IZBI
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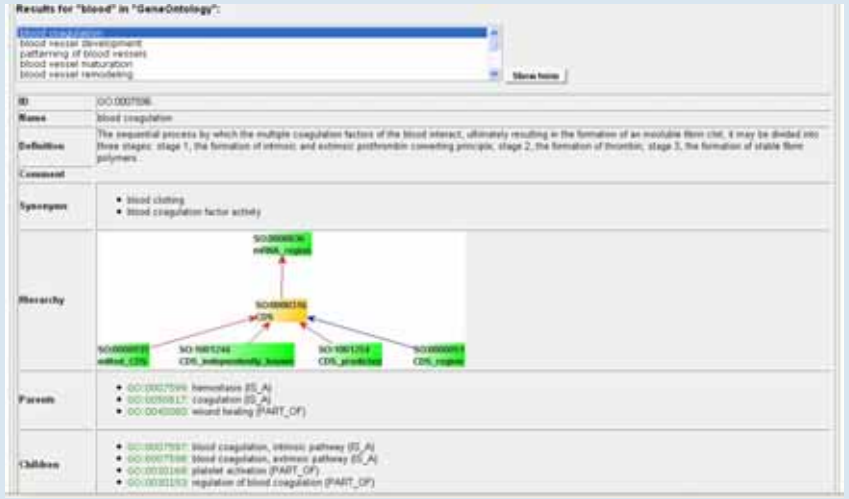
D-GRID



A Grid Middleware for Ontology Access

German e-Science Conference

Baden Baden, May 4, 2007

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Interdisciplinary Centre for Bioinformatics, Leipzig

MediGRID

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Introduction

- **Module Ontology Tools in MediGRID**
  - Responsible for integration of ontologies in MediGRID
  - Tools that help to use and access ontology information in grids
- **Usage of ontologies depends on applications in MediGRID**
- **3 Pilot classes of applications**
  - Bioinformatics
  - Imaging
  - Clinical Research
- **Linking applications with currently existing ontologies**
  - Integration of further knowledge
  - Utilization of annotation databases, sources
  - First phase: No editing/construction of new ontologies

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Motivation

Key problem: Heterogeneity between existing ontologies

- **Yet no existing ontology access system in grids**
- **Base information**
  - Terms, concepts with name, definition, synonyms
  - Relations between concepts of an ontology
  - Cross references to other ontologies, data sources
- **Different source formats of ontologies**
  - Relational databases: GeneOntology
  - Structured flat files: NCI Thesaurus
  - Standardizations: OBO-Ontologies
  - Web Standards: OWL, RDF
- **Different design of ontology information**
  - Modeling of relationships
  - Presentation of synonyms, properties

OBO
open biomedical ontologies

National Cancer Institute

FMA
University of Washington
School of Medicine

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Goals

Simple and transparent access middleware for ontologies in grids

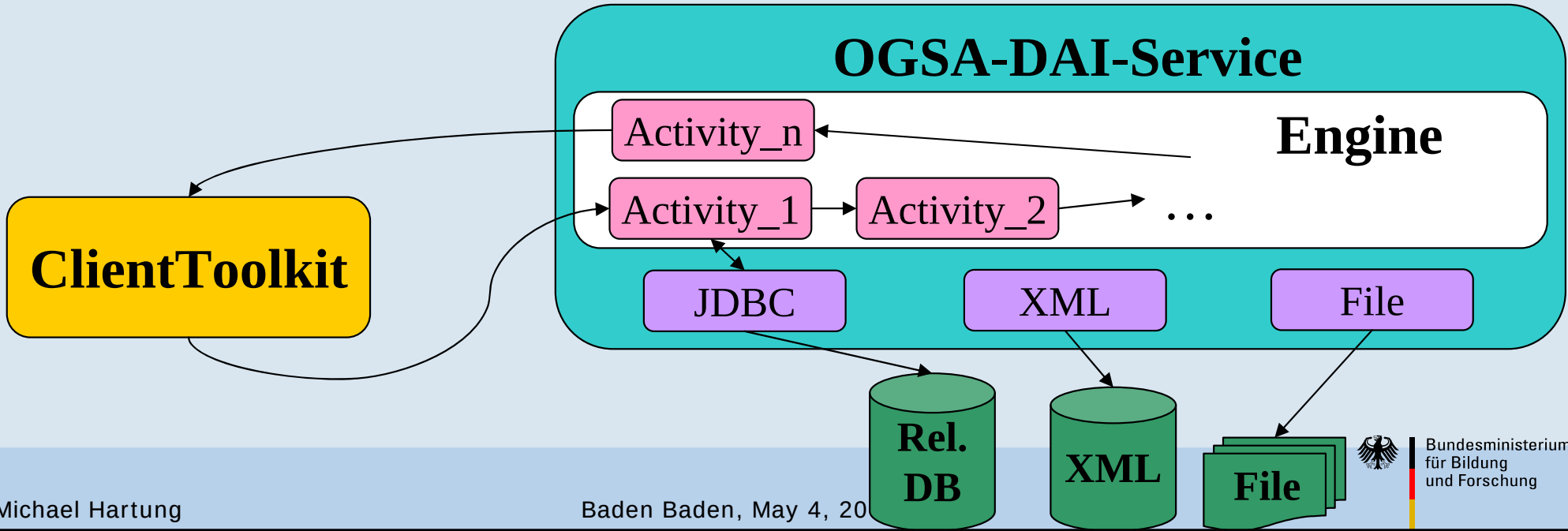
- **Functionalities**
  - Look Up of concepts/terms in available ontologies
  - Access to ontology information: definitions, synonyms, relations, cross references → uniform interface for all clients (API)
  - GUI: navigation in ontologies, graph representation of ontologies

- **Service based access to ontologies**
  - Ontology Services as middleware between applications and ontologies
  - Support for clients (MediGRID applications, other services)
  - Usage of grid: Distribution of ontologies → load balancing, failure safety
  - Extensibility: simple integration of new ontologies, extension in functionalities
  - Usage of D-Grid basis software, integration in D-Grid infrastructure

OGSA-DAI as base infrastructure

Access to data sources in grids

- **Extensible framework for “data access” and “integration”**
  - Access to distributed and heterogeneous data sources in grids
  - Web service based access system (WSRF, Globus Toolkit 4)
  - Extensibility as an important feature (activities, resources)
  - Client Toolkit API for service interaction



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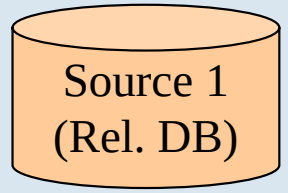
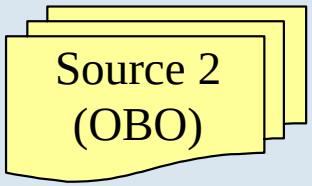
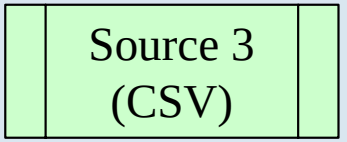
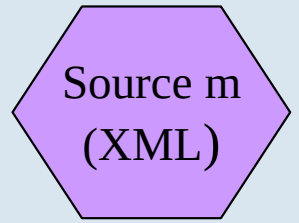
Ontology Access Middleware









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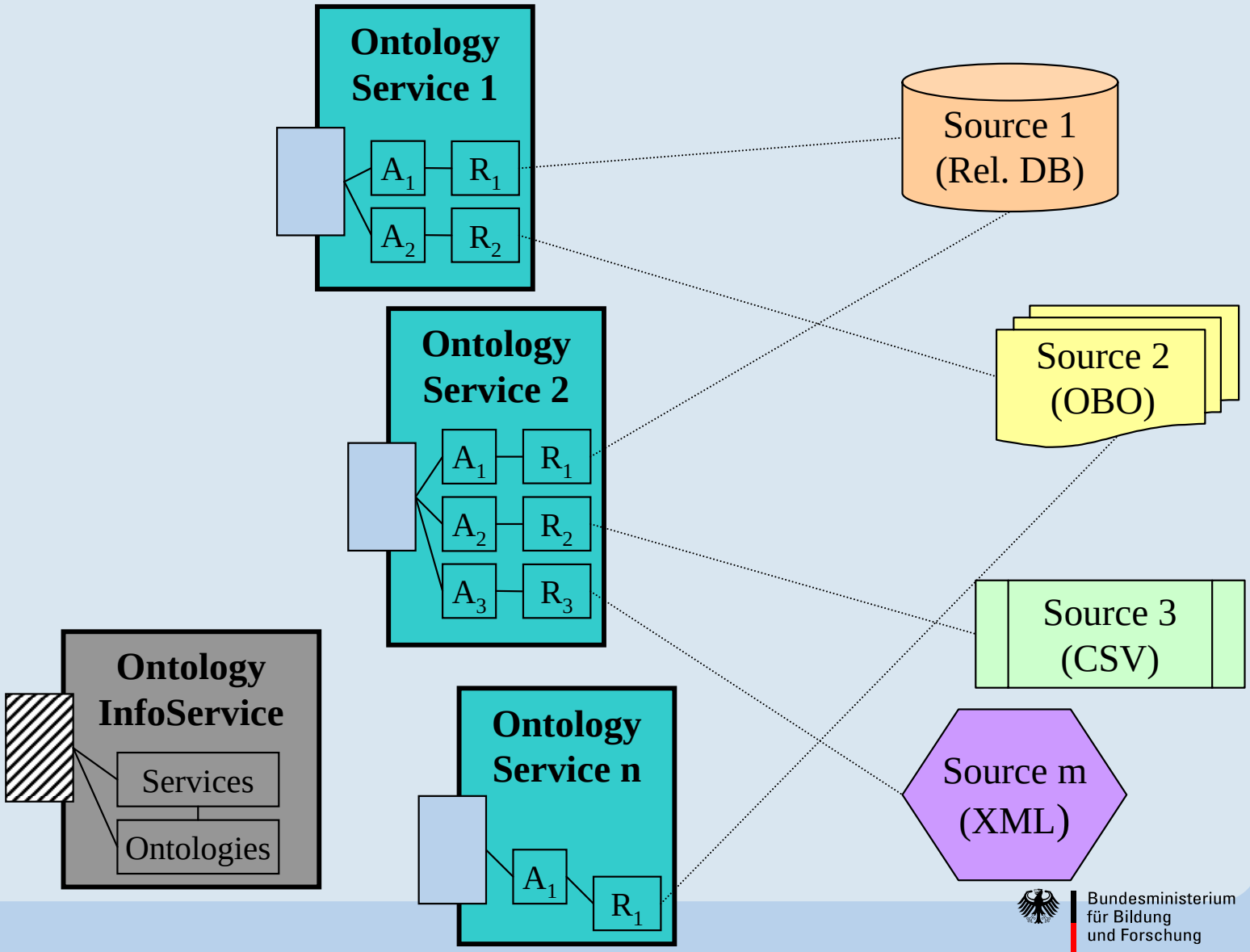

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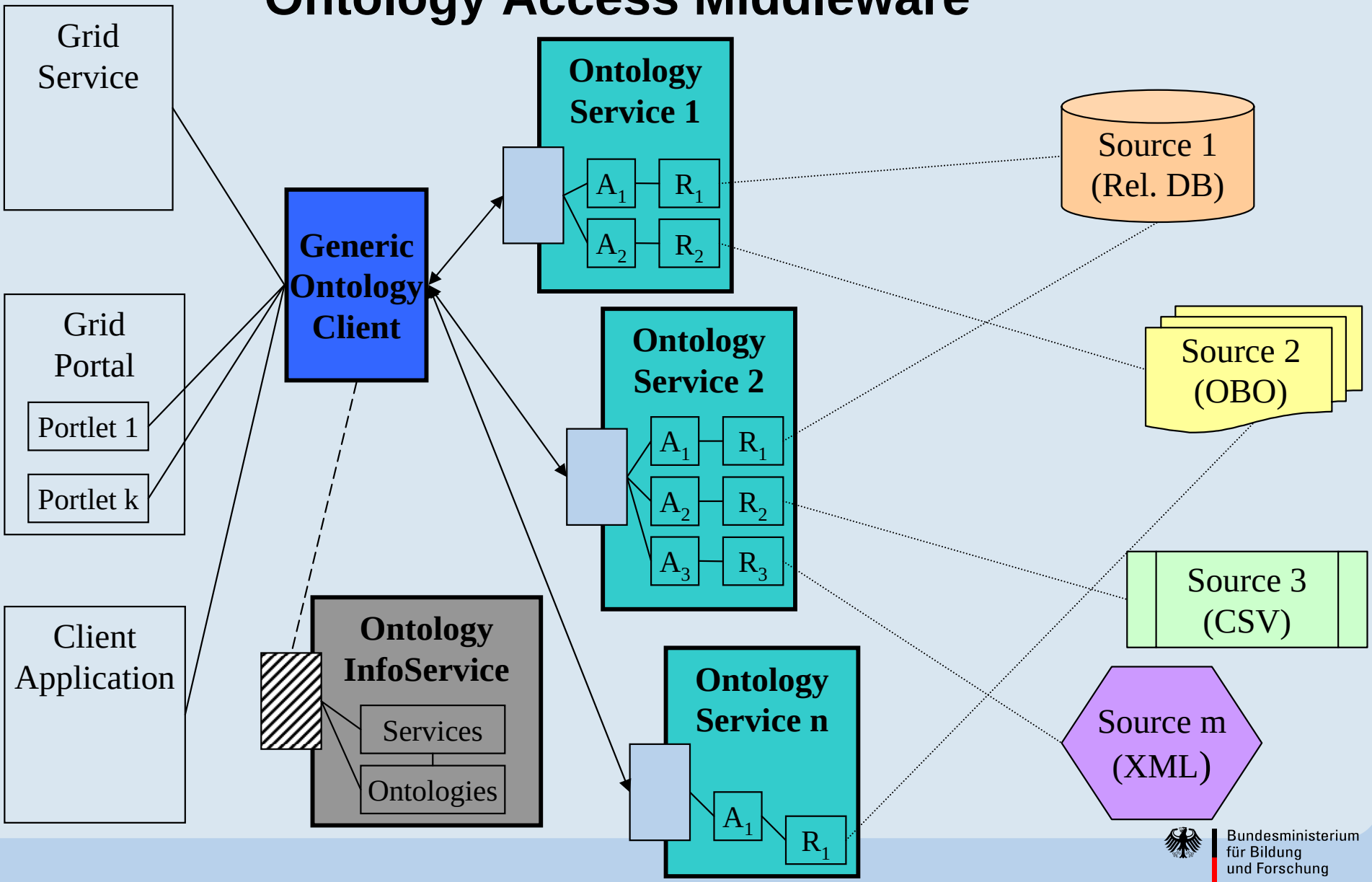

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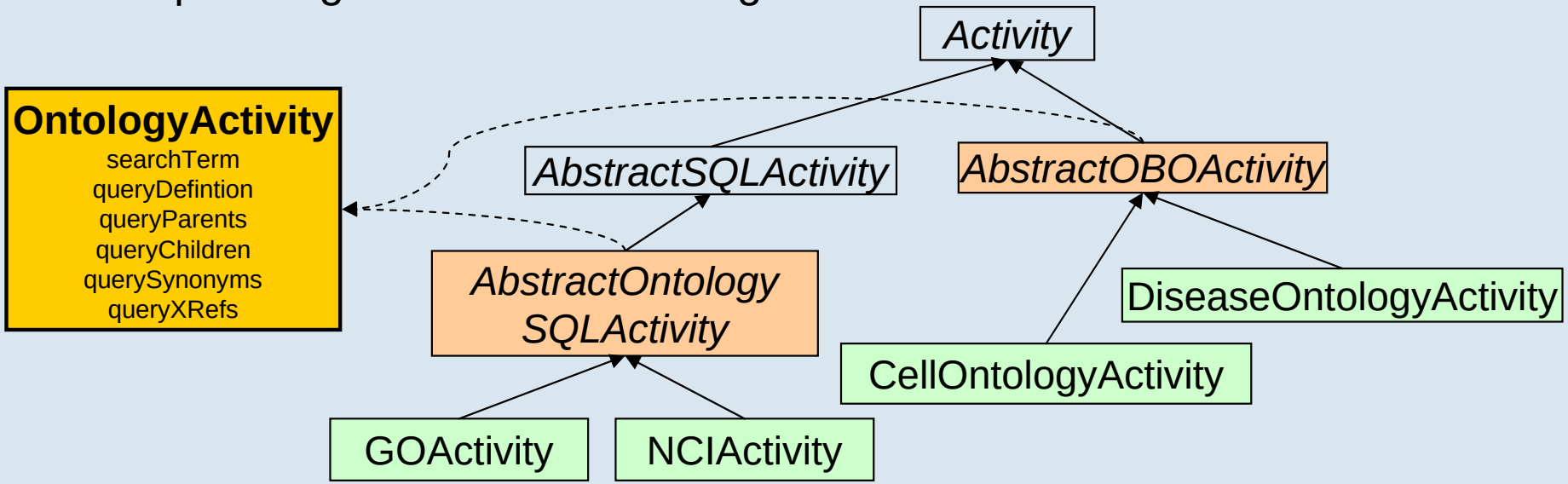
Extensions to OGSA-DAI

Ontology services as extension of OGSA-DAI data services

- **Activities**
  - Special ontology activities as wrapper for ontology sources
  - Central ontology interface: OntologyActivity
  - Hierarchy of ontology activities
  - Simple integration of new ontologies



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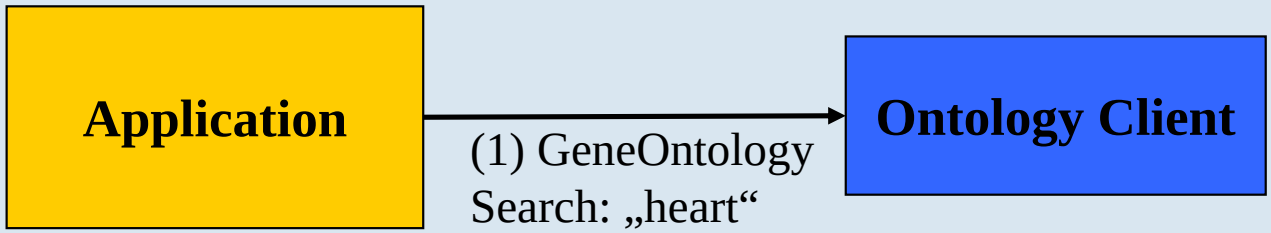

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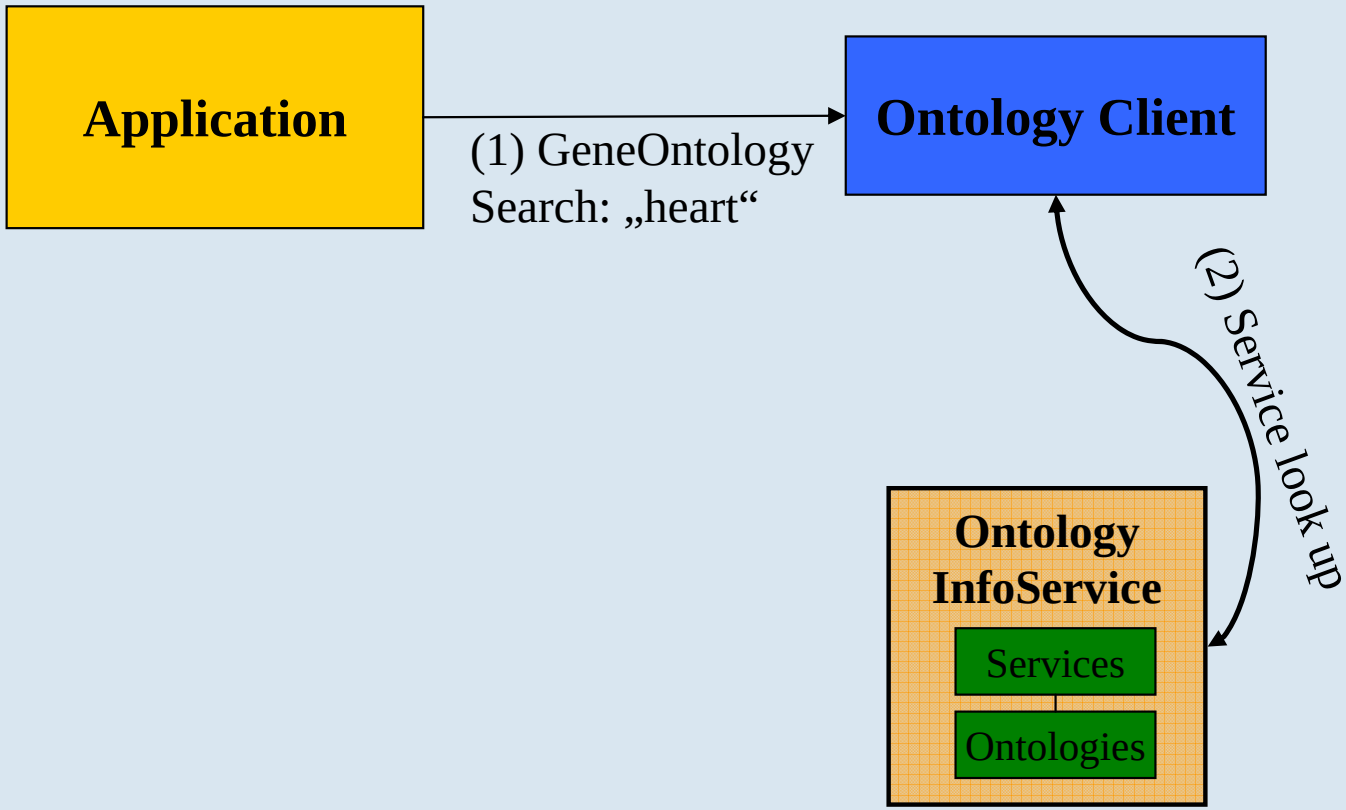

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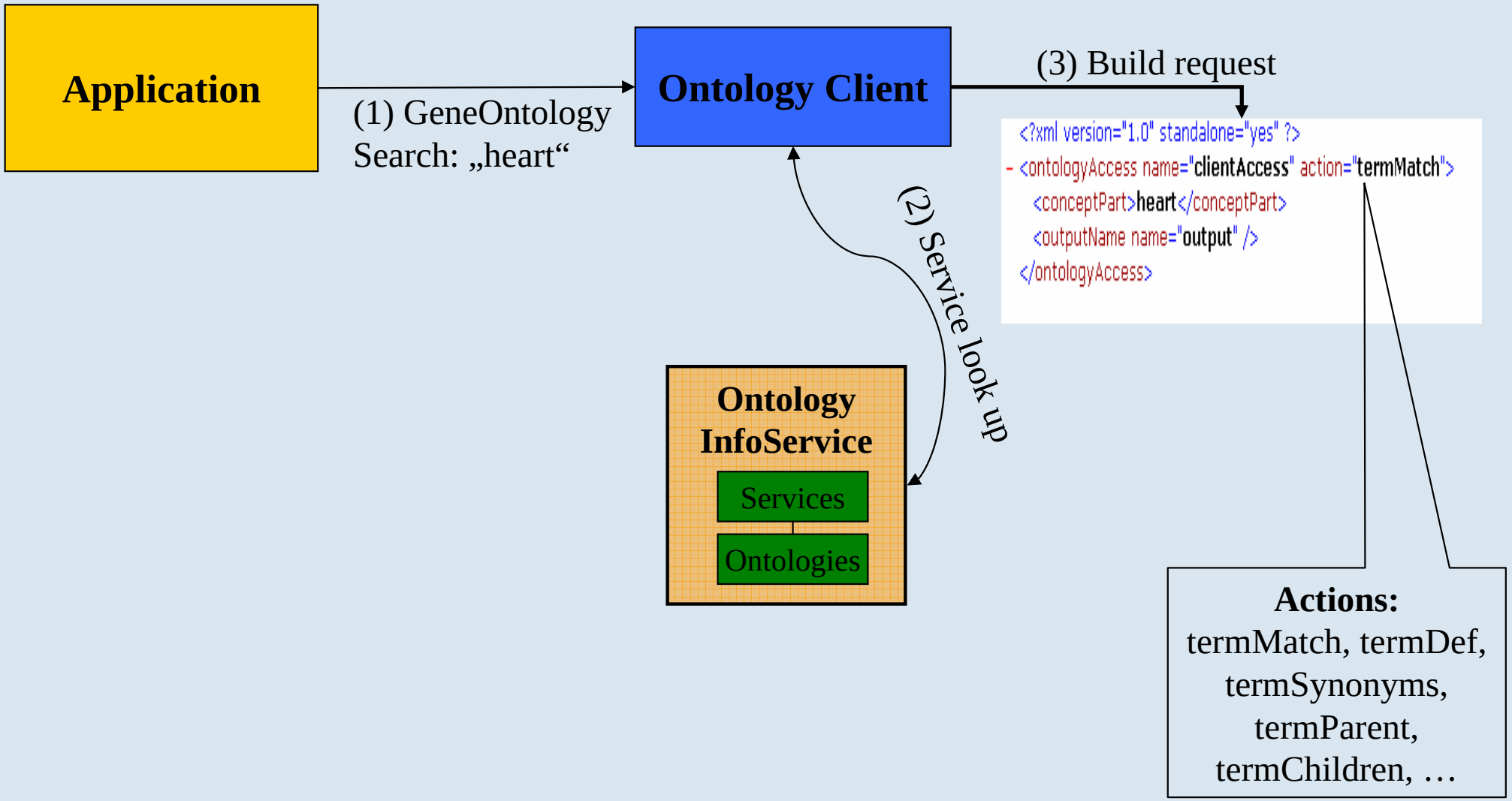
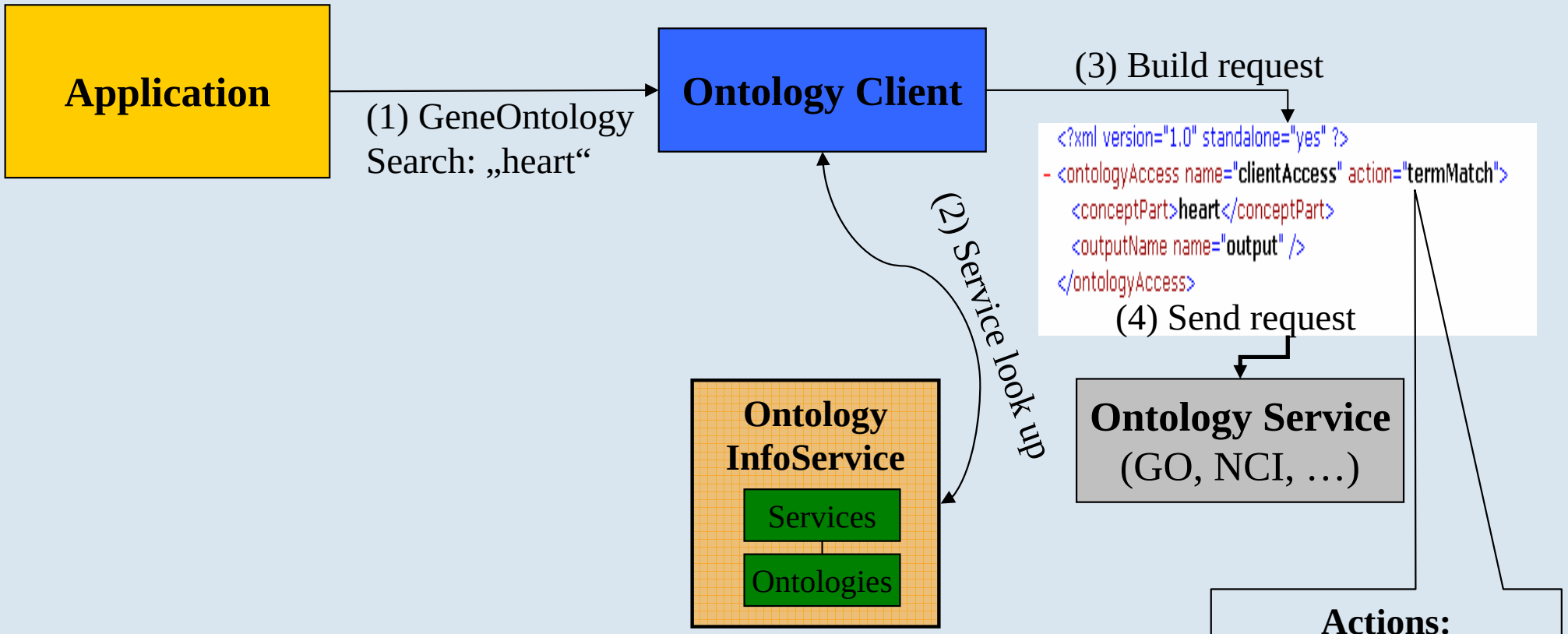

Application
(1) GeneOntology Search: „heart“
Ontology Client
(3) Build request
<?xml version="1.0" standalone="yes" ?>
- <ontologyAccess name="clientAccess" action="termMatch">
<conceptPart>heart</conceptPart>
<outputName name="output" />
</ontologyAccess>
(2) Service look up
Ontology InfoService
Services
Ontologies
Actions:
termMatch, termDef, termSynonyms, termParent, termChildren, …



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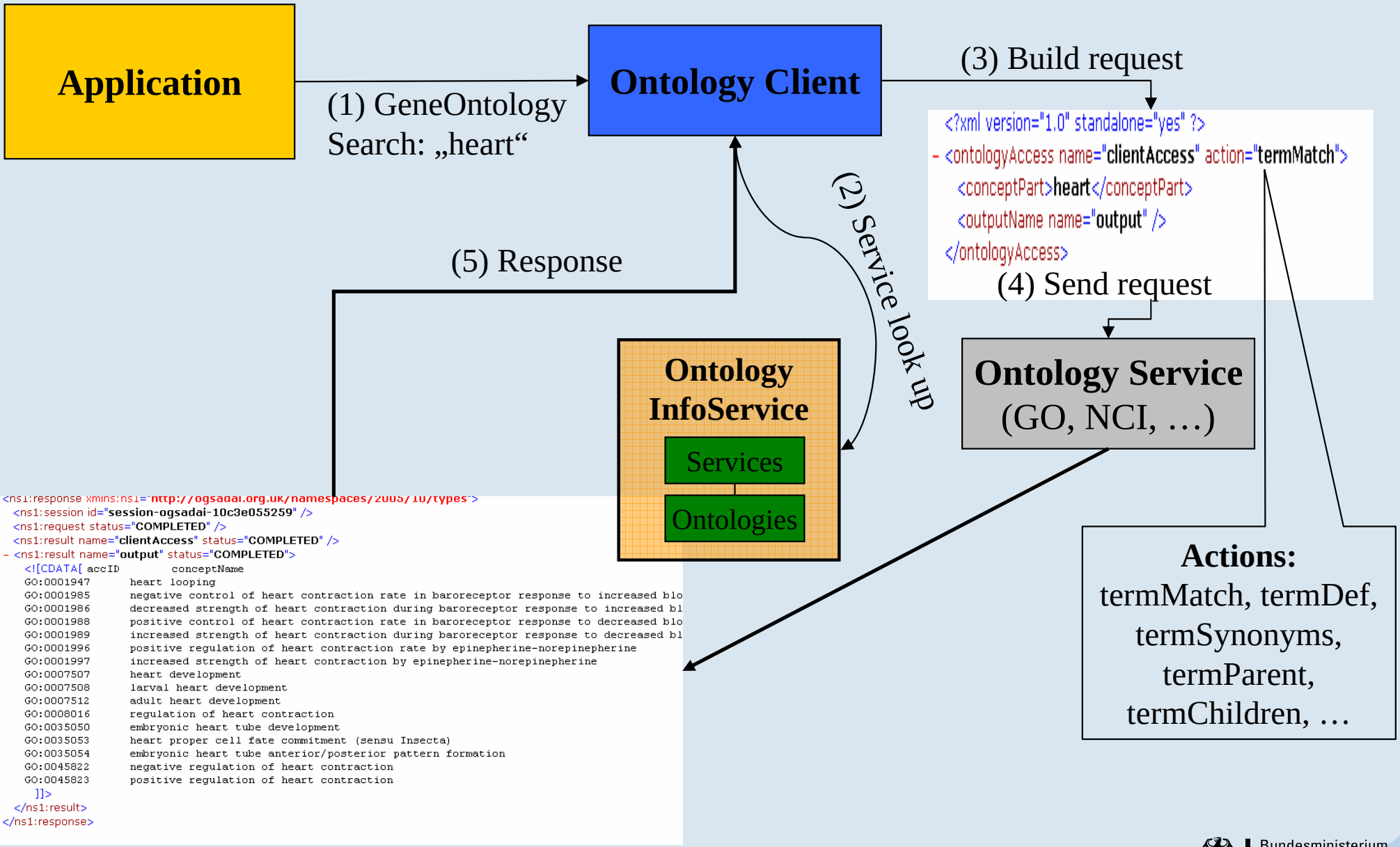
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(4) Send request
(2) Service look up
(5) Response
Ontology InfoService
Services
Ontologies
Ontology Service (GO, NCI, …)
- <ns1:response xmlns:ns1="http://ogsadai.org.uk/namespaces/2005/10/types">
<ns1:session id="session-ogsadai-10c3e055259" />
<ns1:request status="COMPLETED" />
<ns1:result name="clientAccess" status="COMPLETED" />
- <ns1:result name="output" status="COMPLETED">
<![CDATA[accID conceptName
GO:0001947 heart looping
GO:0001985 negative control of heart contraction rate in baroreceptor response to increased blo
GO:0001986 decreased strength of heart contraction during baroreceptor response to increased bl
GO:0001988 positive control of heart contraction rate in baroreceptor response to decreased blo
GO:0001989 increased strength of heart contraction during baroreceptor response to decreased bl
GO:0001996 positive regulation of heart contraction rate by epinepherine-norepinepherine
GO:0001997 increased strength of heart contraction by epinepherine-norepinepherine
GO:0007507 heart development
GO:0007508 larval heart development
GO:0007512 adult heart development
GO:0008016 regulation of heart contraction
GO:0035050 embryonic heart tube development
GO:0035053 heart proper cell fate commitment (sensu Insecta)
GO:0035054 embryonic heart tube anterior/posterior pattern formation
GO:0045822 negative regulation of heart contraction
GO:0045823 positive regulation of heart contraction
]]>
</ns1:result>
</ns1:response>
Actions:
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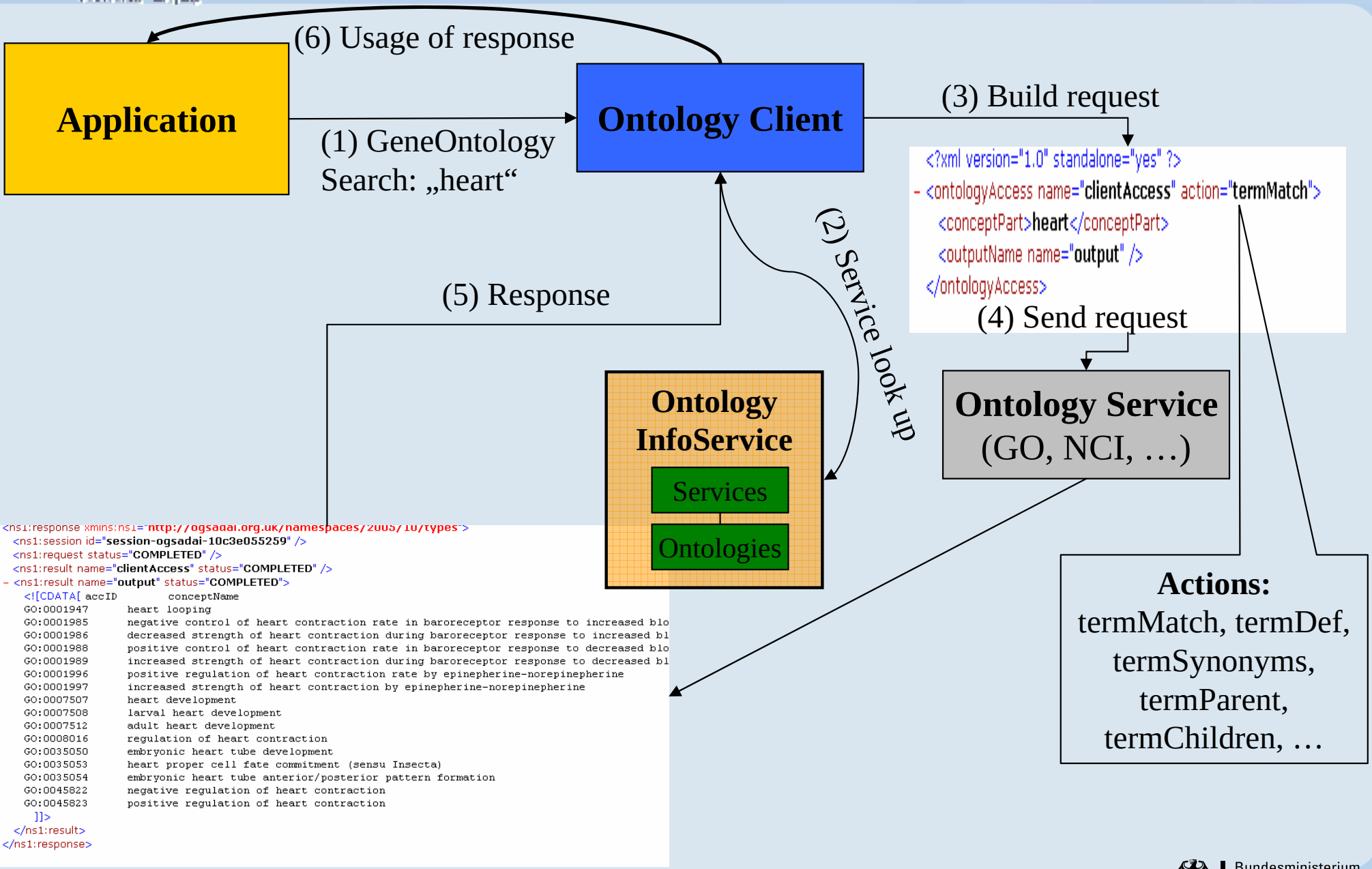
(6) Usage of response
Application
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<?xml version="1.0" standalone="yes" ?>
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GO:0001997 increased strength of heart contraction by epinepherine-norepinepherine
GO:0007507 heart development
GO:0007508 larval heart development
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Applications using the middleware

MediGRID portal as central entry to grid applications

- **Advantages**
  - User friendly interaction with grid resources
  - Central access without knowledge about resource locations etc.
  - Portlets as re-usable software components
  - Graphical representation of results, workspace for users

- **Ontology Access Middleware in the MediGRID portal**
  - Ontology Client interacts with distributed Ontology Services
  - Client is integrated in application portlets

1. Central Ontology Look Up Service
2. AUGUSTUS gene prediction tool
3. SNPSelection

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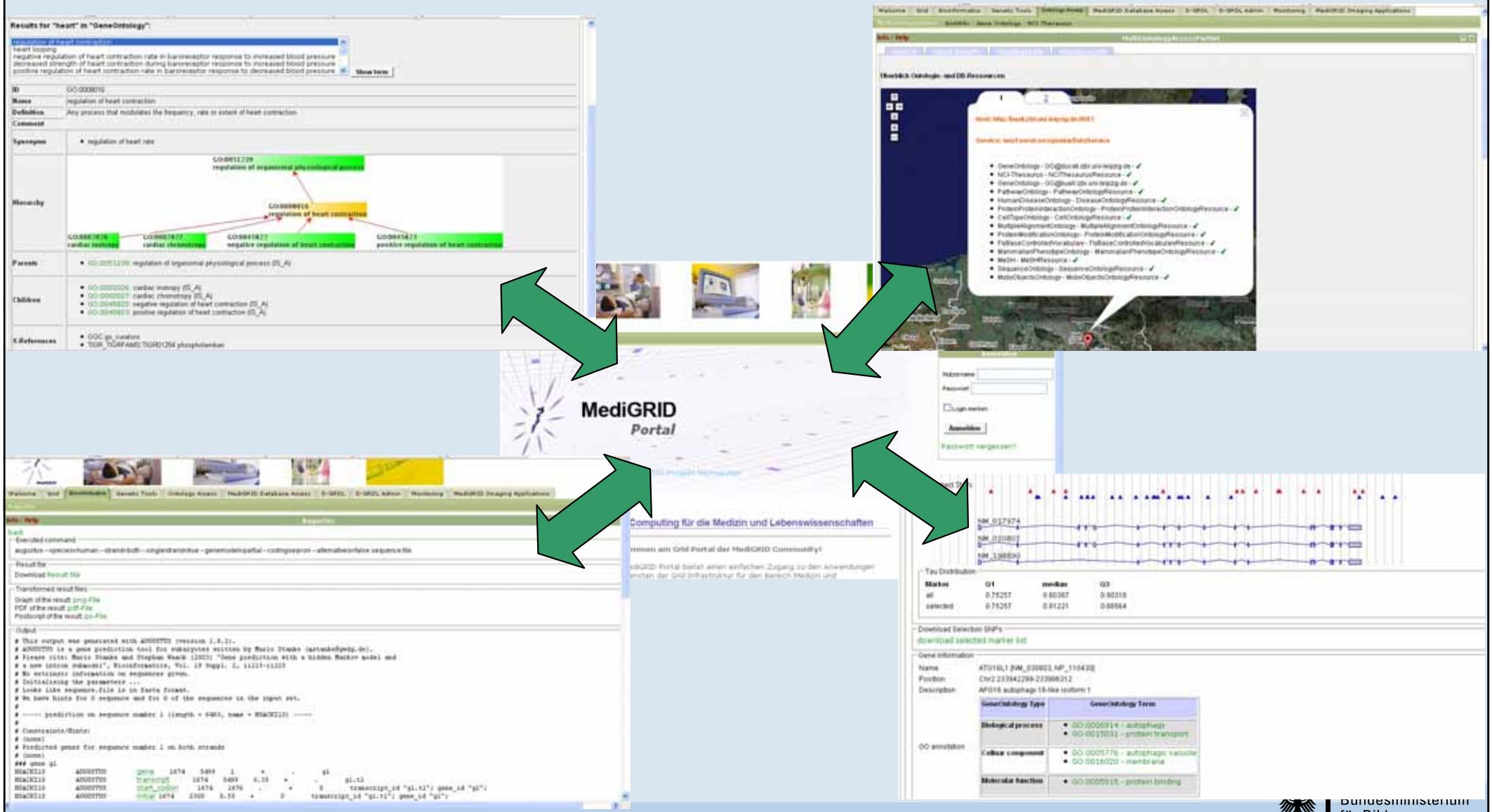
Applications using the middleware (II)



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Summary and Future

- **Service-based middleware to integrate ontologies in grids**
  - Based von grid standards (GT4, OGSA-DAI)
  - Distribution of ontologies, simple and uniform access to ontologies in grids
  - Integration in the central portal of MediGRID
  - Usage in different MediGRID applications

- **Future topics**
  - Integration of further ontologies for upcoming MediGRID applications
  - Matching of ontologies
  - Wiki-like system for collaborative editing and development of domain-specific ontologies (e.g. D-Grid initiative)