

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

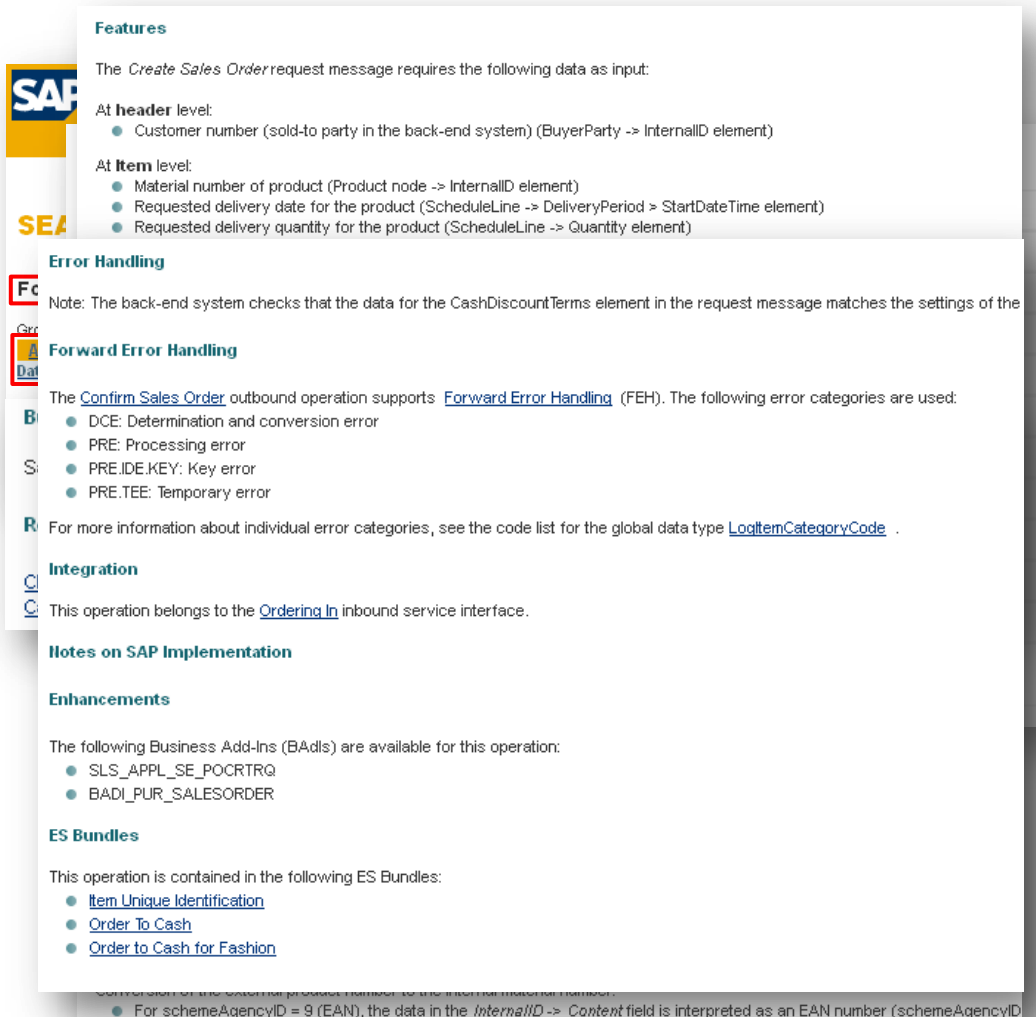
➔ **BUT:** Do not consider the cost-effective creation of semantically enabled service descriptions

➔ Unaffordable to migrate existing service infrastructures to proposed frameworks

01 Introduction

Motivating Example

Service Search via Enterprise Service Workplace



Features

The *Create Sales Order* request message requires the following data as input:

At header level:

- Customer number (sold-to party in the back-end system) (BuyerParty -> InternalID element)

At Item level:

- Material number of product (Product node -> InternalID element)
- Requested delivery date for the product (ScheduleLine -> DeliveryPeriod > StartDateTime element)
- Requested delivery quantity for the product (ScheduleLine -> Quantity element)

Error Handling

Note: The back-end system checks that the data for the CashDiscountTerms element in the request message matches the settings of the

Forward Error Handling

The *Confirm Sales Order* outbound operation supports [Forward Error Handling](#) (FEH). The following error categories are used:

- DCE: Determination and conversion error
- PRE: Processing error
- PRE.IDE.KEY: Key error
- PRE.TEE: Temporary error

For more information about individual error categories, see the code list for the global data type [LogItemCategoryCode](#).

Integration

This operation belongs to the [Ordering In](#) inbound service interface.

Notes on SAP Implementation

Enhancements

The following Business Add-Ins (BAdIs) are available for this operation:

- SLS_APPL_SE_POCTRQ
- BADI_PUR_SALESORDER

ES Bundles

This operation is contained in the following ES Bundles:

- [Item Unique Identification](#)
- [Order To Cash](#)
- [Order to Cash for Fashion](#)

- 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

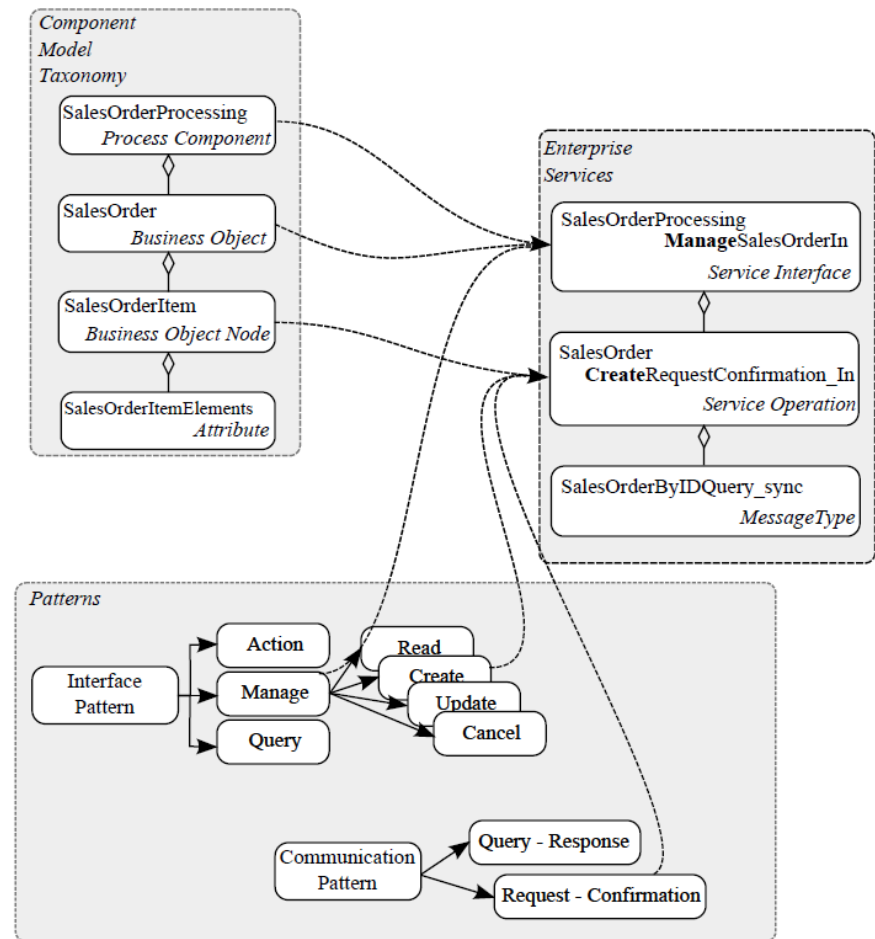


Figure: SOA Governance Model for Enterprise Services

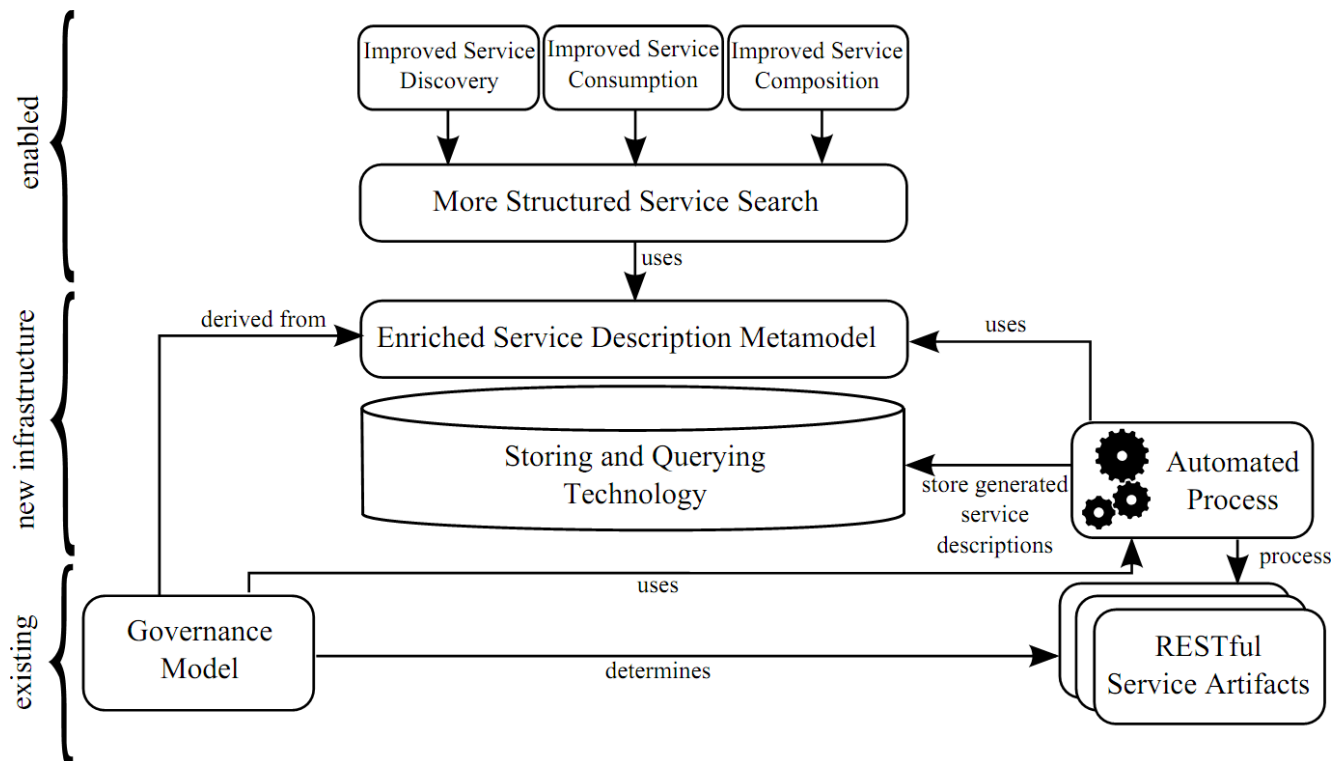
01 Introduction

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

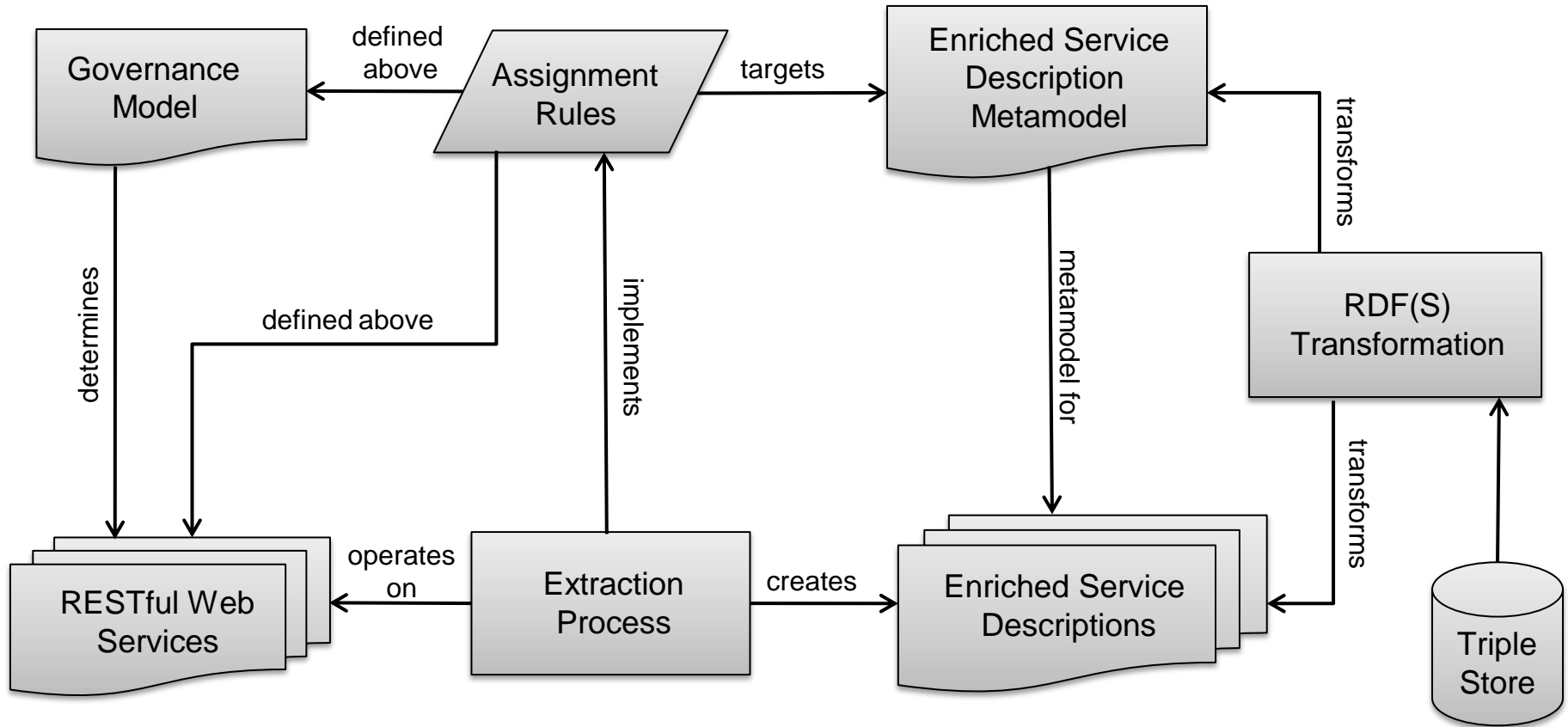
<i>Requirement</i>	<i>Candidates</i>	<i>Used Technologies</i>
<i>Enriched Service Description Model</i>	<ul style="list-style-type: none">• <i>Semantic Web Frameworks</i> (OWL-S, WSMO, SAWSDL)• <i>Technical Description Models</i> (WSDL, WADL, OData)• <i>Business Description Models</i> (USDL, WS-*)	<ul style="list-style-type: none">• SAWSDL• OData• USDL
<i>Representation Language</i>	<ul style="list-style-type: none">• XML• RDF• OWL	<ul style="list-style-type: none">• RDF
<i>Storage and Querying Facilities</i>	<ul style="list-style-type: none">• Relational Data Bases & SQL• Triple Stores &• SPARQL	<ul style="list-style-type: none">• 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

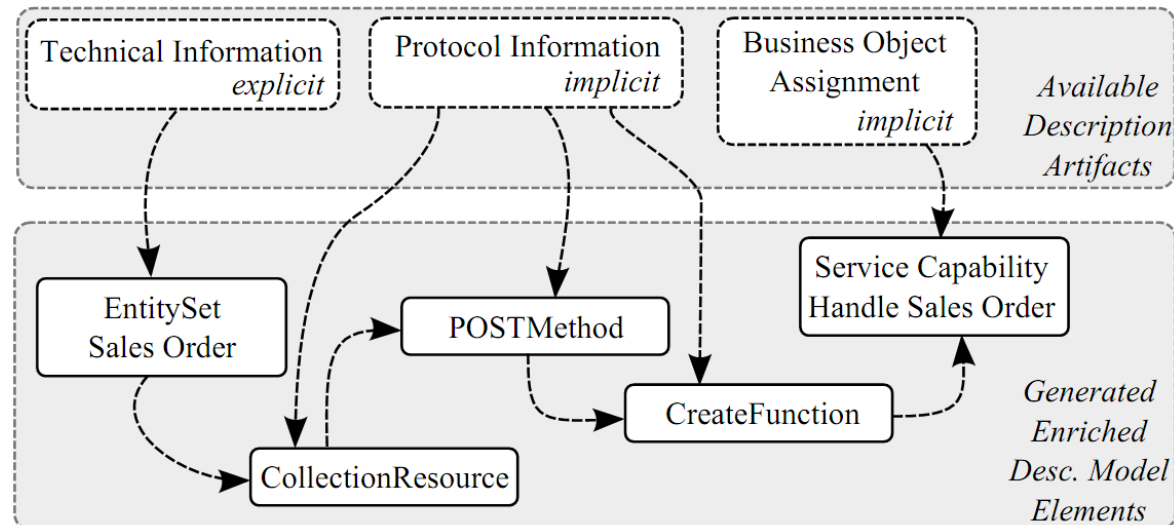
Source Artifact Target Concept

$\alpha_k(EntityType) = \{EntityType\}$

$\alpha_l(EntityType.Name) = \{EntityType.hasName\}$

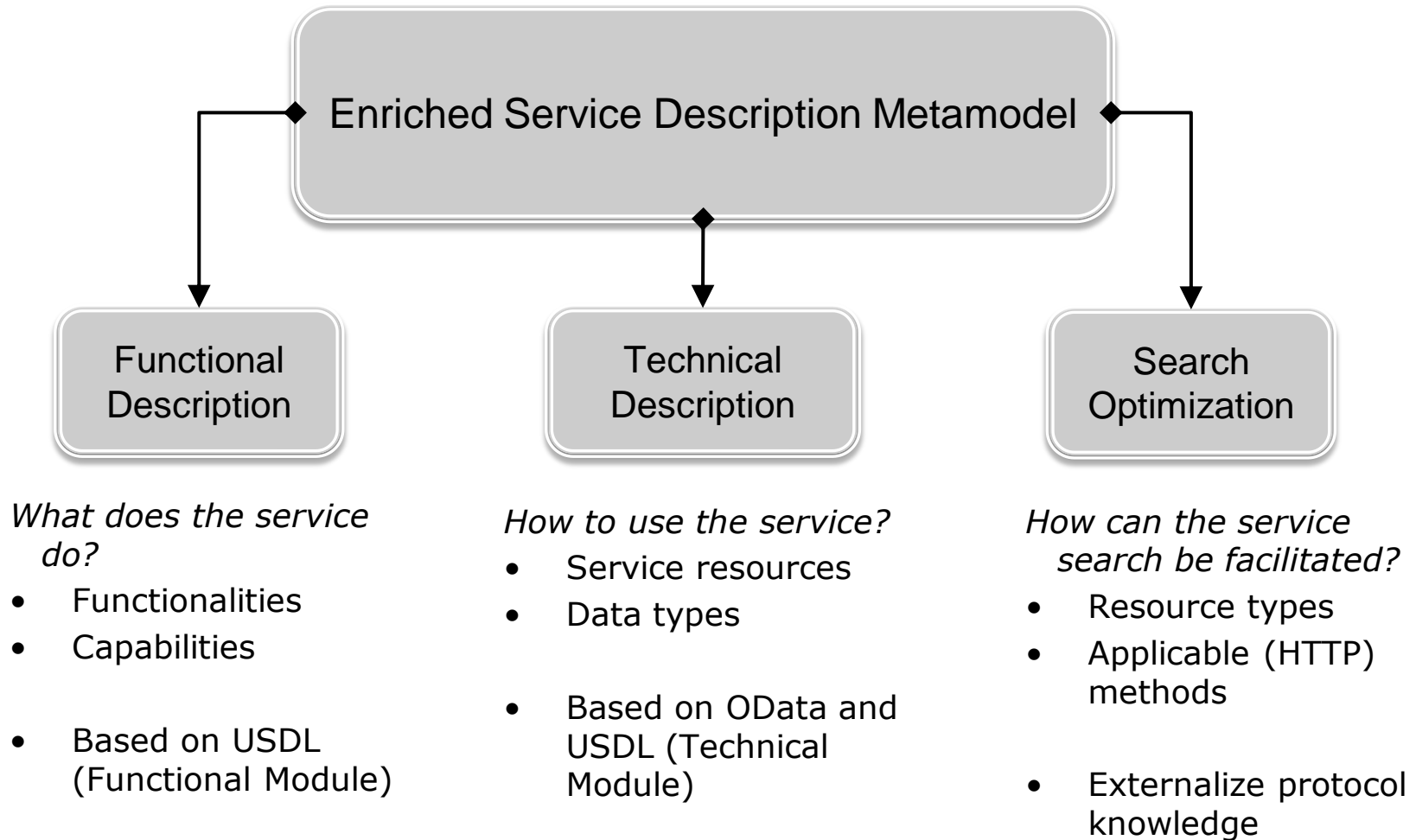
$\alpha_m(EntityType.Property) = \{EntityType.hasProperty\}$

- For structured information



03 Conceptual Design

Enriched Service Description Model

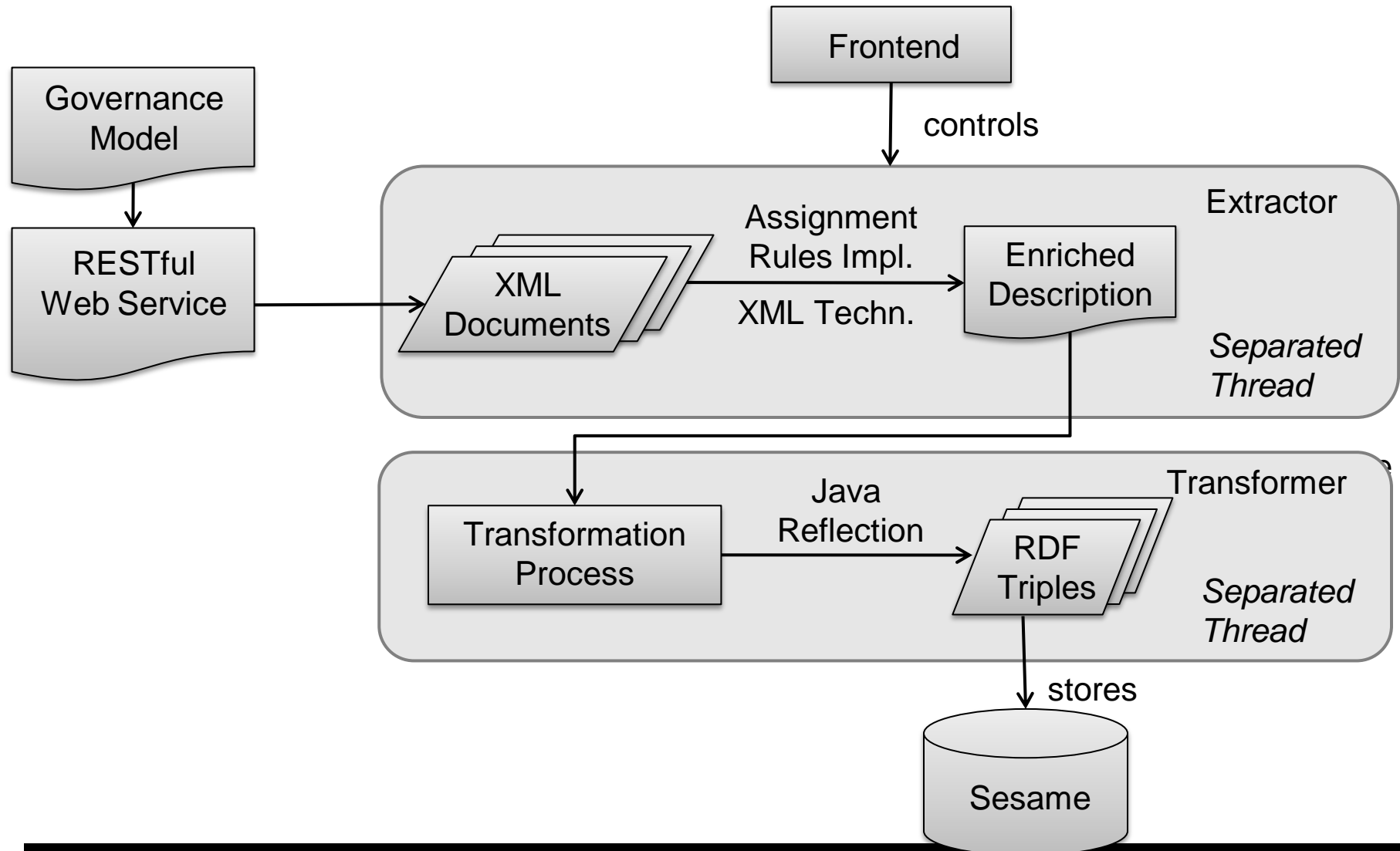




04 Implementation

04 Implementation

Technical Architecture

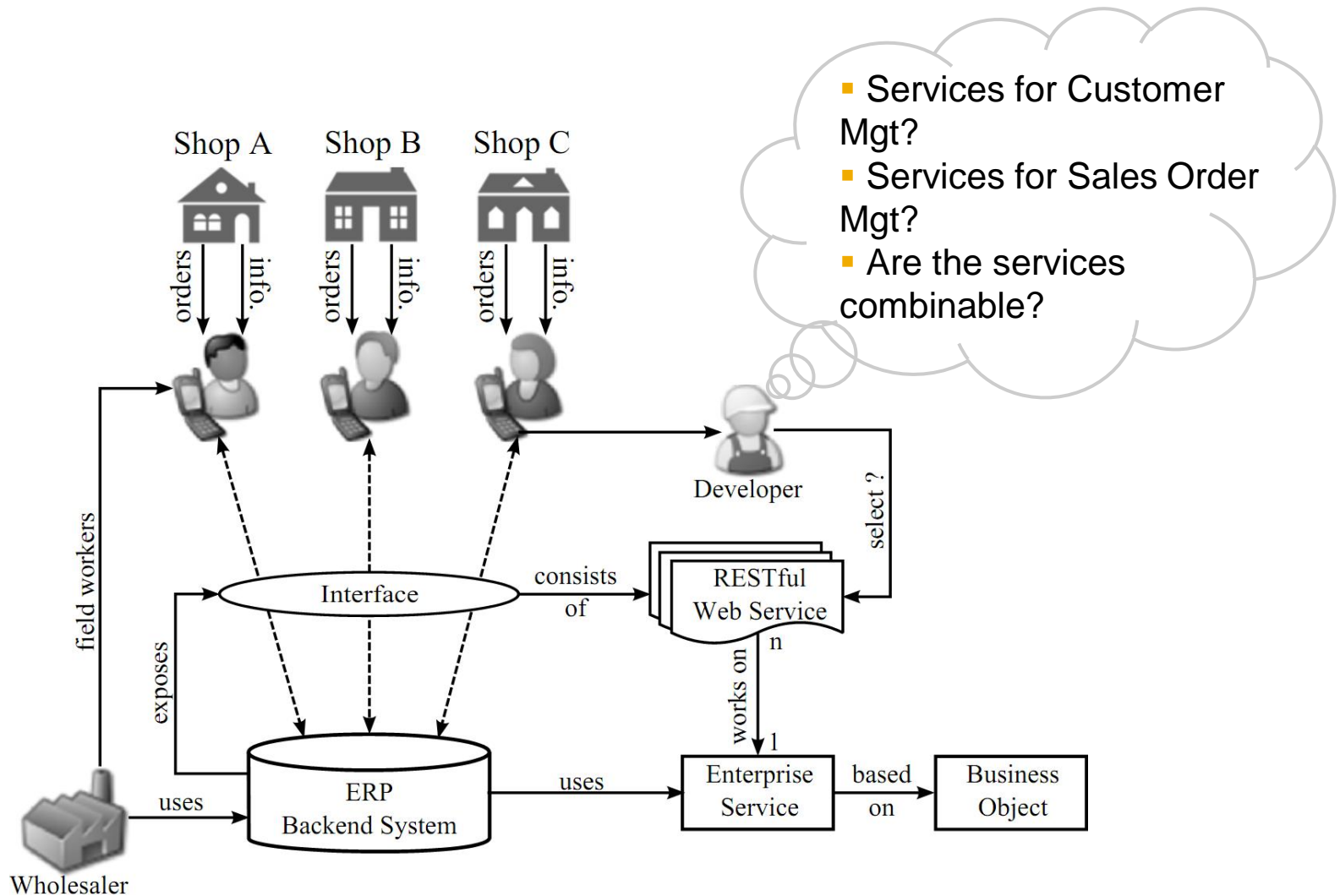




05 Evaluation

05 Evaluation

Scenario-based Evaluation (1)



05 Evaluation

Scenario-based Evaluation (2)

The screenshot shows the SAP Data Service RDF Repository interface. It includes a 'File' menu, tabs for 'QueryPerspective' and 'Service Process Rep', and a 'Search Parameters' section. Under 'Search Parameters', the 'Select Query Type' is set to 'Structural Query'. The 'Business Object Structure' section shows a tree with 'Customer' selected, and buttons for 'Add' and 'Delete'. The 'Supported Functions' section has checkboxes for 'Read' (checked), 'Create' (checked), 'Update' (unchecked), and 'Delete' (unchecked). The 'Properties' section shows a table with columns 'Name' and 'Type', containing 'Firstname' and 'Lastname' with 'String' type. There are 'Add' and 'Delete' buttons. The 'Additional Parameters' section has fields for 'Request Type' and 'Response Type', and a 'Search' button at the bottom.

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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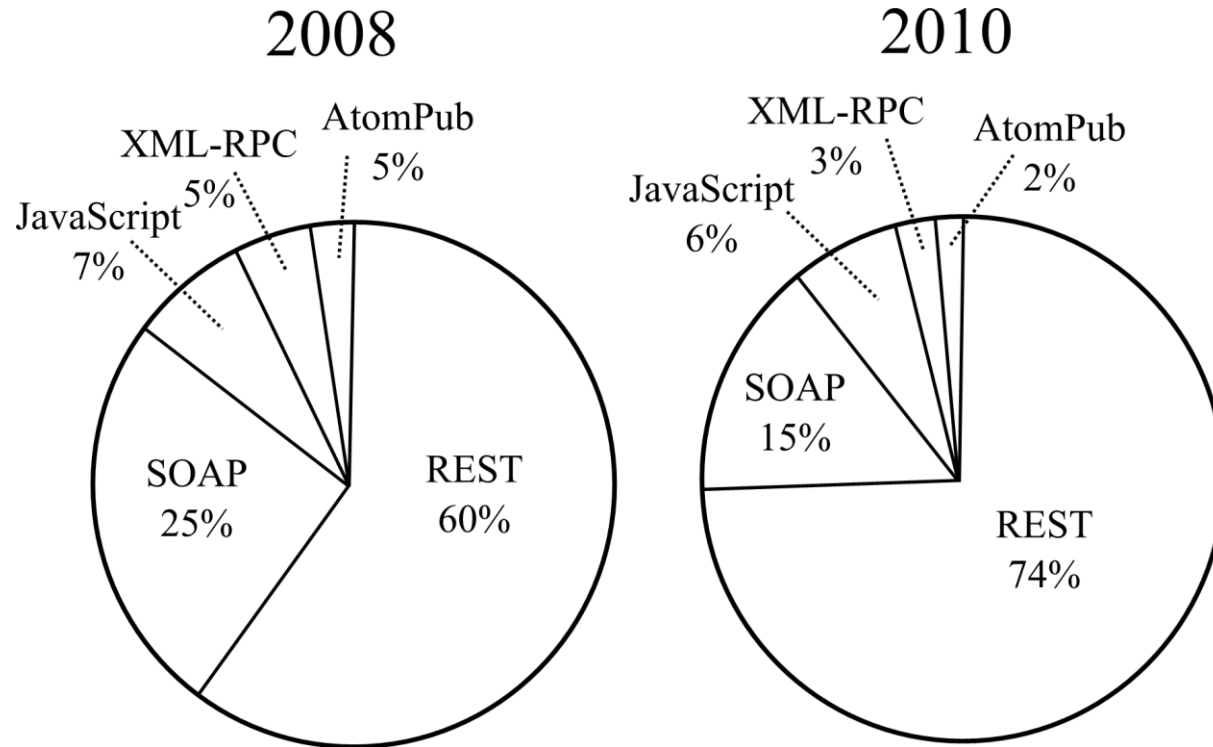
michael.stollberg@sap.com



Backup Slides

07 Backup

Usage Study RESTful Web Services



07 Backup

Service Search via ProgrammableWeb.com

Search: Storage

Storage

Your search returned 88 mashups

#blue	Text messaging storage service	Messaging	2011-04-23
Adobe Share	Service for publishing and sharing documents	Storage	2007-10-07
Amazon S3	Online storage services		
AnyHub	File sharing service		
AudioBox.fm	Cloud-based audio manag		
Baconfile	Web based file storage in Amazon s3		
Beanstalk	Hosted subversion and st service		
Box.net	Online file storage		
Burstn	Instant photo sharing and service		
CloudApp	File sharing and cloud-ba storage service		
CloudCache	Cache in the cloud		
CrashPlan PRO	Online Backup Service		
DigitalBucket	Online storage service		
DivShare	Media hosting service		
DocVerify	E-signature and secure fil service		
DriveCast	Web based media manag		
Drop.io	Content sharing service		
Dropbox	Online storage provider		
edocr	Online document collabor storage, and publishing		
Estate++	Virtual safe deposit box		

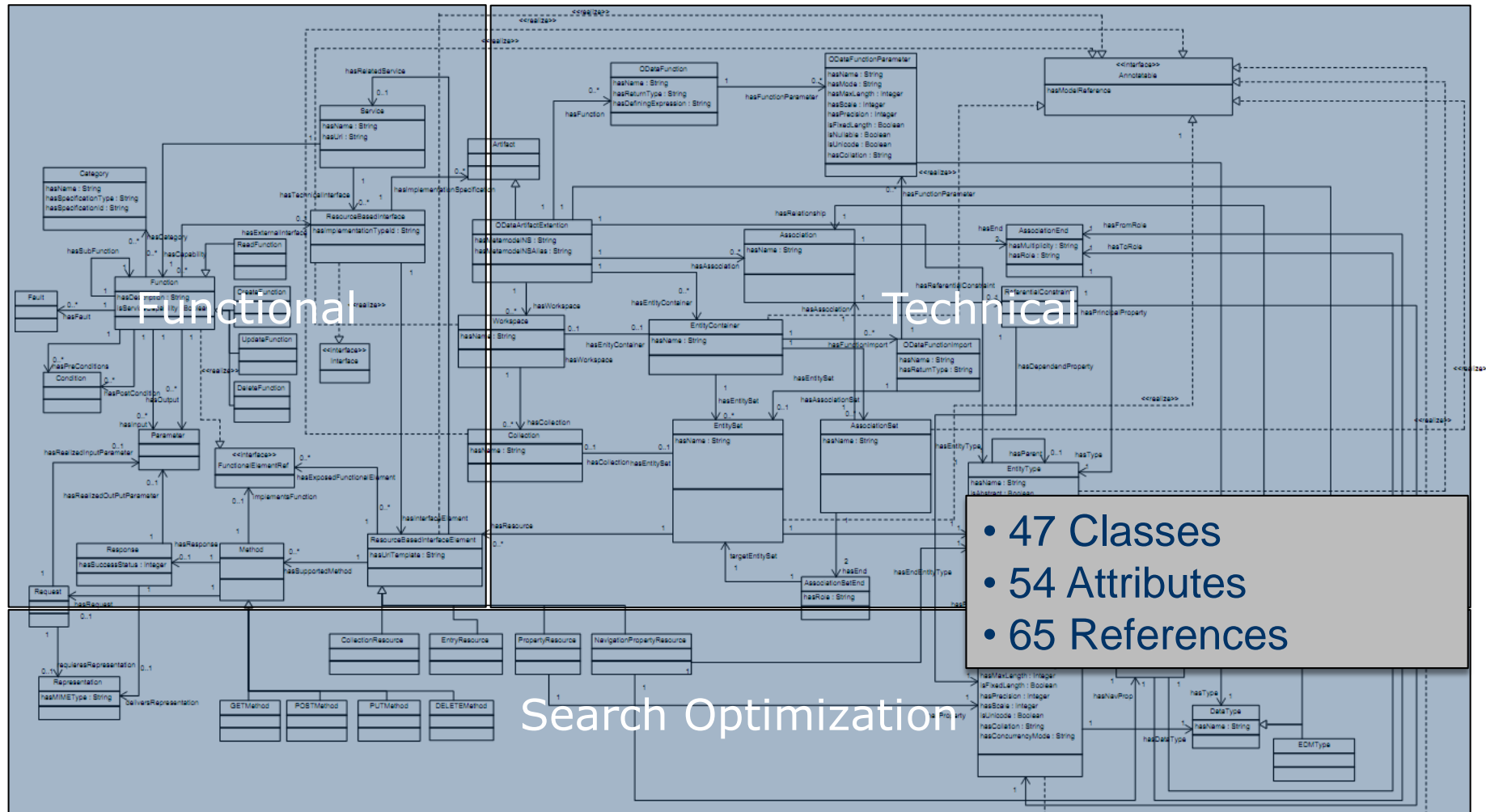
Amazon S3 How-to's

Summary Mashups (73) **How-To (10)** Developers (46) Comments (1)

Name	Description
ActionScript Library for Amazon S3	An AS3 library for accessing Amazon's S3 service.
AWS::S3 for Ruby	A Ruby library for Amazon's Simple Storage Service, S3, REST API.
Java Library for Amazon S3 REST API	A library in Java for working with the Amazon S3 REST interface.
Java Wrapper for Amazon S3 SOAP API	A library in Java for working with the Amazon S3 SOAP interface.
Perl Wrapper for Amazon S3 API	A library in Perl for working with the Amazon S3 REST interface.
PHP Wrapper for Amazon S3 API	From the site: This class is a standalone S3 REST implementation for PHP 5 using CURL.A PHP implementation with support for reading/writing large objects and streams, access control lists and bucket logging.
Python Interface for Amazon Web Services	From the site: An integrated interface to current and future infrastructural services offered by Amazon Web Services. Currently, this includes:Simple Storage Service (S3),Simple Queue Service (SQS),Elastic Compute Cloud (EC2),Mechanical Turk, and SimpleDB
Ruby Library for Amazon S3 API	A Ruby Library for Amazon's Simple Storage Service's (S3) REST API.
Ruby Library for Amazon Web Services	RightScale's AWS gems provide Ruby interfaces to four key Amazon Web Services: EC2, S3, SQS, and SDB. The gems use Amazon's REST and query interfaces to provide full programmatic control. An optional HTTP layer retries and clears transient error
Using Silverlight with Amazon S3 API	Overview and source code for using Amazon S3 storage with Microsoft Silverlight.

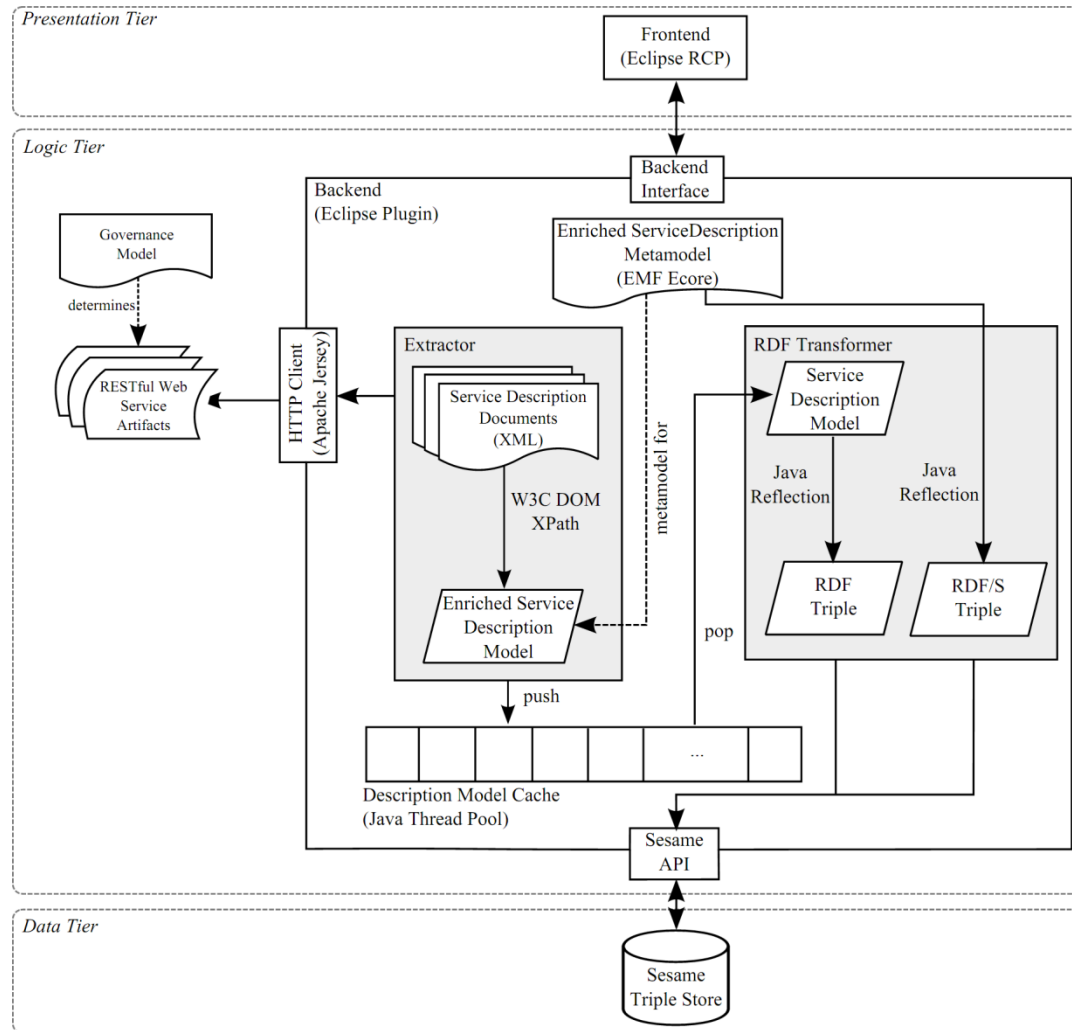
07 Backup

Enriched Service Description Metamodel



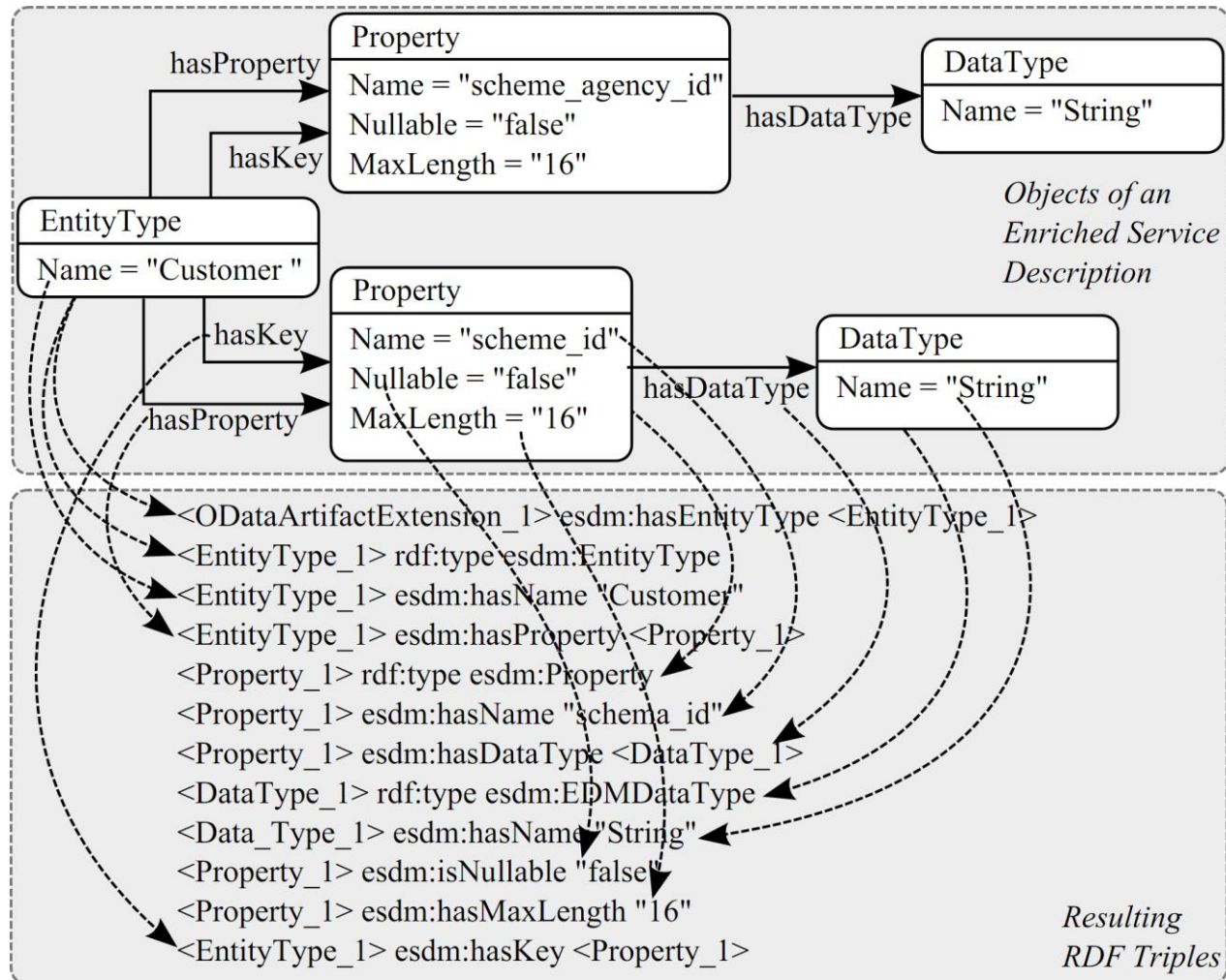
07 Backup

Detailed Technical Architecture



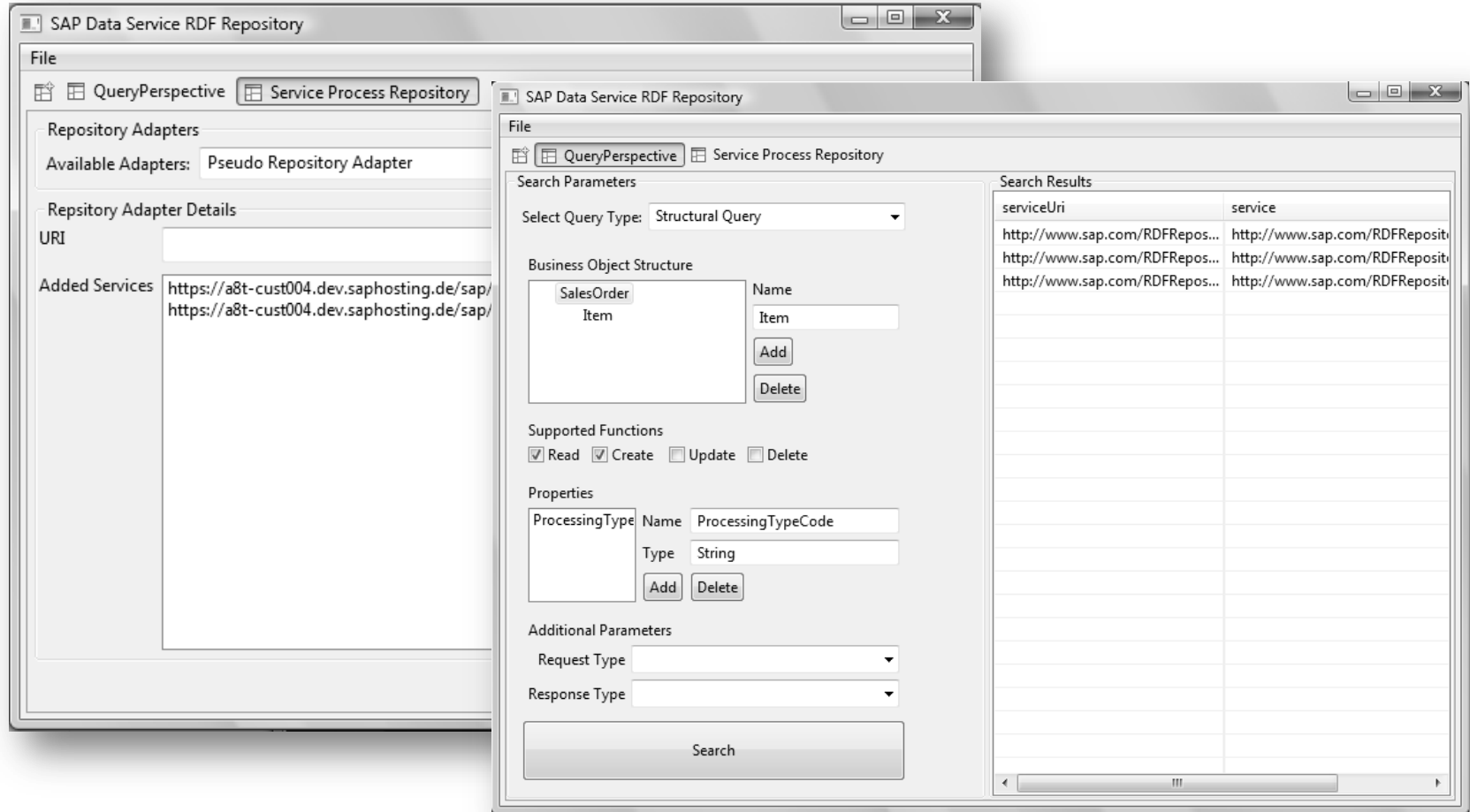
07 Backup

RDF Transformation



06 Backup

Frontend



06 Backup

Quantitative Evaluation

Results

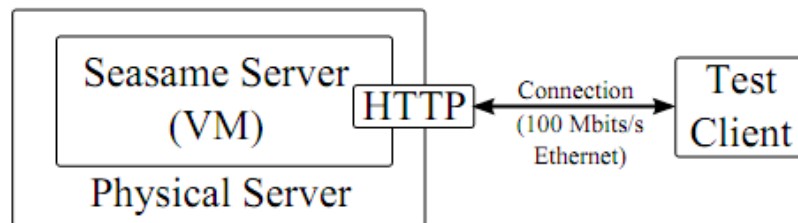
Query No.	Mean μ	Median \bar{x}	Std. Deviation σ	Query No.	Mean μ	Median \bar{x}	Std. Deviation σ
1	87.4	86.1	6.45 (7.39 %)	7	59.1	56.9	11.14 (18.84 %)
2	122.3	120.0	10.18 (8.33 %)	8	239.5	233.3	21.36 (8.92 %)
3 (1)	10.5	9.7	3.49 (33.18 %)	9	12.8	11.2	11.24 (87.94 %)
3 (2)	59.0	57.5	5.32 (9.02 %)	10	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)

	Service Number	Generated Triples	Elapsed Time
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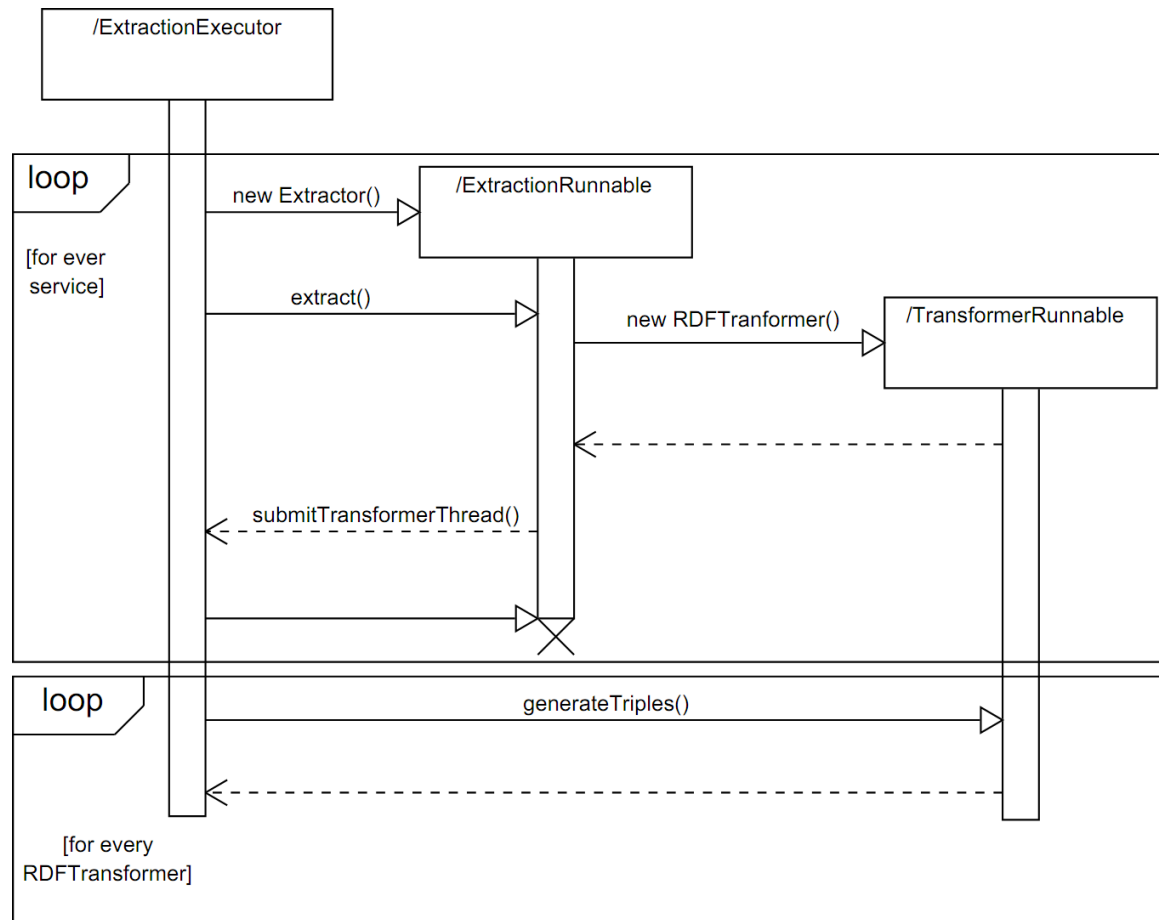


Tests

- Client-Server setup (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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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" .
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24  ?navProp3 esdm:hasName "MarketingAttribute" .
25 }
```

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