Stephan Körnig

User Needs and Digital Libraries Design (2):

Design Principles for Digital Library Services

Objectives

- Switching to the aspects of technology / modeling of applications
- Focus on user driven development for “Scientific Networks”
- Stress on the aspects of DL-service provision

Outline

- User driven development
- Design principles for Digital Library Services
- Protocols and their usage
- Problems of technology driven development
- Conclusions

User driven development

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Conclusion

User driven development

- Roles in behalf of systems and applications
- Use Case modeling
- The “Unknown user”
- Exercise

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Types of Roles

- Three different types of roles
  - Content provider
  - Developers
  - Users
- A single person or institution will interact in different roles

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Roles: different views

Service	Provider	Developer	User
Notification / Profile Service	How to reach possible interested users, costs of metadata, …	Scalability, database model, heteroge-neity of systems, …	How to configure, no loss off interesting material, security of personal information,…

Use case modeling – Background (1)

- Analysis of „using the system“
  - Workflow / business processes
  - User behavior and requirements
  - Dependencies between system components

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Use case modeling – Background (2)

- Traditional: paperwork as part of the first analysis
- OO-development: the „user“ as part of the project team
  - Shaping system elements as objects (abstract data types) according to the user‘s view [idealiter]
  - Understandable diagrams with a real meaning for developers

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Use case modeling in UML (1)

- UML = Unified modeling Language
- Different diagram techniques
  - Type systems
  - Sequences
  - Interactions
  - State machines
  - …
  - and Use Cases

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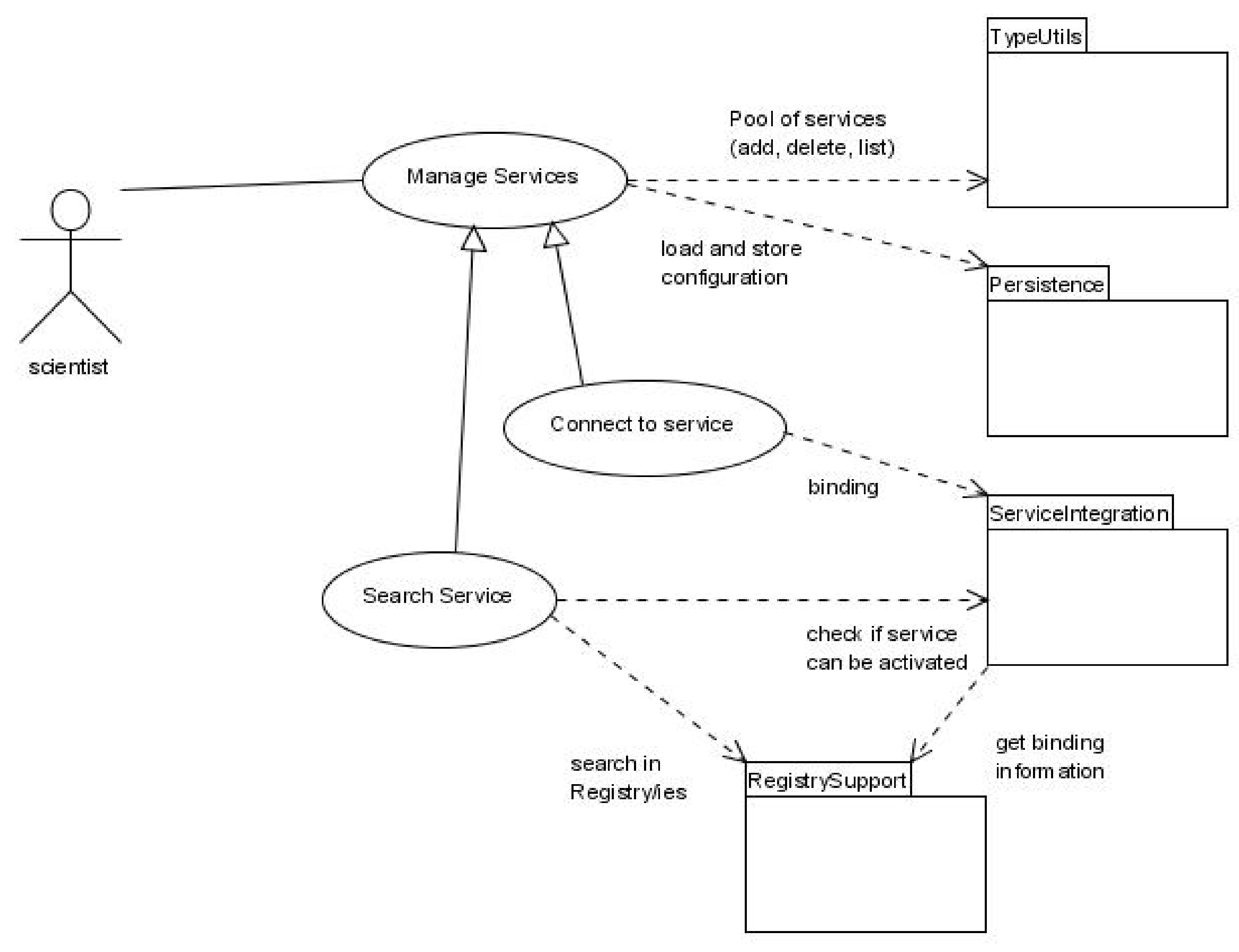

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Use case modeling in UML (2)

- Some of UML’s offers
  - Supports the whole process from design to implementation
  - Documentation according to different views
  - Reengineering of existing code
  - Refactoring
  - Code Generators
- Is this the ultimate solution to meet the user‘s needs?

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Use case modeling in UML (3)

- Developers
  - No **red button**: Code generators need as much „input“ as coding
  - Re-engineering and refactoring works good
- „User‘s view“
  - Use cases are informal
  - Correct implementation is not guaranteed
- Integration of users in project

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The „unknown user“

- Users know very well
  - What they need for their work
  - If a working system is what they need
- Users often do not know
  - How to shape an innovative and more powerful system that replaces the existing one

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Exercise

Literature:
Alistair Cockburn, „Writing Effective Use Cases“, 2001

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Design principles for DL-Services

- SOA
- „Web Services“
- REST
- How to model a distributed landscape?
- Discussion: Divergence of Web Services specs and REST

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SOA Background

- Service Oriented Architecture
- New buzzword
- Promoted by the „big players“
- Closely related to the „Web Services“ activity of the W3C (driven by the same players)

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SOA Basics

- Services as a Component
  - Platform-independent „interface contract
  - Dynamic service localization
  - Self-containg: service maintains its own state
- Communication via messages
- W3C „Web Services“ as a framework for SOA

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Web Services

- Just another hype?
- Basics
- Perspectives
- Drawbacks and limitations

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Web Services – the Hype

- What does this term imply?
  - Every service in the web is a web service
  - Generic approach
- Support by the big players
- Open standardization process
- Self-describing capabilities
- XML based

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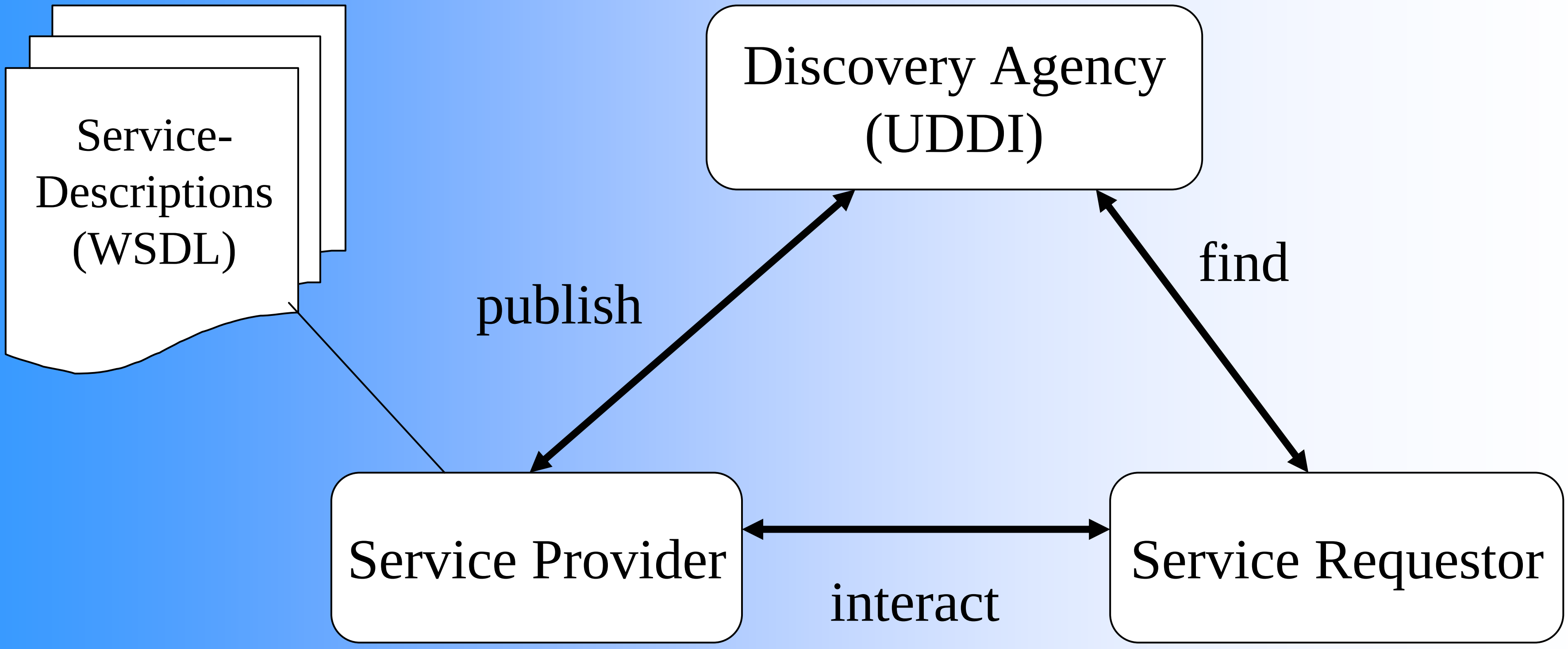
Web Services Basics

- RPC (Remote Procedure Calls) via HTTP
- Interaction of loosely coupled and reusable components
- Integration of legacy systems
- Machine readable interface descriptions (WSDL)

Provision of Web Services



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Web Services - Perspectives

- Generic, all-purpose specification based on XML
- Possibilities for automated workflows
- Allows visibility of offers (services, content,...)
- Needs frameworks to be useful for a specific domain

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Web Services – Open Problems

- Still undergoing changes
- WSDL tries to support divergent concepts
  - Object oriented
  - Functional programming
  - Relational database modeling

➡ Automated processing of „any to any“ not possible

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REST - Background

- „Representational State Transfer“
- Roy T. Fielding 2000: „Architectural Styles and the Design of Network-based Software Architectures“ (Dissertation)
- Model for the modern Web architecture

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REST – Concepts (1)

- Utilizes the widely accepted standards
  - URI (addressing, localization)
  - HTTP (communication)
  - HTML (links)
- Basic concept: resource
  - Representation, not the object itself
  - Accessible via URI

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REST – Concepts (2)

- Stateless Client-Server interactions
  - Each request contains all necessary information to be executed
  - Server status is always unknown
- Resources marked as "cacheable" or "non-cacheable"
- Code on demand

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REST - Perspectives

- Not technology-dependent
- URI-space instead of layered architectures
- Allows straightforward implementations (no protocol stack overhead)
- Not compliant to the vision of the “machine-readable” Web

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Modeling the Landscape

- Vendors try to do so – we should even not try…
- Prescribing a technology will not be accepted
- Investments in metadata and conversion to XML-formats
- Available technology offers an infrastructure for DL-Services

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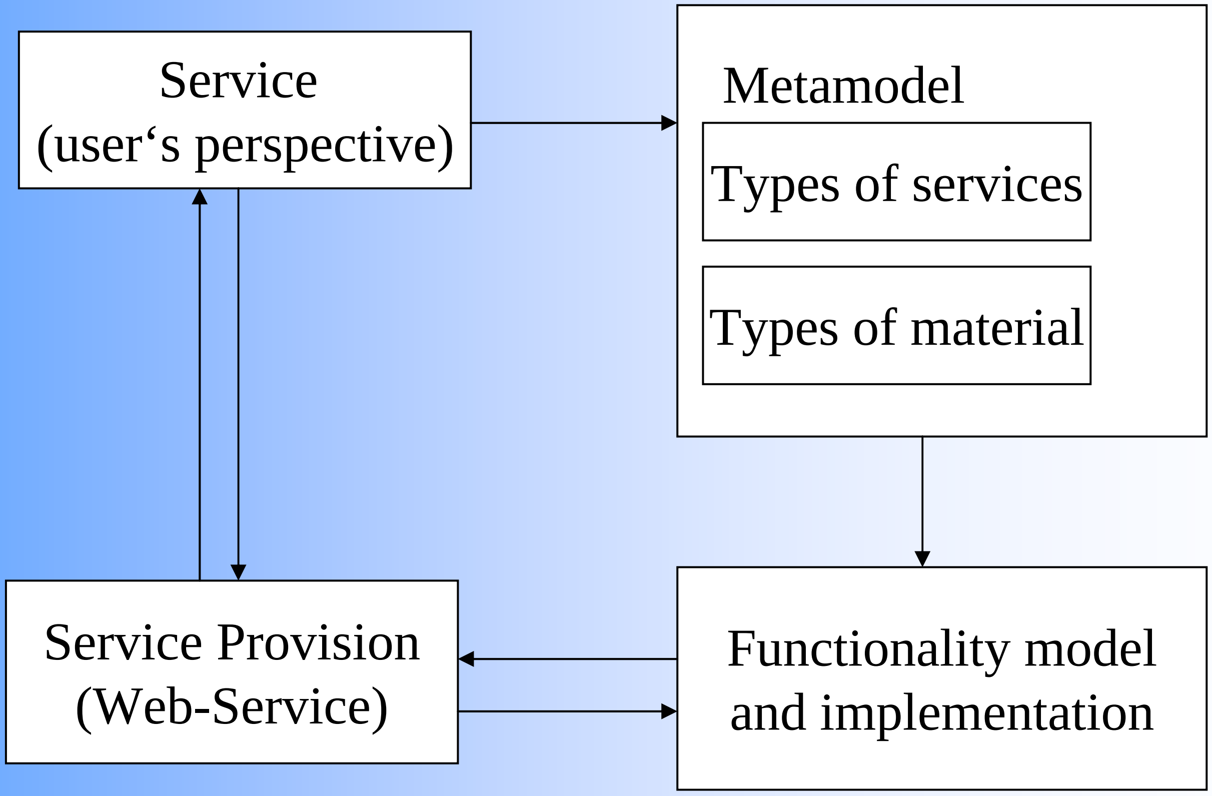
DL-Services (logical view)



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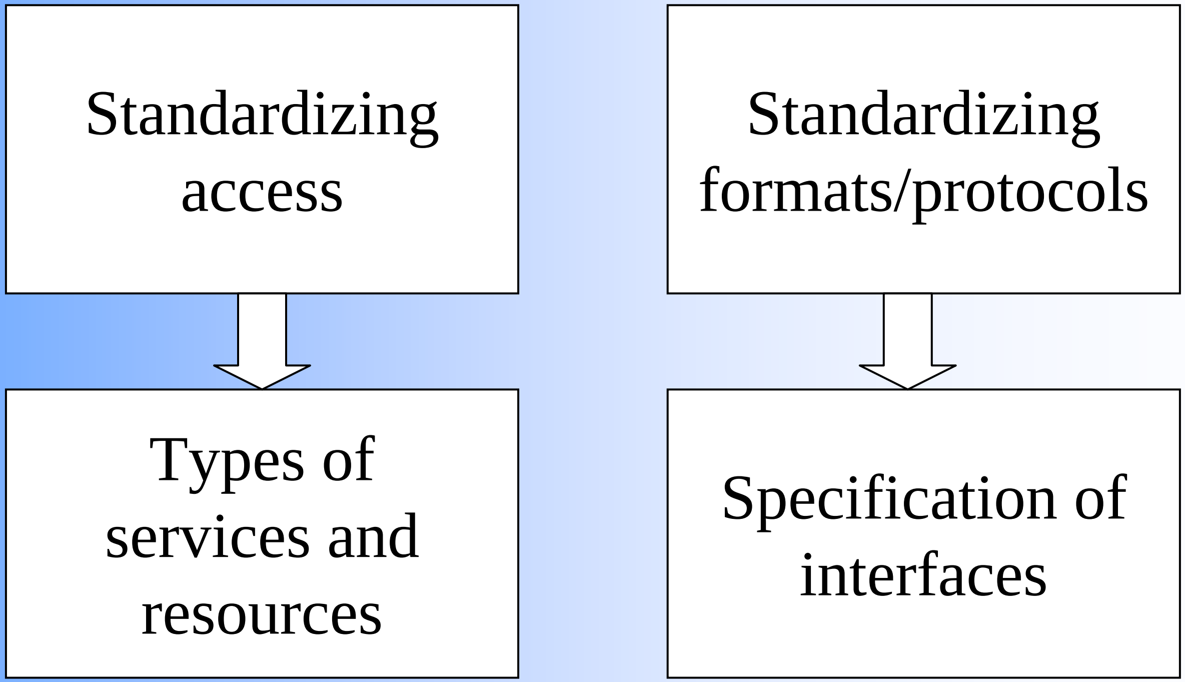
Access and Formats



Standardizing access

Types of services and resources

Standardizing formats/protocols

Specification of interfaces

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Type System: Services

- Authentication/Identification
- Search for services/content
- Management of structured research/education related information
- Communication
- Serializing/Rendering
- Archiving

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Type System: Types of Resources

- Application specific data
- Data structures (aggregates of basic types)
- Documents
- Metadata
- References (links, identifiers, handles, …)

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REST-style Interfaces

- Foundation is the REST model
  - HTTP: GET, PUT, DELETE und POST
- General operations
  - Insert
  - Read
  - Update
  - Search
  - Delete

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REST-style Interfaces

- Services are accessible via an URL
- Explain service as starting point
- Example: Typekit (www.typekit.org)

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Conclusion

Protocols and Usage

- Protocols and Standardization
- Z39.50
- OAI-PMH
- XML-RPC
- SOAP
- SRW / ZING
- WebDAV
- On „Layered Technologies“

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Protocols and Standardization (1)

- Supporting standards nowadays is a „conditio sine qua non“
- Standards as a part of the problem
  - Standardizing of own products is an advantage in the market
  - Too high/low level of details, due to strategic considerations
  - Standardizing is research

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Protocols and Standardization (2)

- Protocol = standard?
- Open and de facto standards
- Conclusion:
  - Use the most promising standards not in technological but in user‘s perspective
  - Reuse available standards whenever possible
  - Make the usage of standards explicit (e.g. Registries, Typekit, Explain-Services, etc.)

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Z39.50 (1)

- Protocol to access OPACs (Online Public Access Catalog)
- Specifies services from the user‘s (librarians) point of view
- Copes with heterogeneity
- Can be utilized for distributed services
- Can support distributed systems / huge amount of (bibliographic) datasets

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Z39.50 (2)

- Connects client stateful to server
- ASN-1 for data exchange
- Core services for search and retrieval
- Extended services to support the use case “OPAC”
- Explain Service
- Supports diverse bibliographic formats

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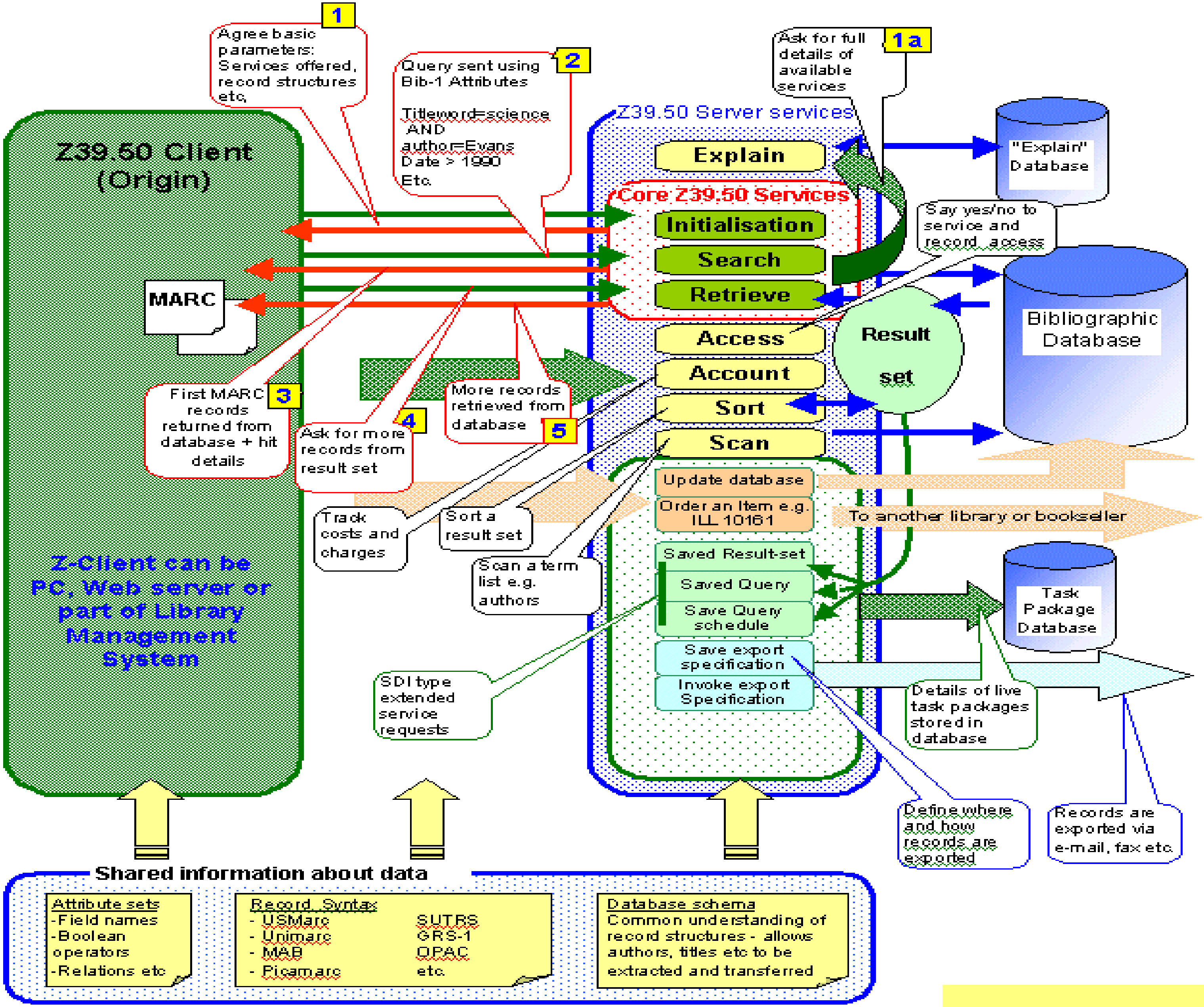
Z39.50 (3)

- ASN-1 is obsolete
- Heavy-weight protocol
  - Very rich functionality
  - Stateful protocol
  - Hard to implement
- Not widely supported
- Incomplete implementations


1
Agree basic parameters: Services offered, record structures etc.
2
Query sent using Bib-1 Attributes
Titleword=science AND author=Evans Date > 1990 Etc.
1a
Ask for full details of available services
Z39.50 Client (Origin)
MARC
Z39.50 Server services
Explain
"Explain" Database
Core Z39.50 Services
Initialisation
Search
Retrieve
Say yes/no to service and record access
Bibliographic Database
Access
Account
Sort
Scan
Result set
3
First MARC records returned from database + hit details
4
Ask for more records from result set
More records retrieved from database
5
Track costs and charges
Sort a result set
Scan a term list e.g. authors
Update database
Order an Item e.g. ILL 10161
To another library or bookseller
Saved Result-set
Saved Query
Save Query schedule
Task Package Database
Save export specification
Invoke export Specification
Details of live task packages stored in database
Z-Client can be PC, Web server or part of Library Management System
SDI type extended service requests
Define where and how records are exported
Records are exported via e-mail, fax etc.
Shared information about data
Attribute sets
-Field names
-Boolean operators
-Relations etc
Record Syntax
- USMarc
- Unimarc
- MAB
- Picamarc
SUTRS
GRS-1
OPAC
etc.
Database schema
Common understanding of record structures - allows authors, titles etc to be extracted and transferred

Any questions?

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Open Archives Initiative (1)

- Metadata harvesting of open archives
- OAI-PMH 2.0 (Protocol for Metadata Harvesting)
- Keep it simple
  - REST-style interface
  - Response in XML
  - DC metadata (unqualified)
- Widely accepted
- Generic approach

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Open Archives Initiative (2)

- Problems
  - Unqualified DC demands normalization
  - Missing mechanisms required for distributed services
  - No specs for use cases beyond bibliographic metadata harvesting (generic service model)

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XML-RPC Basics

- Remote procedure calls HTTP, encoded in XML
  - HTTP-request and its response
- Supports most common types and aggregates

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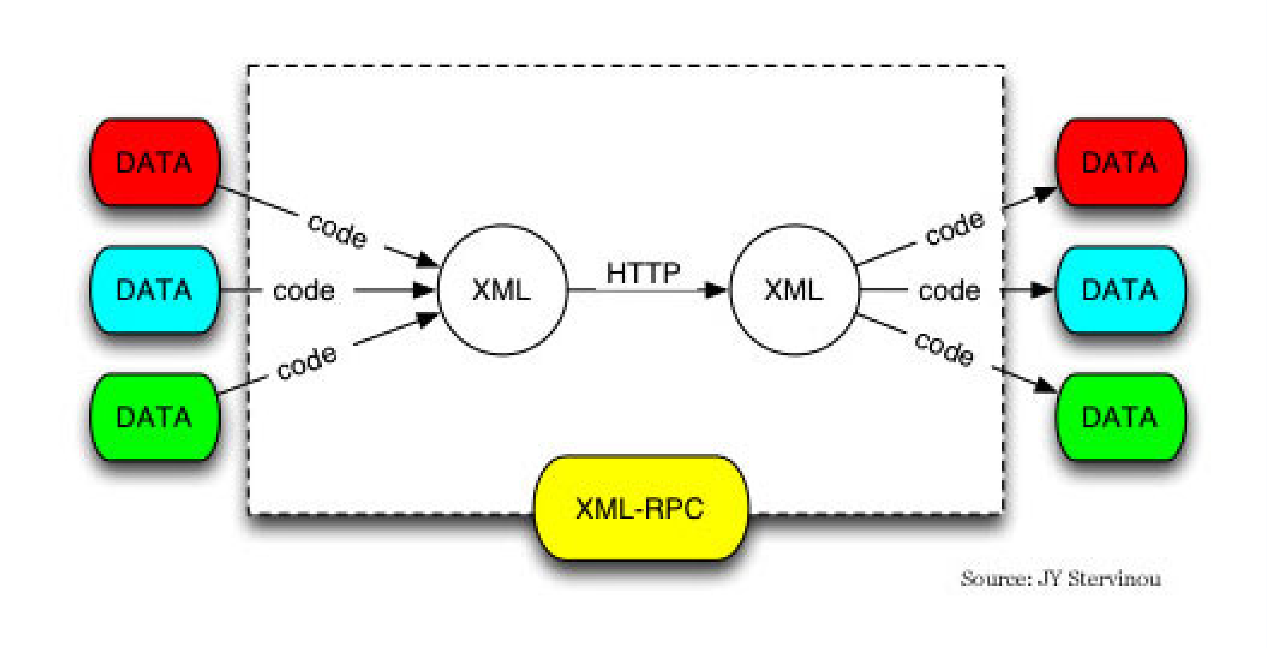
XML-RPC



Source: JY Stervinou

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Conclusion

XML-RPC - Request

```
POST /RPC2 HTTP/1.0
User-Agent: Frontier/5.1.2 (WinNT) Host
betty.userland.com
Content-Type: text/xml
Content-length: 181

<?xml version="1.0"?>
<methodCall>
    <methodName>examples.getStateName</methodName>
    <params>
        <param>
            <value><i4>41</i4></value>
        </param>
    </params>
</methodCall>
```

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XML-RPC - Response

```
HTTP/1.1 200 OK
 Connection: close
 Content-Length: 158
 Content-Type: text/xml
 Date: Fri, 17 Jul 1998 19:55:08 GMT
 Server: UserLand Frontier/5.1.2-WinNT

<?xml version="1.0"?>
<methodResponse>
     <params>
              <param>
                            <value><string>South
     Dakota</string></value>
              </param>
     </params>
</methodResponse>
```

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XML-RPC Perspectives

- Libraries for many programming languages available
- Fairly simple and fast
- Implicit knowledge about interfaces required

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SOAP - Basics

- „Simple Object Access Protocol“ (W3C standard)
- Communication between applications via messages
- Platform and language independent
- Based on XML

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SOAP-Messages

- SOAP Envelope
- Header with meta information e.g. on
  - Routing
  - Security
  - Transactions
- Body contains the payload, compliant with XML Schema

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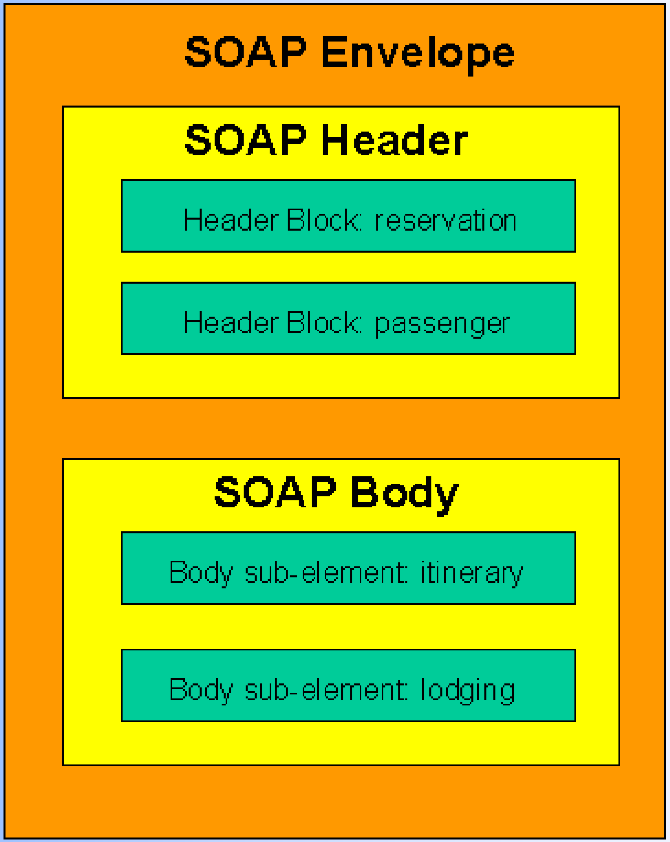
SOAP-Messages



SOAP Envelope

SOAP Header

Header Block: reservation

Header Block: passenger

SOAP Body

Body sub-element: itinerary

Body sub-element: lodging

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SOAP Perspectives

- Supported by the vendors
- Cornerstone of „Web Services“
- Human-readable?
- Depends on XML Schema type system
- Overhead
- Vendor specific tools
- Vendor specific type systems

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SRW / ZING

- “Search/Retrieve Web Service” of the ZING Initiative, hosted by the Library of Congress
- ZING = Next Generation of Z39.50
- SOAP based implementation
- Leverages CQL query language
- Supports the librarians needs

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WebDAV - Background

- Web Distributed Authoring and Versioning Access Protocol
- Microsoft, Netscape, Xerox, IBM, Novel…
- Extensions to HTTP protocol
- XML based
- Generic

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WebDAV - Services

- Overwrite prevention
- Properties
- Namespace management
- Version management
- Advanced collections
- Access control

WebDAV - Perspectives

- Supported by
  - Office software packages
  - Content management Systems
  - Webservers
  - Databases
  - Browsing facilities
  - …

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Layered Technologies and the Semantic Web

- Example: OSI
- Transparency of layers
- Semantic Web
- Transparency in Scientific Workflow and Networks

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OSI - Background

- „Open Systems Inter-connection Reference Model“ (OSI Model or OSI Reference Model)
- Framework for standards of the ISO
- Specifies seven layers for communications and computer network protocols

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OSI - Layers

- Physical layer
- Data link layer
- Network layer
- Transport layer
- Session layer
- Presentation layer
- Application layer

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OSI – Transparent layers

- Independence of layers allows replacing implementations
- Extensions don‘t interfere with other layers
- Users or developers are concerned only with „their“ layers

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OSI – In Real Life

- Vendors reduced the number of layers
- Early implementations very instable
- Real solutions (like TCP/IP) established de facto standards

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Semantic Web – Vision I

- Global database
- Democratic access to information (vs. information divide)
- Web of knowledge

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User‘s Perspective on Semantic Web

- Missing support for semantics
- Real use is behind possibilities
- Problem of standardization
  - Standards as a part of the problem
  - Domain specific solutions required
  - Technology driven development

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Semantic Web today

- Generic specification (plus vendor-specific features)
- B2B – supported by detailed frameworks
- Weak support for scientific networks

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Semantic Web – Vision II

- Coupling of distributed information systems
- Support of information flow
- Foundation for (new) services
- Machine-machine communication
- Support for machine reasoning

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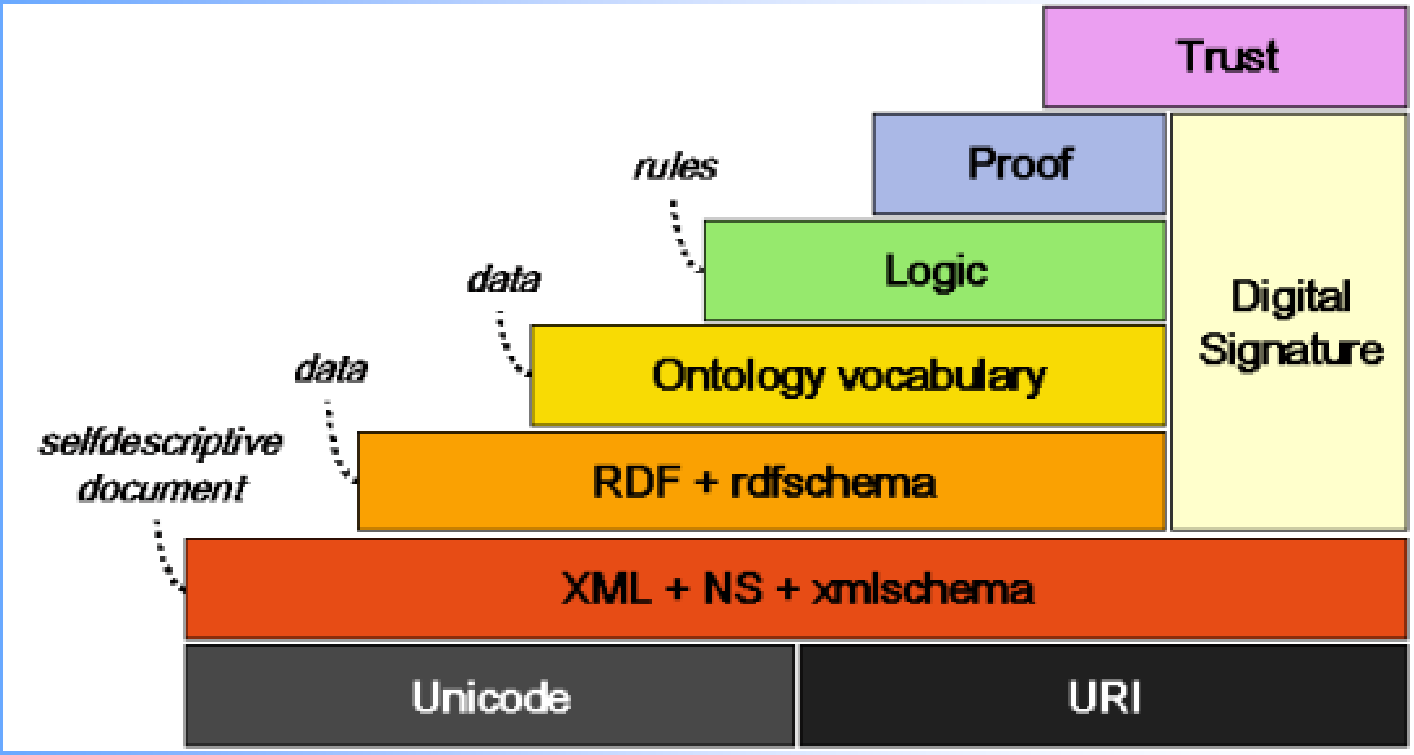
Layers of the Semantic Web



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Layers of Web Services Standard (W3C)

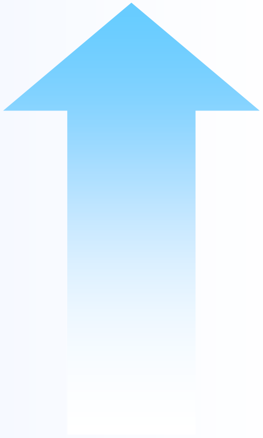
Service Discovery Layer

Service Description Layer

XML Messaging Layer

Service Transport Layer

Informal / high level of semantics



formal / low level of semantics

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Problems of “semantic” layers

- Implicit assumptions and assertions of layered technology
  - basic vs. higher functions
  - completeness
  - independent layers
- Independence of semantic layers is not given
- Conceptualization is domain specific

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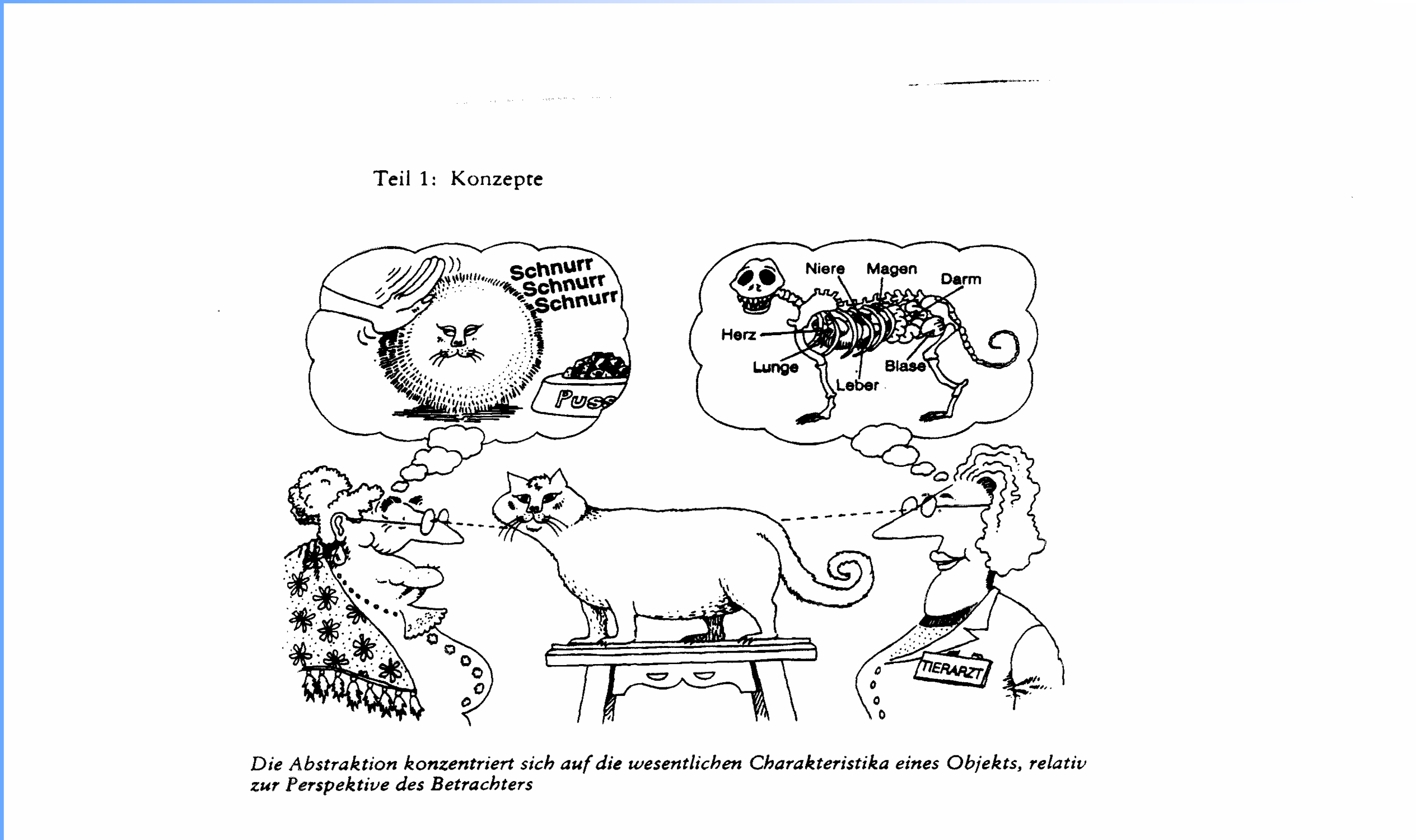
Conceptualization and Common Sense



Teil 1: Konzepte

Die Abstraktion konzentriert sich auf die wesentlichen Charakteristika eines Objekts, relativ zur Perspektive des Betrachters

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Requirements for Scientific DL-Services

- Support of scientific workflow
- Support of new emerging roles or change of roles
- Information on information needed
- Support of distributed generation of content

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Technology and Solutions

- „We do what we have“
- „One size fits all“ – the generic way
- Semantic GRID: we have the technology – now we invent the problems to solve

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Conclusion

- Best „return on investment“: metadata
- Information on Information
- Specification on usage of standards
- Transparency in science and education
- People behind solutions