BUILDING SCALEABLE AND SMART MULTIMEDIA APPLICATIONS ON THE SEMANTIC WEB

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ABSTRACT

In the design and implementation of Semantic Web multimedia applications (SWMA), real-world requirements have not yet been widely addressed. This work contributes to building scaleable and smart SWMA. Regarding scalability and expressivity, three main areas are researched: (i) processing of metadata sources on the RDF-level, (ii) formal representation of multimedia vocabularies, and (iii) multimedia metadata deployment issues.

1. MOTIVATION

The cornerstones of using multimedia metadata (M3) on the Semantic Web has been extensively researched [1]. While certain issues, as interoperability, etc. have been addressed, the practical utilisation of M3 on the Semantic Web w.r.t. scalability and expressivity is still neglected. Studer et.al. [2] recently claimed a *challenge w.r.t. the expressivity-scalability trade-off of reasoning over declarative knowledge*. Existing Web applications handling millions of multimedia assets are starting to take advantage of Semantic Web technologies [3].

2. ENVIRONMENT & REQUIREMENTS

As the target environment for utilising a M3 format in our context is the Semantic Web, we first give an interpretation of the Semantic Web stack as depicted in Fig. 1. We differentiate between information primarily targeting at human users (eg., a video in a Web page), and information primarily targeting at software agents, such as metadata about the video. The research described herein focuses on the latter type of information, taking into account requirements stemming from the Semantic Web.

While on the one hand expressivity is defined relatively sharp, the term scalability is used to address a range of issues in different domains. The challenge is to combine M3 formats and Semantic Web languages regarding both expressivity and scalability.

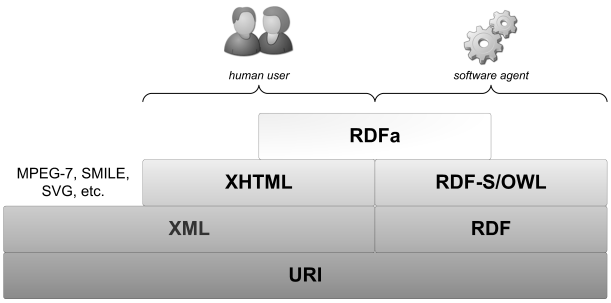

Fig. 1. The Semantic Web Stack in the context of this work.

In order to describe multimedia assets, a language has to meet a range of requirements:

- The **granularity of the description**. An audio clip might for example be described globally in terms of genre or there might be a detailed description of the wave shape, etc. for a certain time period;
- The required **inferential capabilities** of the system influence the choice of the representation. If only simple queries are expected, a simple metadata format might be sufficient. Advanced retrieval operations usually require logic-grounded languages.
- The **usage of the metadata** affects the overall scalability behaviour. Here, the main concern is that of the deployment of the metadata (embedded in the content or referenced from it).

3. CONTRIBUTIONS

Firstly, an analysis of practical problems stemming from past projects has been performed [4]. For three identified areas appropriate solutions have been proposed:

3.1. Processing Metadata Sources

Regarding processing of metadata sources on the RDF-level, we found that when building a SWMA, the question how the triples of a virtual RDF graph are produced is crucial. We have looked at variables that influence the performance and scalability of a SWMA, and proposed a performance and scalability metric for virtual RDF graphs [5] . Along with the metric, a showcase implementing the metric has been made available[1]. We have recently demonstrated how to apply good practices in building a Semantic Web application [6], accepted for demonstration at the Semantic Web Challenge 2007.

3.2. Formal Representation of a M3 Format

Today's M3 formats (as MPEG-7, Exif, etc.) are typically not grounded in formal languages. Semantic Web languages based on RDF are regularly utilised to resolve interoperability issues, and to formalize the domain of interest, but typically do not offer multimedia content description facilities. Though MPEG-7 is well-suited for representing low-level features, such as colour, etc., it fails to support sound inferential services [7]. OWL, on the other hand is expressive, but lacks native support for temporal descriptions, etc.

For a closed domain we have shown that it is feasible to map low-level features to logical entities [8]. Applying the principle of subsidiary by utilising ontologies and rules yields an effective and efficient retrieval. Further, this work has been applied [9] in the 'New Millennium, New Media' (NM2) project; a project focusing on the production of non-linear, interactive movies.

3.3. M3 deployment

We have identified a shortcoming in deploying M3 formats on the Semantic Web. Consequently, we have proposed a solution allowing to deploy M3 formats for Semantic Web agents in a scaleable and non-disruptive way. The author has—together with other multimedia metadata researchers—launched the RDFa-deployed Multimedia Metadata (ramm.x)[2] initiative [10] to address this issue. This work was accompanied by the author's activities in the W3C Multimedia Semantics Incubator Group (2006/2007), and the Semantic Web Deployment Working Group (ongoing).

4. CONCLUSION & ACKNOWLEDGEMENTS

When taking practical limitations and requirements into account, it is possible to develop scaleable and smart SWMA. In this work we have shown how to address real-world issues w.r.t. expressivity and scalability.

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[1] http://sw.joanneum.at:8080/psimeter/

[2] http://sw.joanneum.at/rammx/

5. REFERENCES

[1] M. Hausenblas, S. Boll, T. Bürger, O. Celma, C. Halaschek-Wiener, E. Mannens, and R. Troncy, "Multimedia Vocabularies on the Semantic Web," W3C XGR, W3C Multimedia Semantics Incubator Group, 2007.

[2] R. Studer, A. Ankolekar, P. Hitzler, and Y. Sure, "A semantic future for ai," *IEEE Intelligent Systems*, vol. 21, no. 4, pp. 8–9, 2006.

[3] S. Ortiz, "Searching the Visual Web," *Computer*, vol. 40, no. 6, pp. 12–14, 2007.

[4] T. Bürger and M. Hausenblas, "Why Real-World Multimedia Assets Fail to Enter the Semantic Web," in *International Workshop on Semantic Authoring, Annotation and Knowledge Markup (SAAKM07)*, Whistler, Canada, 2007.

[5] M. Hausenblas, W. Slany, and D. Ayers, "A Performance and Scalability Metric for Virtual RDF Graphs," in *3^{rd} Workshop on Scripting for the Semantic Web (SFSW07)*, Innsbruck, Austria, 2007.

[6] M. Hausenblas and H. Rehatschek, "mle: Enhancing the Exploration of Mailing List Archives Through Making Semantics Explicit," in *Semantic Web Challenge 2007 at the 6^{th} International Semantic Web Conference(ISWC07)*, Busan, South Korea, 2007.

[7] R. Troncy, W. Bailer, M. Hausenblas, P. Hofmair, and R. Schlatte, "Enabling Multimedia Metadata Interoperability by Defining Formal Semantics of MPEG-7 Profiles," in *1^{st} International Conference on Semantics And digital Media Technology (SAMT'06)*, Athens, Greece, 2006, pp. 41–55.

[8] M. Hausenblas, "Applying Media Semantics Mapping in a Non-linear, Interactive Movie Production Environment," in *1^{st} International Conference on New Media Technology (iMedia07)*, Graz, Austria, 2007.

[9] M. Hausenblas and F. Nack, "Interactivity = Reflective Expressiveness," *IEEE MultiMedia*, vol. 14, no. 2, pp. 1–7, 2007.

[10] M. Hausenblas and W. Bailer, "RDFa-deployed Multimedia Metadata (ramm.x)," Specification, ramm.x Working Group, 2007.