



# Bacula

## The Network Backup Solution

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Presented by Kern Sibbald at FOSDEM

25 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

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Do you do backups?

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

Problems with the above that Bacula solves by:

- Finding the files you need to restore (GUI)
- Restoring to a point in time
- Knowing what was backed up when
- Scaling to handle 2000 machines
- Providing a bare-metal recovery (non-trivial)

# Introduction

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

Project goals are to:

- backup any client from a Palm to a mainframe computer
- provide “Enterprise” features similar to the largest commercial applications
- assure data compatibility for 30 years (providing you have the appropriate hardware)
- use a Free and Open Source (GPL v2 + clarifications) license

## Project History and Statistics

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- **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 (current 2.0.2)
  
- 41 Source Forge project members
- 13 (35) developers with subversion 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

# The Six Bacula Components

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## 1. Director (DIR)

- Control and administration for everything is centralized
- Basic unit is a Job (one client, one set of files, ...)
- Schedules, initiates and supervises all Jobs
- Maintains the catalog
- Typically one Director except in very large shops

## The Six Bacula Components

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### 2. File daemon or Client (FD)

- Does file backup, restore and verification as requested by Director
- Installed on each machine as a service (daemon)
- Communicates over network with Director and Storage daemon
- Needs access to all files to be backed up (root)
- Common code but adapted specifically to each OS
- Typically multiple File daemons per Director; one for each machine

## The Six Bacula Components

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### 3. Storage daemon (SD)

- Reads and writes data to the physical medium
  - Disk
  - Tape
  - DVD
  - USB
- Accepts orders and authorization from the Director
- Accepts and returns data to/from File daemons (FD)
- Sends file storage location to Director -> Catalog
- Typically one per Director

## The Six Bacula Components

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### 4. Console

- Allows user or administrator to control Bacula
- Communicates with Director via network
- Start jobs, review Job output, query/modify catalog
- Consoles available
  - TTY (bconsole)
  - wxWidgets (GUI) – Linux, Unix, Win32
  - Gnome (GUI)
  - Several web interfaces
    - Comprehensive Qt 4 console being developed (bat)
- Restricted consoles (ACL) for security



## The Six Bacula Components

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### 5. Catalog database

- Only component not written by Bacula team
- SQL database (MySQL, PostgreSQL, or SQLite) - unique
- Tracks Jobs run, Volumes used, File locations, ...
- Permits rapid restores
- Allows inquiry of when and where files were backed up
- Old data automatically pruned by Director
- Supports multiple databases of same vendor - scaling

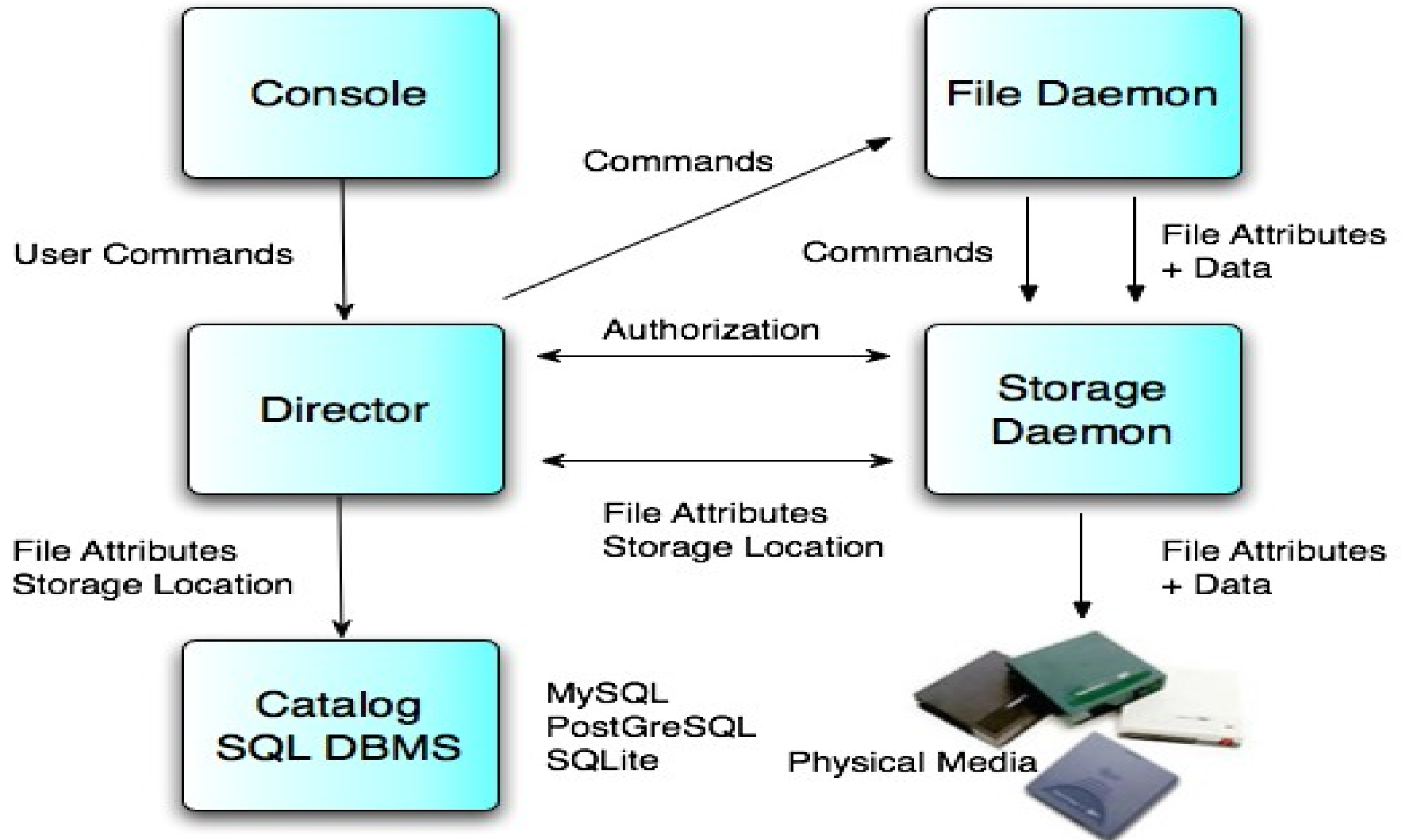
## The Six Bacula Components

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### 6. Tray Monitor

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

## Main Components



## Features

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- A central server and catalog with distributed backup
- All components communicate via the network and are deployed separately.
- Internal scheduler for automatic and simultaneous job execution with priorities.
- Interactive restore of one or more files from:
  - current backup
  - prior backup of time and date
  - many more options
- Simple administration with consoles (command line, GUI, and web)
  - bconsole (TTY) ideal over remote ssh connection

## Features (cont.)

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- Labeled Volumes, to prevent accidental overwriting
- Support for ANSI / IBM labels
- Machine independent Volume data format - extensible
- Support for Unicode on Win32; UTF-8 on Unix
- Python interpreter for user “event” (job start, end, ...) scripting
- Rescue CDROM for “bare metal” recovery.

## Bacula – Hardware Features

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

## Bacula – Security Features

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

## Technical Highlights

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



## Bacula – Director Configuration File

---

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

```
Console {  
  Name = Monitor  
  Password = "monitor-secret"  
  CommandACL = status, .status  
  CatalogACL = BackupDB  
}
```

## Bacula Configuration - Job

---

Jobs are the basic unifying structure

- Name – unique name
- Type – what to do: backup, Backup, Migrate, Admin, Restore
- Level – level of detail of type: Full, Differential, Incremental
- FileSet – what to files to backup
- Client – where to get the files (machine name)
- Storage – where to put the files (which hardware)
- Pool – which set of Volumes (tapes, disk) to use
- Schedule – when to do it

## Bacula – Director Configuration File

---

```
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

---

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

## Bacula Configuration – FileSet

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- 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
- Sparse file handling
- Signature (MD5, SHA1, ...)

## Bacula – Director Configuration File (cont)

---

```
FileSet {
  Name = "Full Set"
  Include {
    Options {
      signature=SHA1; sparse = yes
      regex = ".*\.c$"; wild = "*.txt"
      exclude = yes
    }
    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  
  Working Directory = /var/bacula  
  PID Directory = /var/run  
}
```

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



## Bacula – Storage Configuration File

---

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

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

## Bacula – Storage Configuration File (cont)

---

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

## Bacula – Storage Configuration File (cont)

---

```
AutoChanger {  
    Name = LTO-Changer  
    Device = Drive-0, Drive-1  
    Changer Device = /dev/sg0  
    ...  
}  
Device {  
    Name = Drive-0  
    Archive Device = /dev/nst0  
    Device Type = Tape      # DVD, File, FIFO  
    Media Type = LTO-2  
    Autochanger = yes  
    ...  
}
```

## Developers

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Most developers believe that backup programs are not very “sexy”. Perhaps, but 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)

## Project development

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

Development style:

- SourceForge project
- Developer's guide with code style guidelines
- Developer SVN access. Currently 13 developers may commit
- Patches and commits reviewed by K. Sibbald
- All code tested using a regression test suite
- Email list for developers (bacula-devel)

License:

- GPL 2 (+ clarifications) copyright assigned to FSFE.
- Freedom Task Force (FTF)

## Resources

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For users 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.sourceforge.net](mailto:bacula-users@lists.sourceforge.net)

For developers

- Docs: <http://www.bacula.org/developers/index.html>
- Email list: [bacula-devel@lists.sourceforge.net](mailto:bacula-devel@lists.sourceforge.net),  
[bacula-commits@lists.sourceforge.net](mailto:bacula-commits@lists.sourceforge.net)
- SVN at Source Forge

## Credits

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### Thanks

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

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

<http://www.bacula.org> -> Presentations -> ...

## Live Demo

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The following slides are not part of 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

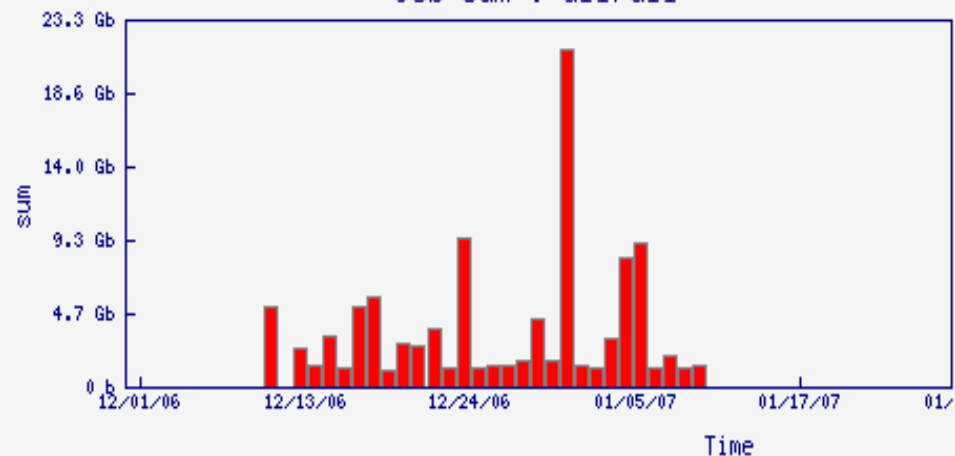
## Running Jobs

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		



## Statistics





Job sum : all/all

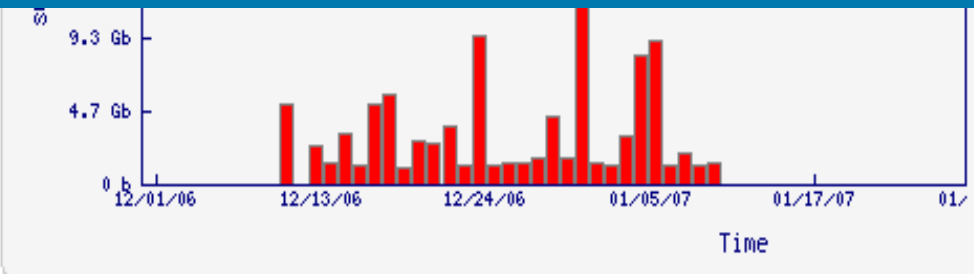


## Last Jobs ( limited to 10)

JobId ▾	Client	Job Name	FileSet	Level	StartTime	Duration	JobFiles	JobBytes	Errors	Status
1436	Roxie	CatabgBackup	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		








## 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	
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 ...
roxie-fd: /boot is a different filesystem. Will not descend from / into /boot
roxie-fd: /home is a different filesystem. Will not descend from / into /home
roxie-fd: /tmp is a different filesystem. Will not descend from / into /tmp
roxie-fd: /usr is a different filesystem. Will not descend from / into /usr
roxie-fd: /sys is a different filesystem. Will not descend from / into /sys
roxie-fd: /dev is a different filesystem. Will not descend from / into /dev
roxie-fd: /mnt is a different filesystem. Will not descend from / into /mnt
roxie-fd: /net is a different filesystem. Will not descend from / into /net
roxie-fd: /smb is a different filesystem. Will not descend from / into /smb
roxie-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
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
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****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	<input type="checkbox"/>
LTO-003		389.8 Gb		Full	Default	LTO-2	2006-10-07 03:32:53	2007-10-07 03:32:53	<input type="checkbox"/>
LTO-004		277.3 Gb		Append	Default	LTO-2	2007-01-10 05:04:44	2008-01-10 05:04:44	<input type="checkbox"/>



## Statistics

### Options

**Level**

**Status**

**Age**

**Size**

 Width: 

 Height: 
**Clients**

- Matou
- MatouVerify
- Minou
- Polymatou
- Roxie
- Rufus
- RufusVerify
- Tibs
- Timmy
- Watchdog
- timmy-fd

**Job Name**

- CatalogBackup
- Matou
- Minou
- Polymatou
- RestoreFiles
- Rufus
- Tibs
- Timmy

**Type**

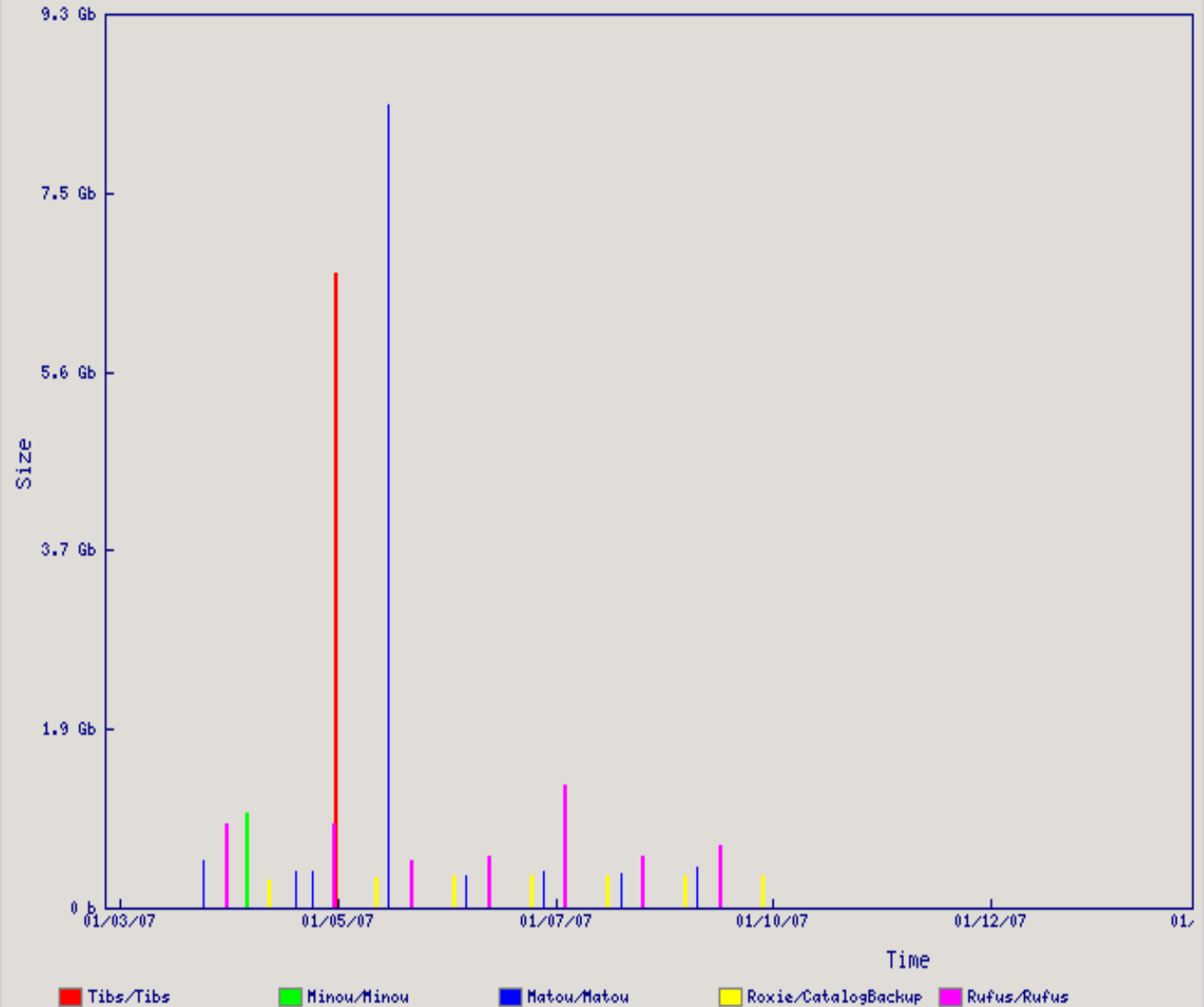
**Number of items**

**Graph type**



### Current





Job Size : all/all



## Clients

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

### Actions

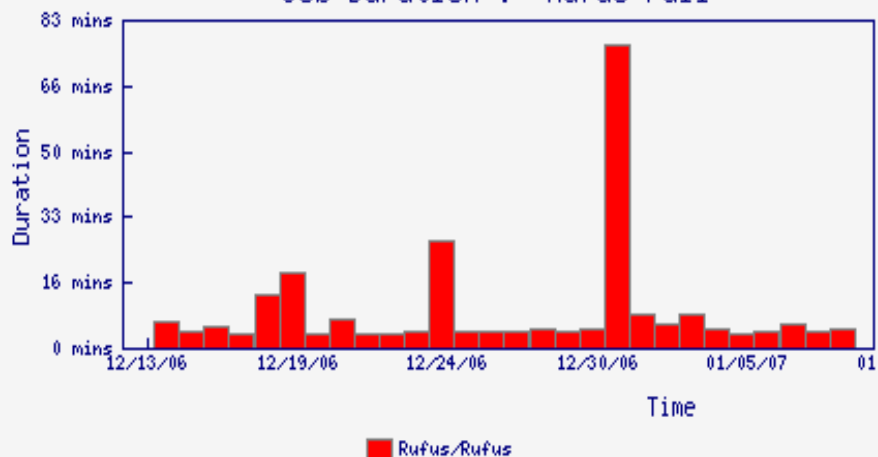
-  Last jobs
-  Current jobs
-  Status
-  Stats



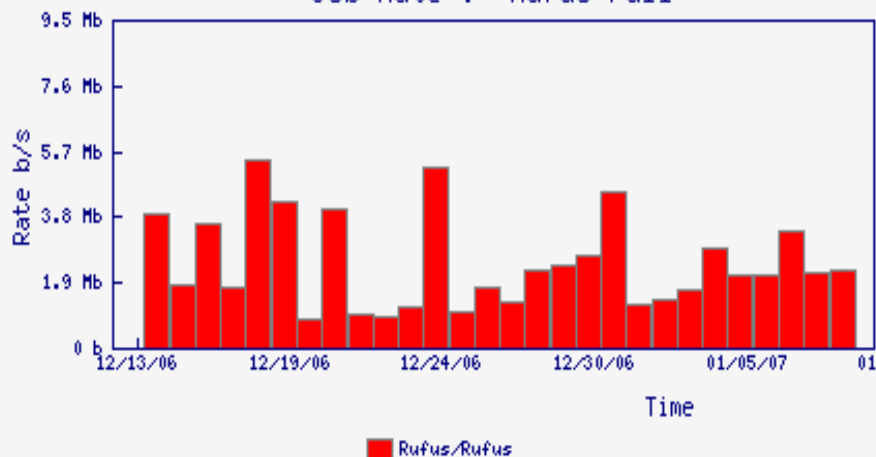
## Client : Rufus (last 7 days)

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

Job Duration : 'Rufus'/all



Job Rate : 'Rufus'/all



Job Size : 'Rufus'/all

