# Zoomify

# Zoomify Technology & Products

# White Paper

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# I.  Abstract

Zoomify's technology makes ultra-high-resolution images fast and interactive on the Web. This is accomplished using image *streaming*: incremental, on-demand access to image data by level of detail and area of view.

Zoomify's products each provide complete high-resolution imaging solutions including support for encoding, publishing, and viewing.  The products share standard storage options. They are differentiated by features tailored to particular audiences.  For example, Zoomify's Enterprise product includes support for browser-based image annotation.  Each of Zoomify's products are standards-based and can be easily integrated with existing workflow and infrastructure.

This white paper explains how Zoomify's technology works and how Zoomify products can be applied. While technical in nature, it is intended to be accessible to image users and business managers in varied professions, as well as to technology professionals.

# II.  High-Quality Images: Opportunities and Challenges

## Image Value

High-quality images reveal detail to inform decisions and compel purchases, accurately record truly representative data from transient or perishable sources, and much more. Unfortunately, high-quality images involve massive amounts of data and present challenges including slow access and difficulty in simply displaying images far larger than the largest computer screen.  Zoomify address these concerns by enabling rapid viewing access and intuitive zoom and pan navigation.  Zoomify makes working with large images practical.

## Increasing Prevalence

The ability to capture high-quality images has increased dramatically in the last decade and has, in fact, surpassed the ability to share and make use of the level of resolution now commonly achievable.  Digital cameras now surpass film in capture quality and are approaching film in annual exposures with over 9.1 billion exposures in 2000 to 29.5 billion expected in 2005 (IDC, March 2000).  Multi-megapixel cameras now capture images so large that storage costs have become a major implementation consideration and Web-based presentation a daunting technical challenge.  Evolving at an equally unprecedented pace, scientific and security-related imaging systems previously capturing megabytes of data through complicated manual processes over many hours now capture gigabytes of data automatically in minutes.  Zoomify makes viewing and annotating these images simple and cost effective.

## Mission Critical Applications

High-quality images have become a mission critical component of professional techniques and operating procedures in most fields of academic and corporate endeavor.  Affected arenas include but are by no means limited to: education, medicine, criminal justice, defense, commerce, mapping, aerial photos, entertainment and more.

## III. The Zoomify Solution: Achieving Speed with Quality

### The Limits of Broadband and Compression

The increasing availability of high-bandwidth network access greatly eases access to images of moderate quality. Images of high quality, however, easily exceed the capacity of even the highest volume transmission technologies. While hundreds of kilobytes of data are commonly downloaded, megabytes, tens of megabytes, and certainly gigabytes of data are impractical to transfer over current infrastructure.

Advanced compression techniques achieve 4 to 1 or even greater *lossless* compression and 10 to 1 or even 100 to 1 *lossy* compression. Even in combination with a high-bandwidth connection, however, compression is inadequate for publishing high-quality images. A 32 megabyte image licensed from a stock photo house – even if compressed 100-fold with wavelet technology to approximately 320k – is inconvenient for Web viewing. The time required to download larger files makes them impractical to publish without image streaming. Zoomify supports real-time viewing of images many gigabytes in size.

### How Zoomify Works: Image Streaming

The encoder provided with each Zoomify product automatically creates multiple copies of an image at many resolutions *tiers* – from the original source resolution down to a thumbnail. Each tier is then cut into many small *tiles*. All the tiles from all the tiers are combined into a convenient folder of JPEG files, or into one new file (optional) with an index of the exact location of every tile. Tile organization is *pyramidal* – stacked from a thumbnail down to the highest resolution, tier upon tier.
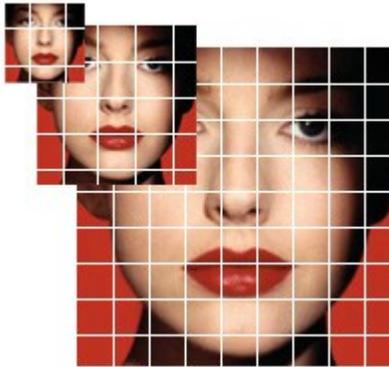


Figure 1: Pyramidal Tiled Multi-Resolution Image

When the converted image is viewed, the Zoomify Flash Viewer requests tiles from the appropriate tier to fill the display area. Each zoom and pan requests only a small additional number of tiles – those at the level of zoom desired, for the part of the image panned to. These additional tiles are streamed on-demand, to the viewer. No tiles are ever delivered unless required for the current display, or for a display that is anticipated to immediately follow (intelligent *pre-fetching*).

## III. The Zoomify Solution: Achieving Speed with Quality (continued)

### Why Zoomify is Fast

Intelligent Encoding: *Avoid view-time data processing.*  Zoomify's products include encoding tools and server extensions designed to minimize view-time processing through pre-processing and sophisticated caching.

Efficient Data Access: *Never deliver data you can't see.*  Zoomify's image streaming technology ensures that only the part of an image that fits within the defined display area, at the resolution desired, is delivered.

Efficient Data Use: *Never deliver data twice.*  Zoomify employs multiple cache levels (server and client, hard drive and memory, compressed data and uncompressed, more) to ensure that image tiles once delivered, are, to the greatest degree possible given the available system resources, not required to be downloaded redundantly.

Distributed Processing: *Let your clients decide what data they need.*  In addition to streaming image data, Zoomify is designed to stream image metadata – tile indices or *file offsets*.  This architecture enables client-side logic to determine what image data is needed for any particular view thereby minimizing server-side processing and maximizing performance and scaling.

Data Compression: *Leverage complementary technologies*.  Zoomify's encoding tools implement JPEG tile compression to user-definable levels as a complement to the streaming optimizations listed above.  (JPEG2000 wavelet compression available soon.)

Zoomify Image Streaming: *Resolution On-Demand.*  Zoomify employs the most advanced combination of technologies and design efficiencies to deliver the fastest access to high-resolution images with the lowest possible impacts on bandwidth and server resources.

## IV.  Zoomify Products and Their Features

Zoomify's products each provide complete high-resolution imaging solutions including support for encoding, publishing, and viewing.  The products share standard storage options. They are differentiated by features tailored to particular audiences.

### Zoomifyer *EZ*

Delivers the core benefits of Zoomify technology – instant viewing of ANY size image over the Web with interactive zoom and pan – all right in Flash.  And it's totally free.

Features and benefits:

- Drag-and-drop convert ANY image to a folder of JPEGs to stream
- Automatically make HTML to embed the tiny Flash viewer SWF in any Web page
- Easily copy the image folder, Web page, and tiny Flash viewer SWF to any Web site
- Flash-based viewing accessible to over 98% of desktops
- End-users interactively zoom & pan (plus toolbar, nav view, slideshows, and more.)
- Completely compatible with popular Web tools and Zoomify's other great products
- Totally free (fully functional, not a trial version)

Designed for:

- Anyone who wants to include high-quality images in a Web page with entirely standard technologies, at no cost whatsoever.

### Zoomifyer for *Flash*

Adds superior viewer customization options, seamless Flash MX and MX 2004 integration, and publishing flexibility.

Features and benefits:

- All the functionality of Zoomifyer *EZ*
- Developer-friendly viewer component includes powerful API and FLA (source code)

Designed for:

- Education and training
- Image galleries, aerial photography, and maps
- Entertainment and the arts
- Electronic commerce and marketing
- Online auctions and classifieds

## IV.  Zoomify Products and Their Features (continued)

### Zoomifyer *Enterprise*

Adds server-side automation support, annotation, and advanced image format support.

Features and benefits:

- All the features of Zoomifyer for *Flash*
- Server-side, command-line-driven image conversion for automation/integration
- Web-based annotation including non-destructive icon and labeling capabilities
- Stream direct from native files in advanced storage formats (JPEG2000 coming soon)
- Conversion support for images comprised of multiple source tiles or strips
- Optional lossless encoding and optional image decoding to editable BMP format
- Decoding support for images in LizardTech MrSid and MGI FlashPix formats
- One year maintenance contract (phone and email support, issue tracking, updates)

Designed for:

- Telepathology and medical research
- Pharmaceutical chemistry & biotechnology
- Higher-education image galleries and archives
- Art restoration systems and image asset management
- Defense, criminal justice, and security
- Insurance and criminal justice applications
- Industrial quality assurance and semiconductor inspection

### Zoomifyer *VR*

Supports special media types, alternative viewing options, and 'serverless' publishing.

Features and benefits:

- High-resolution 3D image objects, cubic panoramas, and animations
- QuickTime, ActiveX, Java, and plug-in viewing alternatives
- No special server software required – zero maintenance publishing

Designed for:

- Educational presentations involving detailed imagery and interaction
- Virtual tours including museums, real estate, automotive, and more.
- Product catalogs including fine quality goods and crafts

### The Zoomify *SDK*

The Zoomify SDK enables integration of Zoomify encoding and viewing capabilities into third-party software, hardware, and service offerings.  Target applications include microscopy, wireless, image appliances, auto-navigation, and more.  For additional information contact *business@zoomify.com*.

## V. Case Study Scenarios

- Image Archives / Medical Research. In 2000, the National Cancer Institute (NCI) created the Mouse Models of Human Cancer Consortium (MMHCC) with a broad mission to create, evaluate, and validate mouse models of human cancer. The MMHCC's Pathology Committee was tasked with developing an annotated image archive illustrating the comparative pathology of tumor biology. This archive, a concerted effort in informatics, imaging, and communications, is being implemented by the University of California at Davis Center for Comparative Medicine, and will be publicly accessible. Included slide sets now encompass 758 slides in eight organ systems, with images commonly constituting multiple gigabytes in image data. Zoomify Enterprise and Zoomify Annotation System are core components of this project.

- Education / Microscopy.  Traditional use of microscope and glass slides – in fields such as pathology, histology, physiology, and embryology – to examine normal and diseased tissues and cells at various levels of magnification present numerous problems. These include limited access to microscopes, preparation of multiple similar specimens for students, the cost of the microscopes themselves, and issues of classroom access. Efforts have been made to digitally capture microscopic images for instructional purposes, but this method has been limited to one field of view at one magnification: the overall sense of the scale of the tissue is lost, and there is no ability to navigate through an entire tissue sample.

  MicroBrightField, Inc. has developed a bioinformatics system enabling capture of complete microscopic specimens at highest magnification, storage of the image data in web-enabled databases, and sharing of the images with colleagues and students via image streaming technology over intranets and the Internet. The system provides solutions to the challenges of teaching with microscopes as well as to issues faced by scientific and clinical collaborators.  (Excerpted text courtesy of MicroBrightField, Inc., 2002.) The Zoomify SDK enables core components of the MicroBrightField offerings and is compatible with those of other vendors.


## V.  About Zoomify, Inc.

Vision: Zoomify's unique technologies make high-quality images fast and simple to view and annotate on the Web.  Zoomify is revolutionizing network imaging in science, defense, education, commerce, and entertainment.

History: Founded in 1999, the Zoomify team has spent over three years developing its next-generation imaging technologies.

Executive Team: Zoomify's founders include former managers and developers at Live Picture, Netflix, and Borland International.

IP: Internally developed technologies are complemented by licensed intellectual property (SGI, MGI, others) and industry standard technologies (XML, HTTP, Java, Flash, QuickTime, etc.).

Funding: Zoomify, Inc. is a privately held Delaware corporation built on imaging product sales, technology integration licensing, and strategic investment.

## Appendix I.  Why One-File

Zoomifyer for Flash includes two ways to prepare an image to stream. This document will help you select between the two approaches by providing concise information about their differences and relative strengths.

The first method Zoomifyer for Flash provides for preparing an image to stream is to convert an image to a folder filled with small JPEG pieces ('tiles') at multiple resolutions. During viewing on a Web site, the Zoomify Flash Viewer Component requests needed JPEG tiles from the Web server, just as any Web page requests various JPEGs or other files from a Web server. The Zoomify Viewer positions these JPEG tiles accurately to create the particular view to which the site visitor has zoomed and panned.

The second method Zoomifyer for Flash provides for preparing an image to stream is to convert an image to a single new file in a format with the extension .PFF.  This new file contains the same tiles that would be created using the folder-based approach discussed above. This approach is referred to as the One-File System in the documentation and in the product file and folder names.  The primary advantage of embedding the files within a single file is faster copying to and from your Web server and reduced total files to store on your Web server.  It should be noted that Zoomifyer for Flash works equally well with images megabytes or gigabytes in size - and the latter can constitute millions of tiles when converted. Storing such tiles in a single file greatly reduces the number of total files the operating system needs to track during copying, backups, etc.  The Zoomify Flash Viewer requires some assistance retrieving these embedded tiles from the Web server. For this reason, a tiny server-side component (a servlet or CGI 'ByteHandler') must be set up on the Web server to use the One-File, or PFF-based approach. (For more information on working with the One-File System, please see the chapter entitled "Zoomifyer for Flash One-File System".)

Most users will find the first method - folder-based conversion - most convenient.  Users working with large numbers of files and/or very large files will find the One-File or PFF-based approach better suited to their needs.  Both approaches are completely compatible with the following Zoomify products: Zoomifyer EZ, Zoomifyer for Flash, and Zoomifyer Enterprise.

## Appendix II.  System Requirements

Hardware
Apple Macintosh: PowerMac
Intel: Pentium II or better
64 megabytes of RAM required, 128 recommended

Operating systems
Apple Macintosh OS: Version 9.1 or higher, including OS X
Microsoft Windows: 98, ME, NT 4, 2000, XP
Server-side components provided as servlet, CGI, ISAPI extension and Apache module

Software applications
Macromedia Flash: For viewing: Player v6.  For Component / source editing: Flash MX
Web servers: server-side components compatible with HTTP 1.1 compliant servers

## Appendix III.  Licensing and System Requirements

Zoomify's product licensing policies are designed to provide maximum customer convenience and minimum implementation restrictions.  Zoomify's solutions never involve any annual license fees, bandwidth or CPU-based fees, 'broadcast keys', or arcane contracts.  Zoomify places no strings on your images and imposes no charges related to end-user access.

Zoomify's Zoomifyer *VR* and Zoomifyer for *Flash* products are licensed on a per-seat basis – similar to standard licensing procedures for programs such as Macromedia Flash MX and Adobe Photoshop.  Zoomifyer Enterprise is licensed on a per-server basis – similar to server-side products such as Macromedia ColdFusion MX and Microsoft SQL Server.  Site licenses and educational discounts are available for convenience and cost efficiency.

Legal Notices: ZOOMIFY LICENSE AGREEMENT
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PROVIDED SOFTWARE
Zoomifyer EZ, Zoomifyer for Flash, Zoomifyer VR, Zoomifyer Enterprise
Zoomify Viewers, ZoomifyViewer SWF, Zoomify HTML Maker SWF, Zoomify Test Server
Zoomify Annotation System SWF, Zoomify Servlet and CGI

PROVIDED SOURCE CODE
ZoomifyViewer FLA, Zoomify Servlet Java Source Code Class Files, Zoomify CGI Source Code .c file


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This Agreement is governed by the laws of the State of California and of the United States of America.

Should you have any questions concerning this Agreement please write:

Zoomify, Inc.
Customer Service
Box 8008
Santa Cruz, CA  95061

## Appendix IV.  Glossary and Additional Resources

### Glossary

| | |
|---|---|
| ActionScript: | Macromedia's Flash-based scripting language, similar to JavaScript. |
| Compression: | Sophisticated means to reduce file size while retaining file information by substituting representations or approximations of the file data for the actual data. |
| FLA: | Macromedia's editable Flash format. |
| Flash MX: | The latest version of Macromedia's tool for creating rich Internet content and applications. |
| Lossy/Lossless: | Compression that permanently removes image data to reduce file size. Lossless compression, by comparison, keeps all original image data intact. |
| Multi-resolution: | Data file containing many levels of quality. |
| PFF: | Zoomify's optional streaming image format. |
| Pixel: | The smallest unit of screen display. A point of color. |
| Resolution: | The amount of image data available for display. One measure of image quality.  Screen equivalent of printer 'dpi' (dots per inch). |
| Servlet: | A small Java-based server-side application.  Requires a servlet container. |
| Servlet container: | Calls upon servlets to perform specific server-side tasks. |
| SWF: | Macromedia's Flash format for published Flash movies. |
| Tile: | 64x64 pixel piece of image at a given resolution. |
| Tomcat: | The Apache Software Foundation's servlet container application. |
| Wavelet: | Highly effective image compression approach enabling maximum reduction in file size while preserving image quality. |

### Additional Resources

For more information please visit the Zoomify Web site at www.zoomify.com. You may call us toll-free at 877-ZOOMIFY (966-6439) or for international callers, 831.420.0400.

You can contact us via email as follows:
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- And for technical assistance with Zoomify products: support@zoomify.com