



UNIVERSITY OF UTAH
STUDENT COMPUTING LABS

Radmind

Mac OS X File System Management

Case Study

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University of Utah
Student Computing Labs**

Presentation Overview

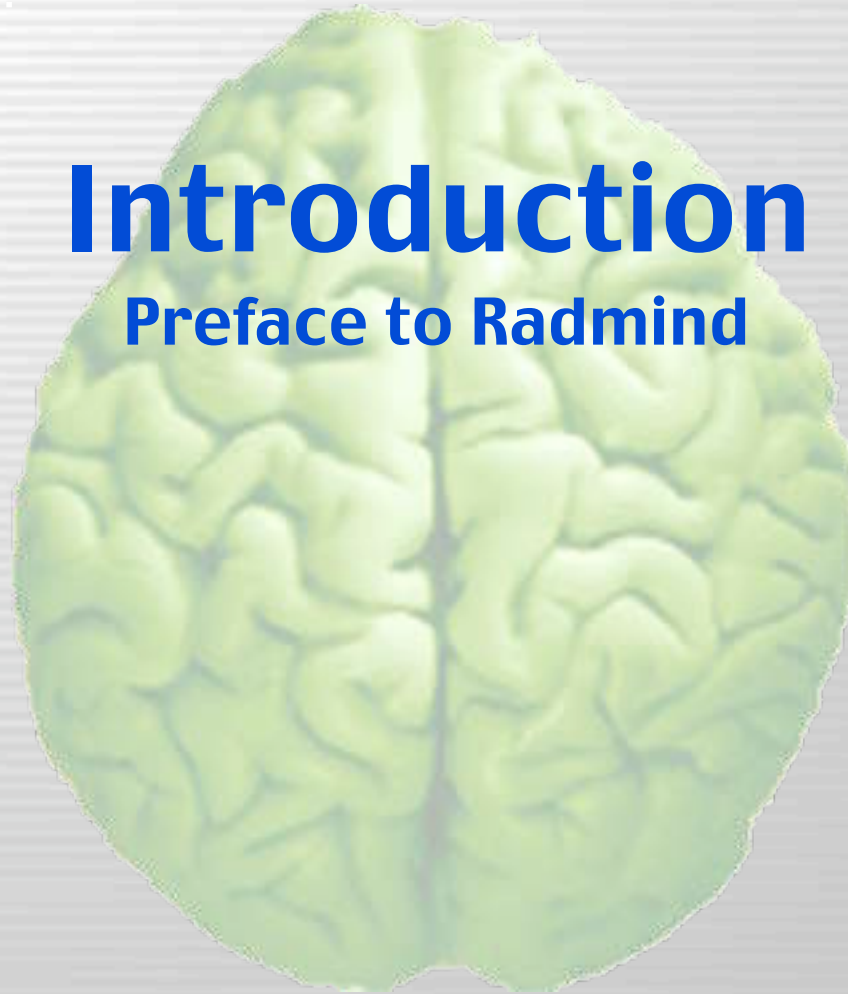
- Introduction
- The Basic Concept
- Why use it?
- How to deploy it?
- Terms
- Description of the Tools
- Case Study – Radmind Integration
- Issues
- Q & A



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Introduction

Preface to Radmind



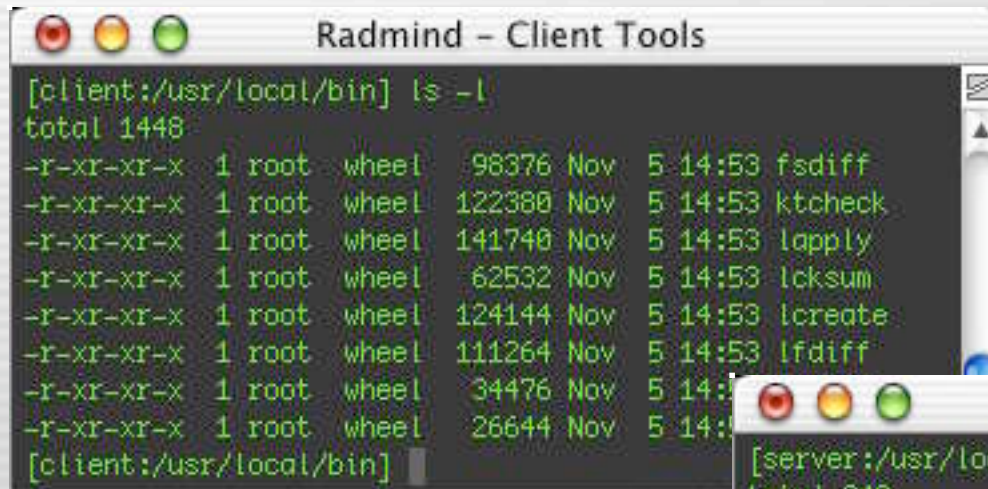
Who's Developing it?

- **Developed & supported by:**
 - **Research Systems Unix Group (RSUG)**
 - **At the University of Michigan**
 - **Includes:**
 - **Technical support, questions and feature requests**
 - **Mailing List – Archived & Searchable**

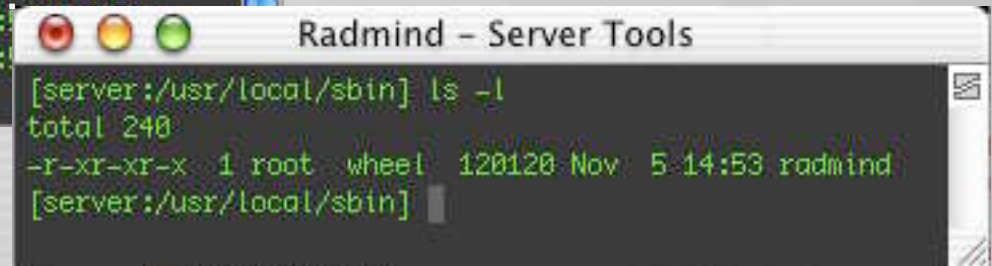
research systems  group

Command Line Tools

- Suite of command line tools
 - Both client & server tools
 - Open Source



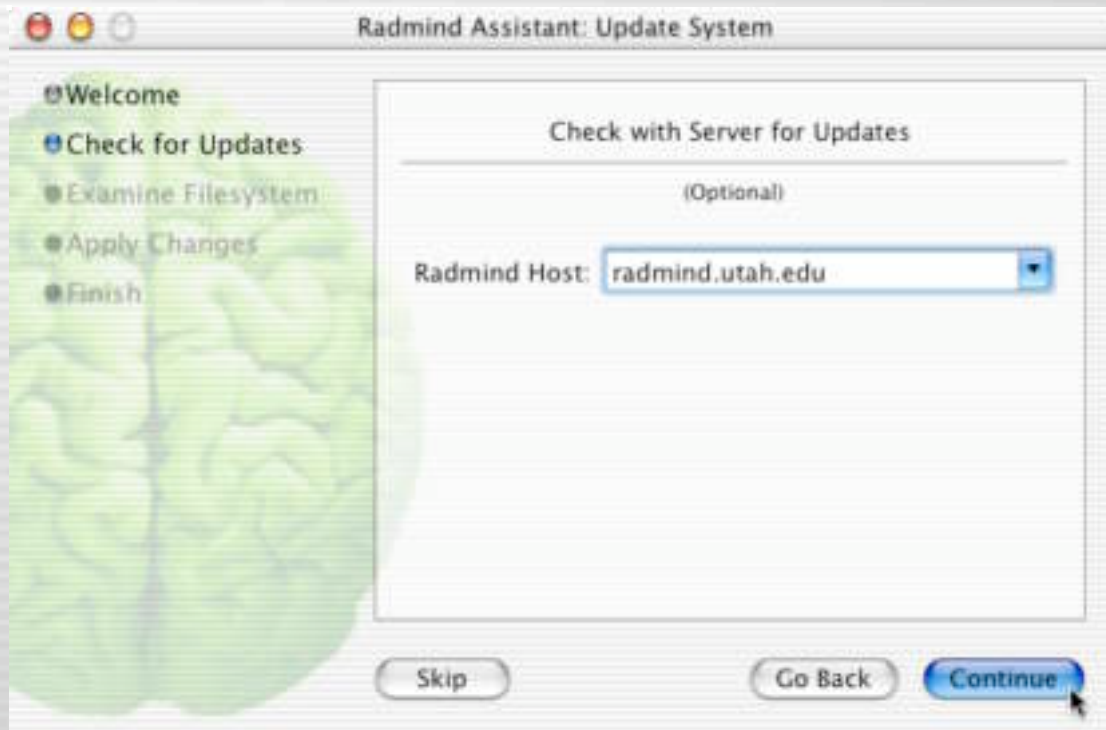
```
[client:/usr/local/bin] ls -l
total 1448
-r-xr-xr-x 1 root wheel 98376 Nov 5 14:53 fsdiff
-r-xr-xr-x 1 root wheel 122388 Nov 5 14:53 ktcheck
-r-xr-xr-x 1 root wheel 141748 Nov 5 14:53 lapply
-r-xr-xr-x 1 root wheel 62532 Nov 5 14:53 lcksum
-r-xr-xr-x 1 root wheel 124144 Nov 5 14:53 lcreate
-r-xr-xr-x 1 root wheel 111264 Nov 5 14:53 lfdiff
-r-xr-xr-x 1 root wheel 34476 Nov 5 14:53
-r-xr-xr-x 1 root wheel 26644 Nov 5 14:53
[client:/usr/local/bin]
```



```
[server:/usr/local/sbin] ls -l
total 248
-r-xr-xr-x 1 root wheel 128128 Nov 5 14:53 radmind
[server:/usr/local/sbin]
```

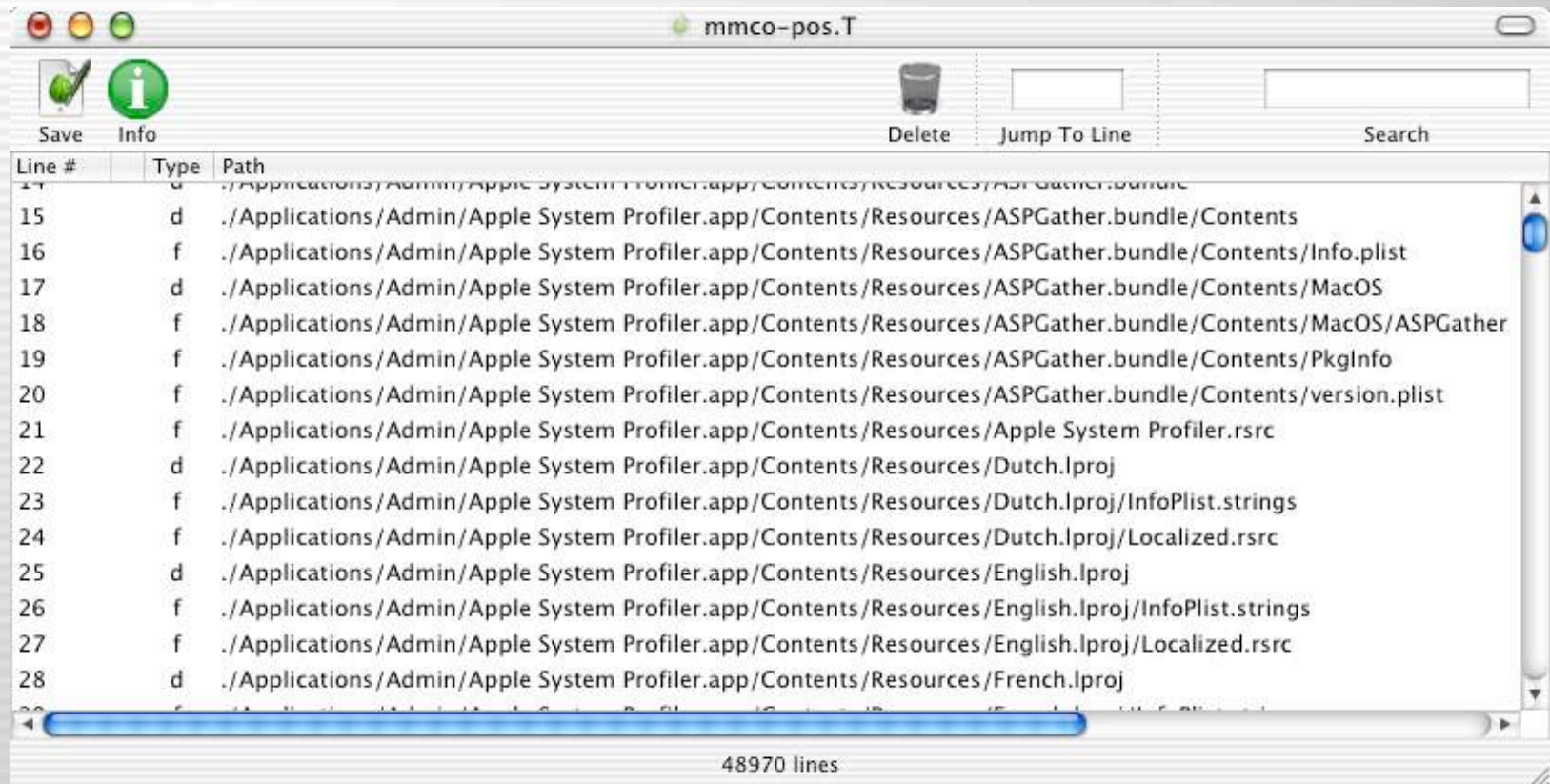
Radmind Assistant

- Mac OS X GUI that supports most options
 - Updating client file system, creating loadsets



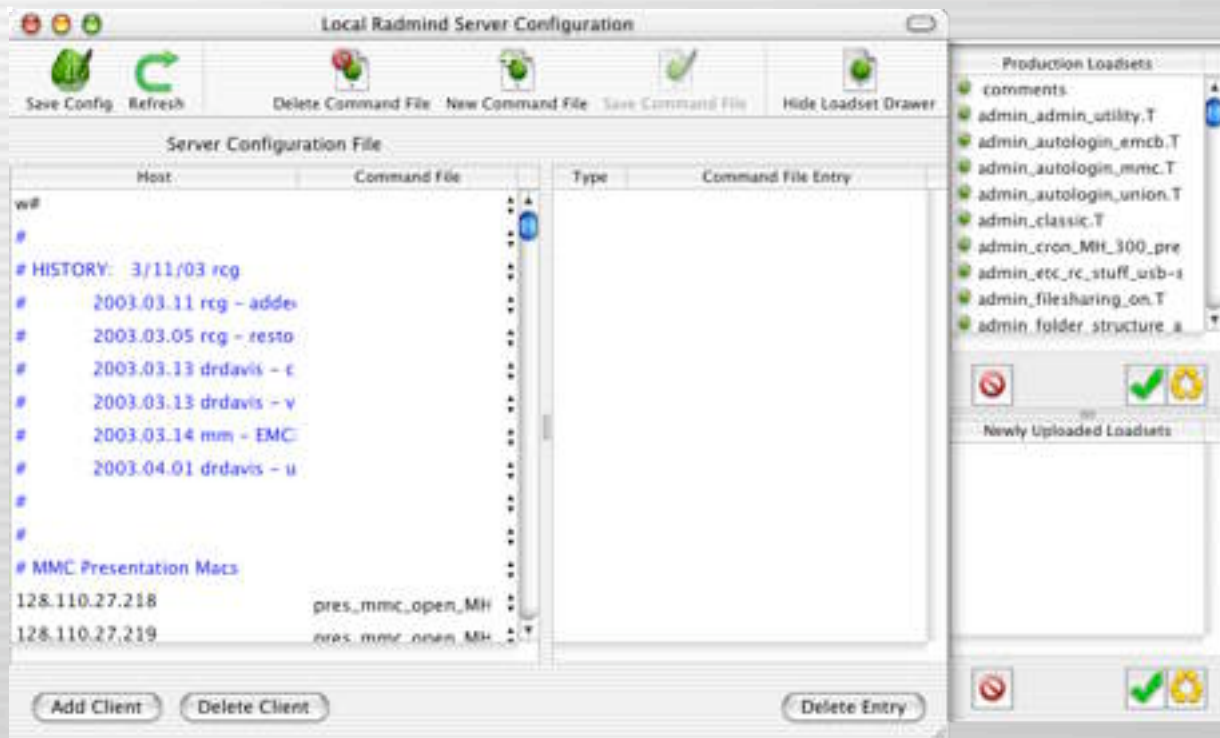
Radmind Transcript Editor

- Used to edit file system descriptions



Server Manager

- Configuration client file system mgmt.
- Manages file system descriptions



Supported Platforms – Unix

- Can be used with any supported Unix
 - Mac OS X
 - Solaris
 - FreeBSD
 - OpenBSD
 - Linux



Other Platforms

- **Windows Client/Server**



- **Currently NOT supported**
- **Ports are in development**
- **Focus will be radmind server port**

Requirements – Mac OS X

- **Client**
 - Requires Mac OS X 10.1.3 or later
- **Server**
 - Requires Mac OS X 10.2 or later
 - Mac OS X Server NOT required
 - The radmind server can run on Mac OS X client





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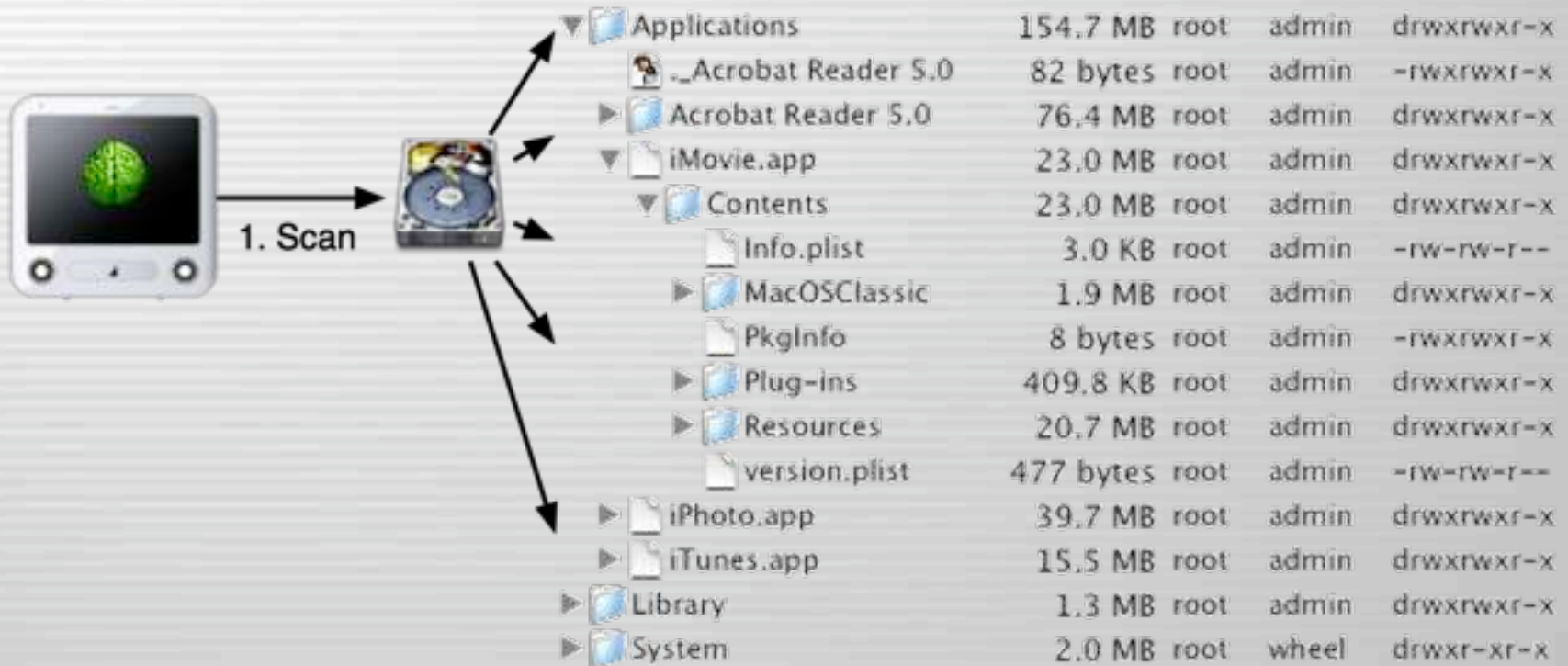
The Basic Concept

The Fundamentals of Radmind



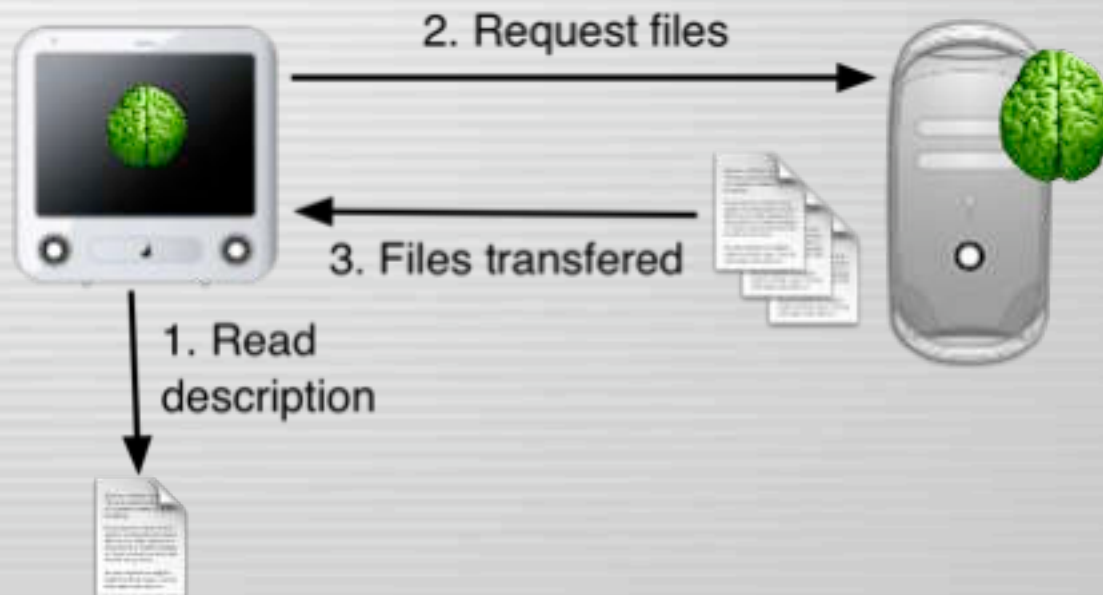
Tripwire

- Radmind can run as a tripwire
 - Detects file system modifications



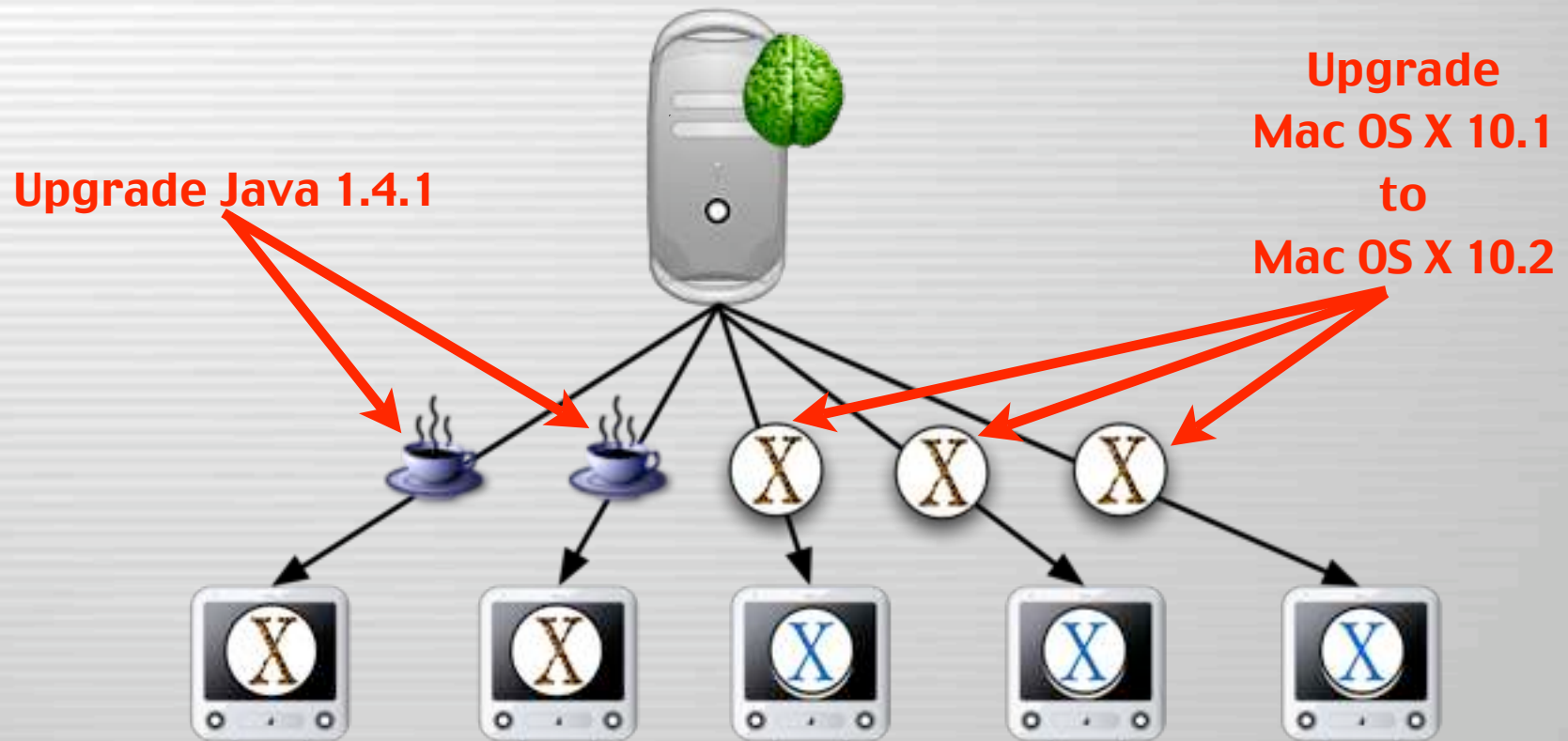
Restore to Managed State

- Radmind can restore to managed state
 - Downloads and/or removes files/folders
 - Sets attributes & permissions



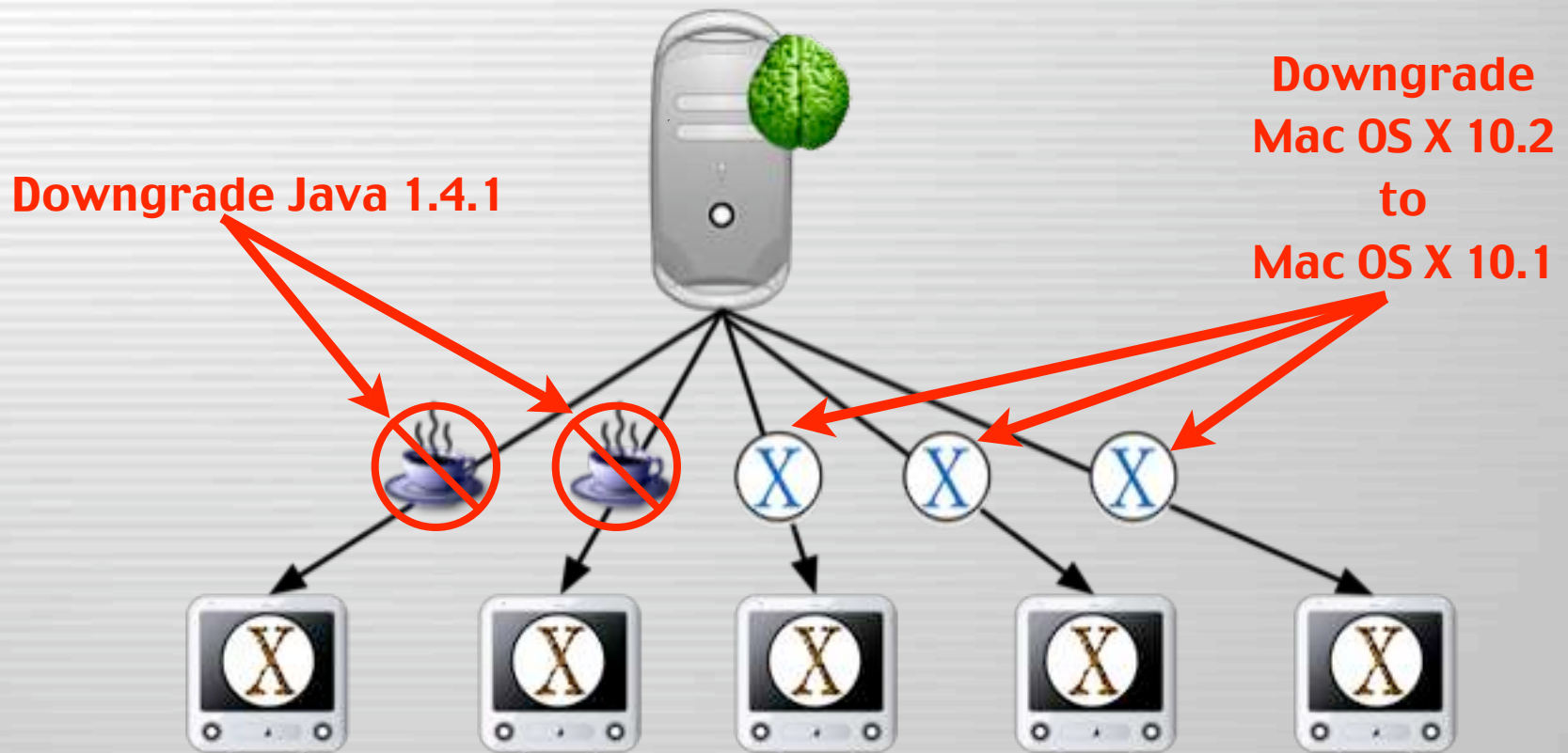
Distribute/Remove Software

- Radmin allows you to upgrade the OS and software



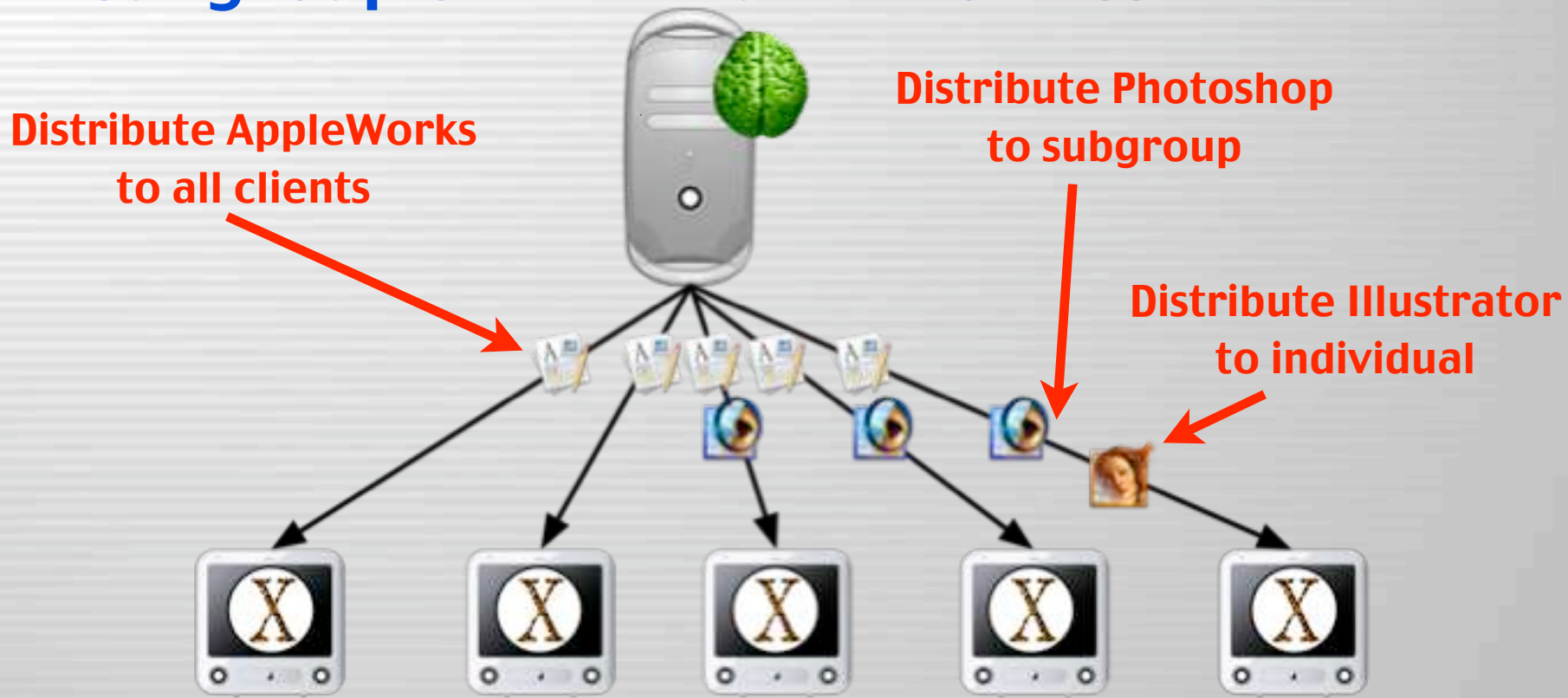
Distribute/Remove Software

- Radmind allows you to downgrade the OS and software



Distribute/Remove Software

- Radmind allows distribute software to all, subgroup or individual machines.

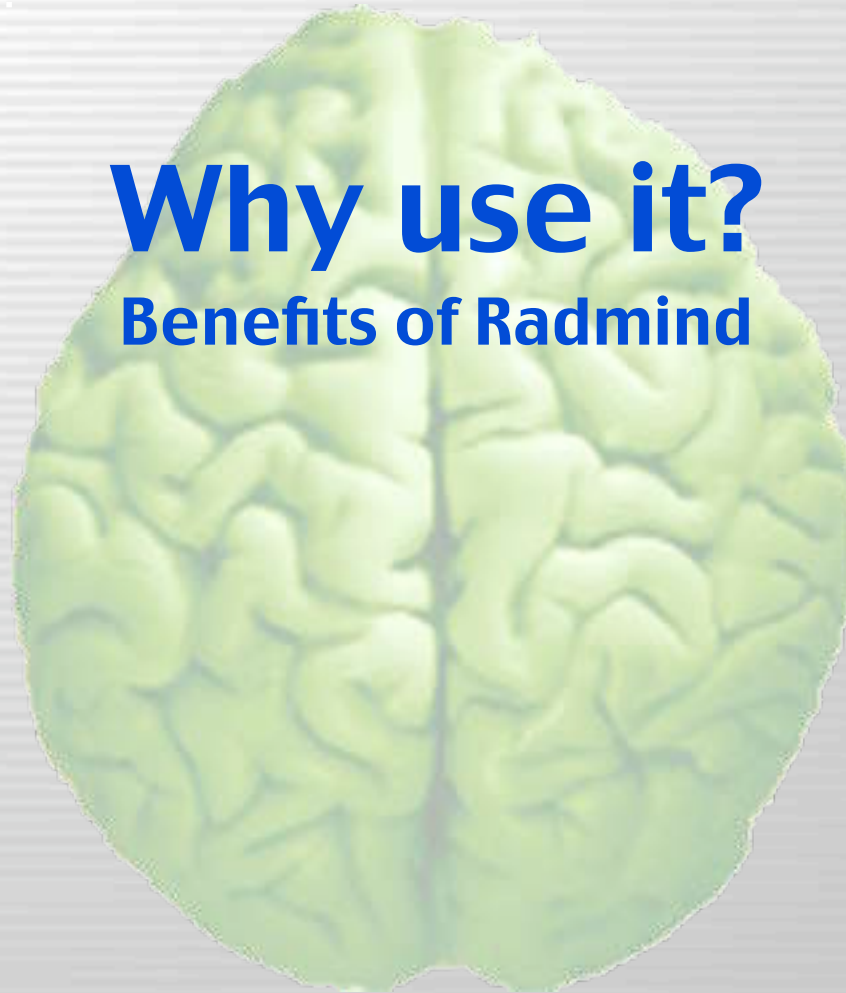




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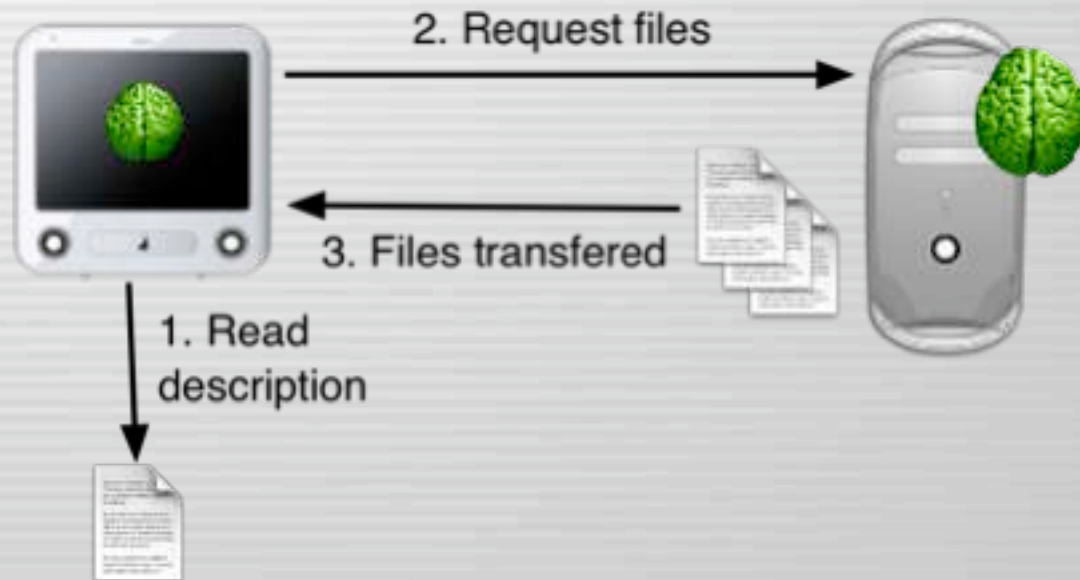
Why use it?

Benefits of Radmind



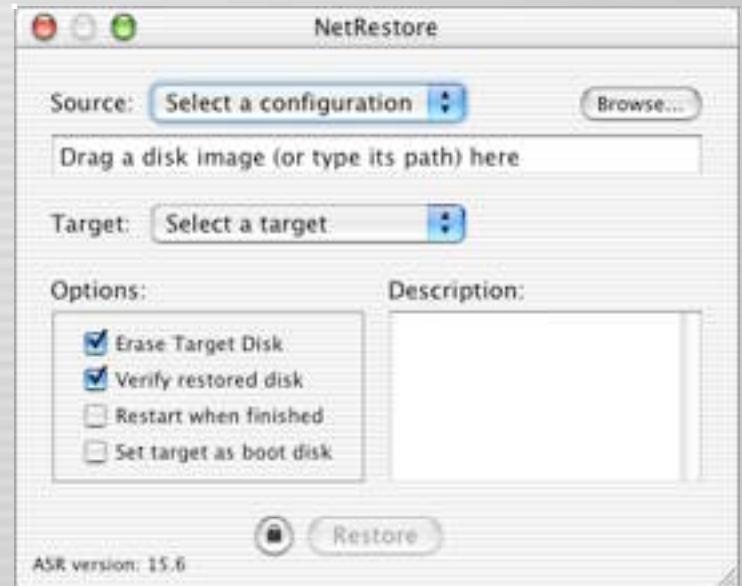
Network Usage

- Few files are transferred over network for incremental updates
 - Only needed files are downloaded



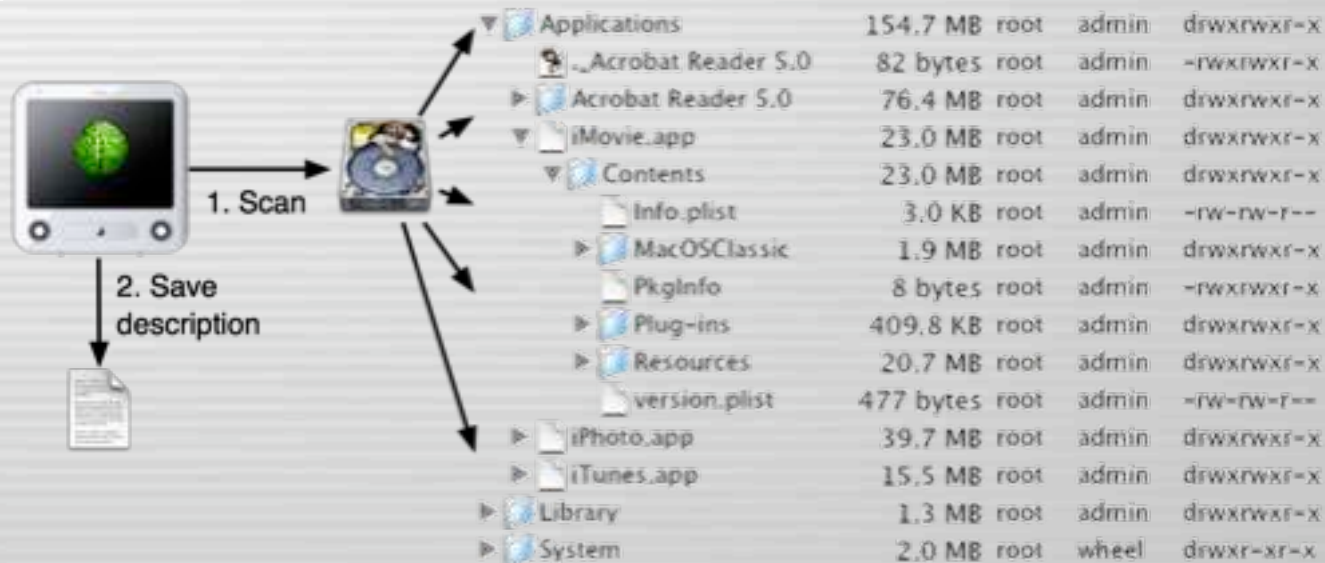
Network Usage

- Unlike tools that transfer an entire HD image
- Even if client needs a few updates
 - Apple Software Restore
 - NetRestore
 - Great tools for initial setup
 - Or brute force re-imaging
 - Not ideal for ongoing maintenance in large deployments



Server Usage

- Minimizes server/network usage
 - The client scans the hard disk locally, doesn't talk to server during scan



Server Usage

- Unlike tools that usually compare the client hard disk to a server master over the network

- RsyncX

- Mac OS 9

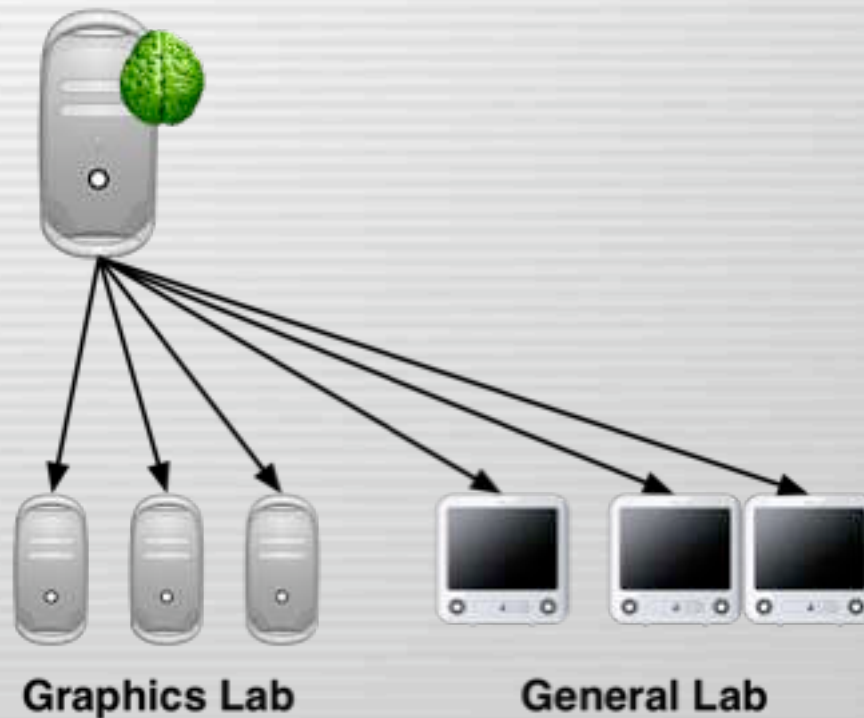
- Assimilator

- RevRdist



Remote Administration

- Remotely control & distribute file systems on multiple machines



Remote Administration

- Unlike tools like that require you to visit each machine in a lab environment with portable drive
 - ASR
 - Carbon Copy Cloner
 - NetRestore
 - Great tool for individual cloning or syncing
 - Not ideal for ongoing management of large labs



DHCP Not Required

- It is flexible, you just need an IP address
- Doesn't matter how it gets assigned
 - Unlike tools, like NetBoot, NetInstall that require DHCP to operate.



Manage by Certificate

- **Allows client verification via SSL certificate.**
- **Nomadic Machines**
 - Laptops used in various locations, like home & work, can be managed.
- **IP Dynamic Assignments**
 - IP is completely irrelevant for client identification.



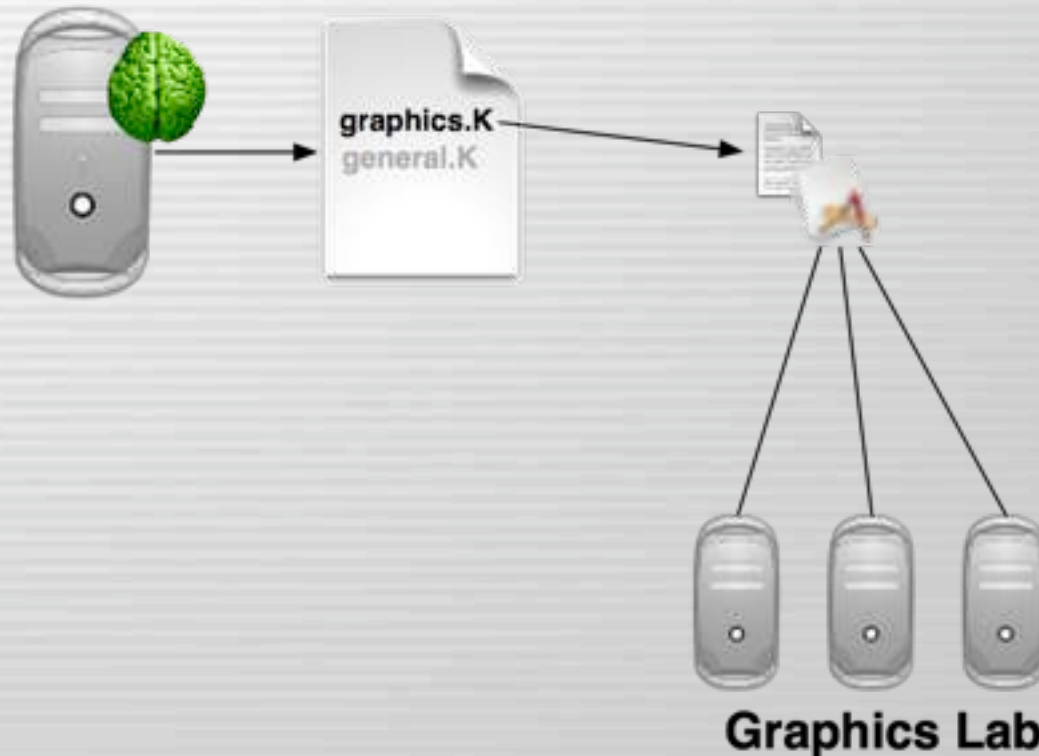
Software Management

- Tracks software & OS installations
 - Unlike other tools, radmind has built-in support for tracking individual software or OS installations.
 - And has built-in support for uploading & restoring individual software or OS installations.



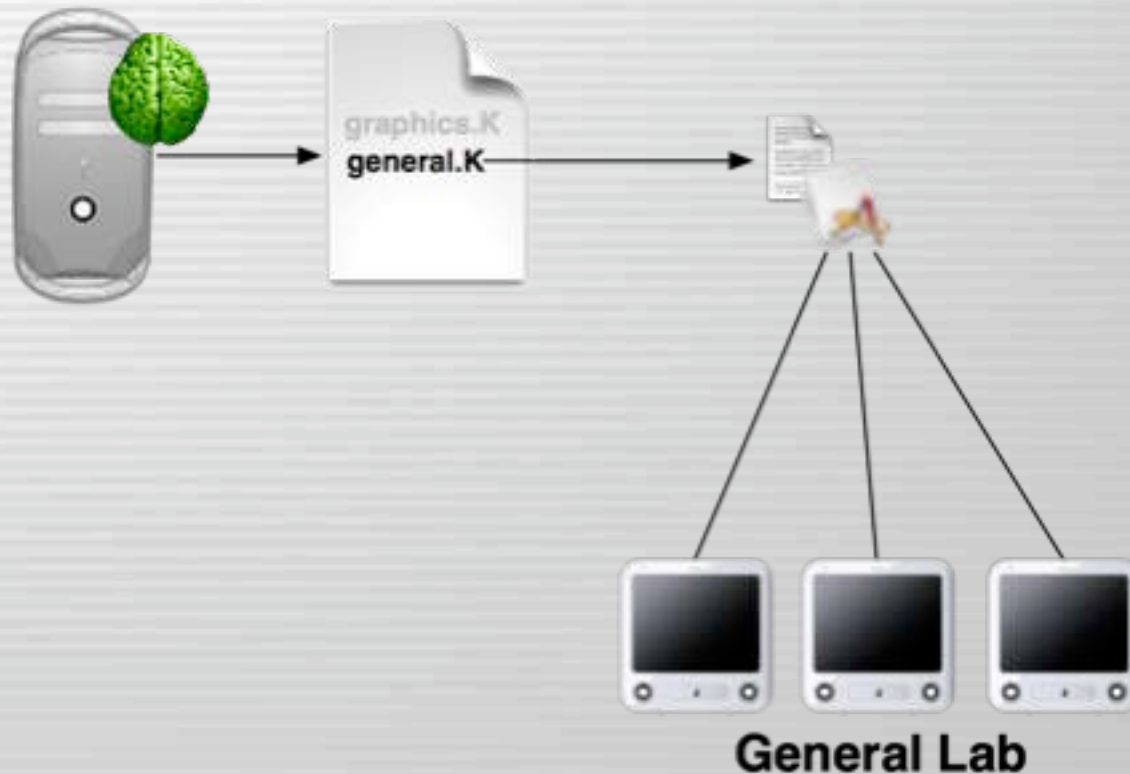
Client Management

- One file on server to manage file systems of multiple machines.



Client Management

- One file on server to manage file systems of multiple machines.





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How to deploy it?

Planning & Preparation



What to manage on file system?

- **Student Lab**

- Try to manage the entire file system
- Restore file system due user modifications, hacks, OS and hardware bugs.

- **Staff & Faculty**

- Maybe allow local admin manage
 - Users Home Folders (i.e. /Users)
 - Users Web Folders (i.e. /private/etc/httpd/users)
- Local Admin needs to be trusted and technical

How to update client?

- **Manually**
 - User makes decision to update or not.
 - Useful in a staff & faculty environment
 - Nice additional option in labs
- **Automatic**
 - Logout, not ideal in busy labs
 - Scheduled, off hours maintenance
 - Remotely , not ideal for primary method

How to manage loads?

- **How to setup machine deployment?**
 - **Full – File System**
 - Everything is in base deployment
 - **Partial – File System**
 - OS & Global Apps in base deployment
 - Adds more granularity
 - **Small – File System**
 - Small base deployment (OS)
 - Flexible & Powerful
 - More complex



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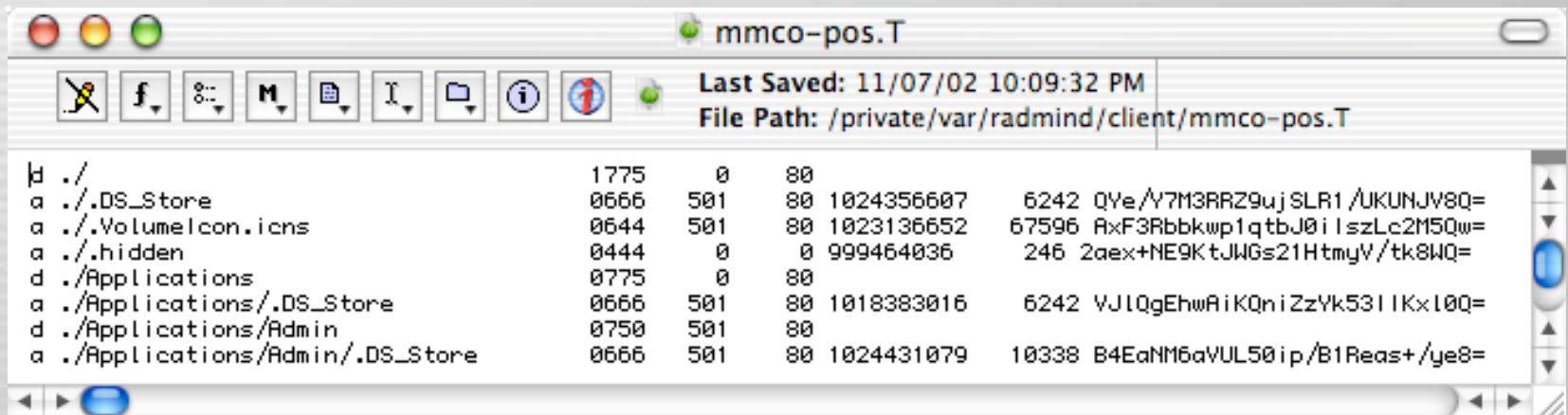


Terms

Radmind Lingo & Slang

Transcript

- **Transcript**
 - A description of the file system
 - A list of files, directories, links.
 - Includes attributes like size, permissions, modification dates, checksums, etc.



The screenshot shows a window titled "mmco-pos.T" with a toolbar and a list of files and directories. The list includes columns for file type, size, permissions, and other attributes.

File Type	File Name	Size	Permissions	Checksums
d	./	1775	0 80	
a	./_DS_Store	0666	501 80	1024356607 6242 QYe/v7M3RRZ9ujSLR1 /UKUNJV8Q=
a	./VolumeIcons	0644	501 80	1023136652 67596 RxF3Rbbkwp1qtbJ0 i l szLc2M5Qw=
a	./_hidden	0444	0 0	999464036 246 2aex+NE9KtJWGs21HtmjV/tk8WQ=
d	./Applications	0775	0 80	
a	./Applications/_DS_Store	0666	501 80	1018383016 6242 VJlQgEhwAikQniZzYk53lIKx10Q=
d	./Applications/Admin	0750	501 80	
a	./Applications/Admin/_DS_Store	0666	501 80	1024431079 10338 B4EaNM6aVUL50ip/B1Reas+/ye8=

Positive Transcript

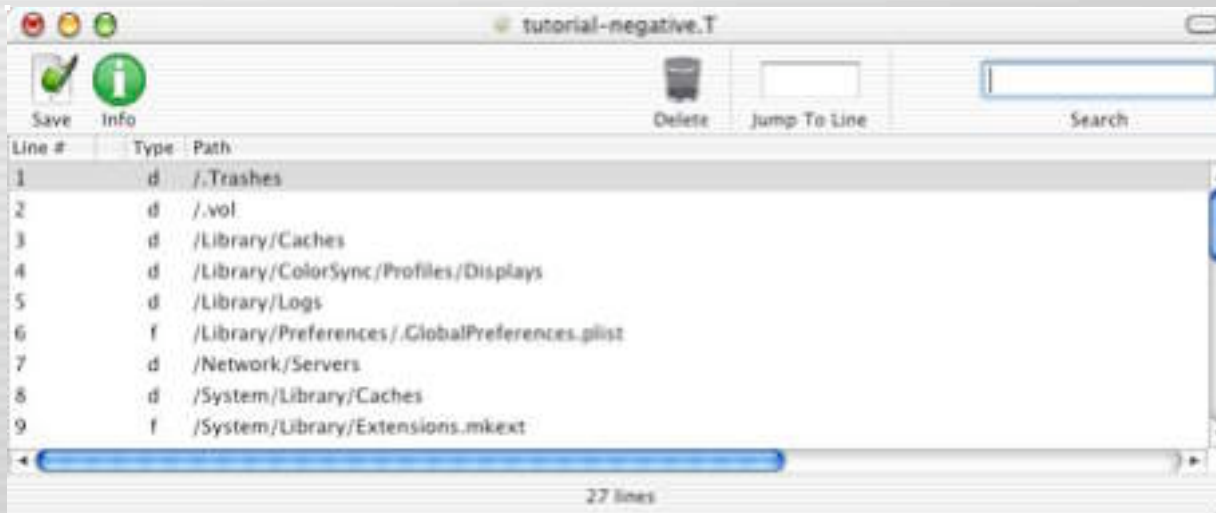
- Lists file system objects
 - That must exist & match all attributes

Line #	Type	Path
1	f	./Applications/Admin/Apple System Profiler.app/Contents/Resources/Spanish.lproj/InfoPlist.strings
2	f	./Applications/Admin/Apple System Profiler.app/Contents/Resources/Spanish.lproj/Localized.rsrc
3	d	./Applications/Admin/Apple System Profiler.app/Contents/Resources/da.lproj
4	f	./Applications/Admin/Apple System Profiler.app/Contents/Resources/da.lproj/InfoPlist.strings
5	f	./Applications/Admin/Apple System Profiler.app/Contents/Resources/da.lproj/Localized.rsrc
6	d	./Applications/Admin/Apple System Profiler.app/Contents/Resources/fi.lproj
7	f	./Applications/Admin/Apple System Profiler.app/Contents/Resources/fi.lproj/InfoPlist.strings

48990 lines

Negative Transcript

- List file system objects that must exist
- Only some attributes checked
 - Directories UID & GID set
 - The directory contents are not read or modified



The screenshot shows a terminal window with a title bar that reads "tutorial-negative.T". The window contains a list of file system objects with columns for "Line #", "Type", and "Path". The list includes directories like "/.Trashes", "/.vol", and "/Library/Caches", as well as files like "/Library/Preferences/.GlobalPreferences.plist" and "/System/Library/Extensions.mkext". The window also features a toolbar with "Save", "Info", "Delete", "Jump To Line", and "Search" buttons, and a status bar at the bottom indicating "27 lines".

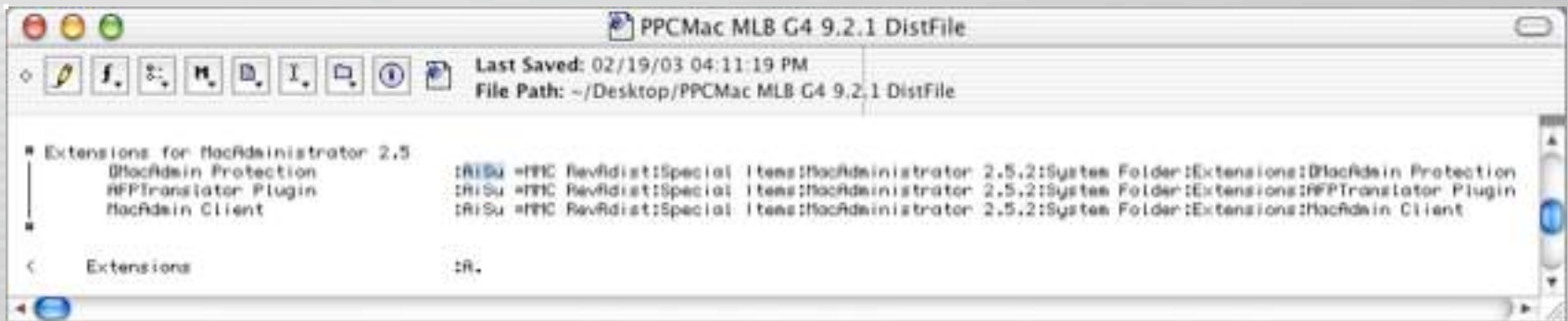
Line #	Type	Path
1	d	/.Trashes
2	d	/.vol
3	d	/Library/Caches
4	d	/Library/ColorSync/Profiles/Displays
5	d	/Library/Logs
6	f	/Library/Preferences/.GlobalPreferences.plist
7	d	/Network/Servers
8	d	/System/Library/Caches
9	f	/System/Library/Extensions.mkext

Negative Transcript

- Analogous to RevRdist AiSu parameter



Mac Administrator Files



Loadset

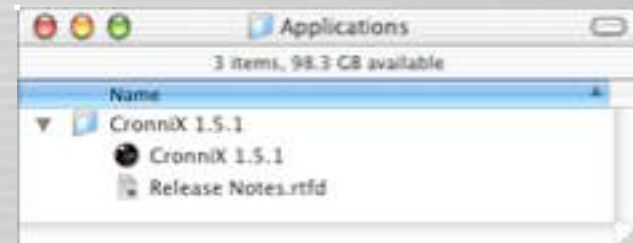
- A transcript & its associated files

Transcript (file system description)



```
d .Users/eac/Applications/CronniX\b1.5.1 0750 501 20
d .Users/eac/Applications/CronniX\b1.5.1/CronniX\b1.5.1.app 0750 501 20
o .Users/eac/Applications/CronniX\b1.5.1/CronniX\b1.5.1.app/.DS_Store 0751 501 20 1034796106 6242 T17zEBtrjH8w0Pz48|1002w5R8#
d .Users/eac/Applications/CronniX\b1.5.1/CronniX\b1.5.1.app/Contents 0750 501 20
f .Users/eac/Applications/CronniX\b1.5.1/CronniX\b1.5.1.app/Contents/Info.plist 0640 501 20 1034796106 1005 xjgecFTQwR1L12bz0+rciLGeIR#
f .Users/eac/Applications/CronniX\b1.5.1/CronniX\b1.5.1.app/Contents/Info/CronniX 0751 501 20 1034796106 796746 61u2037j8Euu1uef7L|tzW3rk#
f .Users/eac/Applications/CronniX\b1.5.1/CronniX\b1.5.1.app/Contents/Resources 0750 501 20
d .Users/eac/Applications/CronniX\b1.5.1/CronniX\b1.5.1.app/Contents/Resources/.DS_Store 0751 501 20 1034796106 6242 0gr105efmEE0sk9Ec0w+hr0ac0B#
d .Users/eac/Applications/CronniX\b1.5.1/CronniX\b1.5.1.app/Contents/Resources/English.lproj 0750 501 20
f .Users/eac/Applications/CronniX\b1.5.1/CronniX\b1.5.1.app/Contents/Resources/English.lproj/InfoPlist.strings 0751 501 20 1034796106 334 161x0H1xgLiKx1eF8E7c0Wamp1U#
```

Associated Files

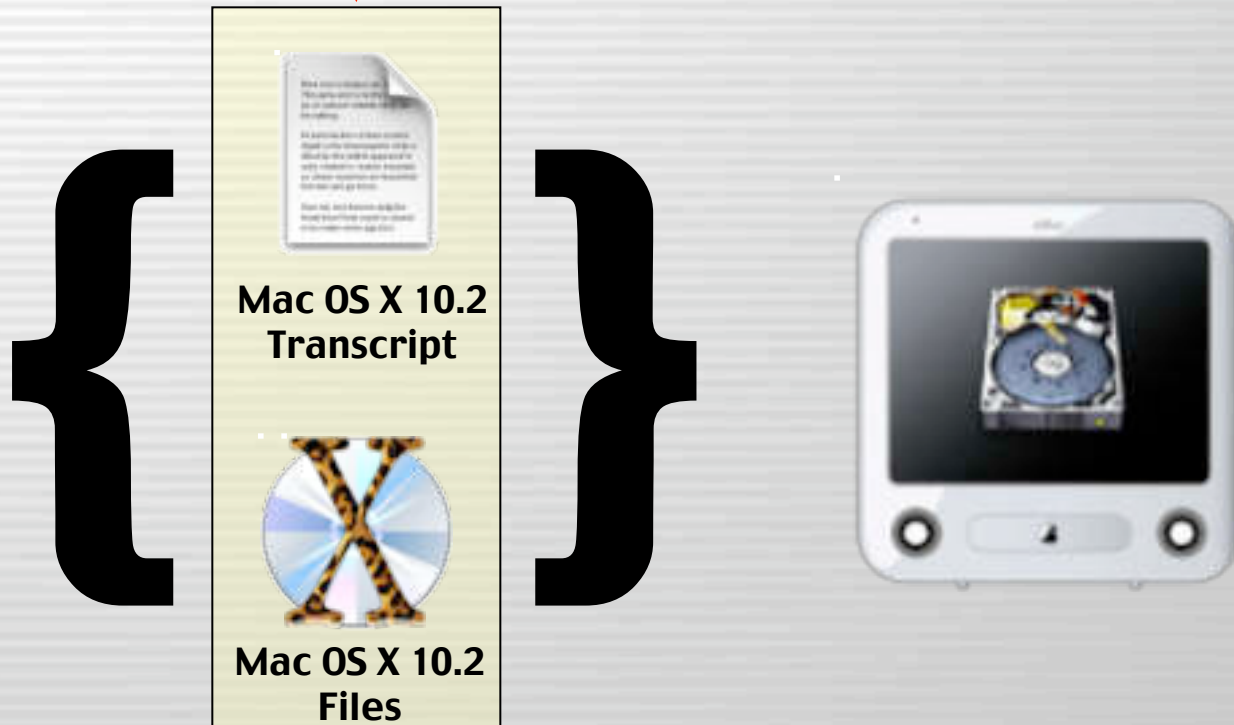


Base Load

- The primary file system loadset
- Usually a large transcript & associated files.
 - A base load could be:
 - Mac OS X
 - Mac OS X and global applications
 - Or the entire client file system deployment
 - Including Mac OS X
 - Applications
 - Admin Modifications
(users & groups, directory setup, scripts, etc.)

Base Load – Example

Base Load

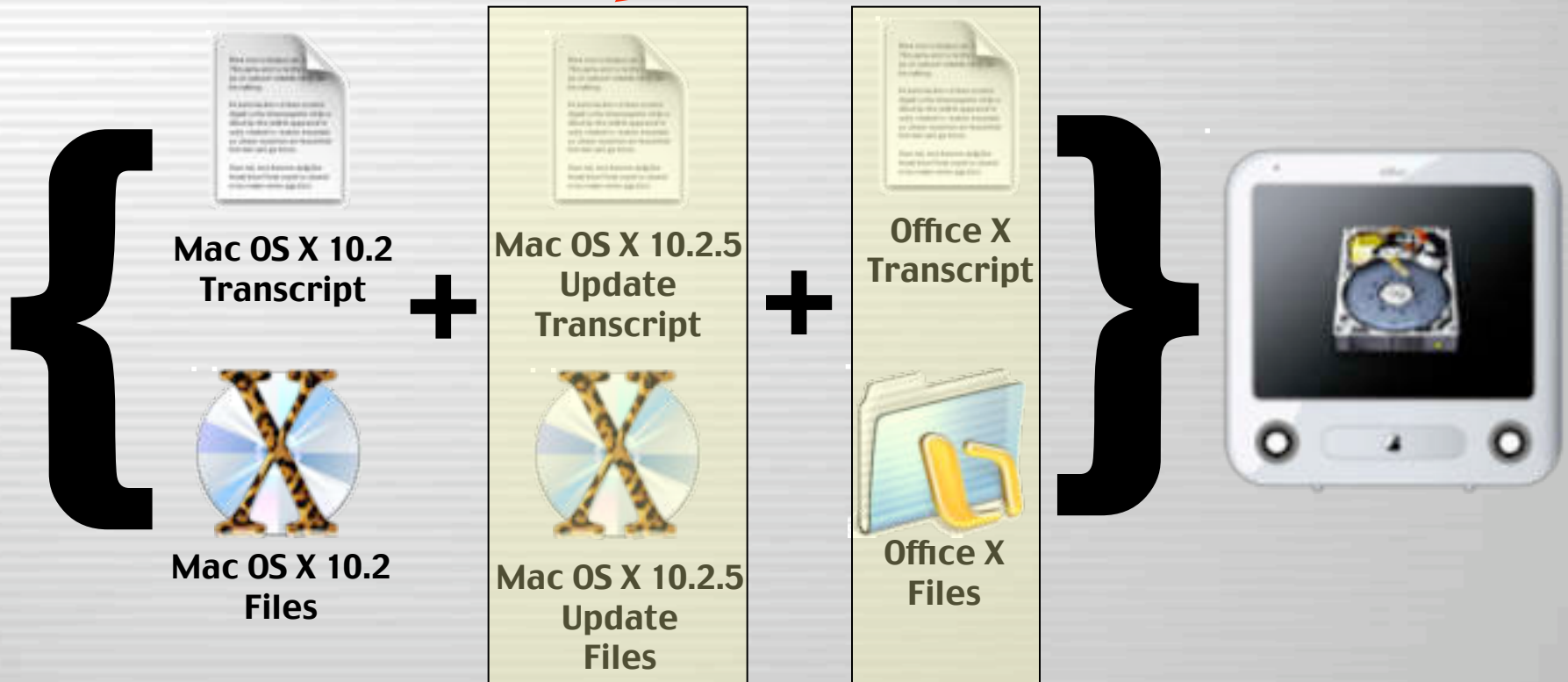


Over Load

- A smaller additional loadset
- Used with the base load for the machine deployed file system.

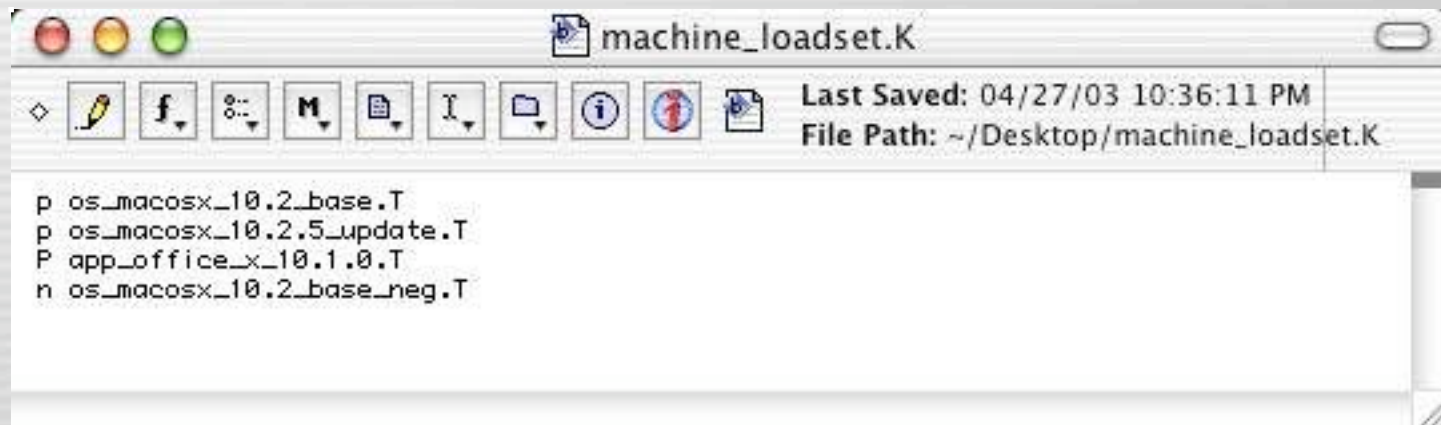
Over Load - Example

Over Loads



Command File

- Defines the machine managed file system
- A list containing the names of the base load and additional overloads.



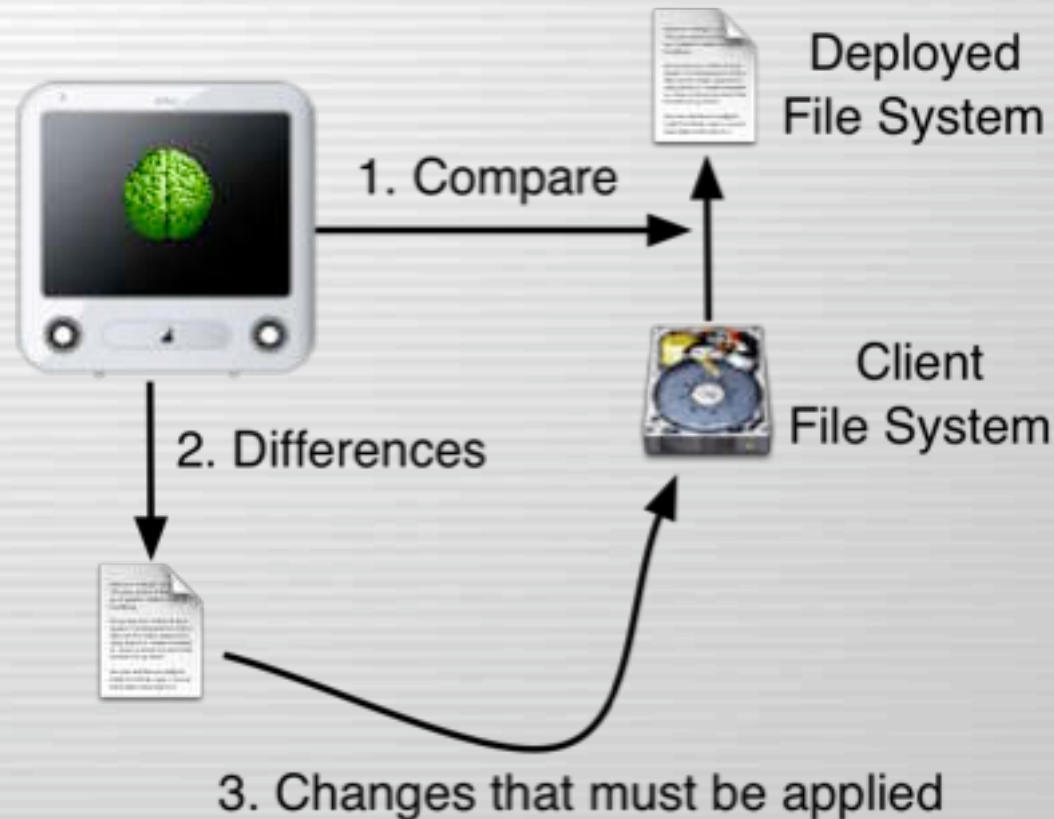
The screenshot shows a text editor window with the title 'machine_loadset.K'. The window contains a list of file names, each on a new line, starting with a letter and followed by a file extension. The text is as follows:

```
p os_macosx_10.2_base.T  
p os_macosx_10.2.5_update.T  
P app_office_x_10.1.0.T  
n os_macosx_10.2_base_neg.T
```

Apply-able Transcript

- Is a transcript containing the differences between the managed & local client file system.
- These are the changes that must be applied to the client for it to match the deployed file system.
- Used to restore client to managed state

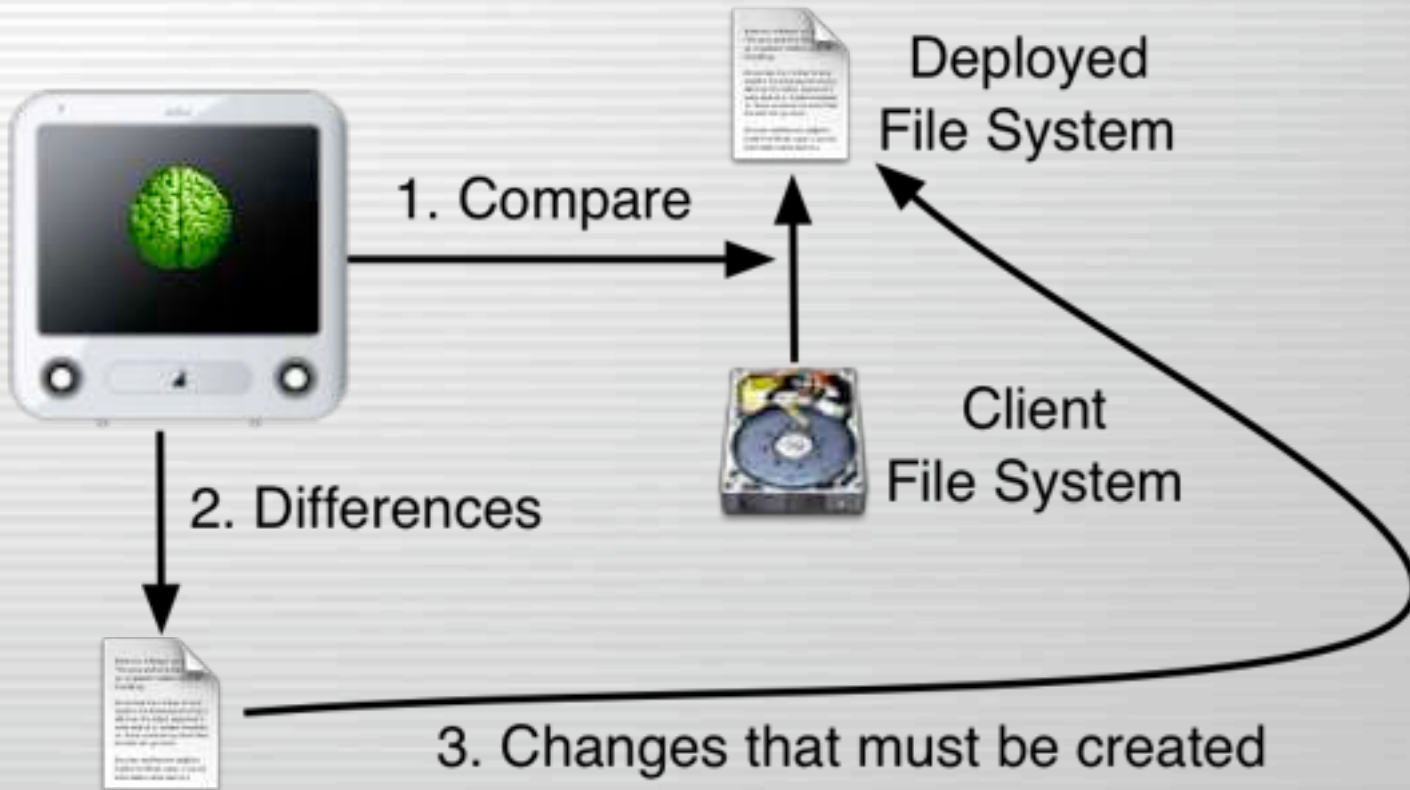
Apply-able Transcript - Example



Create-able Transcript

- Is a transcript containing the additions on the local client not on the managed file system.
- These are the changes that must be created on the deployed file system to match the client.
- Used to create overloads

Create-able Transcript

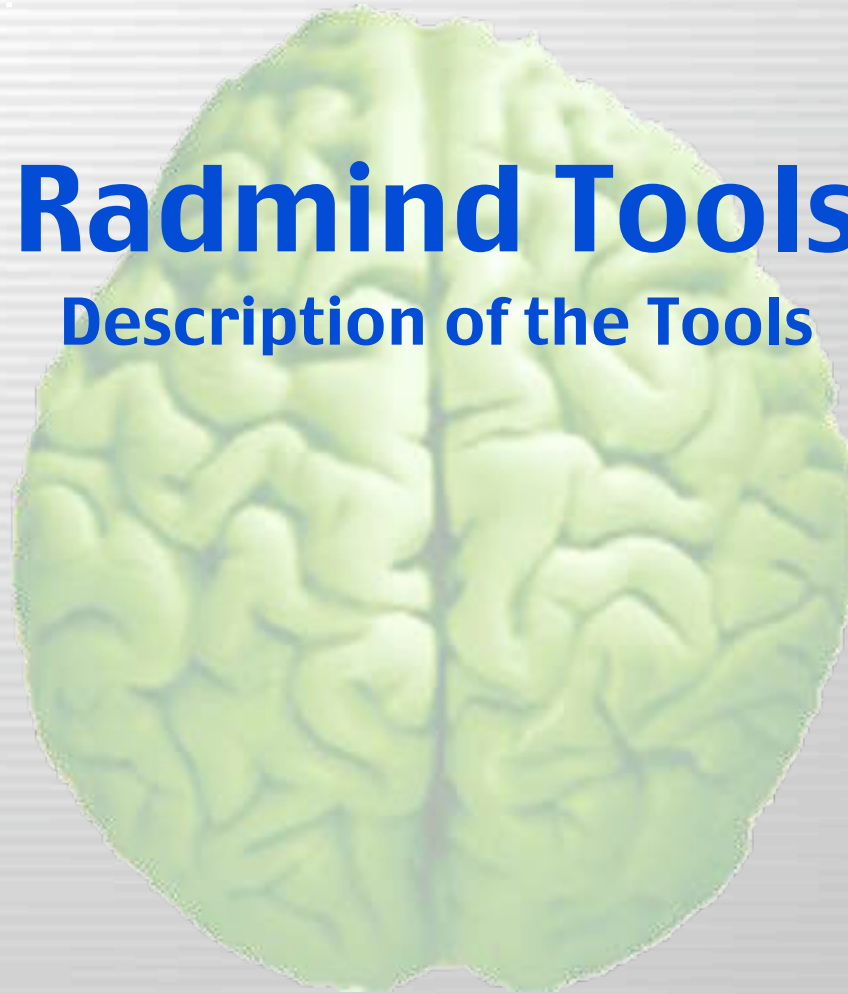




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Radmind Tools

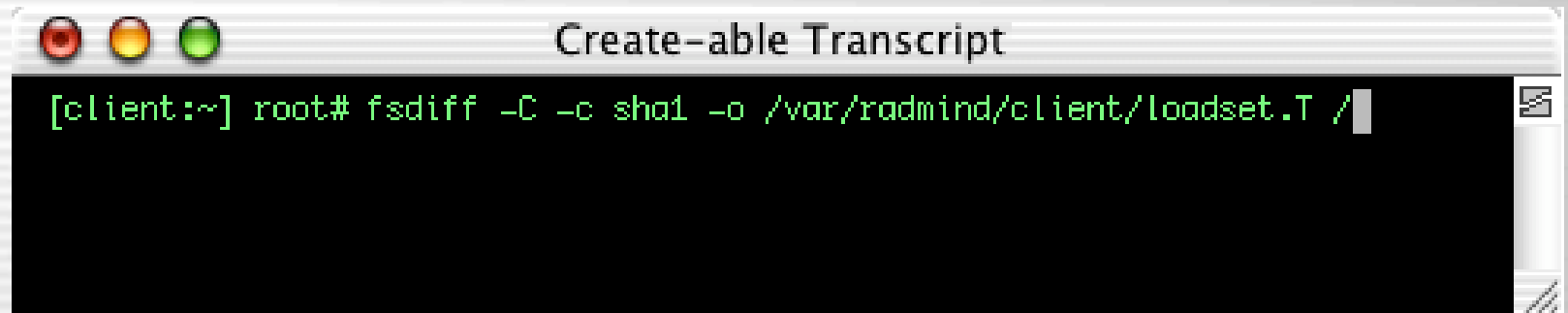
Description of the Tools



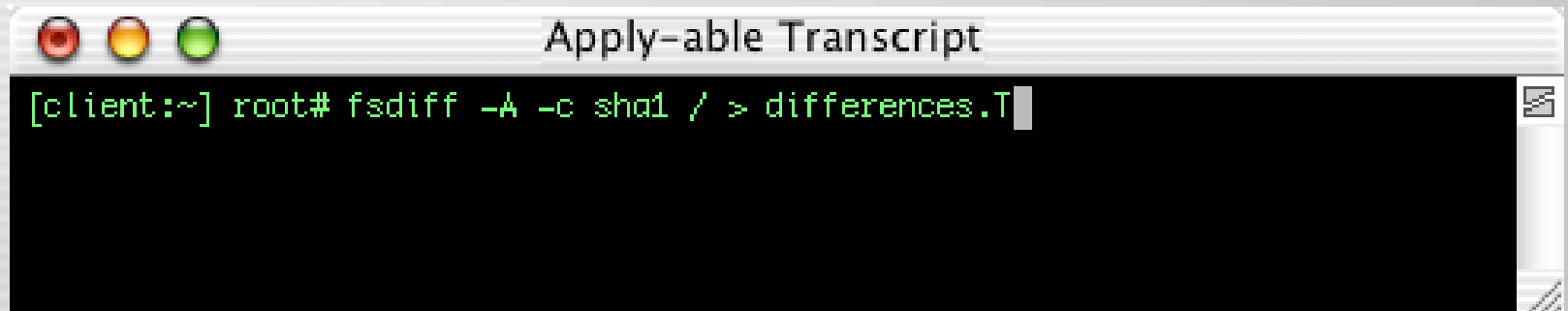
fsdiff

- **File System Differences**
 - The primary radmind tool
 - Compares the file system to a set of transcripts described by a command file
 - Produces the differences in the form of a transcript
 - Never talks on the network
 - Detects file system modifications (Tripwire)

fsdiff – Example



```
[client:~] root# fsdiff -C -c sha1 -o /var/radmind/client/loadset.T /
```



```
[client:~] root# fsdiff -A -c sha1 / > differences.T
```

lcreate

- **Loadset Create**
 - Uploads a transcript and associated files to the server

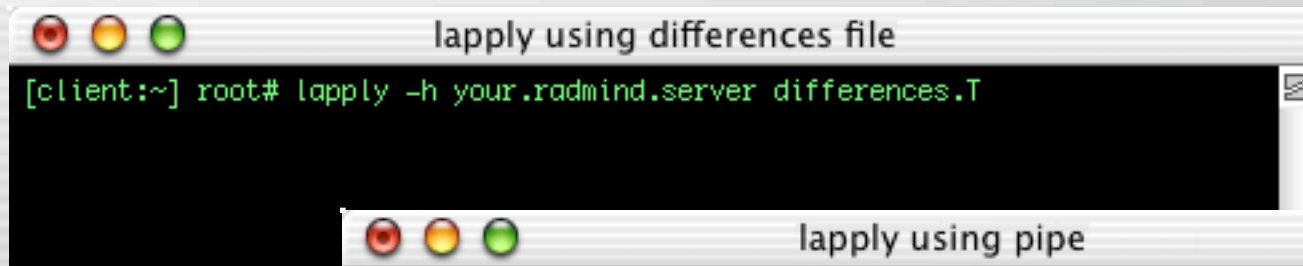
A terminal window titled "Terminal — tcsh (tty1)" with three window control buttons (red, yellow, green) in the top left. The terminal prompt is "[client:~] root#". The command being entered is "lcreate -h your.radmind.server /var/radmind/client/loadset.T".

```
Terminal — tcsh (tty1)
[client:~] root# lcreate -h your.radmind.server /var/radmind/client/loadset.T
```

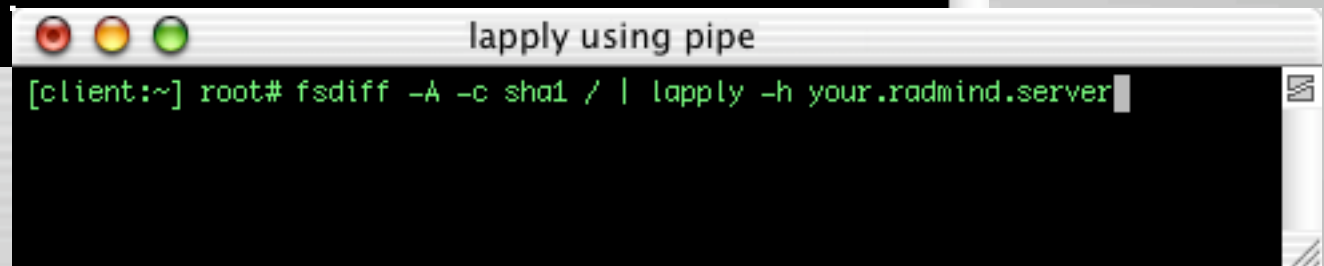
lapply

- **Loadset Apply**

- Changes local file system as described by an apply-able transcript
- Retrieves updated files as required from the server



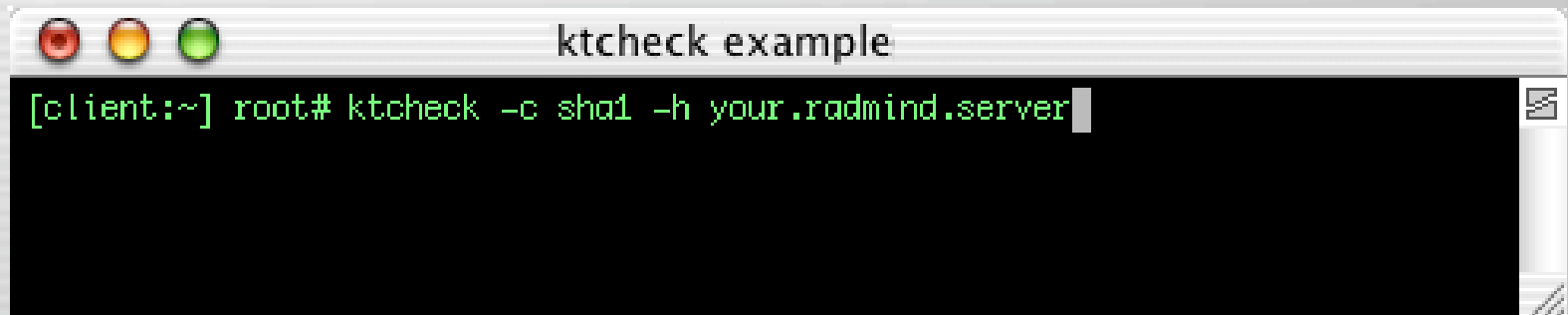
```
lapply using differences file
[client:~] root# lapply -h your.radmind.server differences.T
```



```
lapply using pipe
[client:~] root# fsdiff -A -c sha1 / | lapply -h your.radmind.server
```

ktcheck

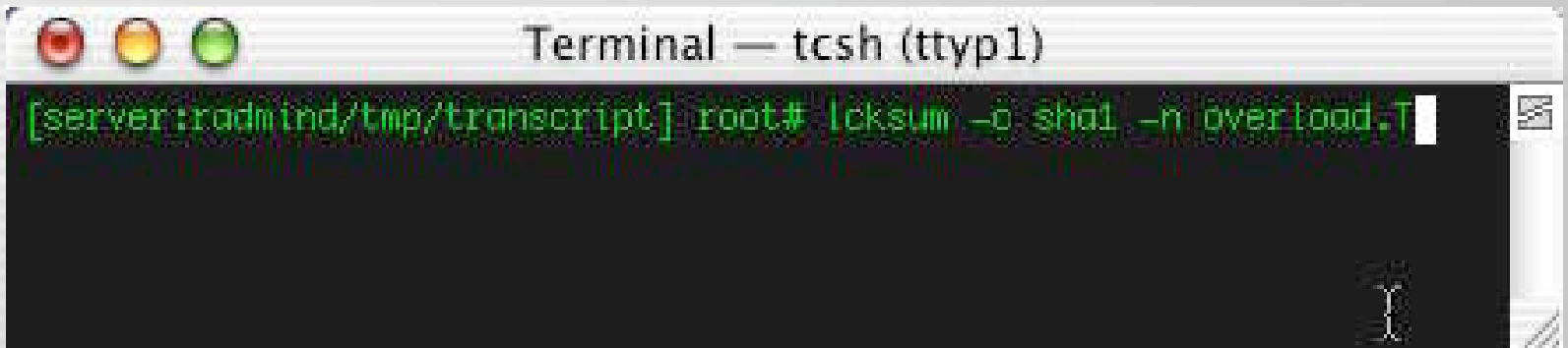
- **Command & Transcript Check**
 - Compares local command file and associated transcripts with those stored on the server
 - Retrieves updated command files and transcripts from the server

A terminal window titled "ktcheck example" with three window control buttons (red, yellow, green) in the top-left corner. The terminal text shows a root user at a client prompt typing the command: `root# ktcheck -c sha1 -h your.radmind.server`.

```
ktcheck example
[client:~] root# ktcheck -c sha1 -h your.radmind.server
```

Icksum

- **Loadset Checksum**
 - Verifies the checksum & size of files associated with a transcript on the server.

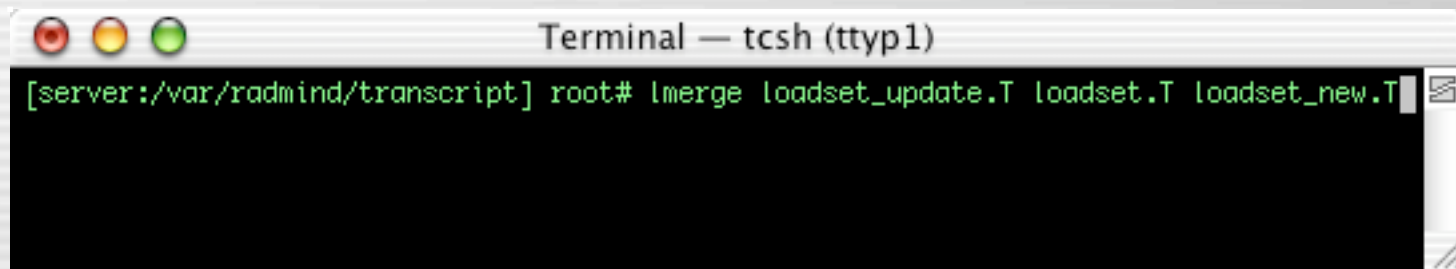


```
Terminal — tcsh (tty1)
[server:radmind/tmp/transcript] root# lcksum -o sha1 -n overload.T
```

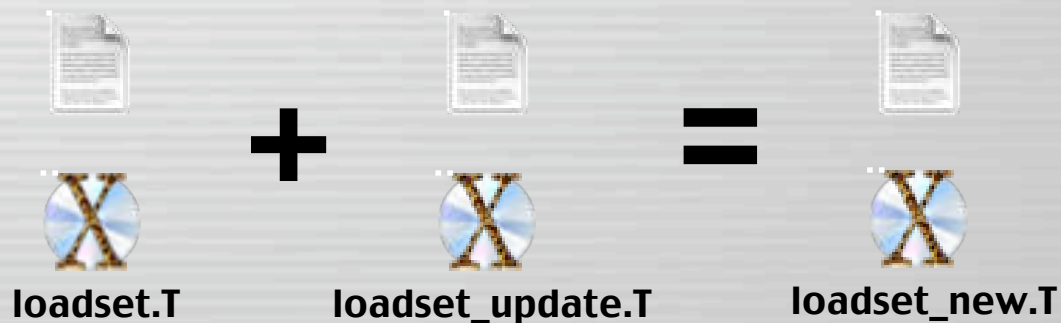

Imerge

- Loadset Merge

- Combines two or more transcripts and corresponding files into one loadset



```
Terminal — tcsh (ttyp1)
[server:/var/radmind/transcript] root# lmerge loadset_update.T loadset.T loadset_new.T
```

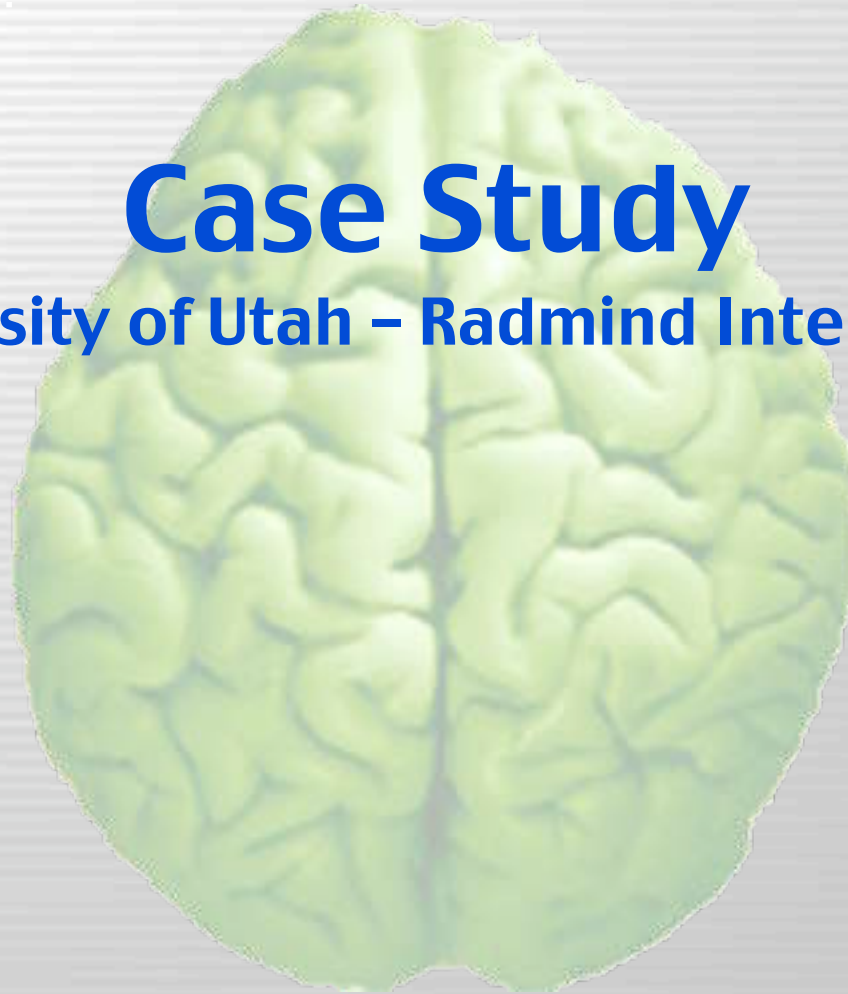




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Case Study

University of Utah – Radmind Integration



History – First Stage

- **First stage (June 2002)**

- **Mac OS X 10.1.5**
 - **Larger Base Load**
 - **Mac OS X**
 - **Admin Mods**
 - **Default Apps**
 - **Fewer overloads**
- **Radmind 0.6**
- **Kiosks**



History – Second Stage

- **Second stage (July 2002)**
 - Added authentication
 - Deployed
 - Teaching lab
 -
 - Student labs
 -
 - Staff machines



History – Third Stage

- **Third stage (Oct 2002)**

- **Mac OS X 10.2.1**
 - **Smaller & more specific base load**
 - **More granular loadsets**
- **Radmind 0.9.1**



Current Stage

- **Current Stage (May '03)**
 - **Mac OS X 10.2.5**
 - **Radmind 0.9.4**
 - **All Mac's except one teaching lab**
 - **Totals**
 - **325 Mac's**



Customizations – Initial Installer

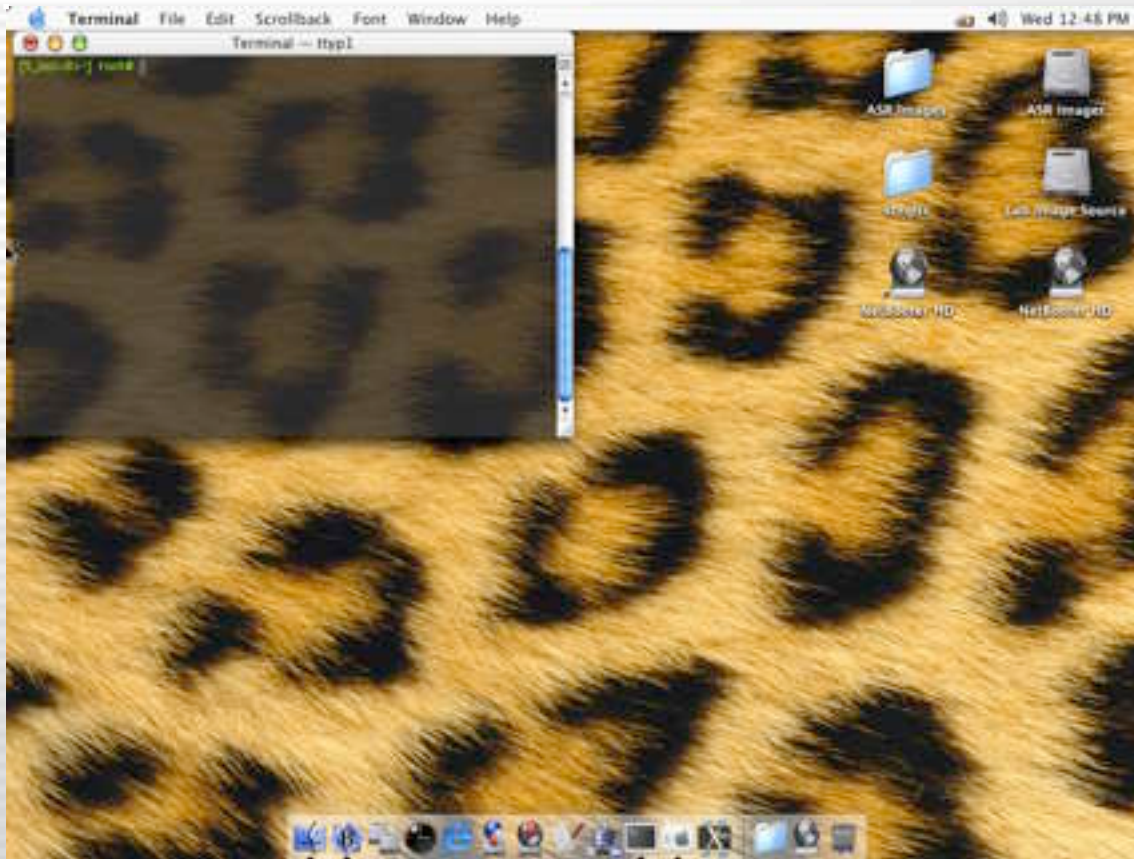
- **Install base OS**
 - Imaging Software
 - Install CD
- **Run Initial Installer and restart**
 - Requires no other installs
- **Then radmind updates client**
 - Will continue running even if restarted
 - Runs without risk of being used or compromised



Customizations – Initial Installer

- Don't use it anymore
 - Too slow
 - Future version of radmind will support pipeling
- **Apple Software Restore**
 - Automatically update radmind & create ASR image and upload to server.
 - Use NetRestore with Network Install server or using FireWire drive or FireWire/ATA bridge.
 - Use multi-port card to support 6 subnets.

Customizations – Radmind/ASR



1. Schedule with cron
2. chroot
3. Update volume with radmind
4. Create ASR Image
5. Mount Server
6. Upload Image

Customizations – “Please Wait”

- Big and obvious (to most users ;-)
- Covers login panel when running at startup
 - Prevents users from logging in and using apps
 - Prevents users from force quitting
- Uses iHook to display graphic & other GUI



Customizations – Visual Status

- Why?
 - Gives status to lab staff & users
 - Useful when there is an important update or problem
-
- System Menu
 - Menuversum
-
- Login Panel



Customizations – System Menu

Green Icon – No Problems



Red Icon – Problems



Customizations – Login Panel

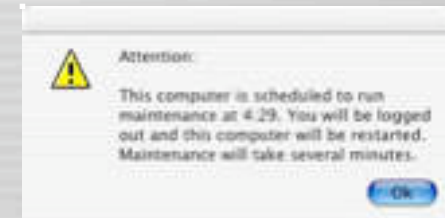
Green Icon – No Problems

Red Icon – Problems



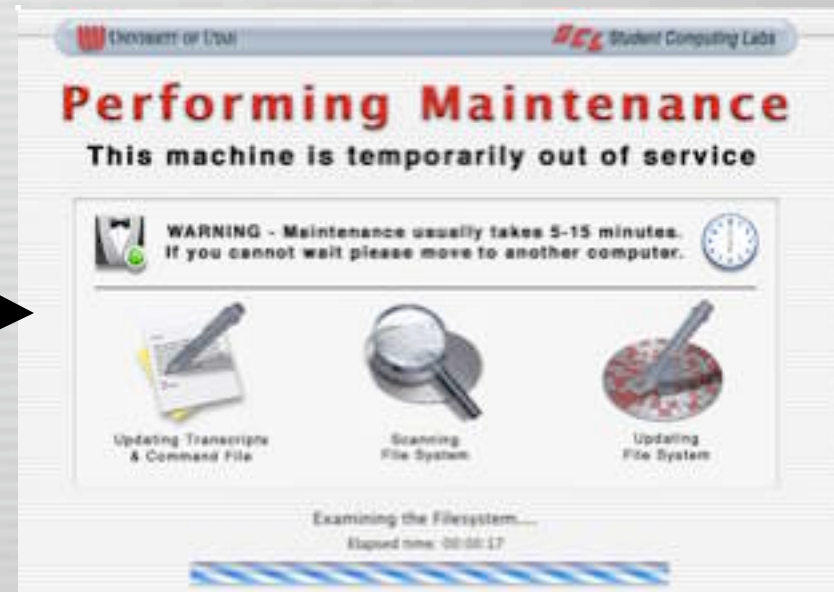
When we run radmind?

- When a specific user logs in
- Scheduled with cron,
 - every 3rd day, 1 am - 6 am
 - Load balanced
 - Regularly distribute updates & restores machines
- Manually
 - Logs out & runs radmind
- Single User mode
 - If it won't boot to GUI
- Remotely



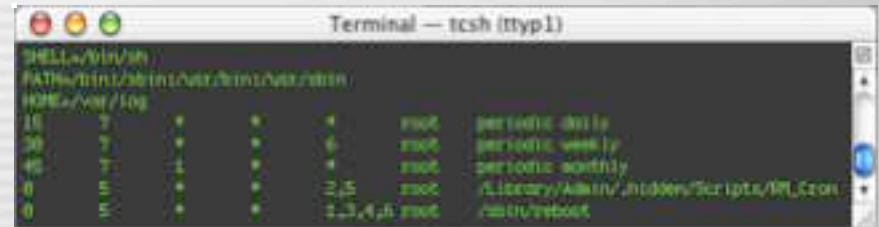
Running Radmind – Login

- Create a radmind user
- LoginHook checks for specific user
 - Runs radmind if that user logs in

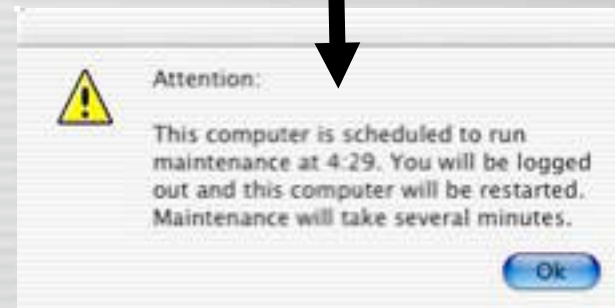


Running Radmind – Scheduled

- Cron executes script
- If user logged in
 - Open AppleScript warning user
- Restart
- Run radmind at startup

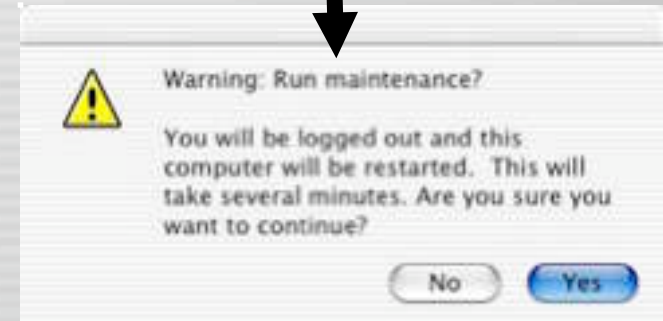


```
Terminal — tcsh (tty1)
SHELL=/bin/csh
PATH=/bin:/sbin:/usr/bin:/usr/sbin
HOME=/var/log
10 * * * * root periodic daily
30 * * * * root periodic weekly
45 * * * * root periodic monthly
0 5 * * * root /Library/Admin/hidden/Scripts/MJ_Cron
0 * * * * root /sbin/reboot
```



Running Radmind – Manually

- Can be launched from icon
- Displays dialog warning user
- Logs out
- Runs radmind



Running Radmind – Single User

- Tell radmind to run ***after*** network loads
 - Useful if machine doesn't fully boot

```
StorageBlaBla/Maxtor 90648D2Media/IOApplePartitionScheme/MacOS@5
BSD root: disk0s5, major 14, minor 5
devfs on /dev
Nov 11 16:17:3 mach_init[2]: Started with uid=0
Singleuser boot -- fsck not done
Root device is mounted read-only
If you want to make modifications to files,
run '/sbin/fsck -y' first and then '/sbin/mount -uw/'
```

```
Welcome!
```

```
sh-2.04a# runRadmind
```

```
This mac will reboot and run radmind. Are you sure? Yes
```

```
Saving status...
```

```
Rebooting...
```



Catch Force Restart

- Will continue running at startup until completed.
 - Prevent user from bypassing radmind execution
 - Power failures during execution, etc.



Running Radmind – Remotely

- **SSH**
- **Timbuktu Pro**
 - Only on administrative test boxes
- **Apple Remote Desktop**
 - Plan on deploying ARD to all clients
- **Web Server**
 - Could develop cron job that cURLS a web page
 - Allows lab faculty/staff remotely run radmind
 - Doesn't require SSH to be enabled on clients.



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Issues

Problems & Concerns with Radmind



Slow Upload & Downloading

- **Radmind doesn't support pipeling**
 - Every transfer involves at least one round trip
- **Mac OS X is an OS with many small files**
 - Average file size 25 KB - 43 KB
 - This combination makes it worse
- **Workaround**
 - Use ASR for initial or re-imaging
- **Future**
 - Will be fixed in a post-1.0 release of radmind
 - With pipelining enabled, the client won't wait for the server to respond to it's requests.

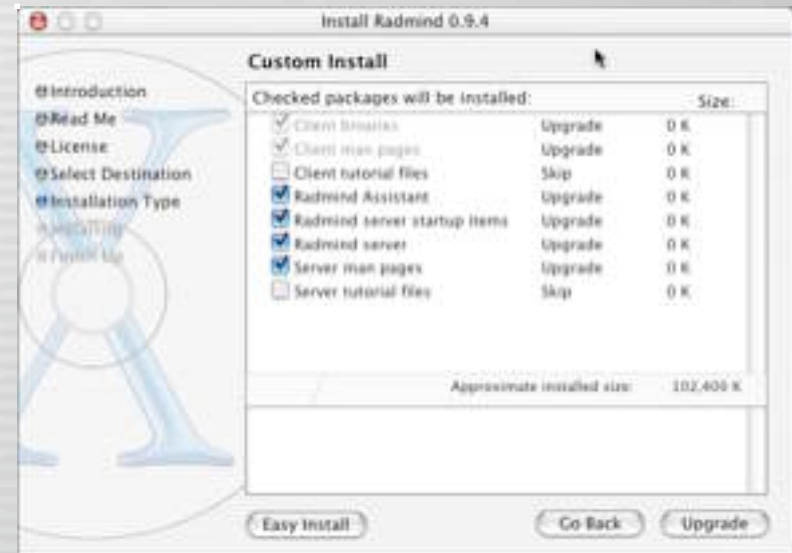
2 GB File Limit with Checksum

- Large Classic image (i.e. ShadowClassic)
- Large multimedia files
- Workaround
 - Remove checksum option when scanning file system
 - Example, don't use “-c sha1” option
- Future
 - Will be fixed in a post-1.0 release of radmind



Installer Overwrite Files

- When upgrading using the installer
- It is possible production files will get overwritten
- Workaround
 - Backup config file
 - Select custom
 - deselect tutorial files
- Future
 - Will be fixed in a future release of radmind
 - Move tutorial into GUI packages



Default Environment Paths

- Radmind installs executables in `/usr/local/bin`
- Under Mac OS X 10.2.x, this is not one of the default environment paths.
- Workaround
 - Enter at the beginning of each radmind session
`setenv PATH "${PATH}:/usr/local/bin"`
 - Or modify script `/ect/csh.login`
`# System-wide .login file for csh(1).`
`setenv PATH "/bin:/sbin:/usr/bin:/usr/sbin:/usr/local/bin"`

Default Man Paths

- Radmind installs man pages in `/usr/local/share/man`
- Under Mac OS X 10.2.x, this is not one of the default man paths.
- Workaround
 - `setenv MANPATH /usr/share/man:/usr/local/share/man`
 - Or edit script `/etc/manpath.config`

Prebinding vs Tripwire

- Under 10.2, the system automatically updates prebinding information any time an application is launched that lacks complete prebinding information.
- OS update binaries automatically and in background
- This situation makes it impossible to setup up a secure & accurate tripwire

Questions and Answers

