

## Chapter 87

# Context-Aware Presentation of Linked Data on Mobile

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### ABSTRACT

*In this paper the authors focus on context-aware adaptation for linked data on mobile. They split up the problem in two sub-questions: how to declaratively describe context at RDF presentation level, and how to overcome context imprecisions and incompleteness when selecting the proper context description at runtime. The authors answer their two-fold research question with PRISSMA, a context-aware presentation layer for Linked Data. PRISSMA extends the Fresnel vocabulary with the notion of mobile context. Besides, it includes an algorithm that determines whether the sensed context is compatible with some context declarations. The algorithm finds optimal error-tolerant subgraph isomorphisms between RDF graphs using the notion of graph edit distance and is sublinear in the number of context declarations in the system.*

### INTRODUCTION

Semantic Web mobile applications might not have built-in assumptions about the schemas of the data they consume, as data models could be unknown a-priori, and provided by heterogeneous sources: users might consume any type of data, as long as it is relevant to their context (Schraefel & Rutledge, 2010). To improve the effectiveness of Linked Data consumption, content adaptation must be adopted, i.e. the process of selecting, generating, or modifying content units in response to a requested URI<sup>1</sup>. Essential in the mobile Web, such process is driven by the multifaceted notion of *client context* (Dey, 2001). Content adaptation reduces the fan-out of RDF entities, and provides coherent information by using context as a dynamic filter. Furthermore, it orders, groups, and formats triples, thus creating “optimized” content units ready for user consumption.

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This paper addresses the question of *how to enable context-aware adaptation for Linked Data consumption*. We split up the problem in two sub-questions: i) *how to model context for Linked Data presentation* and ii) *how to deal with context imprecision to select proper presentation metadata at run-time*. Modelling context-aware presentation concepts for Linked Data needs a proper ontology that fills the gap between traditional context ontologies and the Web of Data (e.g. support for future extensions, adoption of a lightweight vocabulary instead of a vast, monolithic context ontology, etc.). The selection of presentation metadata is complicated by a series of constraints: first, the intrinsic imprecision of context data determines the need for an error-tolerant strategy that takes into account possible discrepancies between context descriptions and actual context. Second, this error-tolerant mechanism must support heterogeneous context dimensions (e.g. location, time, strings). Third, since the procedure must run on the client-side - to avoid disclosing sensitive context data - we must design a mobile-friendly algorithm, with acceptable time and space complexity. Finally, the adopted strategy must support runtime updates of RDF graphs, as context descriptions might be fetched from remote repositories and added to the selection process at runtime, and the sensed context may change at any time.

Our contribution is PRISSMA, a context-aware presentation framework for Linked Data. PRISSMA answers our two-fold research question with the following contributions: i) a vocabulary for describing context conditions, compatible with Fresnel (Pietriga, Bizer, Karger, & Lee, 2006), and ii) an error-tolerant subgraph matching algorithm that determines whether the sensed context is compatible with context declarations. The paper is organized as follows: first we survey state-of-the-art presentation-level frameworks for the Semantic Web. We also provide an overview of error-tolerant matching techniques for RDF. We hence proceed with describing the design principles of PRISSMA, and we introduce the PRISSMA vocabulary. We explain the error-tolerant selection algorithm and provide experimental evaluation results. We present PRISSMA Browser, a proof-of-concept mobile application adopting PRISSMA, and we conclude by discussing the limitations of our approach and future work.

## RELATED WORK

The Haystack platform UI (Ozone), as well as Noadster and Xenon are early works targeting RDF presentation, but they do not support multiple media (Huynh, Karger, & Quan, 2002; Quan & Karger, 2005; Rutledge, Ossenbruggen, & Hardman, 2005). Gandon's Surrogates focus on UI representations of SPARQL queries over RDF repositories (Gandon, 2005). Although it supports multimodality, binaries are not available online. Champin's Tal4RDF, and Auer et al.'s LESS are template languages for textual output of RDF (Auer, Doehring, & Dietzold, 2010; Champin, 2009). They do not adopt standard Semantic Web languages. Dadzie et al present a template-based visualization framework for Linked Data (Dadzie, Rowe, & Petrelli, 2011). The proposal takes into account user context, but only in a hardwired, implicit manner. Fernéandez et al. propose a formal Linked Data Visualization Model, LDVM (Fernéandez, Auer, & Garcia, 2012). They focus on visualizing data from large-scale RDF datasets, without being domain-dependent. Binaries are not available online. More importantly, as shown in Figure 1a, none of the existing presentation frameworks for Linked Data fully supports context awareness. Fresnel (Pietriga et al., 2006) is a rendering engine for RDF built on the assumption that data and its related schema do not carry sufficient information for representing triples, hence it provides additional presentation-level

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