Towards Semantic Interoperability in an Evolving Environment

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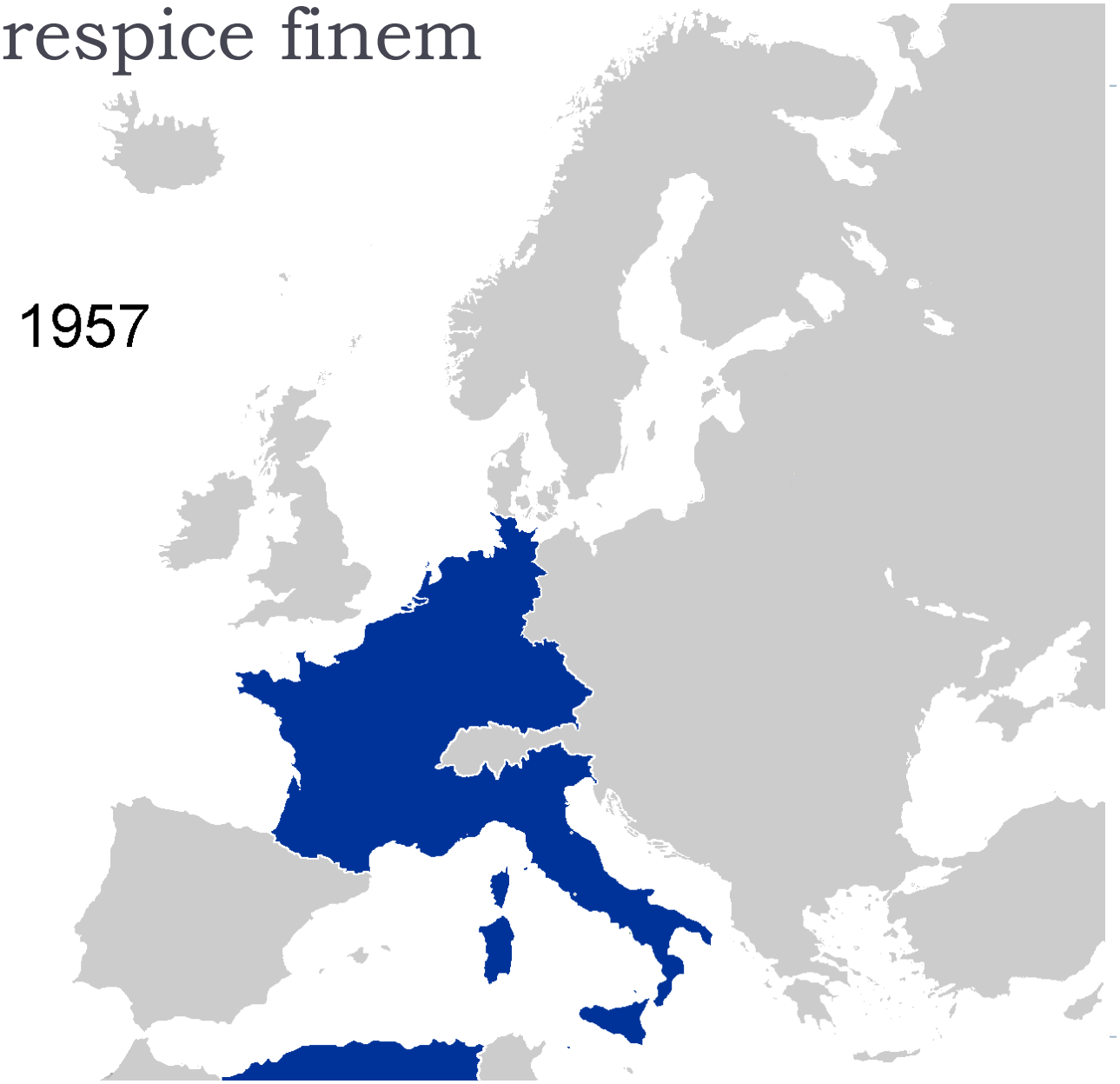


Requirements for Interoperability Support

- Semantic expressiveness
- Operational scalability
- Maintainability

Distributed Information Systems

- Today we have the technique to deploy distributed information systems with affordable setup costs.
  - Web Services: interoperability on the syntactic level.
  - Emerging semantic interoperability (Semantic Web Services).
  - Emerging Approaches for formalizing and modeling distributed workflows.

- Typical problems in enterprise-scale applications:
  - Very high number of data instances
  - Demands for efficient computation → Can be a limiting factor for semantic applications.

Sub-Problem exchange of documents

- In an enterprise scenario one major use-case is the exchange of business documents. Due to evolution the content and meaning of such documents can change.
- Situation today: Transformation of documents with hand-written (tool assisted) scripts (i.e. XSLT).
  - Task of the programmer:
    - Error-prone writing of mapping-scripts that map the syntactic and the semantic level.
- General idea (semi)-automatic transformation between document versions.

Evolution an different levels

Schema change without ontology change

S->S' ; O = O' (Change on the syntactic level)

Example: Rename of XML-tag

Ontology change without schema-change

S->S; O->O' (Change on the semantic level)

Example: Data gets new meaning: ICD-code version, German zip-code in 1993.

Combination of schema and ontology-change

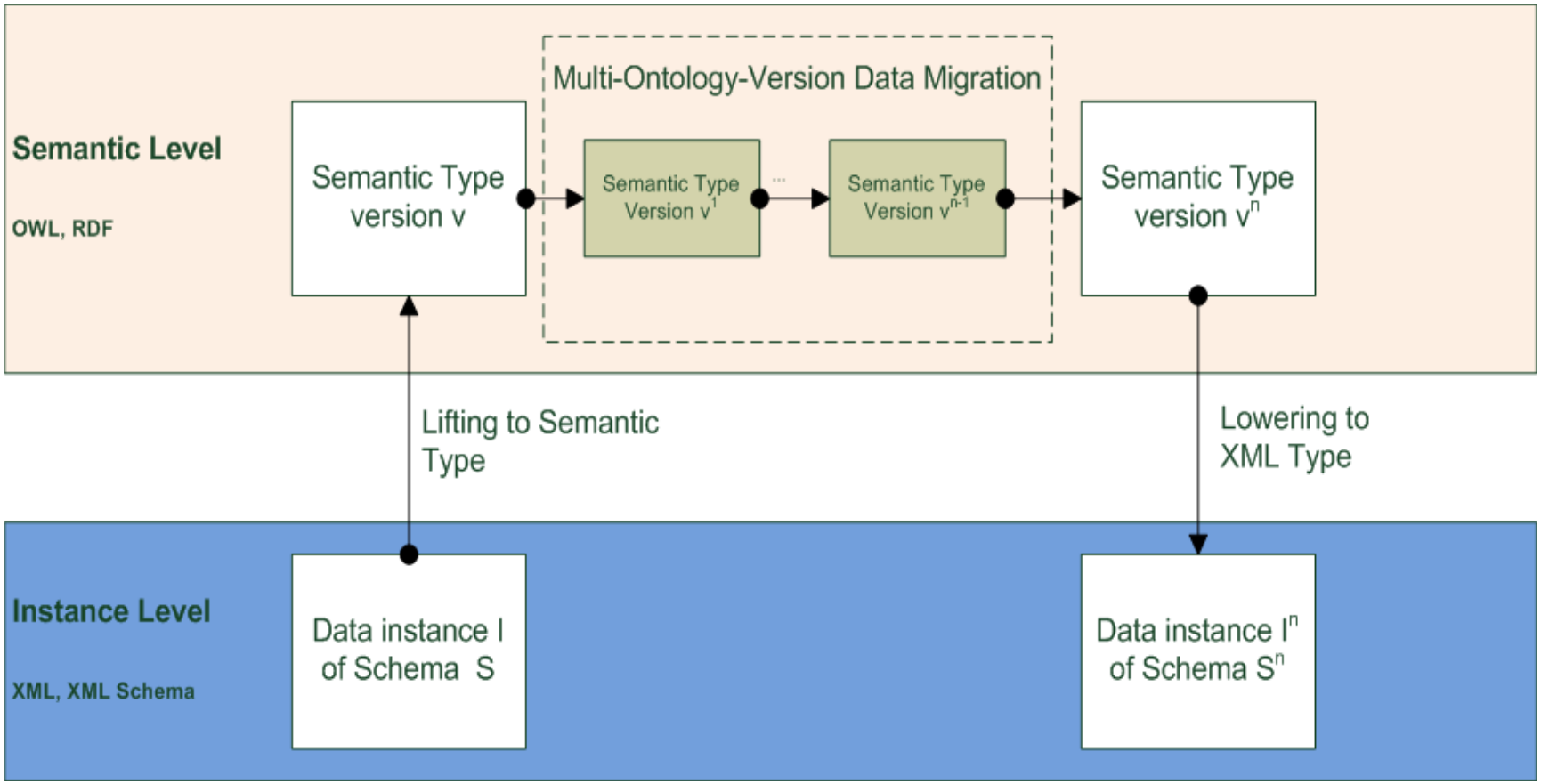
S->S'; O->O' (Changes on both levels)

Often schema-change induced by ontology change.

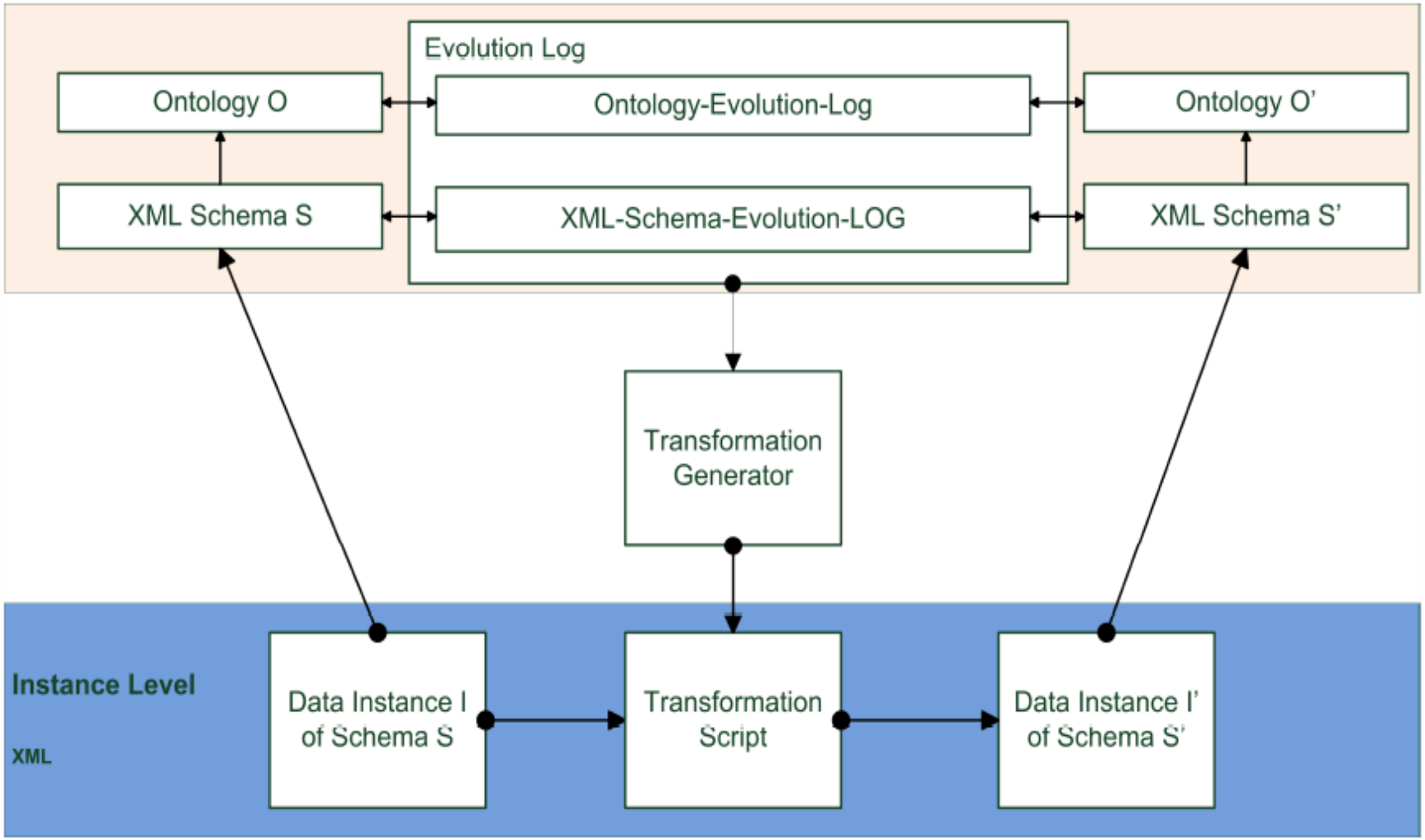
Introduction of a new attribute.

Example: Every invoice must now contain a tax number.

Possible Solution I



Possible Solution 2: Proposed architecture



Scientific Basis for Evolvable Interoperability

- Required expressiveness
  → Ontologies
- Operational scalability
  → Fast document transformers
- Maintainability
  → Ontology Versioning, Knowledge Compilation

Need for (semi-)automatic adoption

1. There is the need for a system or language to record changes in a powerful way.
   - Goal: Automatic computation of the consequences of changes and decisions for adoption.
   - Can possibly be fulfilled by powerful semantic web techniques with reasoning capabilities.
2. Need for a highly effective and efficient transformation system which is scalable to support the high throughput expected in enterprise-scale applications.

- 1 and 2 stay in conflict.

Conclusion:

- Evolution is a major concern in information systems.
- Distributed systems make the problem even more complex.
- There is a need for a system or language to record changes and their consequences in a powerful way. This requires reasoning support.
- Industrial-scale applications require a very high scalability.
- Scalability and Reasoning support stay in conflict.
- We propose "Knowledge Compilation" techniques to overcome this issue.

Possible Solution 1

- Advantages:
  - Full reasoning support for the transformation on the semantic level. Rules can apply on schema and data.
- Enterprise-Scale Applications:
  - Very high number of instance documents
  - Comparably low number of schemata.
- Drawbacks:
  - Computation on the semantic level is supposed to be expensive.
  - The transformation is done for every single instance document.