

Semantic Description of Web Services using Visual Contracts

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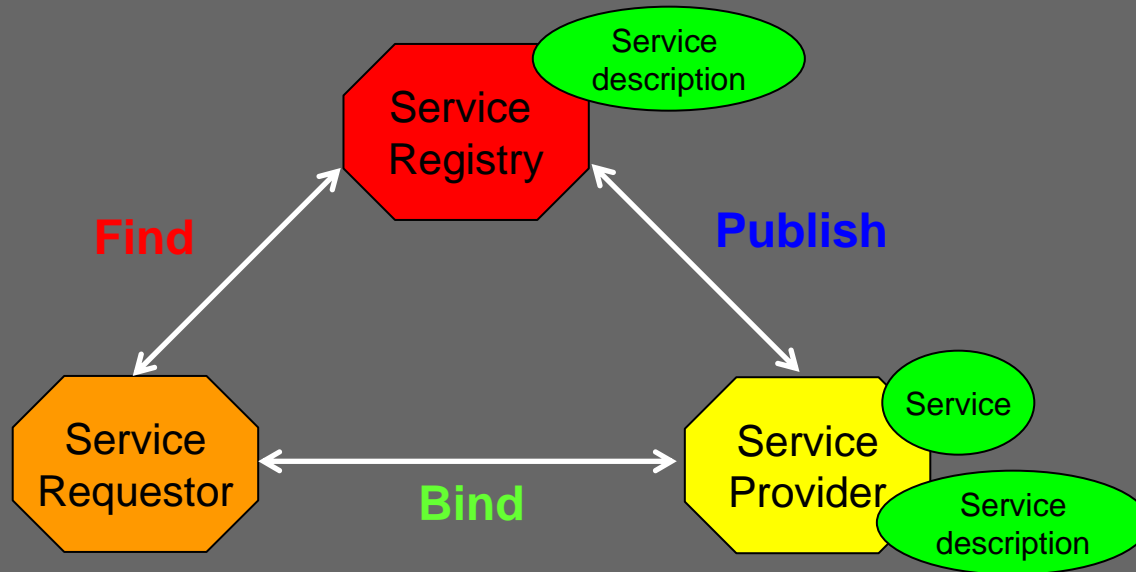
**AIM@SHAPE in Tallinn 2006,
Summer School**

- Introduction & Motivation
- Research Approach
- Presentation of a prototypical tool chain
- Summary & Outlook

- What is a Web Service?
 - “Web Services can be accessed and executed via the web” (*Dieter Fensel*)
- Why are Web Services important?
 - Integration of software components
 - Companies can share their web applications among each other and save costs

Service-oriented Architecture (SOA)

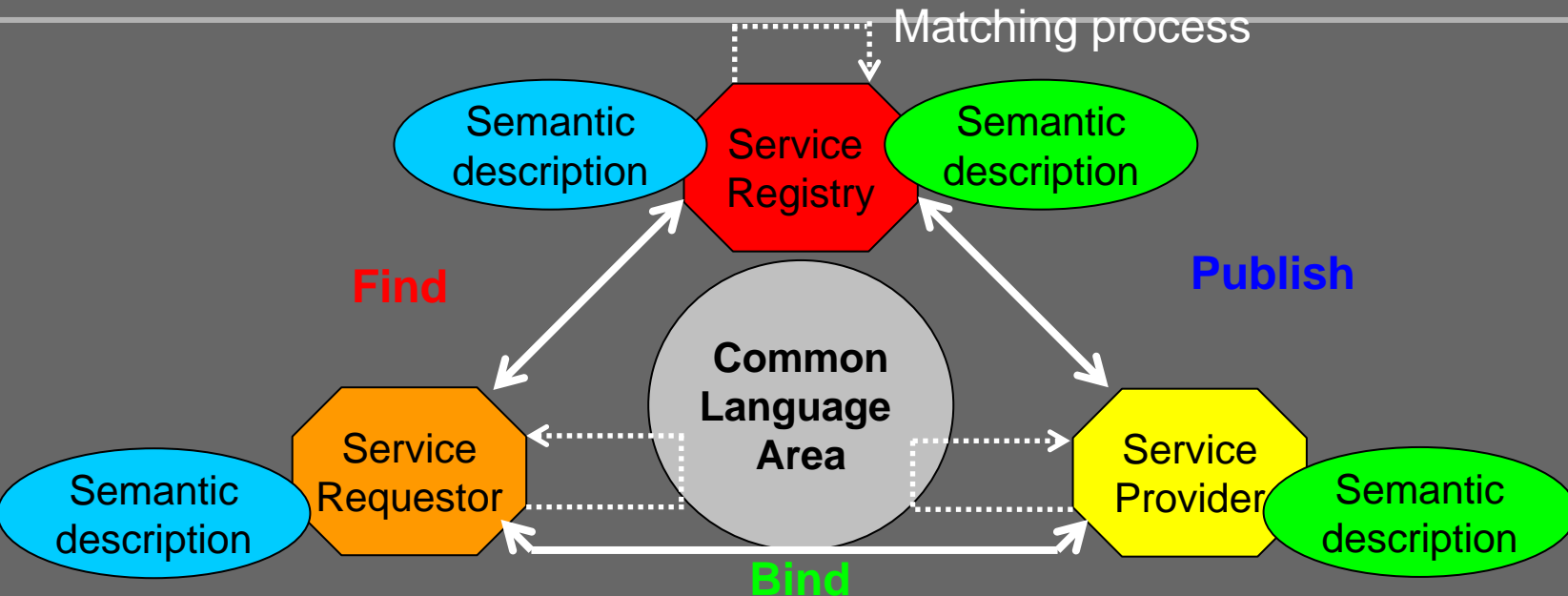
- Web Services follow a service-oriented architecture:



- What is the problem?
 - automated localization of web services in the internet
- Why is that a problem?
 - Technologies used to support the application of Web Services are not sufficient: UDDI, WSDL
 - Current state: manual search for Web Services

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Research Approach



1. Common language area for Service Requestor and Service Provider
 2. Service Provider: Semantic description of the Web Service he wants to offer
 3. Service Requestor: Semantic description of the Web Service he is looking for
 4. Service Registry: starts the Matching process
- Matching process: automated comparison of both semantic descriptions

Ontologies: A short introduction

- What is an ontology?
 - “An ontology is an explicit specification of a conceptualization” (Gruber, 1993)
- For what do we need Ontologies?
 - In computer science: formalization of domain knowledge, knowledge representation and exchange
 - Here: common language area between Service Providers and Service Requestors in order to describe the semantic of provided and requested Web Services

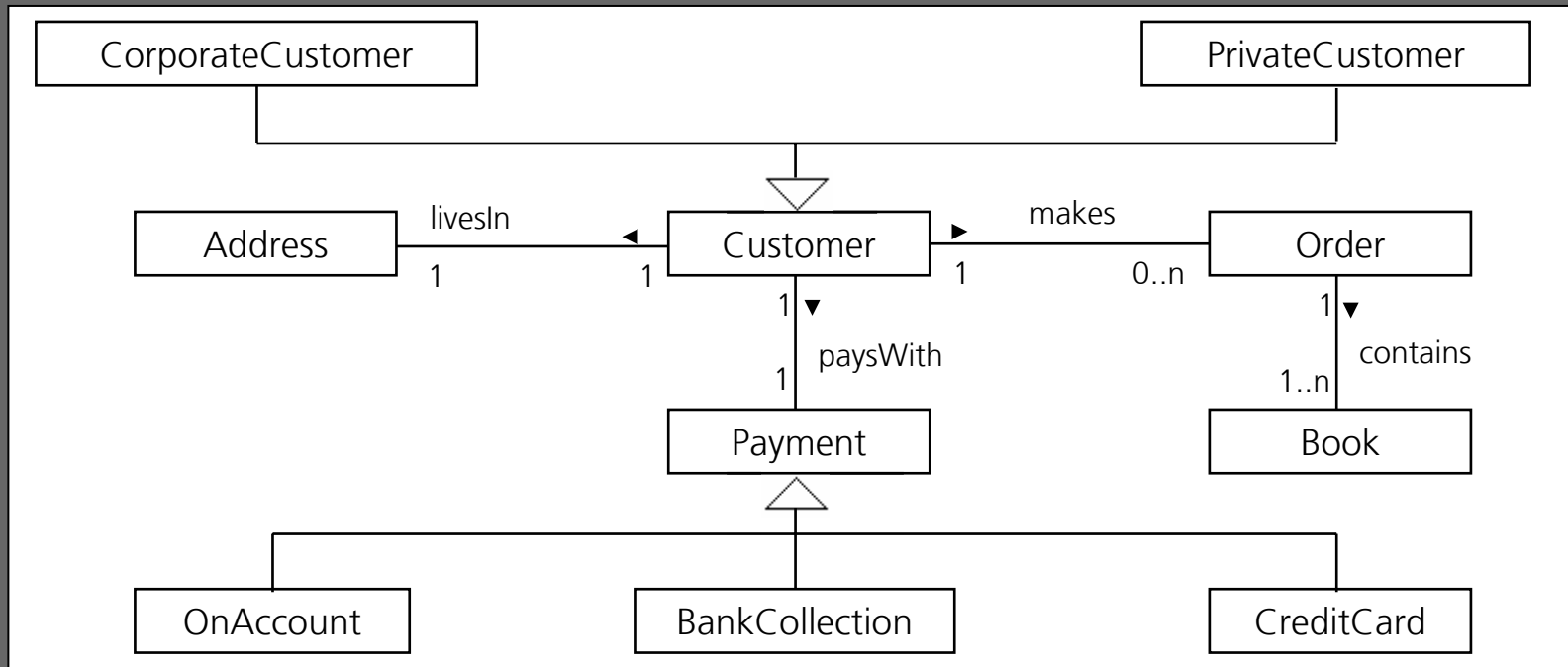
Ontologies: Representation languages

- Model-based representation:
 - UML Class diagrams
- XML-based representation:
 - W3C standards: RDFS and OWL
 - Both RDFS and OWL are widely used
 - Tool support is available, i.e. Protégé, Racer, Jena, Sesame, etc.

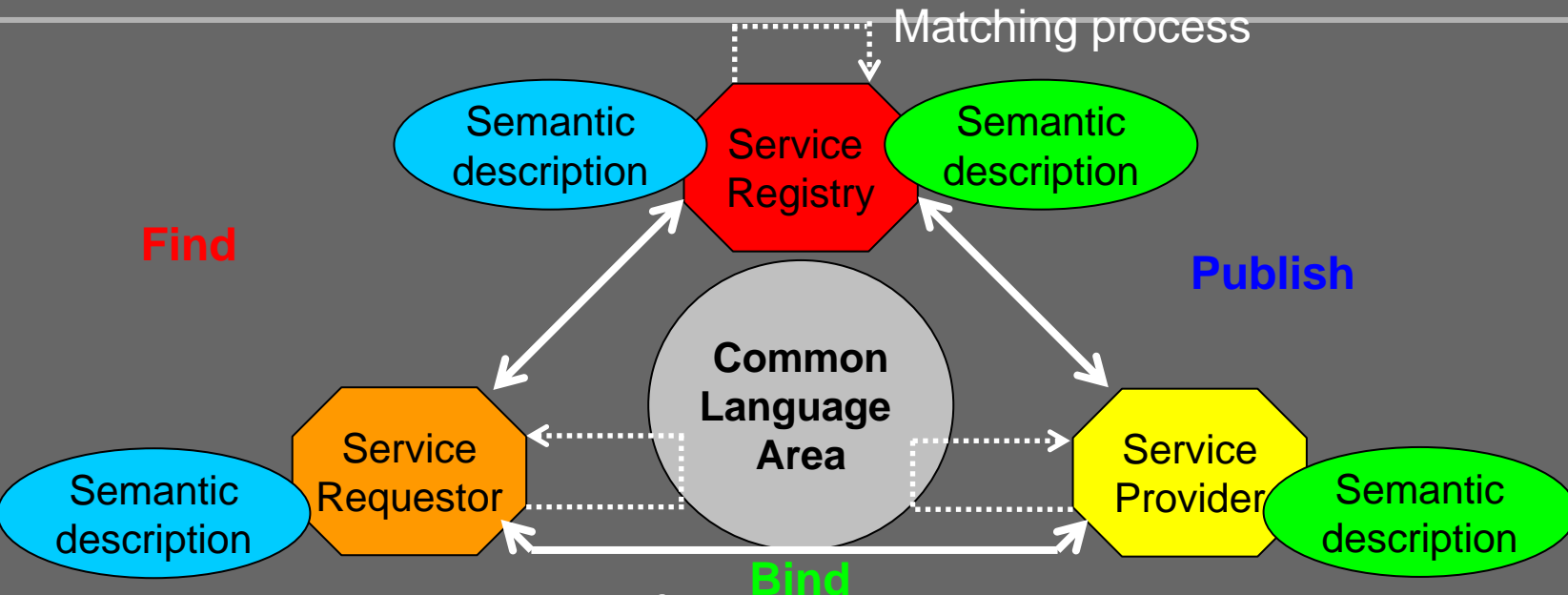
⇒ We use class diagrams and OWL

Ontologies: An introductory example

- Graphical representation of an ontology for an online book shop through a UML class diagram:



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Semantic Description of Web Services

- We can describe the semantic of web services with pre and post conditions.
- Semantic Description of Web Services using **Visual Contracts**:
 - graphical representation of pre and post conditions
 - Pre and post conditions are typed over the class diagram representing the ontology
 - ⇒ Pre and post conditions are valid instances, that is they fulfill the restrictions given by the ontology

- Different Views:

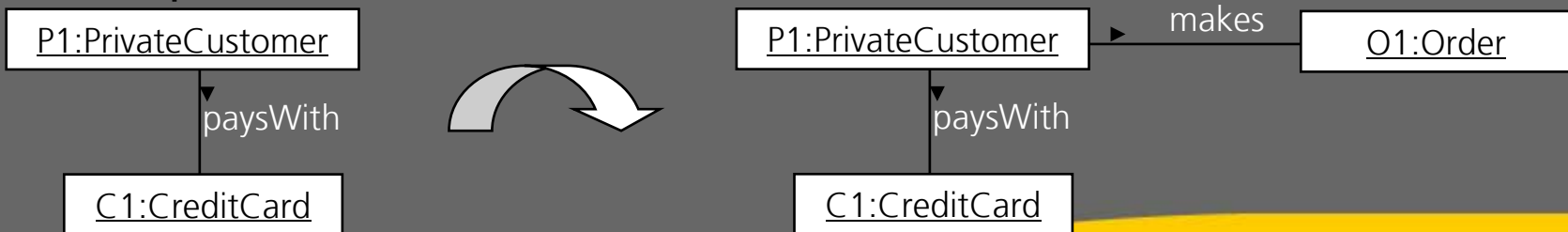
- Service Requestor:

- Pre condition contains data the Service Requestor is willing to provide
 - Post condition describes the expectations

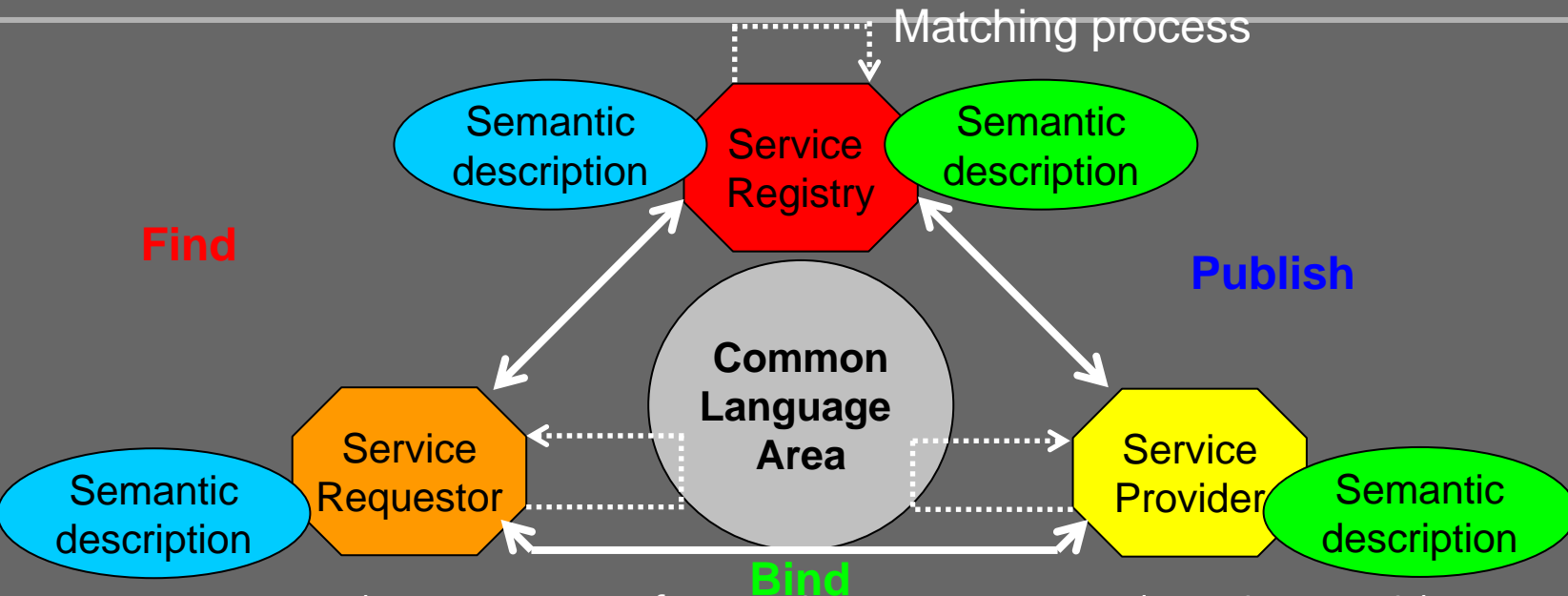
- Service Provider:

- Pre condition contains data the Service Provider expects from a Service Requestor
 - Post condition contains data the Service Provider is willing to provide

- Example:



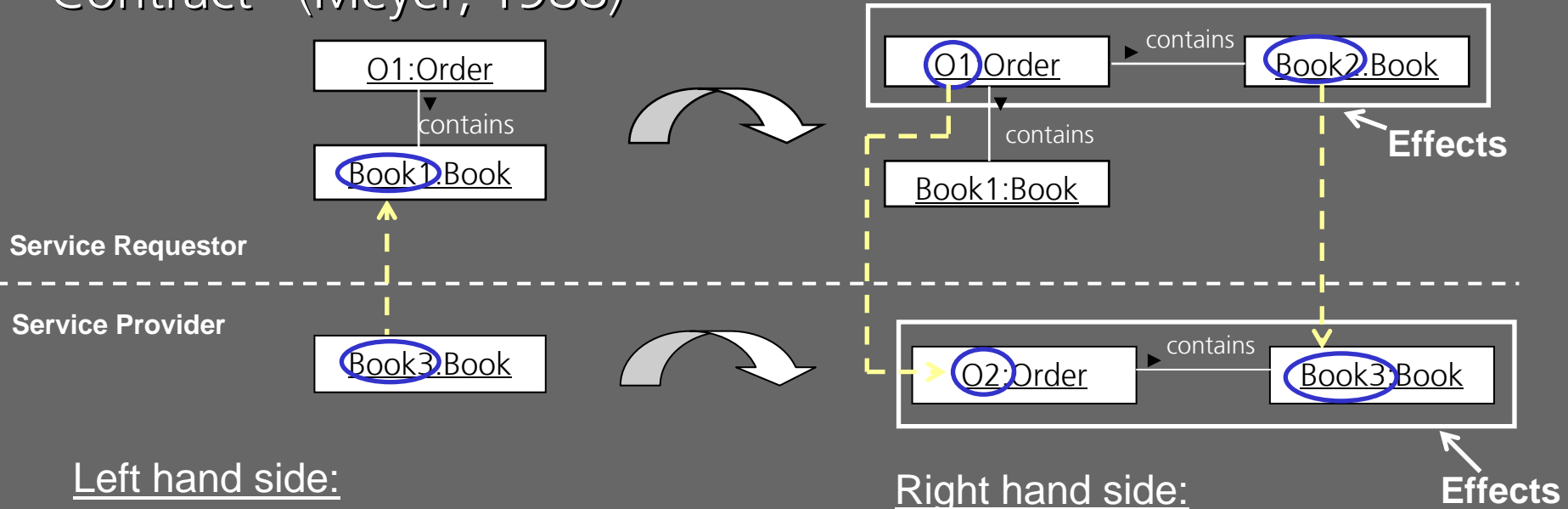
Research Approach



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Matching process: automated comparison of both semantic descriptions

Matching Process: Example (1)

- The Matching Process is based upon the approach "Design by Contract" (Meyer, 1988)



Left hand side:

L1) Book3 - - - ➔ Book1

Comparison of the mappings:

L1), R2): ⇒ Conflict!

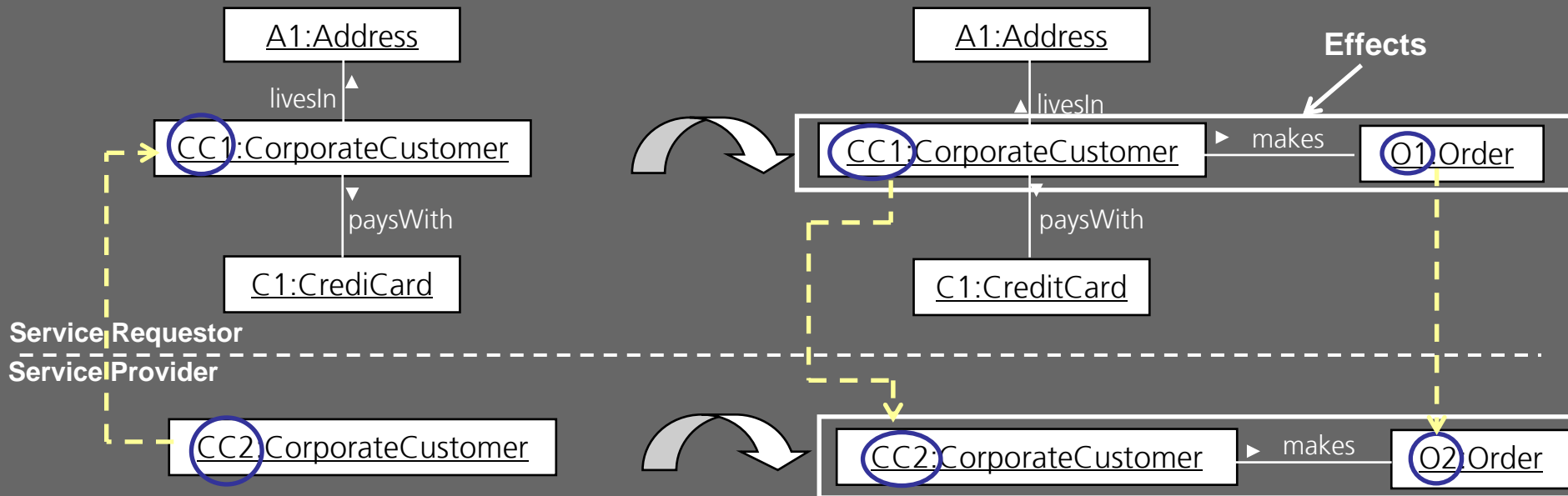
Right hand side:

R1) O1 - - - ➔ O2

R2) Book2 - - - ➔ Book3

⇒ Service Provider does NOT provide the Web Service the Service Requestor is looking for!!!

Matching Process: Example (2)



Left hand side:

L1) CC2 - - - -> CC1

Comparison of the Mappings:

L1), R1): O.K.

Right hand side:

R1) CC1 - - - -> CC2

R2) B1 - - - -> B2

⇒ Service Provider does support the Web Service the Service Requestor is looking for!!

- Development of an exchange format for visual contracts based on OWL, since OWL does not support packages.
- Realization of the sub-graph relations:
 - Usage of the query language RDQL from the Jena API version 2.0
 - RDQL queries represent RDF graphs with variables
 - If for each variable a concrete value can be found, then the sub-graph relation is given

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- Technically, the visual contracts are exchanged on the basis of XML
- Objective:
 - Support users in defining pre and post conditions visually (visual contracts)
- Usage of the tool AGG (Attributed Graph Grammar System):
 - developed by Technical University of Berlin
 - rule-based visual programming language
 - supports the formulation of pre and post conditions on the basis of AGG type graphs

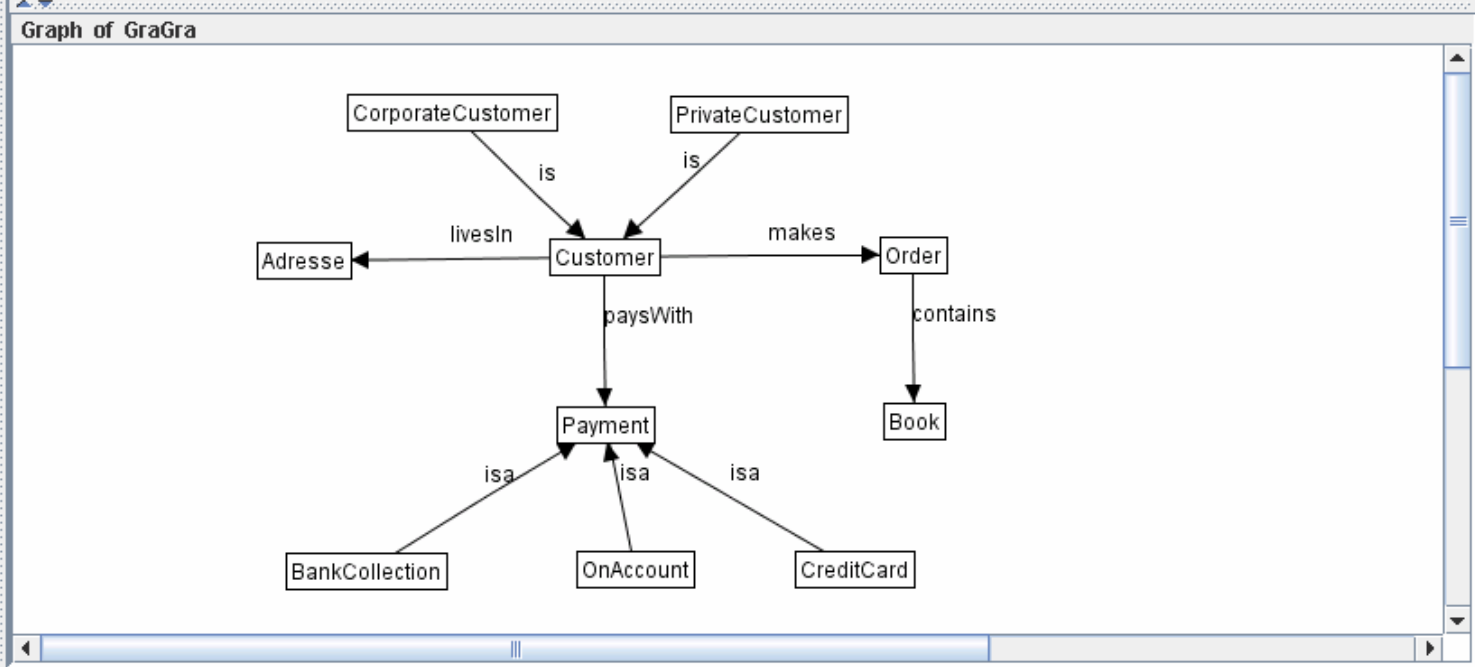
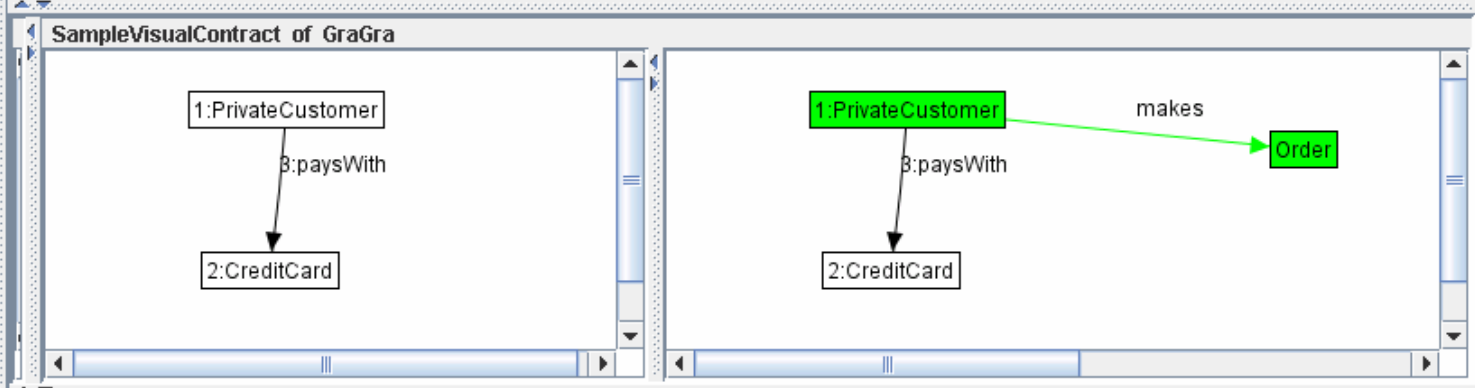


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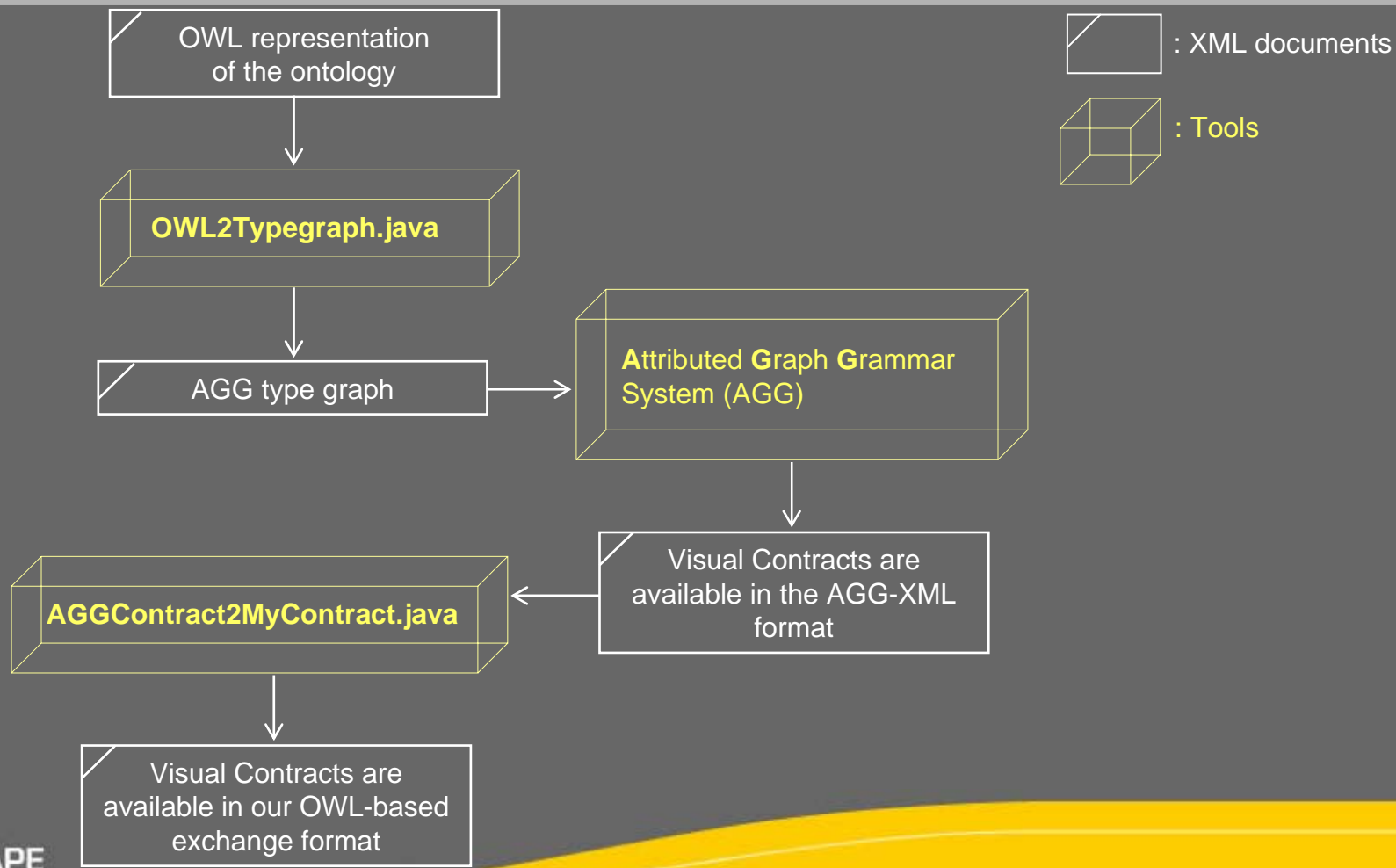
- GG GraGra
- Graph
- SampleVisualContract

Node Type Order

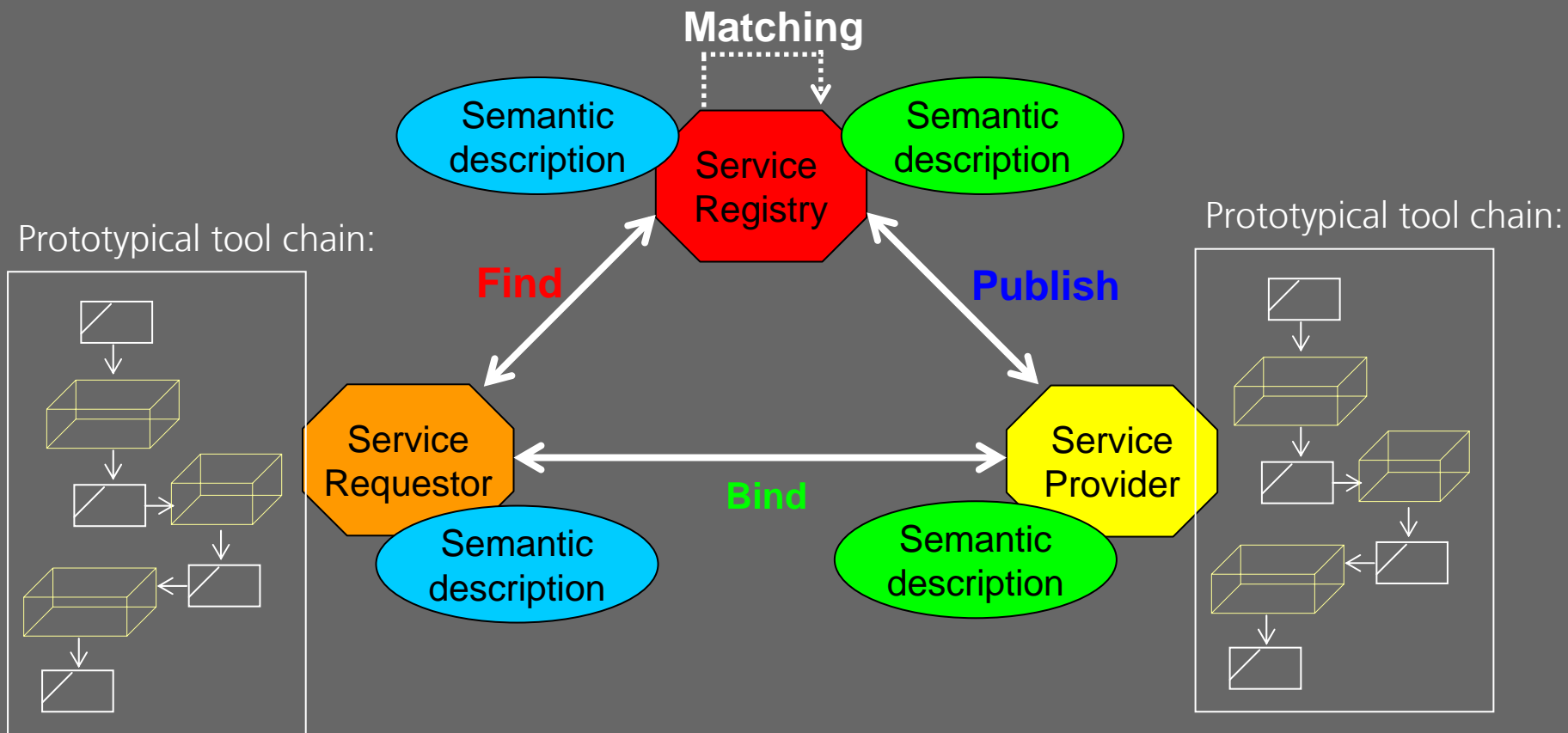
Edge Type



Conceptual design of the prototypical tool chain



Integration of the tool chain in the SOA



- Introduction & Motivation
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- What was the problem?
 - Automated Service Discovery
- Research Approach (Concept)
 - Usage of Ontologies as a common language area for Service Requestor and Service Provider
 - Description of the semantic of the web services on the basis of commonly used Ontologies
 - Automated comparison of semantically described service descriptions

- Research Approach (Realization):
 - pre condition of the Service Provider must be a sub-graph of the pre condition of the Service Requestor
 - effects of the Service Requestor must be a sub-graph of the effects of the Service Provider
 - automated comparison of the mappings
 - automated decision making regarding the outcome of the Matching process
- Creation of a prototypical tool chain to enable users to specify the semantic of Web Services visually and to test the Matching process

- Inclusion of disjunctions in order to support alternatives in semantic descriptions of web services
- Inclusion of multi-objects
 - Example: “Who can deliver me n books?”
 - The concept of the Matching process will change

More Questions ??