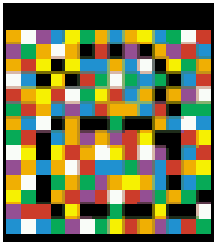
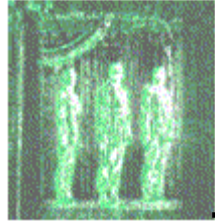


# Agent Communication & Semantic Web



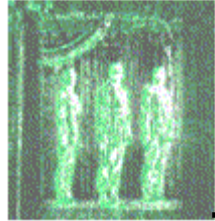


# **Agent Communication & Semantic Web**

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## Inhalt

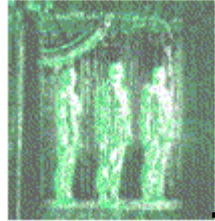
- Einführung
- Agent
- Agent Communication
- Semantic Web
- Projekt AComm
- Technologien
- Prototype III
- Zusammenfassung



# **Agent Communication & Semantic Web**

---

# **Einführung**

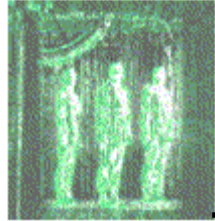


# **Agent Communication** & Semantic Web

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## Einführung

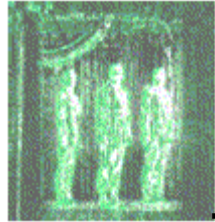
- Wer sind wir?
- Was haben wir gemacht?
- Warum sind wir hier?



# **Agent Communication & Semantic Web**

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# Agent

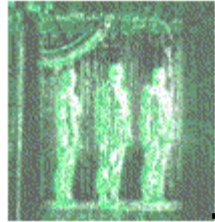


# Agent Communication & Semantic Web

---

## Agent - Allgemein

- Agent = Persönlicher Assistent
- Idee ist nicht neu
- Eigenschaften eines Agenten
  - Autonomie
  - Kommunikationsfähigkeit
  - Anpassungsfähigkeit
  - Lernfähigkeit
  - (Mobilität)

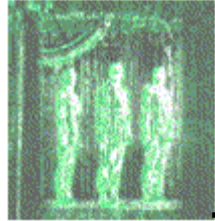


# **Agent Communication** & Semantic Web

---

## Agent - Funktionen

- Informationsbeschaffung, -verarbeitung, -speicherung
- Wissensaustausch
- Aufträge ausführen
- Anfragen verarbeiten
- Transaktionen abwickeln
- Arbeitsteilung

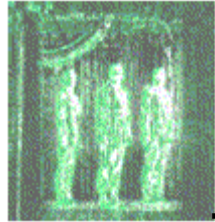


# **Agent Communication & Semantic Web**

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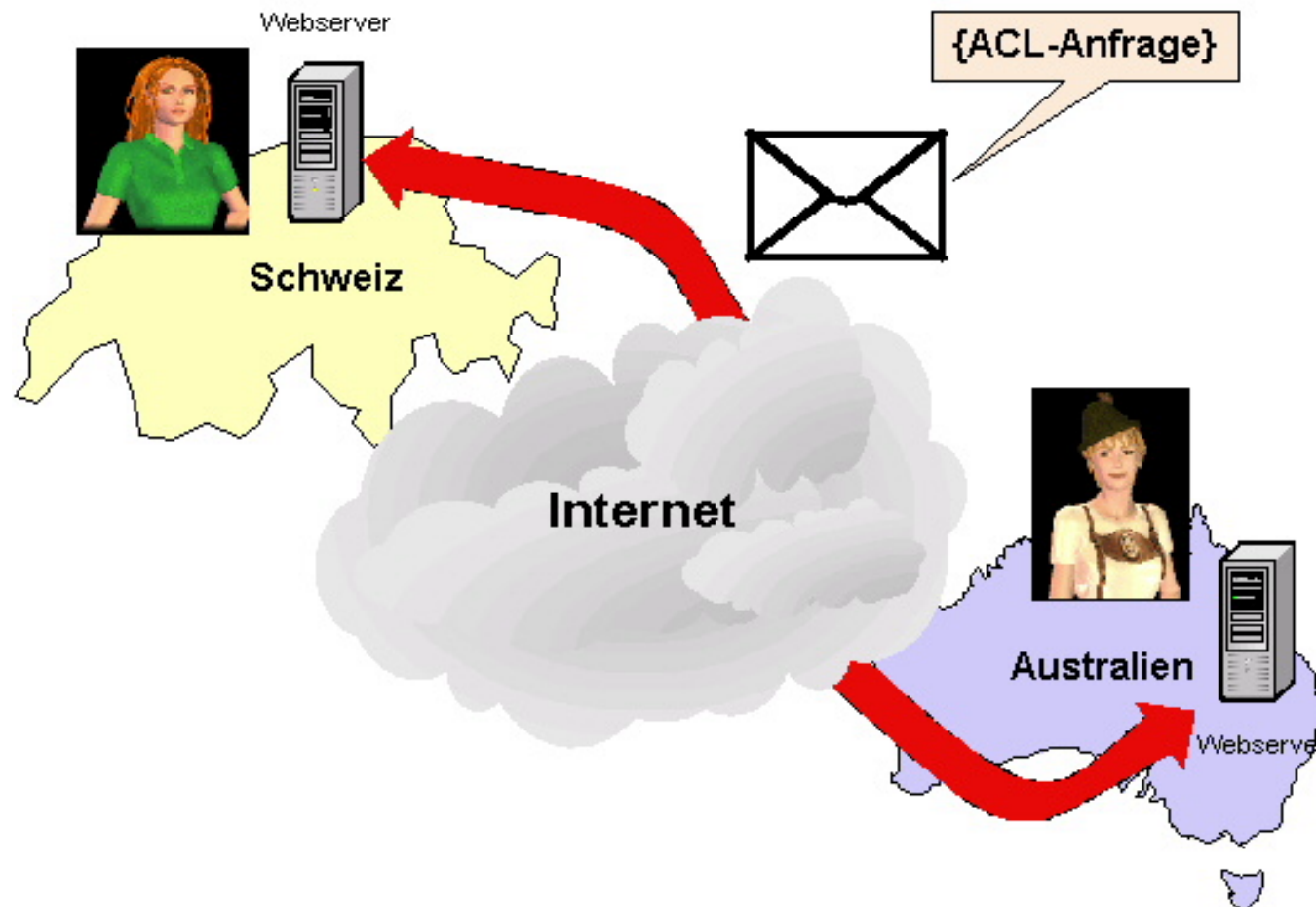
# **Agent Communication**

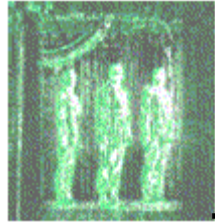




# Agent Communication & Semantic Web

## Agent Communication



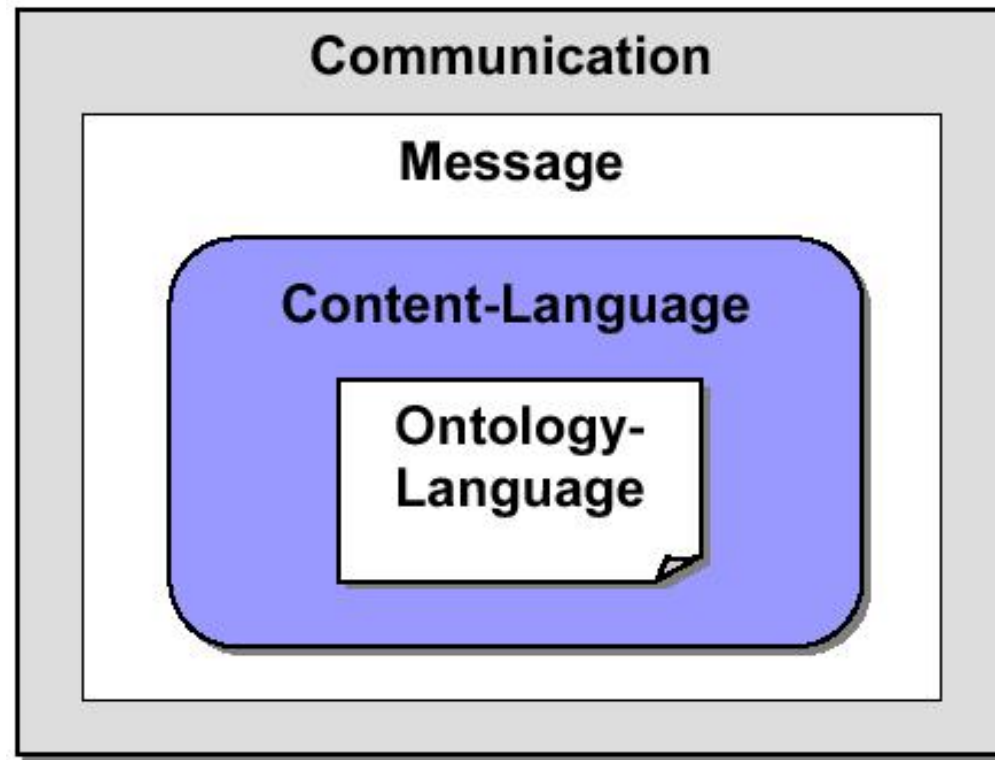


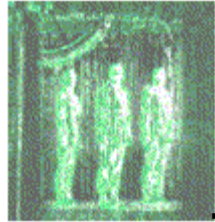
# Agent Communication & Semantic Web

---

## Agent Communication - Message

- Aufbau

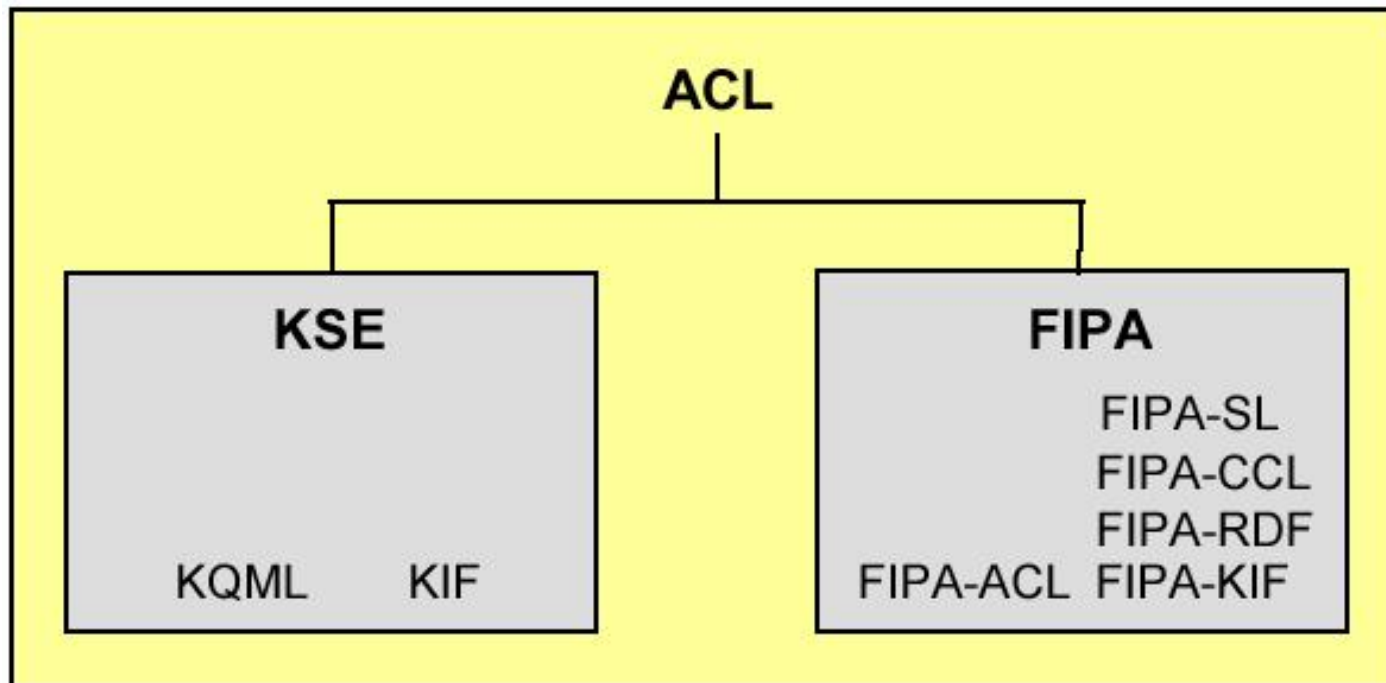


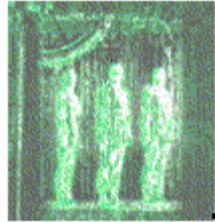


# Agent Communication & Semantic Web

## Agent Communication - Standards

- Übersicht



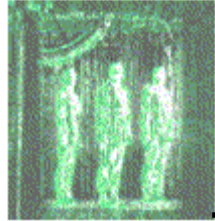


# Agent Communication & Semantic Web

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## Agent Communication – KQML in XML

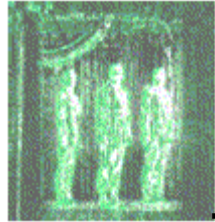
<code>(ask-one</code>		<code>&lt;?xml version="1.0"?&gt;</code>
	<code>:sender</code>	<code>&lt;word&gt;</code>
	<code>:receiver</code>	<code>&lt;word&gt;</code>
<code>*</code>	<code>:in-reply-to</code>	<code>&lt;word&gt;</code>
	<code>:reply-with</code>	<code>&lt;word&gt;</code>
	<code>:language</code>	<code>&lt;word&gt;</code>
	<code>:ontology</code>	<code>&lt;word&gt;</code>
	<code>:content</code>	<code>&lt;expression&gt;</code>
		<code>&lt;kqml&gt;</code>
		<code>&lt;ask-one</code>
		<code>  sender="A"</code>
		<code>  receiver="B"</code>
		<code>  reply-with="id0"</code>
		<code>  language="xKIF"</code>
		<code>  ontology=""&gt;</code>
		<code>  &lt;content&gt;</code>
		<code>    ...</code>
		<code>  &lt;/content&gt;</code>
		<code>&lt;/ask-one&gt;</code>
		<code>&lt;/kqml&gt;</code>



# **Agent Communication & Semantic Web**

---

# **Semantic Web**

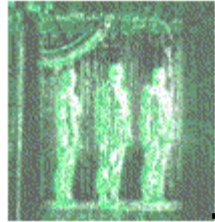


# **Agent Communication** & Semantic Web

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## Semantic Web

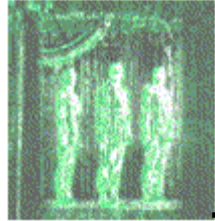
- Second Generation Web
- Daten im Internet sollen für Mensch und Maschine verständlich abgelegt werden  
→ Dies wird durch den Einsatz von Metadaten erreicht



# **Agent Communication & Semantic Web**

---

# **Projekt AComm**



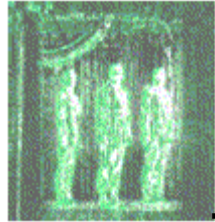
# **Agent Communication** & Semantic Web

---

## Projekt AComm - Ziele

- Realisierung eines Agenten Systems mit statischen Agenten
- Die Agenten können miteinander kommunizieren und Wissen austauschen
- Entwicklung verschiedener Prototypen
- Einsatz von neusten Technologien

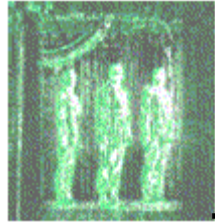




# **Agent Communication & Semantic Web**

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# **Technologien**

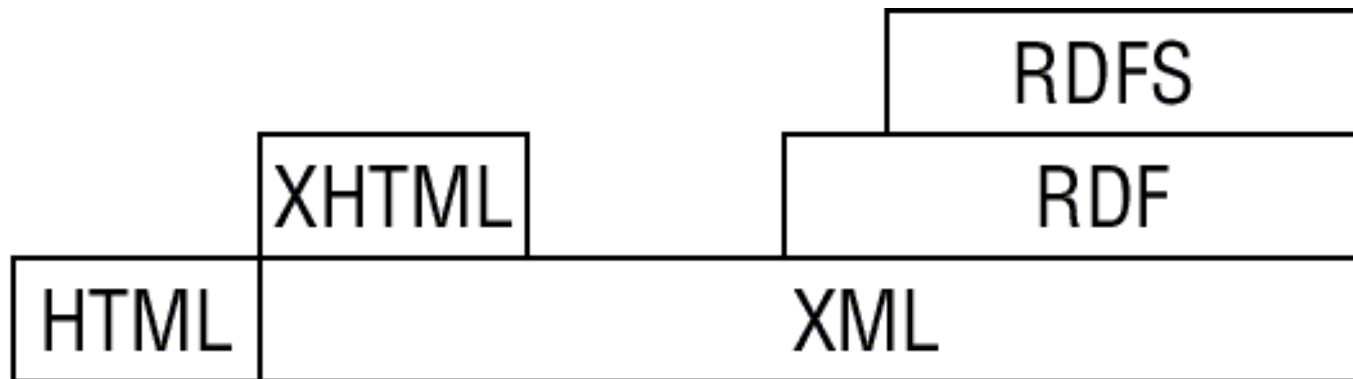


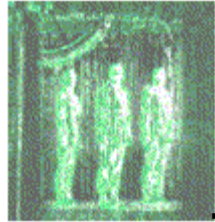
# Agent Communication & Semantic Web

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## Technologien - RDF(S)

- Resource Description Framework (Schema)
- Der RDF Standard bietet einen Rahmen für die Behandlung von Metadaten



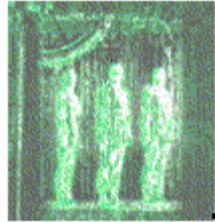


# Agent Communication & Semantic Web

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## Technologien - RDF(S)

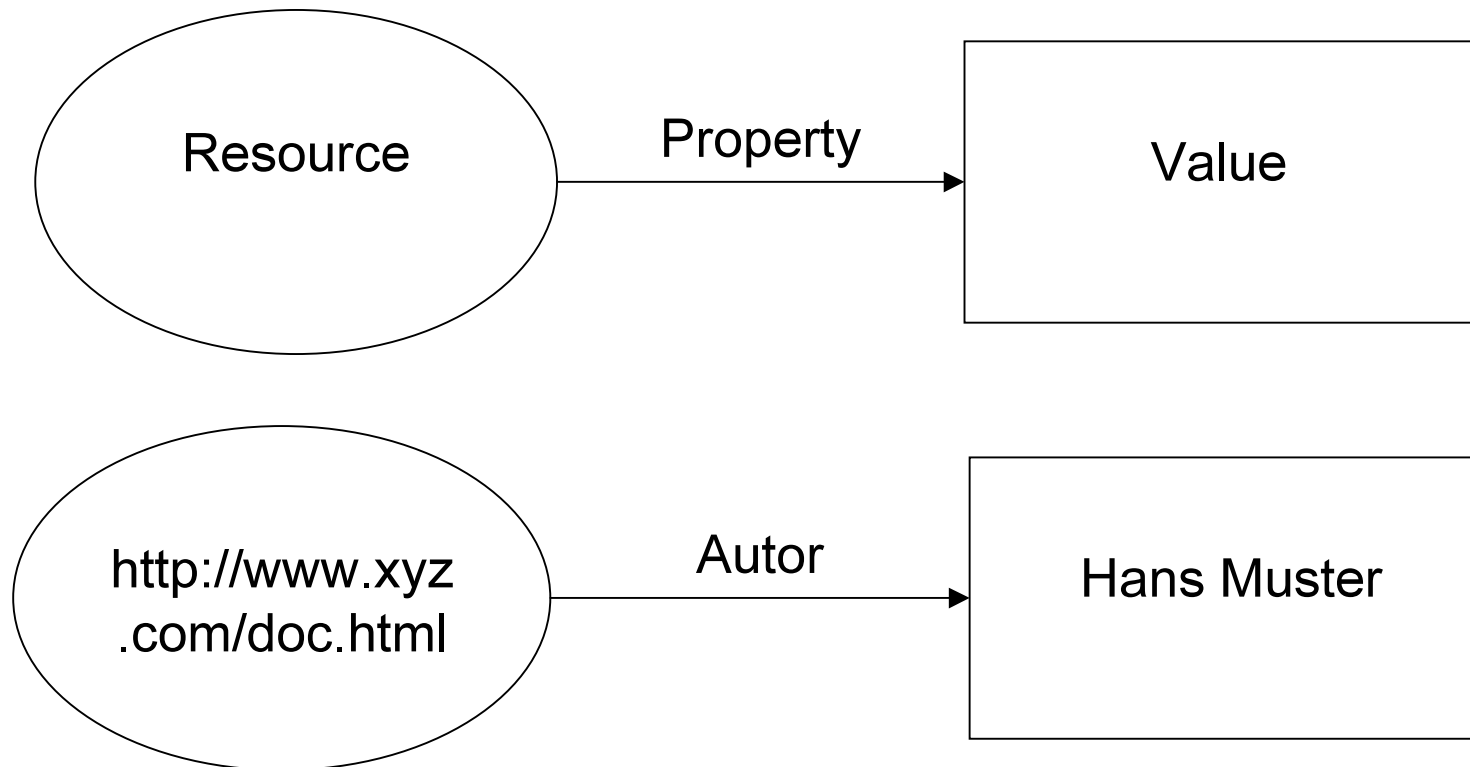
- *RDF*:
  - Definiert den Syntax und ein einfaches Datenmodell für Metadaten
  - Aufgabe: Beschreibung von Ressourcen
- *RDFS*:
  - Erweiterung der fundamentalen Modellierungsgrundlagen von RDF (vgl. Java)
  - Aufgabe: Definition des Wortschatzes, der Struktur und den Nebenbedingungen

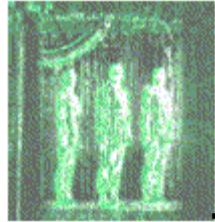


# Agent Communication & Semantic Web

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## Technologien - RDF Datenmodell



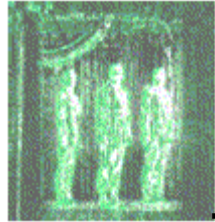


# Agent Communication & Semantic Web

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## RDF(S) – RDFS Beispiel (1/3)

```
<?xml version='1.0'?>
<rdf:RDF
  xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#"
  xmlns:rdfs="http://www.w3.org/2000/01/rdf-schema#">
  <rdfs:Class rdf:ID="Person">
    <rdfs:comment>Die Klasse von Menschen.</rdfs:comment>
    <rdfs:subClassOf rdf:resource="http://www.w3.org/2000/
03/example/classes#Animal"/>
  </rdfs:Class>
  <rdf:Property ID="ahv">
    <rdfs:comment>AHV Nummer</rdfs:comment>
    <rdfs:range rdf:resource="http://www.w3.org/2000/03/
example/classes#Integer"/>
    <rdfs:domain rdf:resource="#Person"/>
  </rdf:Property>
```

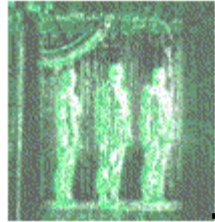


# Agent Communication & Semantic Web

---

## RDF(S) – RDFS Beispiel (2/3)

```
<rdf:Property ID="alter">
  <rdfs:range rdf:resource="http://www.w3.org/2000/03/
example/classes#Integer"/>
  <rdfs:domain rdf:resource="#Person"/>
</rdf:Property>
<rdf:Property ID="zivilStand">
  <rdfs:range rdf:resource="#ZivilStand"/>
  <rdfs:domain rdf:resource="#Person"/>
</rdf:Property>
```

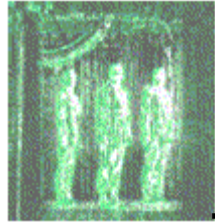


# Agent Communication & Semantic Web

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## RDF(S) – RDFS Beispiel (3/3)

```
<rdfs:Class rdf:ID="ZivilStand">
  <MaritalStatus rdf:ID="Verheiratet"/>
  <MaritalStatus rdf:ID="Verlobt"/>
  <MaritalStatus rdf:ID="Ledig"/>
  <MaritalStatus rdf:ID="Verwitwet"/>
</rdfs:Class>
</rdf:RDF>
```

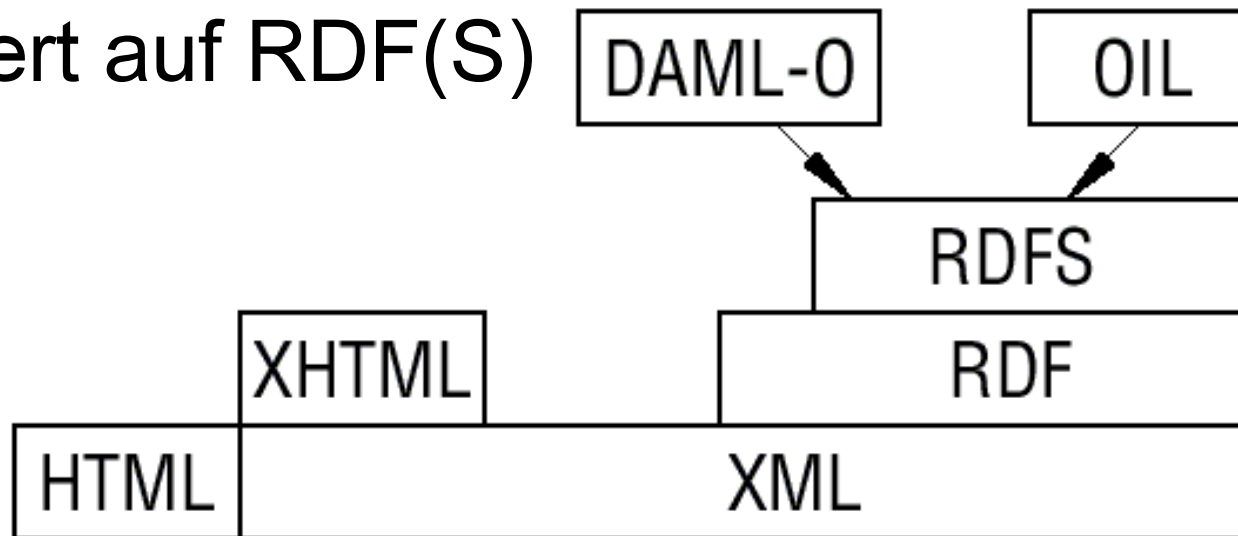


# Agent Communication & Semantic Web

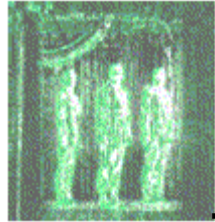
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## Technologien - DAML+OIL

- DAML+OIL (DARPA Agent Markup Language + Ontology Inference Layer)
- Weiterentwicklung von OIL
- Basiert auf RDF(S)





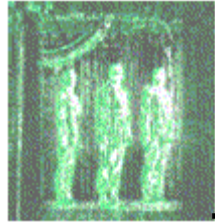


# Agent Communication & Semantic Web

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## Technologien - DAML+OIL

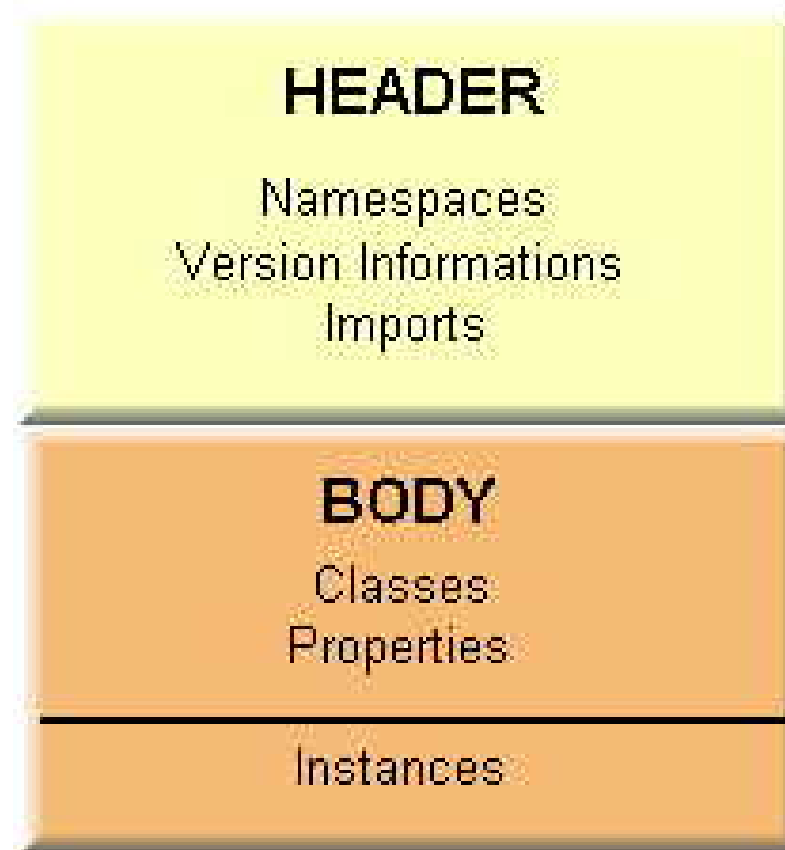
- Standard um Ontologien zu beschreiben und Informationen zu speichern
- Definition Ontologie:  
*Eine Ontologie ist ein gemeinsamer Wortschatz und eine vereinbarte Bedeutung um einen Gegenstand zu beschreiben.*

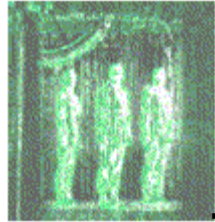


# Agent Communication & Semantic Web

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## DAML+OIL - Struktur der Sprache



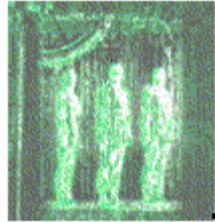


# Agent Communication & Semantic Web

---

## DAML+OIL - Beispiel (1/4)

```
<?xml version='1.0'?>
<rdf:RDF
  xmlns:rdf='http://www.w3.org/1999/02/22-rdf-syntax-ns#'
  xmlns:rdfs='http://www.w3.org/2000/01/rdf-schema#'
  xmlns:daml='http://www.daml.org/2001/03/daml+oil#'
  xmlns='http://as01/DAML/image.daml#'
>
<daml:Ontology rdf:about="">
  <daml:versionInfo>Image Ont. v0.1</daml:versionInfo>
  <rdfs:comment>AComm images ontology.</rdfs:comment>
  <daml:imports rdf:resource="http://www.daml.org/2001/
    03/daml+oil"/>
</daml:Ontology>
```



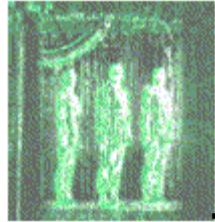
# Agent Communication & Semantic Web

---

## DAML+OIL - Beispiel (2/4)

```
<daml:Class rdf:ID="Image">
</daml:Class>

<daml:Class rdf:ID="Picture">
  <rdfs:subClassOf rdf:resource="#Image"/>
</daml:Class>
```



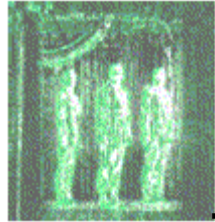
# Agent Communication & Semantic Web

---

## DAML+OIL - Beispiel (3/4)

```
<daml:Property rdf:ID="photographer">
  <daml:domain rdf:resource="#Picture"/>
  <daml:range
    rdf:resource="http://www.sri.com/daml/Person#"/>
</daml:Property>

<daml:Property rdf:ID="name">
  <daml:domain rdf:resource="#Image"/>
  <daml:range rdf:resource="http://www.daml.org/
    2001/03/daml+oil#Literal"/>
</daml:Property>
```



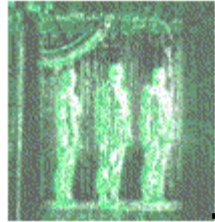
# Agent Communication & Semantic Web

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## DAML+OIL - Beispiel (4/4)

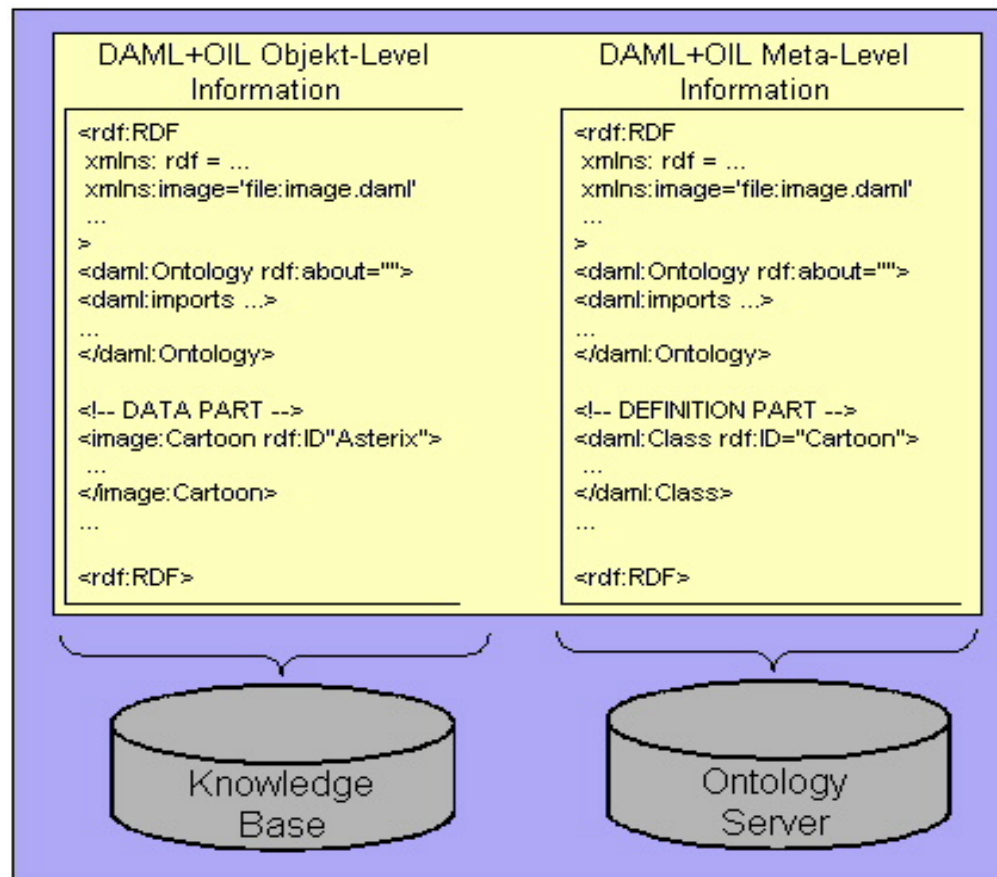
```
<Picture rdf:ID='picture0'>
  <photographer
    rdf:resource='http://www.people.com/Person#pers26' />
  <name>Sunset in Australia</name>
</Picture>

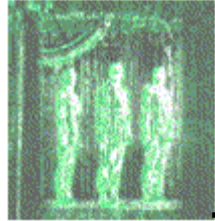
</rdf:RDF>
```



# Agent Communication & Semantic Web

## DAML+OIL - Objekt- / Meta-Level Informationen





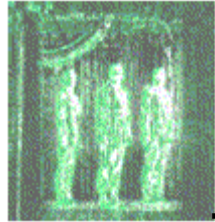
# Agent Communication & Semantic Web

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Technologien – RQL bzw. RDQL

- Resource (Description) Query Language
- Abfragesprache für RDF(S) bzw. DAML+OIL Dokumente
- Ähnlicher Syntax wie SQL
- Bis heute ist kein offizieller Standard (W3C) verfügbar



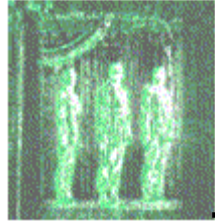


# Agent Communication & Semantic Web

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## R(D)QL – RDQL Beispiel

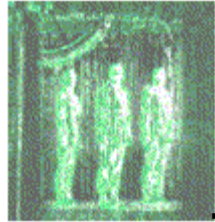
```
SELECT ?a, ?b
FROM    <http://XY/image.daml>
WHERE
  (?b, <http://XY/image.daml#subject>, ?a),
  (?b, <rdf:type>, <http://XY/image.daml#Cartoon>)
USING rdf FOR <http://www.w3.org/1999/02/
  22-rdf-syntax-ns#>
```



# **Agent Communication & Semantic Web**

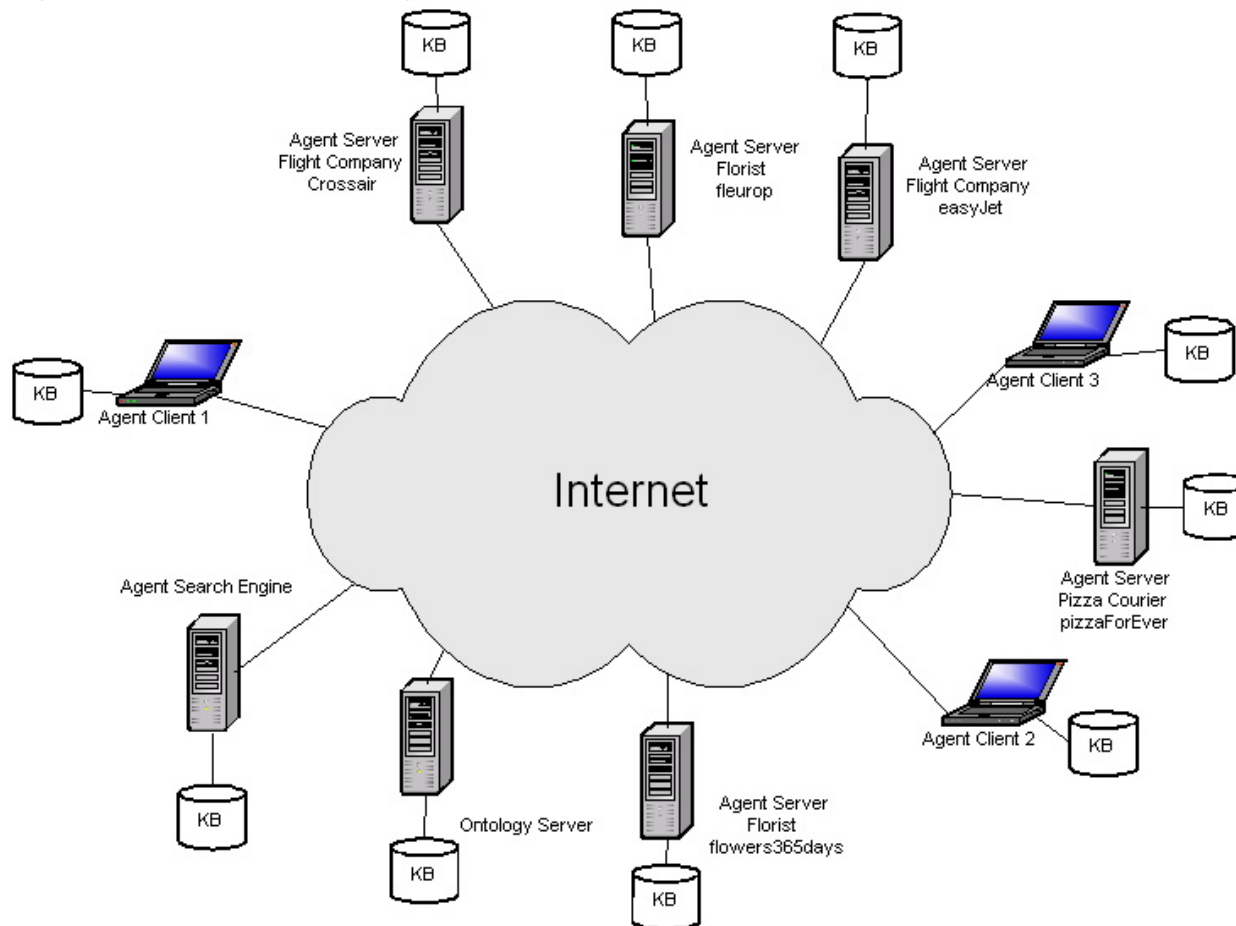
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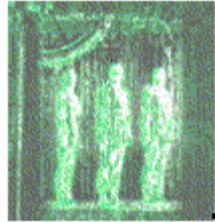
## **Prototype III**



# Agent Communication & Semantic Web

## Prototype III - System Übersicht



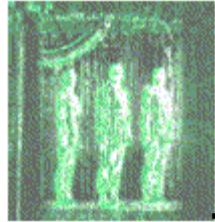


# **Agent Communication** & Semantic Web

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## Prototype III - System Komponenten

- Ontology Server
- Agent Search Engine
- Agent Servers (Diverse Anbieter)
- Agent Clients (Benutzerspezifische Agenten)

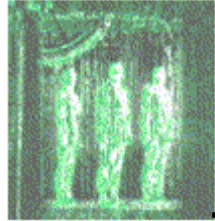


# **Agent Communication** & Semantic Web

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## Prototype III - Ontology Server

- Zentrale Stelle für das Speichern von Ontologien (Webserver)
- Die Ontologien können mittels Suchbegriffen gesucht werden
- Der Ontology Server ist ebenfalls ein Agent

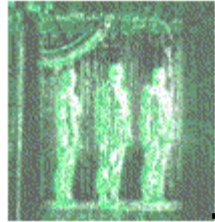


# **Agent Communication** & Semantic Web

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## Prototype III - Agent Search Engine

- Verzeichnisdienst für Agenten
- Die Agenten können sich bei der Agent Search Engine registrieren
- Die Agent Search Engine stellt Suchfunktionen für Agenten zur Verfügung
- Der Agent Search Engine ist ebenfalls ein Agent

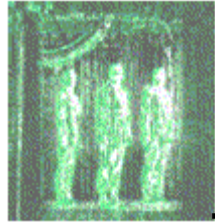


# **Agent Communication** & Semantic Web

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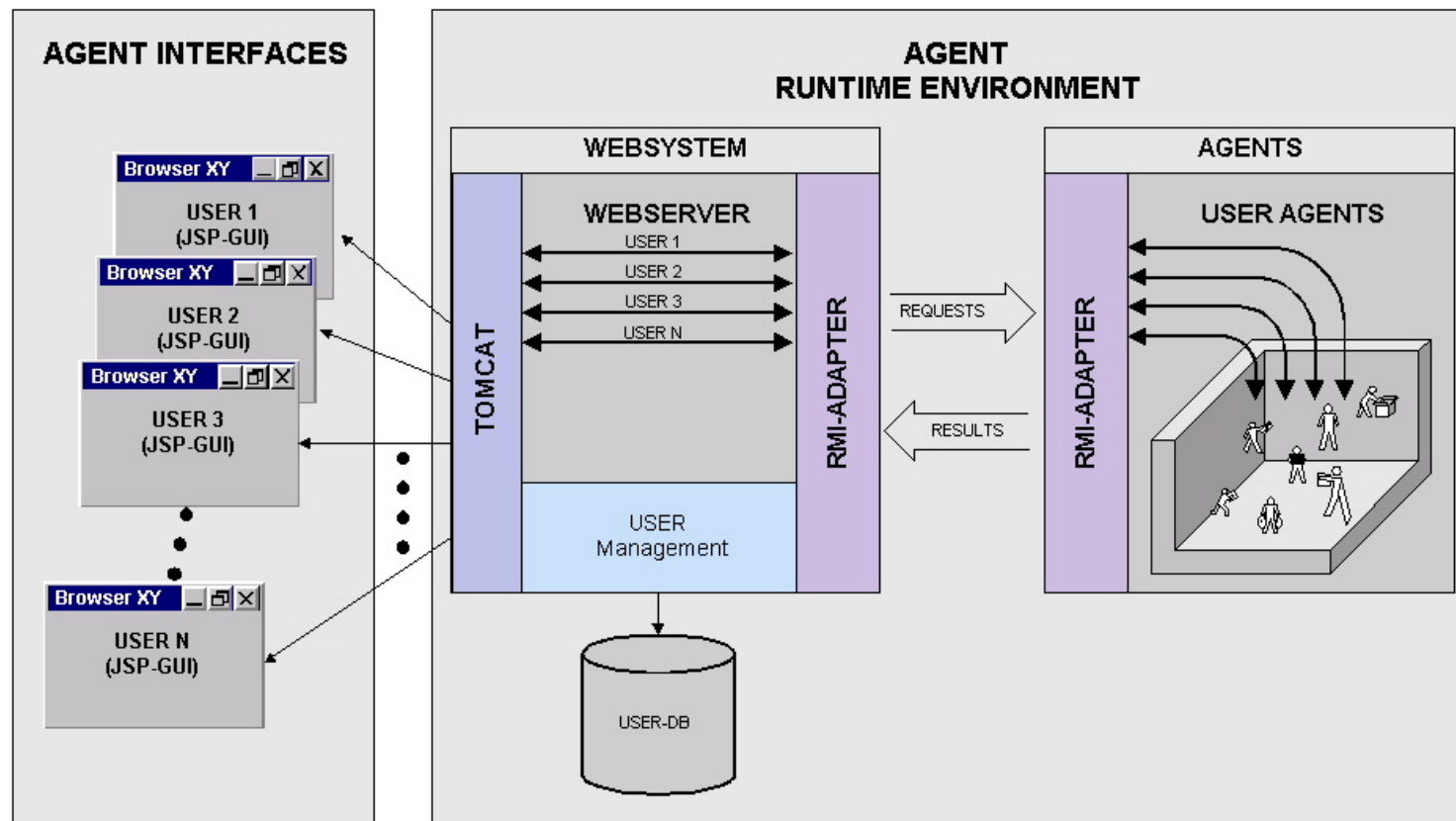
## Prototype III - Zentrales

- Jeder Agent im System baut auf der selben Software Architektur auf
- Ein Agent kann als Server wie auch als Client agieren
- Jeder Agent besitzt eine eigene KB (Knowledge Base)

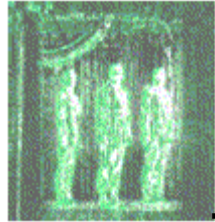


# Agent Communication & Semantic Web

## Prototype III - Agent Runtime Environment

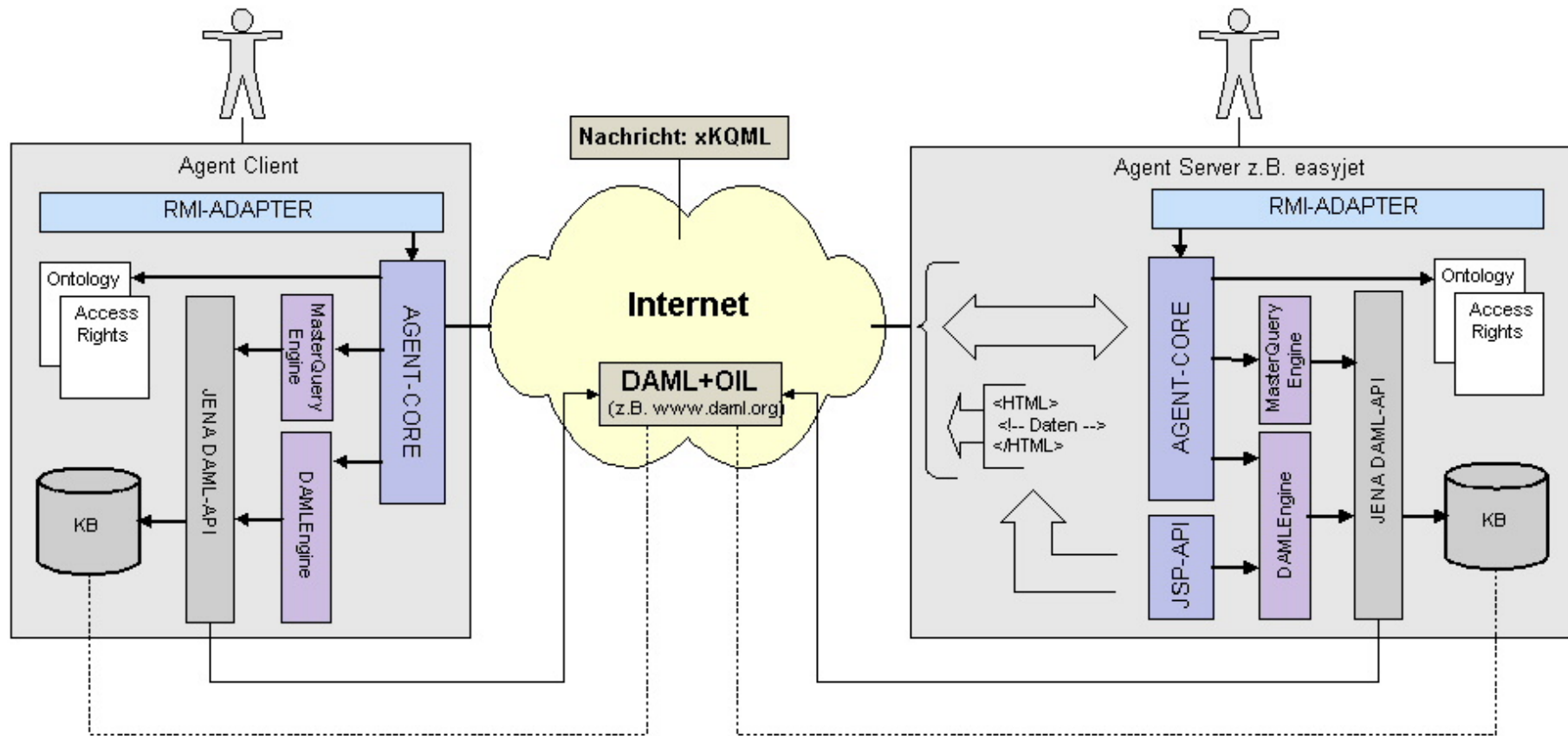


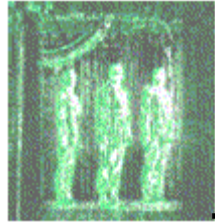




# Agent Communication & Semantic Web

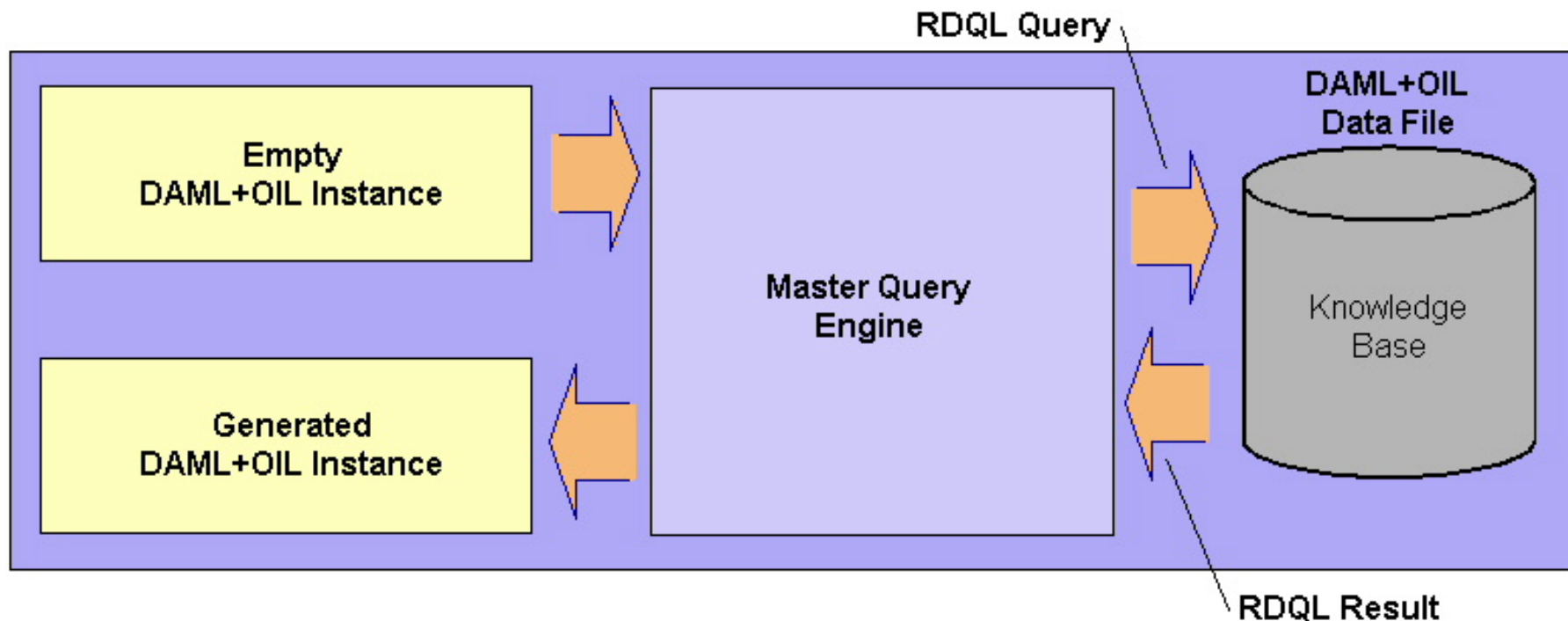
## Prototype III - Agent Architektur

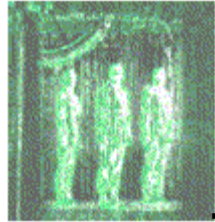




# Agent Communication & Semantic Web

## Prototype III - Wissensabfrage

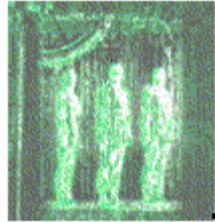




# **Agent Communication & Semantic Web**

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# **Zusammenfassung**

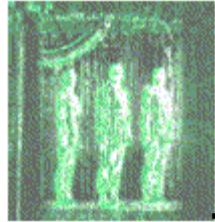


# **Agent Communication** & Semantic Web

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## Zusammenfassung

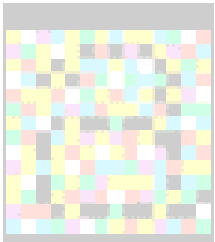
- Ontology Server nur schwer als zentrale Stelle realisierbar
- RDQL muss standardisiert werden
- Metadaten bringen ganz klare Vorteile
- KB, Ontologien und Datenaustausch basieren auf dem DAML Standard
- Für kommerziellen Einsatz zu jung



# Agent Communication & Semantic Web



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WAKE UP,  
THAT'S THE END!



artificial life

