legal proceeding as documentary evidence.

It is possible to reformulate the above listed qualities into design goals which in the case of the CC-F resulted in the following requirements:

- a) support the embedding of all information relating to the contract
- b) be able to provide a pleasant, human readable representation in web browsers

- c) use a solution which makes it possible to sign (or time stamp) the contract electronically

### **2.1.2. Ensuring the possibility of processing legal information by machines**

Rights and obligations defined by contracts are important during the whole life of a contractual relationship. In case of web applications it is important to know what rights the users and what obligations the service providers have in their contractual relationship. This knowledge can be easily derived from contracts by humans, but to extract this information from plain text by machines is quite a demanding exercise. Therefore we put forward the design requirement for the CC-F to provide support for processing legal information by machines.

The main problem is that the possible use of the information contained in a contract cannot be assessed in advance. Unsurprisingly nobody was able to create a generic framework so far, which could have expressed all potential information embedded into a contract. In this regard contracts are not different from any other documents. Therefore the task of creating a format capable of representing contractual information creates basically the same problem as representing structured information embedded in any kind of document.

Therefore we have decided to lower our expectations in relation to the representation of information contained in contracts and instead of tackling the whole problem, we opted to create only a generic solution, which can support the enhancement of the electronic contracts with information about the content of the contract. We have named our approach semantically enhanced representation, by which we intend to emphasise that the CC-F is a format which can fully express the structure of a contract and which is also capable of carrying additional information ready for machine processing.

## **2.2. Use of compound documents**

We use compound documents in order to provide a solution that can support the embedding of all information related to the contract, and that can help the processing of contractual information by machines at the same time,. The key property of a compound document is that it contains several types of documents or document fragments. The different types can be chosen to satisfy different requirements. In our case, we have a generic format to model the structure of a legal document (CC-F), in which extensions are allowed almost everywhere. Every extension contains a small document or document fragment. The role of the extensions is to create a way to embed machine readable, semantic information into the text of the contract. Ideally, all information related to the contract are embedded into an extension somehow, which makes the CC-F document very useful in a legal procedure as documentary evidence.

We can implement other requirements by combining different types of documents. We use standard tools, like XSL Transformation, HMTL, CSS and Javascript to provide visual representation for a CC-F contract. All of these are placed in the same file as the CC-F. Using this method, the document contains not only the legal text and the machine readable information, but also the code necessary to make the document nicely formatted when opened in a browser.

## **2.3. Adherence to W3C principles**

In order to ensure compatibility with web applications we took the W3C principles into account. W3C set up a number of general directives in it's Web Architecture Document on how to create

XML-based data formats. Here we emphasize some of the more important points of the recommendation we considered:

- a) Use XML namespaces to avoid name collisions
- b) Use of a namespace document
- c) Use of XML fragments as intended
- d) Use of XML Schema IDs as intended
- e) Develop Orthogonal Specifications (no schema dependency if it can be avoided)
- f) Use Extended elements as possible

In later sections we will detail how our format realizes these points.

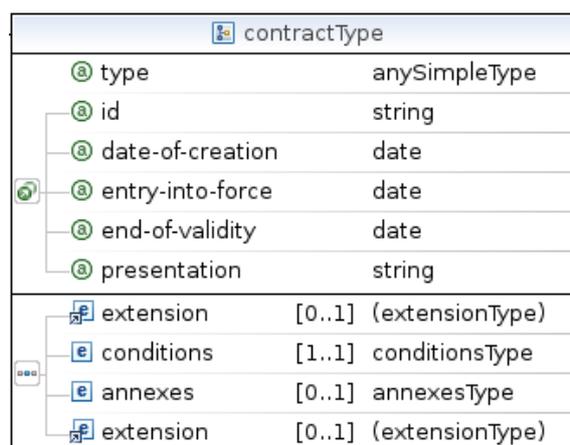
### 3. The representation format

In the following sections we discuss the details of our format. First we describe the core of our concept, the CC-F, which is an XML format to model the structure of legal documents. CC-F has its own namespace, defined by an XML Schema Document. Then we discuss the Carneades Contract Compound Document (CC-D), which is comprised of a CC-F document, with additional extensions, an XSL Transformation and optionally an XML Digital Signature.

#### 3.1. The CC-F

To model legal documents, we have produced a relatively simple XML Schema. The target namespace of the schema is <http://www.carneades.hu/xml/carneadescontract/contract.xsd>. As it is recommended in the W3C web architecture document, the actual Schema file is available at the location the namespace points to.

The root of the CC-F document is always a **contract** element. The possible child elements of a contract element are shown on the figure below.



A **contract** element has a required **type** attribute, which can be a custom string. The type indicates the type of the contract. Our schema does not pre-define contract types, we let the users to create them. The element has other attributes as well, grouped in an attribute group called **commonAttributes**.

The **commonAttributes** group contains the following attributes:

**id(required)**: this must be a unique identifier of the element

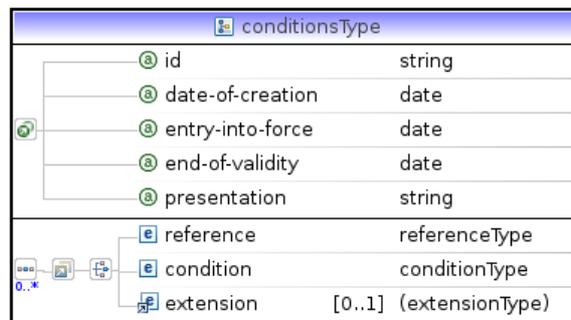
**date-of-creation**: the date and time when the element was created

**entry-into-force**: the date and time when the contents of the elements come into force (e.g. a condition)

**end-of-validity**: the date until the contents of the element are valid

**presentation**: a custom text which may indicate the way the element should appear in the visual representation. In our implementation we use html element names as **li** or **ul**. However, an other implementation may use anything else. As this attribute is intended to help with the visual rendering of the text only, the presenter software may not take it into account. The presenter software must provide a default appearance to elements which does not have presentation attribute, or the presentation attribute contents of which cannot be interpreted or are unknown to the software.

The **conditions** element stores the main contents of the contract, while the **annexes** element stores the appendices. The content model of a **conditions** element is shown on the following figure.



The **conditions** element also has the common attributes, and there is a multiple choice of **reference**, **condition** and **extension** elements when appending a child.

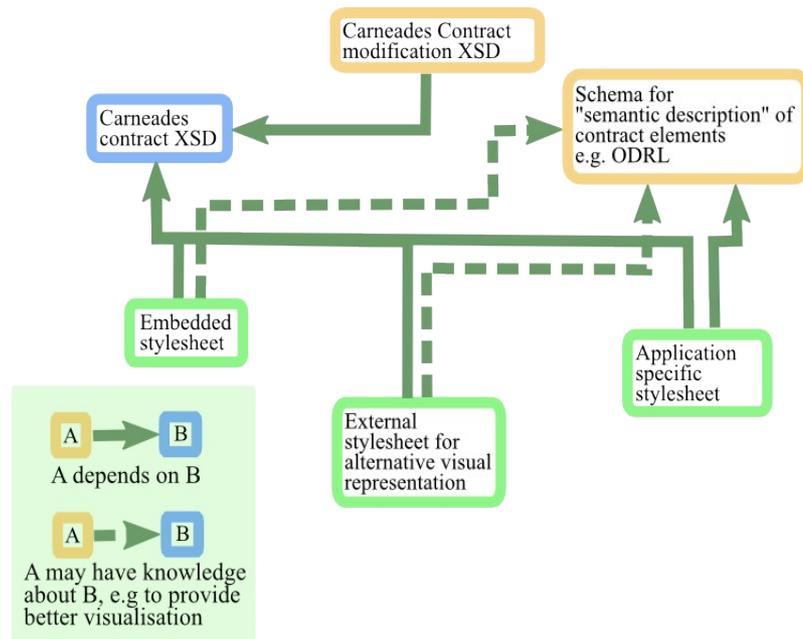
The **condition** element is the basic building block of the format. It is used to structure the text of the legal documents. It may contain plain text, references, extensions and other conditions or a combination of them. The condition element has the common attributes. The data model of a condition element is the same as the conditions element.

The **reference** element is used to refer to an other part of the contract XML by its identifier. The reference element must be interpreted the same way, as the referenced element were included in its place. The reference element has only one attribute, the **targetId**, which contains the id of the referenced element. The element does not have any content.

The **extension** element creates the possibility of inserting arbitrary XML fragments almost everywhere in the contract. Any namespace is allowed as its content. It has three attributes: **id**, **text**, and **metadata**. The **id** attribute makes it possible to reference the given extension element from elsewhere in the document by using a reference element. The **text** attribute contains the text, which is to be rendered in its place in the visual representation of the contract. This piece of text should appear in a distinctive way in the visual representation, so as to call the attention to the fact that it is an annotated text. The **metadata** attribute designates that the given extension element is not bound to a certain portion of the text, but it provides information about the contract in general. The data model of the extension element is shown on the next figure.

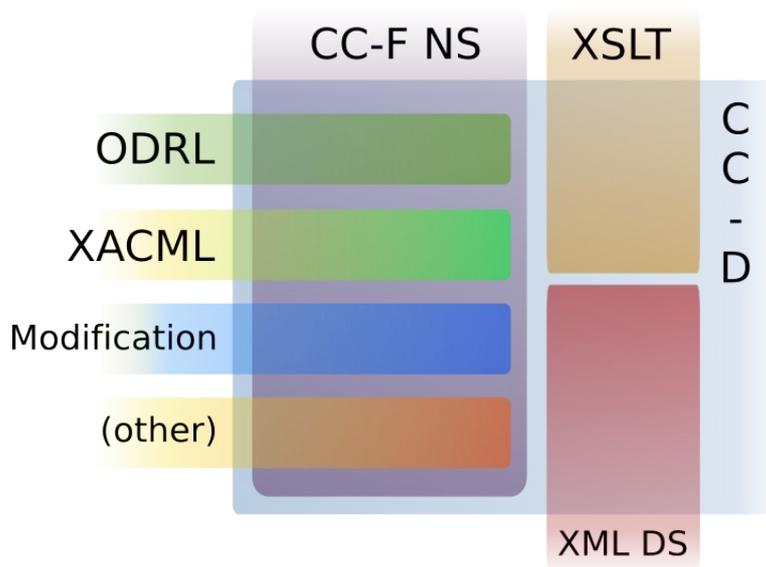
(extensionType)	
Ⓜ metadata	boolean
Ⓜ text	string
Ⓜ id	string
Ⓜ any	[0..*]

### 3.1.1. Schema design



An important feature of our design is that the Carneades Contract Schema and the schema of the embedded semantics are mutually independent from each other, as apparent on the figure. In our definition, A depends on B, when there is any reference in A to B. More strictly, this means that a change in B may render some changes necessary in A in order to keep the system working as intended. When two schemas are independent from each other, they can evolve independently. This is very important as different legal formats are maintained by different working groups.

We define an other type of dependency, the optional dependency. This means, that A provides a basic functionality independently from B, but there may be some additional features which depend on B. A typical example is our embedded XSLT which provides a default visualisation for every annotation, but it recognizes certain ODRL elements and visualise them differently, to achieve a better user experience. A major change in the ODRL schema may render this feature broken.



### 3.2. The CC Compound Document

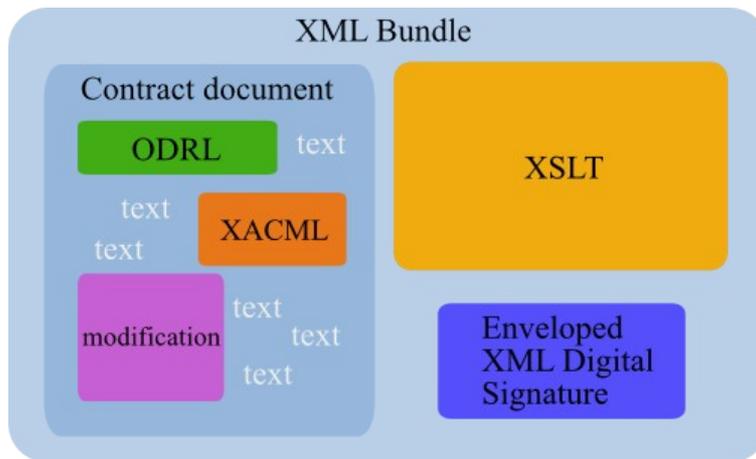
After a CC-F XML was created, we embed the whole document into an other XML file, which contains an XSLT transformation and optionally an enveloped XML Digital Signature as well. We call the XML file which also contains the XSLT transformation “CC-D”. We reference the documents, which are also enveloped with an XML Digital Signature as “CC-DS.”

The rationale behind this embedding is that this way we can create an XML file, which becomes self-representing in web browsers. At the beginning of the CC-D file there is a processing instruction for browsers to execute the file as an XSL transformation. Then the running transformation parses the CC-F document embedded into the transformation itself, recognizes the presentation elements and turns a contract into a nicely formatted XHTML page, with embedded CSS and Javascript. The CSS provides customisable look and feel, while Javascript can provide visual annotations (e.g. a pop-up window) when the user hovers the cursor over a piece of annotated text. Actually, this XSL-generated document is a compound document itself.

As mentioned previously, everywhere in the CC-F there is the possibility of embedding valid XML from any namespace (e.g. ODRL or XACML) using the extension elements.

The semantic annotations in the document become simple visual annotations in this representation by default. If there are parts of the XSLT prepared to handle the particular namespaces used in the extension elements, the visual representation becomes even more informative.

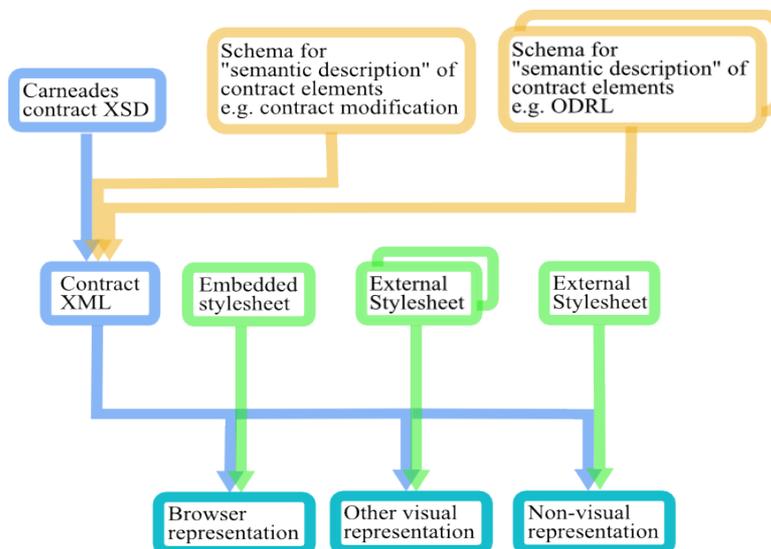
A special kind of annotation is the contract modification, which we have placed in a different namespace. Using the elements of this namespace, we can produce contracts which modify other contracts. Using the original contract and the modifications we can always derive a consolidated view of the contract. At the technical level however, the modification schema is just like an external schema to the Carneades Contract, like XACML, ODRL or others.



### 3.2.1. Building a document

To overview how the pieces fit together, let us consider an example, in which a user agrees upon the downloading of a film for a certain price. There is a legal text template given in simple text format in which the name of the user, the identifiers of the film and the price are left blank. From this, we generate the actual usage agreement. Then we convert the text into Carneades Contract format, which is a structural representation of the text, consisting of conditions, sub-conditions and annexes. After that, we annotate certain conditions with ODRL XML fragments: the parties in the agreement, the price, the item, and the conditions of use, all of which has a particular syntax in ODRL. Then we bundle this document together with an XSLT which provides a visualisation when the document is opened in a browser. Finally one can optionally place an enveloped XML Digital Signature in the document.

The figure below illustrates this process.



## 4. Evaluation

In order to provide a better understanding of what the CC-D actually is, we find it important to summarize the useful qualities of the CC-D. Additionally we would like to provide an overview of how the CC-D compares to other contract representation formats in our assessment.

#### **4.1. Qualities of CC-D**

According to our view there are many compelling characteristics of the CC-D. A very important one is that no custom system is needed to open the documents for reading; the user can use an everyday browser. Moreover, given that every embedded piece of information has pleasant visual appearance by default, it encourages the use of embedded semantics even when there is no application to process it at the time being. Another advantage of a CC-D document is that unifies the accessibility of the microformats and the sophisticated characteristics of the application specific formats.

There are several practical advantages of CC-D. One of them is the possibility to store and to handle the documents in the many existing COTS and open source web page management systems. From the point of view of the future development, it is very important that in theory, the CC schema can act as a carrier of future legal formats without modifications.

Beside the visual representation, machine processing is still possible, since the source file is structured and semantically annotated. The annotations can be used to generate statistics, reasoning and performing authorization decisions.

We do not assert that other solutions are not able to provide identical or similar advantages, but we are confident that the CC-F provides the above mentioned capabilities in a uniquely simple and elegant way.

#### **4.2. Semantically enhanced representation and other approaches to represent semantics**

In order to represent the semantics of the contracts, the CC-F provides a generic solution that we call semantically enhanced representation. In the following we present an overview of these technologies in order to explain our approach and describe its relationship with other currently available semantic technologies.

##### **4.2.1. Semantic Web**

The Semantic Web is intended to be a large framework on the internet which enhances the ability of the web to store structured data and knowledge. To achieve this, it is crucial to mark the data in the documents found on the web and to provide meaning, or semantics at the same time. This can be done by using a stack of technologies. There are many possibilities to mark and structure the data on web pages: HTML and XHTML meta tags, embedded RDF, attached RDF using GRDDL, embedded RDF using RDFa and there are Microformats such as hCard and hCalendar.

To define the different roles, classes and relationships between data, there is RDF Schema, and

OWL. Two of the three versions of OWL, OWL-DD and OWL-Lite are direct applications of the mathematical theory of description logics and do have formal semantics.

#### **4.2.2. Community driven semantic technologies**

Other, community-driven semantic technologies, such as hCard do not have a defined formal semantics in the mathematical sense, but they do have a specification where the semantics are defined in English.<sup>1</sup> These formats (often called microformats) differ from the academic approaches, as they use (x)HTML, CSS, and arbitrary XML to mark the data, which allows standard web browsers to render them properly, without knowing the format.

#### **4.2.3. Application specific standards**

There are application-specific standards such as ODRL or XACML, which may be characterised as semantic technologies, as they have a syntax to store data and have a definition of the meaning of the data, or semantics as well. However, these are designed to be used in specific applications, rather than to be embedded in standard web pages. The latter, application-specific approach especially holds for the majority of legal formats such as P3P or ODRL.

#### **4.2.4. Semantically enhanced representation**

The CC documents (CC-D) reuse the semantic vocabularies of the application specific legal formats (e.g. ODRL), by including XML fragments into the CC-F's extension elements. But we also adhere to the most important microformat design principle: we always provide some visual representation to the embedded semantic information. While a microformat embeds the semantic information into the HTML code directly, exploiting the HTML class mechanism, we have a more sophisticated and more flexible solution to do the same. With bundled CC-F and XSLT we are able to preserve the original form of the semantic information (i.e. an XACML fragment) and to provide a nicely formatted, human readable visual representation at the same time. This way we hope to unify the advantages of two different approaches.

### **4.3. W3C compound documents and the CC-D**

The W3C institute runs a project called Compound Document Format (CDF). This effort aims to provide a recommendation on how to combine specific web standards, such as XHTML, SVG, Xforms, and others properly. The W3C has two approaches: the Compound Document Framework by Reference (CDRF) and the Compound Document Framework by Inclusion (CDIF). CDRF is in Candidate Recommendation stage at the time of writing, while CDIF is just an editor's draft. In the W3C's concept, the CDIF builds on the top of CDRF.

While we call our document a compound document, there are some differences in comparison to the W3C CDF. The main differences between our approach and the W3C's effort are that first we have developed a format for legal documents specifically, and second we provide a visual representation of them when opened in a browser, by using web technologies, whereas CDF is about how to

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<sup>1</sup> The hCard, for example, is a 1:1 mapping of the vCard which is defined in the RFC 2426

combine certain web technologies to render them properly.

One might define our Semantically Enhanced documents as XML files which transform themselves into something like a CDIF document in the web browser. But again, given that CDIF is in a very early stage and nothing can be assumed from its details and its future browser support yet, this statement is inappropriate as premature. At the time being we always test our documents in the current generation of web browsers and tailor the code as necessary to make them work in these.

#### **4.4. Comparison with other contract representation formats**

We have started to develop the CC-F in 2005 independently of other existing solutions. Most of our work was carried out during 2007 and 2008. During this later period we have started to evaluate our results and explore how it compares to other solutions.

There are several contract representation formats available. The leading ones are the following:

- a) Platform for Privacy Preferences - P3P
- b) Open Digital Rights Language (ODRL) Initiative
- c) OASIS - Legal XML eContracts
- d) Web Services Agreement Specification
- e) IST-CONTRACT

##### Platform for Privacy Preferences – P3P

P3P can be considered to be the first initiative to express legally relevant information with a standard vocabulary in the domain of web applications. P3P focuses on the expression of personal data-sharing preferences of users and personal data processing needs of web applications. P3P work has been suspended in 2007 due to the lack of browser implementations and all relating work has been taken up by the W3C Policy Languages Interest Group.<sup>2</sup>

##### Open Digital Rights Language (ODRL) Initiative

The ODRL Initiative ([www.odrl.net](http://www.odrl.net)) is developing a right expression language (REL), which is capable of expressing rights and obligations in relation to the sale and use of digital assets. The ODRL REL focuses on the expression of the semantics of the sale and usage agreements of digital assets.

##### OASIS - Legal XML eContracts

The OASIS eContracts XML schema is developed by the OASIS LegalXML eContracts Technical Committee. The main purpose of the schema is “to describe the generic hierarchical structure of a wide range of contract documents.”<sup>3</sup> The schema contains 51 elements, most of them are used to represent structural elements of contracts (e.g. body of text, attachments), but some of the elements also encode semantic information as well (e.g. parties, witnesses). Semantics of the contracts can be expressed with metadata or external elements from other schemas.

##### Web Services Agreement Specification

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<sup>2</sup> <http://www.w3.org/P3P>

<sup>3</sup> <http://www.oasis-open.org/committees/download.php/23988/legalxml-econ-specification-1.0.html>

Web Services Agreement Specification (WS-Agreement, [www.ogf.org/documents/GFD.107.pdf](http://www.ogf.org/documents/GFD.107.pdf)) was developed by the Open Grid Forum. The WS-Agreement provides a “protocol for establishing agreement between two parties, such as between a service provider and consumer.”<sup>4</sup> The WS-Agreement format defines an extensible XML language, which is capable of expressing the contractual rights and obligations in order to help the negotiation between the service provider and the user. The WS-Agreement provides a basic, high level vocabulary to express certain contractual informations like type of contract, description of qualities of a service and service guarantees.

## IST-CONTRACT

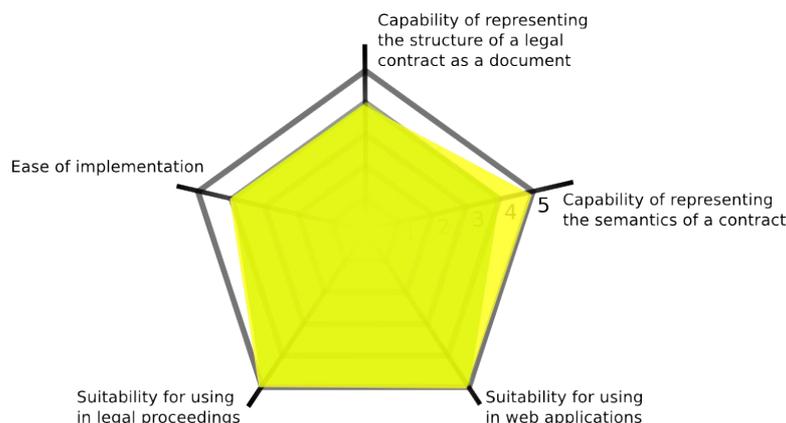
The EU funded ist-contract project is “developing frameworks, components and tools which provide advanced contract based design, management and verification capabilities for Web Services environments.”<sup>5</sup> The project has developed a specification the Contracting Language and Syntax,<sup>6</sup> which intends to provide a generic framework for the expression of contractual rights and obligations.

In order to place the CC-F into context we have compared the above described formats with our approach based on the following criteria:

- a) capability of representing the structure of a legal contract as a document
- b) capability of representing semantics of the contract
- c) suitability to be used in web applications
- d) suitability to be used in legal proceedings
- e) ease of implementation

We have assessed the different solutions at a 1-5 point scale (1: low - 5: high). Obviously this is a very subjective approach, however it can provide a high level overview about how these solutions compare to each other.

The figure below shows the capabilities of the CC-D in our assessment.

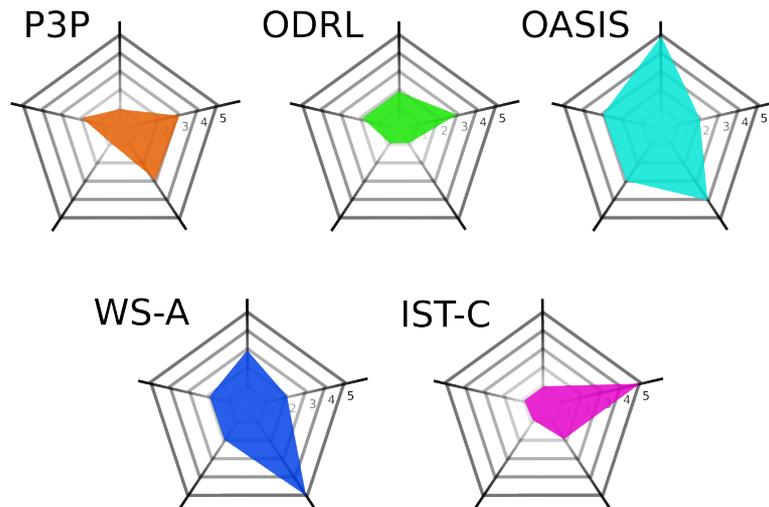


4 Web Services Agreement Specification, [www.ogf.org/documents/GFD.107.pdf](http://www.ogf.org/documents/GFD.107.pdf), p. 1

5 <http://ist-contract.sourceforge.net>

6 [http://www.ist-contract.org/index.php?option=com\\_docman&task=doc\\_download&gid=11&Itemid=44](http://www.ist-contract.org/index.php?option=com_docman&task=doc_download&gid=11&Itemid=44)

The next figure shows our assessment of some other solutions using the same graph layout.



## 5. Application experience

During the last year we have been testing our approach in the framework of a research project called “AAI based authorization broker.”<sup>7</sup> The AAI based authorization broker is an e-commerce solution based on strong identity and policy management. It is a sub-project of the Mobile Innovation Centre, which is a research and development program sponsored by the Hungarian government. The project covers the area of mobile telecommunication, the consortial partners are telecommunication equipment manufacturers, mobile operators, IT companies, other SMEs, universities and the MTA Sztaki Research Institute.

Until now we have explored two application scenarios of the CC-F in more detail.

### 5.1. XACML Scenario

On a site of a domain name and web hosting provider there are many different offers. The services are available after registration when the user agrees upon a document which covers the general conditions of use. Hosting a web site or registering a domain name requires payment and additional, fixed length agreements, which are to be renewed after a certain period of time. Depending on the plan there may be an administration interface for the web space or a control panel for the DNS.

To implement this system, a very sophisticated access control is required, which, ideally is based on the agreements made with the user. Today, the vast majority of the sites similar to the one above, use a typical solution, in which the information needed to access control is stored in some kind of a database, and maintained in parallel with the related legal documents. The documents are not on a per-user basis.

With semantically enhanced Carneades Contracts, and an XACML based access control system there is no need to store information redundantly. The access information in XACML can be

<sup>7</sup> [www.sztaki.hu/search/projects/project\\_information/?uid=00210](http://www.sztaki.hu/search/projects/project_information/?uid=00210)

embedded in the corresponding legal text, which is readable for the user and for the access control system at the same time. This way, the access and authorization decision can be derived directly from the usage agreement documents. This allows us to have many types of customized agreements without the need to modify the access control system. Special offers, off-line made agreements can be inserted into the system seamlessly.

## 5.2. ODRL Scenario

A digital content provider uses CC-F enriched with ODRL when selling images, sounds, videos, etc. ODRL is an XML format which is especially capable of expressing rights about a digital content, including the interval of usage, the types of usage, the numbers of usage and so on. It also contains detailed information about the buyer and seller parties. Alice buys an mp3 from the content provider. She pays extra, because she wants to reproduce the song in 100 instances, on a CD which introduces her company. The content provider's system generates a CC-D file with ODRL fragments embedded. The generator program takes information as input from Alice's registered profile at the provider, from the database of mp3 metadata, and from the details of the transaction. The generated document provides sufficient information to identify Alice, the song, the seller, the amount paid and the purpose. The document is XML signed by the seller. Alice distributes the CDs on corporate events and exhibitions. When a representative of an Artist's Rights Organisation turns up, she easily proves that she has the right to redistribute the song within the given limitation.

## 6. Conclusions

We consider the CC-F a relatively novel approach, which is designed to support the needs of both technical implementation of web applications and that of the legal practice. The CC-F is currently under development, however it is now mature enough for the use of real life applications. We have published the schema on our website<sup>8</sup> and licensed it under LGPL.

Next steps will include the further refinement of the CC-F and the CC-Modification schema and we will explore new application scenarios as well. The development of customizable template contracts for common use cases and the development of tools for the creation of custom Carneades Contracts are planned.

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<sup>8</sup> [www.carneades.hu/xml/carneadescontract](http://www.carneades.hu/xml/carneadescontract)

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