Automated Generation of Semantic Service Descriptions by Leveraging on Service Governance Models

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Agenda

01 Introduction

02 Related Work

03 Conceptual Design

04 Implementation

05 Evaluation

06 Conclusion

01 Introduction

01 Introduction
Problem Statement

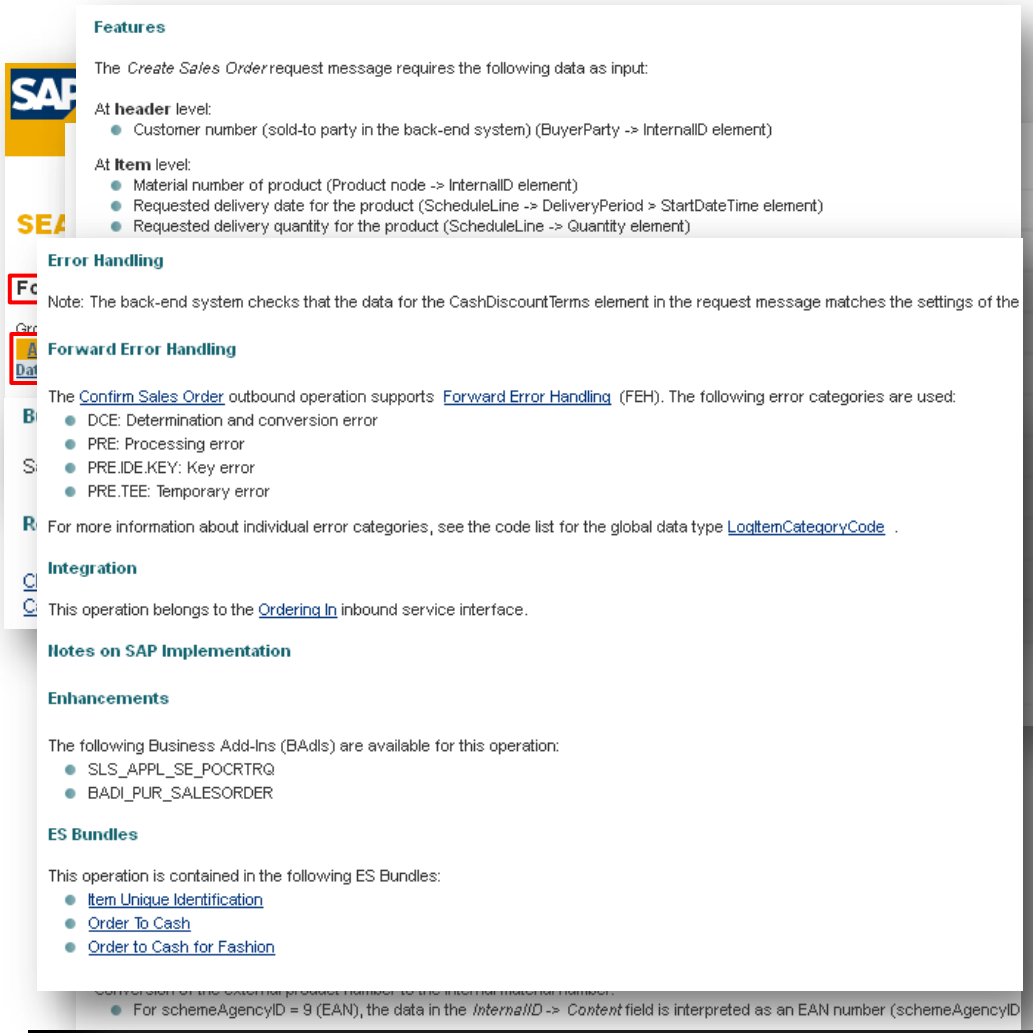
- **Current service management support is insufficient**
  - A lot of services in modern service-based business systems
  - Applied service description models are insufficient (syntactic focus)
    - Additional information is needed
    - Presented in an informal and not machine processable manner
  - Service search & consumption requires a lot of manual intervene

- Existing research and development efforts are not applied in industrial practice
  - Provide sophisticated frameworks for semantic service description
  - ➔ **BUT:** Do not consider the cost-effective creation of semantically enabled service descriptions
  - ➔ Unaffordable to migrate existing service infrastructures to proposed frameworks

01 Introduction

Motivating Example

Service Search via Enterprise Service Workplace



- Necessary: Manual consideration of provided information
- ➔ A lot of manual intervene
- ➔ Require expert knowledge
- Hampers effective use of services

- Need for more sophisticated service descriptions which enables automated processing and more precise query languages

01 Introduction
Solution Approach (1)

Leverage (SOA) Governance Models

- Governance models are organizational structures common in industrial service infrastructures:
  - Definition of patterns and guidelines
  - Ensure compatibility and interoperation
- Quality management process enforce model compliance (governance process)
- Provide a lot of implicit knowledge about organized services
- Enforced compliance enable automated access

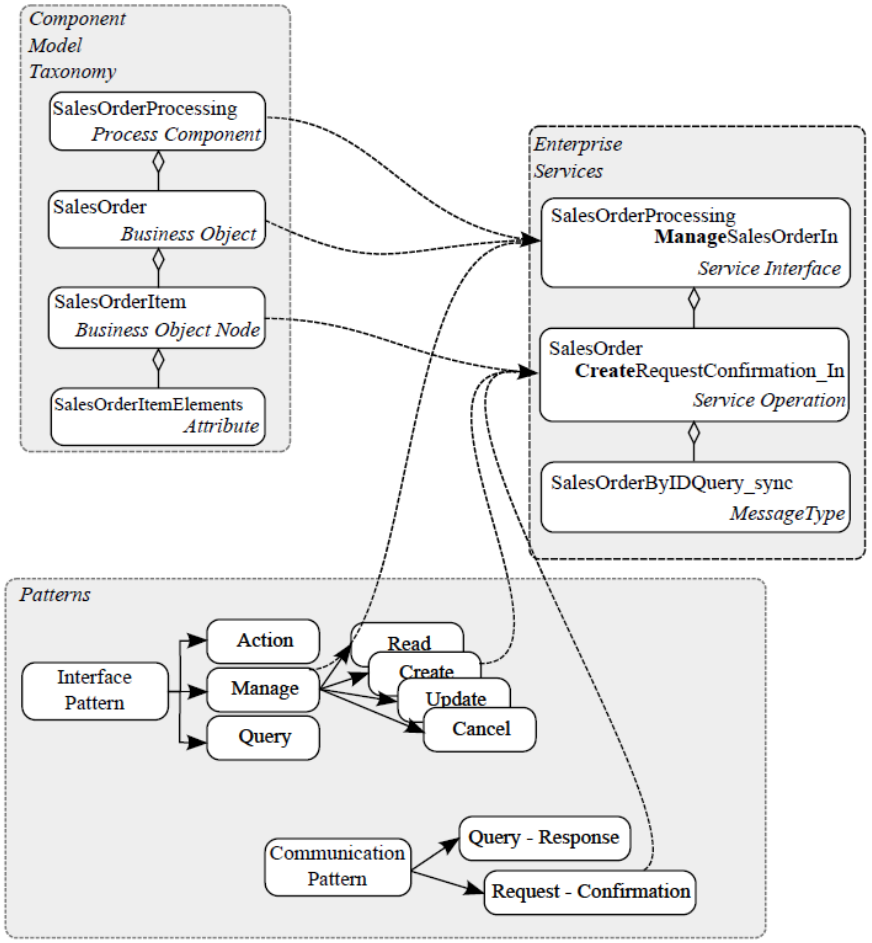


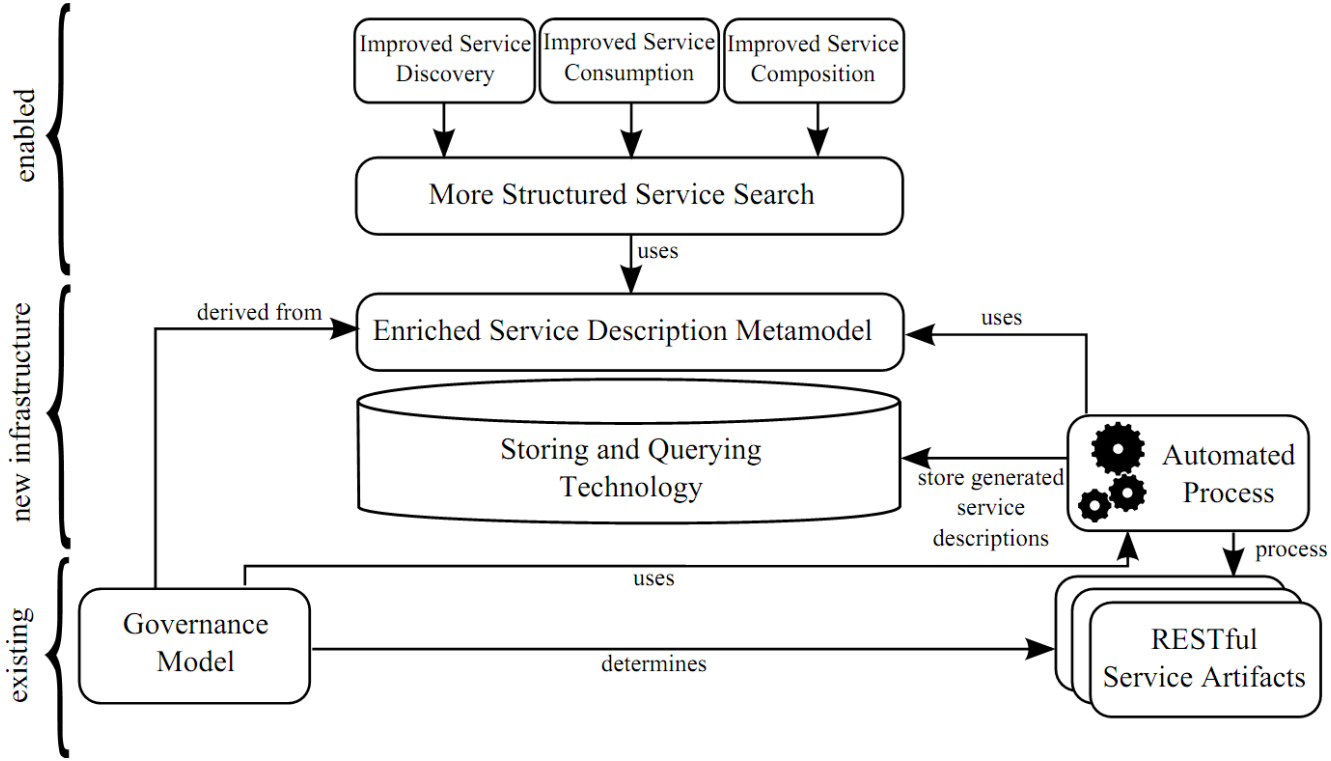
Figure: SOA Governance Model for Enterprise Services

01 Introduction
Solution Approach (2)

Explication of implicit knowledge

Transfer implicit knowledge of Governance Models into explicit representation

- Definition of an appropriate metamodel
- Access and transformation via automated process
- Use of appropriate storage and querying technologies to enable better service management



01 Introduction
Outline

- The presented work provides
  - An infrastructure to create richer service descriptions at **minimal costs**
  - A proof-of-concept implementation for **RESTful services using the OData protocol**

- Outline of remaining presentation
  - Discussion of related work
  - Detailed introduction into conceptual design
  - Short overview about implementation details
  - Presentation of Evaluation results
  - Summary and Conclusion

02 Related Work

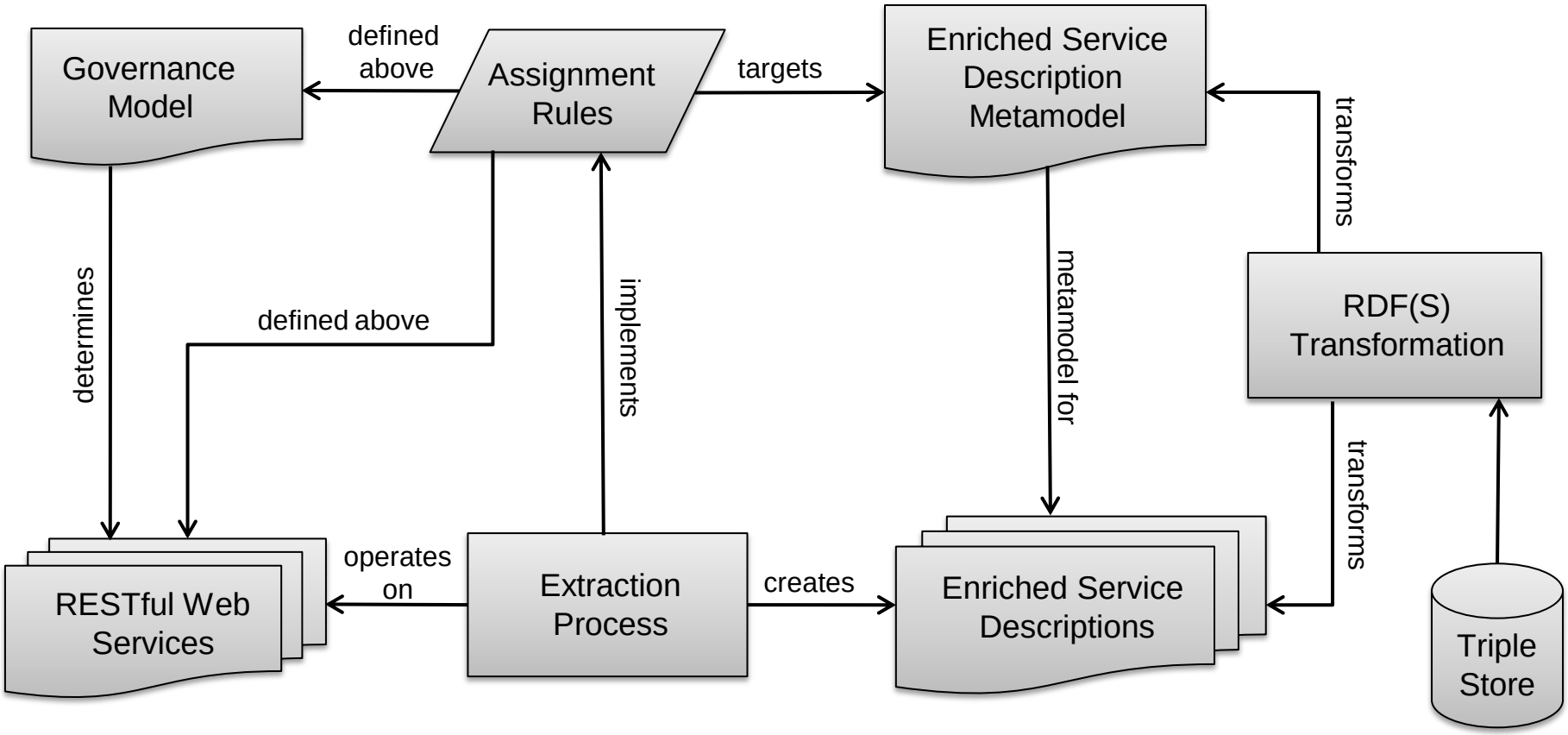
02 Related Work

Requirement	*Candidates*	*Used Technologies*
Enriched Service Description Model	• *Semantic Web Frameworks* (OWL-S, WSMO, SAWSDL) • *Technical Description Models* (WSDL, WADL, OData) • *Business Description Models* (USDL, WS-*)	• SAWSDL • OData • USDL
Representation Language	• XML • RDF • OWL	• RDF
Storage and Querying Facilities	• Relational Data Bases & SQL • Triple Stores & • SPARQL	• Triple Store & SPARQL

02 Conceptual Design

03 Conceptual Design

Top-Level Application Design



03 Conceptual Design

Assignment Rules

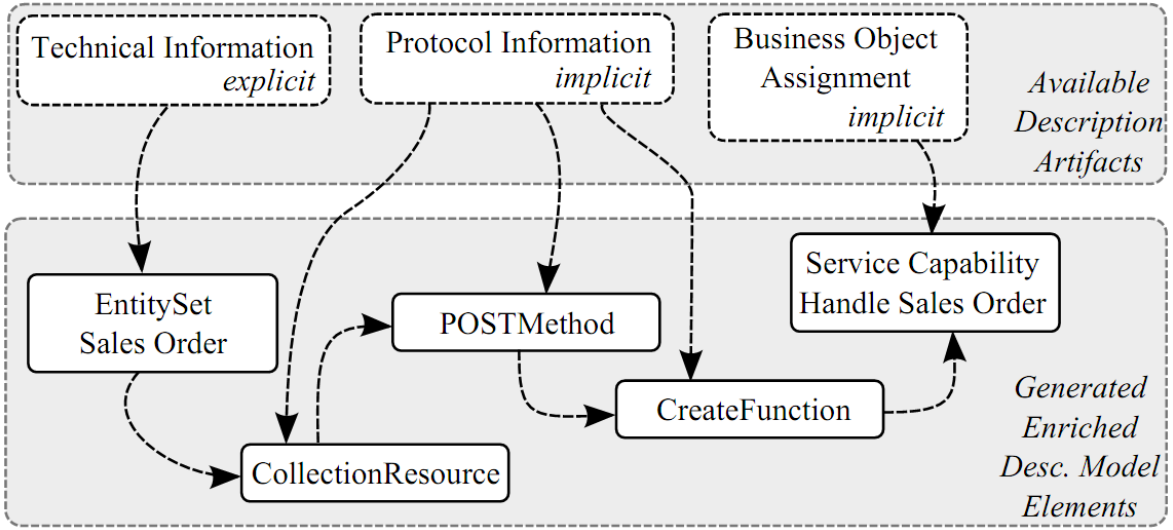
Two types of roles:

- For structured information

Source Artifact *Target Concept*

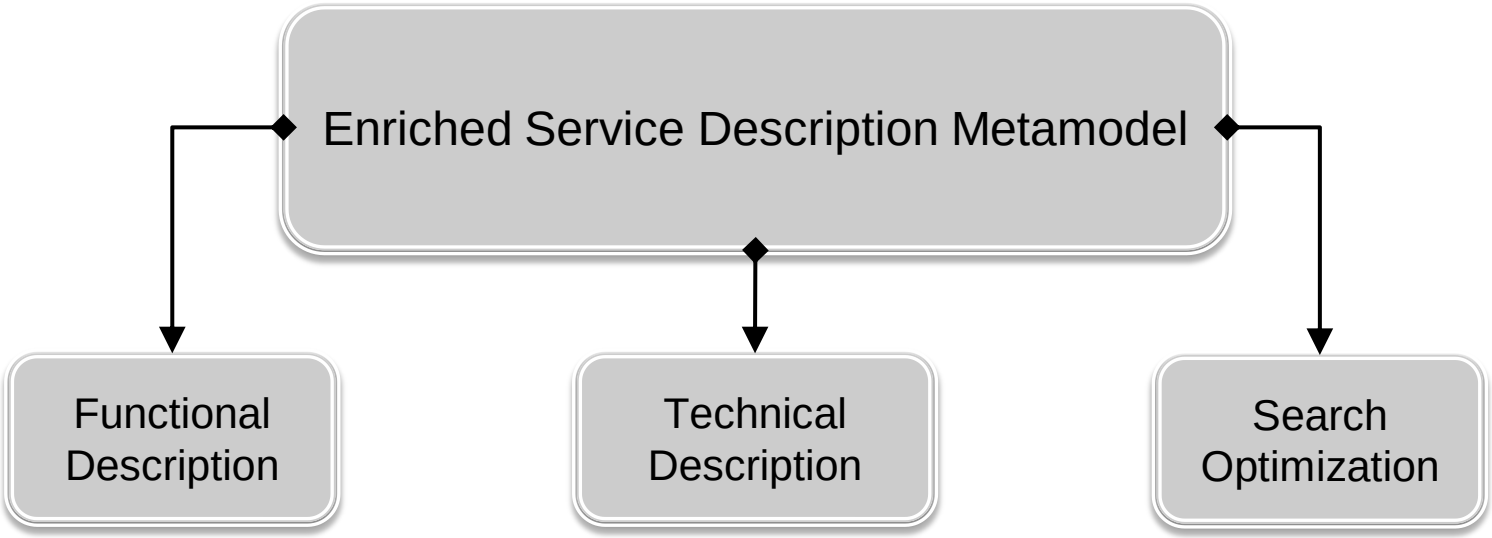
$$\alpha_k(EntityType) = \{EntityType\}$$
$$\alpha_l(EntityType.Name) = \{EntityType.hasName\}$$
$$\alpha_m(EntityType.Property) = \{EntityType.hasProperty\}$$

- For structured information



03 Conceptual Design

Enriched Service Description Model



What does the service do?

- Functionalities
- Capabilities

- Based on USDL (Functional Module)

How to use the service?

- Service resources
- Data types

- Based on OData and USDL (Technical Module)

How can the service search be facilitated?

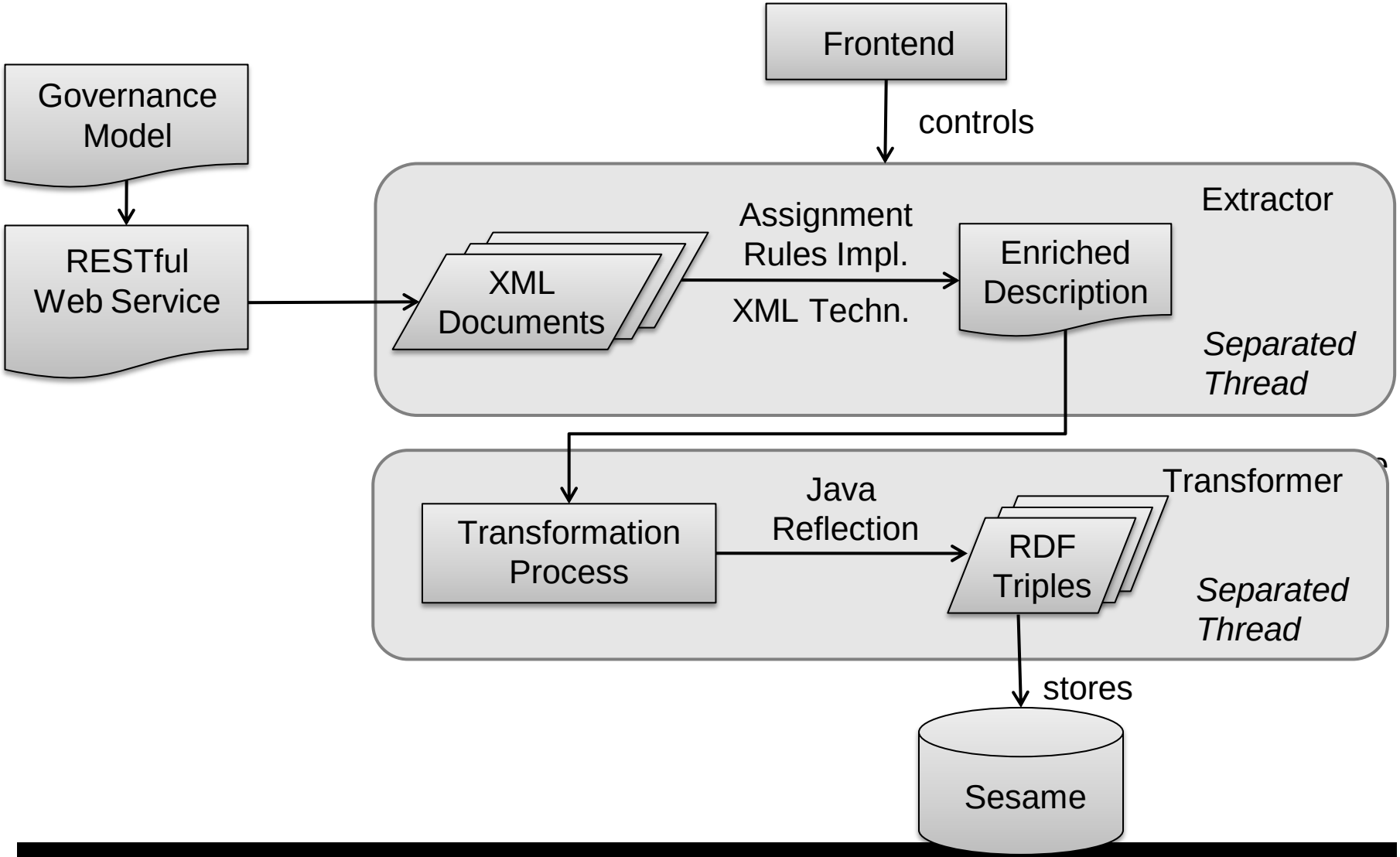
- Resource types
- Applicable (HTTP) methods

- Externalize protocol knowledge

04 Implementation

04 Implementation

Technical Architecture

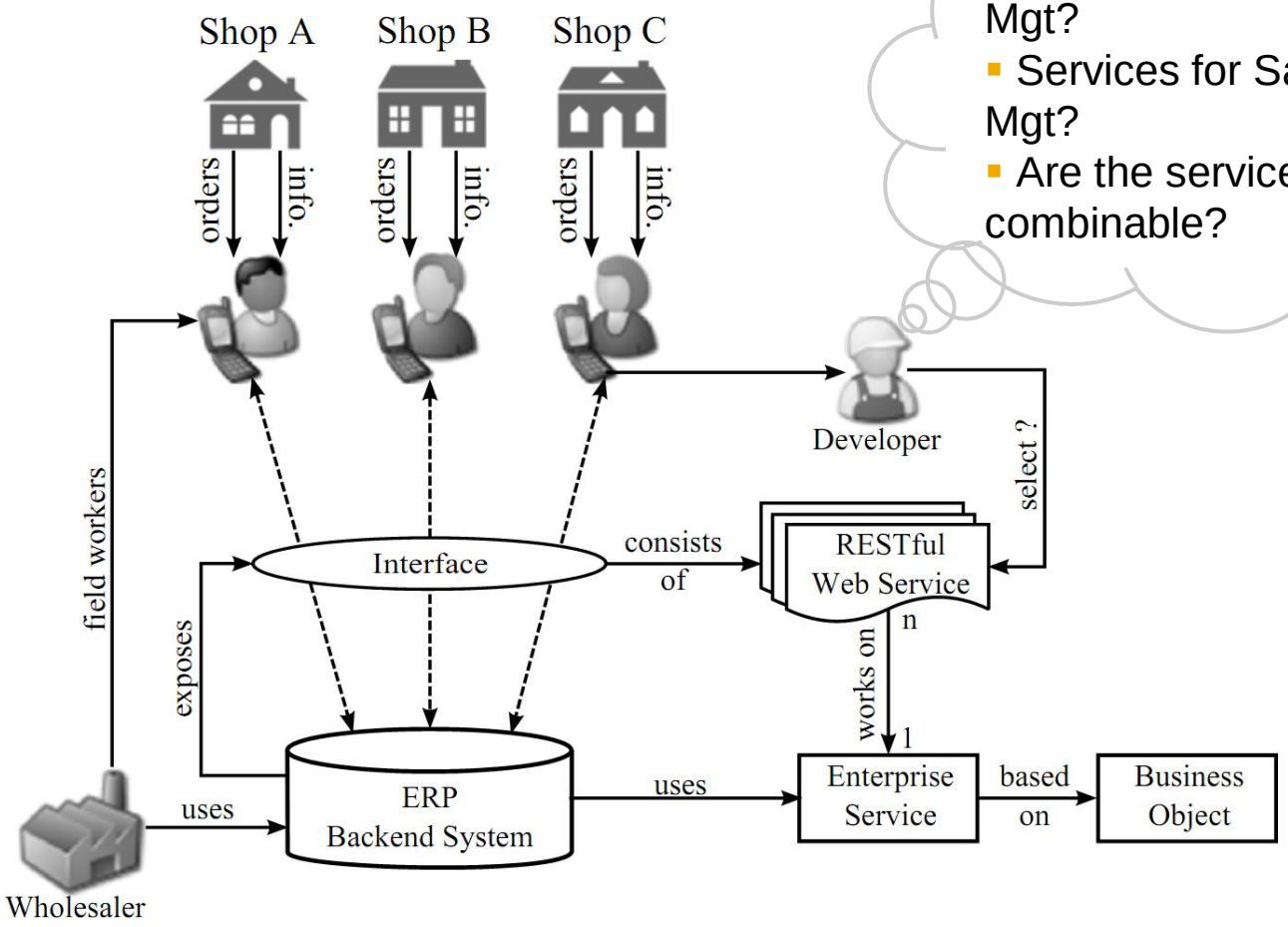


05 Evaluation

05 Evaluation

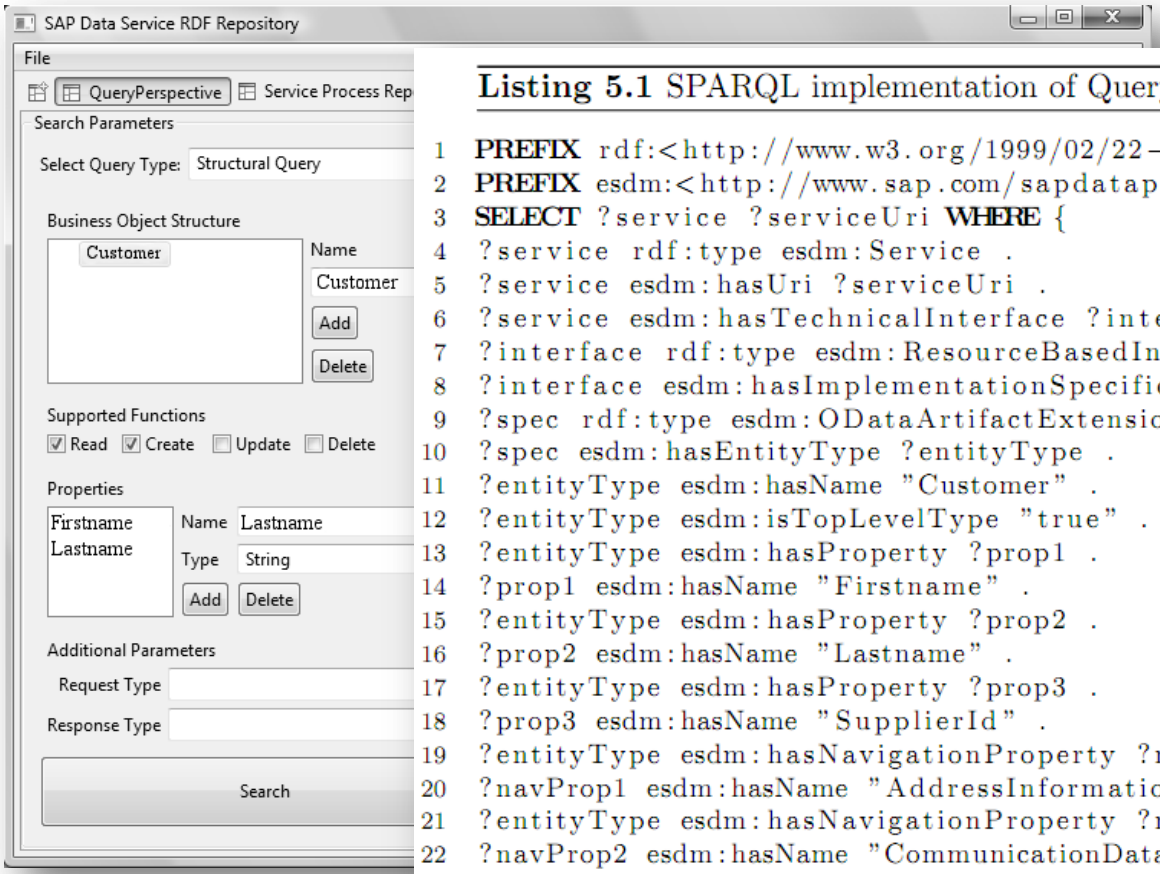
Scenario-based Evaluation (1)

- Services for Customer Mgt?
- Services for Sales Order Mgt?
- Are the services combinable?



05 Evaluation

Scenario-based Evaluation (2)



Listing 5.1 SPARQL implementation of Query1

```
1  PREFIX rdf:<http://www.w3.org/1999/02/22-rdf-syntax-ns#>
2  PREFIX esdm:<http://www.sap.com/sapdataprotocol/rdf-s#>
3  SELECT ?service ?serviceUri WHERE {
4  ?service rdf:type esdm:Service .
5  ?service esdm:hasUri ?serviceUri .
6  ?service esdm:hasTechnicalInterface ?interface .
7  ?interface rdf:type esdm:ResourceBasedInterface .
8  ?interface esdm:hasImplementationSpecification ?spec .
9  ?spec rdf:type esdm:ODataArtifactExtension .
10 ?spec esdm:hasEntityType ?entityType .
11 ?entityType esdm:hasName "Customer" .
12 ?entityType esdm:isTopLevelType "true" .
13 ?entityType esdm:hasProperty ?prop1 .
14 ?prop1 esdm:hasName "Firstname" .
15 ?entityType esdm:hasProperty ?prop2 .
16 ?prop2 esdm:hasName "Lastname" .
17 ?entityType esdm:hasProperty ?prop3 .
18 ?prop3 esdm:hasName "SupplierId" .
19 ?entityType esdm:hasNavigationProperty ?navProp1 .
20 ?navProp1 esdm:hasName "AddressInformation" .
21 ?entityType esdm:hasNavigationProperty ?navProp2 .
22 ?navProp2 esdm:hasName "CommunicationData" .
23 ?entityType esdm:hasNavigationProperty ?navProp3 .
24 ?navProp3 esdm:hasName "MarketingAttribute" .
25 }
```

05 Evaluation

Scenario-based Evaluation (3)

Results

Solution approach provides substantial benefits in comparison to existing technologies

Precise selection of appropriate service

No manual inspection of informal descriptions needed

Complexity of the provided *Enriched Service Description Metamodel* allows different query types:

Search for structural and functional features

Search for semantic service behavior

Support for service composition

05 Evaluation

Performance and Scalability

Test Data Set

	Service Number	Generated Triples	Elapsed Time
SAP Test Services	105	417 175	4h 21s
Scenario Test Services	7	17 513	12 min 44 s
Total	112	434 688	4 h 13 min 5s
Single Service		3882	1min 16s

Results

- **Scalable processing (overall mean: 85.69 ms)**
- **High performance (highest execution time: 239.5 ms)**
- **Reliable results (low standard deviation)**

06 Conclusion

06 Conclusion

Summary and Future Work

Conclusion

- Governance information can be used to achieve richer and more structured service descriptions
- Automated extraction for concrete service allows the creation at minimal costs
- Significantly improved service search and consumption techniques can be supported

Possibilities for Future Work:

- Performance improvements (other triple store, query optimization, SPARQL-to-SQL rewriting)
- Sophisticated frontends
- Framework to integrate other types of governance information and services

Links

Presentation online

PDF and PPT (with animations)

Acknowledgements

This work has been supported and partially funded by the FInest project (FP7 – 285598).

Please refer http://www.finest-ppp.eu/ for further details.

Thank You!

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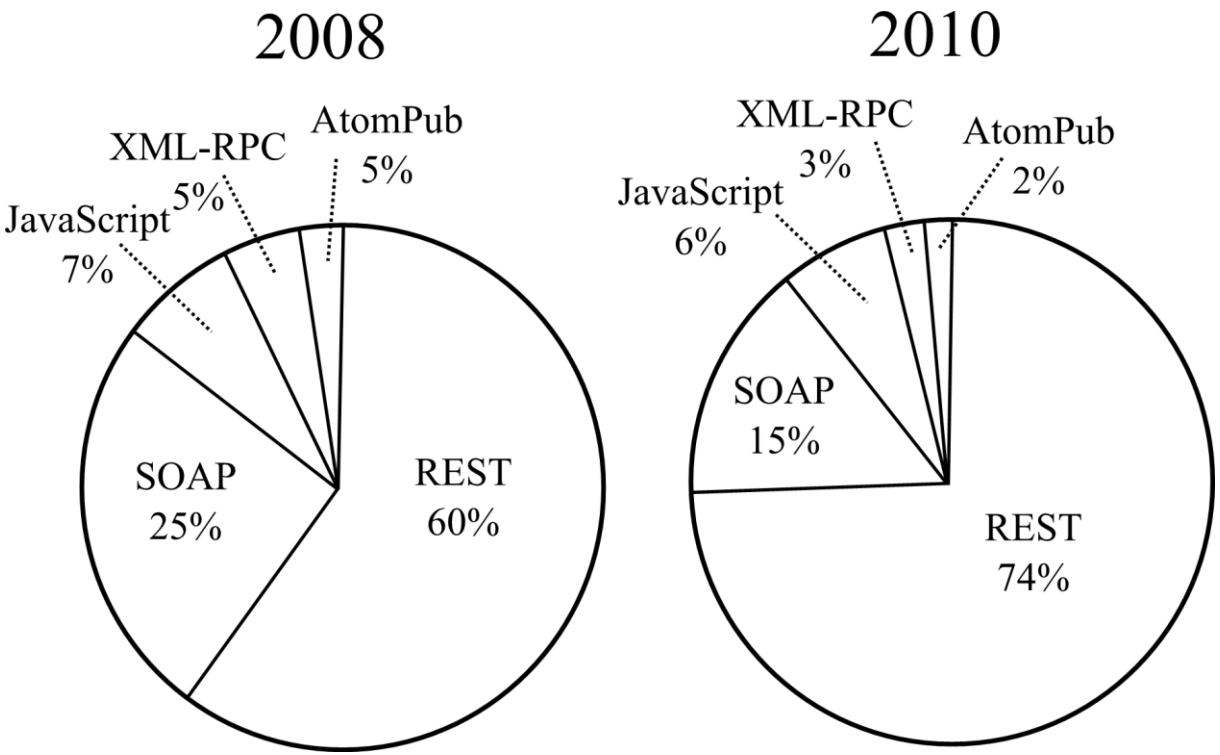
Backup Slides

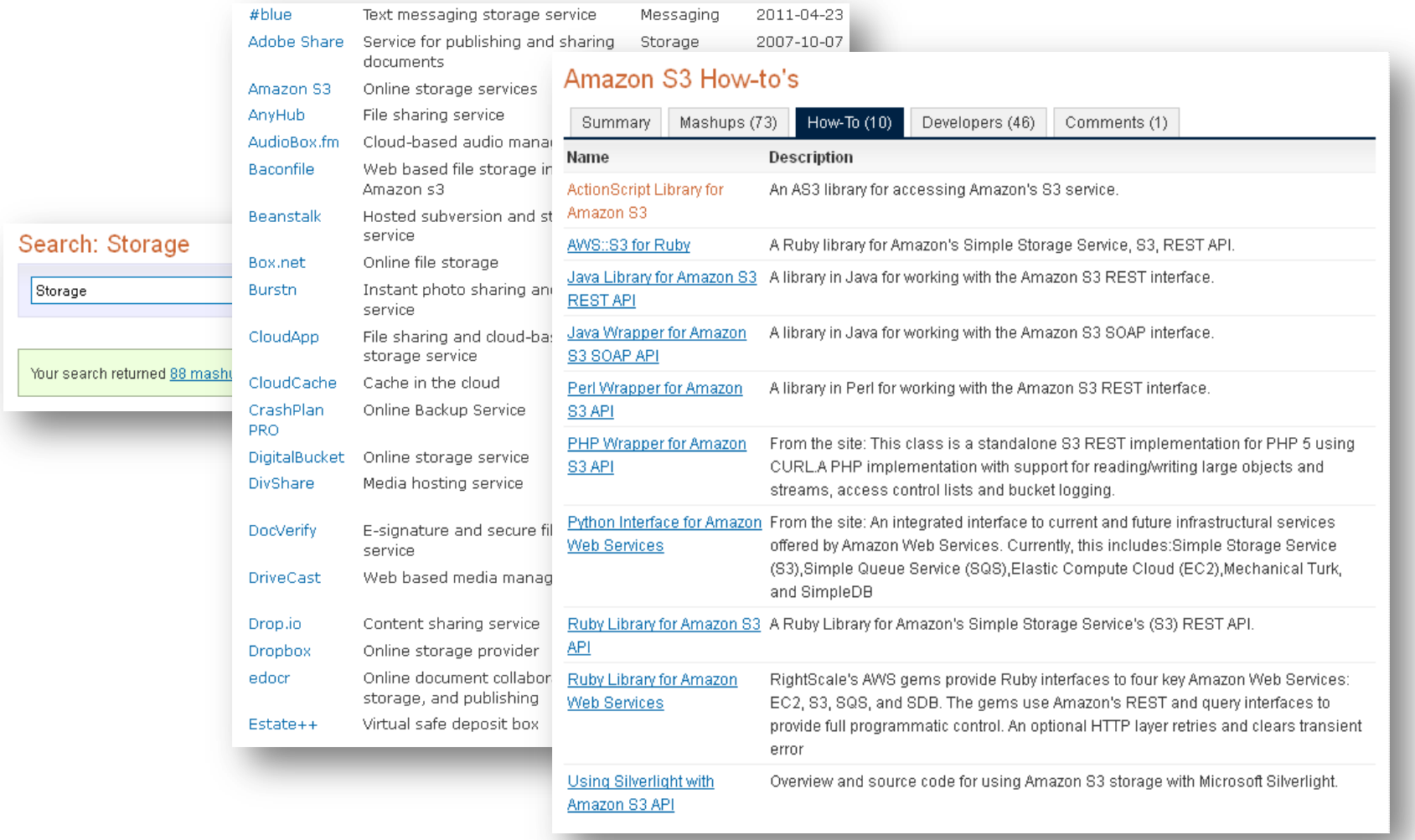
07 Backup

Usage Study RESTful Web Services



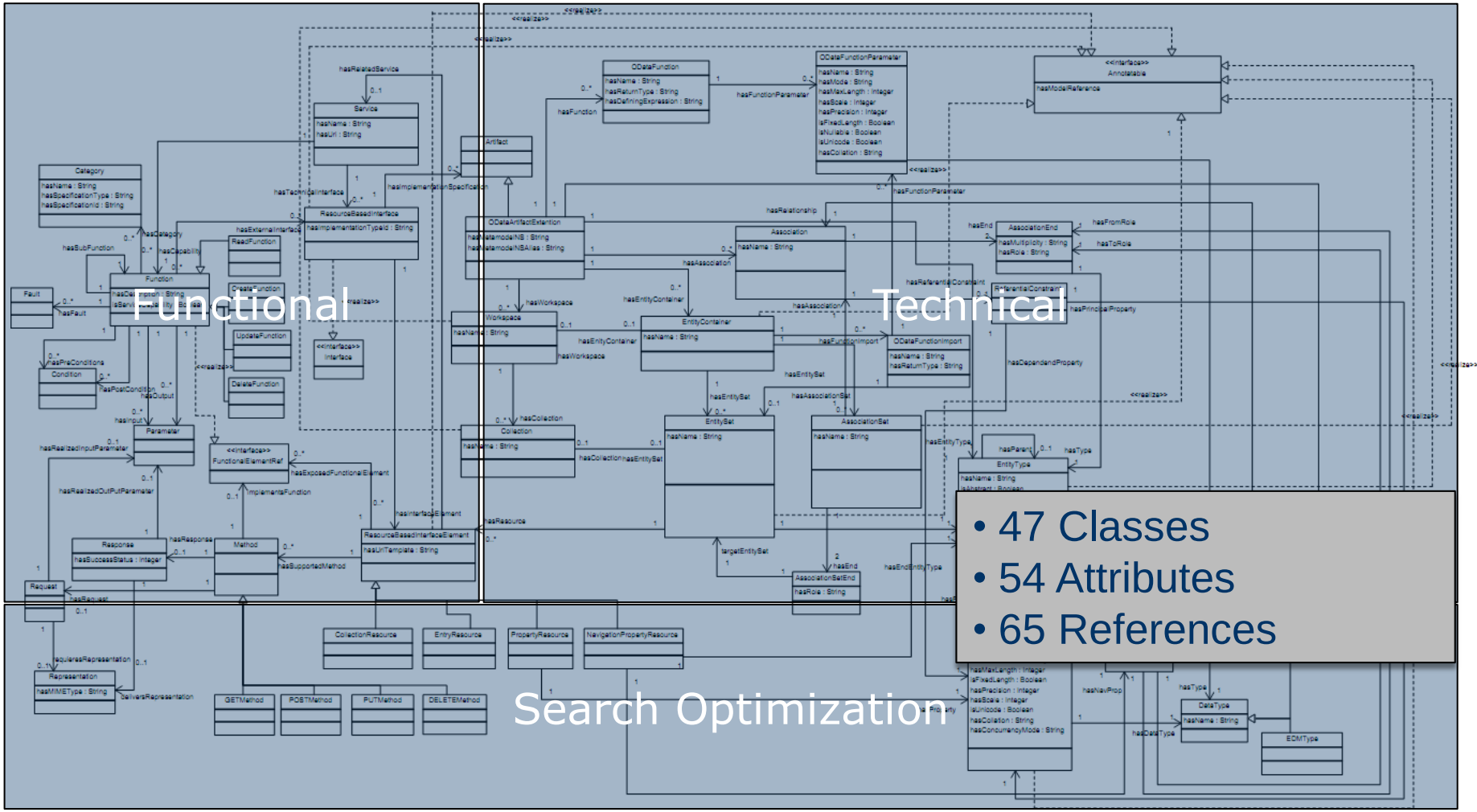
07 Backup

Service Search via ProgrammableWeb.com



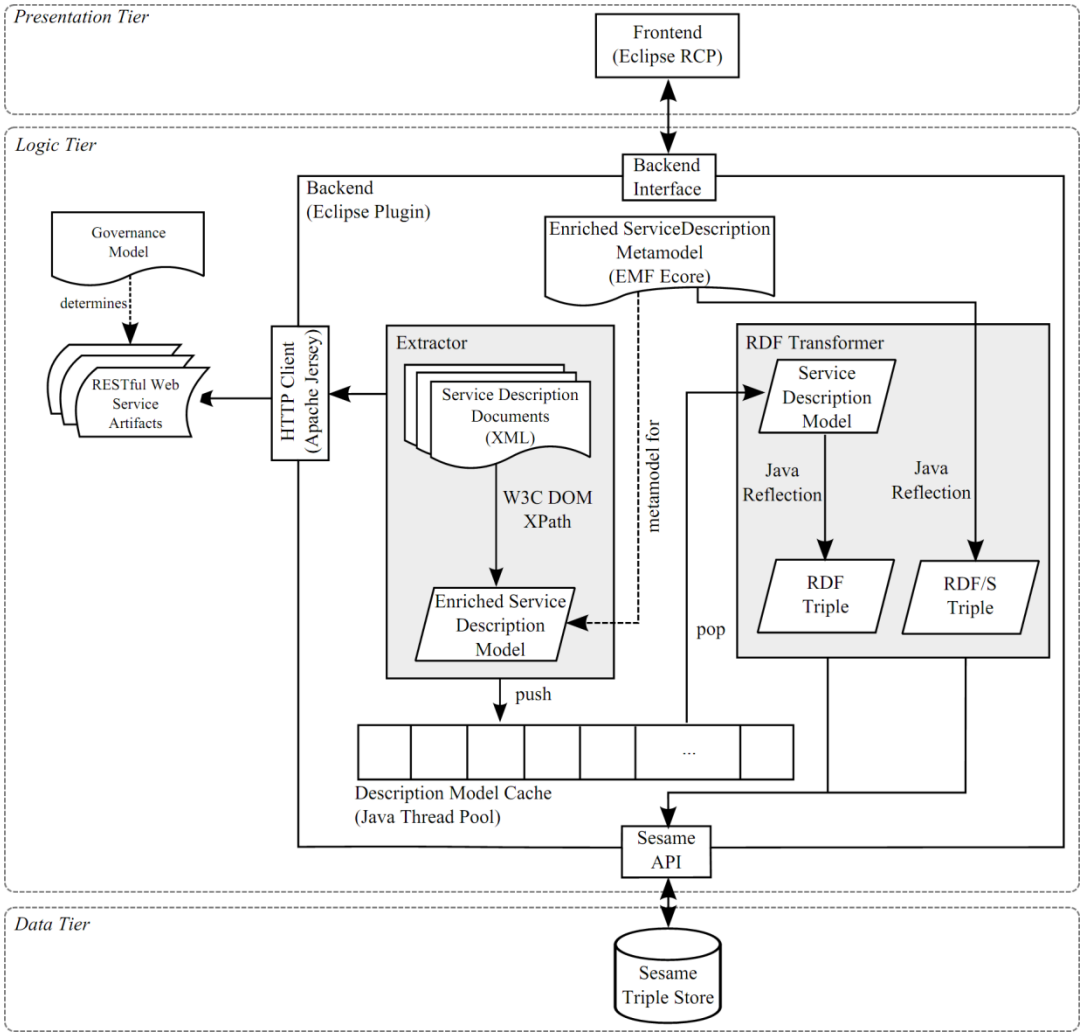
07 Backup

Enriched Service Description Metamodel

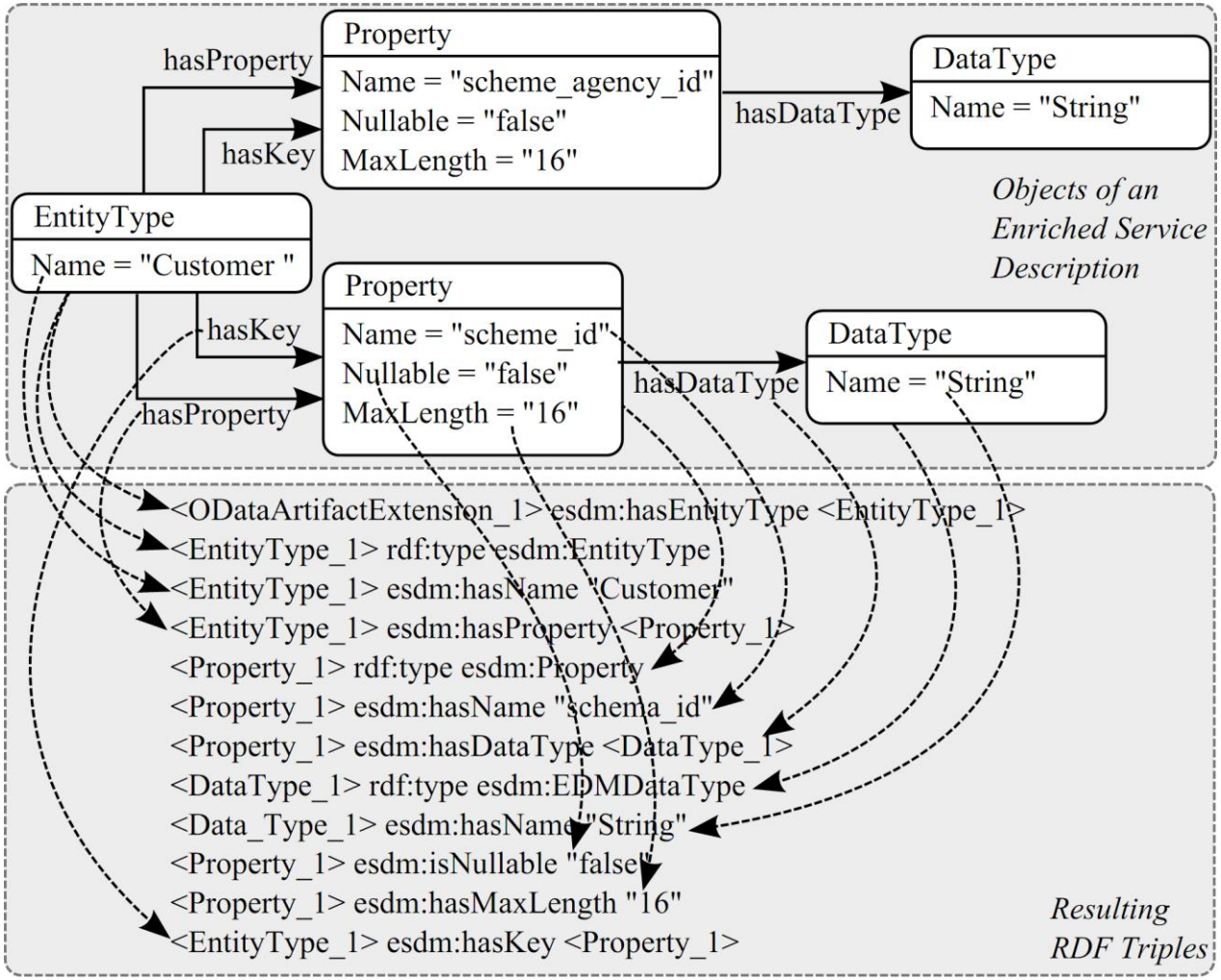


07 Backup

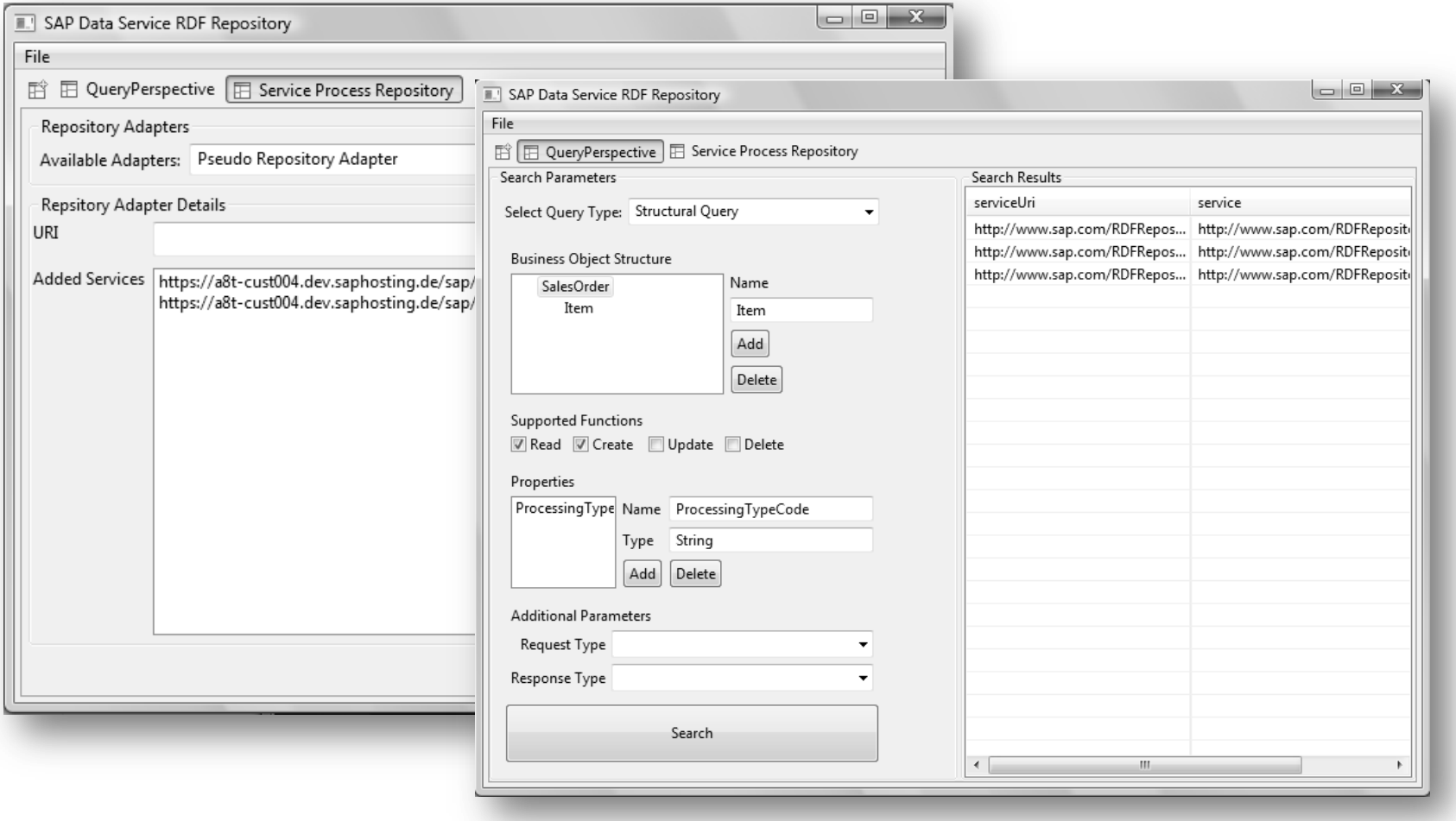
Detailed Technical Architecture



07 Backup
RDF Transformation



06 Backup
Frontend



06 Backup

Quantitative Evaluation

Results

Query No.	Mean μ	Median $\overline{x}$	Std. Deviation σ	Query No.	Mean μ	Median $\overline{x}$	Std. Deviation σ
1	87.4	86.1	6.45 (7.39 %)	7	59.1	56.9	11.14 (18.84 %)
2	122.3	120.0	10.18 (8.33 %)	8	239.5	233.3	21.36 (8.92%)
3 (1)	10.5	9.7	3.49 (33,18 %)	9	12.8	11.2	11,24 (87.94 %)
3 (2)	59.0	57.5	5.32 (9.02 %)	10	66.0	63.3	10.12 (15.33 %)
4	79.6	76.7	13.67 (17.11 %)	11	17.3	14.8	12.75 (73.60 %)
5	87.6	85.9	10.43 (11.90 %)	12	219.1	214.4	16.40 (7.49 %)
6	106.1	102.6	12.68 (11.96 %)	13	33.3	34.6	2.87 (8.38 %)

Overall mean: 85.69 ms

06 Backup

Test Data Set (Quantitative Evaluation)

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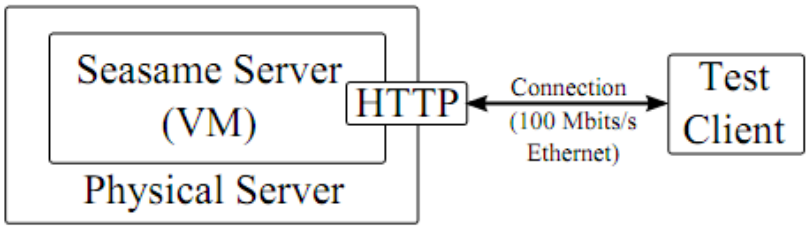
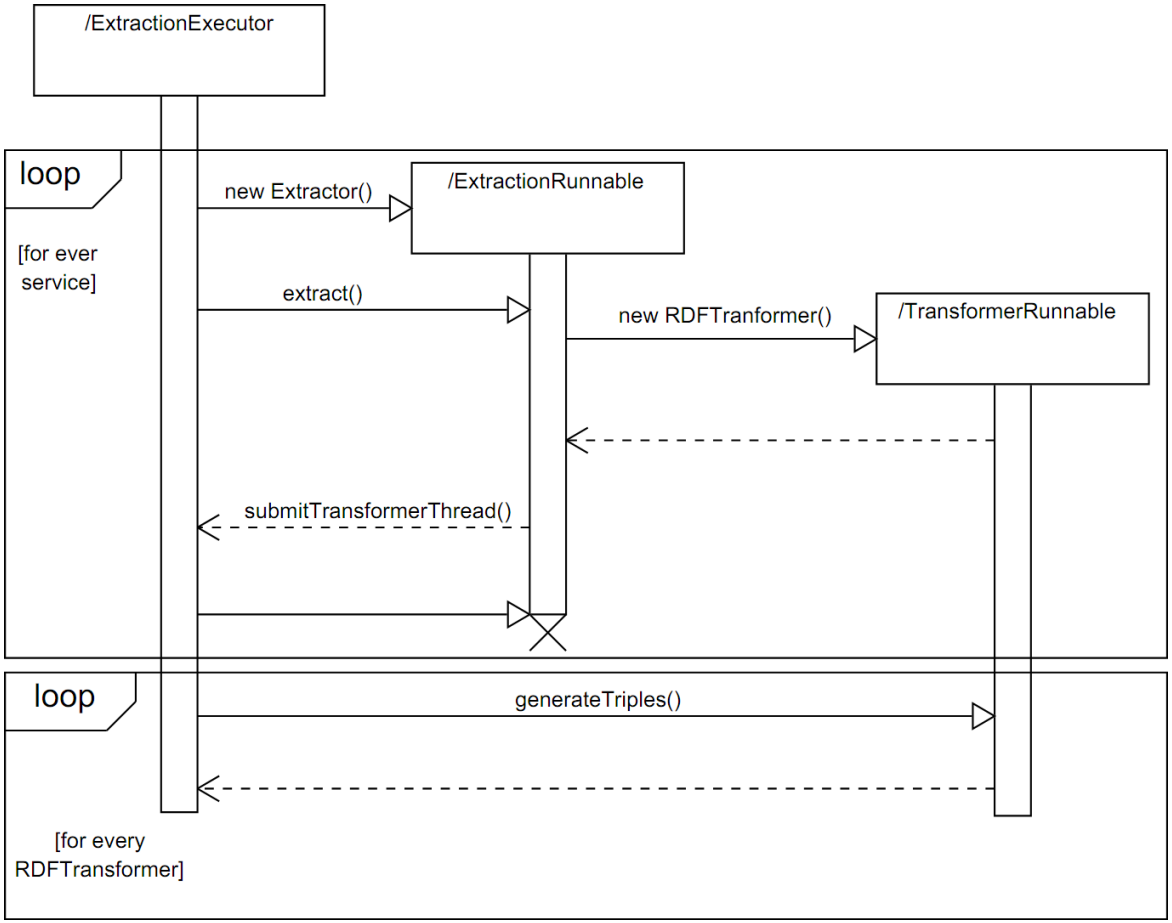


Tests

- Client-Server setupt (real-world aligned)
- Use of 13 Queries from qualitative evaluation
- Each query repeated 100-times for statistically valid results

07 Backup

Interaction Backend Components



06 Backup

Example SPARQL Query

Listing 5.1 SPARQL implementation of Query1

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8  ?interface esdm:hasImplementationSpecification ?spec .
9  ?spec rdf:type esdm:ODataArtifactExtension .
10 ?spec esdm:hasEntityType ?entityType .
11 ?entityType esdm:hasName "Customer" .
12 ?entityType esdm:isTopLevelType "true" .
13 ?entityType esdm:hasProperty ?prop1 .
14 ?prop1 esdm:hasName "Firstname" .
15 ?entityType esdm:hasProperty ?prop2 .
16 ?prop2 esdm:hasName "Lastname" .
17 ?entityType esdm:hasProperty ?prop3 .
18 ?prop3 esdm:hasName "SupplierId" .
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```

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