OAI and ODL
Building Digital Libraries from Components

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Outline

1. Introduction to OAI
2. Definitions and Concepts
3. OAI Protocol for Metadata Harvesting
4. Introduction to ODL
5. OAI and ODL Components
1. Introduction to OAI

• What is the Open Archives Initiative?
  – Group of people and organizations dedicated to solving problems of digital library interoperability by developing simple protocols.

• Major Accomplishment:
  – Protocol for Metadata Harvesting (OAI-PMH)
1.1. What is the OAI-PMH?

• What is the Protocol for Metadata Harvesting?
  – Network protocol to transfer metadata from one archive to another
    • Any metadata (XML-encoded data records)
    • In a continuous stream
    • As simply as possible
1.2. General System Strategy

- Services
- Metadata Harvesting
- Document Model
1.3. Case Study: AmericanSouth

- Digital library of resources related to Southern history and culture
- Multiple independent university-based collections of electronic documents

Emory
UTK
Virginia Tech

OAI Protocol for Metadata Harvesting

American South.Org portal

OAI & ODL - CS5604
1.4. Versions of OAI-PMH

• v1.0 January 2001
• v1.1 July 2001
  – Minor revision from v1.0
  – These notes are based on version 1.1!
• v2.0 June 2002
  – Mostly syntactical changes
2. Definitions / Concepts

• Basic Principles
  – What is an Open Archive?
  – Harvesting vs. Federation
  – Data and Service Providers

• Underlying Technology
  – HTTP and XML

• Protocol Policies
  – What is a record?
  – Multiplicity of Metadata
  – Sets
  – Datestamp, Harvesting and Flow Control
2.1. What is an Open Archive?

- Any WWW-based system that can be accessed through the well-defined interface of the Open Archives Protocol for Metadata Harvesting
- … aka OAI-Compliant Repository
- No implications for:
  - Physical storage of data
  - Cost of data
  - Metadata and data formats
  - Access control to server
2.2. Harvesting vs Federation

• Competing approaches to interoperability
  – Federation is when services are run remotely on remote data (e.g. Meta-searching)
  – Harvesting is when data/metadata is transferred from the remote source to the destination where the services are located (e.g. Union catalogues)

• Federation requires more effort at each remote source but is easier for the local system and vice versa for harvesting

• OAI currently focuses on harvesting
2.3. Data and Service Providers

- Data Providers refer to entities who possess data/metadata and are willing to share this with others (internally or externally) via well-defined OAI protocols (e.g. database servers).

- Service Providers are entities who harvest data from Data Providers in order to provide higher-level services to users (e.g. search engines).

- In networking terms, the data provider is a network server and a service provider connects to the server as a client.
2.4. HTTP and XML

- Protocol for Metadata Harvesting is an almost stateless request/response protocol
- Requests and responses are sent via the HTTP protocol
- Requests are encoded as GET/POST operations
- Responses are well-formed XML documents
2.5. What is a record?

- A record refers to an independent XML structure that may be associated with digital or physical objects.
- Records are usually associated with metadata, not data.
- OAI advocates harvesting of records, which contain metadata and additional fields to support the harvesting operation.
2.6. Sample OAI Record

<record>
  <header>
    <identifier>oai:sigir:ws3</identifier>
    <datestamp>2001-08-13</datestamp>
  </header>
  <metadata>
    <dc>
      <title>OAI Workshop at SIGIR</title>
      <creator>Hussein Suleman</creator>
      <language>English</language>
    </dc>
  </metadata>
  <about>
    <metadataID>oai:sigir:ws3md</metadataID>
  </about>
</record>
2.7. Multiplicity of Metadata

- Multiple formats of metadata allowed
- Dublin Core is mandatory
- Any other format allowed as long as it has an XML encoding
- E.g. MARC (Libraries), IMS (Education), ETDMS (Theses/Dissertations), RFC1807 (Bibliographies)
2.8. Sets

- Protocol mechanism to allow for harvesting of sub-collections
- No well-defined semantics – depends completely on local data providers
- May be defined by arrangement between data providers and service providers
- E.g. Subject areas, years, author names, search queries
2.9. Datestamps & Harvesting

- Each record needs a datestamp that indicates its date of creation or modification
- Dates are used to allow for harvesting by date range, thus allowing incremental and continuous transfer of metadata from a data provider to a service provider
2.10. Flow Control

- HTTP “retry-after” mechanism can be leveraged to support server-side delaying of a client’s request.
- Resumption Tokens can be used to return partial results – the client is issued with a token which may be presented to the server to receive more results.
2.11. Basic OAI Model
2.12. The baseURL

- Requests are sent by HTTP to baseURLs, with parameters appended, e.g.:
  - http://www.test.org/oai.pl?verb=Identify

- Responses are the documents that are returned by the server

- The baseURL is the point of contact to communicate with a component!
3. Protocol for Metadata Harvesting

- Service Requests
  - Identify
  - ListMetadataFormats
  - ListSets
  - GetRecord
  - ListIdentifiers
  - ListRecords

- Metadata Multiplicity

- Date Ranges

- Resumption Tokens
3.1. Identify

- **Purpose**
  - Return general information about the archive and its policies

- **Parameters**
  - None

- **Sample URL**
  - http://www.anarchive.org/cgi-bin/OAI?verb=Identify
3.2. Identify - Response

```
<?xml version="1.0" encoding="UTF-8" ?>
<Identify xmlns="http://www.openarchives.org/OAI/1.1/OAI_IDidentify"
    xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
    <responseDate>2002-05-21T15:39:14-05:00</responseDate>
    <requestURL>http://scholar.lib.vt.edu:80/theses/OAI/cgi-bin/index.pl?verb=Identify</requestURL>
    <repositoryName>Virginia Tech Electronic Thesis and Dissertation Collection</repositoryName>
    <baseURL>http://scholar.lib.vt.edu:80/theses/OAI/cgi-bin/index.pl</baseURL>
    <protocolVersion>1.1</protocolVersion>
    <adminEmail>mailto:webmaster@scolarb.lib.vt.edu</adminEmail>
    <description>
            xmlns="http://www.openarchives.org/OAI/1.1/oai-identifier">
            <scheme>oai</scheme>
            <repositoryIdentifier>VTETD</repositoryIdentifier>
            <delimiter>:</delimiter>
            <sampleIdentifier>oai:VTETD:etd-171110282975860</sampleIdentifier>
        </oai-identifier>
    </description>
    <description>
        <eprints xmlns:xsi:schemaLocation="http://www.openarchives.org/OAI/1.1/eprints http://www.openarchives.org/OAI/1.1/enprints.xml"
            xmlns="http://www.openarchives.org/OAI/1.1/eprints">
```

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3.3. ListMetadataFormats

• **Purpose**
  – List metadata formats supported by the archive as well as their schema locations and namespaces

• **Parameters**
  – identifier – for a specific record (O)

• **Sample URL**
3.4. ListMetadataFormats - Response

```xml
<?xml version="1.0" encoding="UTF-8" ?>
<ListMetadataFormats xmlns="http://www.openarchives.org/OAI/1.1/OAI_ListMetadataFormats"
    xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
    <responseDate>2002-05-21T15:40:33-05:00</responseDate>
    <requestURL>http://scholar.lib.vt.edu:80/theses/OAI/cgi-bin/index.pl?verb=ListMetadataFormats</requestURL>
    <metadataFormat>
        <metadataPrefix>oai_rfc1807</metadataPrefix>
        <schema>http://www.openarchives.org/OAI/1.1/rfc1807.xsd</schema>
    </metadataFormat>
    <metadataFormat>
        <metadataPrefix>oai_marc</metadataPrefix>
        <schema>http://www.openarchives.org/OAI/1.1/oai_marc.xsd</schema>
        <metadataNamespace>http://www.openarchives.org/OAI/1.1/oai_marc</metadataNamespace>
    </metadataFormat>
</ListMetadataFormats>
```
3.5. ListSets

• Purpose
  – Provide a hierarchical listing of sets in which records may be organized

• Parameters
  – None

• Sample URL
  – http://www.anarchive.org/cgi-bin/OAI?verb=ListSets
3.6. ListSets – Response

```
<?xml version="1.0" encoding="UTF-8" ?>
<ListSets xmlns="http://www.openarchives.org/OAI/1.1/OAI_ListSets"
           xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
           xsi:schemaLocation="http://www.openarchives.org/OAI/1.1/OAI_ListSets
                               http://www.openarchives.org/OAI/1.1/OAI_ListSets.xsd">
    <responseDate>2002-05-21T15:41:03-05:00</responseDate>
    <requestURL>http://scholar.lib.vt.edu:80/theses/OAI/cgi-bin/index.pl?
                verb=ListSets</requestURL>
    <set>
        <setSpec>All</setSpec>
        <setName>All theses and dissertations</setName>
    </set>
</ListSets>
```
3.7. GetRecord

• **Purpose**
  – Returns the metadata for a single identifier in the form of an OAI record

• **Parameters**
  – identifier – unique id for record (R)
  – metadataPrefix – metadata format (R)

• **Sample URL**
3.8. GetRecord - Response

```xml
<?xml version="1.0" encoding="UTF-8" ?>
<GetRecord xmlns="http://www.openarchives.org/OAI/1.1/OAI_GetRecord"
  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xsi:schemaLocation="http://www.openarchives.org/OAI/1.1/OAI_GetRecord
  http://www.openarchives.org/OAI/1.1/OAI_GetRecord.xsd">
  <responseDate>2002-05-21T15:42:19-05:00</responseDate>
  <record>
    <header>
      <identifier>oai:VTETD:etd-3123162539751141</identifier>
      <datestamp>1997-04-22</datestamp>
    </header>
    <metadata>
      <dc xmlns="http://purl.org/dc/elements/1.1/"
        xsi:schemaLocation="http://purl.org/dc/elements/1.1/
        http://www.openarchives.org/OAI/1.1/dc.xsd">
        <dc:title>SMA-Induced Deformations in general Unsymmetric Laminates</dc:title>
        <dc:creator>Dano, Marie-Laure</dc:creator>
        <dc:subject>Engineering Science and Mechanics</dc:subject>
        <dc:description>General unsymmetric laminates exhibit large natural curvatures at room temperature. Additionally, inherent to most unsymmetric laminates is the presence of two stable configurations. Multiple configurations and stability issues arise because of the geometric nonlinearities associated with the large</dc:description>
      </dc>
    </metadata>
  </record>
</GetRecord>
```
3.9. ListIdentifiers

• **Purpose**
  – List all unique identifiers corresponding to records in the repository

• **Parameters**
  – from – start date (O)
  – until – end date (O)
  – set – set to harvest from (O)
  – resumptionToken – flow control mechanism (X)

• **Sample URL**
3.10. ListIdentifiers - Response

```xml
<?xml version="1.0" encoding="UTF-8" ?>
<ListIdentifiers xmlns="http://www.openarchives.org/OAI/1.1/OAI_ListIdentifiers"
    xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
    xsi:schemaLocation="http://www.openarchives.org/OAI/1.1/OAI_ListIdentifiers
    http://www.openarchives.org/OAI/1.1/OAI_ListIdentifiers.xsd">
    <responseDate>2002-05-21T15:43:05-05:00</responseDate>
    <requestURL>http://scholar.lib.vt.edu:80/theses/OAI/cgi-bin/index.pl?
        verb=ListIdentifiers</requestURL>
    <identifier>oai:VTEDT:edt-3345131939761081</identifier>
    <identifier>oai:VTEDT:edt-171110282975860</identifier>
    <identifier>oai:VTEDT:edt-05012000-14030054</identifier>
    <identifier>oai:VTEDT:edt-3621112139711101</identifier>
    <identifier>oai:VTEDT:edt-133422039701091</identifier>
    <identifier>oai:VTEDT:edt-23281533974920</identifier>
    <identifier>oai:VTEDT:edt-123322282975860</identifier>
    <identifier>oai:VTEDT:edt-255314202974780</identifier>
    <identifier>oai:VTEDT:edt-335713312971890</identifier>
    <identifier>oai:VTEDT:edt-104722369631841</identifier>
    <identifier>oai:VTEDT:edt-831102339731121</identifier>
    <identifier>oai:VTEDT:edt-454016449701231</identifier>
    <identifier>oai:VTEDT:edt-3034112939721181</identifier>
    <identifier>oai:VTEDT:edt-522014589642481</identifier>
    <identifier>oai:VTEDT:edt-274210359611541</identifier>
</ListIdentifiers>
```
3.11. ListRecords

• Purpose
  – Retrieves metadata for multiple records

• Parameters
  – from – start date (O)
  – until – end date (O)
  – set – set to harvest from (O)
  – resumptionToken – flow control mechanism (X)
  – metadataPrefix – metadata format (R)

• Sample URL
  – http://www.anarchive.org/cgi-bin/OAI?
    verb=ListRecord&metadataPrefix=oai_dc&from=2001-01-01
3.12. ListRecords - Response

<?xml version="1.0" encoding="UTF-8" ?>
<ListRecords xmlns="http://www.openarchives.org/OAI/1.1/OAI_ListRecords"
    xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
    xsi:schemaLocation="http://www.openarchives.org/OAI/1.1/OAI_ListRecords
    http://www.openarchives.org/OAI/1.1/OAI_ListRecords.xsd">
    <responseDate>2002-05-21T15:44:12-05:00</responseDate>
    <requestURL>http://scholar.lib.vt.edu:80/theses/OAI/cgi-bin/index.pl?
        verb=ListRecords&metadataPrefix=oai_dc</requestURL>
    <record>
        <identifier>oai:VTETD:etd-3345131939761081</identifier>
        <datestamp>1997-03-31</datestamp>
    </record>
</ListRecords>
3.13. Metadata Multiplicity

```xml
<?xml version="1.0" encoding="UTF-8" ?>
<GetRecord xmlns="http://www.openarchives.org/OAI/1.1/OAI_GetRecord"
   xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xsi:schemaLocation="http://www.openarchives.org/OAI/1.1/OAI_GetRecord
   http://www.openarchives.org/OAI/1.1/OAI_GetRecord.xsd">
   <responseDate>2002-05-21T15:45:08-05:00</responseDate>
   <requestURL>http://scholar.lib.vt.edu:80/theses/OAI/cgi-bin/index.pl?
   verb=GetRecord&metadataPrefix=oai.rfc1807&identifier=oai:VTED:etd-
   3123162539751141</requestURL>
   <record>
     <header>
       <identifier{oai:VTED:etd-3123162539751141}</identifier>
       <datestamp>1997-04-22</datestamp>
     </header>
     <metadata>
       http://www.openarchives.org/OAI/1.1/rfc1807.xsd">
         <bib-version>1</bib-version>
         <id>etd-3123162539751141</id>
         <entry>1997-04-22</entry>
         <organization>Virginia Polytechnic Institute and State University</organization>
         <title>SMA-Induced Deformations In general Unsymmetric Laminates</title>
         <type>Thesis/Dissertation</type>
         <author>Dano. Marie-Laure</author>
       </rfc1807>
     </metadata>
   </record>
</GetRecord>
```
3.14. Date Ranges

```xml
<?xml version="1.0" encoding="UTF-8" ?>
<ListIdentifiers xmlns="http://www.openarchives.org/OAI/1.1/OAI_ListIdentifiers"
     xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
     xsi:schemaLocation="http://www.openarchives.org/OAI/1.1/OAI_ListIdentifiers
     http://www.openarchives.org/OAI/1.1/OAI_ListIdentifiers.xsd">
  <responseDate>2002-05-21T15:46:22-05:00</responseDate>
  <requestURL>http://scholar.lib.vt.edu:80/theses/OAI/cgi-bin/index.pl?
     verb=ListIdentifiers&from=2000-11-24&until=2000-12-01</requestURL>
  <identifier oai:VTEDT:etd-11212000-155513</identifier>
  <identifier oai:VTEDT:etd-11242000-130040</identifier>
  <identifier oai:VTEDT:etd-11272000-115149</identifier>
  <identifier oai:VTEDT:etd-11162000-19160016</identifier>
  <identifier oai:VTEDT:etd-11222000-095443</identifier>
  <identifier oai:VTEDT:etd-11142000-16540027</identifier>
  <identifier oai:VTEDT:etd-11282000-110022</identifier>
  <identifier oai:VTEDT:etd-11152000-13100048</identifier>
  <identifier oai:VTEDT:etd-11272000-114011</identifier>
  <identifier oai:VTEDT:etd-11182000-10350010</identifier>
  <identifier oai:VTEDT:etd-11272000-214847</identifier>
  <identifier oai:VTEDT:etd-11182000-16030010</identifier>
</ListIdentifiers>
```
3.15. Resumption Token

```
<Address>http://scholar.lib.vt.edu/theses/OAI/cgi-bin/index.pl?verb=ListIdentifiers</Address>
<identifier>oai:VTED:etd-643151739741061</identifier>
<identifier>oai:VTED:etd-3025191349721321</identifier>
<identifier>oai:VTED:etd-254122839711171</identifier>
<identifier>oai:VTED:etd-4524171049761291</identifier>
<identifier>oai:VTED:etd-3156151139751001</identifier>
<identifier>oai:VTED:etd-424817300974290</identifier>
<identifier>oai:VTED:etd-13514459731541</identifier>
<identifier>oai:VTED:etd-2047101569611961</identifier>
<identifier>oai:VTED:etd-5414132139711101</identifier>
<identifier>oai:VTED:etd-3132141279612241</identifier>
<identifier>oai:VTED:etd-3123162539751141</identifier>
<identifier>oai:VTED:etd-556181169641921</identifier>
<identifier>oai:VTED:etd-342482139711101</identifier>
<identifier>oai:VTED:etd-1913943975930</identifier>
<identifier>oai:VTED:etd-402515359721531</identifier>
<identifier>oai:VTED:etd-2025212339731121</identifier>
<identifier>oai:VTED:etd-3331171059721601</identifier>
<identifier>oai:VTED:etd-18409759651581</identifier>
<identifier>oai:VTED:etd-34521672975650</identifier>
<identifier>oai:VTED:etd-120142139711101</identifier>
<identifier>oai:VTED:etd-4019122049721391</identifier>
<identifier>oai:VTED:etd-4871426397611151</identifier>
<resumptionToken>!!!!100</resumptionToken>
</ListIdentifiers>
```
4. Introduction to ODL

• Open Digital Libraries
  – Framework for componentized Digital Libraries
  – Design principles for components
  – Protocols for inter-component communications
  – Built upon OAI-PMH v1.1
4.1. Users and Objects

users

digital objects
4.2. Digital Library

Monolithic and/or Custom-built web-based application

digital library
4.3. Componentized DL

componentized digital library
4.4. How about OAI-PMH?

- Metadata transfer among digital libraries “is almost =” metadata exchange among components
- Need a few changes to support inter-component communication, including:
  - Support for additional information in responses
  - Support for adding records as well (PutRecord)
4.5. Open Digital Library

open digital library

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Protocol for Metadata Harvesting

Extended OAI-PMH

Open Digital Library Protocol
Extended OPEN ARCHIVE

Open Digital Library Component
4.8. Open Digital Library

• Network of Extended Open Archives where each node acts as either a provider of data, services or both.

• Component = Node

• Protocol = Arc
4.9. Example Open Digital Library

Students and researchers

ETD Digital Library

ETD collections

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Some Recent Additions to our Collection


- The Ontology of Persistence, Love, Shanon, Virginia Polytechnic Institute and State University, 2001-06-25 [More Info]

- Virginia Save Our Streams (SCS): Volunteers’ Motivations for Participation and Suggestions for Program Improvement, Haas, Steven Christopher, Virginia Polytechnic Institute and State University, 2000-08-03 [More Info]
4.11. Prototype - Search

Electronic Thesis/Dissertation
OAI Union Catalog

Search Results

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1. Characterizing Web Response Time
   Liu, Binzhang M.S.
   - Abstract: It is critical to understand WWW latency in order to design better HTTP protocols. In this study we characterize Web response time and examine the effects of proxy caching, network bandwidth, traffic load, persistent connections for a page, and periodicity. Based on studies with four workloads, we show that at least a quarter of the total elapsed t...

   - Date: 1998-05-07

   [ More Info ] [ Go To Document ] [ Find Similar Documents ]

2. Chemical Interferences on the Atomization Yield of High Reduction Potential Elements - Signal Suppression in the Plasma Source Spectrometry
   Liu, Jian, jianliu78@yahoo.com, 1960-11-04, Changchun, CHINA
   - Date: 2001-03-08

   [ More Info ] [ Go To Document ] [ Find Similar Documents ]
4.12. Prototype - Browse

Browse ETDs

Institution: All
Sort By: [ ]
Year: All

1. Test

   Bossert, Sven
   Abstract: The solidification microstructure in wedge-shaped castings of Cu-Ni-Ti-Zr glass forming alloys is investigated, while the composition was systematically varied. Near the critical thickness for glass formation, a spatially inhomogeneous dispersion of nanocrystals is observed, where spherical regions contain a much higher density of nanocrystals than...
   Date: 2001-07-13
   [ More Info ] [ Go To Document ] [ Find Similar Documents ]

3. All-Optical Logic Circuits based on the Polarization Properties of Non-Degenerate Four Wave Mixing
   OAI & ODL - CS5604
4.13. ODL Component Requirements

• Search
  – Retrieve a list of items
  – Index new items

• Annotate
  – Add annotation to item
  – Retrieve a list of annotations for an item
4.14. Layer 1 : OAI PMH

• Protocol for Metadata Harvesting
  – Transfer stream of metadata from one archive or component to another

• Service Requests
  – Identify, ListSets, ListMetadataFormats
  – GetRecord, ListIdentifiers, ListRecords
4.15. Layer 2 : Extended OAI-PMH

- OAI-PMH + extensions for general-purpose inter-component communication
  - Added in generic containers in every response for additional information
  - Added “PutRecord” to submit a record
  - Increased granularity to support times as well as dates (same as OAI-PMH v2.0)
  - Ignored DC requirement
4.16. Layer 3 : ODL Protocols

• Specialized protocol semantics for different components, e.g.:
  – Search component uses ODLSearch protocol
    • ListRecords and ListIdentifiers embed query terms in “set” parameter
  – Annotation component uses ODLAnnotate protocol
    • ListRecords and ListIdentifiers specify the item for which annotations are requested in the “set” parameter
    • PutRecord adds an annotation to an item
4.17. Case Study: ETD ODL Prototype

- Electronic Thesis and Dissertation Open Digital Library
4.18. Ultimate Goal

- Package different configurations into instant DL systems
- DL building = component configuration
- All DLs speak the same language(s)
- Basic services are trivial to provide so more effort is spent on advanced capabilities of DLs
5. OAI and ODL components

- No one needs to start from scratch!
- OAI Components create OAI data providers from existing systems or collections
  - XMLFile, ETD-db extensions, etc.
- ODL Components implement basic digital library services and communicate using ODL and OAI protocols
  - Search, Browse, Annotate, etc.
5.1. Basic Model

![Diagram showing the OAI & ODL model with User Interface, ODL Service Provider Component, and OAI Data Provider connected by OAI-PMH and ODL Protocol.]
5.2. Simple Searching

- **OAI Data Provider**
- **OAI-PMH**
- **ODLSearch**
- **Search Engine Component**
- **Search Engine WWW Interface**

- **IRDB**
- **IRDB user interface**
- **XMLFile**
5.3. Software to be installed

• XML-File
  – create Open Archive from collection of XML files
• Harvester
  – test harvesting of data from OAI archive
• IRDB
  – simple search engine
• IRDB user interface
5.4. Steps in building it

- Install XMLFile
  - Test XMLFile

- Install IRDB
  - Connect to XMLFile’s baseURL
  - Test IRDB

- Install user interface
  - Connect to IRDB’s baseURL
  - Test user interface
5.5. Testing: Repository Explorer

- The Repository Explorer is a tool for testing Open Archives.
- You can issue individual commands and validate the results (using XML Schema)
- You can also perform a sequence of automatic tests
- [http://purl.org/net/oai_explorer](http://purl.org/net/oai_explorer)
5.6. Wrap up and discussion

- We will build a simple digital library from components!

XML-File Data Provider ➔ IRDB Search Engine (with built-in Harvester) ➔ HTML User Interface
6.1. Final Thoughts

- OAI-PMH is a simple protocol for exporting and importing metadata
- ODL Components based on OAI can be used to build modular systems
- Lots of tools available now!
- Lots of interest from other people already, even publishers!
6.2. Links

- Open Archives Initiative
  - http://www.openarchives.org
- OAI Metadata Harvesting Protocol
  - http://www.openarchives.org/OAI/openarchivesprotocol.htm
- Virginia Tech DLRL OAI Projects (XML-File)
  - http://www.dlib.vt.edu/projects/OAI/
- Repository Explorer
  - http://purl.org/net/oai_explorer
- Open Digital Libraries (Harvester, IRDB)
  - http://oai.dlib.vt.edu/odl
6.3. More Links

- ARC Cross-Archive Search Service
  - [http://arc.cs.odu.edu/](http://arc.cs.odu.edu/)

- XML Schema Validator
  - [http://www.w3.org/2001/03/webdata/xsv](http://www.w3.org/2001/03/webdata/xsv)

- Dublin Core Metadata Initiative
  - [http://www.dublincore.org](http://www.dublincore.org)

- E-Prints DL-in-a-box
  - [http://www.eprints.org](http://www.eprints.org)

- XML Tools at W3C
  - [http://www.w3.org/XML/#software](http://www.w3.org/XML/#software)
That’s All, Folks!

Questions?