

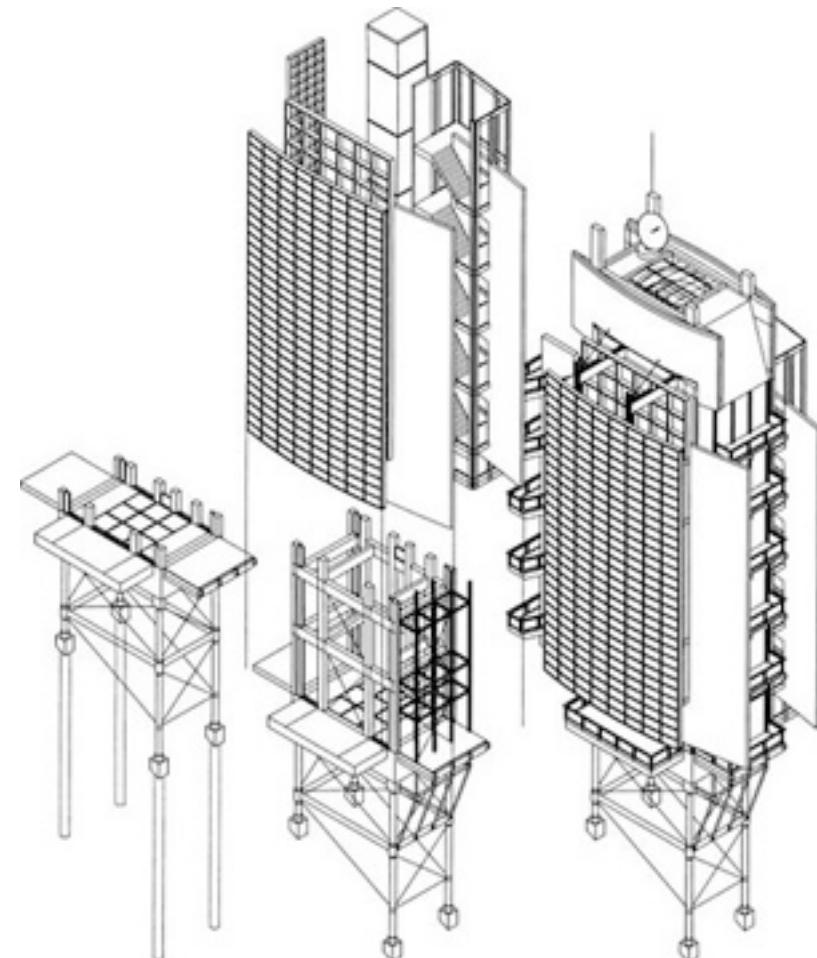


January 2010 Beijing, China

PHIL CRYER
open source systems architect
and accidental tourist

> BHL hardware architecture

- storage issues and solutions
- hardware risks and configuration
- cloud computing possibilities
- code and communication



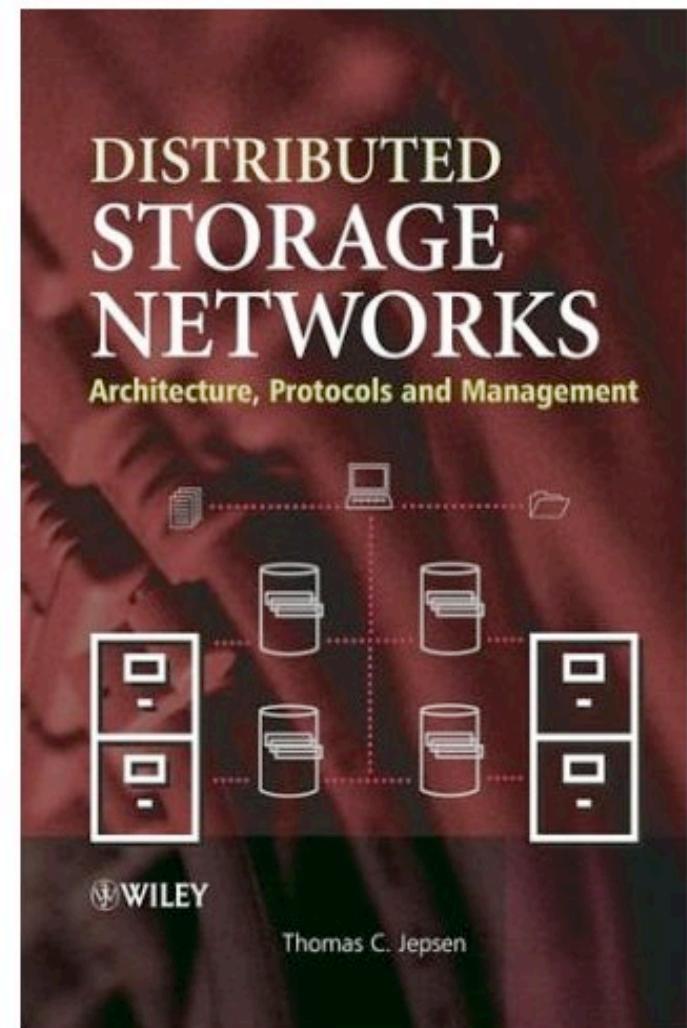
> Storage issues

- more data being created and saved
- expanding SANs can be expensive
- storage has not kept up with Moore's Law
- backups are usually for disaster recovery, not redundancy or failover



> Storage solutions: distributed storage

- write once, read anywhere
- **replication and fault tolerance**
- error correction
- **automatic redundancy**
- scalable horizontally



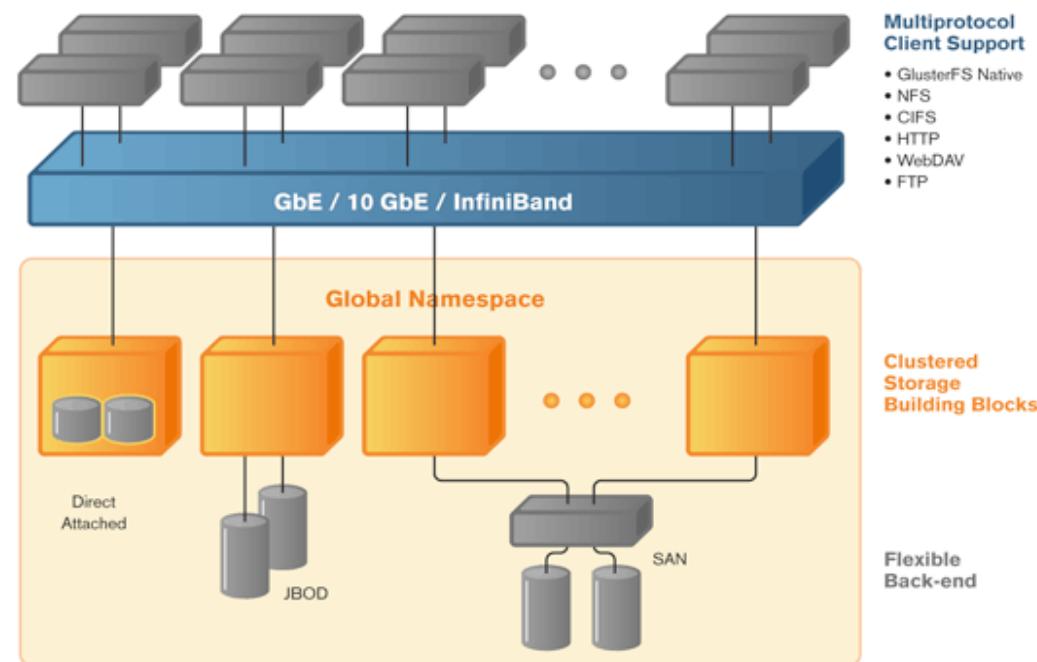
> Distributed storage – Options

- hosted storage (cloud, Amazon S3)
- self hosted with proprietary hardware and software (Sun Thumper)
- self hosted with commodity hardware and open source distributed filesystem (GlusterFS, Lustre)



> Distributed storage – GlusterFS

- GlusterFS: a cluster file-system capable of scaling to several petabytes*
- open source software on commodity hardware
- simple to install and manage
- very customizable
- offers seamless expansion

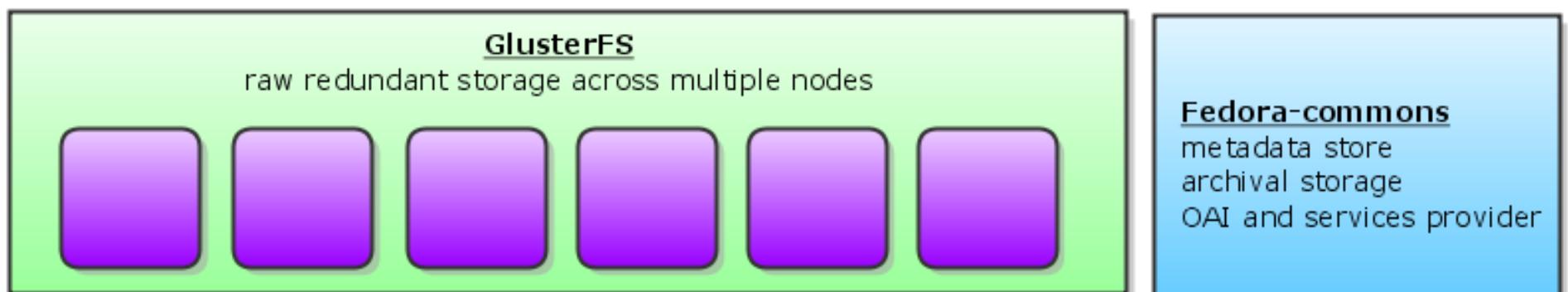
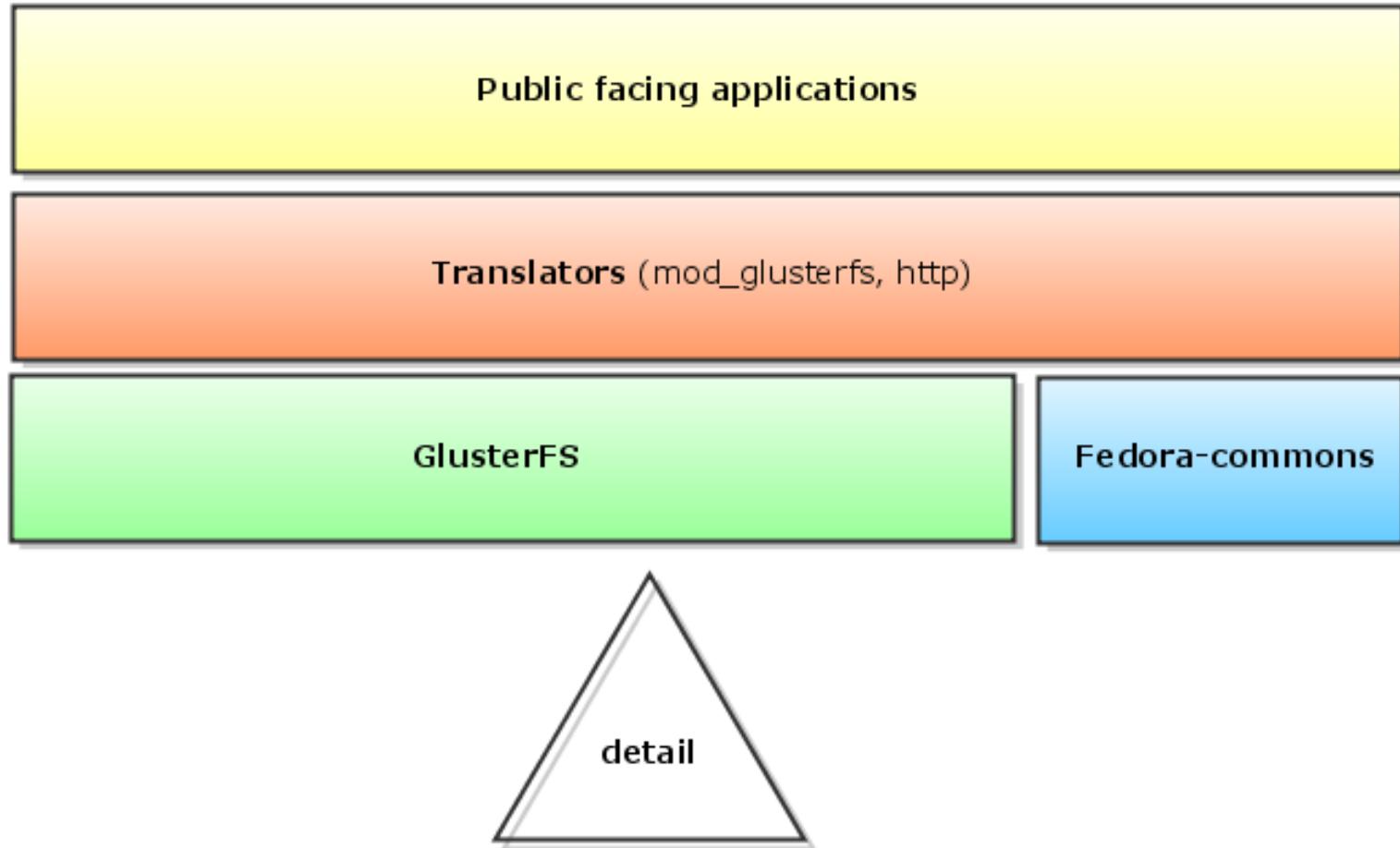


*(1,024 terabytes = 1 petabyte)

> Distributed storage – Archival

- Fedora-commons is an open source repository (not a Linux distribution)
- accounts for all changes, so it provides built-in version control
- provides disaster recover
- open standards to mesh with future file formats
- provides open sharing services such as OAI-PMH





> Distributed storage – Mirrored data

- now we have redundancy
- in fact, **multiple redundant copies**
- provides fault tolerance
- offers load balancing
- **gives us future geographical distribution**



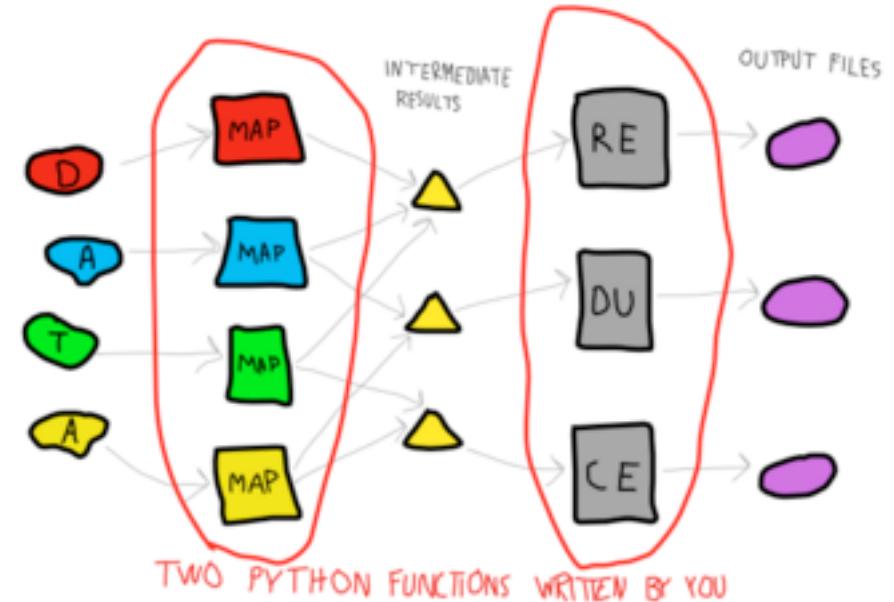
> Distributed processing

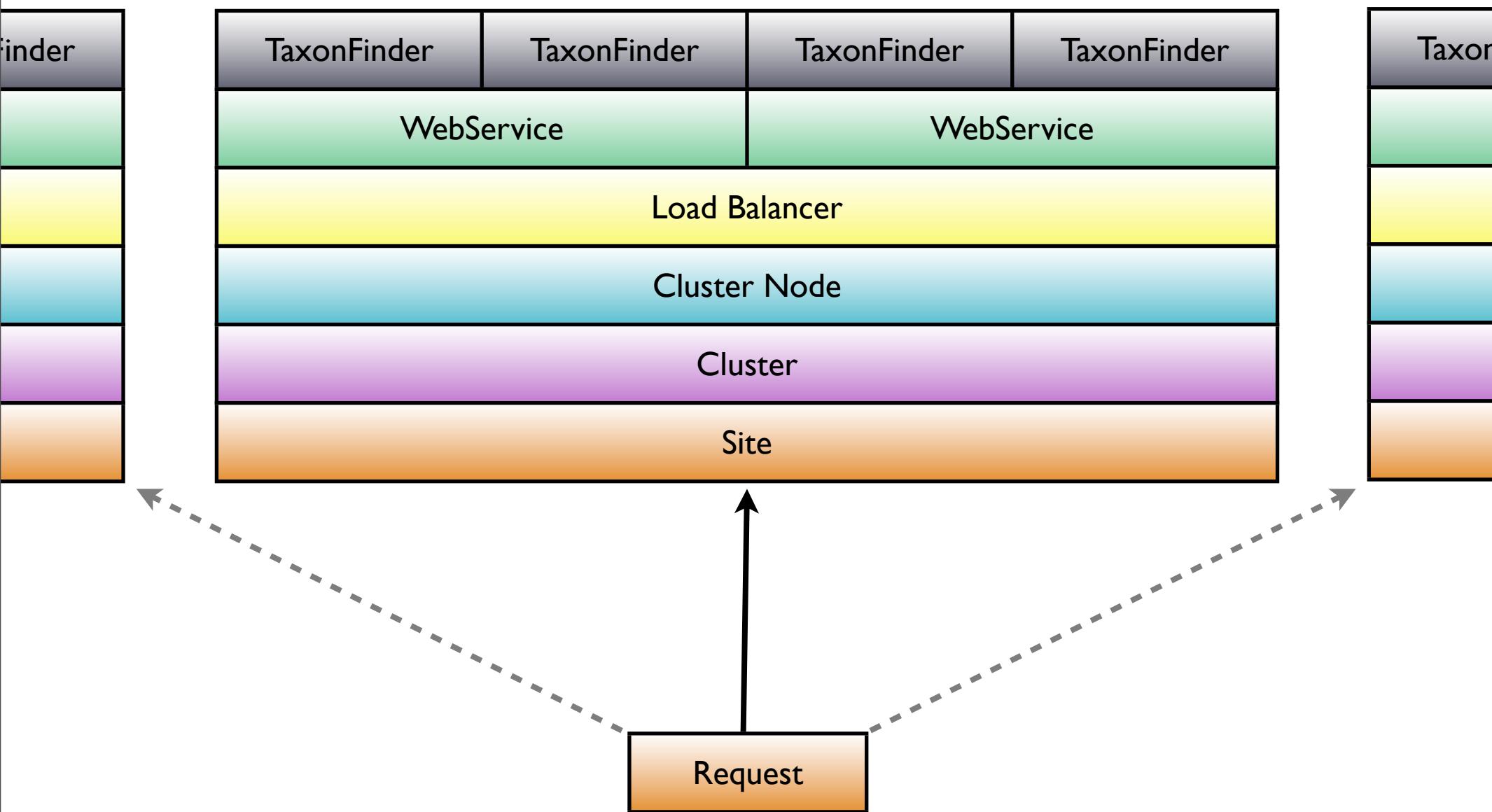
- more abilities available than just storing data
- with distributed storage comes distributed processing
- distributed processing means faster answers
- faster answers mean new questions
- lather, rinse, repeat



> Distributed processing

- make existing data more useful
- image and OCR re-processing
- distributed web services
- identifier resolution pools
- map/reduce frameworks
- generate new visualizations, text mining, NLP and ???





> Hardware configuration: risks

- computers crash
- hard drives die
- networks fail
- natural disasters occur

but...





...so plan for it.

> Hardware configurations



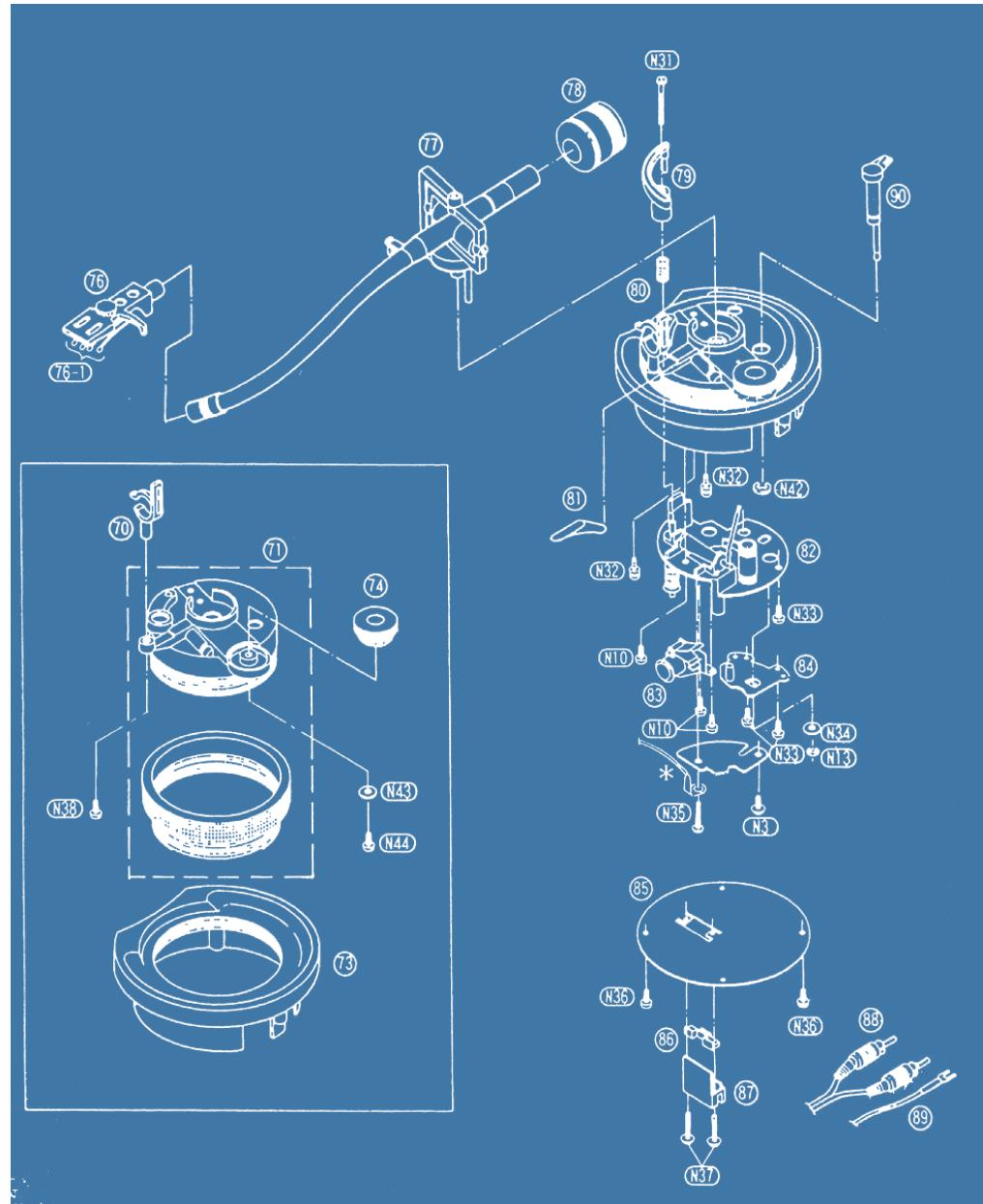
- six 5U sized servers hosted at MBL in Woods Hole
- 8 Gigs RAM in each server
- 24 / 1.5 TB drives in each server
- 100 TB storage overall
- fast connection, far greater bandwidth than ever before
- mirror sets (3 and 3) will be stored in different locations

but...



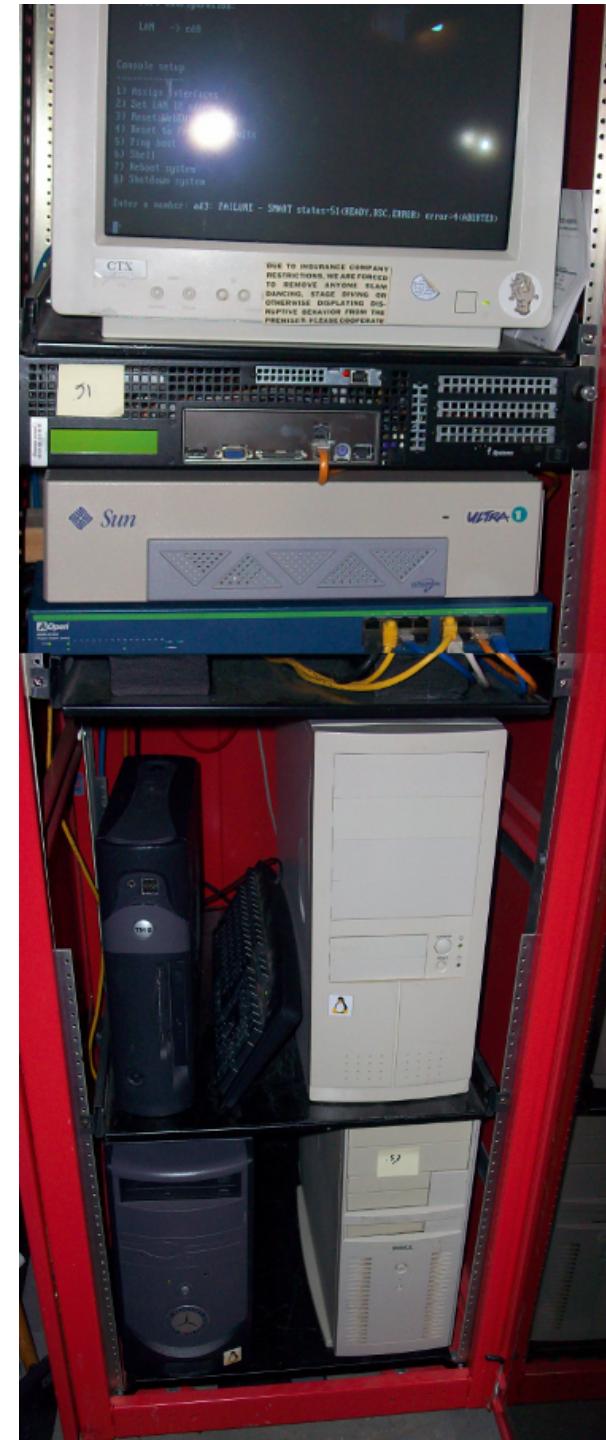
> Some assembly required (optional)

- while our example uses new, faster commodity hardware...
- it could run on any hardware that can run Linux
- you could **chain together old "out dated" computers**
- build your own cluster for next to nothing (host it in your basement)
- solves some infrastructure funding issues and provides a working proof of concept
- hardware vendor neutrality



> Our proof of concept

- we ran a six box cluster to demonstrate GlusterFS clustered filesystem
- ran Debian/GNU Linux
- simulated hardware failures
- synced data with a remote cluster (STL to MBL/WH)
- ran map/reduce jobs (distributed computing)
- defined procedures, configurations and build scripts



> Distributed storage – Projected costs



Graph from Backblaze (<http://www.backblaze.com>)

> Cloud computing

- BHL is participating in a pilot for Duraspace with The New York Public Library
- Duraspace would provide a link to cloud providers
- pilot to show feasibility of hosting
- testing use of image server, other services in the cloud
- cloud could seed new clusters



> Code (63 6f 64 65)

- our **code** and **configurations** are open source, hosted on Google Code

<http://code.google.com/p/bhl-bits/>

phil.cryer@gmail.com | [My favorites](#) | [Profile](#) | [Sign out](#)



bhl-bits

Open Source code from the various Biodiversity Heritage Library (BHL) projects

 Search projects

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This is the repository for code from various Biodiversity Heritage Library (BHL) projects, all of which are released under various Open Source licenses. Our current portal website runs on .NET, connects to a MSSQL backend database, and utilizes an Apache Tomcat webapp fronted image viewer. Our new citation web site runs under Linux (Debian), Drupal, Apache, PHP and MySQL with help from HAProxy, Solr/Lucene, OpenVZ, KVM and other software. We'll be releasing code, as well as the all important configuration files for applications we use and support on our servers. We're open to any and all suggestions from the community, and of course accept any patches that improve our code. We appreciate your interest in our projects.

Latest updates

Starred ([view starred projects](#))

Code license: [New BSD License](#)

Labels: [bhl](#), [linux](#), [djatoka](#), [imageviewer](#),
[java](#), [asp.net](#), [c-sharp](#)

Links: [Biodiversity Heritage Library](#)

Blogs: [BHL Blog](#)
[BHL updates on Twitter](#)

Feeds: [Project feeds](#)

[People details](#)

Project owners:

• [Portal](#) portal is the .NET based code that

> Communication

- our **Projects** server is a portal for various projects and ideas

<http://projects.biodiversitylibrary.org/>

Home

Ten major natural history museum libraries, botanical libraries, and research institutions have joined to form the Biodiversity Heritage Library Project. The group is developing a strategy and operational plan to digitize the published literature of biodiversity held in their respective collections. This literature will be available through a global "biodiversity commons."

The participating libraries have over two million volumes of biodiversity literature collected over 200 years to support the work of scientists, researchers, and students in their home institutions and throughout the world.

The BHL will provide basic, important content for immediate research and for multiple bioinformatics initiatives. For the first time in history, the core of our natural history and herbaria library collections will be available to a truly global audience. Web-based access to these collections will provide a substantial benefit to people living and working in the developing world -- whether scientists or policymakers. The Biodiversity Heritage Library Project strives to establish a major corpus of digitized publications on the Web drawn from the historical biodiversity literature. This material will be available for open access and responsible use as a part of a global Biodiversity Commons.

We will work with the global taxonomic community, rights holders, and other interested parties to ensure that this legacy literature is available to all. The Biodiversity Heritage Library Project must be a multi-institutional project because no single natural history museum or botanical garden library holds the complete corpus of legacy literature, even within the individual sub-domains of taxonomy.



Latest projects

- [Data Hosting Centre Task Group](#) (12/02/2009 02:24 PM)
Whilst an unprecedented volume of biodiversity data is currently being generated worldwide, it is perceived that significant amounts of data get lost or will be lost after project closure. To investigate the causes of such loss, and recommend strategies as to how biodiversity data can be rescued and archived, through 'data hosting centres' a Task Group on 'Data Hosting Centres' will be commissioned.
- [Consistant, updated Identity](#) (09/21/2009 03:50 AM)
An ongoing project to update BHL's identity, theme and logo across BHL Portal and Citebank
- [Clustered storage](#) (08/25/2009 05:28 AM)
The project to build a reproducible clustered file-system distributed across multiple servers, utilizing [GlusterFS](#), to house all of BHL Global content.
- [Website feedback](#) (06/15/2009 11:11 AM)
A project to accept feedback from users to [cite.bhl.org](#)
- [MOBOT djatoka implementation](#) (04/13/2009 04:30 PM)

> Communication

- each project has its own wiki, allowing for detailed, how-to instructions

<http://projects.biodiversitylibrary.org/wiki/clusteredfilesystem/>

INSTALL

the following is a continuously updated doc and howto for configuring a BHL cluster node on a current Debian GNU/Linux installation. A breakdown of times involved in the physical building of nodes is available at the [build times page](#)

System configuration

- 1) upgrade system to Squeeze (Lenny uses kernel 2.26, which doesn't fully support ext4) and enable contrib and non-free repos

Copy the next 4 lines, and paste them in as 1:

```
echo "deb http://ftp.us.debian.org/debian/ squeeze main contrib non-free
deb-src http://ftp.us.debian.org/debian/ squeeze main
deb http://security.debian.org/ squeeze/updates main
deb-src http://security.debian.org/ squeeze/updates main" > /etc/apt/so
```

and update the system

```
apt-get update
aptitude safe-upgrade
```

and now is a good a time as any to make sure the timezone data is all setup correctly (mine wasn't)

```
dpkg-reconfigure tzdata
```

- 2) reboot to use latest kernel (if needed)

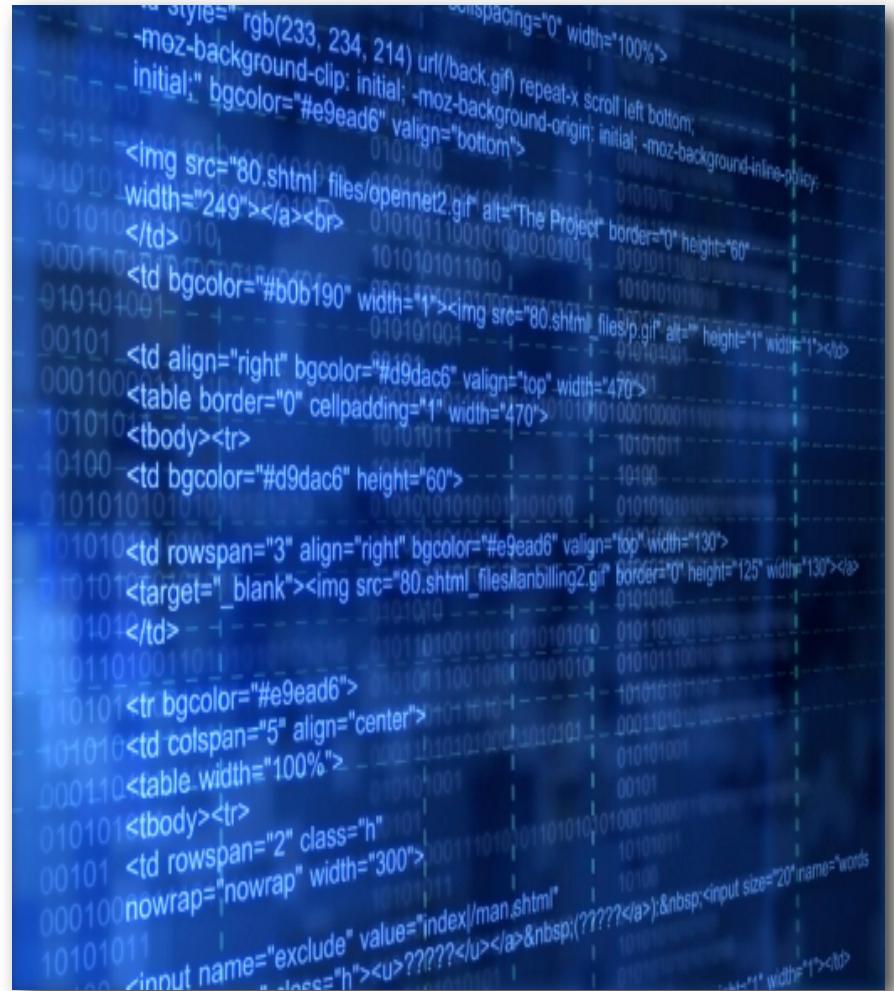
```
/sbin/shutdown -r now
```

- 3) install needed utilities and applications

```
apt-get install build-essential flex bison screen nginx vim-nox git-cor
```

> Code (63 6f 64 65)

- our code and configurations are open source and hosted on Google Code
- our projects server shares detailed instructions to get you get started
- get involved
- join our mailing-lists (bhl-tech, bhl-bits)
- ask us questions
- you can do it, and we will help





code <http://code.google.com/p/bhl-bits>
projects <http://projects.biodiversitylibrary.org>

questions phil.cryer@mobot.org

