aDORe djatoka: An Open-Source Jpeg 2000 Image Server & Dissemination Service Framework

Ryan Chute[1], Luydimilla Balakireva[2], Stephan Dresher[3]

Digital Library Research & Prototyping Team
Research Library
Los Alamos National Laboratory

(1) rchute@lanl.gov
(2) ludab@lanl.gov
(3) stephand@lanl.gov

Outline

Presentation breaks down into two parts:

1. aDORe djatoka Image Server
   - Introduction
   - Features & Interfaces
   - Service Framework
2. Interoperability & Integration
   - Repository: Fedora, aDORe, WWW
   - Clients: Ajax, OpenLayers, Flex, iPhone

Los Alamos NATIONAL LABORATORY

Part 1 - aDORe djatoka Image Server

Context: The aDORe Project Design Principles

- **Scale**: Concrete need to design and implement a solution to ingest, store, access the vast and growing collection of the LANL Research Library.
- **Interoperability:** Interest in repository interoperability (OpenURL, OAI-PMH)
- **Standards:** Leverage existing standards and technologies to make development and migration more straightforward.
- **Component-based:** Use a distributed, component-based approach to meet challenges of scale.
- **Abstract Variations:** Use Digital Objects, Datastreams, and Surrogate abstractions to characterize content.
- **Uniform Access:** Facilitate a uniform manner for client applications to discover and access content objects available in a group of distributed repositories.
- **Federated Access**: Provide single repository behavior for a group of distributed repositories.

Los Alamos NATIONAL LABORATORY

What is aDORe djatoka?

- **Open-Source**: an open-source JPEG 2000 image server and dissemination framework; provides Web Service & Java API
- **Standards:** Leverages existing standards and technologies
  - Standards: ISO JPEG 2000 / NISO OpenURL
  - APIs: ImageJ, JAI, ImageIO, OOM
- **SDK Interface:** Provides of an implementation agnostic (e.g. Kakadu, Aware, etc) framework for JPEG 2000 compression and extraction.
- **Interoperability:** Geared towards reuse through URI-addressability of all image disseminations including regions, rotations, and format transformations
- **Uniform Access:** Provides uniforms access to distributed and heterogeneous repositories using identifier resolver interface.
- **Extensible:** Provides an extensible service framework for image disseminations

Why aDORe djatoka?

- Lack of **open source** image server implementations.
- Lack of an easily **extensible** image dissemination service framework.
- Lack of **standard syntax** for the URI-addressability of image disseminations including regions, rotations, and format transformations.
- Desire to encourage the **adoption** of JPEG 2000 as a service image file format.
- Desire to develop a **community-defined** open source image dissemination server platform.

Why JPEG 2000?

- State-of-the-art compression techniques based on wavelet technology.
- **Standard**: Open Standard Specification
- **License-Free**: Implementable without payment of royalty and license fees.
- **Compression**: Mathematically Lossless, Visually Lossless & Lossy
- **Performance**: Superior compression and rotation performance
- **Multi-scale**: Multiple resolution representation
- **Random Access:** Random code-stream access and processing
- **Metadata**: Rich Metadata Support
- **Scalable**: Multiple versions can be extracted from a single compressed file.
- See project wiki for additional details.

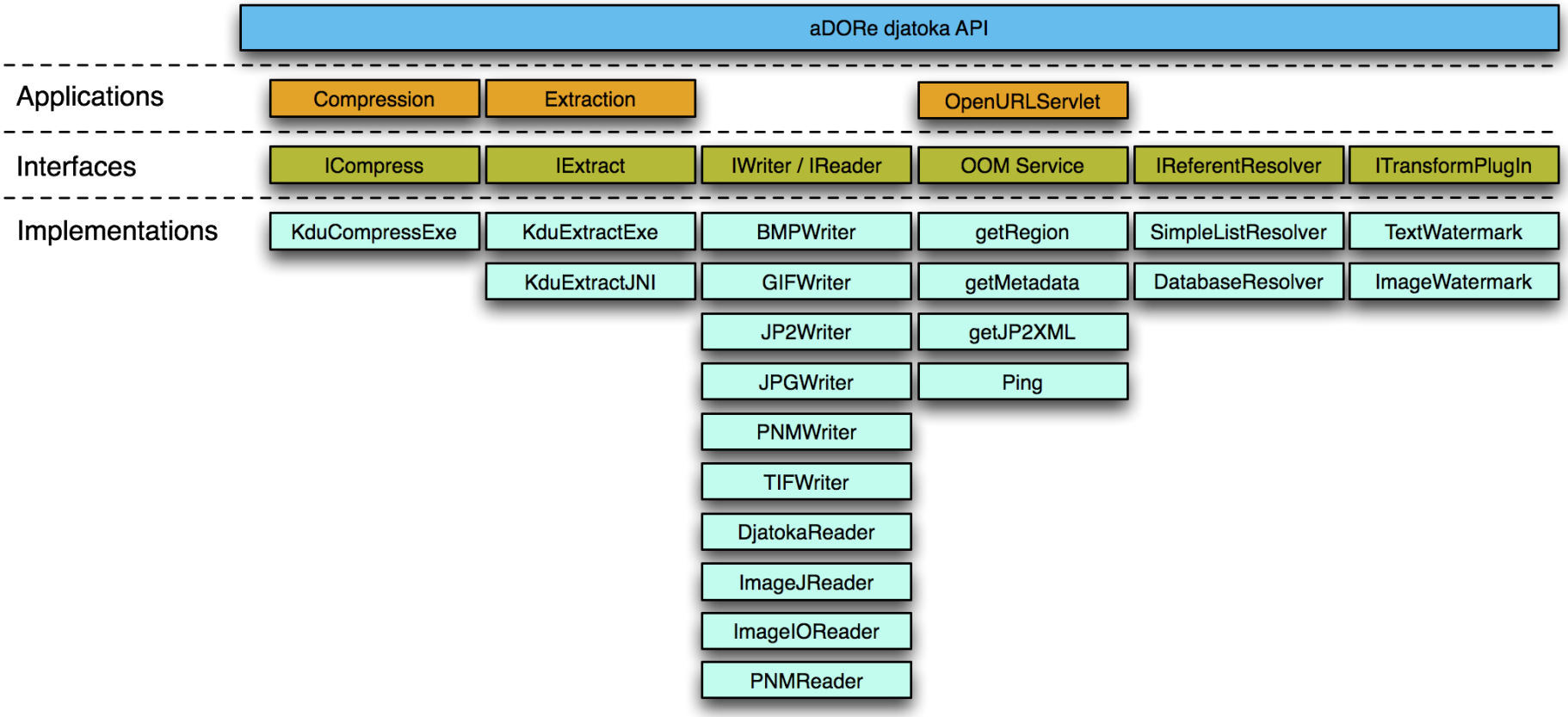
djatoka v1.1 Key Features

Version 1.1 is now available - 2009/05/11

- **Dynamic Scaling**: Adds Scaling Support ("svc.scale")
- **JPX Layers**: Added JPX Layer Extraction support ("svc.clayer")
- **DB Resolver**: New resolver implementation (DatabaseResolver)
- **XML Box Support**: New info:lanl-repo/svc/getJP2XML Service
- **Status Check**: New info:lanl-repo/svc/ping Service
- **Access Controls** for Resolvable Referent URI (e.g., http & ftp)
- **File Support**: Wider range of possible JP2 and image file formats
- **Caching**: Improved Tile Caching Logic
- **Logging**: Improved Logging Support
- **Performance**: Improved Performance
- See project wiki for complete list.

Los Alamos NATIONAL LABORATORY

aDORe djatoka Interfaces

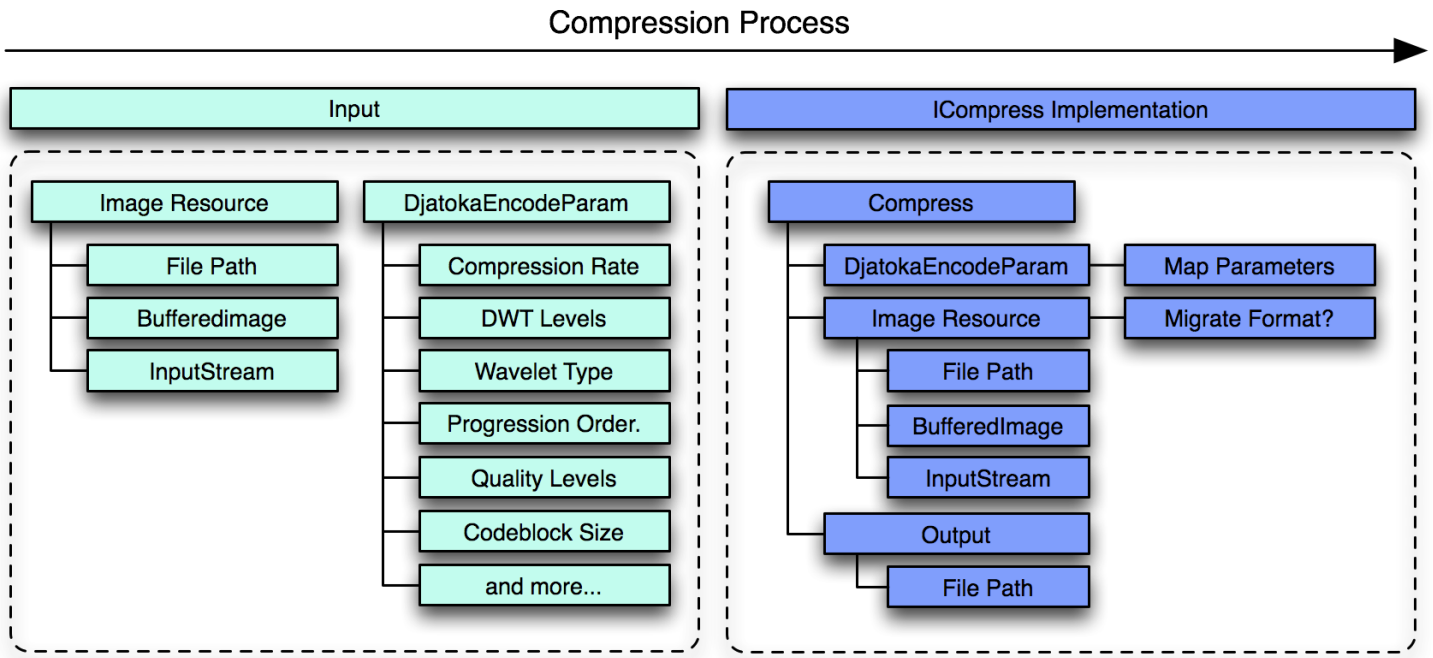


BY NC SA

Los Alamos NATIONAL LABORATORY

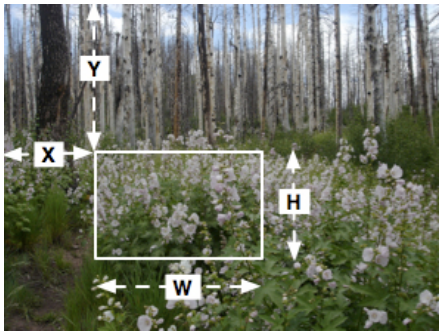
Compression Features

- Application and API provide the current capabilities:
  - Default: Dynamically determines the number of resolution levels
    - # of times an image can be halved from max(w,h) to 96 pixels or less.
  - Default values intended to provide balance of "Image Quality" and performance.
  - Highly configurable (e.g. command-line, properties file, Java Properties object)
  - Ability to define alternate JPEG 2000 compression implementation (e.g., Aware)

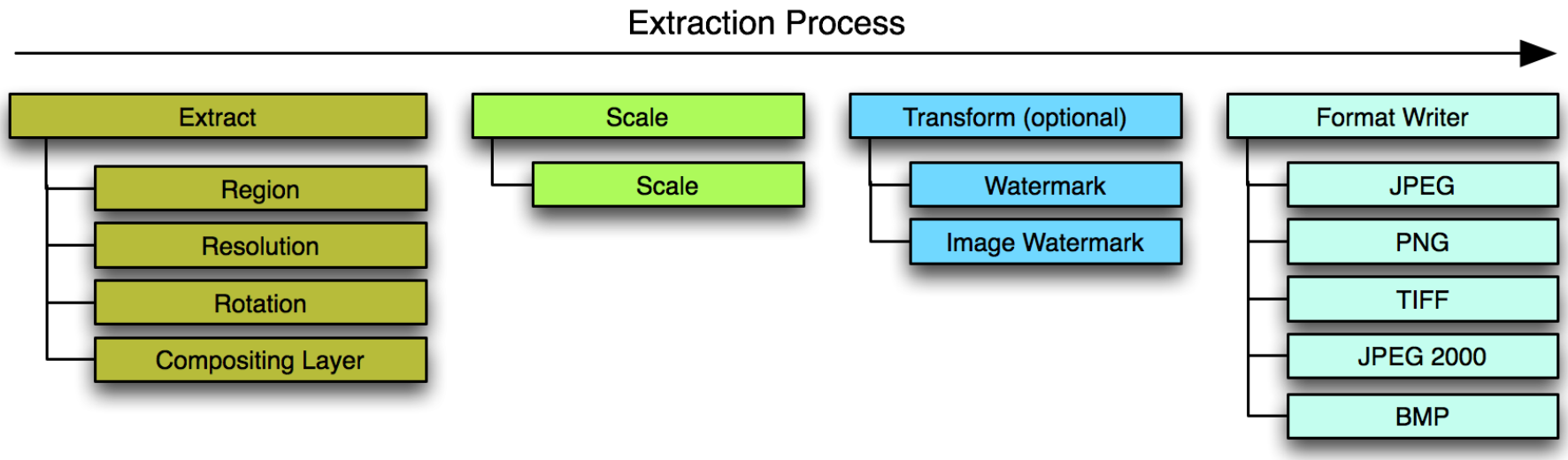


Los Alamos NATIONAL LABORATORY

Extraction Features

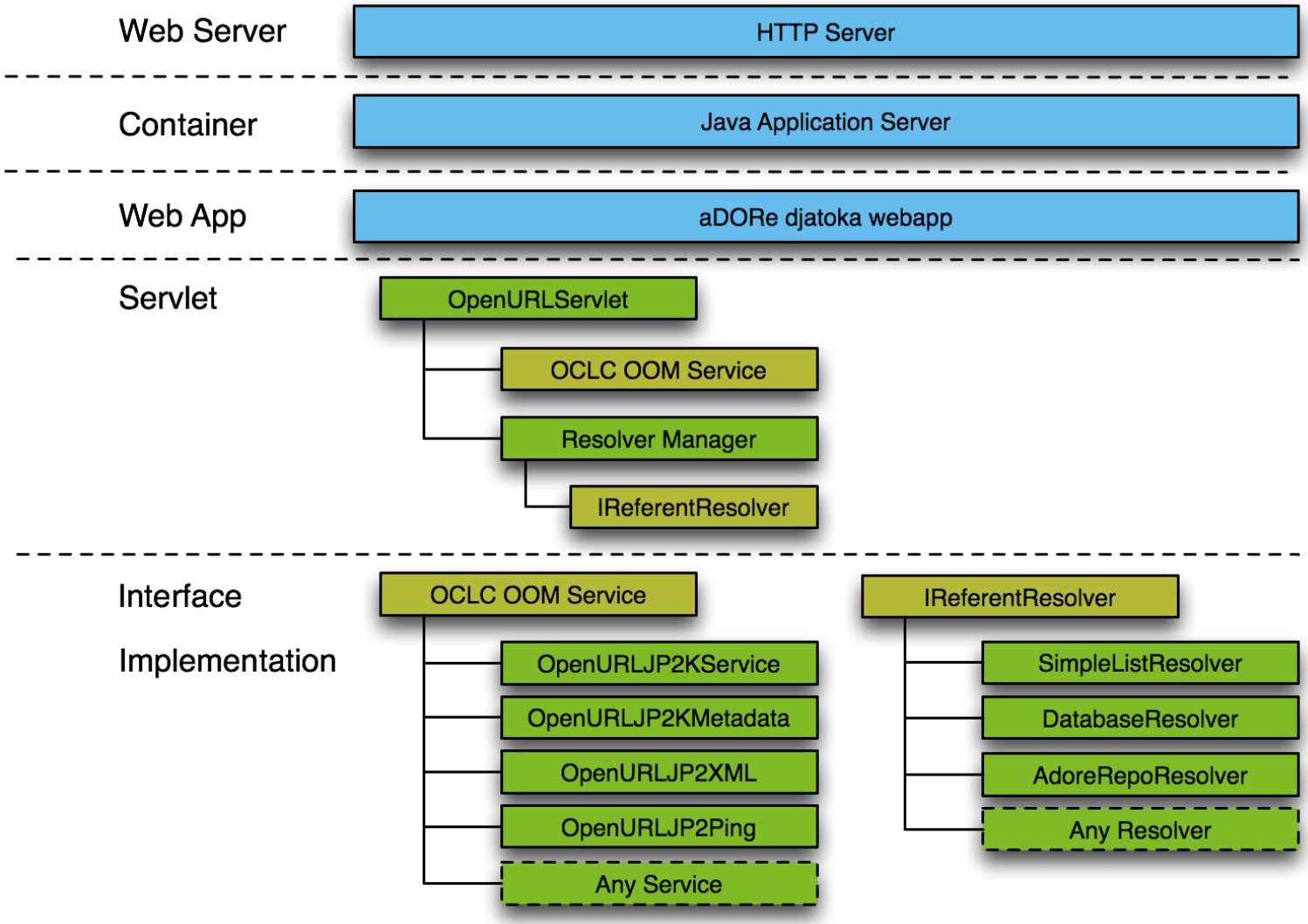


- Application and API provide the current capabilities:
  - Resolution & Region Extraction
  - Rotation
  - Scaling
  - Support for a rich set of input/output formats (e.g. JPG, PNG, TIF, JPEG 2000)
  - Extensible interfaces to perform image transformations (e.g., watermarking)



Los Alamos NATIONAL LABORATORY

aDORe djatoka Service Stack



cc BY NC SA

Los Alamos NATIONAL LABORATORY

Why OpenURL?

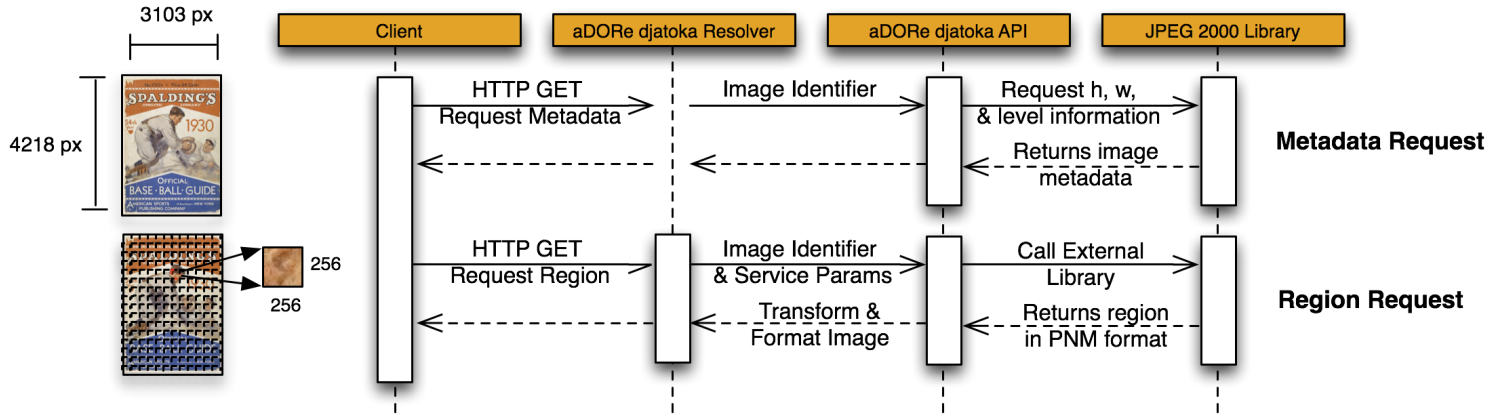
- Existing solutions provide URI-addressability of specified regions, but…
  - Offer limited extensibility for identifier resolution / dissemination services
  - Use home grown HTTP URI syntaxes
- **Standards**: Helpful to have standardized syntax to request Regions or other services.
- **Interoperability**: Resource URIs serve the purpose of requesting services pertaining to an identified resource (the entire JPEG 2000 image), which is a very natural fit with OpenURL.
- **Extensibility**: OpenURL provides an easily extensible dissemination service framework.
- **Re-use**: Availability and familiarity with OCLC's Java OpenURL package, an open source OpenURL Service Framework.

Djatoka & OpenURL

- ContextObject contains info about a **Referent** and a **ServiceType.**
  - **Referent Identifier** (i.e. rft_id) is used to identify the resource.
  - **ServiceType** (i.e. svc_id) is used to identify the service to perform.
- Two types of Referent Identifiers are supported:
  - **Local Persistent Identifiers** (i.e. info URIs)
    - Referent Resolver implementation does the following:
      - Resolve identifier to file path or bitstream
      - Wrap resource reference in ImageRecord object.
  - **Resolvable URIs** (i.e. http, file, ftp URIs)
    - Referent Resolver implementation does the following:
      - Download remote resource & compress
      - Manage storage approach (permanently store?)
      - Wrap resource reference in ImageRecord object
- Four Service Types are currently provided.
  - Services include getRegion, getMetadata, getJP2XML, ping

Los Alamos NATIONAL LABORATORY

aDORe djatoka Sample Service Request



Metadata Request

http://../resolver?url_ver=Z39.88-2004
&rft_id=info:loc-repo/i/00001
&svc_id=info:lanl-repo/svc/getMetadata

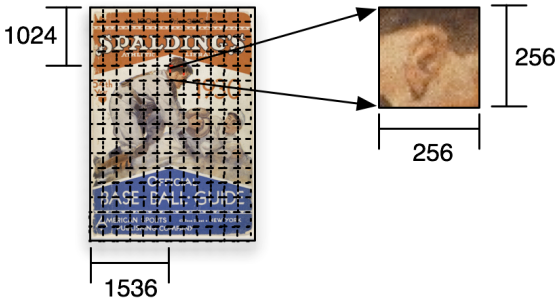
Metadata Response


```
{
"identifier": "info:loc-repo/i/00001",
"width": "3103",
"height": "4218",
"dwtLevels": "6",
"levels": "6",
"compositingLayerCount": "1"
}
```


Region Request

http://../resolver?url_ver=Z39.88-2004
&rft_id=info:loc-repo/i/00001
&svc_id=info:lanl-repo/svc/getRegion
&svc_val_fmt=info:ofi/fmt:kev:mtx:jpeg2000
&svc.format=image/jpeg
&svc.level=6
&svc.rotate=0
&svc.region=1024,1536,256,256

Request Response



BY NC SA

Los Alamos NATIONAL LABORATORY

info:lanl-repo/svc/getMetadata

- **Request** - an HTTP GET/POST request containing the following parameters:
  - **rft_id** - An unique image resource URI
  - **svc_id** - Service to be performed (i.e., info:lanl-repo/svc/getMetadata)
- **Response** - a JSON object containing the following elements:
  - **identifier** - a unique image resource URI
  - **imagefile** - local file to resource
  - **width** - image width
  - **height** - image height
  - **dwtLevels** - number of native JP2 DWT levels in image
  - **levels** - number of djatoka resolutions, using djatoka Level Logic
  - **compositingLayerCount** - number of JPX compositing layers (i.e., frames)
- **Example**


```
{"identifier": "info:lanl-repo/ds/5aa182c2-c092-4596-af6e-e95d2e263de3",
"imagefile": "/lanl/data/loc/cc5fc4f7-e50a-455f-b3ce-a6a8b54824e/WEJLNXSBWO7LPLC7Z6DITFX7A45XR3GS.jp2",
"width": "5120",
"height": "3372",
"dwtLevels": "6",
"levels": "6",
"compositingLayerCount": "1"}
```

info:lanl-repo/svc/getRegion

- **Request** - an HTTP GET/POST request containing the following parameters:
  - **rft_id** - An unique image resource URI
  - **svc_id** - Service to be performed (i.e., info:lanl-repo/svc/getRegion)
  - **svc.level** - djatoka level to extract from resource
  - **svc.rotate** - Rotates image by 90/180/270 degrees clockwise. Default: 0
  - **svc.region** - Y,X,H,W. (Offsets based on max image resolution)
  - **svc.scale** - Request specific output size by scaling extracted resource.
  - **svc.format** – Mimetype to be provided as response. Default: image/jpeg
  - **svc.clayer** - Index of the JPX codestream contained in JPEG 2000 resource
- **Response** - an image of the mimetype specified in service request.
- **Example**

getRegion →

BY NC SA

Los Alamos NATIONAL LABORATORY

info:lanl-repo/svc/ping

- **Request** - an HTTP GET/POST request containing the following parameters:
  - **rft_id** - An unique image resource URI
  - **svc_id** - Service to be performed (i.e., info:lanl-repo/svc/ping)
- **Response** - a JSON object containing the following elements:
  - **identifier** - a unique image resource URI
  - **status** - Indicates whether image is "OK", "PROCESSSING", or not found, as indicated by a 404 response.
- **Example**


```
{
"identifier": "info:lanl-repo/ds/5aa182c2-c092-4596-af6e-e95d2e263de3",
"status": "OK"
}
```

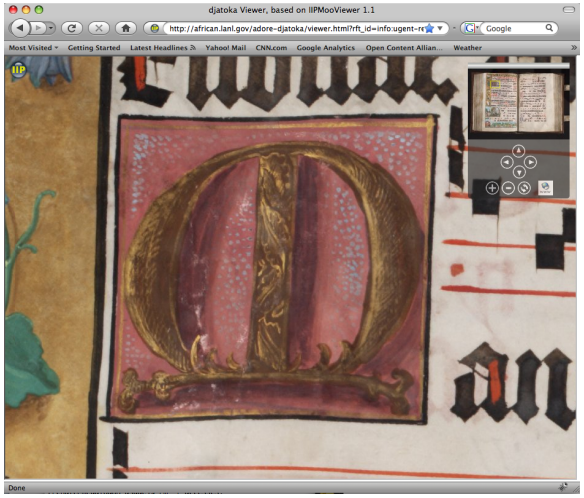
info:lanl-repo/svc/getJP2XML

- **Request** - an HTTP GET/POST request containing the following parameters:
  - **rft_id** - An unique image resource URI
  - **svc_id** - Service to be performed (i.e., info:lanl-repo/svc/getJP2XML)
- **Response** - a XML record with 0 or more XMLBox elements.
  - All responses are wrapped in JP2XML XMLSchema
  - Location: http://purl.lanl.gov/aDORe/schemas/2008-11/JP2XML.xsd
  - Contains:
    - **JP2XML** – root element used to wrap **XMLBox** instances
    - **boxCount** – JP2XML attribute indicating number of XMLBox elements
    - **XMLBox** –unbounded element containing JP2 XML box content
- **Example**

```
<?xml version="1.0" encoding="UTF-8"?>
<jp2:JP2XML
   xmlns:jp2="http://library.lanl.gov/2008-11/aDORe/JP2XML/" boxCount="1">
  <jp2:XMLBox>
    <didl:DIDL xmlns:didl="urn:mpeg:mpeg21:2002:02-DIDL-NS” >…</didl>
  </jp2:XMLBox>
</jp2:JP2XML>
```

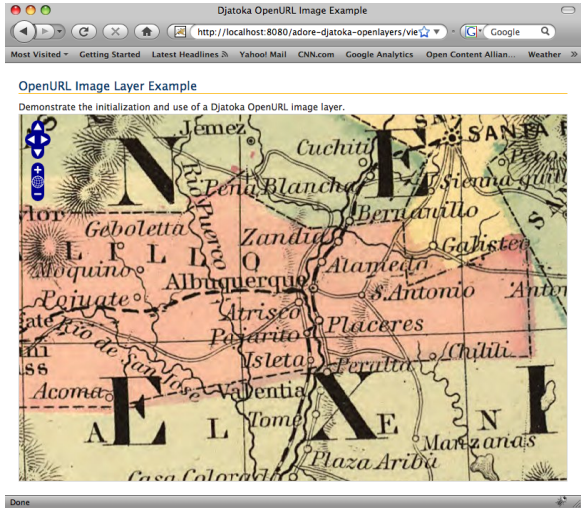

Los Alamos NATIONAL LABORATORY

Client Implementations



IIP Image djatoka Viewer

- Ajax-based client reference implementation
- Tile-based viewer, similar to Google Maps
- HTML / CSS / Javascript
- Asynchronous djatoka region requests
- Distributed under a GPL Free Software License

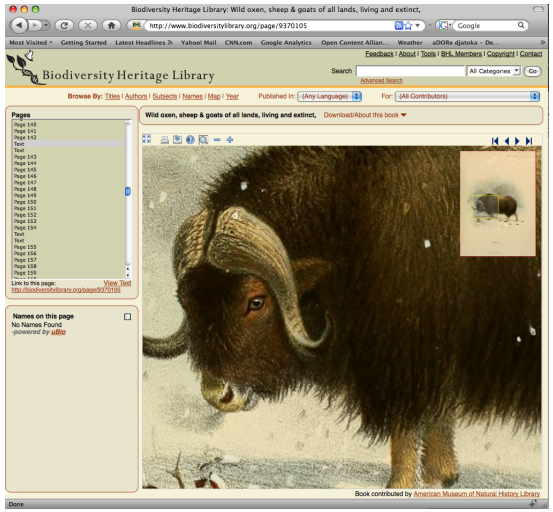


OpenLayers djatoka Viewer

- Ajax-based client reference implementation
- Tile-based viewer, similar to Google Maps
- Put an image widget on any web page
- HTML / CSS / Javascript
- Provides OpenURL Support for OpenLayers
- Asynchronous djatoka region requests
- Distributed under a BSD-style License
- Credits to Hugh Cayless (UNC Chapel Hill)

Los Alamos NATIONAL LABORATORY

Djatoka at the Biodiversity Heritage Library



- Running in production since January, 2009.
- Serving nearly 14 million pages.
- Adapted djatoka IIPImage Viewer to fit seamlessly in BHL interface
- Special Thanks to Chris Freeland, Chris Moyers, and Phil Cryer for their support and courage to be such early adopters.
- View the collection at: http://www.biodiversitylibrary.org

- Now serving all page images via djatoka (Freeland, C. & Moyers, C.) http://biodiversitylibrary.blogspot.com/2009/01/now-serving-all-page-images-via-djatoka.html
- HOWTO: serve jpeg2000 images with a scalable infrastructure (Cryer, P.) http://dailyscour.com/blog/howto-serve-jpeg2000-images-scalable-infrastructure

BY NC SA

Los Alamos NATIONAL LABORATORY

Technical Requirements

- Sun Java 2 Standard Edition 1.5+
- Tomcat 5+
- Ideal:
  - > 512MB RAM
  - Multiple CPUs/cores - Significant Parallel Processing Benefits

Licensing

- **Djatoka** Image Server is distributed under an **LGPL** License.
- **Kakadu** JPEG 2000 compression / extraction library
  - Free for **Non-Commercial** use
  - ~8,500 - ~35,000 USD for commercial license.
- Kakadu Binaries provided for:
  - Win32, Mac OS-X x86, Linux x86_32/64, Sparcv9
- Djatoka **IIPimage** Viewer is a modified IIPMooViewer instance distributed as Open Source under a **GPL** License.

  http://iipimage.sourceforge.net/
- Djatoka **OpenLayers** Viewer is a modified OpenLayers build, released under the Clear **BSD** license.

  http://www.github.com/hcayless/djatoka-openlayers-image-viewer

BY NC SA

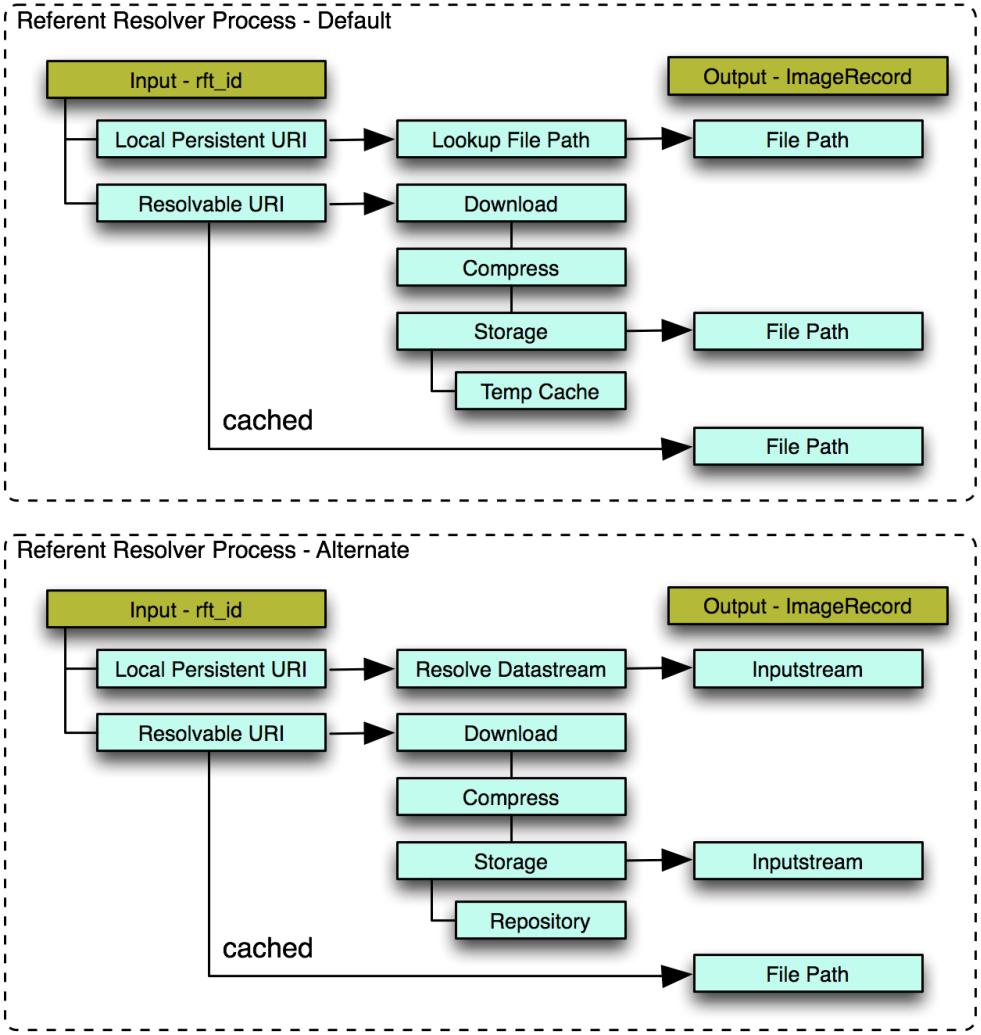
Part 2 - Interoperability & Integration

Interoperability

- Out of the box, a Resolvable URI identifier can be used to integrate/ display content from nearly any repository or from the Web.
- With little effort, this interoperability approach can be integrated into your institutional repository system, such as a Fedora instance.
  - Steps necessary to integrate djatoka with Fedora:
    - Define new Service Definition w/ following methods.
      - getMetadata
      - getRegion
      - getImageView
    - Define new Service Deployment for new Service Definition:
      - Map Fedora methods to djatoka OpenURL services and service parameters.
    - Associate sDef with content model w/ access to datasteam.
    - Update viewer.html to use datastream URI as rft_id.
      - var images = location.href.substring(0,location.href.indexOf("/djatoka:jp2SDef/getImageView")) + "/source";

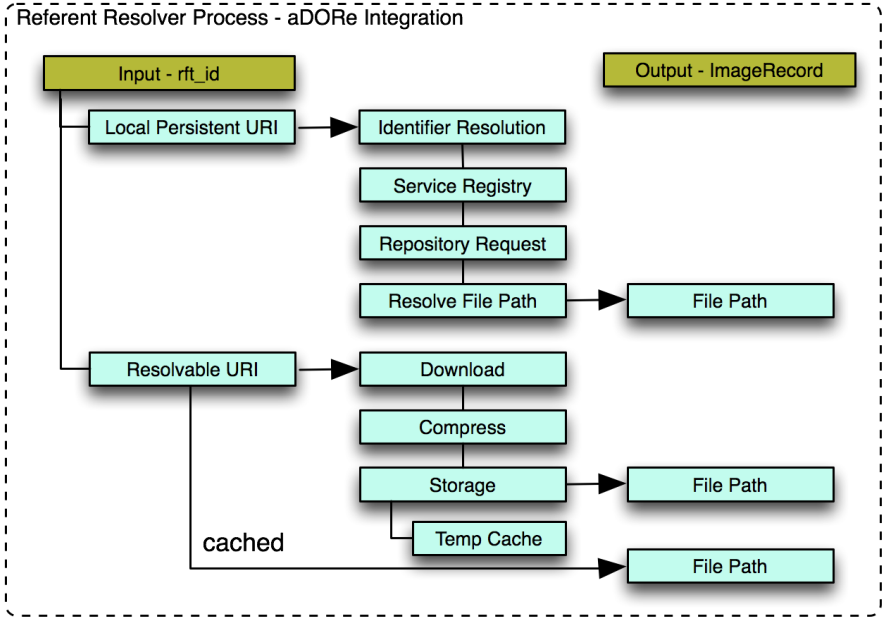
cc BY NC SA

Djatoka OpenURL Referent Resource Resolution



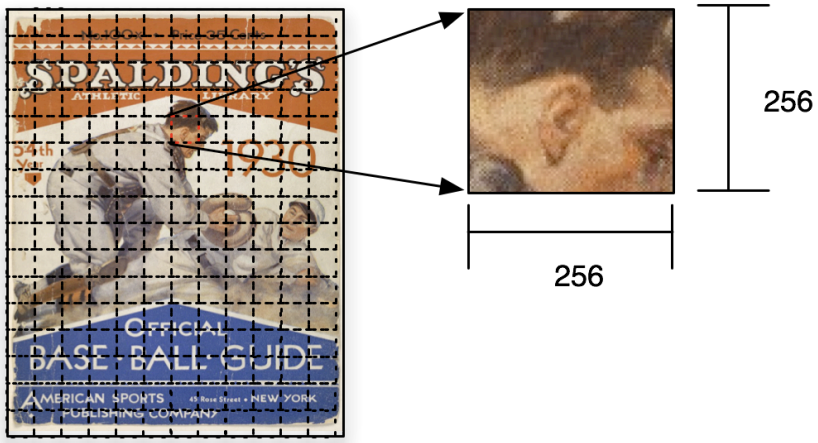
Interoperability – Tighter Integration

- If you manage the resources accessed via djatoka, you'll want to utilize a Referent Resolver instance for the following reasons:
  - By-pass need to download resource; direct access to file path.
  - No need for second cached instance managed by djatoka.
- Rather quickly, we can integrate djatoka and aDORe with direct access to the resource.

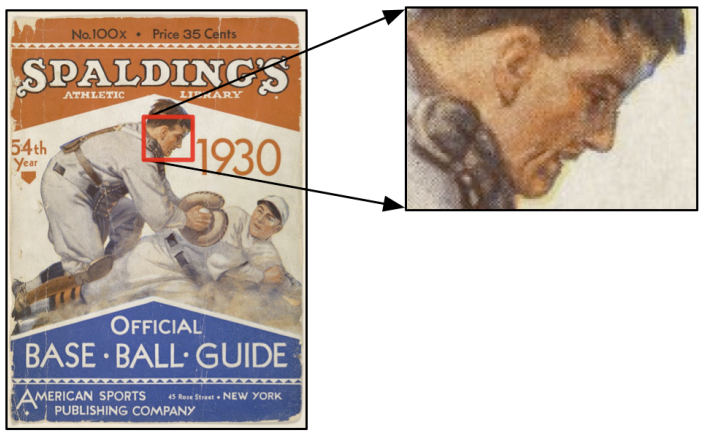


Client Implementation Approaches

Dynamic Tiles



Window View



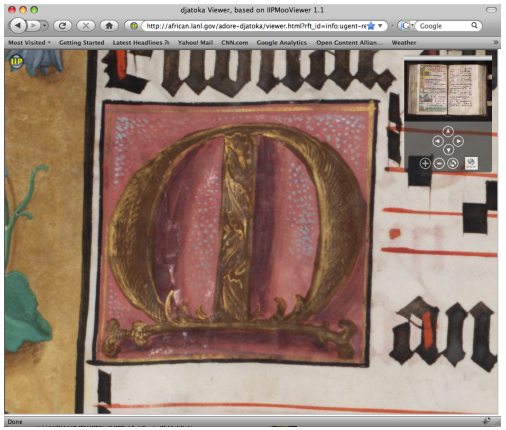
Full View

BY NC SA

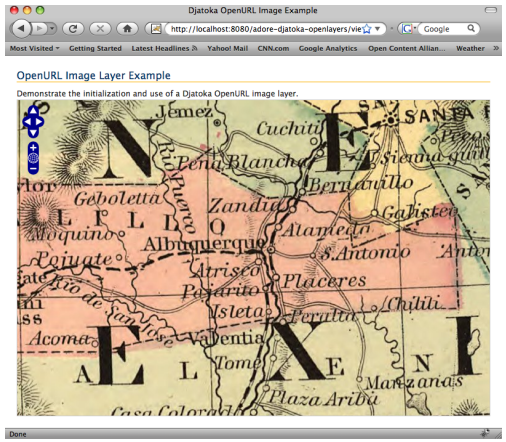
Los Alamos NATIONAL LABORATORY

Current Client Implementations

IIPImage djatoka Viewer

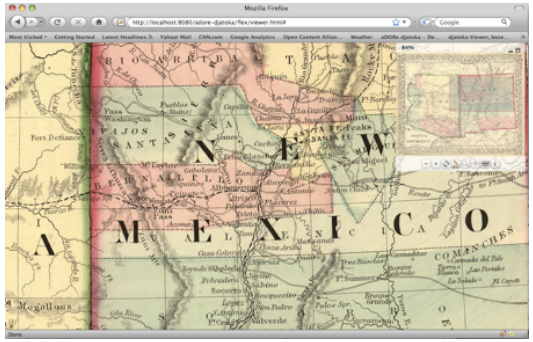


OpenLayers djatoka Viewer



iPhone / iPod Touch djatoka Viewer

Flex djatoka Viewer



BY NC SA

Los Alamos NATIONAL LABORATORY

Thank You

- Please feel free to contact us and thank you for your support.
- Wiki at:
  http://apps.sourceforge.net/mediawiki/djatoka/
- SourceForge effort at:
  http://sourceforge.net/projects/djatoka
- Demonstrations at:
  http://african.lanl.gov/adore-djatoka/

BY NC SA

Los Alamos
NATIONAL LABORATORY