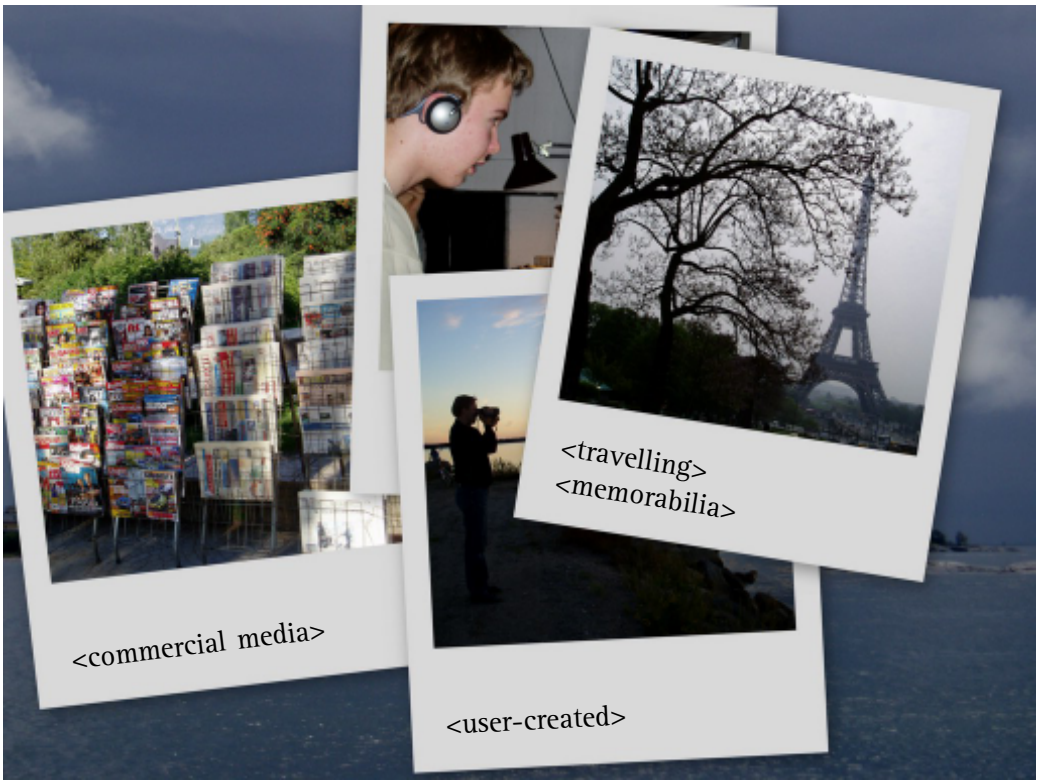
ESPOO 2006 VTT PUBLICATIONS 612



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Report on the RISE-project

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ISBN 951–38–6857–5 (soft back ed.)
ISSN 1235–0621 (soft back ed.)

ISBN 951–38–6858–3 (URL: http://www.vtt.fi/publications/index.jsp)
ISSN 1455–0849 (URL: http://www.vtt.fi/publications/index.jsp)

JULKAISIJA – UTGIVARE – PUBLISHER

VTT, Vuorimiehentie 3, PL 1000, 02044 VTT
puh. vaihde 020 722 111, faksi 020 722 4374

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Technical editing Anni Kääriäinen

Valopaino Oy, Helsinki 2006

Bäck, Asta, Vainikainen, Sari, Näkki, Pirjo, Reti, Tommo, Sarvas, Risto, Seppälä, Lassi, Turpeinen, Marko & Hietanen, Herkko. Semantically supported media services with user participation. Report on the RISE-project [Käyttäjien osallistumista tukevat semanttiset mediapalvelut]. Espoo 2006. VTT Publications 612. 99 p.

Keywords semantic media, collaborative media, media services, metadata, user-generated content, Web applications, ontologies, participatory media, prototypes, Semantic Web

Abstract

This publication presents the main results of the project "Rich Semantic Media for Private and Professional Users" (RISE). The background to the launch of the project was the identification of two important developments: the emergence of user-generated content and Semantic Web technologies. The goal was to study what kind of new opportunities semantic metadata and combining commercial media content with user-created material give to media companies and their suppliers for product and service development.

The publication gives an overview on recent developments relating to utilising user-generated content and metadata in public Web applications, and an update on development on Semantic Web technologies related issues on their relevance to the application development made in the project.

The project chose to explore research issues by building prototypes. Each of the prototypes is presented including a user scenario, implementation, results, discussion and future work.

- The StorySlotMachine is travelling related application, which allows users to make their own guidebooks to be used during the trip. After the trip users can make presentations combining their own photos and commercial content. Ontologies are used for automatic aggregation and to offer content that deals with the topic.
- The Remix Engine prototype is a Web-based video editing and compilation application that lets the user combine his or her own media with commercial media with the help of pre-made templates. The end product, a video, is

composed of professional material that includes team logos, TV brands, advertisements, and so on.

- DiMaS is a Digital Content Distribution Management System for multimedia producers to publish their work on P2P file sharing networks. The system enables producers to insert content metadata, to manage intellectual property and usage rights, and to charge for the consumption.

Applications like StorySlotMachine and RemixEngine could be built in connection to media archives, like news archives, or in connection to encyclopaedia, where the material is already modular. If and when users do the final aggregating and editing work themselves, the costs for offering content this way are not high after the initial investment in the tools and metadata have been made. Commercial media must be able to offer more value to the users than free services and utilising ontologies in making services more intelligent is one opportunity.

There are still challenges for building this kind of services: A big issue in utilising semantic metadata and Semantic Web technologies is developing and maintaining ontologies. Another issue is adding semantic metadata to the content. Also legal issues like commercialisation of the content creation activity, intellectual property rights within the creators, the brand image of the content or the group, and managing the liability risks in content production need to be solved.

If media companies turn their content into more modular format and add semantic metadata to support reusability and active exploration of content they have more opportunities to create new consumer applications with rich user experience.

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Tiivistelmä

Tämä julkaisu esittää RISE-projektin (Rich Semantic Media for Private and Professional Users) keskeisimmät tulokset. Projektin käynnistämisen taustana oli kaksi tärkeää kehitystrendiä: käyttäjien tuottaman sisällön kasvu ja semanttisen webin teknologioiden kehittyminen. Tutkimuksen tavoitteena oli selvittää, millaisia uusia mahdollisuuksia semanttinen metatieto ja kaupallisen ja käyttäjien tuottaman sisällön yhdistäminen tarjoavat uusien tuotteiden ja palvelujen kehittämiseen mediataloille ja niiden järjestelmätoimittajille.

Tämä julkaisu sisältää yhteenvedon viimeaikaisesta kehityksestä käyttäjien tuottaman sisällön ja metatietojen hyödyntämisessä verkkosovelluksissa ja päivityksen semanttisen webin teknologioiden kehitykseen siltä osin kuin näillä on liittymäpintaa projektissa tehdylle sovelluskehitykselle.

Projektissa kehitettiin kolme ohjelmistoprototyyppiä. Näistä jokaisesta esitetään käyttäjäskenaario, sovelluskehitys, tulokset, johtopäätökset ja jatkokehitys. Sovellukset ovat seuraavanlaiset:

- StorySlotMachine (Matkamasiina) on matkailuun liittyvä sovellus, jonka avulla käyttäjät voivat tehdä omia matkaoppaita käytettäväksi matkan aikana. Matkan jälkeen voi tehdä matkakertomuksia, joissa hyödynnetään omia ja kaupallisia sisältöjä. Ontologioita hyödynnetään sisältöjen koostamisessa ja eri aihepiireihin liittyvien sisältöjen tarjoamisessa käyttäjien toimista saatavien vihjeiden perusteella.
- Remix Engine on verkkopohjaisen videoeditorin prototyyppi. Sen avulla käyttäjä voi yhdistää itse tuotettua mediaa kaupalliseen mediaan valmiiden

mallien pohjalta. Lopputuloksena syntyvä video sisältää kaupallista mediaa, kuten joukkueiden logoja, TV-ohjelmabrändejä ja mainoksia.

- DiMaS (Digital Content Distribution Management System, digitaalisen sisällön jakelun hallintajärjestelmä) antaa monimedian tekijöille mahdollisuuden julkaista töitään P2P-vertaisverkoissa. Tekijä voi tallentaa mukaan sisällöstä kertovaa metatietoa, hallita tekijän- ja käyttöoikeuksia ja laskuttaa käytöstä.

Matkamasiinan ja Remix Enginen kaltaisia sovelluksia voitaisiin liittää media-arkistoihin, kuten uutisarkistoihin, tai vaikkapa tietosanakirja-aineiston yhteyteen. Näissä molemmissa sisällöt ovat modulaarisia. Tällaisten palvelujen luominen vaatii investointeja työkalujen ja metatietojen kehittämiseen. Palvelun käyttökustannukset ovat kuitenkin suhteellisen pienet, koska käyttäjät tekevät tuotteiden lopullisen koostamisen ja viimeistelemisen.

Kaupallisen median tulee pystyä tarjoamaan lisäarvoa – yksi mahdollisuus on tehdä palveluista älykkäämpiä ontologioita hyödyntäen. Iso haaste tällaisten palvelujen kehittämisessä liittyy ontologioiden ylläpitämiseen. Toinen haaste on semanttisen metatiedon lisääminen sisältöihin. Myös lainsäädännölliset asiat, kuten yksityisen sisältötuotantotoiminnan kaupallistuminen, tekijänoikeudet, sisällön tai ryhmän tuoteimago ja sisältöihin liittyvät vastuukysymykset, pitää ratkaista.

Muuttamalla sisältöjään modulaarisempaan muotoon ja lisäämällä semanttista metatietoa, joka tukee sisältöjen uudelleenkäyttöä ja tutkivaa selailua, mediatalojen on mahdollista toteuttaa uusia, rikkaita käyttökokemuksia tarjoavia kuluttajasovelluksia.

Preface

This publication presents the main results of the project “Rich Semantic Media for Private and Professional Users” (RISE). The two-year project was part of a technology programme “Interactive Computing Technology Programme” (FENIX) run by the Finnish Funding Agency for Technology and Innovation (Tekes). The main objective of the project was to study and develop tools to support private and professional content creators as well as publishers in producing and utilising rich semantic content through the whole content lifecycle. The project also wanted to help professional actors to position themselves and their products in the semantic content markets of the future. The background to the launch of the project was the identification of two important developments: the emergence of user-generated content and Semantic Web technologies.

Besides the main financier, Tekes and VTT, four companies supported the project financially and by giving expertise and tools for the project, and they were represented in the project management group. The project steering group consisted of the following persons: Eskoensio Pipatti (SanomaWSOY Oyj) and Tuomo Suominen (Werner Söderström Osakeyhtiö), Hannele Vihermaa (first half of the project) and Teppo Kurki (the second half of the project) (Alma Media Oyj), Jouni Siren (Yle), Janne Saarela (Profium Oy), Keith Bonnici (Tekes), Caj Södergård (VTT) and Marko Turpeinen (HIIT). The project group members want to thank the steering group for their good support and feedback. We want to express our special thanks to the Häme Ox Road project and project manager Matti Korolainen for their co-operation in the project – the materials and user contacts provided by them contributed to the successful completion of the project.

VTT and Helsinki Institute for Information Technology (HIIT) carried out the project. Project group members contributing to this publication were Asta Bäck, Sari Vainikainen and Pirjo Näkki from VTT, and Tommo Reti, Risto Sarvas, Lassi Seppälä, Herkko Hietanen and Marko Turpeinen from HIIT. In addition to the authors, Magnus Melin and Sonja Kangas from VTT have contributed to the project.

The project group members wrote the Chapters 1, 2 and 6 of this publication as a collaborative effort. The StorySlotMachine application was made at VTT, and the Chapter 3 describing it was written by Asta Bäck, Sari Vainikainen and Pirjo Näkki. The Remix Engine and Dimas applications were made at HIIT; Chapter 4 “Remix Engine” was written by Risto Sarvas and Lassi Seppälä and Chapter 5 “DiMaS” by Tommo Reti.

Hopefully, this publication gives insights into the opportunities that user-generated content and semantic metadata bring to media companies and their suppliers for product and service development, and encourage launching further work in this quickly-developing and interesting area.

Contents

List of acronyms and terms

AAF	Advanced Authoring Format
AJAX	Asynchronous JavaScript and XML
Atom	The Atom Syndication Format
AVI	Audio Video Interleave
Blog	A weblog, which is usually shortened to blog, is a type of Web site where entries are made (such as in a journal or diary), displayed in a reverse chronological order. http://en.wikipedia.org/wiki/Blog
CC	Creative Commons license
CIDOC CRM	CIDOC Conceptual Reference Model – a formal ontology intended to facilitate the integration, mediation and interchange of heterogeneous cultural heritage information. http://cidoc.ics.forth.gr/docs/cidoc_crm_version_4.2.pdf
CSS	Cascading Style Sheet
DVD	Digital video/versatile disc
DRM	Digital Rights Management
EBU	European Broadcasting Union
FDL	Free Documentation License

GFDL	GNU Free Documentation License
Folksonomy	A "folksonomy" is a collaboratively generated, open-ended labelling system that enables Internet users to categorise content such as Web pages, online photographs, and Web links. http://en.wikipedia.org/wiki/Folksonomy
HTTP	Hypertext Transfer Protocol
IPR	Intellectual Property Rights
IPTC	International Press Telecommunications Council
Metadata	Data about data, or information about information. In practice, metadata comprises a structured set of descriptive elements to describe an information or media resource. http://www.ktweb.org/rgloss.cfm
Microformat	Microformats are markup that allow expression of semantics in an HTML (or XHTML) Web page. This is done using specific HTML attributes. Programs can extract meaning from a standard Web page that is marked up with microformats. http://en.wikipedia.org/wiki/Microformats
MOV	QuickTime file format
MPG321	mpg321 is a free replacement for mpg123, a very popular command-line mp3 player. http://mpg321.depooter.org/project/
MPEG	Moving Picture Experts Group
MPEG-21	Multimedia Framework – standard developed by Moving Picture Experts Group

MPEG-7	"Multimedia Content Description Interface" – standard developed by Moving Picture Experts Group
MPEG-4	The standard for multimedia for the fixed and mobile Web developed by Moving Picture Experts Group
MP3	MPEG-1 Audio Layer 3, digital audio encoding and lossy compression format
MXF	The Material Exchange Format
Ontology	In philosophy, ontology is the study of what there is, an inventory of what exists. In this publication, ontology refers to a model of entities and interactions in some particular domain of knowledge or application. In other words, an ontology captures knowledge of its domain. According to Tom Gruber, an AI specialist at Stanford University, "ontology is the specification of conceptualisations, used to help programs and humans share knowledge".
ODRL	Open Digital Rights Language
OpenIPMP	Open-Source Rights Management. IPMP = "Intellectual Property Management and Protection"
OWL	Web Ontology Language
PDA	Personal Digital Assistant
PHP	Hypertext Preprocessor, PHP is a server-side HTML embedded scripting language.
P2P	A peer-to-peer computer network

RDF	Resource Description Framework
RDFa	Embedding RDF in XHTML utilising attributes. (Formerly name RDF/A.)
RDFS	RDF Vocabulary Description Language (RDF Schema)
REL	Right expression language
RSS	Rich Site Summary
Semantic media	Media that is described with ontology-supported metadata. The meanings defined in the ontology may relate to the actual content that is discussed or presented in the media object, or its role as a component in the media product or service.
Semantics	The study of meanings: the historical and psychological study and the classification of changes in the signification of words or forms viewed as factors in linguistic development. http://www.m-w.com/
SMPTE	Society of Motion Picture and Television Engineers (USA)
SNA	Social Network analysis
SSE	Simple Sharing Extensions
SPARQL	SPARQL Query Language for RDF
SWF	SWF is a proprietary vector graphics file format produced by the Macromedia Flash software. http://en.wikipedia.org/wiki/SWF

SWRL	Semantic Web Rule Language
Taxonomy	A hierarchical classification of things, for example, in the classification of biological organisms
Tag	A tag is a keyword or descriptive term associated with an item as means of classification by means of a folksonomy. Tags are usually chosen informally and personally by the author/creator of the item – i.e. not usually as part of some formally defined classification scheme. http://en.wikipedia.org/wiki/Tags
Vocabulary	A set of selected words that are to be used for some purpose, e.g. to describe the content of a document.
Web 2.0	The term Web 2.0 is a marketing phrase that refers to a second generation of services available on the World Wide Web that lets people collaborate and share information online. http://en.wikipedia.org/wiki/Web_2
XHTML	eXtensible HyperText Markup Language
XML	eXtensible Mark-up Language
XrML	eXtensible rights Markup Language
XSL	eXtensible Stylesheet Language
XSLT	eXtensible Stylesheet Language Transformations
YSA	A general-purpose thesaurus in Finnish (Yleinen suomalainen asiasanasto)
YSO	The Finnish General Upper Ontology

1. Introduction

Electronic media is profoundly changing the media landscape and consumption patterns. Internet is not only a new publishing channel, but it has made it possible for many kind of companies to offer media-related content and services. It also gives the readers or viewers the opportunity to take a more active role in their media usage. User activity consists of not only discussing the issues presented by the media, but also of actively creating media objects, either out of their own material or by combining content from various sources. Digital devices, such as digital cameras and mobile phones, make it possible to produce and consume electronic media practically anywhere.

This has also meant that the competition of consumers' time and interests is fierce. Even though many media companies have the user trust and remain an important source of news and other content, media companies need to improve their services and introduce new features that meet users' expectations and give high user experience. In some cases, like with the open encyclopaedia, Wikipedia[1], the user-created content has become an esteemed source of information and is a player and a production model that has to be taken seriously also by the commercial media.

Web technologies, including the Semantic Web technologies, give new opportunities to create richer user experience with Web applications. The promise of the Semantic Web technologies is to create more intelligent services: the applications can do more for the user. Web applications can automatically and intelligently analyse user actions and utilise the contextual information about what the user is aiming at, and combine this with the semantic metadata available about the media resources.

An important question for the media sector is how the media companies should utilise these technologies in developing their products and services, and in particular, how could semantic metadata be utilised in media production and processes to enhance media services and add value to them. Another important issue is to understand the role of user-generated content in commercial media

[1] http://en.wikipedia.org/

products: what are the opportunities and models for the user-created and commercial media content to co-exist and complement each other.

This publication summarises the results of the project "RISE: Rich Semantic Media for Personal and Professional Users" that set out to find answers to the above mentioned questions. The RISE project defined the concept of rich semantic media as media of which there is descriptive metadata. Metadata does not only relate to a stand-alone vocabulary, but there is an ontology – or several ontologies that give meaning to the metadata. An Ontology defines the relations between the concepts, and it will be possible to make inferences utilising the knowledge that has been captured into the ontology. This means that some tasks may be completely automated, or, at least, people may be offered more advanced support in their tasks.

The most typical example of a semantically supported application is information search and retrieval. When a search utilises semantic knowledge of concepts and their relations, it is possible to find more relevant material than for example when the search is made by utilising free text where the search term must be found within the document. The underlying ontology may be utilised to expand or focus the search query. Semantics can also be utilised to suggest additional related sources of information or content. At the most advanced level, Semantic Web technologies can be utilised to extract knowledge out of a document pool, and this, for example, can be used to build or update ontologies. These technologies can also be utilised to aggregate media collections automatically. Here the vision is to make it possible to automatically compile presentations that meet individual needs and expectations – this would be useful both to support professionals and to offer personalised collections to individual users.

In order to build new interesting media applications, there are several challenges to address. We must understand what people would like to do with content and then we must be able to define the ontology and metadata vocabularies that describe the content in a way that support this. It is crucial that the needs are anticipated correctly, otherwise all work put to creating the semantic metadata is wasted. The different media formats – text, images, audio and video – pose additional challenges relating to metadata. They have and to some extent they also need media-specific metadata descriptions. However, interoperability across

media formats is needed, because electronic platforms make it possible to easily utilise and combine different formats.

The project chose to explore these issues by building prototypes. They served for the purpose of testing Semantic Web technologies in practice, producing functional applications for creating and distributing user-generated content, and for getting feedback from real users.

The project was focused at consumer applications. User involvement with content processing sets high requirements on the application and user interfaces because users must be given a pleasant and enjoyable experience with the content with a considerable element of play and fun. Ontologies and semantic metadata may play an important role here, because with their help knowledge relating to the application area can be captured and relevant content offered to the user. To complement the work, surveys were made relating to the developments in relevant technologies and applications (Kangas 2005; Bäck et al. 2005).

This publication is organised as follows: Chapter 2 gives an overview on recent developments relating to utilising user-generated content and metadata in public Web applications, and an update on development on Semantic Web technologies related issues. The topics for this chapter were chosen based on their relevance to the application development made in the project.

Each of the Chapters 3, 4 and 5 describe one of the three independent prototype applications developed in this project. Each of the chapters includes their own results and discussion.

Chapter 6 presents and discusses the conclusions and business implications on a more general level. Here, both the recent developments in the area and the results gained with the prototypes were taken into consideration.

2. Recent developments

2.1 Introduction

The main themes of this project were the potential of Semantic Web technologies and semantic metadata in media production, and the growing importance of user-generated media. This chapter takes a look at the main development in these areas. The issues that are addressed in this chapter were chosen based on the project focus, earlier reports and the prototypes. The trends in media consumption are presented mostly at international level, but also the development in Finland is briefly commented.

2.2 Media consumption trends

User-generated media has been grown into a widely notified trend during the last two years, and user-generated content plays on important role in most of the popular Web sites[2]. Also the main stream media has adopted some of these developments, most importantly blogging, where journalists blog in order to communicate more informally and frequently with their readers. Some newspapers, as well as Associated Press, have also connected themselves into the blogosphere by utilising a service that lets readers see what bloggers are saying about their articles (Hirshberg 2006). Also user-provided material – mainly text and photos – are being utilised in commercial media products, particularly in connection to big accidents where people on the spot may take photos with their camera phones and transmit them quickly.

A new buzzword *Web 2.0* has emerged during the last two years (Figure 1). This term is used to refer to Web applications that are based on active user participation (O'Reilly 2005). Another term that is often utilised in connection to this type of applications is social media (Boyd 2005). The value of a social media application increases as more and more people use it and increase its value by adding or modifying existing content and importing new content. In addition to the actual media content, such as photos and videos, user contributions include comments, recommendations and tags that describe and

[2] http://www.alexa.com/site/ds/top_500

add meaning to the actual content (Weiss 2005). These kinds of user contributions help others to find relevant content more easily. There user-contributions may be seen as a social layer or filter on top of search engines or newsfeed (RSS) readers helping people to find the most relevant resources. Also new user communities emerge around shared interests and resources.

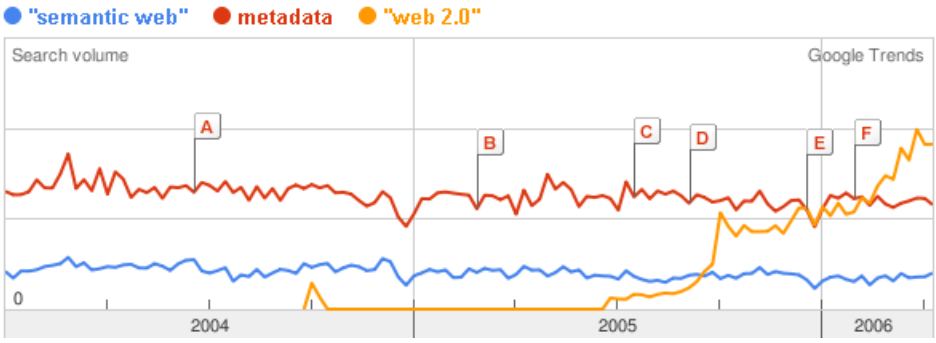

Figure 1. Search volume trends in Google[3] for the words "semantic web", "metadata" and "web 2.0" during the RISE project (created in June, 2006).

Another important trend that constitute to the Web 2.0 phenomenon are so called *mash-up services* (Musser 2006), which mean new services created by bringing together content from different services that have published their APIs for this purpose. Often, the key connecting component is a map, and most varying information is then gathered from different sources and displayed on it.

User-generated content comes in many different ways and formats. Flickr[4] for sharing photos, YouTube[5] for sharing videos, del.icio.us[6], and Yahoo!My Web[7] for sharing bookmarks with comments and tags, MySpace[8] for various types of self-publishing and networking, and Wikipedia[9] as a collaborative encyclopaedia, are some of the most important examples.

[3] http://www.google.com/trends
[4] http://www.flickr.com/
[5] http://www.youtube.com/
[6] http://del.icio.us/
[7] http://myweb2.search.yahoo.com/
[8] http://www.myspace.com/
[9] http://en.wikipedia.org/wiki/Main_Page

Some of the new sites have gained a huge number of users in a very short time (Figure 2). For example, two years ago Wikipedia and MySpace reached only a minuscule number of Web users, but at the beginning of year 2006, they passed BBC in popularity and now both of them have an audience that is roughly twice that of BBC. Wikipedia seems to keep on growing, whereas some flattening can be seen in the MySpace numbers possibly due to increasing competition from similar social Web sites, such as Facebook[10] and Cyworld[11].

The growth rate of YouTube is even more extraordinary. In on year, it has become the top 23 in the world according to Alexa[12]. This is a sign of increasing speed of development and spreading of new innovations when the users and services are networked. The importance of networks and networking in producing new ideas and new forms of culture has been discussed thoroughly by (Benkler 2006).

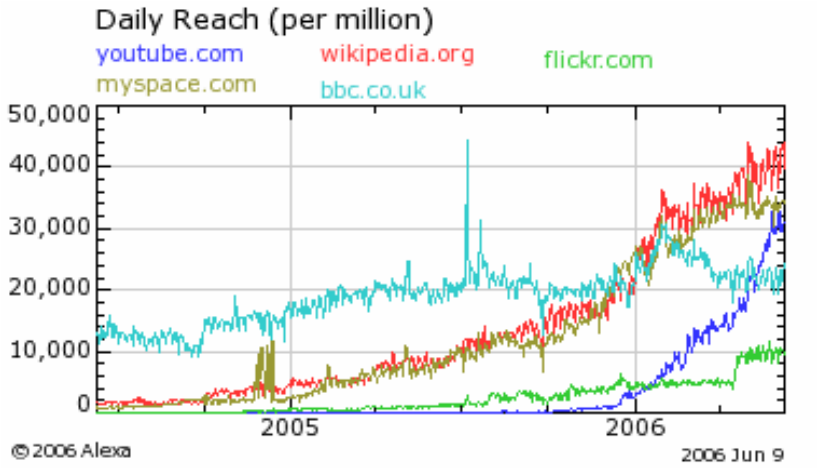

Figure 2. Traffic trends to popular sites with user-generated content – YouTube.com, Wikipedia.org, Flick.com and MySpace.com – and to the BBC Web site, which here represents traditional media operators (http://www.alexa.com).

[10] http://www.facebook.com/
[11] http://www.cyworld.com/
[12] http://www.alexa.com/

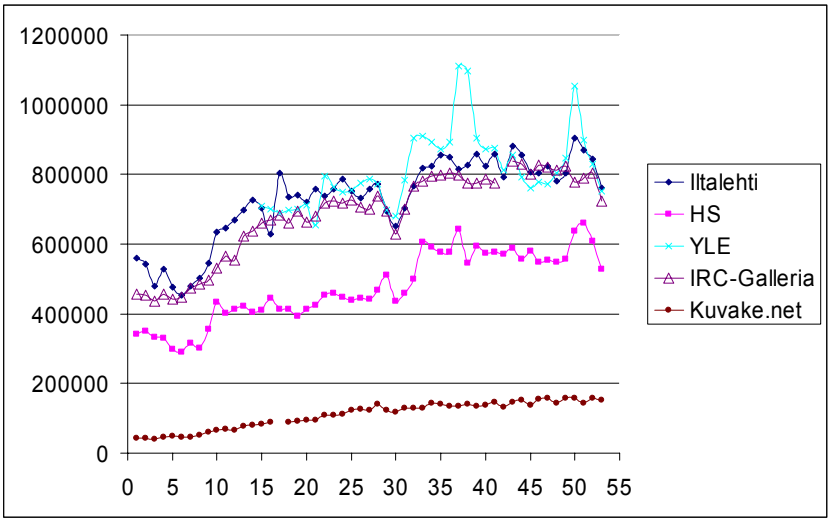

Figure 3. The number of weekly visitors in some popular Finnish Web sites between week 23/2005 and week 23/2006. HS (Helsigin Sanomat) the largest daily newspaper in Finland, Iltalehti is a popular tabloid newspapers, Yle the Finnish broadcasting company and IRC-galleria and Kuvake.net popular site for networking and user-created content. (TNX metrix numbers, accessed on June 16, 2006. http://www.gallupweb.com/tnsmetrix/.)

We cannot see any dramatic changes in the media consumption in Finland during the last two years, whereas changes have been more marked during the last ten years. In 2005, the combined newspaper circulation was down 7% from the level in 1995[13], whereas the combined magazine circulation has increased by about 40%[14]. Some examples of the number of weekly visitors to some Finnish Web sites can be seen in Figure 3. IRC-galleria[15], the Finnish counterpart for MySpace, has gained a large audience, which is comparable in size to popular main stream media sites. The number of weekly visitors fluctuates, but the overall trend of recent Web usage has been constant rise, as it has been for the past 10 years.

[13] http://www.sanomalehdet.fi/
[14] http://www.aikakauslehdet.fi/
[15] http://irc-galleria.net/

2.3 User-generated content, metadata and filtering processes

Simple solutions are needed to manage user-created content. The solutions must be easy and intuitive to use both at importing and exploring content, and yet let people to find what they are looking for. So far, the old method of media annotation with freely defined keywords has become the basic solution for semantic metadata with user-created content, only renamed this time as "tagging". These metadata tags are primarily aimed at helping each user to manage their own content, but when people end up using the same words to describe their content, links emerge between resources and people. Tags were initially used in del.icio.us to describe bookmarks, and in Flickr to describe photos. The use of tagging is expanding and they are currently also used, for example, to describe blog postings, destinations or personal goals[16]. Even though tags are not a perfect or novel solution, with large content masses they provide a simple way of connecting related items. A new concept, folksonomy[17], has been proposed to describe the collection of tags that ordinary users (folk) have created that has resulted in a kind of ad-hoc and unstructured ontology.

Vander Wal (2005) divides the folksonomies into broad and narrow ontologies. According to his definition, del.icio.us is an example of a broad folksonomy whereas Flickr of a narrow ontology. In a broad folksonomy, anyone is free to describe a resource, whereas in a narrow ontology, where only the resource owner gives the descriptive metadata or tags.

Tom Gruber, famous for his ontology definition from the year 1993 (Gruber 1993), has also talked about the relationship between ontologies and folksonomies (Gruber 2005). He emphases that they cannot be compared, because they function at different levels. He proposes a simple ontology for tagging related concepts: *object*, *tag*, *tagger*, *source*, + *or* –. *Object* is the resource being described, *tag* the actual word used for describing, *tagger* the person who gave the tag, *source* the repository where the tag is stored and + or – are evaluations from other users, which tell whether they consider this tag appropriate for the object. Also Peter Morville (Morville 2005) emphasises that metadata and finding relevant resources are big challenges and there all sources

[16] http://www.43things.com/
[17] http://en.wikipedia.org/wiki/Folksonomy

of metadata should be utilised: both the traditional metadata and the metadata that is created explicitly or implicitly by users and contexts.

Bielenberg and Zacher (2005) have published a study and software that shows how tags can be utilised to visualise interests and to compare individual interests with each other. Tags and social bookmarking have also found their way into supporting scientific knowledge creation and sharing (Hammond et al. 2005; Lund et al. 2005).

NewsVine[18]*, NowPublic*[19] and *Digg*[20] are examples of news related sites, where user-contributions determine what are the main news. The idea of user-created news and strong user participation has been a popular topic since early 2000 (Bowman & Willis 2003; Gilmor 2004), and now we can see many examples in practice. NowPublic combines social bookmarking and collaborative news editing, where people may add on a previously created item, for example by importing a related image. NewsVine combines news feeds form The Associated Press and ESPN and user submitted news that are either links to news somewhere else on the Web or news items created by individual users. Digg describes itself in the following way[21]: Digg is a technology news Web site that combines social bookmarking, blogging, RSS, and non-hierarchical editorial control. With digg, users submit stories for review, and instead of an editor, users decide what are the top news. Once a user submits a story, it is instantly posted in the digg area queue. This is a temporary holding place where stories wait to be promoted to the homepage. Stories get promoted, when users "digg" them, which means giving a vote for the item. Once a story has received enough diggs, it is instantly promoted, and those that do not receive enough diggs eventually fall out of the digg area queue. Similar process was actually featured already ten years ago by (Chesnais et al. 1995) in the Fishwrap project.

Lightweight news feeds, such as RSS, Atom and SSE are making it possible to keep oneself up-to-date on almost anything. Initially feeds were utilised to keep track of blog entries, but they are now utilised for most diverse purposes. For example, media companies provide news feeds, and software companies provide

[18] http://www.newsvine.com/
[19] http://www.nowpublic.com/
[20] http://www.digg.com/
[21] http://www.digg.com/faq

feeds relating to their products. Most sites with user contributions let their users subscribe to feeds at various levels; for example, at the del.icio.us Web site it is possible to subscribe a feed that lists all the bookmarks that a user makes, or all resources linked with a certain tags. Similar options are available at Flickr. This means that it is possible to build a dynamic "personal world monitor" that makes it possible to keep up to date with whatever is happening in the areas you are interested in and what the people you are connected to are doing and contributing. The huge number of available RSS feeds makes it hard to keep track on all interesting ones, so there are services, like Techmeme[22] and Technorati[23] that aim at filtering the most important issues out of the feeds, or FeedRinse[24] lets the users themselves define the rules for filtering the feeds.

Even though light-weight news feeds, and RSS in particular, have been available for some time now, they are not yet so familiar to the great user masses. We can expect this to change when the new version of Microsoft Internet Explore becomes available and installed on the user computers, because it is expected support these feeds in an easy to use way.

Flickr groups are a good example of *user-innovation*, even though the processes and tools for it are simple. In Flickr, users may create a group and define a theme for it. Other users may submit their photos into the groups creating a pool of photos relating to a theme. A large variety of group themes can be found such as the obvious ones like travel and location related, ambitious ones like photojournalism, visual story telling, and new types like recording everyday life and details, which have been made possible with the low cost of digital images.

Wikipedia and Flickr have become huge resources that are or can be utilised for many purposes, such as complementing other services and for research purposes. Published APIs make this possible. Wikipedia and Flickr licence their content in different ways. All Wikipedia content is licensed to the public under the GNU Free Documentation License (GFDL)[25], which is the only feasible way since the content has been created in collaborative and granular fashion. Flickr lets each user choose the licence terms for their images.

[22] http://www.techmeme.com/
[23] http://www.technorati.com/
[24] http://www.feedrinse.com/
[25] http://en.wikipedia.org/wiki/Wikipedia:Copyrights

Advertising is the main way of generating income for sites relating to user-generated media. Often Google Adsense[26] is utilised, because it offers the complete infrastructure, and the site owner need not market the advertising space. In some cases, like for example Flickr, the basic service is free, but additional features are available for paying customers. Also some additional services may be sold to users, like printing photos. News Corporation bought company owning the popular social media site MySpace in 2005 for $580 dollars[27]. In a recent interview, Ross Levinsohn, President of Fox Interactive, says that the most valuable asset for the News Corporation in MySpace is the demographic and psychographic data that accumulates there as people tell about themselves and their interests. This can be used in advertising and product development (Gupta 2006).

2.4 Remix phenomena

As the ingredients of our everyday pop culture are made available in digitized form, they can be easily reassembled and remixed to create new works. Originating mostly in dance music, digital remixing culture has recently dispersed to other areas, such as movies, TV shows, and video games. Media content can be seen as something that can be re-used and edited, and made widely available on the Internet.

Video game modifications ("mods") are gaining popularity in the world of PC gaming, and currently most popular games are specifically designed to be extended by the gamers: new adventures with new characters, terrains, objects, sound effects, background music, in-game movies, etc. can be added to existing games. Game publishers are often supportive of the user community, and providing sophisticated tools and extensive documentation for extending their game and for building new tools. This strategy has proven successful, as modding increases the life cycle of a game product as the gamers have access to a large variation of new content made available by other players.

[26] http://www.google.com/ads/
[27] http://www.newscorp.com/news/news_251.html

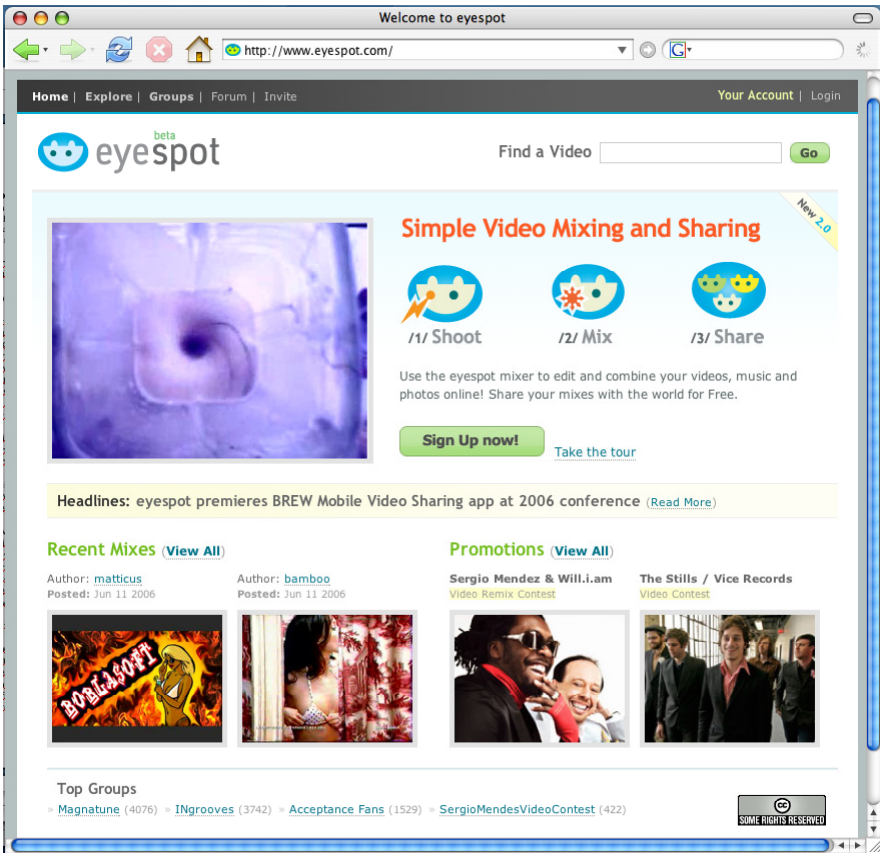

Figure 4. Eyespot, a site for video editing and sharing.

Eyespot[28], Jumpcut[29] and Motionbox[30] are examples of the new online video editing and publishing services (see Figure 4). They make it easy to capture, edit, remix and dub video content that is accessible on the Internet. Their goal is to help people to produce video content without needing to use any dedicated software, and with the added advantage of having an online venue to share, publish, market and syndicate their video productions to the world.

These video services provide interesting new opportunities for independent video-makers, producers, movie entrepreneurs and anyone with the skills to communicate with video, as well for those who own access and rights to

[28] http://www.eyespot.com/
[29] http://www.jumpcut.com/
[30] http://motionbox.com/

uniquely characterised video and film content archives. Some professional movie studios have already taken advantage of this phenomenon as a marketing tool, as in the "make your own movie trailer" competition for the movie "A Scanner Darkly"[31]. (See Figure 5.)

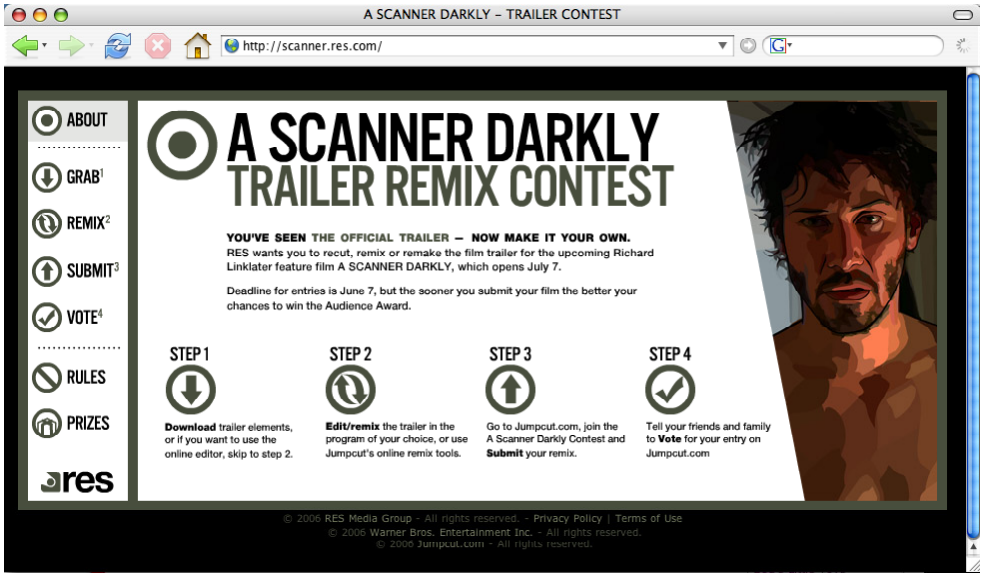

Figure 5. Movie trailer remix competition.

Most current online video remixing services use Flash video format[32]. It easy to distribute on the Web as it can be embedded into standard Web pages, blogs or news sites without requiring the end user to download or install any dedicated software to view it. Viewing the video content requires only the Flash plug-in, which comes already pre-installed on most PCs sold today. The quality of Flash video can vary a great deal, and this fully depends on what the online services offer. This quality control is likely to move to the user, and one or multiple output quality levels (possibly for an additional fee) can be selected to match the specific needs and requirements of each online publisher.

All sites mentioned in this chapter use streaming media on the Web as their distribution mechanism. The DiMaS system (see Chapter 5) introduces another

[31] http://scanner.res.com/
[32] Flash Video Learning Guide
http://www.adobe.com/devnet/flash/articles/video_guide.html

system architecture for distributing multimedia, and especially video, content on the Internet. It introduces metadata content wrappers, i.e. Distribution Packages, and utilizes heterogeneous networks for content discovery and delivery, including a controlled manner of using peer-to-peer networks for content distribution.

2.5 Semantic metadata and ontologies

2.5.1 Light-weight approaches: Microformats and RDFa

There are many current efforts to make the Web more intelligent by turning the information and knowledge in the Web into a machine-usable format. The main areas are the standardisation work at W3C, vocabulary and ontology development in various projects and for different application areas, and what we can call light-weight approach to add structural or semantic information by utilising the current tools.

Microformats are based on the idea of defining small vocabularies for well-defined needs, such as a calendar entry, contact information or a review, and embedding this information by utilising attributes in XHTML. This belongs to the light-weight approach. By utilising the attributes in XHTML document, the structural information can be embedded into normal Web pages, and by adhering to the agreed microformat structure, it also becomes available for applications. There are already some tools that support imbedding information as microformats, and also some search applications are available for these entries (Çelik 2006). (Figure 6.)

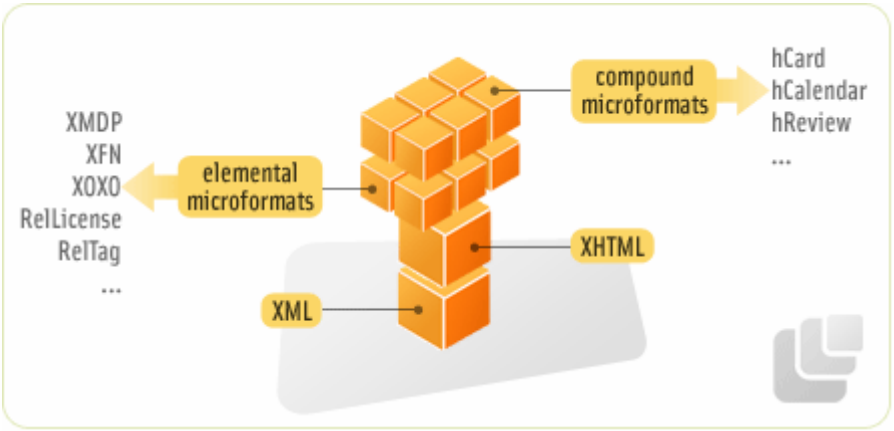

Figure 6. Microformats let users embed information, such as visiting card (hCard), calender entry (hCalendar) and reviews (hReview) into XHTML document by utilising normal XHTML attributes. The information is both machine and human readable.[33]

A related approach is used in a W3C RDFa (formerly RDF/A) initiative, which is being designed for embedding RDF in XHTML utilising attributes. An important design goal has been to achieve this without repeating existing XHTML content when the same string literal can be used to specify both the document content and metadata. The Working Draft of the RDFa Primer 1.0[34] introduces the syntax for expressing RDF metadata within XHTML and explains the use of the XHTML metadata modules. The document presents some use scenarios, such as adding contact information and embedding the RDF metadata, like the title and creator from a photo management system, into XHTML.

2.5.2 Semantic information retrieval

W3C has made progress in developing the query language SPARQL[35] for RDF. It has proceeded in the W3C process to the 'Candidate Recommendation' status, which means it is stabilising. Some tools with SPARQL support have already come to market, but because of the unfinished status of the specification,

[33] http://microformats.org/about/
[34] http://www.w3.org/TR/xhtml-rdfa-primer/
[35] http://www.w3.org/TR/rdf-sparql-query/

implementations vary. This is expected to improve after the specification has been completed.

Dodds (2006) argues for SPARQL to be a strong candidate to become the standard query language for the Web. One reason is its easy integration with AJAX environments. The SPARQL Query Response Format makes it possible to apply an XSLT transformation to retrieved data and generate alternate formats. Currently SPARQL lacks aggregate functions such as the ability to count results, calculate minimums and maximums. XSLT helps dealing with one of the primary limitations of SPARQL since XSLT 2.0 provides the necessary features to post-process the data.

There is still research needed for optimising SPARQL queries and query costs should be considered when implementing a SPARQL service. Dodds (2006) lists a couple of options: limits could be set on the execution time of each query by using time-outs; each query could be run in a separate thread; it is also possible to impose an upper limit on the number of results returned by a single query by the LIMIT keyword.

Privacy is always an issue when data is published onto the Web. Dodds (2006) advises to store the private data in a separate RDF data store, or otherwise avoid mapping it into RDF so that it is not accessible to SPARQL queries. Another option is to determine whether incoming requests involve expressions or triple patterns that match against the sensitive data. Such queries can then be rejected.

One major issue to decide is what to do with the existing data that is stored in relational databases: should it be converted into RDF or is there some other way to expose it so that it can be accessed with SPARQL queries. Converting the entire database to RDF requires a huge additional effort and is generally not a feasible solution for large databases. Relational database vendors, such as Oracle, have started to extend their products to support storing RDF data, which is a more promising alternative. In the future, we may also have support for direct SPARQL querying of relational data. “Gateway” products, like D2R that provide middleware features that can map a relational schema to RDF, are another option. (Dodds 2006.)

Standardised rule languages and supporting inference engines are needed for implementing Semantic Web applications. OWL[36] (Web Ontology Language) is a standardized language, which enables inference engines to reason over a set of data in a standardized way. Most of the OWL reasoners support the more limited versions of the language, OWL Lite or OWL DL, whereas the support for reasoning OWL FULL is very limited.

The number of ontology editors with OWL support has increased during the project and new commercial RDF/OWL ontology editors like Altova SemanticsWorks 2006[37] and TopBraid Composer[38] (Eclipse based) have come to the market during the last 12 months.

However, OWL does not have enough expressing power for more complicated user-defined search rules, for which a rule language like SWRL (Semantic Web Rule Language)[39] is needed. SWRL is based on the sub-languages of OWL and RuleML (Rule Markup Language). Some of the reasoners (like RacerPro1.9[40], KAON2[41]) have initial support for the SWRL, but it is not yet widely used and the standardization process will take time. KAON2 is one of the few tools that support both the SWRL rule language and SPARQL query language, but this is expected to change.

2.5.3 Metadata vocabularies, taxonomies and ontologies

Although common metadata vocabularies have been developed, most of them do not have a commonly accepted mapping from XML Schema definitions into the standard RDF or OWL.

IPTC has established a firm foothold in news industry and has started to develop the next generation of NewsML based on the feedback gathered from use of NewsML 1. The experimental phase 2 for the IPTC NewsML 2 Architecture

[36] http://www.w3.org/TR/owl-features/
[37] http://www.altova.com/products/semanticworks/semantic_web_rdf_owl_editor.html
[38] http://www.topbraidcomposer.com/
[39] http://www.w3.org/Submission/SWRL/
[40] http://www.racer-systems.com/products/racerpro/index.phtml
[41] http://kaon2.semanticweb.org/

(NAR)[42] has launched in May 2006. The basic goal of the NewsML 2 Architecture is to provide a single generic model for exchanging all kinds of newsworthy information, thus providing a framework for a future family of IPTC news exchange standards. This new model aims at including the features of existing standards like NewsML 1 and SportsML, and also standards which are under development like EventsML, ProgramGuideML or a future WeatherML. Also the IPTC defined controlled vocabularies – the IPTC NewsCodes – are planned to make use of the NAR technology to express a set of topics and their relationships and will collate all corresponding codes into a single NAR based "concept scheme".

The NAR syntax is built on XML and it makes use of XML Schema and complies with RDF. This allows an easy transfer of NAR structures to other XML-based standards and the integration of news and topics into the Semantic Web. The plan is to release a comprehensive set of specifications and supplemental documentation for public use in summer 2007.

IPTC Core metadata is used within Adobe's XMP (Extensible Metadata Platform) framework. Adobe launched a new beta version of its Adobe XMP Toolkit in the March 2006[43]. The goal of the product is to make the design and publishing workflows more efficient by making it possible to use metadata technology across diverse applications and systems. A new feature is the ability to consistently add metadata to popular image, document and video file formats so that the assets become more "intelligent" by carrying critical status and standards information with them.

The development of the YSO, Finnish General Ontology is ongoing. It is currently used in the applications developed in the FinnOnto (National Semantic Web Ontology Project in Finland) project. The first public version of the YSO is expected to be available in autumn 2006.

CIDOC CRM cultural heritage ontology is in its the final stage of the ISO process and it is being used in museum related applications, but could also be used in other applications related to cultural heritage.

[42] http://www.iptc.org/NAR/
[43] http://labs.adobe.com/technologies/xmptoolkit/

BBC has developed a generic metamodel to describe content in an atomised, re-usable way (Quinn & Wood 2006). The idea is to break down a page on a Web site into separate, reusable components such as "article text" object, one or more images, Web links, audio and video links and event description or sport result. These individual "content objects" can be pulled together in a different way to be published to another platform.

The metamodel has been created with RDF/OWL. The core parts of the metamodel are objects, containers and properties. Object has subclasses like BinaryObject and ContentObject, which can then be instantiated to create the model for a given content object. Property has subclasses such as PlainTextProperty, RichTextProperty and DateProperty. The metamodel describes the content structure and how objects can relate to each other (through the ContentObjectReferenceContainer). BBC is planning to release the model to the public in the future to help other content creators in similar situations.

2.5.4 Adding semantics to the content

The Semantic Web Best Practices and Deployment Working Group have published the First Public Working Draft of Image Annotation on the Semantic Web[44]. It describes the creation, storage, manipulation, interchange and processing of image metadata, and gives examples of the use of Semantic Web languages and tools for image annotation, based on use cases like management of personal digital photo collections, cultural heritage and television archive. It also briefly surveys some currently available vocabularies and tools that can be used to semantically annotate images.

The conclusion of the report is: "Commonly accepted, widely used vocabularies for image annotation are still missing. Having such vocabularies would help in sharing metadata across applications and across multiple domains. Especially, a standard means to address sub regions within an image is still missing. In addition, tool support needs to improve dramatically before Semantic Web-based image annotation can be applied on an industrial scale: support needs to be integrated in the entire production and distribution chain. Finally, many existing

[44] http://www.w3.org/TR/2006/WD-swbp-image-annotation-20060322/

approaches for image metadata are not based on Semantic Web technologies, and work is required to make these approaches interoperable with the Semantic Web."

BBC Radio & Music Interactive (Ferne 2006) have developed a system for collaborative annotation of radio programmes, which they plan to pilot in the BBC Web site. This is a good example of utilising active users as metadata creators. BBC has created the playback screen where users can create and edit segments and annotations. In order to encourage users to annotate, there has to be some obvious benefits for them. One idea is to allow users to easily link to the programme clips from their blogs or Web sites. Other ideas to using the annotated radio programmes include creating chapterised podcasts, searching within programmes, customising programmes e.g. using the tags to create customised programmes for download and also visualisations of radio programmes.

Wikipedia has become a huge encyclopaedia with voluntary work. The content is currently in a format that is suitable for human consumption, but researchers have contemplated turning the Wikipedia material into structured format or ontologies. Völkel et al. (2006) have proposed additions to the current Wikipedia authoring syntax that allows adding information in a structured way. The proposal builds on and follows the Wikipedia ideology of giving users a lot of freedom, but creating structures that make possible to create a bigger whole out of the entries. In the proposal, typed links and attributes are used for adding knowledge in machine-readable format. Knowledge is encoded at document level. Users can define the relations (link types) and attribute values freely, but of course, the more users choose to use the same terms, the more usable the information becomes. Völkel et al. (2006) expect that this addition will be implemented in the English Wikipedia version by the end of 2006. As an example the typed link called "Category" has gained widespread use in Wikipedia, which provides dynamic hierarchical structures for classifying Wikipedia pages.

2.5.5 License and rights metadata

One domain of use for semantic metadata descriptions is describing the licensing terms and immaterial property rights (IPRs) of digital products or services. Rights expression languages (REL) are meant to describe the rights involved in a specific product in a detailed manner so that all entities involved can act accordingly. For example, using a rights expression language, an entity can state that it gives another entity a non-exclusive license to complete specific operations on particular information certain amount of times in a specified period of time if the other entity pays certain fees. Such information is adequately included in the rights description part of information product's metadata. It is quite demanding to define a formal language that can be used to correctly express all the necessary rights in different jurisdictions. There is some interesting work going on for defining such a language. The two most prominent emerging Rights Expression Languages for common standards are MPEG-21/5 REL (former Extensible Rights Markup Language [XrML]) from ContentGuard, Inc. and Open Digital Rights Language (ODRL) from IPR Systems Ltd. For further reading see MobileIPR Final Report, HIIT Publications 2003-3 (http://www.hiit.fi/publications/pub_files/mobileiprfinalrep2003-3.pdf).

MPEG-21/5 REL and XrML

The real victory for the XrML language was sealed when it was selected to the MPEG-21 Framework as MPEG-21/5 Rights Expression Language. The growth engine for XrML is Microsoft that has incorporated either the full language or a subset of the language in all of its DRM solutions, including Media Rights Manager for Windows Media Format (audio and video) and Windows Rights Management Services for Windows Server 2003. Another big name that has licensed XrML from the early years is Sony, but the consumer electronics giant has yet to implement any technology based on XrML. See more at http://www.xrml.org/.

ODRL

ODRL is the selection created by Open Mobile Alliance (OMA), headed by Nokia. Nokia has already released an SDK for implementing OMA compatible download applications with DRM, and it has implemented the spec in its 3595

phone. ODRL is also supported in an open-source DRM package for the emerging MPEG-4 multimedia format called OpenIPMP. When comparing the languages, ODRL has the advantage of being more concise, meaning that rights descriptions in ODRL tend to be more compact than their equivalents in XrML and that ODRL interpreters can be smaller (in memory footprint) than XrML interpreters. The latter factor is especially important in the mobile device space, where memory is at a premium. Research group Datamonitor predicts that the market for digital content over mobile phones will reach 38 billion dollars in three years. ODRL also has some media-specific constructs that XrML does not share, including the ability to specify attributes of media objects such as file formats, resolutions and encoding rates. See more at http://www.odrl.net/.

2.6 Creative Commons licenses

Considerable amount of new online amateur content is distributed with open content licenses. Open Content licenses that broaden users' rights from copyright's "all rights reserved" default, have seen big growth in past five years.[45] Wikipedia lists two requirements for open content; format that enables copying and permission to do it:

> Open content, coined by analogy with "open source" describes any kind of creative work including articles, pictures, audio, and video that is published in a format that explicitly allows the copying of the information.[46]

Creative Commons[47] (CC) -licenses have grown to be the most popular open content licenses. In fall 2005, Yahoo indexed[48] over 53 million links back to CC licenses[49] and just six months later Google's queries for CC-content returned

[45] Wikipedia an open encyclopaedia defines open content as: "Any kind of creative work including articles, pictures, audio, and video that is published in a format that explicitly allows the copying of the information." *See* Wikipedia, Open content, *at* http://en.wikipedia.org/wiki/Open_content.
[46] Wikipedia article: Open content. Available at: http://en.wikipedia.org/wiki/Open_Content
[47] http://www.creativecommons.org
[48] http://search.yahoo.com/cc
[49] Linksvayer, M.: 53 million pages licensed, 2005-08-09
http://creativecommons.org/weblog/entry/5579

over 140 million pages.[50] The licensed works range from classical music to sci-fi movies and from MIT courses in electronic engineering to governmental reports and publications. 68% of the licensed content included non-commercial clause that reserves commercial use.

The online photo service Flickr alone hosts over 10 million photos that are licensed with CC-licenses. In Flickr, each user may define separately for each photo whether to keep the copyright, or license the image using the Creative Commons (CC) license[51]. Consequently, searches can be targeted at Creative Commons (CC) licensed photos. To give some idea of the popularity of the CC licensing model, some exemplary searches were made. In these examples, roughly 5% of the photos are available for commercial work and about three-quarters of them could be also modified any way. (Table 1.)

Table 1. Examples of the number of Flickr photos with different Creative Commons licences (June 2006).

Search term	**Total**	**CC modify, adapt and build on**	**CC commercial use allowed**	**CC modify, adapt and build on, and commercial use allowed**
Flower	1 131 944	146 549 (13%)	50 583 (4,5%)	43 042 (3,8%)
Flower + red	57 953	8 293 (14,3%)	2 862 (4,9%)	2 497 (4,3%)
Lake	669 430	75 726 (11,3%)	25 694 (3,8%)	22 130 (3,3%)
Helsinki	67 642	14 269 (21,1%)	3 511 (5,2%)	2 999 (4,4%)

CC-licenses are not the only popular open content licenses. FDL has been used extensively to license software manuals and the collaborative online encyclopaedia Wikipedia[52] that has nearly 1.5 million registered user accounts and over three million articles. In 2005, the number of Wikipedia articles doubled and there were 70 % more contributors than in 2004.[53]

[50] Linksvayer, M.: Midyear license adoption estimates, http://creativecommons.org/weblog/entry/5936
[51] http://creativecommons.org/
[52] http://en.wikipedia.org
[53] Wikipedia Statistics, May 10, 2006, http://stats.wikimedia.org/EN/Sitemap.htm

Creative Commons licenses are tools for authors who don't have the skills or resources to create their own copyright licenses. The licensing system provides help to a sector where little or no legal aid has been available. During the first four years when the licenses have been available four distinct user groups have emerged: 1) Casual users who participate in open content projects that require the use of such licenses. 2) Public bodies use the licenses to disseminate works that are paid by the public. 3) Ideologists who value the freedom that the licenses give to their peers. 4) Business oriented group which see that the licenses enable them to reduce producing, marketing and distribution costs and create additional value to users with open content licenses.[54]

While the Creative Commons licensing system does lower the transaction costs of licensing content with permissive terms, some major problems remain to be solved:

- The whole distribution chain of the works is liable if the work was licensed with out the consent of the rights owner.[55] Licenses are granted for the duration of the copyright and currently there is no way to revoke them.
- Creative Commons licenses are localised to over two dozen countries and legal systems. While the license localisation process is monitored by Creative Commons Corporation, the licenses are not interchangeable. The international licenses suffer the problem but the problem persists with other open content licenses like with the FDL.
- While the numbers of creators who contribute their works with open content licenses grow, some of the most important institutions have not managed to adapt their systems to foster open content distribution. Especially the incompatibility of European music collecting societies and open content licensing is a pressing problem. None of the European music collecting societies let their members to use open content licenses.[56]

[54] Hietanen; Open content licensors and business models
[55] See: Hietanen & Dulong de Rosnay; Legal Metadata for Semantic Web Applications: Case Creative Commons
[56] See: Hietanen; Creative Common and collecting societies

3. StorySlotMachine

3.1 Use scenario

The initial use scenario started a slot machine analogy: users are presented with some content in the topic of their interest, and, if they are not happy with the results, they can try their luck again. The assumption was that if a person does not know so much about a topic, exploring a collection with different types of media elements relating to the topic is more pleasant in a browsing manner than by making explicit searches. Also, the results are not shown as a basic list of resources as usual in search engines, but as a page or collection where different elements like images, videos and texts may be seen.

The presented material may be taken as a starting point to explore the topic more, a bit like with a slot machine, where some of the items may be locked and some redrawn to improve the result. The most active users may explore the topic from many different points of view, whereas the less active ones may be satisfied with the first results. This way both the more and less active users are taken into consideration.

An important aspect in user generated content is the feedback that people get from other users, so our scenario also included the opportunity to store the presentation and show it to other people. Other opportunities for utilising it are either exporting the content to a personal devise or to print it. Different templates may be offered to take into consideration, which media elements are emphasised and for which device the presentation is generated. Other people could be given the opportunity to rate presentations, and if allowed by the original creator, other users may utilise these presentations and their components in their own presentations.

We chose location-related content for our pilot application with the emphasis on travelling. When preparing for a trip, people often are interested in exploring the content to find out more about their destination. During a trip, people take photos and videos, which can be used together with content from other sources.

The use scenario can be divided into three separate cases: before, during and after the trip. Before the trip the user can familiarise with potential destinations

and sights to find out more about them. The material can be browsed theme wise, and the user can select and combine the most relevant ones into a collection that can be viewed either on the Web or printed to be taken along for the trip. After the trip, the user makes his own travel story either by utilising his or her own material or by combining it with the material of fellow users or the content that the media company provides. Also after the trip, the user may make theme stories like before the trip as well as normal searches to find more information on some particular issues. The users are encouraged to add metadata in the form of keywords or tags, which are utilised to propose additional material. The users may choose any words to describe their content or choose from the ones that the system offers based on relevant ontologies.

3.2 Main challenges

The aim with the application development was twofold: to get practical experience of implementing an application with Semantic Web technologies, and to test how users find this kind of an application. Building this application includes many types of challenges. The challenges can be divided into two groups: Semantic Web technologies and user interaction.

Directly coming from the utilisation of Semantic Web technologies are the challenges relating to ontologies. Existing ontologies must be adapted to the requirements of this application or new ones must be developed. Ontologies must capture the knowledge needed to help users to explore the target areas, and to combine the media objects into interesting presentations.

Another challenge, which is very central when an application like this is taken into use, is enriching media objects with metadata.

User interface development is another key challenge, particularly as the aim is to develop an application for consumers. Consumers need not be aware of the underlying technologies, but the aim is to offer an enjoyable way of exploring and finding content. With the help of the Semantic Web technologies the application should be able to foresee the user interests and offer interesting content based on the clues that the user gives.

3.3 Implementation

3.3.1 User interfaces

This chapter presents screen shots of the user interfaces and describes their functionality. More detailed descriptions of the implementation and utilisation of underling ontologies are presented in chapter “Ontologies”.

The first step is to select the places of interest from the map or list. The demonstration target area is the Ox road of Häme[57], a historical route between Hämeenlinna and Turku in the South of Finland. After selecting a place, the user is shown a list of the sights located there.

The user can sort the sights by history, nature and culture, read short descriptions of them, view both commercial and user imported pictures and add the sights he or she find most interesting into a personal item list (see Figure 7).

The user can search background information of the selected sights as theme stories (Figure 8). A theme story is a collection of media content from some point of view (Figure 9). Our theme stories are “Life now and then”, “Life stories”, “Nature and animals”, “Historical events”, “Fairytales and stories”, “Wars”, and “Art and culture”. Some of the themes are divided into sub themes. For example, historical events are divided according to historical periods. Only the categories with some content are shown to the user. The user can play with the content: View commercial and user-created pictures and videos, and view and build theme stories. The user may include theme stories into the travel plan to be created for the trip, as well as photos and descriptions of the chosen sights. The travel plan is available as a slide show and as a Web page suitable for printing.

[57] http://www.harkatie.net/english/index.html

Figure 7. Choosing sights to visit.

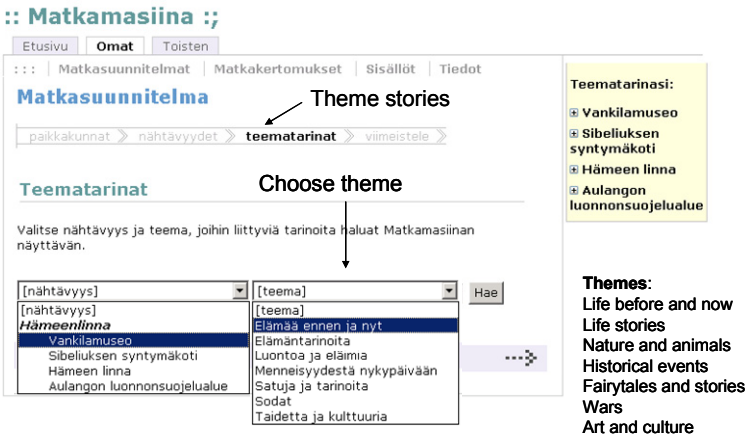

Figure 8. Making theme stories to get background information relating to the selected sight.

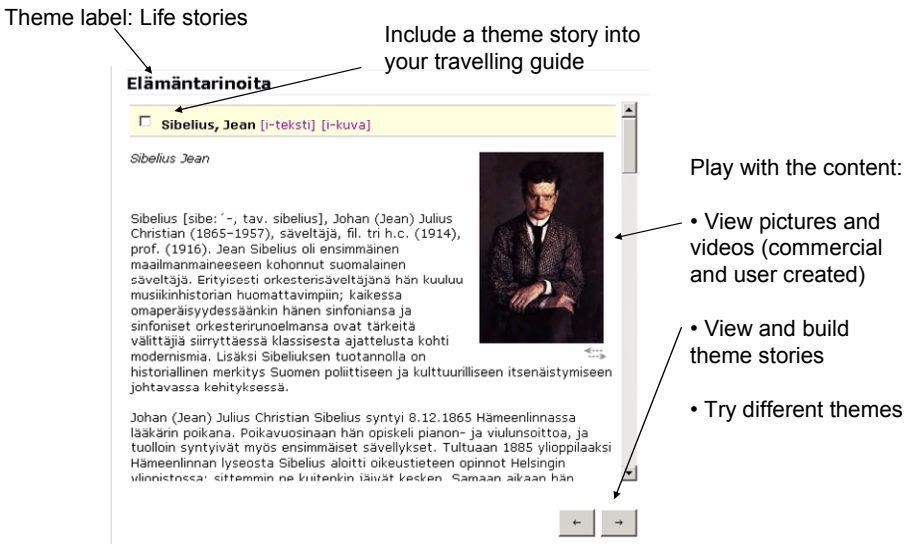

Figure 9. An example of a theme story.

After the trip, the user may create his or her own travel story by utilising his/her own material and the materials in the system. Photos can be uploaded after selecting the visited sights. As part of the uploading process, the user determines whether the photos can be viewed by other users, and accepts the licensing terms.

After uploading the content, the user is asked to add some metadata. As the first step, the photos are connected to the sights by dragging and dropping them to the correct sight. After that, additional metadata can be given in the form of keywords or tags and by indicating the genre of the photo (see Figure 10). The keywords can be written freely or the user may utilise those that are suggested by the system based on relevant ontologies. The user may also add free text to his or her photos and change the visibility of the photos to other users.

Users are offered commercial and other users' content, which they can combine with their own (see Figure 11). There are several ways to search for additional content. The user can browse through the available photos, videos and texts. Content can also be searched with the help of tags, both user's own tags and those suggested by the application based on ontologies, or by making a traditional free text search. The travel story is created automatically out of the content selected by the user. It can be viewed as a slide show or as a Web page suitable for printing.

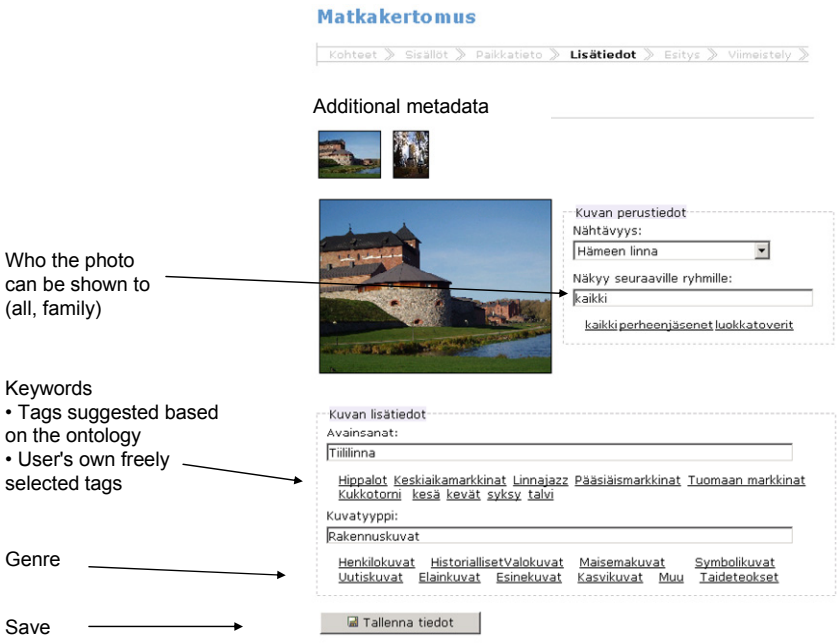

Figure 10. Adding metadata.

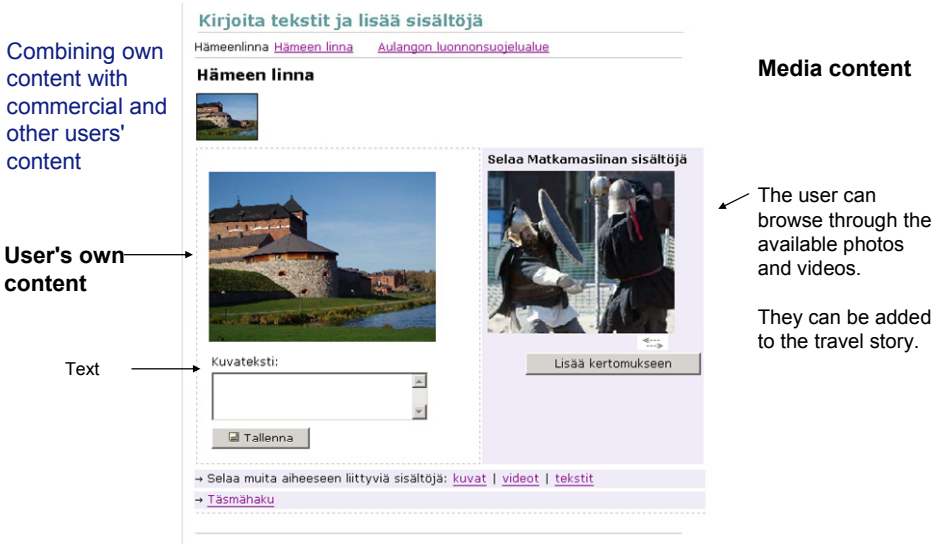

Figure 11. Combining user-created content with commercial and other users' content. Additional content can be found by browsing available photos and videos by media types or tags.

3.3.2 Content

Different types of media content, such as facts, stories and news, are needed in order to be able to create versatile travel plans, theme stories and travel stories. Media content that is directly related to the target area is preferred, but also more general information is usable. A mixture of videos, photos, sounds and texts makes the presentations more appealing and interesting.

The commercial media content of the pilot application consists of newspaper and encyclopaedia articles with images, articles from the Häme Ox road magazines, stories out of a book called "Hämeen Härkätiellä", and photos from the Häme Ox road Web site. In addition to the commercial content, the application has user-created photos. The content is mostly general background information and not specific travel information like opening hours or prices.

This mixture of content and media formats meant that it was necessary to work with several metadata vocabularies. Different vocabularies are used to describe newspaper, magazine and encyclopaedia articles as well as short stories and users' own content. Also different media formats (text, photos, and videos) have different needs and vocabularies for metadata.

The content was delivered for our prototype in different formats and the amount of metadata varied a lot. The project did not address automatic methods for creating semantic metadata, and adding metadata and converting it into RDF required manual work.

The newspaper articles and images had some metadata that had been generated in the normal newspaper production process, and some more metadata like genre, scene and IPTC subject codes were added by the media company persons for the prototype. We received the metadata in text format and it had a structure that helped us in converting it into XML even though manual work could not be avoided completely.

The encyclopaedia articles were delivered in XML and the structure of the articles could be utilised in converting their metadata into RDF. The encyclopaedia content also has the potential for populating the target ontology, for example with persons relating to the Finnish history.

The content received from the Häme Ox road did not contain any metadata so the metadata was created by hand. The articles of the Häme Ox road magazines were received in PDF format, and that caused also extra work.

3.3.3 Ontologies

3.3.3.1 The role of ontologies

The prototype utilises a number of ontologies, each of which captures knowledge of some area that is necessary to fulfil the required functionality. Ontologies are utilised when selecting content and also to produce some basic information to be shown to the users. The ontologies are also utilised when users add metadata to their own content such as suggestions to keywords.

The Target ontology describes the knowledge related to places, routes and sights, and contains information that has relevance to them such as persons, events, objects and nature.

The Media ontology describes the media content. Relevant elements were selected out of the Dublin Core (DC) and IPTC Newscode vocabularies. The Media ontology includes the typical metadata fields, such as title, creator, publisher, date, media type, genre, scene, but also relations to the Time and Target ontologies, for example relations to persons, sights, places, routes, events, objects, animals or plants. The subject of media content was described with the YSA ontology (a general-purpose thesaurus in Finnish) whenever possible, but for news articles also the IPTC and for encyclopaedia articles the Facta ontologies were used.

The Presentation ontology contains the information on themes and their subcategories and what kind of content (subject, genre, scene, time) is to be searched for presentations. There are themes like “Life now and then”, “Life stories”, “Nature and animals”, “Historical events”, “Fairytales and stories”, “Wars”, and “Art and culture”.

An ontology based on YSA (a general-purpose thesaurus in Finnish) is utilised as a kind of upper ontology for classifying the knowledge. Target, Media and

Presentation ontologies are connected to each other via the concepts of this upper YSA ontology. The YSA ontology was created only to a limited extent because the idea was to replace it with YSO (Finnish General Ontology), which was under development and not yet available during the time when the application was made.

The Time ontology defines a taxonomy of time eras and periods by time intervals, and it is based on the ontology developed in the MuseumFinland project[58]. We added some time periods relating to the Finnish history as well as the seasons.

The subject of the media content is determined differently for different content types: the IPTC ontology is used to determine the subject of newspaper articles. The ontology is based on the IPTC ontology[59] that was developed in the Neptuno-project. The content of encyclopaedia uses its own taxonomy (Facta ontology). YSA-ontology is usable as a general subject ontology.

3.3.3.2 Searching content for theme stories

Theme stories consist of elements like a title, text, image and fact box, and they are selected on the fly based on the knowledge in the ontologies. The fact box shows information retrieved out of the ontology. It may contain knowledge about how events, like a war, are related to the sight or basic information about a person who has a connection to the sight. Sometimes the user may wonder why a certain article was shown, and the role of the fact box is to give some indication about the connection.

Media content is not linked directly to the various themes. The knowledge in the Target ontology and the search rules are utilised in searching and offering relevant media content. The search rules are determined with the Presentation ontology, Java application and SPARQL queries. The criteria for how the media content is connected to a theme, such as the subject, genre or time, are determined in the Presentation ontology. The advantage is that the search criteria are not hidden inside the Java code, but that they can be changed by modifying

[58] http://museosuomi.cs.helsinki.fi/
[59] http://nets.ii.uam.es/neptuno/iptc/

the instances of the ontology. Also, themes may be created, changed or deleted by modifying the ontology classes or their instances.

The Java application creates SPARQL queries for searching relevant media content based on the knowledge in the Presentation ontology. Searches utilise the knowledge in the Target ontology (e.g. Life stories -> persons related to the sight) and/or subjects related to themes (e.g. Every day life now and before -> food, professions, clothing etc. or Wars -> Great Northern War, World War I & II etc.). In addition to that, some restrictions may be used, like time (e.g. Historical events), genre (e.g. Stories and fairy tails), place or sight.

The subjects of the different themes are determined as relations to the YSA ontology. Also the subjects of the IPTC and Facta ontologies are connected to themes. Media content that is related to same subjects is searched for. If content that is described with some other ontology were brought into the system, the subjects of this new ontology would need to be connected to the existing themes.

3.3.3.3 Adding metadata to user generated content

Users can add metadata to their own content. Users are free to use any words they want to describe their content, but by utilising the available contextual information and the Target ontology, keywords are suggested. These suggestions relate to yearly events, objects, terms, other related sights and seasons. It was made easy to use these terms– it is enough to click a word, and no writing is needed. Users are thus encouraged to use these words that can then be utilised to suggest additional relevant content from the system.

In similar manner, users are encouraged to add keywords relating to the genre based on the knowledge in the Media ontology. Genres have been defined for all media types but only image genres are currently utilised. The genre information is useful when the user generated media objects are utilised with future users.

3.3.3.4 Searching commercial content to complement user's own content

Offering media content to complement user's own content is based on the user-given metadata and the knowledge of the Target ontology. First, the media

content that is related directly to the sight is searched. After that, more general media content relating to events, persons and places is searched for. The relevance of the media content is determined with the help of the search order starting with from exact searches and then proceeding to more general searches.

Additional content can be searched with the help of tags. The tags suggested by the ontology may also be related persons or events in addition to tags relating to yearly events, objects, terms, other sights relating to sight and seasons. Already existing theme stories made by earlier users might be an additional way to search information also when creating one's own travel story. Theme stories give ready-made text and image/video combinations that can easily be added to a new travel story.

3.3.4 Software and architecture

The ontology editor Protégé 3.1 was used for developing ontologies. Ontologies were developed as RDFS-schema.

The application is implemented as a Java client – server solution using Struts framework and Java Server Pages (JSP). Tomcat 5.5 is used as the Web server. The user interfaces were implemented with AJAX (Asynchronous JavaScript and XML) in order to offer good interactivity and usability, and to add new features, like drag-and-drop. Different views of the travel plan and travel story are generated utilising CSS style sheets.

The ontologies and RDF-based data are handled by Profium SIR (Semantic information router). A beta version with support for SPARQL-queries was used. Profium SIR saved the RDF data into a Postgres 7.4 database. Postgres 7.4 was used also for managing user information.

The Sparql4j-jdbc driver[60] was used for quering RDF-data. Profium SIR created the result according to the SPARQL Protocol for RDF specification[61] and forwarded it to a Sparql4j-jdbc driver, which provides the results via the Java ResultSet abstraction.

[60] http://sourceforge.net/projects/sparql4j
[61] http://www.w3.org/TR/rdf-sparql-protocol/

It is not easy to choose the tools for application development with Semantic Web technologies. There are several open source tools, most of which have been created for research purposes. Semantic Web related standards and recommendations are still under development, and different tools support different subsets of the standards. For example, we used one tool for developing the ontologies and another for handling the RDF-data, and this caused some extra work to overcome the incompatibilities.

Protégé 3.1 is a versatile ontology editor with many useful features. It also has features for managing and developing multiple related ontologies, but we had problems with this feature. Reopening a Protégé project file with connections to other ontologies caused error messages and sometimes even meshed up the instance data.

The development of a standard query language SPARQL for querying RDF repositories is a step to the right direction. We wanted to use such a version of Profium SIR that supported SPARQL even though it was in beta at the time. Java application development was speeded up by using the Sparql4j-jdbc driver with SIR, even though it supported only select and ask type of queries at the time of the application development.

Utilising AJAX made it possible to add impressive features into the Web user interface. A downside was the lack of good development tools; debugging JavaScript code is troublesome. We also encountered the well-known problem for developing Web applications for different Web browsers: what works in one browser does not necessarily work in another.

As a brief summary we can conclude that there already are usable tools for developing Semantic Web application, but currently many tools only have a partial support for the specifications. There is room and need for further development to make the implementation and management of Semantic Web applications easier.

3.4 Results

3.4.1 User tests

The user experience of the application was tested in two phases in the context of real school excursions. The test group consisted of 33 schoolchildren (12–18 years old) and 4 teachers from four different schools. In the first phase, user needs and expectations were studied using artefact interviews, observation, collages, metadata test and prototype tests. The prototype tests were made using a co-discovery method, where two participants used the prototype together and discussed about the decisions they made. Some users tested the travel planning part of the software before an excursion, whereas others had already made a trip and created travel stories with the prototype.

At the end of the project the functional application was tested again with the same user group but with a smaller number of participants (6 schoolchildren, 12 years old). The test users had made a trip to the Häme Ox road and they used the application afterwards to store their own pictures and memories. The users were interviewed both before and after testing. After the test session they also filled out a short questionnaire.

As the result of the first interviews, observation and collages made by users, following requirements for the StorySlotMachine were found. The application should

- *arouse interest* and offer necessary facts before the trip
- enable *experiencing the stories* during the trip
- give *additional information* about the themes studied on the trip, as well as the themes about which no information was available on the trip
- support creating a *personalised travel story*
- enable storing *rich metadata* about pictures, e.g. memories and feelings, as well as comments and hints for other travellers.

A metadata test was made in order to gather information about the meanings that the users associate with their travel photos. The aim was to find out, how semantic information could be added into the pictures. The users were asked to add captions and keywords into their own travel photos, as well as select applicable tags from a list of keywords. The written captions were generally very short, and the users did not necessarily remember anything about the objects of their photos. The intuitiveness of selecting keywords varied a lot among the users. The users must understand what the purpose of adding metadata is in order to find it easy to do. In addition, the user should see immediate advantage of adding metadata.

The keywords used to describe their photos can be divided into five groups: 1) description of an object or an action, 2) memories and atmosphere, 3) background information about the place or object, 4) questions for additional information (history and/or present), and 5) hints for other travellers.

The application functioned only partially in the first user tests. For that reason many of the test users found the user interface somewhat confusing and the idea of mixing own and media content did not become clear to everyone. In addition, media contents were not presented attractively enough to rouse the interest of users. Nonetheless, half of the users found the application engaging and useful. Schoolchildren appreciated the idea of finding the necessary information easily in one place. Images were regarded as the most interesting part of the content. The complete report of the first user tests can be read in Näkki (2006).

The prototype was developed further after the first user tests and tested again at the end of the project. In the second test, user attitudes towards the functional application were very positive. The system was found useful, quick and easy to use. Users found the StorySlotMachine more pleasant than traditional search machines, because the relevant content could be found easily as stories. The users regarded photos as the core of the application and added both their own and commercial pictures into their travel stories. The users were also eager to write short captions to the photos. Adding metadata into their own pictures was intuitive and did not burden the users. Other users' pictures from the same excursion were found interesting, as well.

Some users wanted to create their travel story quickly, whereas others were ready to use a lot of time to finish their stories. Interestingly, the StorySlotMachine was found to be suitable for both these user groups. All participants of the last tests said that they would like to use the system again. Summary of user experiences in the both test phases can be seen in Figure 12.

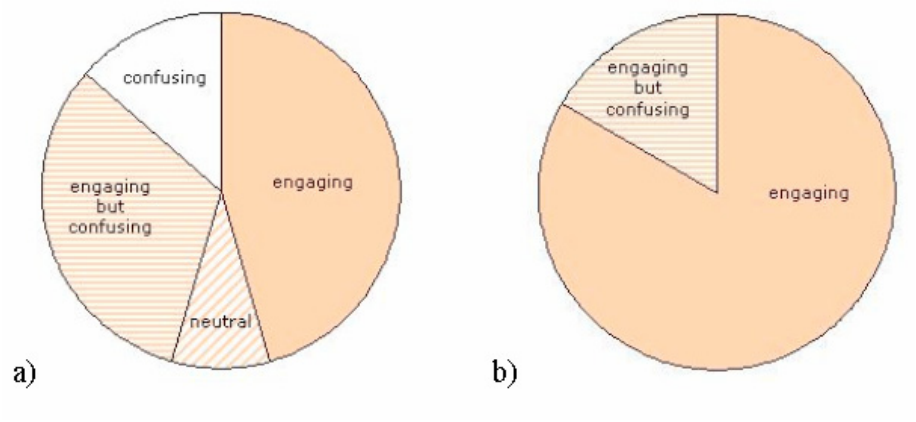

Figure 12. User experiences of the system: a) after the first user test (N=22), b) after the second user test (N=6).

From the users' point of view, the value of semantic content is in the quickness and easiness of information retrieval. The way to find information as stories was something new for the users, but most of them found the idea easy to understand. However, the users did not necessarily want to collect, store and print stories, when planning the trip. The system should therefore better support pure browsing of the content. After a trip it was seen more understandable and useful to create a travel story, where own memories are linked to editorial material.

When users create semantic content, one challenge lies in the process of adding metadata. It was discovered that the travel images and memories include a lot of meanings that are hard to put into words as simple keywords. Users' active participation will be needed, even though automatic semantic reasoning is used for creating presentations. It is the user who decides which content is valuable for her. However, the StorySlotMachine can substantially help the user by offering suggestions about the media content related to the theme of the user's

trip. The semantic processing makes it possible to discover interesting and surprising relations between contents that would be hard to find otherwise.

3.4.2 Ontologies and implementation

Creating, updating and managing ontologies are not easy tasks, but there are clear benefits in this type of an application:

- Ontologies make it possible to search content from multiple directions (sights, events, persons etc.).
- Also general media content can be utilised.
- It is possible to make different thematic presentations or views for people with different interests.
- For example, one user might be interested in the historical places and events of the Ox road during the 19th century and another is only in churches during the trip. They can easily be served with this kind of an application.
- Ontologies contain knowledge that makes it possible to create visualisations such as timelines, cause-effect diagrams, dialogues, trees, and maps of related resources.
- Ontologies support generating aggregations automatically.
- The benefits of being able to link the content automatically into different themes become significant as the number of content items increases and grows continuously.

There already are usable tools for developing Semantic Web applications, but currently many tools only have a partial support for the specifications. There is room and need for further development to make the implementation and management of Semantic Web applications easier.

Theme stories were the most central part of the application for ontology deployment. Theme stories could be easily generated for sights with a long history, but not so smaller sights. Theme stories should rather be offered at higher level like for a town or a village or as in our case, for the whole historical route, than for a single sight.

There were challenges in creating general search rules for the themes. Every theme had unique requirements and complicated the Presentation ontology. Some examples are listed below:

- "Every day life now and before" has subcategories weekday, celebration and society. Subjects like food, professions, clothing, inhabitation, celebrations, laws, and source of livelihood relate to this theme. These determine the main framework for searching, but to get more relevant content also the time periods and the type of the sight should be determined to find relevant content for a particular sight.

- "Arts and culture" is divided into the following subcategories: persons, art and buildings, and environment. When searching for content for the subcategory 'Persons', it is required to find persons who have a connection to the sight and have or had a profession relating to art and culture, such as composer, writer, painter, or architect.

- "Historical events" are divided into historical periods, and time restrictions are needed in searches. There are several ways to do this: search the media content that relates to the time and the sight/place, utilise terms that describe the time period or events that happened during that time.

- In the theme "Stories and fairy tails" the genre is used to restrict the content selection.

When making ontology-based searches, several search criteria can be used and their priority order must be determined. Here, it is important to find the correct balance between the number of different search criteria to use and the speed of the application. First, the most relevant content is searched and after that, the search can be expanded to more general material. The challenge is to know how deep the searches should navigate into the net of relations of the ontology and

still find content that is relevant to the user. We encountered this problem both when making theme stories and searching for additional content to complement users' own content.

When the application has more content, this will probably be less of a problem, and the challenge is the ordering or grouping of the relevant media objects in an interesting way. One of the challenges is to inform user of why certain content is offered to her/him in this context. For example, pictures of historical persons might be confusing, if user does not know who the person is and how he/she is relating to the sight. In connection to the theme stories, a fact box was used to give some indication about the connection by utilising the knowledge in the ontology, and a similar approach should be used elsewhere in the application.

The implementation uses an upper ontology that can be replaced with another one, if needed. This gives flexibility to the application development. We turned selected parts of YSA (a general-purpose thesaurus in Finnish) into ontology, and used it as our upper ontology. There is currently a project in Finland making a comprehensive ontology out of the YSA, and it should be used also here when it becomes available.

We had many different vocabularies for describing the subject of different type of media content in the StorySlotMachine application. Our first idea was to map the IPTC and Facta vocabularies to the concepts of our top YSA-ontology. Mapping different vocabularies to each other turned out to be complicated since it was not always possible to find corresponding concepts in the different ontologies. Also, there was a lack of good tools for ontology mapping.

Instead of mapping ontologies to each other, we decided to keep the different ontologies. As described earlier, the subjects of media objects were described with the concepts of the YSA-ontology when ever possible, but we also stored the original subjects described with IPTC or Facta. The subjects of the different themes were also described with the YSA, IPTC and Facta ontologies. Several searches may be done for media objects during a user session: first utilising the YSA concepts and the subjects from other ontologies. In other words, ontologies are not mapped to each other but to some extent, the mapping is done via the different themes. In order to better test the feasibility of this approach more media content should be added to the system.

This approach will probably work with media companies' own media services, where they can decide which themes are available. Of course, it might be possible to offer users an interface where they can combine ontology concepts and create their own themes. One idea for the future development of the StorySlotMachine is to let users create new themes with the help of the tags they have used.

In general it is good practice to use one common upper vocabulary or ontology for describing the metadata inside the media house and also use standardised vocabularies as much as it is possible. However it is realistic to assume that a media house will have several vocabularies also in the future and one upper vocabulary or ontology cannot solve all issues and challenges. Better tools are needed to support ontology mappings and even better if mappings could be made automatically by the system.

3.5 Related work

The key idea in the StorySlotMachine is to aggregate content in a way that lets users explore the content in an enjoyable manner. Related work is being done in the various areas. The first distinction can be made between the aggregation level: is the aim a single story to be created of out the available content, or a collection of independent resources. Geurts et al. (2003) and the Artequakt project (Kim et al. 2002) work at the first area. Geurts et al. (2003) describe the system where the knowledge of ontologies is used to create multimedia presentations like artists' bibliographies. Presentations vary based on the genre (e.g. Biography and CV) and output format that can be selected by the user. The basic idea of their Discourse ontology is same than our Presentation ontology. The ontologies define rules for searching content. They have different genres, whereas we have themes. Our themes use more versatile data than what is needed for artists' bibliographies and we also have more general content which complicated the ontologies and rules. One difference is that they focus more on ready-made multimedia presentations, which contain parts (e.g. address, private life and career) that are determined in the Discourse ontology.

Our work is more related to creating a collection out of independent resources and turning them into presentations. However, we let users combine images and

texts in new ways and we do not aim at producing one collection for the user to view but a starting point for further exploration with the content.

Mc Schraefel et al. (2005) have developed an open source framework called mSpace, which is available at mspace.sourceforge.net. The starting point for the mSpace development as well as for our StorySlotMachine is same: to offer an exploratory access to content. The user should be able to browse content according to their interests and associations, to leave tracks on the way by storing the most interesting items, and to get multimedia as a result rather than links to resources.

The original mSpace demonstrator was a Classical Music explorer[62], and it has since been utilised in other applications and domain.

mSpace is based on the idea of associative exploration of the content and user-defined and manipulated hierarchies. mSpace lets the user explore the material with the help of hierarchical columns like periods, composers, arrangements and pieces: the selection in the first column constrains the selections of the following column. Users can arrange columns according to their preferences and also add new dimensions or remove them.

mSpace provides preview cues (for example audio clips) of some representative example in the various dimensions to help in exploring and deciding whether an area is interesting. This way users may find new interesting areas without prior knowledge of them. mSpace also has info views to show related information like for example a description of a composer. Interesting items may be stored in favourites for future reference.

The preview cues in mSpace have the same aim as the themes in the StorySlotMachine: to give users ideas and hints as to what kind of content is available relating to a topic.

An interesting feature of mSpace is to let users sort and swap dimensions according to their interests. In the current StorySlotMachine version, the users

[62] http://demo.mspace.fm

are tied to pre-made themes, but one idea for future development is to let users create new themes with the help of the tags they have used.

Creation of different theme stories in StorySlotMachine is based on associations that are inferred automatically by utilising the knowledge in the ontologies. For example, a theme story may tell about a war that relates to a sight and story may include important historical persons. New theme stories are offered based on these relations and other theme story may tell more about the person. Now this is made by the system, as our guiding idea was to give the users the opportunity to try their luck and get surprised, but as an alternative, users could be given the opportunity to guide the process based on their own associations.

One difference between the StorySlotMachine and mSpace is that the StorySlotMachine offer users the possibility to make exportable packages out of the content and also utilise their own content. The mSpace user interface is more formal in style than in the StorySlotMachine, where emphasis has been put to offering a user interface with the element of play.

The Bletchley Park Text application developed for the Bletchley Park Museum (Mulholland et al. 2005) concentrates on post-visitors of museum. During their visit, people may express their interest by sending text (SMS) messages containing suggested keywords relating to displayed objects. After the visit, they can get a collection of content relating to the selected keywords as a personalised Web site. The content can be explored and a number of different views on the collection are provided.

Bletchley Park Text application is made for a specific museum and its specific content. In the StorySlotMachine application, we have several places and sights, and the material is general by nature, since one of the major goals of our project was to study how the general media content can be utilised in new ways with the help of semantic metadata. Both Bletchley Park Text application and the StorySlotMachine share the similar ideas of using the application for learning, but the Bletchley Park Text does not include utilising users' own material like we do.

Bentley et al. (2006) have studied how consumers use photos and music to tell stories. The application is slightly different from ours, as they compare using

only music and photos, but there are important similarities and lessons to be learnt. They find that different media formats, photos and music in this case, and commercial and private content should not be stored in separate silos. Instead, they should be available with the help of similar methods. Serendipitous finding utilising available information like contextual cues should be utilised to remind users of what is available and to help them in finding related resources. They also see a need for systems that allow communication by using media.

3.6 Discussion and future work

This chapter discusses future development opportunities of StorySlotMachine and what are the benefits, opportunities and main challenges of the media companies in creating new semantic media services, particularly in relation to StorySlotMachine type applications. Wider implications of the emergence of user-generated content and Semantic Web technologies for the media sector are discussed in Chapter 6.

Easy access to electronic content and users' participation opportunities into the media production cycle are bringing about huge changes in the way that media content is created, offered and consumed. The StorySlotMachine explores the possibilities of letting people explore content in a playful and theme wise way and letting them do the final touch in putting the presentation together. Semantic metadata and ontologies are utilised to offer multiple views into the available content and help the users to explore and learn in a pleasant way of topics that may not be so familiar to them. The application also lets the users import their own content and mix it with other people's and commercial content.

The application is most suited when the content is available as relatively small units. The user tests indicated that photos and videos are important in raising interest, whereas particularly reading long texts requires more effort and is less attractive in a playful use scenario. This implies that text should be written in a way that makes it quick and easy to see what the text deals with to arouse users' interest. In this kind of a context, the user is not looking for a specific answer to a specific question, but looking around and checking if something interesting comes up, and the content that is presented should support this approach.

The application makes it possible for people to make their own narratives about a topic. This is relevant at least in connection to learning and hobbies, like travelling and making memorabilia. The speciality here is the opportunity to combine self-created content with content from other sources. The final result must have an attractive and professional look in order to motivate the use. The electronic format also makes it possible to add live features; for example, a user-made narrative may be updated with current news and developments.

It was not possible to carry out user tests to such an extent that we would have seen how people would like to use the materials and what new ideas come up. More research is also needed to see, how purposefully prepared content users want, or do they enjoy with a mix of material and modifying it according to their own ideas.

Serendipity is a concept that seems to be popping up as a goal in search related application (Leong et al. 2005; Bentley et al. 2006; Lassila 2006) and here Semantic Web technologies come into play. Particularly in consumer applications easy, intuitive and entertaining user interfaces and applications are needed. Also our work aims at providing serendipitous finding of interesting resources. We did not directly explore how this sensation emerges, and which factors contribute to it. One assumption is that if we know what the users' interests are, we'll be able to suggest resources that he or she is interested in, and can offer experiences of serendipitous finding.

Many media companies have extensive archives that are not effectively utilised as end user services. The StorySlotMachine is an example of how content can be offered in a more interesting context than as mere searches and search result lists. If the content is not already modular and if there is not much metadata about the content, an investment is needed to turn the content into more usable format. The current production processes and practices should be changed so that the content is directly processed into a format that supports the reuse in this kind of applications. The best starting point for offering this kind of a new service is an area where the content is already modular and where people may have longer-term interest and personal material. These include areas like travelling, hobbies, encyclopaedia and news.

Other key questions that media companies need to agree on are descriptive metadata and terms for licensing the content for creating the narratives, and how strictly to guard their IPR. On the other hand, networking to freely available network resources such as photos that are licensed under Creative Commons licenses should be considered as a way to add resources for users to choose.

We can see at least following business opportunities with this type of an application:

- some basic features could be free, but access to more content could be available for paying customers

- related materials could be available for buying, such as books or maps, or additional services like back-up storing of images

- co-operation with operators in the application area, for example with local travel associations

- targeted advertising, particularly if people can be encouraged to longer term use, then information about their interests will accumulate and opportunities for effective advertising becomes better.

There are several opportunities for utilising and developing the StorySlotMachine application further. The StorySlotMachine application can be used as a platform to test user expectations and experiences of mixing and playing with media content, and sharing one's own content with other users' content more extensively. More content should be added for additional testing, and the conversion of metadata into RDF format should be made automatically.

The application could be developed into a commercial travel application or a learning application, e.g. for teaching history. For the travel application, some additional features are needed, like exact travel information (opening hours, prices), maps and mobile user interface, and collecting feedback and recommendations from users. Also new features like collaborative storytelling e.g. creating one travel story from the contents of all group members, and real time travel story that is continuously updated with topical information, could be added.

Similar applications could be built relating to other topics such as hobbies or collecting gathering personal memories from past. A new Target ontology may be needed for a new application, if it does not make sense to expand the existing one. The search criteria are not hidden inside the Java code, but they can be changed by changing the instances of the ontology, which makes it easy to develop the current application further, and to adapt it to new areas. Also, themes may be created, changed or deleted by changing the classes of ontology or its instances.

There is always room for improving the search criteria with help of the Presentation ontology, or even a general tool for automatic generation of theme stories could be created. In the future, RuleML (Rule Markup Language) or SWRL (Semantic Web rule language) may be the solution to use.

At the beginning of the application development, we considered using the CIDOC CRM cultural heritage ontology that is being developed specially for describing the cultural heritage of museum collections. We decided not to, because the ontology seemed too specific and complicated for our purposes. CIDOC CRM is currently in the final stage of the ISO process as ISO/PRF 21127, and it could be reconsidered as an option in a travel-related application like StorySlotMachine to describe cultural heritage. The challenge is to decide which level of the ontology to include and what to exclude as too detailed. Additional benefits could be gained if content or information can be integrated from various museums with the help of a common ontology.

Automatic methods for creating metadata and converting it into RDF format were not addressed in this project, but they are important particularly when existing media archives are utilised in semantic applications. Once the number of concepts in our YSA ontology has been increased, or the national YSO becomes available, utilising automatic methods will be easier. Additionally, users should be utilised as metadata creators, where feasible.

One of the future needs is to increase the amount of available content. In our application, the content resources were moved to our server, but in a commercial application, content from different sources should probably be utilised. This requires that there is an agreement on what metadata to use and the content should have this metadata.

There are many opportunities to develop the searches and the ways that search results are ordered for presentation. Scene and genre information could be used for ordering images. Images from outside and inside a building, and general images and detailed close-ups could be alternated. New ways grouping media objects could be developed in addition to the current location-based presentation.

User generated metadata could be utilised more extensively. The words that people use to describe their content could be stored in case they are not found in the ontologies, and they could be offered to future users visiting the same sight. In the current system, users can add tags only to describe their content, but tags could be utilised more widely, for example, to describe media content, travel plans, and sights. If we had mechanisms to combine tags with more formal semantics and to analyse the reliability of user generated knowledge, this could be one way of adding knowledge into the ontologies.

To summarise, we can conclude that the application lets users explore and combine various types of media content, as well as virtual and real life experiences. Utilising ontologies helps in making the application more intelligent and gives opportunities to offering enjoyable user experiences.

4. Remix Engine

4.1 Use scenario

People want to be a part of the sports world that they follow from TV, the Internet, newspapers, and the actual ice hockey games. Fans show their own team in the way they dress, decorate their rooms, and of course, in any discussion about their favourite sports. They watch the games from TV and newspapers where professional media producers create the magic and fantasia that appeal to people.

Remix Engine a video creation system where the professionally produced, cool-looking media is combined with personal media created by the fan himself. The end product, a video, is composed of professional material that includes team logos, TV brands, advertisements, and so on. From the user's point of view the video clip is a cool and fun keepsake that has the person himself inside the world of sports. From the commercial point of view, the video clip is a customised advertisement that people may create and share (i.e., distribute) to all their friends and relatives. The inclusion of brands and ads is a motivator for the professional stakeholders to enable people to use their material to create and share these personal video clips.

The basic idea is to create a relatively short video clip that combines personal media and preferences with professional media. The end result should be closer to a professional video clip with some personal material rather than an amateur clip with professional material. Presumably the clip is more appealing if the emphasis is on the professional side where there is know-how and knowledge on how to make a video clip appealing.

Figure 13 gives an overview of the basic idea. In the middle is the video template, which is a script or an outline of the video clip with information and rules on what kind of material is to be included and where. There may be different templates for different kind of clips, for example, a video template for creating a video clip from a car show is different from the template described here, i.e., a hockey game. Also, within the genre there can be variations depending on the audience: the template can be designed to be more family oriented or more adult oriented. This can be achieved, for example, by varying

beer commercials and team mascots. Also, extra information about the user and the game can be taken into account as an input to the template: did the user attend the game or watch it from TV, what was the game (time, date and teams), where did the user sit in the arena, were any of the user's friends or family there, and so on.

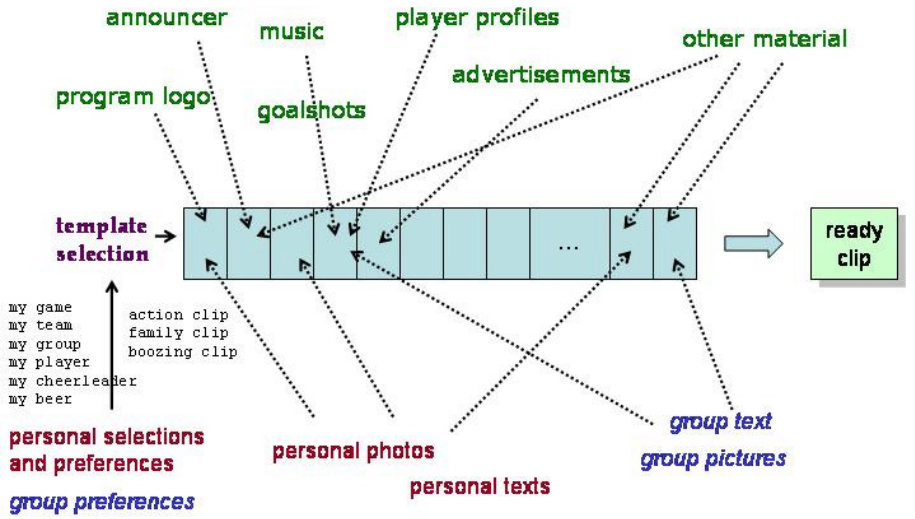

Figure 13. Conceptual illustration of the Semantic Metadata Template for creating a personal hockey video clip. Above the template is professional media, below it is personal and group media. On the left lower section are examples of preferences for selecting the template.

Research challenges:

- searchability, and discovery of content from the network
- automated composition based on semantically rich templates
- technical quality of the automatically rendered video output
- distribution control, who may access the content and how
- license information, especially in derivative remixed works
- business models: individualized content in person-to-person messaging, individualized forms of advertising.

4.2 Implementation

At the current stage, the Remix Engine prototype is a simple Web-based video editing and compilation application that lets the user combine his or her own media with pre-made templates. The application allows the user to upload video, image and sound files to the server and to lay them out on a timeline among the media provided by the template. The user can then proceed to changing the positioning and duration of the media elements. Finally the whole compilation can be previewed as a single video clip.

4.2.1 User interface

The user interface consists of three windows as seen in Figure 14: the editing window, the media pool and the preview window. The windows are movable and can be rearranged according to the user's preferences.

Figure 14. Screenshot of Remix Engine's user interface.

The editing window follows the traditional timeline and tracks approach to video composition. It has a track for visual media (i.e. video and images), for textual overlays and for sound and music. Media elements can be resized by dragging from the right edge of the box, which represents the element's position and duration on the timeline. Respectively, dragging the box to another location changes the element's position. The Trim button collapses the timeline removing all empty spaces between the media elements. The Publish button creates the final video clip on the server and opens it for viewing in the Preview window.

The media pool contains thumbnails of all the media included in the template and uploaded by the user. It also has the interface for uploading new media files that are converted to a format used by the system and added to the media pool after the transfer. Uploaded files are added to the editing timeline by selecting the thumbnail and pressing the Insert Media button. The implementation for adding textual overlays and transitions to videos and images is not yet finished.

4.2.2 Software and architecture

The software architecture of Remix Engine is divided into the client side application, which runs on the user's Web browser, and the server side software, which handles the media conversions and composition in addition to storing and hosting the media files for the duration of the use. The architecture is outlined in Figure 15.

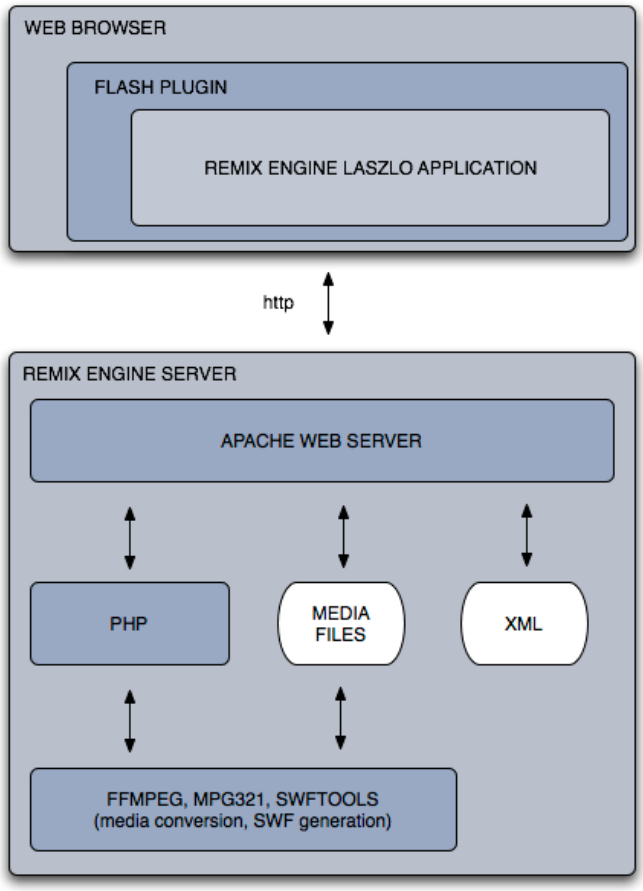

Figure 15. The software architecture of Remix Engine.

The client side application and user interface were implemented using the OpenLaszlo platform[63]. The application is deployed as a Flash file from an Apache Web server running under Linux. Running the application requires version 8 of the Flash plug-in to be installed in the client computer.

The OpenLaszlo flash application communicates with the server using asynchronous HTTP requests. The requests are processed on the server using PHP scripts that return information to the client side application in XML format.

[63] http://www.openlaszlo.org

The XML is either sent as a direct response to the HTTP request or written to a file on the server that is read by the client application when required.

The server-side PHP scripts use command line calls to FFMPEG[64] and MPG321[65] software for converting the media files to formats that can be used for rendering the final video object. Allowed formats for upload are currently MPEG, MOV and AVI for video and MP3 and WAV for audio. Uploaded video files are converted to SWF using FFMPEG and MP3 files are converted to WAV with MPG321.

Information (e.g. frame count) about the media files is gathered using FFMPEG-PHP[66] and SWFDUMP from the SWFTOOLS[67] collection. SWFC from SWFTOOLS is used to create the final video clip according to a dedicated description file[68] written by a PHP script. The description file is written based on the information gained from the OpenLaszlo front-end, such as the duration and location of each media element on the timeline.

Pre-made templates are described in XML files stored on the server. Each template has an associated XML file that describes the media elements included in the template and their location, duration and transitions. The XML file can also be used to describe textual overlays, although the user interface for creating them was not implemented during the RISE project.

4.3 Discussion and future work

It is possible to create this kind of a video automatically, if the media used in the creation is enriched with relevant metadata, and if there is a template or script that contains the information of how to combine the pieces of media together. The main challenge of the use scenario is the availability of semantically rich metadata for the media objects.

[64] http://ffmpeg.mplayerhq.hu
[65] http://mpg321.sourceforge.net
[66] http://ffmpeg-php.sourceforge.net
[67] http://www.swftools.org
[68] http://www.swftools.org/swfc-fileformat.txt

From the user's perspective the annotation of metadata objects can be done as a side product of upload. For example, the user can be asked to upload an image of himself in the hockey game on 27th of February. The image uploaded can then be included with metadata about who is in the picture, as well as, when and where was it taken. The motivation for the user to do this is the video to be created and the anticipation of how the uploaded image looks in the final video. For the end user there is also the motivation that if he decides to share the picture within his group, it will be more probably used in other people's clips if it is richly annotated, i.e., uploaded according to the directions.

For the commercial stakeholders the motivation for annotation is different. Of course, if the creation of these kinds of video clips is profitable, it may be motivation enough to provide the required metadata. Nevertheless, the more customisable the videos are, the more they need annotated media. Therefore, the cost of annotation should be taken into account. We will not go into the details of this, but want to emphasise that the amount of annotated media is proportional to the versatility of the video template, which relates again to the total cost of having a system of this kind. Less versatility means less annotated media, which means less costs.

Future work:

Self-contained distribution packages: The video file itself should include all the metadata used, wrapped in DiMaS distribution packages and made available through the DiMaS system.

User profiles: Not only would the system then create a database of richly annotated media, but the metadata would also provide information about user preferences.

Mobile version: New mobile devices (such as Nokia N-Series phones) are becoming a viable platform for both creation and consumption of remixed video.

Collaborative editing tools: Creating a distributed, collaborative video editing system, in which multiple individuals could actively participate in the putting together of a video.

5. DiMaS

5.1 Use scenario

A content producer has a creation or a piece of digital content, e.g., a video clip, a movie file, an e-book, or a song file, to be published. The file can be the fruit of an amateur hobby production, a travel journal with photos, a result of remixing net content, or any work of art. The content producer browses via PC onto the main page of the content production community's DiMaS system, where he registers into the system. After registration, he logs on and wants to import a micromovie that he has created on his PC. The DiMaS system also offers a Web services interface to content authoring tools that could include a compatible plug-in to publish creations directly from the authoring tool.

The producer goes through the steps of the content description import pages (e.g., he inserts his name as the director of the movie, a text description of the movie, he selects that it is suitable for children, he defines that it is free of charge, and gives the right to make derivative works of the movie), and at the end approves the inserted information and media files. Looking at his personal page he can see the names of the imported content. He decides to publish the newest content with the descriptions he just inserted and the preview file he uploaded. The system announces that a DiMaS Distribution Package is created successfully and the publishing is successful. Transparently to the user the system uploads the content to various channels, e.g., to a few Web and ftp sites, to some P2P network nodes, and to the server of the local school's file bank, the system administrator has selected for this community's channels. The content producer logs off.

After this, another user, a consumer, browses the content selection on the Content Search page. The Content Search page can be, e.g., on her PC, on her television screen, or on her cellular phone, and connected to any of the previously mentioned content channels. In this case, she tries several different search categories (e.g., action and video), browses descriptions of the contents, checks a few content previews, and finally decides to download a micromovie (i.e., Distribution Package) to her PC. When she has finished downloading, she moves the content to her attached PDA. Later, she opens the micromovie on her PDA with one click. The user interface, which is similar to a DVD menu (see

Figure 16) opens. Transparently to the user the Distribution Package attempts to access to the network to update the content metadata. This ensures that the user has always the most updated version of the content description, e.g., the pricing information and license terms.

Figure 16. DiMaS Distribution Package User Interface.

The user browses through the content description, including the pricing information. Before making the purchasing decision, she wants to check the preview again, and after that she buys the content by pressing the "Buy" button on the user interface. The PDA retrieves a decryption key from the Verification Server and informs of the successful purchase. The user notices how the price page shows the new licenses she just bought, i.e., the number of times the user can view the micromovie, and the play button activates from gray to green. The user presses the "Play" button and waits for the content to decrypt. After watching the micromovie, the user fills in a feedback form, which is submitted to the Verification Server, and the metadata on the PDA is updated considering

the new feedback, (e.g., the rating can be changed due to the user's feedback). The user closes the Distribution Packet on her PDA.

5.2 Main challenges

The popularity of digital media recording devices and media editing tools has enabled amateurs to generate professional looking multimedia. Examples of these are computer game modifications (i.e., "mods"), digital image manipulation competitions, and home made movies that have acquired large audiences through "word of mouth" on the Internet. In other words, the availability of multimedia authoring tools and the rather unconstrained distribution on the Internet has enabled non-professionals to produce high-quality digital content for others to enjoy.

To unleash the power of modern networking as a distribution channel to even more amateur multimedia producers, some skilful voluntary users, or authoring product sellers in some cases, e.g. Bioware's Never Winter Nights community, have formed technically advanced and fruitful collaborative communities on the Internet. On these virtual communities amateur authors with lesser technical knowledge can benefit of sharing multimedia authoring experience, knowledge, and tools. The example community we use in this paper and with the DiMaS system is a micromovie producing community that creates short movies for handheld devices such as PDAs or mobile phones.[69]

These multimedia producing communities are looking for alternatives to the traditional media publishing and distribution channels which are hindered by cumbersome intellectual property, organisational, and marketing practices. On the other hand, the community members do not want to lose control over all of their rights to their own works even though might be giving their content away for free. Such rights could be, e.g., author attribution, or right to use the work commercially. By adding verbose content descriptions they want to promote their material and increase searchability. For some authors the most important compensation for their work could be feedback. Furthermore, some of the communities and individual creators are interested in getting a compensation for

[69] http://www.blauereiter.net

their work through charging mechanisms even if they are not using any traditional distribution channels. Hence the distribution of digital content calls for twofold approach in digital rights management. Firstly, the content needs to be licensed and secondly, in some cases, it needs to be encrypted against unwanted usage. By unwanted usage we mean protection against the usage by non-paying customers or otherwise controlling who uses the content. While the latter, content protection, is more challenging to implement, offering licensing and rights management is also very desired by authors. Table 2 illustrates how content distribution divides into categories depending on the target audience. The gray areas highlight how the DiMaS system positions itself and what it has to offer.

Table 2. Content distribution divides into categories depending on the target audience.

Content distribution	**Target Audience**		
	For own use	**For a group**	**For the Internet**
Content Non-Commercial	–	Content non-encrypted	Licensed and Content non-encrypted
Content Commercial	–	Licensed and Content Encrypted	Licensed and Content Encrypted
Content Access Control	No	Encrypted for the group	No

5.2.1 Peer-to-peer file sharing networks

Highly popular P2P file sharing networks offer an alternative approach to distribute information products such as multimedia content. Unlike distributing information products in a central server architecture, e.g., World Wide Web, decentralized P2P networks offer high availability, better bandwidth through many users' wideband connections, and better scalability without central servers as bottlenecks. However, while being mainly a channel for distributing files, P2P file sharing networks lack a way of describing the content alongside the downloadable file itself like what is possible in traditional Web pages. On many file sharing networks the content search is still limited to file names that can be very misleading or otherwise inefficient (Good & Krekelberg 2003; Yang & Molina 2002). Nevertheless, the impact of P2P in file sharing is significant (see,

e.g., Strumpf & Oberholzer [2004]): hundreds of millions of client copies are already in use making P2P the most popular file sharing application on the Internet (Borland 2003). Therefore, P2P file sharing networks create a huge content sharing base and a complex value network, which offers new business opportunities and models to various actors, such as content right owners and network operators, and also, to novel actors like multimedia producing individuals and communities. This potential could be utilized better, if there was a way to include rights, pricing, and content descriptions to enrich searchability and controllability. (Nejdl et al. 2002; Loser et al. 2003; Yee et al. 2003.)

5.2.2 Multimedia content and metadata file formats

To distribute multimedia content on any digital channel there is the issues of file formats and compatibility – for both the content itself and the associated metadata. Multimedia authoring communities want to distribute different kinds of multimedia in all kinds of file formats to reach as wide audience as possible. Also, the authoring tools they use vary a lot and the end-user terminals for their customers come in all shapes and capabilities. However, the lack of common standards, digital rights management systems, and software companies' race for the dominant market leader position have created a cluttered selection of multimedia file and metadata formats. Even among the same media, like movies, there are numerous different file formats and within the file formats several different codecs. In addition, many of the most popular file formats, such as MP3 for song files, are not the most effective ones in compression or content descriptions. Thirdly, hardly any of the multimedia file formats support rich rights, pricing, and content descriptions. Although there are standardised and popular de facto formats for describing user rights and licenses (e.g., Creative Commons[70]), pricing (e.g., ODRL[71]), and multimedia content (e.g., MPEG-7 [Martínez et al. 2002]), these description languages address only certain issues and although academic efforts like MPEG-21 framework has paved the way, there is no widely accepted standard that addresses all of the issues. Therefore, in addition to the content file, there are often several metadata description files associated with it.

[70] http://www.creativecommons.org/
[71] http://www.odrl.org/

Especially, when the actual content is encrypted against unwanted usage, the content description is the only information about the content. In a user-friendly environment, the user shouldn't need to install another content player application to get familiar with the included license and pricing information or to find out, in the worst case, that he doesn't want to buy the actual content. Content distribution should be carried out in a way that the user doesn't need any distribution, DRM, or payment specific player on his terminal.

To summarise, the content producers face the problem of having several different file formats to support and the same problem becomes worse as the multimedia is described with content, rights, or pricing metadata. In the DiMaS system the focus is on the issue of having several metadata descriptions combined with the actual content file.

5.2.3 Main challenges and the offered solution

The multimedia authoring communities want to distribute their creations to a large audience which P2P file sharing networks can provide. However, the P2P networks do not support the use of metadata for digital rights management, charging mechanisms, nor content descriptions. Many existing systems work based on a single file distribution. Having rights, pricing, and content describing functionalities in multimedia is often solved by introducing a new file format and a respective multimedia player that supports the new format.[72] This would add another file and metadata format to the already large pool of different formats for multimedia, and would require the user to install another dedicated player to view the multimedia. Also, different authoring communities might have different requirements for the metadata descriptions, for example, due to local legal regulations or the nature of the multimedia produced.

Therefore, before the P2P file sharing networks can really be harnessed and leveraged by multimedia authoring communities there are several problems to be addressed: How to facilitate the user input of content descriptions as well as rights and charging data into standardised metadata even in amateur content producing communities? How to make these descriptions compatible and

[72] http://www.apple.com/itunes/

comparable with other communities and with other applications? How to sustain compatibility to existing systems by bundling the metadata and the actual content into one package rather than having them in separate files? How to make this package easily accessible by the end-user without creating a new file format and another player application? How to introduce the actual content, i.e., content descriptions, without a dedicated content specific player and when the content is encrypted against unwanted usage?

The DiMaS system provides one solution to these issues. It has a configurable user interface for inserting rights, pricing, and content information, which are automatically converted into user-selected metadata standards. The metadata and the multimedia content itself are combined into one package that is shared on P2P file sharing networks to gain as large audience as possible. The package is a Java file that can be executed on any device that has a standard Java Runtime Environment, therefore, the package does not require any dedicated player application. In other words, the user does not need a "DiMaS player". The user needs only the content specific player, if he decides to view the content. The rights and pricing requirements are taken into account by encrypting the actual multimedia content and control files of the package, and implementing an authentication and charging infrastructure into the consumption of the package.

5.3 Implementation

The DiMaS system relies on an extendible and modular architecture. As the system is further developed, various modules are added which increase the functionality of the system. To support maintainability, the system's module interfaces are carefully defined and documented. By dividing the system into smaller parts, they can be independently designed, and most of all, independently implemented.

There are still some designed features that have not been implemented and open issues that have not been solved. Therefore, it is important to isolate the different modules and problems from each other, so that the basic framework of the system remains functional. This modularity makes also possible to use and utilise third party code, such as open source software. The objective of the implementation is to use open-source software so that the DiMaS system itself

can be distributed as open-source. DiMaS has also been produced using open-source development tools.

The main functional parts of DiMaS are:

1) Content Import User Interface

2) Publishing System

3) Distribution Package

4) Verification Server.

The multimedia author uses the Content Import User Interface to import the actual multimedia content (e.g., a micromovie file) with an associated optional preview file (e.g., a movie trailer or a set of still images), content, rights, and pricing information, and optional feedback questions. The same user interface enables the user to modify and publish the imported content. Once the user chooses to publish the content (the imported content needs to be explicitly published before distribution), the inserted information is processed by the Publishing System. The Publishing System is responsible for converting the inserted information into standardised metadata, and it also does the content encryption, hash key generation, and finally the creation of the Distribution Package that is made available on the P2P file sharing networks and other distribution channels. Also, the Publishing System informs the Verification Server of the newly created Distribution Package so that the Verification Server can handle the authentication, billing, metadata updates, user statistics, and feedback gathering once the Distribution Package is executed. The Distribution Package contains the content file, preview file, inserted metadata, authentication information, and the user interface graphics. The Distribution Package also contains the execution logic for the user interface, e.g., contacting the Verification Server, and decrypting the content file. The actual compatible player that shows the included multimedia content file is called by the Distribution Package from the local computer's available players.

The DiMaS system has been tuned for high portability. It is independent of multimedia content file format, it allows different kinds of payment systems and

the viewer is independent of the end-terminal. Security requirements are taken into account by having the decrypted content only in the main memory of the device. Also, the user is not able to modify the encrypted verification information, and the user always receives the correct verification information intended to the content file of the Distribution Package.

5.4 Related work

5.4.1 The Material Exchange Format (MXF)

Originally called as Media Exchange format, the Material Exchange Format (MXF) has been developed by the Pro-MPEG Forum, EBU, and the AAF Association. User requirements for MXF were developed by the MXF/AAF Joint File Interchange Working Group in co-operation with EBU P/PITV group and the SMPTE. Some of the most important requirements for the MXF standard are the following: open, easy to understand and apply, have a low implementation overhead, and that it must be compression independent. Properties of the MXF format can be summarised as follows:

- MXF is a binary file format capable of containing any kind of audiovisual material with all its metadata.
- MXF is primarily used for interchange and storage.
- MXF is compression and operating system agnostic.
- MXF files can contain a playlist of files, synchronization information as well as several audiovisual items organised in a streamable manner.

MXF is called compression agnostic since it allows different types of essence and metadata to be presented within the file. Descriptive metadata in MXF can be synchronised to a common timeline with the essence it describes. Compliant encoders and decoders can process MXF files without modifying the essence and the relative increase in file size caused by wrapper overhead and embedded metadata is minimal. The metadata plug-in mechanism allows uses to integrate

metadata schemes to MXF without having to redevelop processing applications and equipment.

The MXF standard split into parts, which have to undergo multiple balloting and review processes before becoming approved by SMPTE. Many MXF-aware hardware products already exist on the market, like the Sony XDCAM product series. MXF implements a subset of the Advanced Authoring Format (AAF). While MXF is used for file interchange, AAF has been designed to support complex authoring processes. Both formats facilitate the handling of content as files leading to increased interoperability between products. MXF files can be used in each phase of the production chain, from capture to playoout. This way metadata accumulates in the same MXF file throughout the workflow. However, MXF files do not fit well into the post-production environment, where complex editing operations need to be performed. Also, MXF has a great emphasis on video format over other audiovisual material.

5.4.2 MPEG-21

The MPEG-21 Multimedia Framework initiative aims to enable the transparent and augmented use of multimedia resources across a wide range of networks and devices. MPEG-21 aims at defining a normative open framework for multimedia delivery and consumption for use by all the players in the delivery and consumption chain. This open framework will provide content creators, producers, distributors and service providers with equal opportunities in the MPEG-21 enabled open market. This will also be to the benefit of the content consumer providing them access to a large variety of content in an interoperable manner.

MPEG-21 is based on two essential concepts: the definition of a fundamental unit of distribution and transaction (the Digital Item) and the concept of Users interacting with Digital Items. The Digital Items can be considered the “what” of the Multimedia Framework (e.g., a video collection, a music album) and the Users can be considered the “who” of the Multimedia Framework.

The goal of MPEG-21 can thus be rephrased to: defining the technology needed to support Users to exchange, access, consume, trade and otherwise manipulate Digital Items in an efficient, transparent and interoperable way.

MPEG-21 identifies and defines the mechanisms and elements needed to support the multimedia delivery chain as described above as well as the relationships between and the operations supported by them. Within the parts of MPEG-21, these elements are elaborated by defining the syntax and semantics of their characteristics, such as interfaces to the elements.

The MPEG-21 Multimedia Framework recognises that to achieve true end-to-end interoperability for digital exchange of content, more is needed than interoperable terminal architecture. MPEG-21's goal is to describe a 'big picture' of how different elements to build an infrastructure for the delivery and consumption of multimedia content relate to each other. In setting the vision and starting the work, MPEG-21 has drawn much new blood to MPEG, including representatives from major music labels, the film industry and technology providers; both IDF and the indecs consortium are now active participants.

5.5 Discussion

The Digital Content Distribution Management System DiMaS proves as a concept that it is possible to make a system for multimedia producing communities to publish their work on highly popular P2P file sharing networks and the system enables them to charge for the consumption and manage their intellectual property rights, as well as have content describing information available. In the technical implementation of DiMaS a micromovie producing community was used and consulted as an example. The client device that was used for testing was a PDA (HP iPAQ) with network access and a Java 2 Standard Edition environment.

The key benefits of the DiMaS system for content provider were as follows:

- Authors using the same system form automatically a community that can help the content producers in many ways.

- The system offers DRM capabilities even to amateur content producing communities without needing to understand technology, DRM, legal consequences, or pricing models.

- It is not necessary to limit or to restrict the distribution of the content, but encourage distribution even in the uncontrolled P2P file sharing networks.

- When the content is independent of distribution channels, it can be brought closer to consumers.

- It is possible to utilise different kinds of payment systems, and not be dependable on a single system that may introduce technical constraints.

- Consumer support for browsing the content descriptions on various terminals is included automatically.

The key benefits of the DiMaS system for the content consumer were as follows:

- After downloading the content, a network connection is necessary only for paying. If the paying is done in advance there is no requirement for a connection.

- The consumer can view the multimedia content descriptions without installing another new dedicated client application that understands the content.

- Content consumer does not need any special skills to view the content.

- The content import process creates informative and browsable metadata enriched content files, which enable more efficient searching and browsing.

- The content is also searchable based on licensing descriptions, e.g., “I want only such content that I can use for my own film”.

- A consumer knows his usage rights and has a chance to avoid breaking the law and copyright clauses accidentally, i.e., “I know this is legal”.

5.6 Future work

To provide a sound service-oriented platform for community media and content distribution studies, we plan to utilise and develop further the winning DiMaS architecture. We plan to instrument DiMaS so that extensive SNA data can be gathered to study how the user profiles resulting from the analysis could be used to configure the system for a particular social setting.

This research pursues the future, where P2P networks are not just for exchanging files, but a start toward a big paradigm shift from computer networks to service-oriented networks that combine different kind of resources (i.e., content files and services, and sensor data) onto the same network of multiple distribution channels and under the same retrieval user interface. By separating revenue collection from acquisition of copies, hard drives and personal computers as limited domains can disappear and become a part of the service network that conveys digital goods between producers and consumers.

DiMaS' digital content distribution management refers to any series of enabling technologies and services that together control, create, market, and maintain business rules for the use of any digital content in public or private networks, otherwise known as the digital media distribution value network. For the solution DiMaS take advantage of, e.g., Semantic Web services, the emerging MPEG-21 standard, and hardware-based Trusted Computing.

DiMaS addresses media publication, distribution, and consumption from the perspective of 1) consumers, 2) amateur producers, and 3) professional publishing (Figure 17). It supports consumers in finding and using the media they want easily (tag-based navigation and multiplatform consumption), the amateur producers in making their creations available for large audiences (content annotation and multichannel publishing), and the professional publishers in supporting their copyright and charging models (licensing and copy prevention). DiMaS achieves this by enabling P2P distribution of content and associated metadata, leveraging semantically rich metadata for finding and describing the content, and supporting feasible licensing, rights, and charging models. The whole system architecture is called DiMaS Overlay Network Structure for Service-Oriented Architecture, or the DiMaS Network (Figure 19).

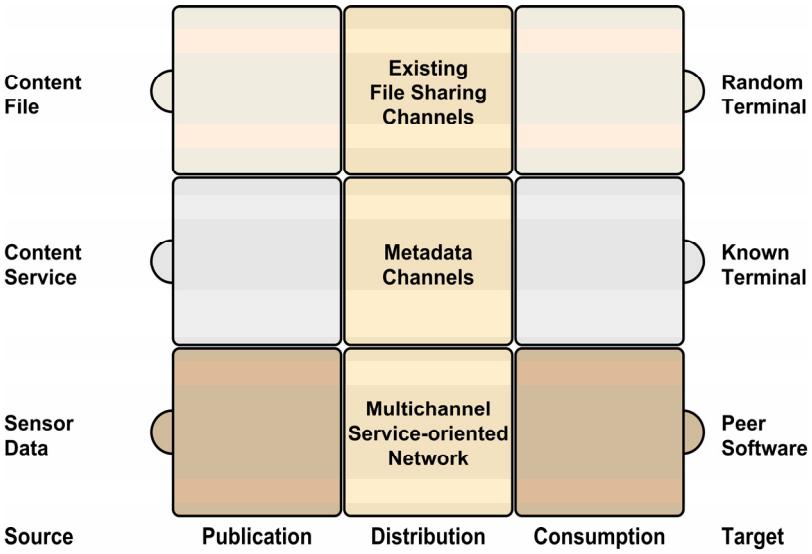

Figure 17. Variety of content sources, distribution channels, and consumption targets.

DiMaS extends content to services and sensor data to content, resulting to a novel service-oriented distribution architecture, the DiMaS Network makes licensed and semantically described resources, (i.e., content files and services, and sensor data), whether produced by amateurs or professionals, available in equal standing. According to the Figure 18, DiMaS divides the research problem into three connected parts: 1) publication, 2) distribution, and 3) consumption; enabling peer-to-peer distribution of content and associated metadata and leveraging semantically rich metadata for describing and finding the content, and supporting feasible licensing, rights, and charging models. The successful distribution system is the combination of all three areas: 1) rich content resource descriptions, 2) simultaneous use of all available distribution channels, and 3) targeting for the particular user and the consumer platform in question (Figure 17).

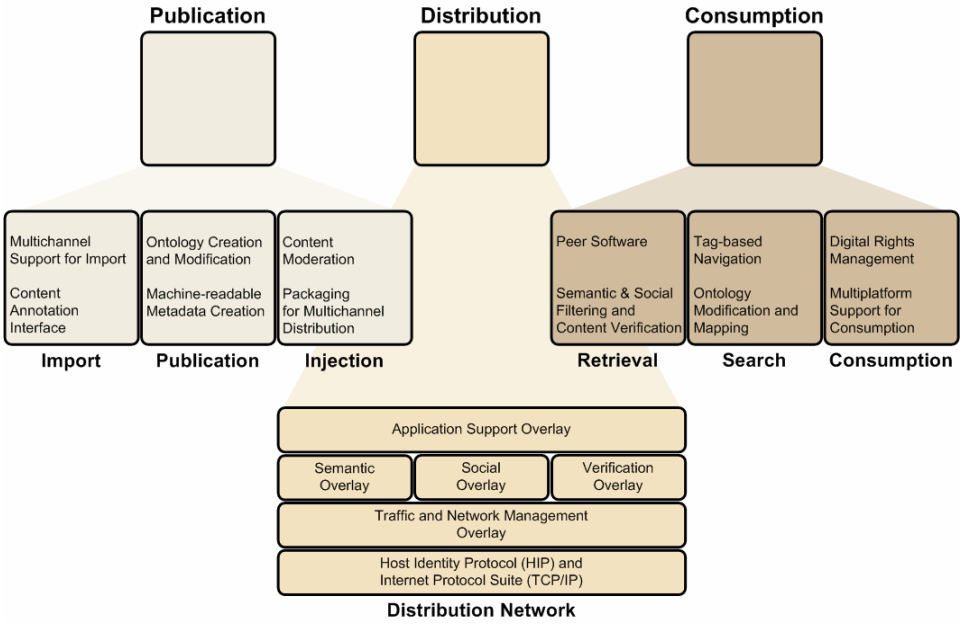

Figure 18. The DiMaS Distribution process for Service-Oriented Architecture.

The opportunity for the mediator is to join consumers' "participatory journalism" by creating professional resources for enriching and feeding the conversation of the consumers and, on the other hand, offering new distribution channels. This research will find answers relating to how mediators can make use of user models that support interaction tailored to the knowledge, interests, and preferences of individuals, and community models that facilitate collaboration and effective communication amongst the community members.

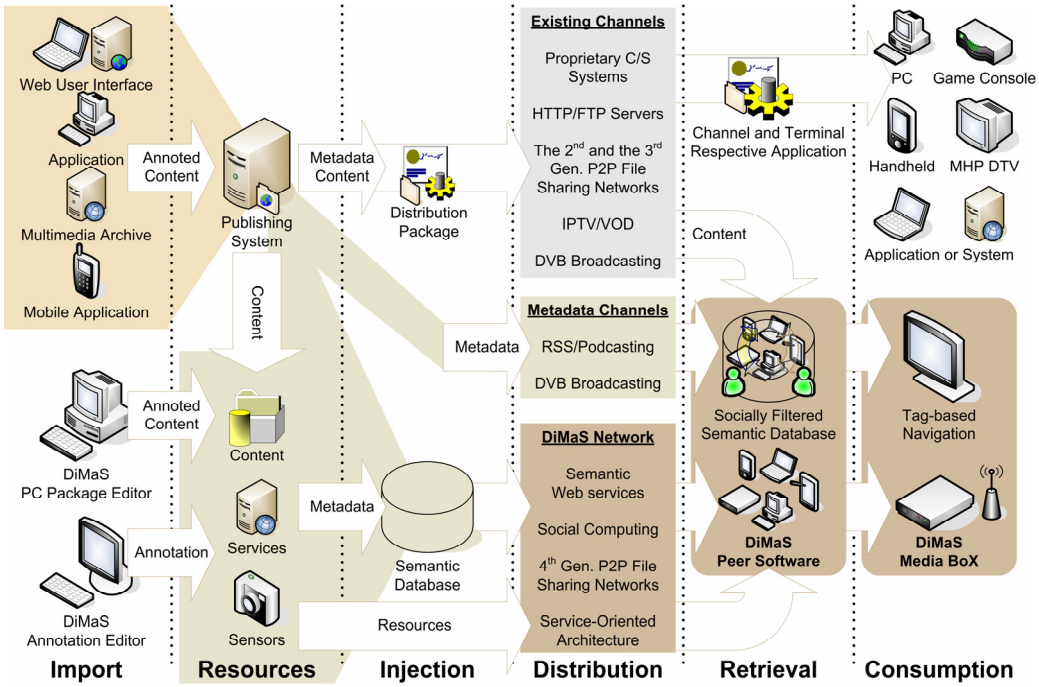

Figure 19. DiMaS Service-Oriented Architecture: Content Annotation and Publishing, Semantic Resource Descriptions, Multichannel Distribution, and Multiplatform Consumption.

6. Conclusions and business implications

This project set out to seek answers to two main research themes: 1) what is the importance of rich semantic metadata for future media products, and 2) how can users make and share, with the aid of rich semantic metadata, new content by mixing professional and personal media content. These two areas may also meet when users participate in adding metadata to the media content.

During the project, we have seen a huge increase in the amount and importance of user-generated content, and also in the amount of unstructured user-generated metadata. The developments in Semantic Web technologies have been slower, and not caught as much attention and real use as user-generated media. However, we have also seen constant progress in their use, mainly in professional archiving and media content management solutions.

One of the key value-adding tasks within the commercial media is the editorial process – going through news or manuscripts and choosing which ones to publish. With user-generated content other approaches are needed, as anyone is free to publish and the selection process is left to the individual users. Here tags, ratings, recommendations and referrals create the way to filter the content and help people to find better content items. It is also important to keep in mind that there is no need to try to find what could be described as the absolutely best resources. People's interests vary widely and the key issue is to set up processes that help people to locate the resources they find most interesting.

User-generated metadata can be explicit or implicit. Explicit ways are such as adding metadata like keywords or tags, ratings and descriptions, and the implicit recording user actions such viewing and access paths. When content consumption is electronic, there are opportunities to track what happens with content during its lifecycle and this way gather metadata. When opening content to the public with the aim that they add metadata to it, some incentives are needed. Opportunities vary from making the application so entertaining that people do it for pleasure, to offering some benefit from adding the metadata or even paying for this.

Media companies should consider where and how they could utilise user generated metadata in evaluating and assessing the interestingness and importance of content items. Other open content phenomena, such as continuous user innovation, emerging practices and community rules, and template-based collaborative content creation, should be taken as ground-breaking examples of potential future practices for professional media creation. In many senses, these are disruptive models for the current publishing business, but they could be utilised to renew existing models.

Internet – like the name implies – is a network of networks, and ultimately a network of people. As the density and size of this network increases, new ideas and services spread more quickly. The rapid growth in the number of users of new services, such as YouTube, is a clear indication of this. This means that successful new players may quickly take an important role, but also that existing networks can be utilised to promote new complementary services and sites.

Also, the so-called long-tail phenomenon – the Web creating opportunities for most specialised content and services – seems to prosper within the most popular sites, if and when they let the diversity of interests emerge. For example, when people may create and manage groups relating to their specific interest, micro-communities will emerge within a large user pool.

User-generated content is a way to add user loyalty. When people invest a lot of time and effort into building a presence within a site and they see their own footprint in a product or service, they are less likely to switch to a competitor.

Tagging has gained a lot of importance as the popular format of user-generated metadata. The sites supporting sharing of user-generated content – be it photos or bookmarks – needed some simple way for content management. Keywords that can be chosen freely to describe content have proven to be a success. This may have been due to simplicity of this old keyword annotation model.

Also a simple visualisation in the form of tag clouds, where the font size of a term indicates the amount of content linked to a tag, have quickly gained wide-spread use. This is another proof of that simple ideas work best in Internet where large numbers of people use applications on their own. Utilising tags should be explored more, as they give a direct view to how users view different resources,

and they also give an easy way of connecting different media formats to each other. Tags may also have potential to produce domain knowledge that can be used to create more structured ontologies. A positive example along these lines is the use of "Category" tag in Wikipedia, which is dynamically forming a machine understandable category scheme for all Wikipedia content.

The StorySlotMachine and RemixEngine prototypes gave examples of how commercial media content could be used in a new way by letting people combine commercial content with their own or other people's content. The StorySlotMachine also gives an example of how one application may offer good user experience for both the more passive and active users. The passive users take what is shown them during the first round, whereas the active users may explore the content more in depth and also make their own collections both from the media content and their own content.

The objective of the video clip keepsake as demonstrated by RemixEngine is threefold: 1) it is a valuable personal keepsake for the end user, 2) it can be used as community memorabilia for a group of people, and 3) it is an advertisement that is shared as a personal creation rather than a commercial message. For the end user the video is a short clip in the fantasy world of professional sports. For the group the video is a medium for group identity creation. For the advertiser the video clip is an automatic advertisement created by the user, customised to the user, and distributed by the user.

These kinds of applications could be built in connection to media archives, like news archives, or in connection to encyclopædia, where the material is already modular. Here also ideas that have proven successful with user-generated content, such as showing the number of views and user ratings and creating channels or groups around user defined themes, could be utilised to make the material easier to approach and create room for user creativity. Developing and offering templates, and complementary tools, for example for making cartoons or posters are other opportunities to help people get started with utilising media content in new ways.

An obvious business model for video remixing is placing ads at the beginning or end of each rendered video. In some cases people might want very much to include advertising or other promotional material in their own version, as it

makes the final work seem more professional. This is the case in the sport content remix example. Letting users share their creations brings more exposure to the advertisements as well. However, we may expect also some hesitance among advertisers who often want to control tightly where their advertisements are shown.

A big issue in utilising semantic metadata and Semantic Web technologies is developing and maintaining ontologies. During our project, the lack of common public ontologies made the development work time-consuming and it also sets additional requirements to ontology maintenance. There are projects under way aiming at building such ontologies, and if they are successful, there is one hurdle less. Even so, it will be necessary to manage and co-ordinate the usage of several ontologies, as it is not easy or even sensible to switch from currently used ontologies to some new ontology. The best approach must be selected case-by-case. With the StorySlotMachine, themes were utilised as an intermediary to link the different vocabularies.

Adding semantic metadata is another big issue that was not directly addressed in this project. Here the initiatives relating to microformats and RDFa may be one part of the solutions. Here common vocabularies and easy-to-use authoring tools are needed.

Digital material can be re-published, re-sold, re-licensed, re-distributed. Re-using content succeeds best when the content is modular and there is metadata that supports accessing it from multiple views. A mixture of different media formats – photos, texts and videos – is welcome. Large media companies, such as BBC and INA (Bachimont 2006), are preparing to or already turning their content into more modular format and adding metadata to support reusability and active exploration of content.

However, as the user-created content gains popularity and moves towards more professional production, legal and organisational issues arise that even amateur content creators should address. These issues include decisions on commercialisation of the content creation activity, intellectual property rights within the creators, the brand image of the content or the group, and managing the liability risks in content production. These issues can be critical for the

existence of the community, and are often largely ignored until they manifest themselves with negative consequences.

The opportunity for the mediator is to join consumers' "participatory journalism" by creating professional resources for enriching and feeding the conversation of the consumers and, on the other hand, offering new distribution channels. Future research needs to find answers as to how mediators can make use of user models that support interaction tailored to the knowledge, interests, and preferences of individuals, and community models that facilitate collaboration and effective communication amongst the community members.

If and when users do the final aggregating and editing work themselves, the costs for offering content this way are not high after the initial investment in the tools and metadata have been made. The content must be acquired with terms that allow these kinds of applications.

The strength of commercial media is the know-how and processes for creating, acquiring and packaging content. This is the basis that commercial media providers can use to keep on offering value to their users and customers. Utilising ontologies to make commercial services more intelligent is one opportunity to increase this value. The vocabularies that media companies have relating to their content give good starting points to progress in utilising semantic metadata and Semantic Web technologies. But, as the example of adding semantic information to Wikipedia shows, also the open content may offer such features in the future. Regarding readers and viewers as co-developers and co-producers is a source of new input and ideas for renewing media products and services.

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Published by

Series title, number and report code of publication

VTT Publications 612
VTT–PUBS–612

Author(s)
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Title

Semantically supported media services with user participation
Report on the RISE-project

Abstract

This publication presents the main results of the project "Rich Semantic Media for Private and Professional Users" (RISE). Semantic Web technologies. The goal was to study what kind of new opportunities Semantic Web technologies, semantic metadata and combining commercial media content with user-created material give to media companies and their suppliers for product and service development. The publication gives an overview on recent developments relating to utilising user-generated content and metadata in public Web applications, and an update on relevant developments on Semantic Web technologies related issues.

The project chose to explore research issues by building prototypes. Each of the prototypes is presented including a user scenario, implementation, results, discussion and future work: The *StorySlotMachine* is travelling related application, which allows users to make their own guidebooks and travel stories. Ontologies are used for automatic aggregation and to offer content that deals with the topic. The *Remix Engine* prototype is a Web-based video editing and compilation application that lets the user combine his or her own media with commercial media with the help of pre-made templates. *DiMaS* is The Digital Content Distribution Management System for multimedia producers to publish their work on P2P file sharing networks. Producers can insert content metadata, manage intellectual property and usage rights, and to charge for the consumption.

Applications like StorySlotMachine and RemixEngine could most easily be built when the material is already modular. Commercial media must be able to offer more value to the users than free services and utilising ontologies in making services more intelligent is one opportunity. Other opportunities lie in giving room to user activity and creativity. There are still challenges for building this kind of services, such as maintaining ontologies and adding semantic metadata to the content. Also legal issues like commercialisation of the content creation activity, intellectual property rights, the brand image of the content or the group, and managing the liability risks in content production need to be solved.

Keywords

semantic media, collaborative media, media services, metadata, user-generated content, Web applications, ontologies, participatory media, prototypes, Semantic Web

ISBN
951–38–6857–5 (soft back ed.)
951–38–6858–3 (URL: http://www.vtt.fi/publications/index.jsp)

Series title and ISSN			Project number
VTT Publications 1235–0621 (soft back ed.) 1455–0849 (URL: http://www.vtt.fi/publications/index.jsp)			1254
Date August 2006	Language English, Finnish abstr.	Pages 99 p.	Price B
Name of project RISE		Commissioned by Tekes, Alma Media, Profium, SanomaWSOY & Yle	

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Julkaisija

Julkaisun sarja, numero ja raporttikoodi

VTT Publications 612
VTT–PUBS–612

Tekijä(t)
Bäck, Asta, Vainikainen, Sari, Näkki, Pirjo, Reti, Tommo, Sarvas, Risto, Seppälä, Lassi, Hietanen, Herkko & Turpeinen, Marko

Nimeke

Käyttäjien osallistumista tukevat semanttiset mediapalvelut

Tiivistelmä

Tämä julkaisu esittää RISE-projektin (Rich Semantic Media for Private and Professional Users) keskeisimmät tulokset. Tutkimuksen tavoitteena oli selvittää, millaisia uusia mahdollisuuksia semanttisen webin teknologiat, semanttinen metatieto ja kaupallisen ja käyttäjien tuottaman sisällön yhdistäminen tarjoavat uusien tuotteiden ja palvelujen kehittämiseen mediataloille ja niiden järjestelmätoimittajille. Julkaisussa on yhteenveto näiden alueiden viimeaikaisesta kehityksestä siltä osin kuin näillä on liittymäpinta projektissa tehdylle sovelluskehitykselle.

Projektissa kehitettiin kolme ohjelmistoprototyyppiä. Näistä jokaisesta esitetään käyttäjäskenaario, sovelluskehitys, tulokset, johtopäätökset ja jatkokehitys. *StorySlotMachine* (Matkamasiina) on matkailuun liittyvä sovellus, jonka avulla käyttäjät voivat tehdä omia matkaoppaita ja matkakertomuksia. Ontologioita hyödynnetään sisältöjen koostamisessa ja eri aihepiireihin liittyvien sisältöjen tarjoamisessa käyttäjien toimista saatavien vihjeiden perusteella. *Remix Engine* on verkkopohjaisen videoeditorin prototyyppi. Sen avulla käyttäjä voi yhdistää itse tuotettua mediaa kaupalliseen mediaan valmiiden mallien pohjalta. *DiMaS* (Digital Content Distribution Management System, digitaalisen sisällön jakelun hallintajärjestelmä) antaa monimedian tekijöille mahdollisuuden julkaista töitään P2P-vertaisverkoissa. Tekijä voi tallentaa mukaan sisällöstä kertovaa metatietoa, hallita tekijän- ja käyttöoikeuksia ja laskuttaa käytöstä.

Matkamasiinan ja Remix Enginen kaltaiset sovellukset ovat helpoiten toteutettavissa modulaarisessa muodossa olevan aineiston yhteyteen. Kaupallisen median tulee pystyä tarjoamaan lisäarvoa – yksi mahdollisuus on tehdä palveluista älykkäämpiä ontologioita hyödyntäen. Tilaa tulee myös antaa käyttäjien aktiivisuudelle ja luovuudelle. Haasteita liittyy mm. ontologioiden ylläpitämiseen ja semanttisen metatiedon lisäämiseen sisältöihin. Myös lainsäädännölliset asiat, kuten yksityisen sisältötuotantotoiminnan kaupallistuminen, tekijänoikeudet, sisällön tai ryhmän tuoteimago ja sisältöihin liittyvät vastuukysymykset, pitää ratkaista.

Avainsanat
semantic media, collaborative media, media services, metadata, user-generated content, Web applications, ontologies, participatory media, prototypes, Semantic Web

ISBN
951–38–6857–5 (nid.)
951–38–6858–3 (URL: http://www.vtt.fi/publications/index.jsp)

Avainnimeke ja ISSN	Projektinumero
VTT Publications 1235–0621 (nid.) 1455–0849 (URL: http://www.vtt.fi/publications/index.jsp)	1254

Julkaisuaika	Kieli	Sivuja	Hinta
Elokuu 2006	Englanti, suom. tiiv.	99 s.	B

Projektin nimi	Toimeksiantaja(t)
RISE	Tekes, Alma Media, Profium, SanomaWSOY & Yle

Yhteystiedot	Myynti
VTT PL 1000, 02044 VTT Puh. vaihde 020 722 111, faksi 020 722 7052	VTT PL 1000, 02044 VTT Puh. 020 722 4404, faksi 020 722 4374

Electronic media is profoundly changing the media landscape and consumption patterns. Digital cameras and mobile phones as the creation tools and Internet as a publishing channel have let people take a more active role in their media consumption. In the technical front, Semantic Web Technologies give new opportunities to create richer user experience with more intelligent Web applications.

This publication presents the main results of the project "Rich Semantic Media for Private and Professional Users" (RISE). The two-year project was part of a technology programme "Interactive Computing Technology Programme" (FENIX) run by the Finnish Funding Agency for Technology and Innovation (Tekes). The project explored the opportunities that user-created content and Semantic Web Technologies give to creating new media services. Three prototypes were developed to study these issues: StorySlotMachine, Remix Engine and DiMaS. Semantic metadata, modular content and tools for combining user-created and commercial media content give new opportunities to offering media services with rich user experience.

Tätä julkaisua myy

VTT
PL 1000
02044 VTT
Puh. 020 722 4404
Faksi 020 722 4374

Denna publikation säljs av

VTT
PB 1000
02044 VTT
Tel. 020 722 4404
Fax 020 722 4374

This publication is available from

VTT
P.O. Box 1000
FI-02044 VTT, Finland
Phone internat. +358 20 722 4404
Fax +358 20 722 4374

ISBN 951–38–6857–5 (soft back ed.)
ISSN 1235–0621 (soft back ed.)

ISBN 951–38–6858–3 (URL: http://www.vtt.fi/inf/pdf/)
ISSN 1455–0849 (URL: http://www.vtt.fi/inf/pdf/)