# Bacula
# The Network Backup Solution

Presented by Kern Sibbald at FOSDEM

24 February 2007 in Brussels

Bacula – the Network Backup Tool for Linux, Mac, Unix and Windows

*It comes by night and sucks the vital essence from your computers.*

# Introduction

Bacula is a network backup solution, designed for Linux, Mac OS, Unix and Windows systems.

Project goals:

- To be able to backup any client from a Palm to a mainframe computer with the same software
- To have “Enterprise” features similar to what are available in the largest commercial applications
- To assure compatibility of your data for at least 30 years (providing you have the appropriate hardware)
- A Free and Open Source (GPL v2 + additions) license

# Introduction (cont)

Do you do backups?

- No
- Yes, I did one last month
- Yes, tarballs every week
- Sometimes I rsync ...
- Yes, CDs every week

Problems with this:

- Finding the files you need to restore
- Restoring to a point in time
- Knowing what was backed up when
- Scaling (how do you handle 2000 machines?)
- Bare-metal recovery is complex

# Project History and Statistics

- Bacula = Backup + Dracula

- January 2000 – Project started
- 14 April 2002 – First release to Source Forge (version 1.16)
- 29 June 2006 – Release 1.38.11
- January 2007 – Release 2.0.0

- 41 Source Forge project members
- 33 developers with CVS write access
- 656 bugs.bacula.org
- 1,444 bacula-users@lists.sourceforge.net
- 712 bacula-announce@lists.sourceforge.net

- Downloads
  - 74 version 1.16
  - 10,919 version 1.36
  - 12,408 version 1.38.11

# Bacula components

- Bacula Director
- Bacula File daemon
- Bacula Storage daemon
- Bacula Console
- Bacula Catalog
- Bacula Monitor

# Bacula Components

## Director

- Knows everything about everything
- Schedules, initiates and supervises all activities (Jobs)
- Runs backup, restore, verify and archive jobs
- Maintains the catalog
- Decides what files are backed up on which client and where
- Typically one Director except in very large shops

# Bacula Components

## File daemon

- Client program that communicates over network with Director and Storage daemon
- Does file backup and restore as requested by Director
- Installed on each system to be backed up
- Needs access to all files to be backed up
- Adapted specifically to each OS
- Typically multiple File daemons per Director

# Bacula Components

## Storage daemon

- Accepts commands from the Director
- Accepts data from File daemons (FD)
- Reads and writes data on the physical medium
  - Disk
  - Tape
  - DVD
  - USB
- Typically one per Director

# Bacula Components

## Console

- Allows user or administrator to control Bacula
- Communicates with Director via network
- Start, cancel, restore, verify backups
- Consoles available
  - TTY
  - wxWidgets (GUI) – Linux, Unix, Win32
  - Gnome (GUI)
  - Several web interfaces
- Restricted consoles (ACL) for security

# Bacula Components

## Catalog database

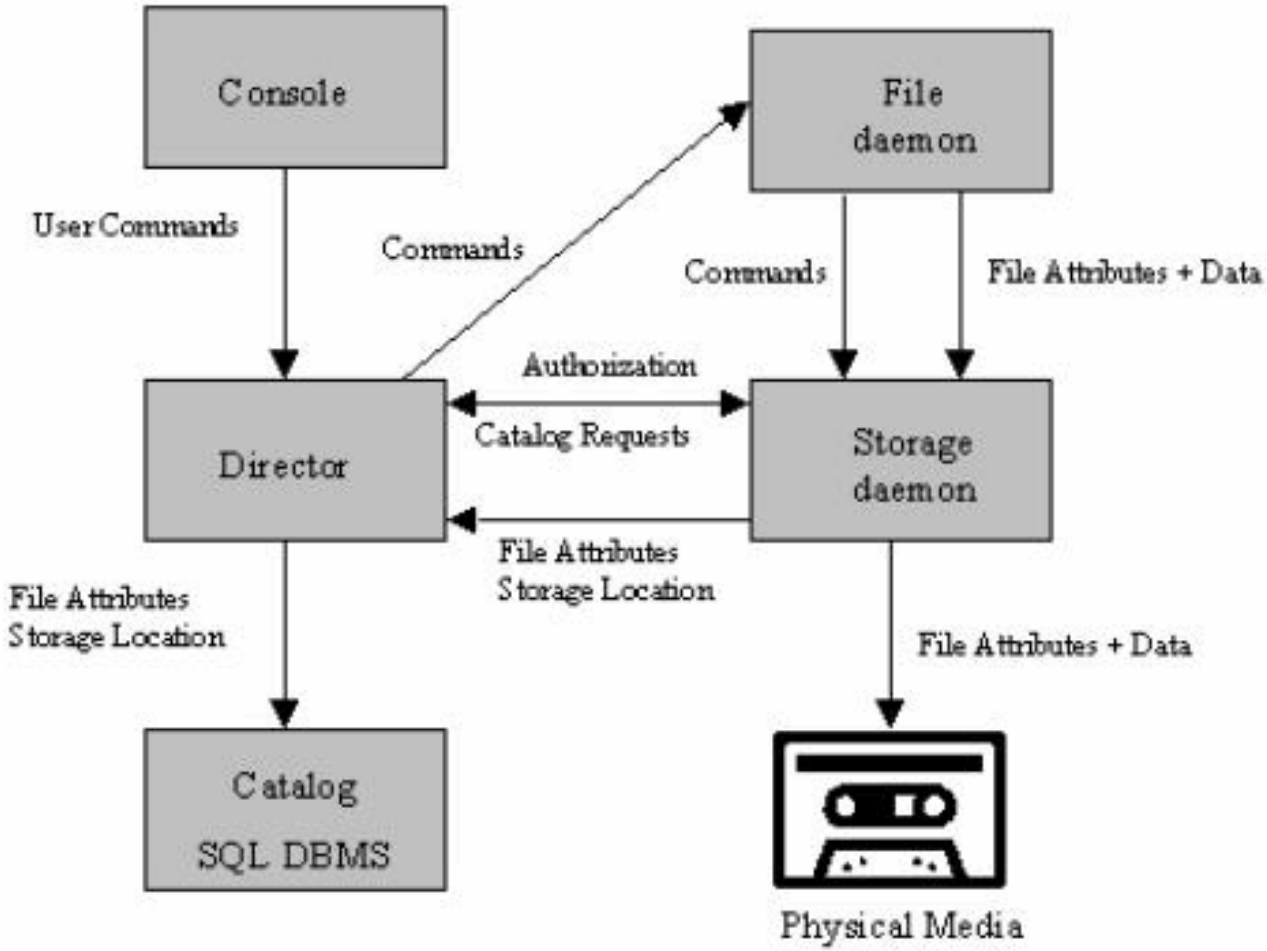
- SQL database (MySQL, PostgreSQL, or SQLite)
- Maintains indexes and Volume databases
- Permits rapid restores
- Allows inquiry of when and where files were backed up
- Supports multiple databases of selected type

# Bacula Components

## Tray Monitor

- Gnome/KDE/Win32 GUI tray applet to monitor components
- Queries Director, File daemons, Storage daemon
- Near real-time display of activity

# Main Components



# Features

- Distributed backup with a central server and catalog
- All components communicate via the network and can be deployed separately.
- Internal scheduler for automatic and simultaneous job execution with priorities.
- Interactive restore of one or more files from current backup or prior to a specified time and date (many more options).
- Simple administration with consoles (command line, GUI, and web)

# Features (cont.)

- Support for ANSI / IBM labels
- Support for Unicode/Win32
- Support for direct writing on DVD
- Integrated Python interpreter for “event” (job start, end, ...) scripting
- Specification of multiple possible devices with automatic selection of a free device
- Rescue CDROM for “bare metal” recovery.

# Bacula – Hardware Features

- Wide hardware support with configurable Device resources
- Support for multiple drive autochangers (libraries)
- Support for tape barcode readers
- Pool and Volume library management
- Backups can span multiple volumes
- Multiple backups (jobs, clients, OSes) per volume
- Rapid restoration of individual files (one user reported 4 to 6 hours with tar and 3 to 4 minutes with Bacula!).

# Bacula – Security Features

- Director and Storage daemon can be run non-root
- MD5, SHA1, ... signatures for each file
- CRC checksum for each Volume block
- CRAM-MD5 daemon authorization
- Restricted consoles and tray-monitors
- Communications (TLS) encryption
- Data (PKI) encryption
- Tripwire like Verify feature

# Technical Highlights

- Multi-OS support : Linux (all versions including the zSeries), Win32, Solaris, *BSD, Mac OS X, Irix, Tru64, AIX, HP-UX
- Backup to disk or tape with spooling capability to avoid “shoe-shine” on tapes
- Backup/restore of POSIX Access Control Lists (ACL)
- Support for large files (>2GB) and 64 bit architectures
- Multi-thread implementation
- Originally written in C, now converted to a subset of C++

# Bacula Configuration - Job

Jobs are the basic unifying structure

- Type – what to do, backup, restore, migrate, ...
- Level – level of detail of type
- FileSet – what to and what not to backup
- Client – where to get the files
- Storage – where to put the files (which hardware)
- Pool – which set of Volumes (tapes, files) to use
- Schedule – when to do it

# Bacula Configuration – Job Type

- Backup – save files
- Migration – move files from Volume to Volume
- Verify – verify Volumes or Client files
- Admin – run administrative tasks
- Restore – restore files

# Bacula Configuration – Job Level

- Full – everything defined in FileSet
- Differential – everything changed since last Full
- Incremental – everything changed since last Full, Diff
- Catalog – Compare Client files to catalog
- InitCatalog – Create base for Client comparison
- VolumeToCatalog – verify Volume files to catalog
- DiskToCatalog – verify Client files to catalog

# Bacula Configuration – FileSet

- Include/Exclude files and/or directories
- Regex or wildcard for file/directory name selection
- Compression using similar selection criteria
- Which filesystem types to backup
- ACL support selection
- Sparse file handling
- Signature (MD5, SHA1, ...)

# Bacula – Director Configuration File

```
Director {
  Name = bacula-dir
  DIRport = 9101
  Query File = “/usr/local/etc/query.sql”
  Working Directory = “/var/bacula”
  PID Directory = “/var/run”
  Maximum Concurrent Jobs = 20
  Password = “secret”
  Messages = Standard
}
```

# Bacula – Director Configuration File (cont)

```
Job {
  Name = “Laptop”
  Type = Backup
  Client = laptop-fd
  FileSet = “Full Set”
  Schedule = “Weekly Cycle”
  Storage = File
  Messages = Standard
  Pool = Standard
  Write Bootstrap = “/var/bacula/laptop.bsr”
  Priority = 10
}
```

# Bacula – Director Configuration File (cont)

```
Client {
  Name = laptop-fd
  Address = laptop.example.org
  FDPort = 9102
  Catalog = MyCatalog
  Password = “secret-fd”
  File Retention = 30 days
  Job Retention = 6 months
  AutoPrune = yes
  Maximum Concurrent Jobs = 20
}
```

# Bacula – Director Configuration File (cont)

```
FileSet {
   Name = “Full Set”
   Include {
      File = /
      File = /usr
      File = /var
   }
   Exclude {
      File = /proc
      File = /tmp
      File = /sys
      File = /.journal
   }
}
```

# Bacula – Director Configuration File (cont)

```
Schedule {
  Name = “Weekly Cycle”
  Run = Level=Full 1st sun at 2:05
  Run = Level=Differential 2nd-5st sun at 2:05
  Run = Level=Incremental mon-sat at 2:05
}
```

# Bacula – File daemon Configuration File

```
FileDaemon {
  Name = laptop-fd
  FD Port = 9102
  Working Directory = /var/bacula
  PID Directory = /var/run
}

Director {
  Name = bacula-dir
  Password = “secret-fd”
}
```

# Bacula – Storage Configuration File

```
Storage {
  Name = bacula-sd
  SD Port = 9103
  Working Directory = /var/bacula
  PID Directory = /var/run
}

Director {
  Name = bacula-dir
  Password = “secret-sd”
}
```

# Bacula – Storage Configuration File (cont)

```
Device {
  Name = FileStorage
  Device Type = File      # DVD, Tape, FIFO
  Media Type = File
  Archive Device = /usr/bacula-backups
  Label Media = yes
  Random Access = yes
}

AutoChanger {
  ...
}
```

# Developers

Most developers believe that backup programs are not very "sexy". However, they **are** extremely complicated:

- Database – SQL
- GUI
- Web
- Networking
- OS (every bit must be restored)
- Restore
  - Full, Diff, Inc
  - Find Volumes
  - Directory tree (100 million records, 5 million files)
  - where is the file?
- Job resource allocation (drives, Volumes)
- Differencing

# Project development

Site : http://www.bacula.org/

Development style:

- Open with SourceForge project
- Patches and commits reviewed, and releases planned by K. Sibbald
- Developer Subversion access. Currently 33 developers may commit.
- Comprehensive developer's guide with code style guidelines
- All code tested using a regression test suite.
- Email list for developers (bacula-devel).

Release organization:

- Development code in Subversion HEAD
- Releases are maintained/updated via stable branches

# Resources

Downloads : http://download.sourceforge.net/bacula

For IT professionals and system administrators

- Manual: http://www.bacula.org/rel-manual/index.html
- OS and Hardware compatibility lists (in manual)
- Bugs reports: http://bugs.bacula.org/
- Email support list : bacula-users@lists.sf.net

For developers

- Docs : http://www.bacula.org/developers/index.html
- Email list : bacula-devel@lists.sf.net
- CVS at Source Forge

# Credits

Thanks

- Dan Langille who created the original presentation
- Karl Cunningham who updated it
- The presentation draws heavily on their work

A .pdf copy of this presentation can be found at:

http://www.bacula.org/presentations/Bacula-FOSDEM-talk-24Feb07.pdf

# Live Demo

The following 10 slides are not part of the this slide show but are screenshots of the live demo that will be presented after the slide show.

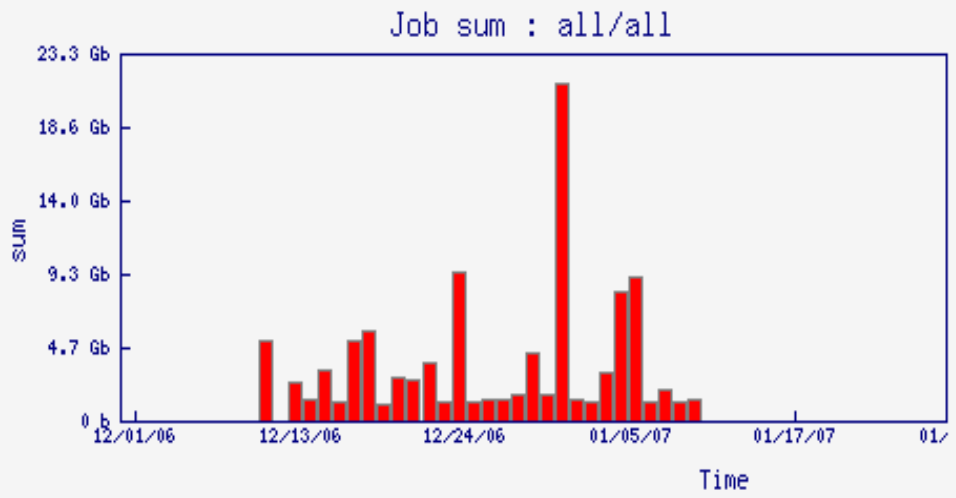
## Informations

Total clients: 11 Total bytes stored: 1.0 Tb Total media: 3

Database size: ??? Total Pool: 1 Total Job: 1334

Job failed (last 7 days): 0

## Statistics




## Running Jobs

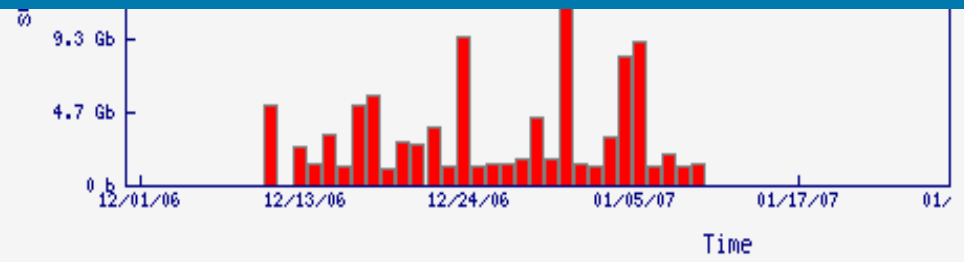
| JobId | Client | Job Name | Level | Start Time | Duration | Status | Select |
|---|---|---|---|---|---|---|---|
| 1038 | Rufus | Rufus | Incr (since last backup) | 2006-10-07 10:52:20 | 2285:49:00 | | |
| 343 | Matou | Matou | Incr (since last backup) | 2006-03-21 14:32:06 | 7081:09:14 | | |

## Last Jobs ( limited to 10)

| JobId | Client | Job Name | FileSet | Level | StartTime | Duration | JobFiles | JobBytes | Errors | Status |
|---|---|---|---|---|---|---|---|---|---|---|
| 1436 | Roxie | CatalogBackup | CatalogFile | F | 2007-01-10 05:04:32 | 00:00:13 | 1 | 345.5 Mb | 0 | ✓ |
| 1435 | Minou | Minou | Minou Full Set | I | 2007-01-10 03:17:18 | 00:00:09 | 1 | 236 b | 0 | ✓ |
| 1434 | Tibs | Tibs | Win32 Full Set | I | 2007-01-10 03:13:42 | 00:03:29 | 24 | 2.3 Mb | 0 | ✓ |
| 1433 | Rufus | Rufus | RufusAll | I | 2007-01-10 03:08:50 | 00:04:45 | 3695 | 657.2 Mb | 0 | ✓ |

## Running Jobs

| JobId | Client | Job Name | Level | Start Time | Duration | Status | Select |
|---|---|---|---|---|---|---|---|
| 1038 | Rufus | Rufus | Incr (since last backup) | 2006-10-07 10:52:20 | 2285:50:04 | | |
| 343 | Matou | Matou | Incr (since last backup) | 2006-03-21 14:32:06 | 7081:10:18 | | |

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| 1433 | Rufus | Rufus | RufusAll | I | 2007-01-10 03:08:50 | 00:04:45 | 3695 | 657.2 Mb | 0 | ✓ |
| 1432 | Matou | Matou | Matou Set | I | 2007-01-10 03:05:03 | 00:03:43 | 158 | 428.9 Mb | 0 | ✓ |
| 1431 | Roxie | CatalogBackup | CatalogFile | F | 2007-01-09 05:04:31 | 00:00:13 | 1 | 345.1 Mb | 0 | ✓ |
| 1430 | Minou | Minou | Minou Full Set | I | 2007-01-09 03:16:13 | 00:00:09 | 1 | 236 b | 0 | ✓ |
| 1429 | Tibs | Tibs | Win32 Full Set | I | 2007-01-09 03:12:35 | 00:03:31 | 26 | 2.3 Mb | 0 | ✓ |
| 1428 | Rufus | Rufus | RufusAll | I | 2007-01-09 03:08:20 | 00:04:05 | 333 | 543.4 Mb | 0 | ✓ |
| 1427 | Matou | Matou | Matou Set | I | 2007-01-09 03:05:04 | 00:03:12 | 137 | 375.9 Mb | 0 | ✓ |

## Information about job

| JobId | Client | Job Name | FileSet | Level | StartTime | Duration | JobFiles | JobBytes | Errors | Pool | Volume Name | Status |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1433 | Rufus | Rufus | RufusAll | I | 2007-01-10 03:08:50 | 00:04:45 | 3695 | 657.2 Mb | 0 | Default | LTO-004 | ✓ |

Delete View media View jobs View stats View FileSet

## Log : Rufus on Rufus (1433)

```
roxie-dir: Start Backup JobId 1433, Job=Rufus.2007-01-10_03.05.01
roxie-sd: Spooling data ...
rufus-fd:       /boot is a different filesystem. Will not descend from / into /boot
rufus-fd:       /home is a different filesystem. Will not descend from / into /home
rufus-fd:       /tmp is a different filesystem. Will not descend from / into /tmp
rufus-fd:       /usr is a different filesystem. Will not descend from / into /usr
rufus-fd:       /sys is a different filesystem. Will not descend from / into /sys
rufus-fd:       /dev is a different filesystem. Will not descend from / into /dev
rufus-fd:       /mnt is a different filesystem. Will not descend from / into /mnt
rufus-fd:       /net is a different filesystem. Will not descend from / into /net
rufus-fd:       /smb is a different filesystem. Will not descend from / into /smb
rufus-fd:       /misc is a different filesystem. Will not descend from / into /misc
roxie-sd: Job write elapsed time = 00:04:26, Transfer rate = 2.592 M bytes/second
roxie-sd: Committing spooled data to Volume "LTO-004". Despooling 690,353,872 bytes ...
roxie-sd: Despooling elapsed time = 00:00:11, Transfer rate = 62.75 M bytes/second
roxie-sd: Sending spooled attrs to the Director. Despooling 1,025,113 bytes ...
roxie-dir: Bacula 2.0.0 (28Dec06): 10-Jan-2007 03:13:35
  JobId:                  1433
  Job:                    Rufus.2007-01-10_03.05.01
  Backup Level:           Incremental, since=2007-01-09 03:08:20
  Client:                 "Rufus" 1.39.34 (28Dec06) i686-pc-linux-gnu,suse,10.2
  FileSet:                "RufusAll" 2005-12-26 19:31:20
  Pool:                   "Default" (From Job resource)
  Storage:                "LTO-changer" (From Job resource)
  Scheduled time:         10-Jan-2007 03:05:00
  Start time:             10-Jan-2007 03:08:50
  End time:               10-Jan-2007 03:13:35
  Elapsed time:           4 mins 45 secs
  Priority:               10
  FD Files Written:       3,695
```

```
roxie-sd: Spooling data ...
rufus-fd:      /boot is a different filesystem. Will not descend from / into /boot
rufus-fd:      /home is a different filesystem. Will not descend from / into /home
rufus-fd:      /tmp is a different filesystem. Will not descend from / into /tmp
rufus-fd:      /usr is a different filesystem. Will not descend from / into /usr
rufus-fd:      /sys is a different filesystem. Will not descend from / into /sys
rufus-fd:      /dev is a different filesystem. Will not descend from / into /dev
rufus-fd:      /mnt is a different filesystem. Will not descend from / into /mnt
rufus-fd:      /net is a different filesystem. Will not descend from / into /net
rufus-fd:      /smb is a different filesystem. Will not descend from / into /smb
rufus-fd:      /misc is a different filesystem. Will not descend from / into /misc
roxie-sd: Job write elapsed time = 00:04:26, Transfer rate = 2.592 M bytes/second
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roxie-dir: Bacula 2.0.0 (28Dec06): 10-Jan-2007 03:13:35
  JobId:                  1433
  Job:                    Rufus.2007-01-10_03.05.01
  Backup Level:           Incremental, since=2007-01-09 03:08:20
  Client:                 "Rufus" 1.39.34 (28Dec06) i686-pc-linux-gnu,suse,10.2
  FileSet:                "RufusAll" 2005-12-26 19:31:20
  Pool:                   "Default" (From Job resource)
  Storage:                "LTO-changer" (From Job resource)
  Scheduled time:         10-Jan-2007 03:05:00
  Start time:             10-Jan-2007 03:08:50
  End time:               10-Jan-2007 03:13:35
  Elapsed time:           4 mins 45 secs
  Priority:               10
  FD Files Written:       3,695
  SD Files Written:       3,695
  FD Bytes Written:       689,101,439 (689.1 MB)
  SD Bytes Written:       689,599,036 (689.5 MB)
  Rate:                   2417.9 KB/s
  Software Compression:   None
  VSS:                    no
  Encryption:             no
  Volume name(s):         LTO-004
  Volume Session Id:      28
  Volume Session Time:    1167914635
  Last Volume Bytes:      297,401,029,632 (297.4 GB)
  Non-fatal FD errors:    0
  SD Errors:              0
  FD termination status:  OK
  SD termination status:  OK
  Termination:            Backup OK
```

## FileSet RufusAll

What is included :

```
/
/boot
/home
/usr
```

What is excluded :

```
/home/kern/bacula/bin/working
/home/kern/bacula/working
.journal
.autofsck
/proc
lost+found
/var/tmp
/var/lock
/var/spool/cups/tmp
/usr/tmp
```

Tips: Warning, this is the current fileset, it could have changed ...

Filter

Media Type

Location

Status

Pool

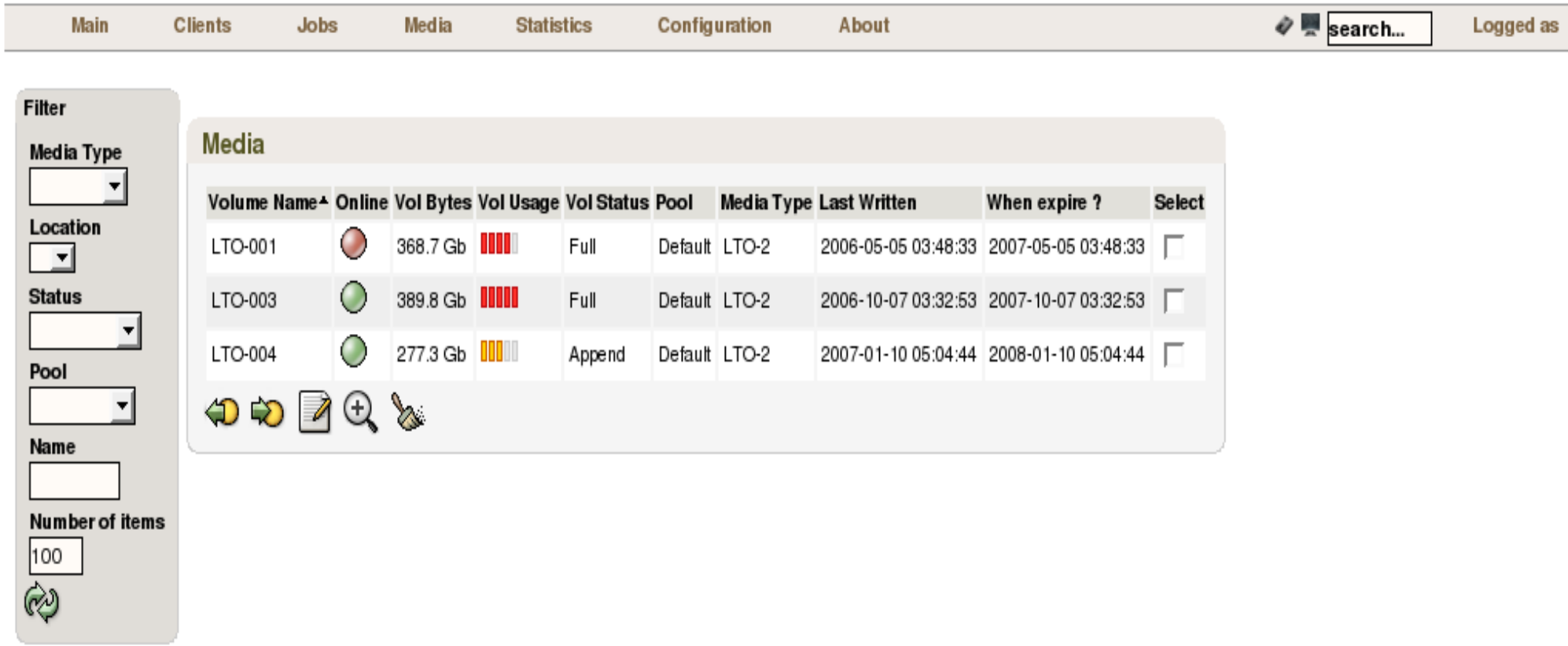
Name

Number of items

100

## Media

| Volume Name | Online | Vol Bytes | Vol Usage | Vol Status | Pool | Media Type | Last Written | When expire ? | Select |
|---|---|---|---|---|---|---|---|---|---|
| LTO-004 | | 277.3 Gb | | Append | Default | LTO-2 | 2007-01-10 05:04:44 | 2008-01-10 05:04:44 | |


Main
Clients
Jobs
Media
Statistics
Configuration
About
search...
Logged as
Filter
Media Type
Location
Status
Pool
Name
Number of items
100
Media
Volume Name
Online
Vol Bytes
Vol Usage
Vol Status
Pool
Media Type
Last Written
When expire ?
Select
LTO-001
368.7 Gb
Full
Default
LTO-2
2006-05-05 03:48:33
2007-05-05 03:48:33
LTO-003
389.8 Gb
Full
Default
LTO-2
2006-10-07 03:32:53
2007-10-07 03:32:53
LTO-004
277.3 Gb
Append
Default
LTO-2
2007-01-10 05:04:44
2008-01-10 05:04:44

## Statistics

### Options

**Level**: Any

**Status**: Any

**Age**: This week

**Size**: Width: 640, Height: 480

**Clients**: Matou, MatouVerify, Minou, Polymatou, Roxie, Rufus, RufusVerify, Tibs, Timmy, Watchdog, timmy-fd

**Job Name**: CatalogBackup, Matou, Minou, Polymatou, RestoreFiles, Rufus, Tibs, Timmy

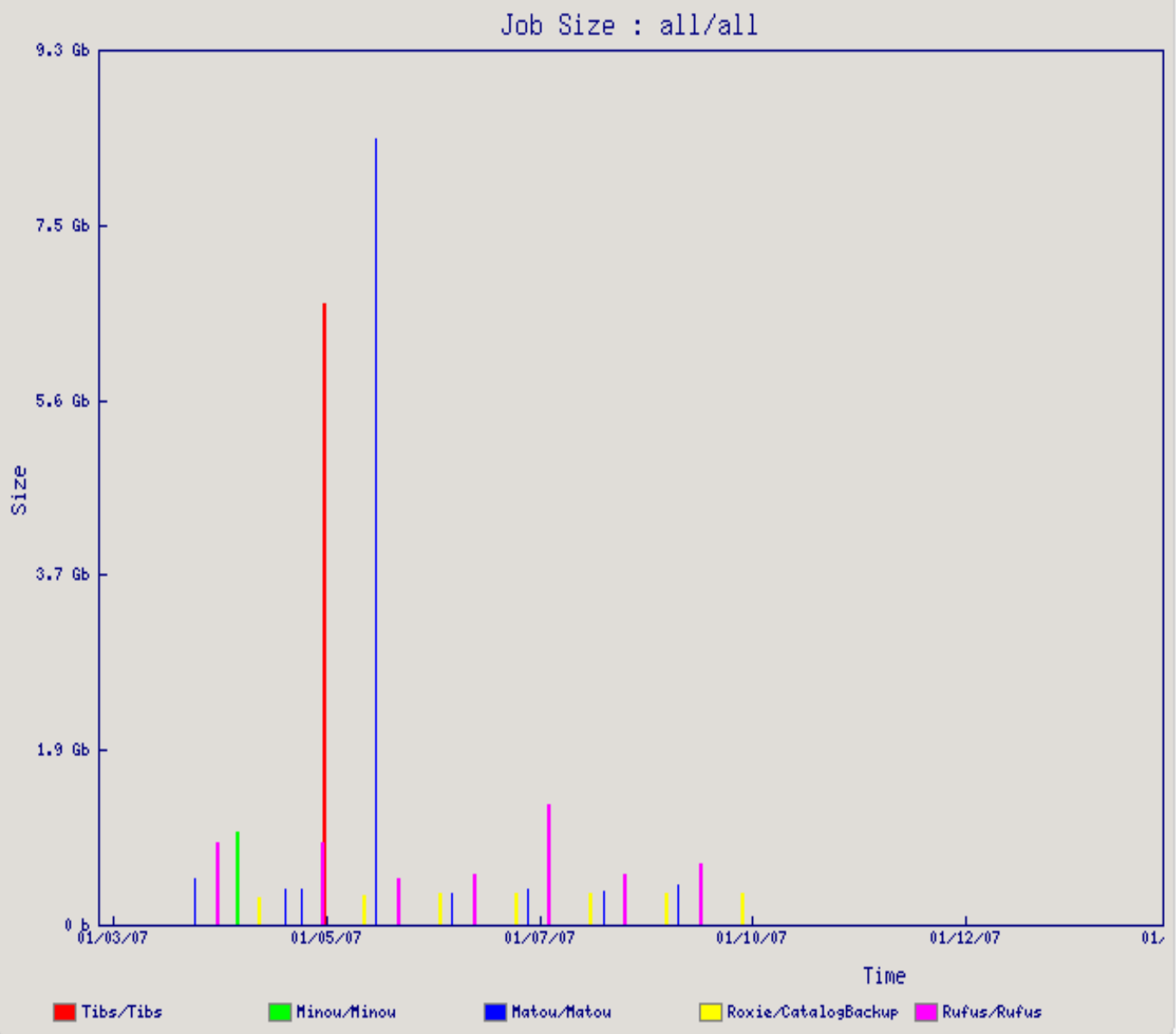
**Type**: Job Size

**Number of items**: 100

**Graph type**: Bars

graph

### Current

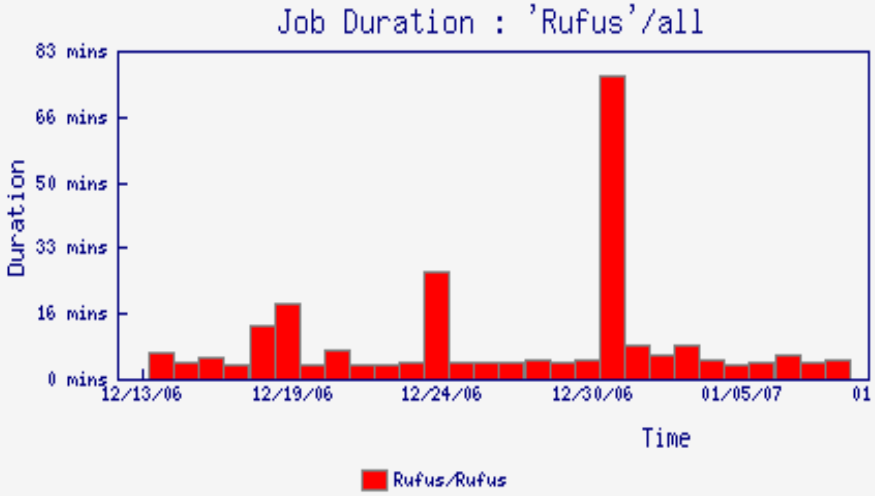
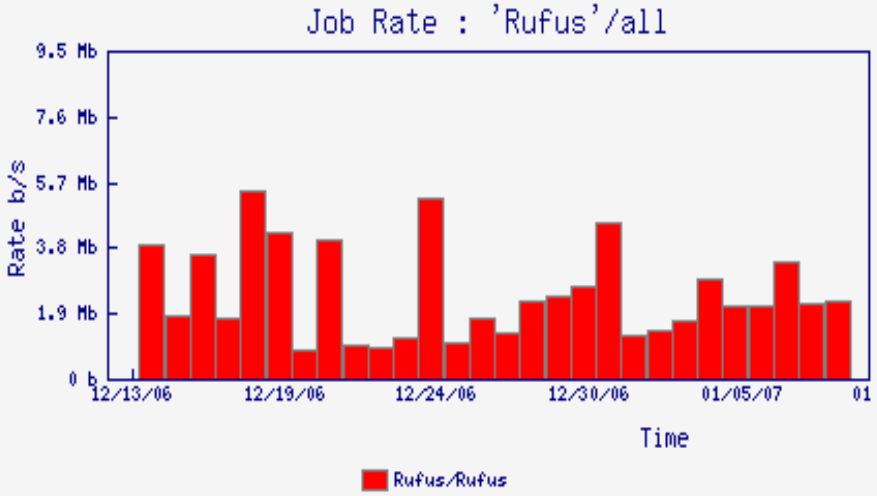
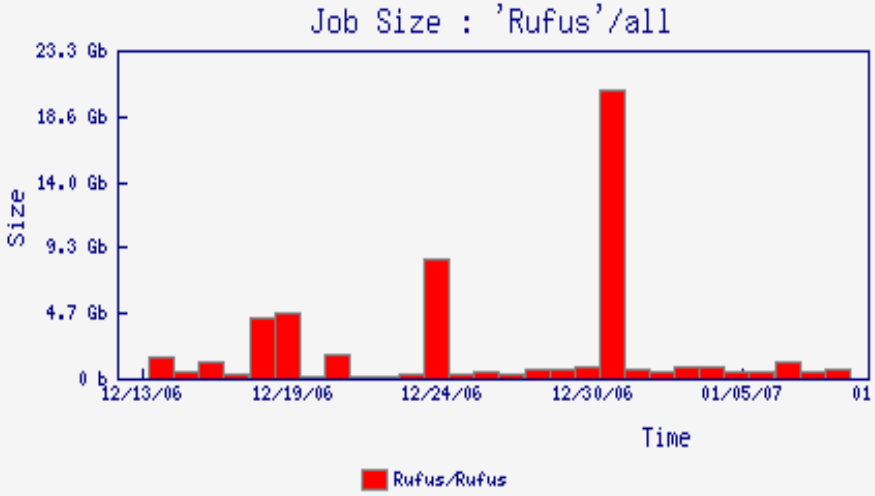


## Clients

| Name▲ | Select | Desc | Auto Prune | File Retention | Job Retention |
|---|---|---|---|---|---|
| Matou | ☐ | 1.39.29 (04Dec06) i686-pc-linux-gnu,redhat,(Stentz) | 1 | 30 days | 365 days |
| MatouVerify | ☐ | | 1 | 30 days | 30 days |
| Minou | ☐ | Windows NT 4.0,MVS,NT 4.0.1381 | 1 | 30 days | 365 days |
| Polymatou | ☐ | i686-pc-linux-gnu,redhat,(Stentz) | 1 | 30 days | 365 days |
| Roxie | ☐ | 2.0.0 (28Dec06) i686-pc-linux-gnu,suse,10.2 | 1 | 30 days | 365 days |
| Rufus | ☐ | 1.39.34 (28Dec06) i686-pc-linux-gnu,suse,10.2 | 1 | 30 days | 365 days |
| RufusVerify | ☐ | i686-pc-linux-gnu,redhat,(Bordeaux) | 1 | 30 days | 30 days |
| Tibs | ☐ | 2.0.0 (04Jan07) Linux,Cross-compile,Win32 | 1 | 30 days | 365 days |
| Timmy | ☐ | i686-pc-linux-gnu,redhat,(Stentz) | 1 | 30 days | 365 days |
| timmy-fd | ☐ | 2.0.0 (28Dec06) i686-pc-linux-gnu,suse,10.2 | 1 | 30 days | 365 days |
| Watchdog | ☐ | | 1 | 24 hours | 30 days |

**Actions**

Last jobs Current jobs Status Stats

## Client : Rufus (last 7 days)

| Name | Nb Jobs | Nb Bytes | Nb Files | Nb Errors |
|---|---|---|---|---|
| Rufus | 7 | 5.3 Gb | 44540 | 0 |