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Digital Library Interoperability,  
Best Practices and Modelling Foundations

## Interoperability best practices and solutions: The DL.org Cookbook

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## Outline

- What a Technology and Methodology Cookbook is expected to be
- An Interoperability Framework
- What the Cookbook is now

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## DL.org Digital Library Technology and Methodology Cookbook

- **Scope**
  - a **portfolio** of **best practices** and **pattern solutions** to common issues faced when developing large-scale **interoperable** Digital Library systems
  - organised in **patterns**, i.e. standard, well-recognized or proven solutions to DL development problems
  - each pattern is characterized by
    - a **context**, a situation giving rise to a problem
    - a **problem**, the recurring problem arising in that context
    - a **solution**, a proven resolution of the problem
    - an **assessment**, a qualitative evaluation of the approach
- **Release schedule**
  - RFC version (October 2010)
  - Final version (February 2011 -> ...)

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## DL.org The interoperability monster

- A companion in any system build as "collection" of existing constituents
  - in G. Anthes, "Happy Birthday, RDBMS!", CACM, Vol. 53(5), May 2010
    - "... integration of heterogeneous data. "A special case that is still really hard is schema mapping – converting data from one format to another," ... "It sounds straightforward, but it's very subtle."
    - "... the "unsolved problem" of querying geographically distributed databases"
- An ever hot topic, e.g. the Digital Agenda for Europe
- Some **thoughts on Interoperability** (by courtesy of Y. Ioannidis, DL Foundations 2008)
  - Is it difficult?
    - yes it is, it is (almost) impossible
  - Is it about content/functionality?
    - it is about content, functionality, user, policy, quality and architecture, it is about (almost) everything
  - What kind of job is it?
    - dirty but **critical**
    - broad but **partitionable**
    - complex but **fun**
    - will never be solved but **must be solved even approximately**

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## Cookbook motivations and challenges

- A lot of solutions exists / are developed
  - lack of systematic approach
  - scarce knowledge of “others” solutions
    - “let’s not to reinvent the wheel”
- Provide an **organised, pragmatic, comprehensive** and **effective** description of ways to attack the interoperability monster
- Challenges
  - scope (almost everything)
  - partitioning schema (per domain vs. cross-domain)
  - multidisciplinary nature (beyond technology)

\*\*\* an **unifying interoperability framework** is needed \*\*\*


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## Interoperability Framework

- Three main aspects has to be captured:
  - *interoperability scenario*, i.e. a setting where interoperability takes place
  - *interoperability issue*, i.e. a problem hindering an interoperability scenario
  - *interoperability solution*, i.e. an approach aiming at removing an interoperability issue in the context of an interoperability scenario


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## Interoperability Framework (cont.)

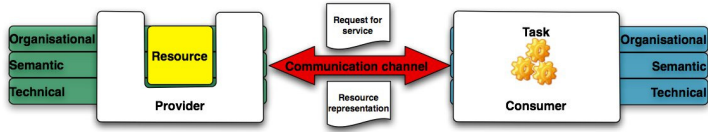
- A plethora of interoperability definitions
- Starting point “*the ability of two or more systems or components to exchange information and to use the information that has been exchanged*” (IEEE, 1990)

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## Interoperability Framework (cont.)

- Rephrasing and elaborating
  - at least two entities *Provider* and *Consumer*
  - willing to “share” a *Resource* to perform a *Task* (has preconditions)
  - through a *Communication Channel*, involving a protocol and information representation
  - across *Organisational*, *Semantic* and *Technical* boundaries of entities



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## Interoperability Framework: focusing on the three key aspects

- **Organizational** deals with **business goals** and **processes** of an entity (Provider or Consumer)
- **Semantic** deals with the **meaning** of the exchanged resource and the rest of information
- **Technical** deals with **technological solution** supporting the operation of the Provider / Consumer as well as the communication among the two
- **Dependencies / constraints among the three boundaries**, e.g. organisational aspects has to be implemented by the technical aspects
- **Implicit / hidden information**, e.g. the technical aspects might implement part of the organisational aspects only
- **Different approaches for diverse boundaries**, e.g. human-centric vs. machine-centric
- **Complete solutions involve all of them**, e.g. the decision to rely on a certain technology might be useless if it is not complemented by proper organisational aspects

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## Interoperability Framework: Issue and Solution

- Interoperability Issue
  - the factor **hindering interoperability** scenario
  - task preconditions are not satisfied
- Interoperability Solution
  - it can be applied under certain conditions
  - if effective it **removes the interoperability issue**
  - it contains a “transformation function” (even in its most abstract case)
- A solution might be “wider” than the issue
  - this is not a problem if its transformation is scenario “safe”

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## Interoperability approaches: Agreement-based

- Include Standard-based approaches
- Infringes autonomy, strong in effectiveness

Consumer-oriented schema

Provider-oriented schema

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## Interoperability approaches: Mediator-based


- An intermediary service linking Provider and Consumer
- Strong in autonomy, development and maintenance cost

Consumer-side schema

Provider-side schema

Third-party schema


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## Interoperability approaches: Blending and Compound solutions

- Combining Agreement-based & Mediator-based approaches, e.g.
  - a Mediator implementing a Standard and complementing it
  - two mediators or two standards form a new solution
- Compatibility issue among solutions
- Alternative solutions
- No solution exist vs for each problem there exists at least a solution


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## The Current Version of the Cookbook

1. Introduction
  - an overview of the document
2. Interoperability Framework
  - a detailed description of the unifying framework
3. Interoperability “Solutions”
  - per domain best practices and solutions
4. Common Interoperability Scenarios
  - “complete” solutions to complex scenarios
5. Conclusions
6. Appendixes (Glossary & Solutions “views”)


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## How is an interoperability solution described?

1. *Overview*  
Context of the proposed approach including pointers to detailed description of it
2. *Requirements*  
Conditions under which the solution might be used
3. *Results*  
Changes resulting from the usage of the solution
4. *Implementation guidelines*  
How the changes are produced
5. *Assessment*  
Qualitative evaluation of the proposed solution


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## Current Solutions Sample

- Content
  - IO publishing (e.g. OAI-PMH, OAI-ORE), metadata (e.g. DublinCore, Europeana, Application Profiles), Identifiers (e.g. DOI), ...
- User
  - User modeling (e.g. GUMO), model conversion (e.g. GUC), AuthN/AuthZ (e.g. OpenID, SAML), ...
- Functionality
  - Interface specification and reconciliation (e.g. WSDL, adapters), behaviour specification and reconciliation (e.g. WS-BPEL, automatic composition)
- Policy
  - almost huge and uncharted territory in DL
  - policy languages (e.g. XACML)
- Quality
  - frameworks (e.g. DAQuinCIS), ontologies (e.g. WS-QoS), guidelines (e.g. DRIVER)
- Architecture
  - Largely overlap with the rest
  - Component profile (e.g. WS-I, WSDL), protocols (e.g. SRU, OpenSearch), ...
- Cross-domain
  - Provenance (e.g. OPM)

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## Cookbook Next Steps

- RFC feedback and contributions (ongoing)
- Cookbook 1.0 Release (February '11 -> ...)
- Beyond DL.org
  - Cookbook wikification (editorial control)
  - Awareness raising

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Thank you

[wiki.dlorg.eu/index.php/Cookbook](http://wiki.dlorg.eu/index.php/Cookbook)

