

# What's New from the OAI



<<http://www.openarchives.org>>

Herbert Van de Sompel <[herbertv@lanl.gov](mailto:herbertv@lanl.gov)>

Michael Nelson <[m1n@cs.odu.edu](mailto:m1n@cs.odu.edu)>

Simeon Warner [simeon@cs.cornell.edu](mailto:simeon@cs.cornell.edu)

Carl Lagoze <[lagoze@cs.cornell.edu](mailto:lagoze@cs.cornell.edu)>

CERN workshop on Innovations in Scholarly Communication (OAI4)

October 20, 2005, Geneva



# Outline



(1) OAI-PMH refresh

(2) OAI-PMH for Resource Harvesting

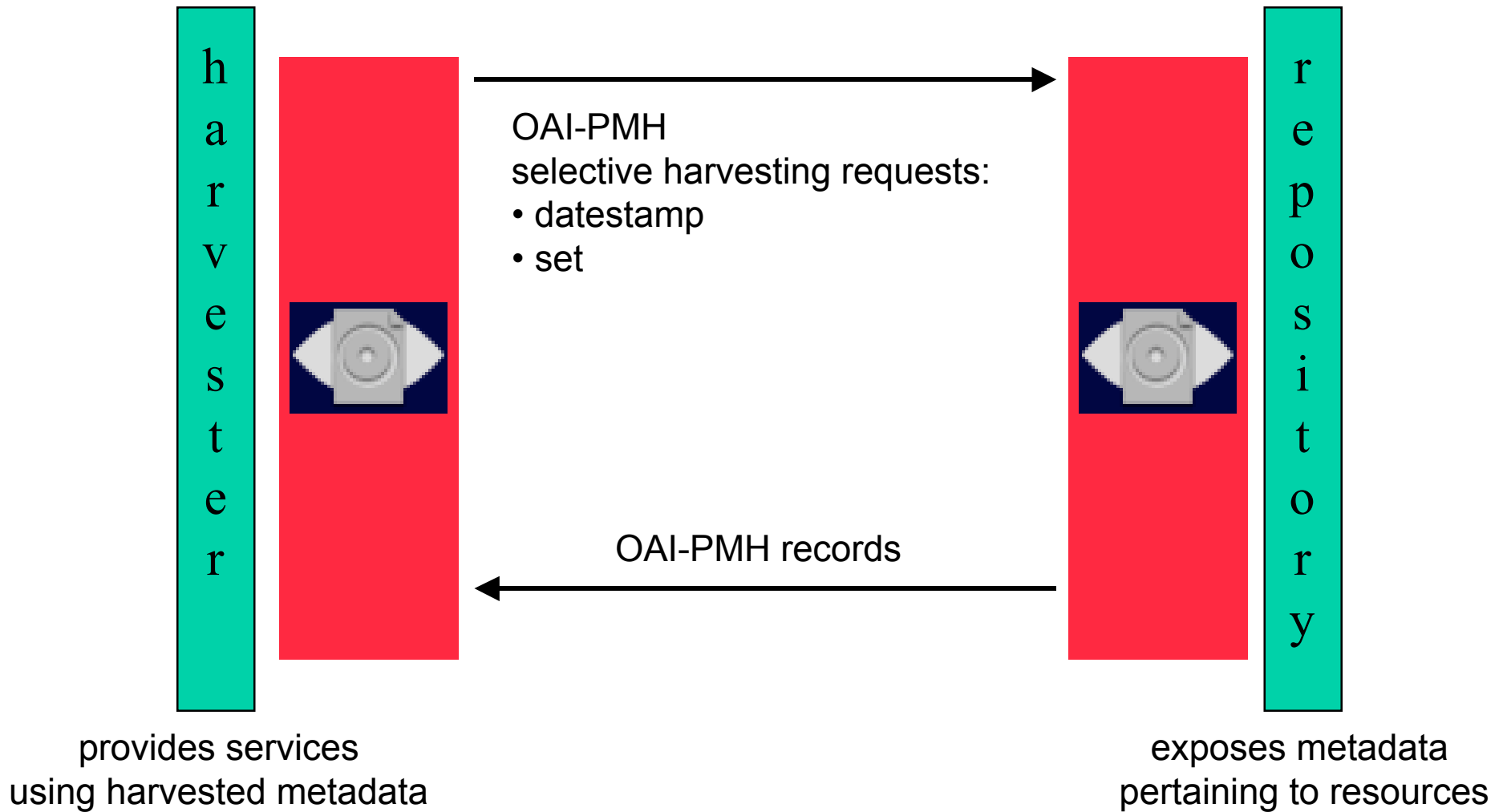
(3) mod\_oai

(4) OAI-rights effort

(5) OAI Best Practices



# OAI-PMH



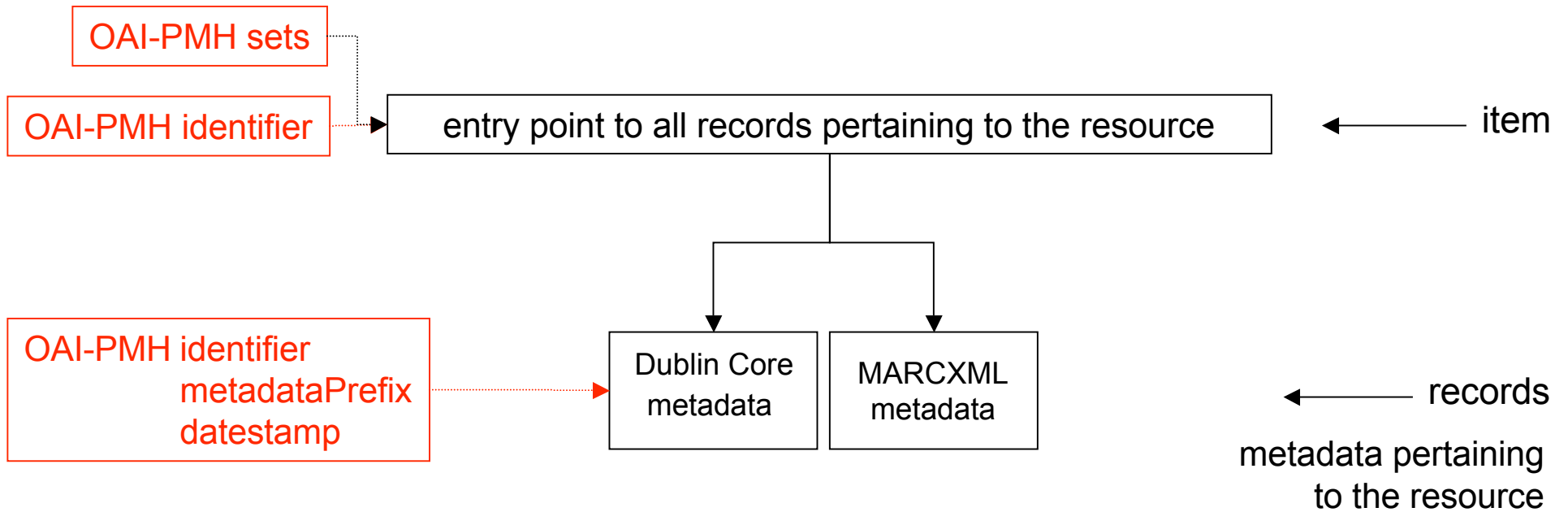
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# OAI-PMH data model



← resource



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## Resource Harvesting: Use cases

- **Discovery:** use content itself in the creation of services
  - search engines that make full-text searchable
  - citation indexing systems that extract references from the full-text content
  - browsing interfaces that include thumbnail versions of high-quality images from cultural heritage collections
- **Preservation:**
  - periodically transfer digital content from a data repository to one or more trusted digital repositories
  - trusted digital repositories need a mechanism to automatically synchronize with the originating data repository



## Resource Harvesting: Use cases

- Discovery: use content itself in the creation of services
  - Institutional Repository & Digital Library Projects: UK JISC, DARE, DINI
  - Web search engines: competition for content (cf Google Scholar)
- Preservation:
  - Institutional Repository & Digital Library Projects: UK JISC, DARE, DINI
  - Library of Congress NDIIP Archive Export/Ingest

***OAI-PMH is well-established.  
Can OAI-PMH be used for Resource Harvesting?***



# Existing OAI-PMH based approaches

Typical scenario:

1. An OAI-PMH harvester harvests Dublin Core records from the OAI-PMH repository.
2. The harvester analyzes each Dublin Core record, extracting dc.identifier information in order to determine the network location of the described resource.
3. A separate process, out-of-band from the OAI-PMH, collects the described resource from its network location.



## Existing OAI-PMH based approaches : Issue 1

- Locating the resource based on information provided in dc.identifier
  - dc.identifier used to convey a variety of identifier: (simultaneously) URL DOI, bibliographic citation, ... Not expressive enough to distinguish between identifier, locator.
    - Several dereferencing attempts required
  - URI provided in dc.identifier is commonly that of a bibliographic “splash page”
    - How to know it is a bibliographic “splash page”, not the resource?
    - If it is a bibliographic “splash page”, where is the resource?



## Existing OAI-PMH based approaches : Issue 2

- Using the OAI-PMH datestamp of the Dublin Core record to trigger incremental harvesting:
  - Datestamp of DC record does not necessarily change when resource changes

	DC record datestamp no change	DC record datestamp change
no resource update	no metadata update OK	metadata update unnecessary resource download
resource update	missed resource update	OK



## Existing OAI-PMH based approaches : Conventions

- Conventions address Issue 1; Issue 2 can not really be addressed.
- First dc.identifier is locator of the resource
  - what if the resource is not digital?
- Use of dc.format and/or dc.relation to convey locator



# Existing OAI-PMH based approaches : Conventions

```
<oai_dc:dc>
  <dc:title>A Simple Parallel-Plate Resonator Technique for Microwave.
    Characterization of Thin Resistive Films</dc:title>
  <dc:creator>Vorobiev, A.</dc:creator>
  <dc:subject>ING-INF/01 Elettronica</dc:subject>
  <dc:description>A parallel-plate resonator method is proposed for
    non-destructive characterisation of resistive films used in
    microwave integrated circuits. A slot made in one ... </dc:description>
  <dc:publisher>Microwave engineering Europe</dc:publisher>
  <dc:date>2002</dc:date>
  <dc:type>Documento relativo ad una Conferenza o altro Evento</dc:type>
  <dc:type>PeerReviewed</dc:type>
  <dc:identifier>http://amsacta.cib.unibo.it/archive/00000014/</dc:identifier>
  <dc:format>pdf
    http://amsacta.cib.unibo.it/archive/00000014/01/GaAs_1_Vorobiev.pdf
  </dc:format>
</oai_dc:dc>
```

splash page

locator of resource



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## Existing OAI-PMH based approaches : Conventions

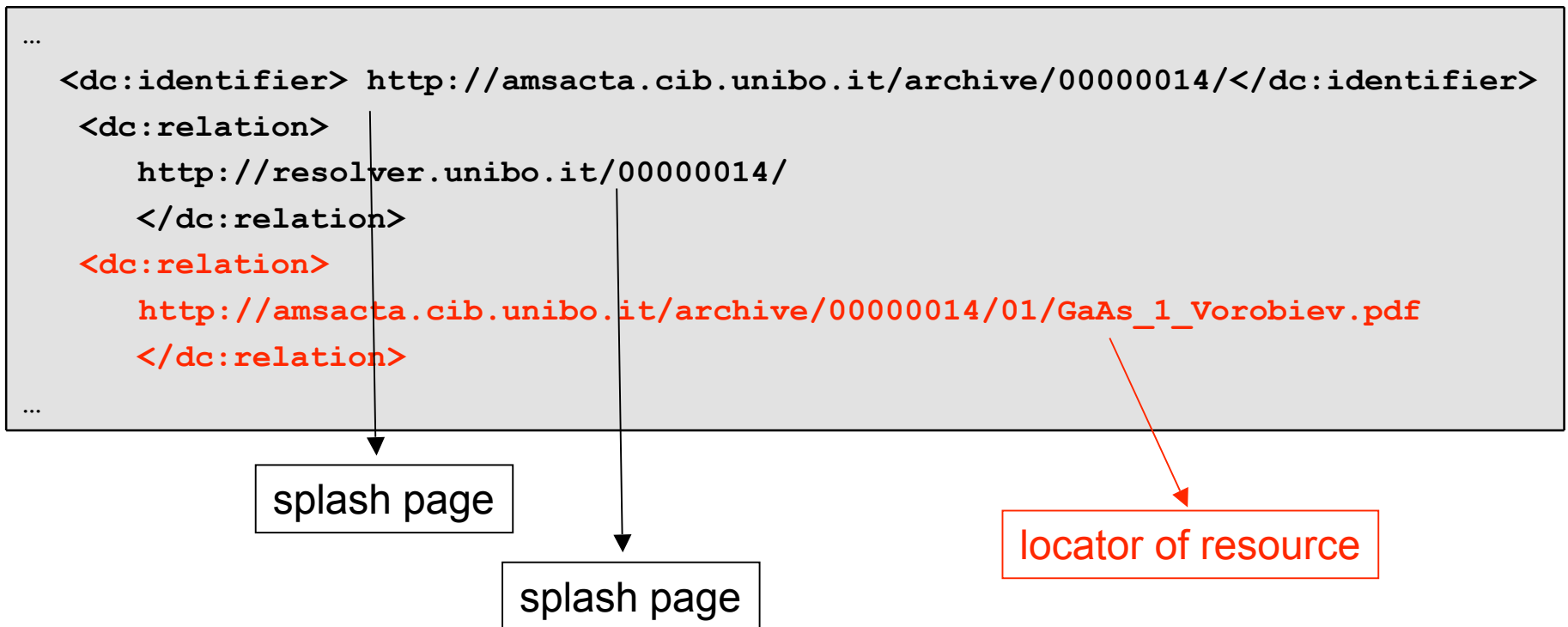
```
...  
<dc:identifier>http://amsacta.cib.unibo.it/archive/00000014/</dc:identifier>  
<dc:relation>  
  http://amsacta.cib.unibo.it/archive/00000014/01/GaAs_1_Vorobiev.pdf  
</dc:relation>  
...
```

splash page

locator of resource



## Existing OAI-PMH based approaches : Conventions



## Existing OAI-PMH based approaches : Other attempts

- dc.identifier leads to splash page & splash page contains special purpose XHTML link to resource(s)
  - What if there is no splash page?
  - How does a harvester know he is in this situation?
- OA-X: protocol extension
  - OK in local context
  - Strategic problem to generalize
  - How to consolidate with OAI-PMH data model
- Qualified Dublin Core
  - Could bring expressiveness to distinguish between locator & identifier
  - But what with datestamp issue?



## Proposed OAI-PMH based approach

- Use metadata formats that were specifically created for representation of digital objects:
  - Complex Object Formats as OAI-PMH metadata formats
  - MPEG-21 DIDL, METS, ..



# OAI-PMH data model



← resource

OAI-PMH identifier  
= entry point to all records pertaining to the resource

← item

metadata pertaining  
to the resource

Dublin Core  
metadata

MARCXML  
metadata

MPEG-21  
DIDL

METS

← records

simple

more  
expressive

highly  
expressive

highly  
expressive



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## Complex Object Formats : characteristics

- Representation of a digital object by means of a wrapper XML document.
- Represented resource can be:
  - simple digital object (consisting of a single datastream)
  - compound digital object (consisting of multiple datastreams)
- Unambiguous approach to convey identifiers of the digital object and its constituent datastreams.
- Include datastream:
  - By-Value: embedding of base64-encoded datastream
  - By-Reference: embedding network location of the datastream
  - not mutually exclusive; equivalent
- Include a variety of secondary information
  - By-Value
  - By-Reference
  - Descriptive metadata, rights information, technical metadata, ...



```

<didl:DIDL>
<didl:Item>
  <didl:Descriptor><didl:Statement mimeType="text/xml; charset=UTF-8">
    <dii:Identifier>
      http://amsacta.cib.unibo.it/archive/00000014/
    </dii:Identifier>
  </didl:Statement></didl:Descriptor>
  <didl:Descriptor><didl:Statement mimeType="text/xml; charset=UTF-8">
    <oai_dc:dc>
      <dc:title>A Simple Parallel-Plate Resonator Technique for
        Microwave. Characterization of Thin Resistive Films
      </dc:title>
      <dc:creator>Vorobiev, A.</dc:creator>
      <dc:identifier>
        http://amsacta.cib.unibo.it/archive/00000014/</dc:identifier>
      <dc:format>application/pdf</dc:format>
      ...
    </oai_dc:dc>
  </didl:Statement></didl:Descriptor>
  <didl:Component>
    <didl:Resource mimeType="application/pdf"
      ref="http://amsacta.cib.unibo.it/archive/00000014/01/GaAs_1_Vorobiev.pdf"/>
  </didl:Component>
</didl:Item>
</didl:DIDL>

```



## Complex Object Formats & OAI-PMH

- Resource represented via XML wrapper => OAI-PMH  
**<metadata>**
- Uniform solution for simple & compound objects
- Unambiguous expression of locator of datastream
- Disambiguation between locators & identifiers
- OAI-PMH datestamp changes whenever the resource (datastreams & secondary information) changes
- OAI-PMH semantics apply: “about” containers, set membership



# OAI-PMH based approach using Complex Object Format

## Typical scenario:

1. An OAI-PMH harvester checks for support of a locally understood complex object format using the ListMetadataFormats verb
2. The harvester harvests the complex object metadata. Semantics of the OAI-PMH datestamp guarantee that new and modified resources are detected.
3. A parser at the end of the harvesting application analyzes each harvested complex object record:
  - The parser extracts the bitstreams that were delivered By-Value.
  - The parser extracts the unambiguous references to the network location of bitstreams delivered By-Reference.
4. A separate process, out-of-band from the OAI-PMH, collects the bitstreams delivered By-Reference from the extracted network locations.

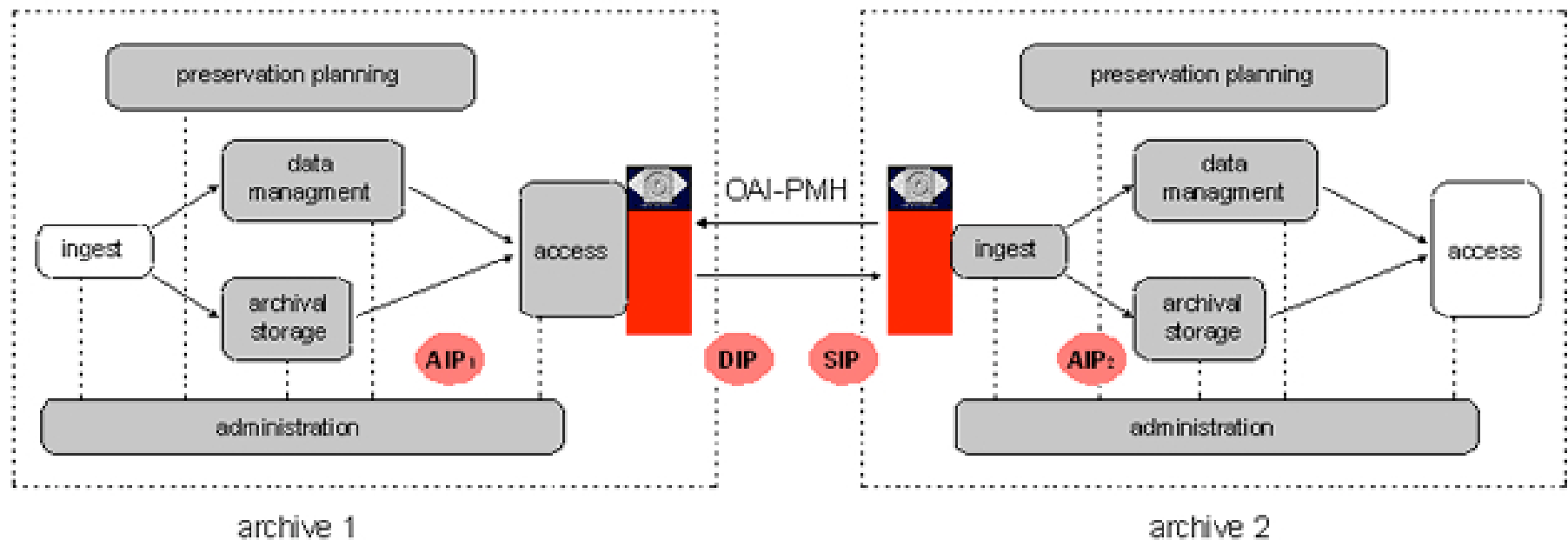


# Complex Object Formats & OAI-PMH : existing implementations

- LANL Repository
  - Local storage of Terrabytes of scholarly assets
  - Assets stored as MPEG-21 DIDL documents
  - DIDL documents made accessible to downstream applications via the OAI-PMH
- Mirroring of American Physical Society collection at LANL
  - Maps APS document model to MPEG-21 DIDL Transfer Profile
  - Exposes MPEG-21 DIDL documents through OAI-PMH infrastructure
  - Includes digests/signatures
- DSpace & Fedora plug-ins
  - Maps DSpace/Fedora document model to MPEG-21 DIDL Transfer Profile
  - Exposes MPEG-21 DIDL documents through OAI-PMH infrastructure
- mod\_oai



# Complex Object Formats & OAI-PMH : archive export/ingest



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## Complex Object Formats & OAI-PMH : issues

- Which Complex Object Format(s)
- How to Profile Complex Object Format(s) for OAI-PMH Harvesting
- Large records
- Making resources re-harvestable
- Because the resource is represented as `<metadata>`, can rights pertaining to the resource be expressed according to the “rights for metadata” OAI-rights guideline?
- Tools:
  - Software library to write compliant complex objects
  - Integration of this library with repository systems (Fedora, DSpace, eprints.org, ....)



# Outline

(1) OAI-PMH refresh

(2) OAI-PMH for Resource Harvesting



(3) mod\_oai

(4) OAI-rights effort

(5) OAI Best Practices



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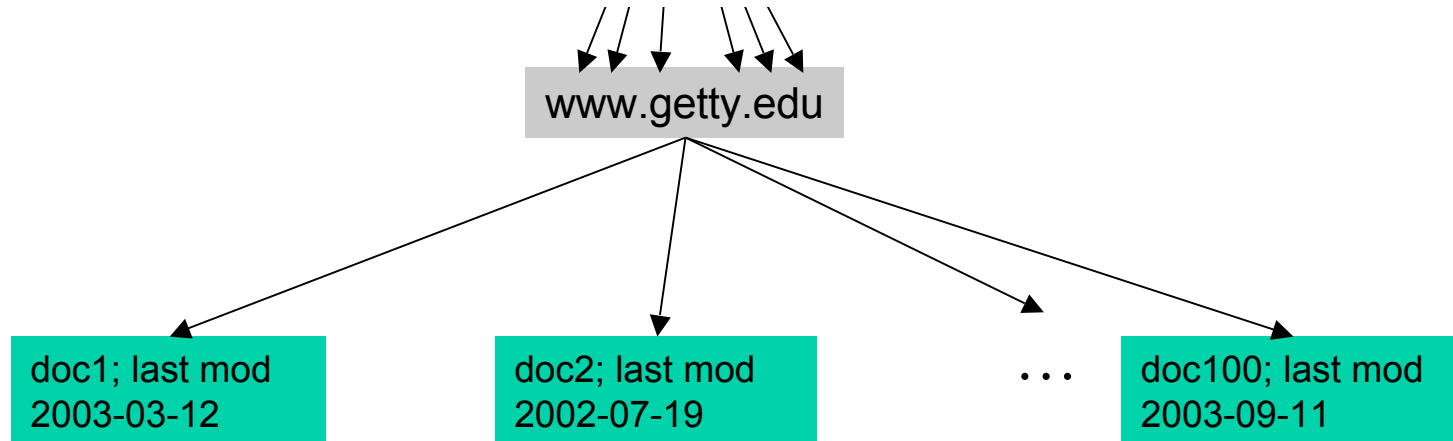
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# Web Robots



what documents have been modified since 2003-11-15 ?

what is this file?  
what are its relationships to other files?  
how often does it change?



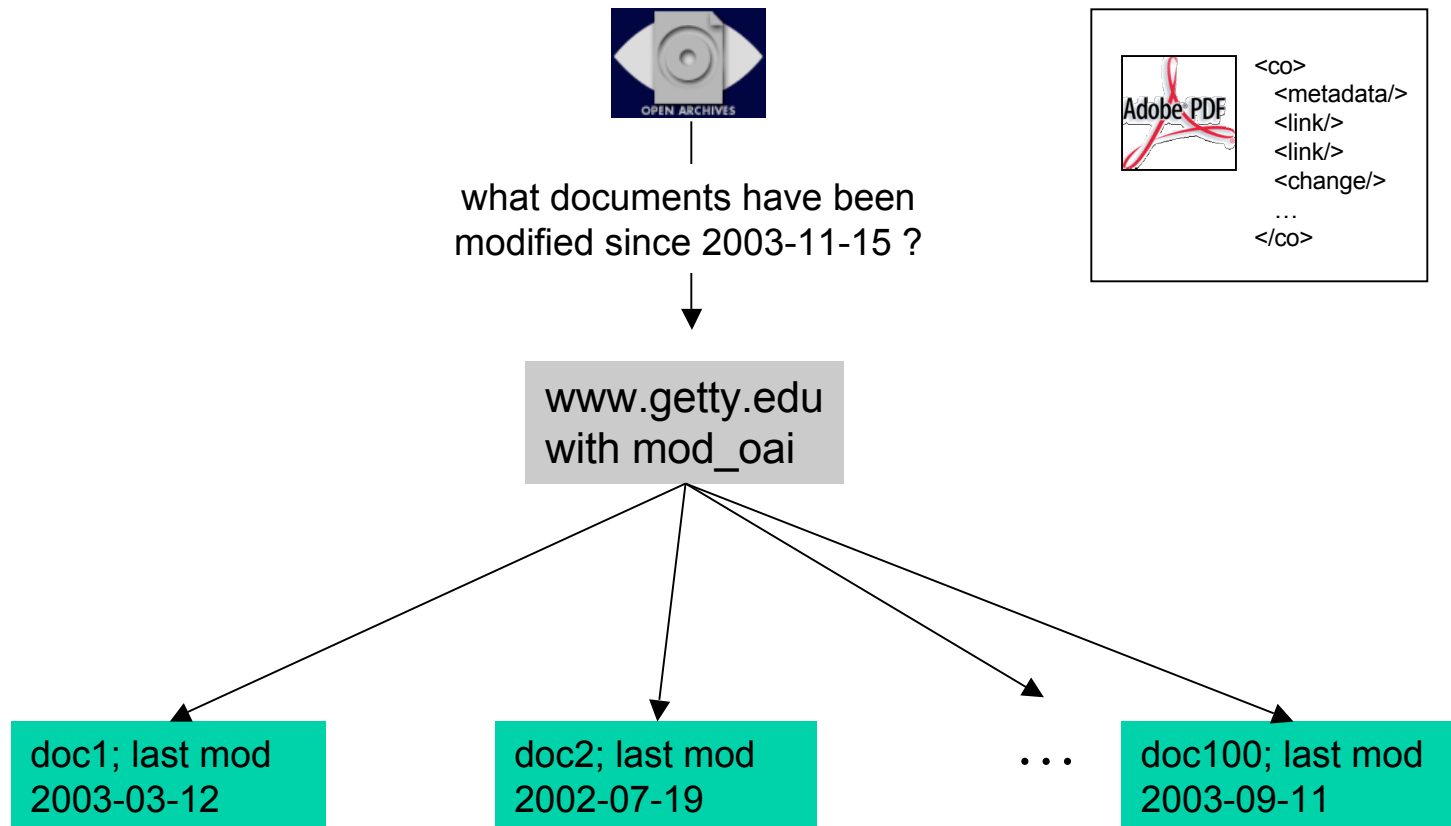
robot image from: <http://www.q-design.com/toy/ToyArt/robots/55.JPEG>



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# A More Efficient Way



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## mod\_oai approach

- Goal: integrate OAI-PMH functionality into the web server itself...
- mod\_oai: an Apache 2.0 module to automatically answer OAI-PMH requests for an http server
  - written in C
  - respects values in .htaccess, httpd.conf
- Result: web harvesting with OAI-PMH semantics (e.g., from, until, sets)
  - `http://www.foo.edu/modoai?`  
    `verb=ListIdentifiers &`  
    `metadataPrefix=oai_dc &`  
    `from=2004-09-15 &`  
    `set=mime:video:mpeg`



## mod\_oai approach

- Install on an Apache 2.0 server
  - compile & edit httpd.conf

<http://www.foo.edu/>

now has an OAI-PMH baseURL of:

<http://www.foo.edu/modoai>



# OAI-PMH data model



← resource

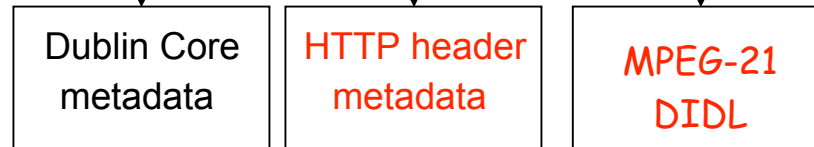
OAI-PMH sets  
MIME type

<http://techreports.larc.nasa.gov/ltrs/PDF/2004/aiaa/NASA-aiaa-2004-0015.pdf>

OAI-PMH identifier  
= entry point to all records pertaining to the resource

← item

metadata pertaining  
to the resource



← records



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## mod\_oai : OAI-PMH concepts

concept	mod_oai implementation
OAI-PMH Identifier	URL of resource
set	MIME type of resource
datestamp	change time of resource
deleted records	“no” deleted records



## OAI-PMH concepts : typical repository

OAI-PMH Entity	value	description
Resource	URL	PDF, PS, XML, HTML or other file
Item		
identifier	OAI Identifier	DNS-based name of metadata about resource
set membership	LCSH	Library of Congress Subject Heading
Record		
metadataPrefix	oai_dc	bibliographic metadata in Dublin Core
datestamp	2004-10-18	modification date of DC record
Record		
metadataPrefix	oai_marc	bibliographic metadata in MARC
datestamp	2004-07-31	modification date of MARC record



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## OAI-PMH concepts : mod\_oai

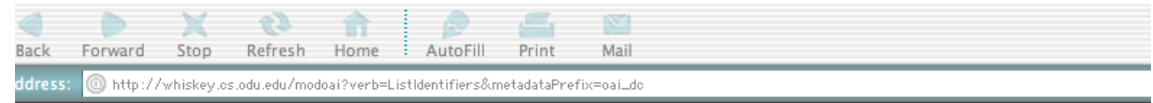
OAI-PMH Entity	value	description
Resource	URL	HTML, GIF, PDF or other web file
Item		
identifier	URL	same URL as the resource
set membership	MIME type	MIME type of the resource
Record		
metadataPrefix	http_header	the http headers that would have been returned via HTTP GET/HEAD
datestamp	2004-07-31	modification date of resource
Record		
metadataPrefix	oai_dc	a subset of http_header in DC
datestamp	2004-07-31	modification date of resource
Record		
metadataPrefix	oai_didl	MPEG-21 DIDL: base64 encoded resource + http_header metadata
datestamp	2004-07-31	modification date of resource

## mod\_oai use cases

- Regular Web Crawling
  - use ListIdentifiers to discover URLs
  - add new URLs to the list of URLs to be crawled
- Harvesting Resources with OAI-PMH
  - use ListRecords to extract the entire resource as an MPEG-21 DIDL AIP



# Regular Web Crawling : ListIdentifiers



## harvester

- issues a ListIdentifiers,
- finds URLs of updated resources
- does HTTP GETs updates only
- can get URLs of resources with specified MIME types

```
<?xml version="1.0" encoding="UTF-8" ?>
- <OAI-PMH xmlns="http://www.openarchives.org/OAI/2.0/" xmlns:xsi="http://www.w3.org/2001/
XMLSchema-instance" xsi:schemaLocation="http://www.openarchives.org/OAI/2.0/ http://
www.openarchives.org/OAI/2.0/OAI-PMH.xsd">
  <responseDate>2004-10-23T02:43:59Z</responseDate>
  <request verb="ListIdentifiers" metadataPrefix="oai_dc">http://whiskey.cs.odu.edu/modoai</request>
- <ListIdentifiers>
  - <header>
    <identifier>http://whiskey.cs.odu.edu/index.html</identifier>
    <timestamp>1999-04-01T17:00:00</timestamp>
    <setSpec>mime:text/html</setSpec>
  </header>
  - <header>
    <identifier>http://whiskey.cs.odu.edu/cs555-abi.pdf</identifier>
    <timestamp>2004-10-02T17:22:43</timestamp>
    <setSpec>mime:application/pdf</setSpec>
  </header>
  - <header>
    <identifier>http://whiskey.cs.odu.edu/test.txt</identifier>
    <timestamp>2004-10-02T17:19:23</timestamp>
    <setSpec>mime:text/plain</setSpec>
  </header>
  - <header>
    <identifier>http://whiskey.cs.odu.edu/pay.jpg</identifier>
    <timestamp>2004-10-02T17:30:47</timestamp>
    <setSpec>mime:image/jpeg</setSpec>
  </header>
  - <header>
    <identifier>http://whiskey.cs.odu.edu/ltrs-pdfs/NASA-59-trr40.pdf</identifier>
    <timestamp>2004-01-01T05:00:00</timestamp>
    <setSpec>mime:application/pdf</setSpec>
  </header>
  <resumptionToken expirationDate="2099-06-26T23:20:00Z">5!oai_dc!0!0!0</resumptionToken>
</ListIdentifiers>
</OAI-PMH>
```



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# OAI-PMH Resource Harvesting

## harvester

- issues a ListRecords,
- Gets updates as MPEG-21 DIDL documents (HTTP headers, resource By Value or By Reference)
- can get resources with specified MIME types

```
address: http://whiskey.cs.odu.edu/modoai?verb=ListRecords&metadataPrefix=oai_didl
- <didl:Descriptor>
- <didl:Statement mimeType="text/xml; charset=UTF-8">
  <dc:type xmlns:dc="http://purl.org/dc/elements/1.1/" xmlns:xsi="http://
  www.w3.org/2001/XMLSchema-instance" xsi:schemaLocation="http://
  purl.org/dc/elements/1.1/ http://dublincore.org/schemas/xmls/
  simpledc20021212.xsd">http://www.openarchives.org/OAI/2.0/
  entity#metadata</dc:type>
  </didl:Statement>
</didl:Descriptor>
- <didl:Component>
- <didl:Resource mimeType="application/xml">
- <http:header xmlns:http="http://www.openarchives.org/OAI/2.0/
  http_header/" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xsi:schemaLocation="http://www.openarchives.org/OAI/2.0/http_header/
  http://purl.lanl.gov/STB-RL/schemas/2004-08/HTTP-HEADER.xsd">
  <http:Content-Length>39117</http:Content-Length>
  <http:Server>Apache/2.0.50 (Unix)</http:Server>
  <http:Content-Type>application/pdf</http:Content-Type>
  <http:Last-Modified>Sat, 02 Oct 2004 17:22:43 GMT</http:Last-Modified>
  <http:Date>Sat, 23 Oct 2004 02:45:19 GMT</http:Date>
  </http:header>
</didl:Resource>
</didl:Component>
</didl:Item>
- <didl:Item>
- <didl:Descriptor>
- <didl:Statement mimeType="text/xml; charset=UTF-8">
  <dii:Identifier xmlns:dii="urn:mpeg:mpeg21:2002:01-DII-NS" xmlns:xsi="http://
  /www.w3.org/2001/
  XMLSchema-instance" xsi:schemaLocation="urn:mpeg:mpeg21:2002:01-DII-
  NS http://purl.lanl.gov/STB-RL/schemas/2003-09/DII.xsd">http://
  whiskey.cs.odu.edu/cs555-abi.pdf</dii:Identifier>
  </didl:Statement>
</didl:Descriptor>
- <didl:Component>
  <didl:Resource mimeType="application/pdf">
  JVBERi0xLjMKJcfsj6IKOCAWIG9iago8PC9MZW5ndGggOSAwIFIvRmlsdGVyYVlC9GbGF0ZURlY29kZT4+
  CnN0cmVhbQp4nNVdy7Ictw3d36+
```



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## mod\_oai

is:

- a simple way to more efficiently harvest web pages
- a possible impact on robots.txt
- fully OAI-PMH compliant
  - works with existing harvesters
- **Funded by the Andrew W Mellon Foundation**

is not:

- yet suitable for dynamic files
- a replacement for
  - DSpace
  - Fedora
  - eprints.org
  - other digital libraries / repositories / cms

info: <http://www.modoai.org/>  
demo : <http://whiskey.cs.odu.edu/>



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## Why OAI-rights?

OAI has matured beyond e-prints and is used to convey metadata about resources for which the ability to express rights is a factor limiting dissemination

⇒ Encourage participation by allowing assertion of rights and restrictions

Even in the open access world it may be important to express permissions

⇒ Work inspired by the RoMEO project (Oppenheim, Proberts, Gadd, 2002-2003)



# How?

“The usual OAI way”:

- Assemble group of knowledgeable and interested parties (the OAI-rights group)
- Distribute first-stab white paper
- Discuss via conference call, scope work
- Email and conference call discussions, develop alpha specification (Jun 2004), revise
- Release beta specification (Nov 2004)
- Release specification (May 2005)

<http://www.openarchives.org/OAI/2.0/guidelines-rights.htm>



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# Who?

The OAI-rights group:

**Caroline Arms** (Library of Congress), **Chris Barlas** (Rightscom), **Tim Cole** (University of Illinois at Urbana-Champaign), **Mark Doyle** (American Physical Society), **Henk Ellerman** (Erasmus Electronic Publishing Initiative), **John Erickson** (Hewlett Packard & DSpace), **Elizabeth Gadd** (Loughborough University & RoMEO), **Brian Green** (EDItEUR), **Chris Gutteridge** (Southampton University & eprints.org), **Carl Lagoze** (Cornell University & OAI), **Mike Linksvayer** (Creative Commons), **Uwe Müller** (Humboldt University), **Michael Nelson** (Old Dominion University & OAI), **John Ober** (California Digital Library), **Charles Oppenheim** (Loughborough University & RoMEO), **Sandy Payette** (Cornell University), **Andy Powell** (UKOLN, University of Bath), **Steve Proberts** (Loughborough University & RoMEO), **Herbert Van de Sompel** (Los Alamos National Laboratory & OAI), and **Simeon Warner** (Cornell University, arXiv & OAI)



# Scope

- No new rights expression language
  - Don't restrict to specific language(s)
  - Don't get bogged down in rights vs permissions vs enforcement, OAI-PMH is about transferring XML data
  - Right about metadata a separate problem from rights about resources
    - Tackle rights about metadata first
    - Postpone work on rights about resources (note overlap with resource harvesting work)
- ? Issues with rights expressions for aggregations of items (OAI sets; whole repositories)
- ? Issues with whether and how changes in rights expressions should be picked up in selective harvesting (datestamps)



## Creative Commons as example language

- Felt we should pick one as an example
  - RoMEO aligned with Create Commons (CC)
  - CC fits well with interests of many of the original OAI participants (e.g. arXiv considering use of CC)
  - CC is a “good thing” to promote
- Picking CC turned out to be a little complicated because of RDF formulation.
  - No XML schema
  - Refer to only by-reference
- CC really is just an example, can use any XML rights expression language (REL)
  - Will likely add appendices with other example languages later



# OAI-PMH data model

Data model elements:

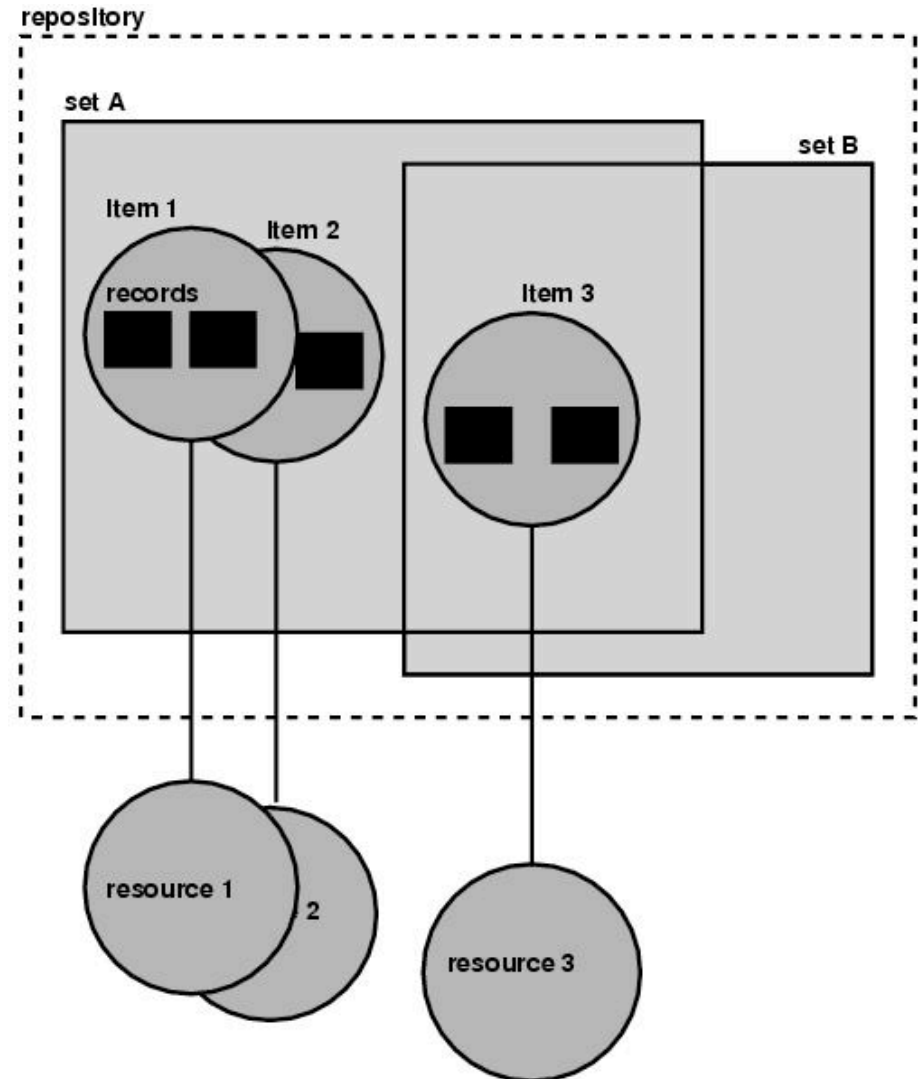
**repository**

**item** - all metadata about a resource, has identifier

**record** - metadata in a particular format, plus header and information about the metadata

**set** - optional, overlapping, hierarchical groupings of items

**resource** outside scope of OAI-PMH



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## Different aggregation levels

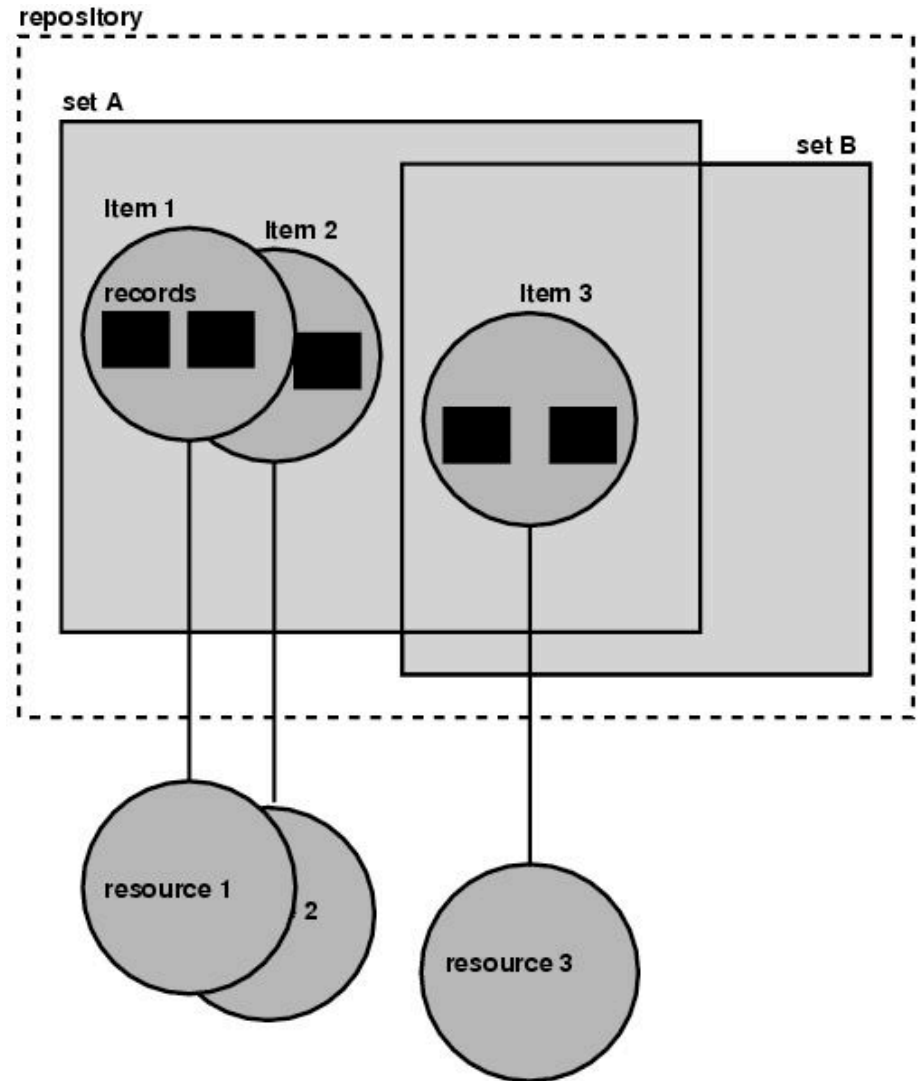
Aggregation levels:

**record** - Rights about an individual record

**repository** - Manifests of rights about all records (all metadata formats from each item) in a repository

**set** - Manifests of rights about all records (all metadata formats from each item) in a set

**Record level** expression is authoritative. Other levels are optional



## record level rights expressions

- W3C XML schema defines format for `<rights>` package to be included in `<about>` container

```
<record>
  <header> id, datestamp, sets </header>
  <metadata> metadata: DC, MARCXML, ... </metadata>
  <about> <rights>...</rights> </about>
  <about> provenance, branding etc. </about>
</record>
```



## record level rights expressions

- Actual rights expression may be in-line (must be valid XML) or by-reference (at given URL, XML recommended)
- In-line method recommended for truly static rights expressions. Avoids possible ambiguity with delayed de-referencing

```
<record>
  <header> id, datestamp, sets </header>
  <metadata> metadata: DC, MARCXML, ... </metadata>
  <about> <rights>...</rights> </about>
  <about> provenance, branding etc. </about>
</record>
```



## set and repository level expressions

- These are **optional** and **non-authoritative**
- W3C XML schema defines `<rightsManifest>` package which contains a sequence of `<rights>` elements (as used at the **record** level)
- `<rightsManifest>` included in
  - For **repository** level: `<description>` in Identify
  - For **set** level: `<setDescription>` in ListSets response
- Useful when there is a small set of expressions within the particular aggregation
- Should be accurate and complete but this is not enforced by specification



## Rights about resources

- Can already be done: use an appropriate metadata format as one of the parallel metadata formats from an item. But:
  - Too much choice: need profile
  - Issues with identification of resources
- Overlap with resource harvesting work

<http://www.openarchives.org/OAI/2.0/guidelines-rights.htm>



# Outline

(1) OAI-PMH refresh

(2) OAI-PMH for Resource Harvesting

(3) mod\_oai

(4) OAI-rights effort

→ (5) OAI Best Practices



# Why?

- OAI has lots of options – need guidelines
- Critical time in development of OAI
  - Implemented by many communities
  - Included in content management systems
  - Service providers have battle scars
- Wild, wild west of metadata
  - Not a shared understanding of shareable metadata
- OAI can't be the last stage in a digital project



# Purpose

To establish best practices for OAI data and service provider implementations and for shareable metadata.

To facilitate communication between OAI data and service provider

To identify tools needed for the OAI community.

DLF / NSDL current focus  
but meant for the wider OAI community



**What's new from the OAI**

October 20, 2005, OAI4, Geneva

# History of Effort

- Part of a DLF grant proposal to IMLS
- Interest in / need for best practices so high, given go-ahead by DLF
- First met in July 2004 in Oakland to hash out all potential issues and develop a plan and timeline



## Participants from...

- California Digital Library
- Cornell University
- DSpace
- Emory University
- Indiana University
- Library of Congress
- National Science Digital Library
- OCLC
- Princeton University
- University of Illinois
- University of Michigan
- University of Tennessee
- University of Southern California
- University of Washington

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Representatives from both data and service provider communities



What's new from the OAI

October 20, 2005, OAI4, Geneva

## Service / Data Providers

- Cognizant of the balance between service and data providers
- Part of effort is establishing and encouraging a culture of communication between data and service providers
- True for both data and service providers



**What's new from the OAI**

October 20, 2005, OAI4, Geneva

# Channels of Communication

- A listserv
- A wiki - <http://oai-best.comm.nsdsl.org/>
- Conference calls
- Meetings at the DLF Forums



**What's new from the OAI**

October 20, 2005, OAI4, Geneva

## Issues on the table

- Implementing a data provider
  - which software
- Set Practices
  - Set description and structure
- Deleted records
  - none, persistent, transient?
- Resumption Tokens
  - What size for each chunk?
- Repository lifecycle
  - registration
  - maintenance
- Metadata formats
  - more than DC!

