The djatoka JPEG 2000 image server

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Presentation Based on the Paper

Ryan Chute, Herbert Van de Sompel. Introducing djatoka: A
Reuse Friendly, Open Source JPEG 2000 Image Server. D-Lib
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<http://dx.doi.org/10.1045/september2008-chute>

What is aDORe djatoka?

- Open-source JPEG 2000 image server and dissemination framework
    - Java-based solution built around the Kakudu JPEG 2000 library
- Leverages existing standards and technologies
    - Standards: ISO JPEG 2000 / NISO OpenURL
    - APIs & Libraries
        - NIH - ImageJ
        - Sun Microsystems - Java Advanced Imaging
        - Kakadu Software - JPEG 2000 SDK
        - OCLC - OpenURL OOM
- Provides of an implementation agnostic (e.g. Kakadu, Aware, etc) framework for JPEG 2000 compression and extraction.
- Geared towards reuse through URI-addressability of all image disseminations including regions, rotations, and format transformations
- Provides an extensible service framework for image disseminations enabled by OCLC's Java OpenURL package

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Why aDORe djatoka?

- Concrete need to introduce a solution to disseminate high-resolution images stored in our aDORe repository.

- Interest in repository interoperability, cf. involvement in OAI-PMH, NISO OpenURL, OAI-ORE

- Interest in digital preservation, cf. National Digital Information Infrastructure and Preservation Program (NDIIP)

- 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 and/or archival image file format.

- Desire to develop a community defined open source image dissemination server platform.

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Why JPEG 2000?

- JPEG 2000's open specification and its rich feature set defined in a multi-part ISO standard provide a suitable image file format for archival and dissemination service uses.

- JPEG 2000 image format has attracted considerable attention in the geospatial, cultural heritage & archival, and medical imaging communities.

- Features of immediate interest in the JPEG 2000 format are:
    - Multiple Resolutions & Quality Layers in a single file.
    - Region Extraction: Random codestream access allows fast extraction of sub-regions and quality layers.
    - Compression: Support for lossless and lossy compression.
    - Self-containedness: Support for embedding XML metadata in file.
    - Progressive Transmission: Stream information so that image quality improves progressively as the downloading proceeds.

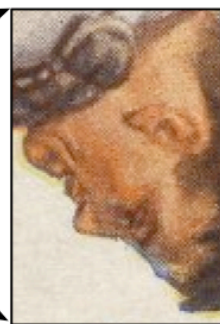- Our previous experience working with JPEG 2000 as a service format.

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Extraction: JPEG 2000 Features

Resolution Extraction

Region Extraction

Region Extraction w/ Rotation

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aDORe djatoka Framework
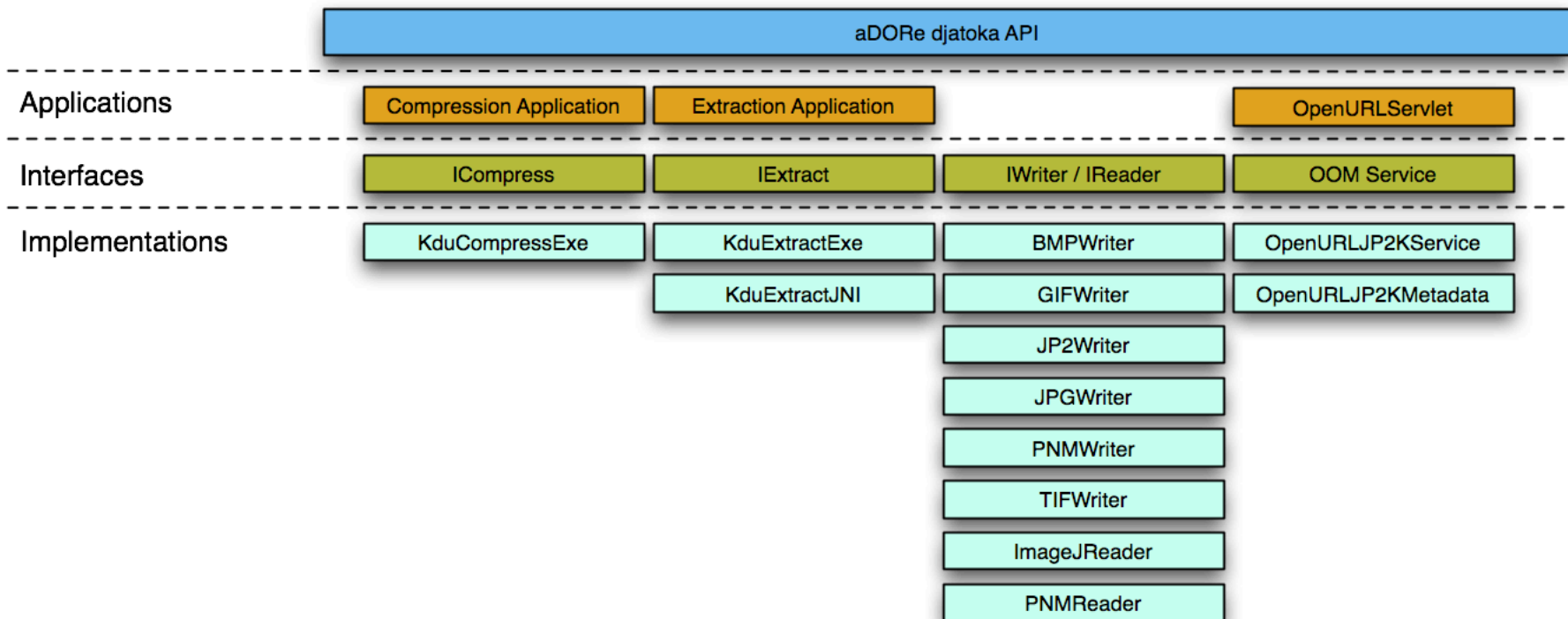
	aDORe djatoka API			
Applications	Compression Application	Extraction Application		OpenURLServlet
Interfaces	ICompress	IExtract	IWriter / IReader	OOM Service
Implementations	KduCompressExe	KduExtractExe	BMPWriter	OpenURLJP2KService
		KduExtractJNI	GIFWriter	OpenURLJP2KMetadata
			JP2Writer	
			JPGWriter	
			PNMWriter	
			TIFWriter	
			ImageJReader	
			PNMReader	

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Compression: Resolution Levels

- djatoka dynamically determines the number of DWT levels
  - # of times an image can be halved from max(w,h) to 92 pixels or less.
- 92 pixels derived from Kodak PhotoCD Base resolution size.

1536 pixels

Size 4	1536 pixels
Size 3	768 pixels
Size 2	384 pixels
Size 1	192 pixels
Size 0	96 pixels

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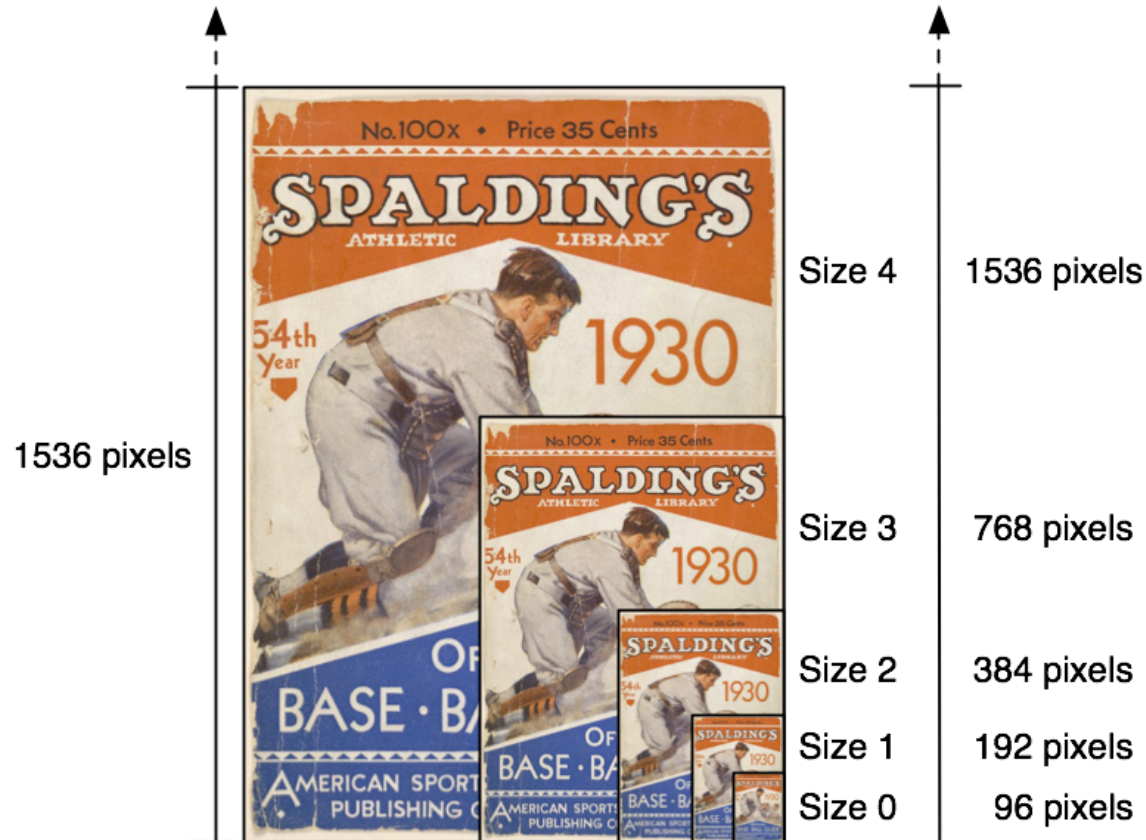
Compression: Quality

- Utilizes rate-distortion slope threshold values to achieve a specific level of "Image Quality", regardless of subject matter. Also supports absolute rates.
- Number of quality layers and rate-distortion slope threshold values are configurable.

9:1

Baseball Guide (LoC)

23:1

William-Adolphe Bouguereau

8:1

Sargis Ptisak, Gospel of Mark

5:1

Ansel Adams - Manzanar War Relocation (LoC)

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Compression: Random Access Efficiencies

- Uses precinct, instead of tiles, to handle random access efficiencies.
  - Tiles are built into the codestream, while precinct data can be changed without recompressing the image. Both are supported for extraction.
- Packet Length-Tile (PLT) Markers are added to improve extraction times.
- A RPCL (Resolution-Position-Component-Layer) order is applied.
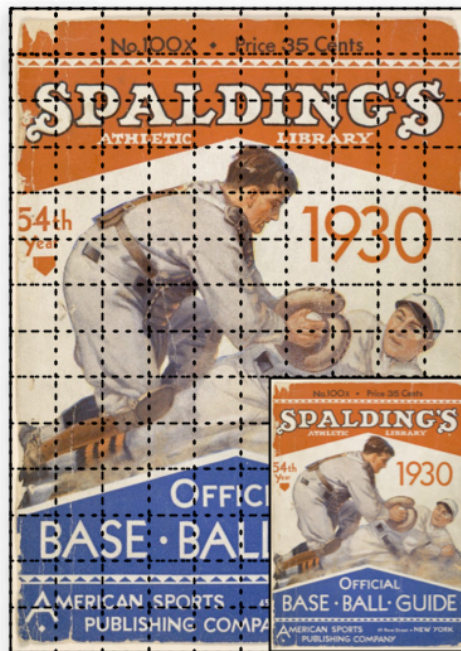

Precinct Structure

Tile Structure

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Extraction: djatoka Features

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

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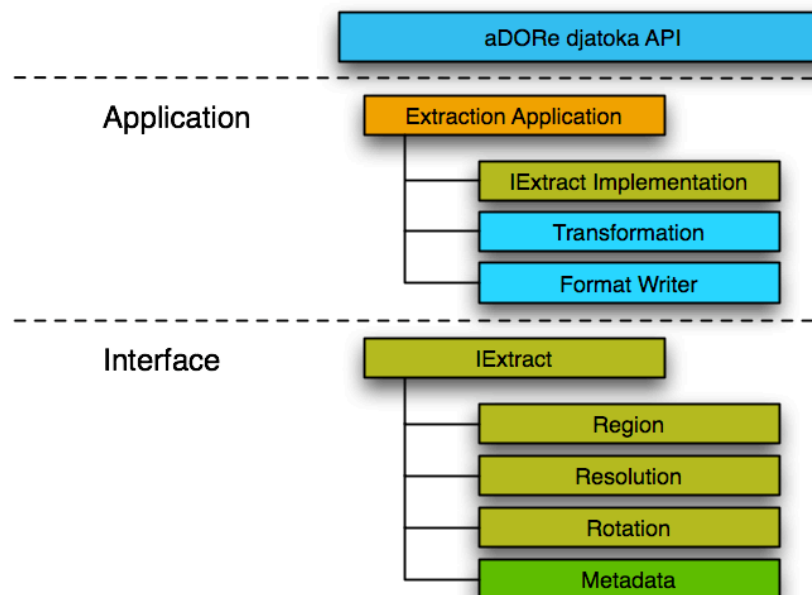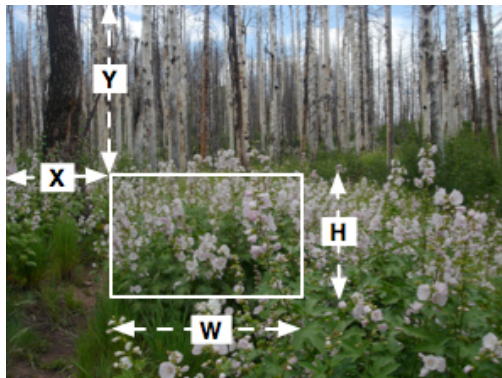
Why OpenURL?

- Existing solutions provide URI-addressability of specified regions, but…
    - Offer limited extensibility for identifier resolution / dissemination services
    - Use home grown HTTP URI syntaxes
    - Use Cases and Functionality not governed by the community.
- Recognized standardized syntax to request Regions or other services pertaining to JPEG 2000 images would be helpful.
- Since URIs clearly serve the purpose of (dynamically) requesting services pertaining to an identified resource (the entire JPEG 2000 image), the OpenURL Framework provides a standardized foundation that can be leveraged in this realm.
- OpenURL provides an easily extensible dissemination service framework.
- Availability and familiarity with OCLC's Java OpenURL package, an open source OpenURL Service Framework.
- Also, to present an alternate Use Case for the OpenURL Framework.

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aDORe djatoka OpenURL Service Framework

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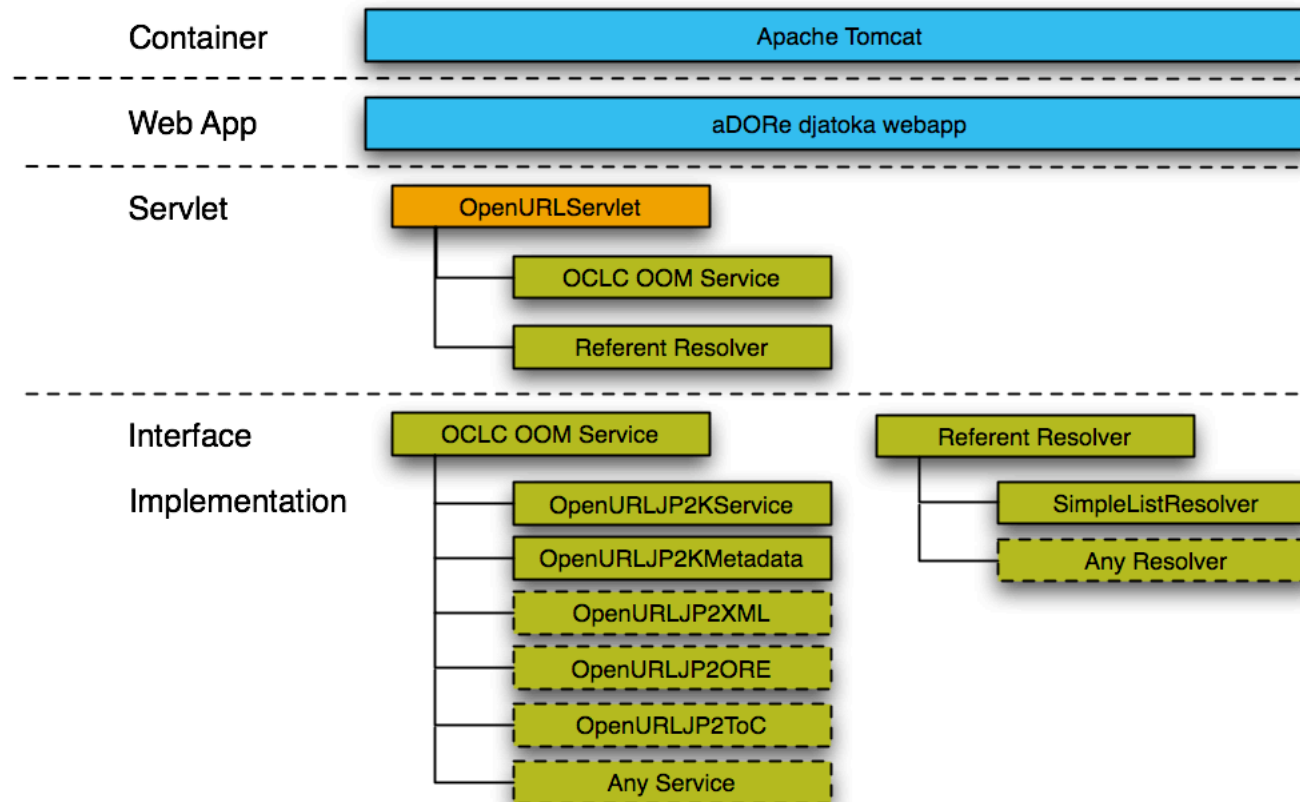
OpenURL Services & Formats

- ContextObject carries information only about a Referent and a ServiceType
  - *info:lanl-repo/svc/getRegion*: the service to request a Region.
  - *info:lanl-repo/svc/getMetadata*: the service to request image metadata.
- JPEG 2000 Region Extraction Service Format
  - Currently registered for Trial Use in the OpenURL Registry
  - Matrix Definition:
    - http://www.openurl.info/registry/docs/mtx/info:ofi/fmt:kev:mtx:jpeg2000

Parameter	Description
format	String. Mime type of the image format to be provided as response. Default: image/jpeg
rotate	Integer. Rotates image by 90/180/270 degrees clockwise. Default: 0
level	Integer. Where 0 is the lowest resolution with each increment doubling the image in size. Default: Max level of requested image, based on the number of Discrete Wavelet Transform (DWT) decomposition levels.
region	Format: Y,X,H,W. Y is the down inset value (positive) from 0 on the y axis at the max image resolution. X is the right inset value (positive) from 0 on the x axis at the max image resolution. H is the height of the image provided as response. W is the width of the image provided as response. All values may either be absolute pixel values (e.g. 100,100,256,256), float values (e.g. 0.1,0.1,0.1,0.1), or a combination (e.g. 0.1,0.1,256,256).

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Service Request Walkthrough

- Ajax-based client reference implementation
  - Tile-based viewer, similar to Google Maps
  - HTML / CSS / Javascript
- Obtains metadata (e.g., width, height, DWT levels) from image server
- Logic to generate and request URLs for 256x256 pixel tiles at each level
  - Asynchronous djatoka region requests
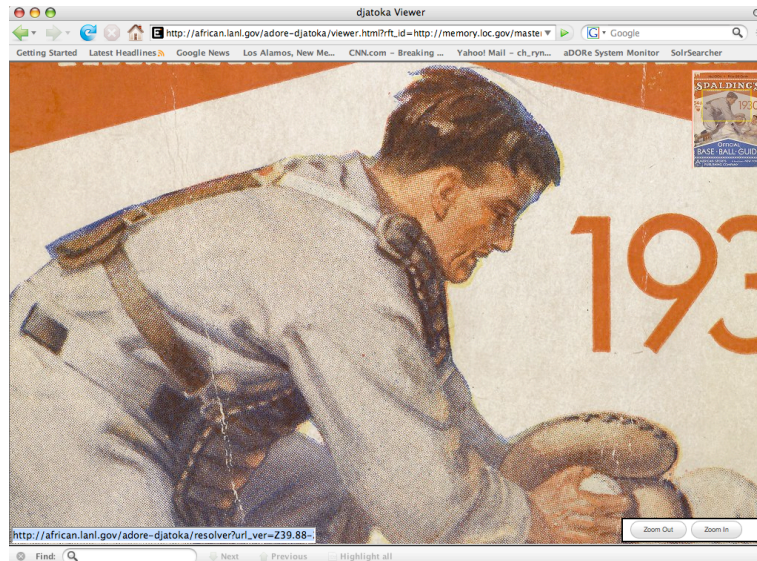
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Service Request Walkthrough
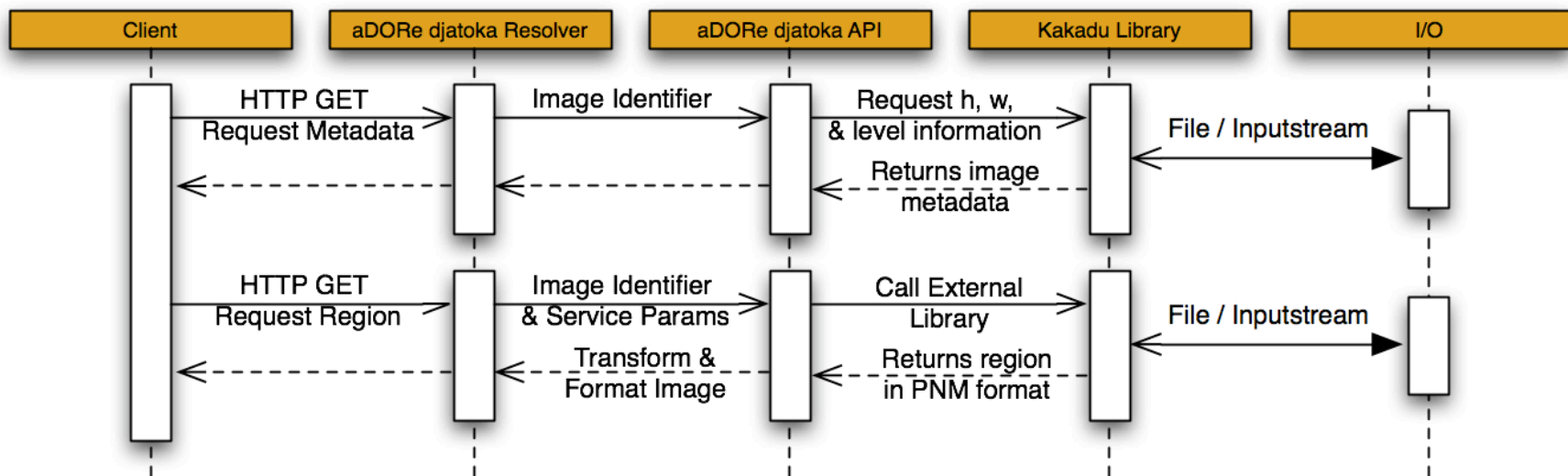
Service Request Walkthrough

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",
"levels": "6"
}
```

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

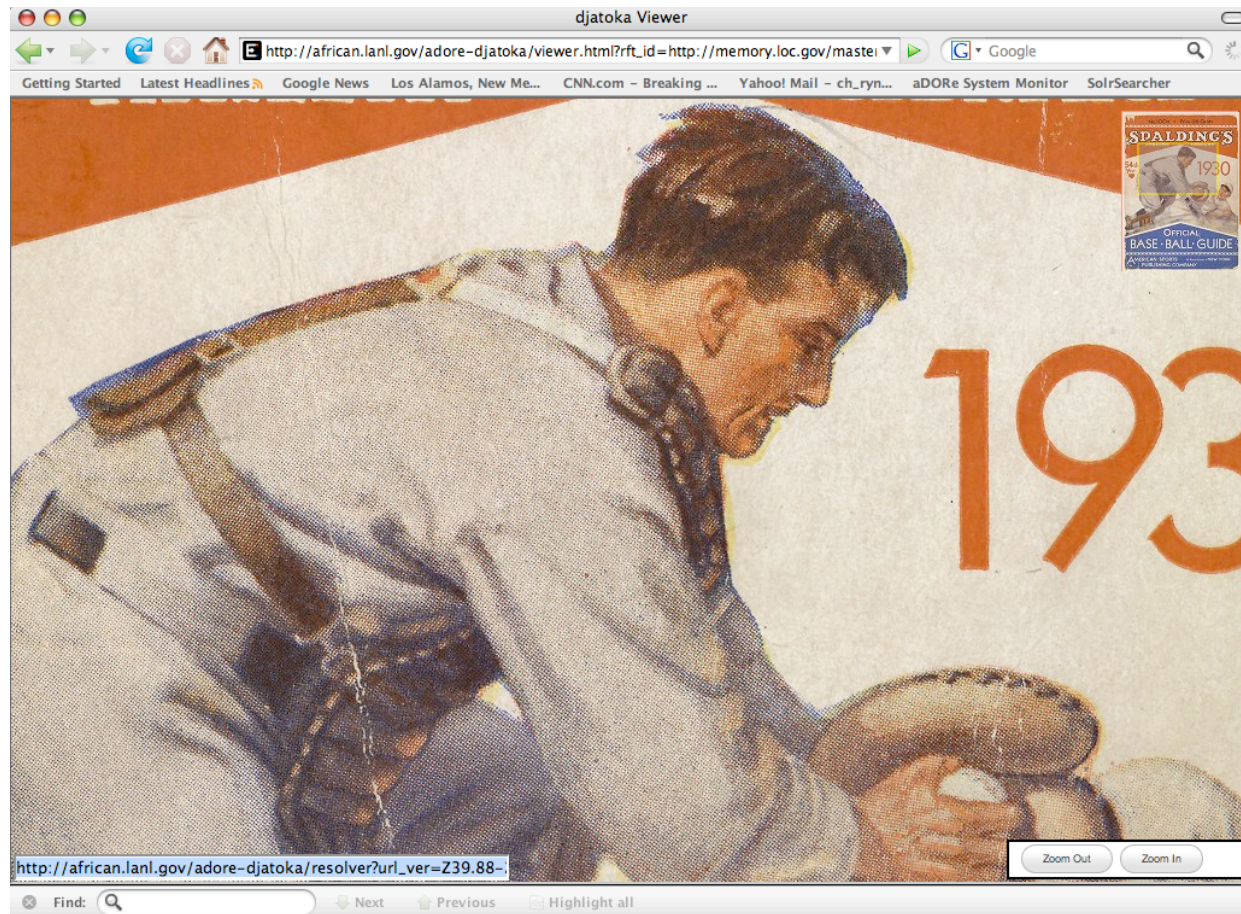Los Alamos
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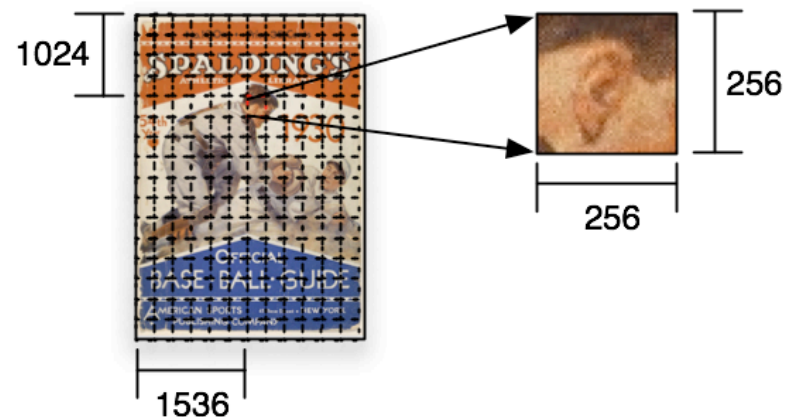
Key Features

- Key Feature of aDORe djatoka Image Server:
    - Compression of JPEG 2000 files using properties to improve extraction performance and provide good compression / quality balance.
    - Dynamic extraction of multiple resolutions and regions.
    - Serialization Plug-in Framework (e.g., BMP, GIF, JPG, JP2, PNG, TIF)
    - Transformation Plug-in Framework (e.g., watermarking)
    - A rich service framework to facilitate the transfer of service parameters via an OpenURL compliant HTTP GET request.
    - Configurable File-based Caching for improved performance.
    - Framework distributed as Open Source under LGPL License
    - Kakadu libraries and executables are free for Non-Commercial Use.
        - Binaries provided for Win32, Mac OS-X x86, Linux x86_32/64, Sparc32
- Technical Requirements
    - Sun Java 2 Standard Edition 1.5+
    - Tomcat 5.5+
    - Ideal: +1GB RAM, Multiple CPUs/cores - Significant Parallel Processing Benefits

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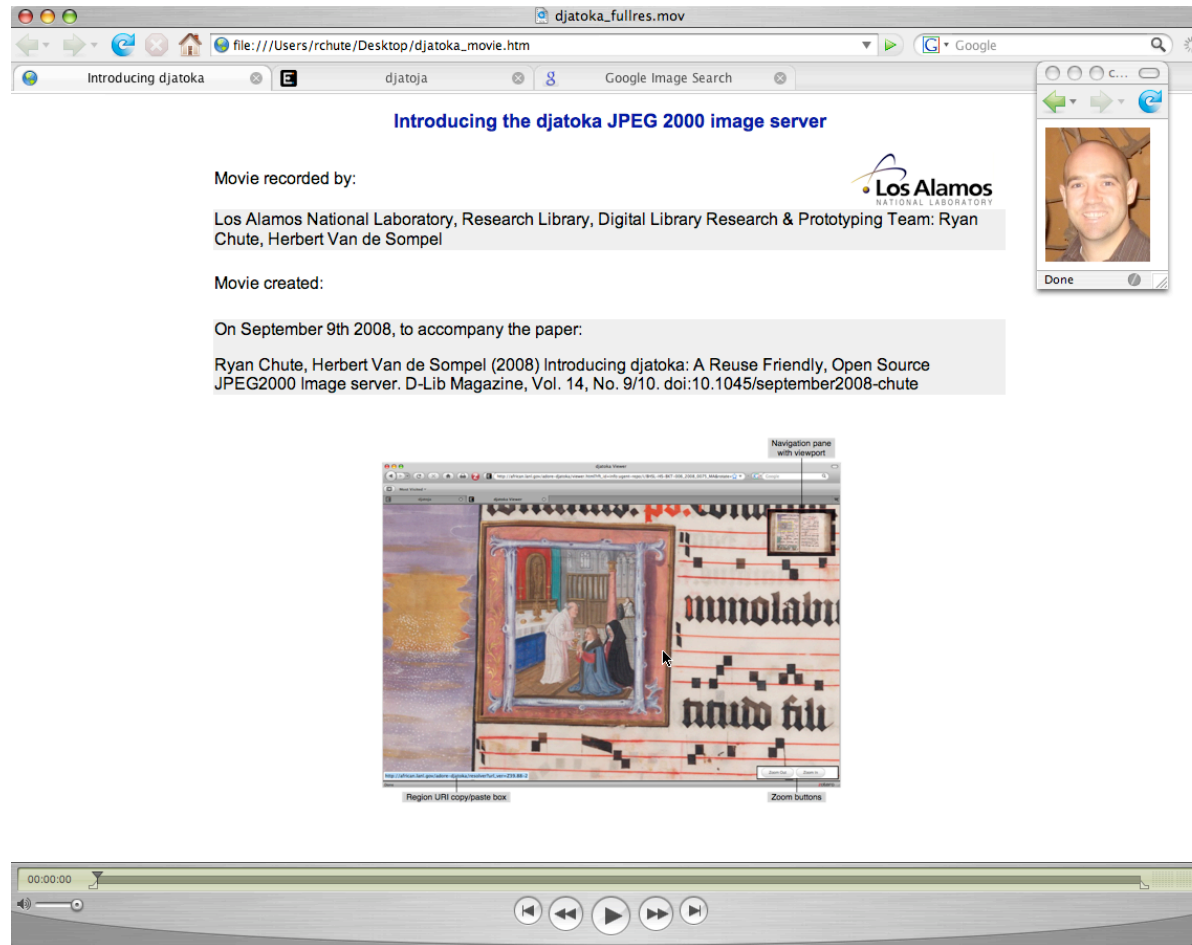NATIONAL LABORATORY

aDORe djatoka: Live Demo

<http://african.lanl.gov/adore-djatoka/viewer.html?rft_id=http://memory.loc.gov/master/gc/spalding/00172/00001.tif>

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aDORe djatoka: The Show

<http://african.lanl.gov/aDORe/projects/djatoka/djatoka_release.mov>

aDORe djatoka: The Download

- Available at:

  <http://african.lanl.gov/aDORe/projects/djatoka>

- SourceForge effort at:

  <http://sourceforge.net/projects/djatoka>

- Demonstrations at:

  <http://african.lanl.gov/adore-djatoka>

  <http://www.antifonarium-tsgrooten.be/highlights.htm>

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How can djatoka help you?

- Significant interest from major scientific and cultural heritage institutions.

- Please come to the BoF Session this afternoon to discuss…
    - ○ Your Use Cases
    - ○ Your Institutional Requirements & Mandates
    - ○ Your issues related to disseminating high resolution digital images.
    - ○ How we can collaborate to develop community defined, open-source…
        - - User Interface Applications (e.g. djatoka viewer)
        - - %Insert Community Needs Here%

- Please feel free to contact us and thank you for your support.

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