

Distributive Computing with Xgrid

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O'REILLY®

Mac OS® X
Conference

Session Overview

- What are people doing with Xgrid right now
- How does Xgrid work
- How do you create jobs
- How do you start jobs
- Xgrid Security
- Installing - Removing - Setting up Xgrid
- We'll run a job
- Tips and Tricks



What Are People Doing With Xgrid?



What Are Others Doing?

- Richard Crandall - Reed College
 - Performing bioterror calculations
 - Complex attack/epidemic/vaccination scenarios
 - 60 machines, 100 GHz
- North Carolina State (PacMUG)
 - Trying to reach 1 Teraflop
 - aka Wolfgrid



What Are Others Doing?

- Noah Adams @ Simon Fraser University
 - Fermant Number Factoring
- Sterling Anderson @ Wisconsin
 - Bioinformatics using hmmpfam
- Alex Majora
 - Protein folding
- Andrew Kator
 - Blender 3D



What Are Others Doing?

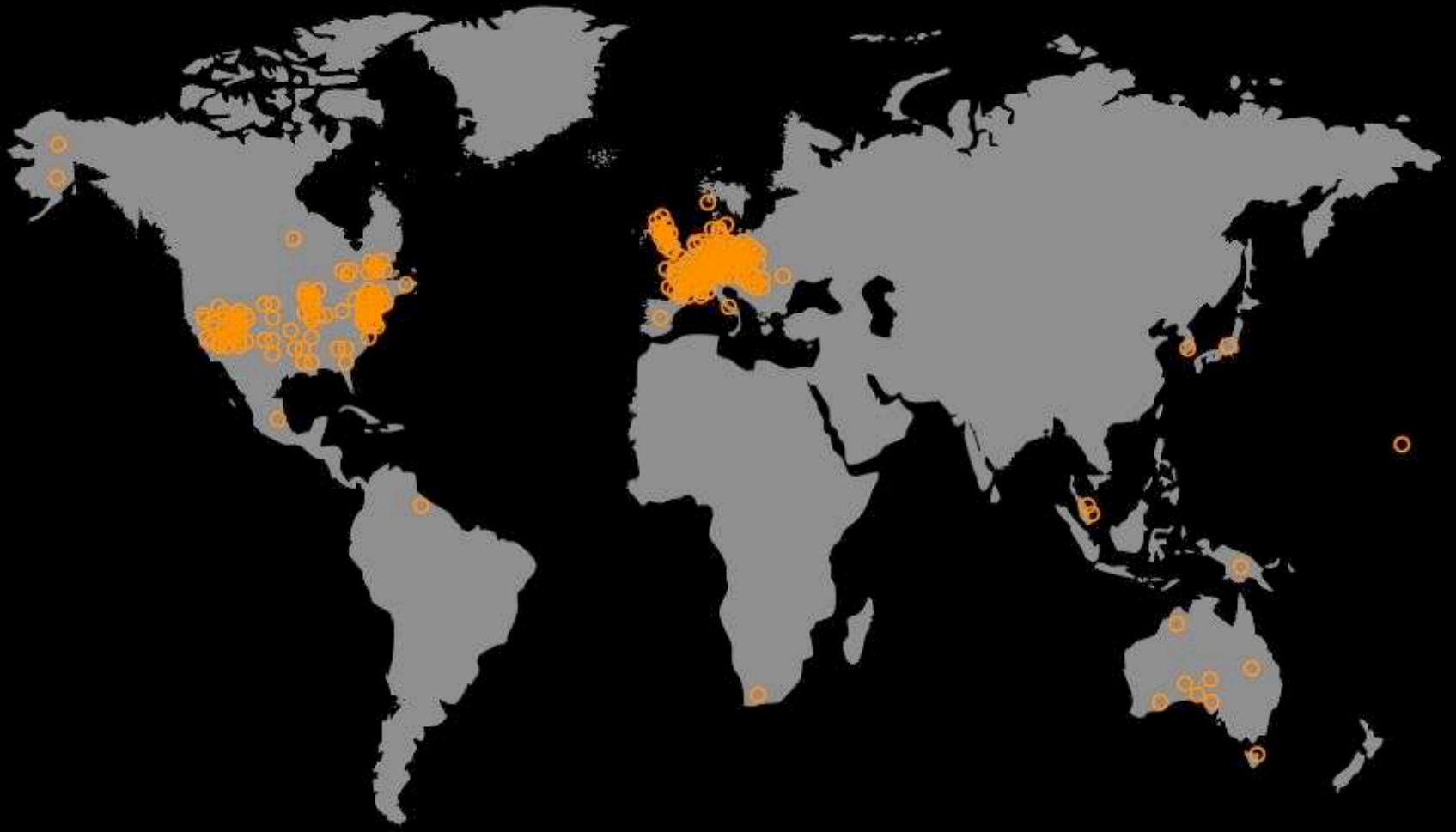
- Charles Parnot - Stanford
 - Studying heart disease/heart rate control
 - Evaluating hypothetical molecular models and comparing the results with the real data from a specific chemical reaction
 - Opened their grid to all
 - 100-200 agents in US
 - 200-300 agents in Europe
 - Usually a total of 200-400 at one time
 - Max of 300+ GHz



Join the cluster!

email: charles.parnot@stanford.edu

web: <http://cmgm.stanford.edu/~cparnot/xgrid-stanford>



University of Utah



University of Utah

- POV-Ray ray tracing
- One frame rendered per computer
- Animation: 2 mins x 25 fps = 8400 frames
- About 130 G5 2.0 GHz lab computers
- About 270 G4's (400 MHz - 1.42 GHz)
- Working with Fine Arts on a system for students to render Maya animations
- Will also work on math & science projects



msscma-3	umac-1	msscma-1	mmlb-6	emac-2	mac1715	mmac-17	mmac-13	mmlb-29	mmac-36
mmlb-25	mmac-5	mmac-32	mmac-59			mac-8	smac-20	mmac-55	mmac-51
mmac-78	emac-13	smac-3	mmac-74			mac-93	pmac-13	mmla-9	mmla-1
umac-2	mmlb-7	ssmac-1	emac-3			mac-15	mmlb-18	smac-17	mmac-25
mmla-11	mmlb-14	smac-13	mmac-21			mac-10	mmac-44	pmac-9	pmac-1
mmac-40	smac-4	mmac-63	umac-17	mmac-86	umac-13	mmac-82	mmla-2	umac-3	uiemac-4
mmlb-8	emac-4	uiemac-2	mmac-18	mmac-14	mmac-10	mmac-37	mmlb-26	smac-25	mmac-7

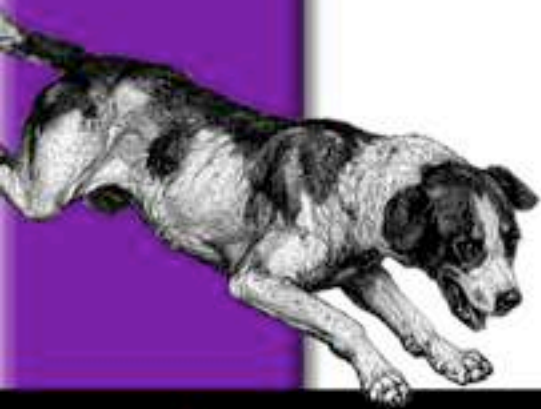


Watch movie



About the LEGO's...

- Movie created by Anton Raves
 - www.antonraves.com
 - His library of parts are available for download
- Related LEGO 3D library called LDraw
 - www.ldraw.org
 - There was an LDraw BOF yesterday
 - Notes can be obtained at www.ldraw.org



How Does Xgrid Work?





Client



Controller

Distributed agents



Dedicated agent

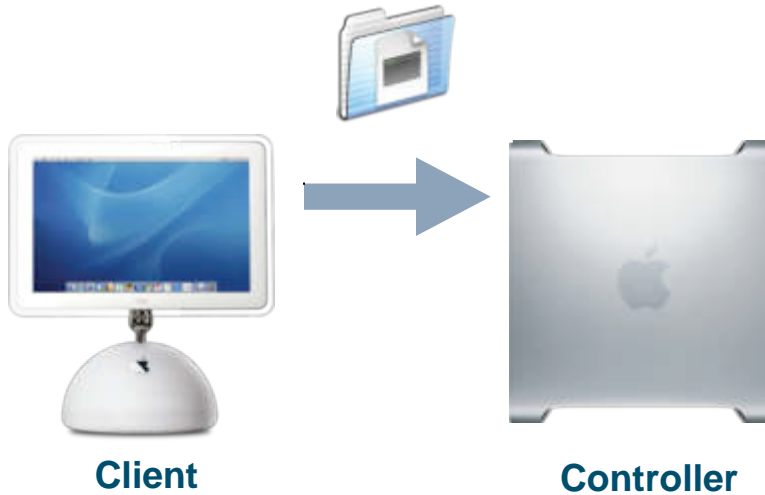


Dedicated agents



Screensaver agent

1 Client submits job to controller



Distributed agents



Dedicated agent



Dedicated agents

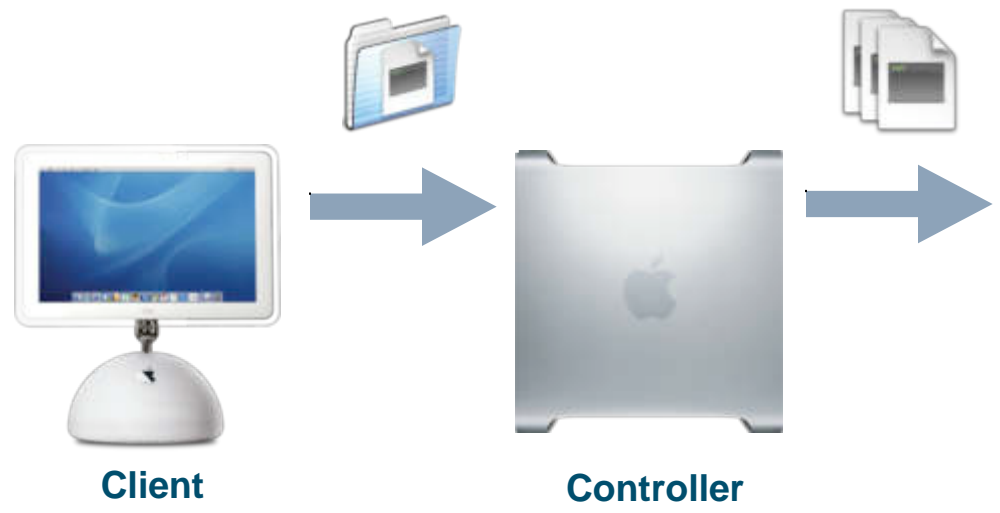


Screensaver agent

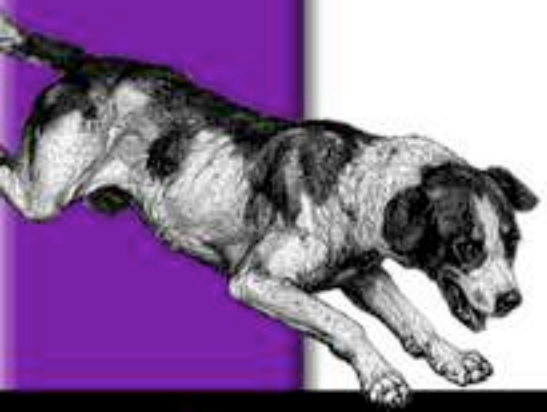
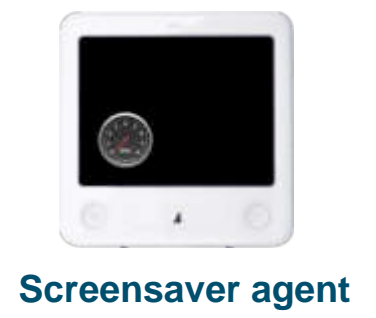
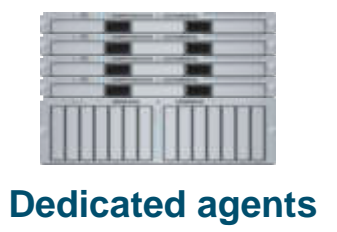


1 Client submits job to controller

2 Controller splits job and submits to Agents



Distributed agents



1 Client submits job to controller



Client



2 Controller splits job and submits to Agents



Controller



3 Agents execute tasks



Dedicated agent



Dedicated agents



Screensaver agent

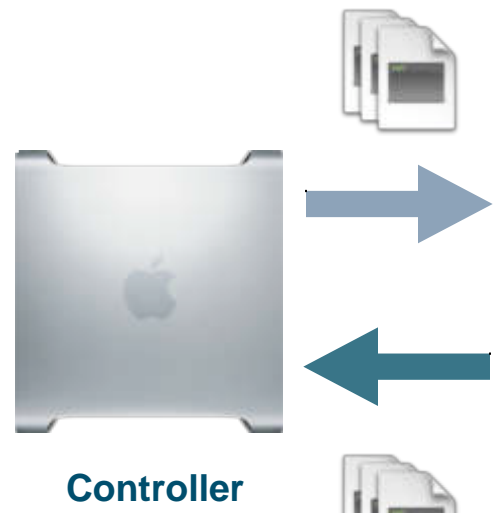
Distributed agents



1 Client submits job to controller



2 Controller splits job and submits to Agents



Distributed agents

3 Agents execute tasks



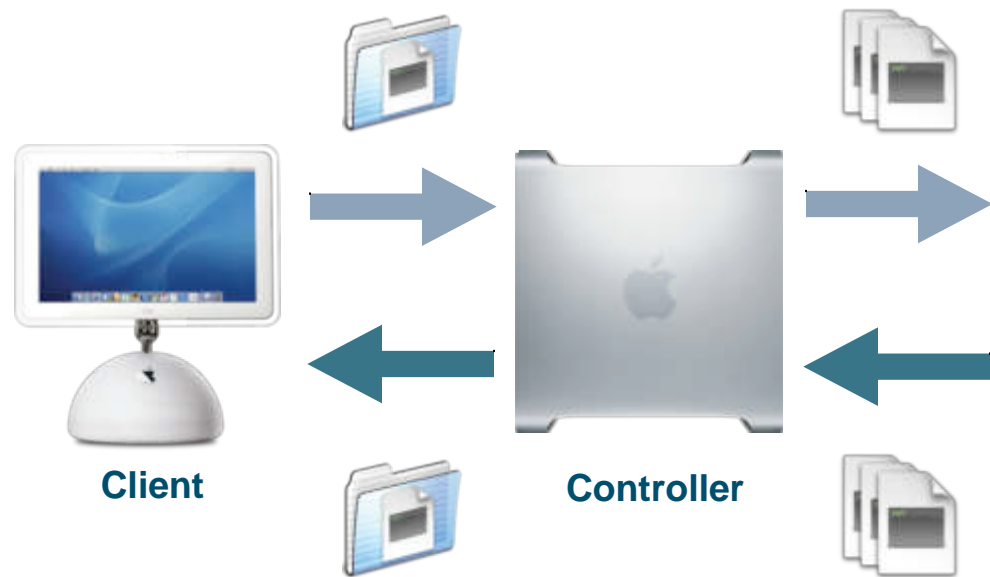
4 Agents return results to Controller



1 Client submits job to controller

2 Controller splits job and submits to Agents

3 Agents execute tasks



5 Controller collects task results, then returns job to Client

4 Agents return results to Controller

Distributed agents

- Dedicated agent
- Dedicated agents
- Screensaver agent



How Do You Create Jobs



Creating Jobs

- Agent is main focus
- This has nothing to do with Xgrid
- A “job” is just an application
 - Application must run unattended
 - Application tasks must be dividable
 - Tasks must be parallel



Dedicated agent



Application must run unattended

- Command line apps are *perfect & easy*
 - Don't require user input
 - No account required (runs as user "nobody")
 - Can be logged out
- GUI apps are harder
 - AppleScript UI scripting may be required
 - Account required
 - Must be logged in



Dividing Application Tasks

- Partial execution

- `povray -SF1 -EF2 file_to_render.ini`

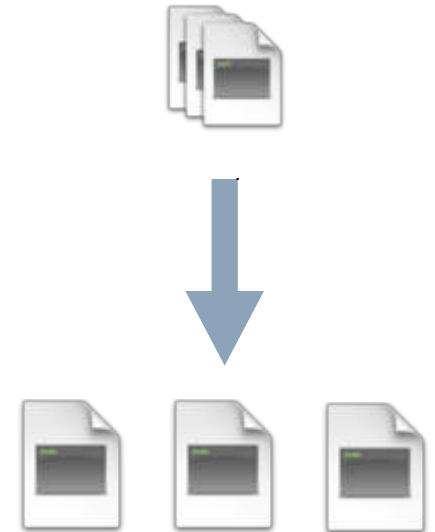
- `povray -SF3 -EF4 file_to_render.ini`

- Multiple files

- `povray file_to_render1.ini`

- `povray file_to_render2.ini`

- MPI applications



Gridding Apps

- Not easy
 - Photoshop
 - Final Cut Pro
 - Video compression
 - ffmpeg
 - Sorenson Squeeze looking into Xgrid
- Yes
 - Probably 99% of scientific/math apps
 - Many rendering/animation apps
 - POV-Ray/Blender
 - Maya 6 (create “/Alias/maya” writable by “nobody”)



How Do You Start Jobs?



How Do You Start Jobs?

- Client is your main focus
- Interfaces into the grid
 - Xgrid.app & Plugin architecture
 - Command line
 - Cocoa
 - Xgrid.app plugin API
 - Xgrid API



Client



Xgrid.app & Plugins

Create Custom Plug-in - Untitled

Status: Ready

Select the combination of command line arguments that describes the command you wish to make a new plug-in for. See the help documents for examples of use. [Show help](#)

Make User Editable

New Plug-in Name:

Command: [Choose...](#)

Argument 1:

Argument 2: File:

Argument 3:

Argument 4: From: to: by:

Working Dir: [Choose...](#)

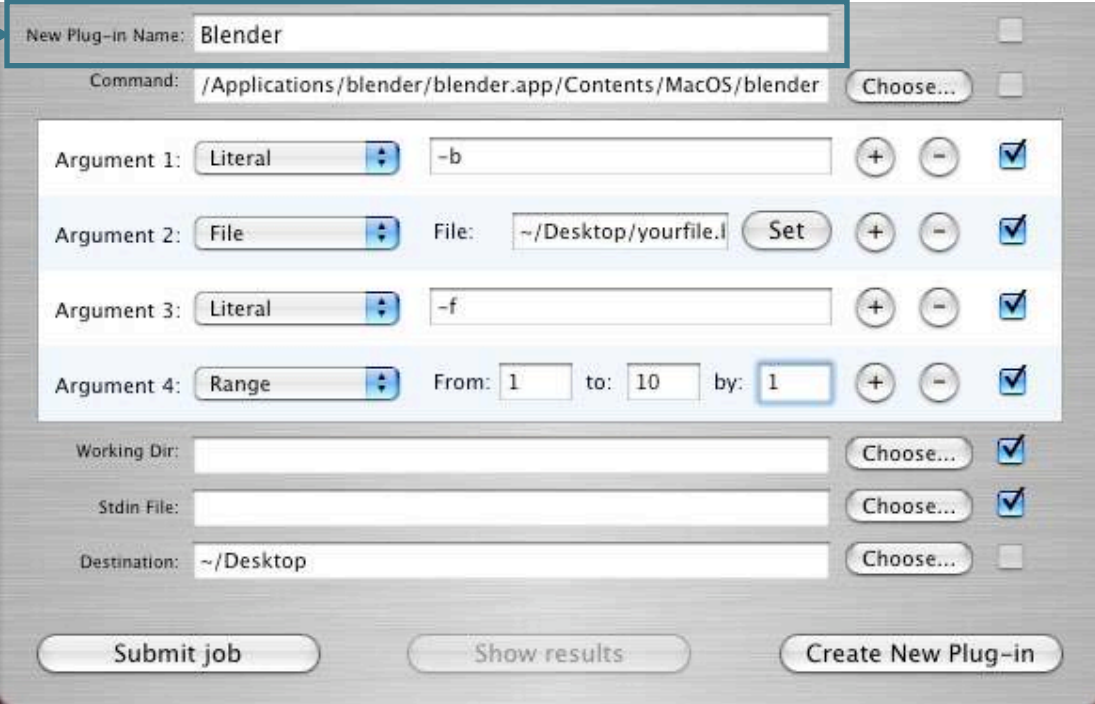

Stdin File: [Choose...](#)

Destination: [Choose...](#)



Xgrid.app & Plugins

Name of plugin



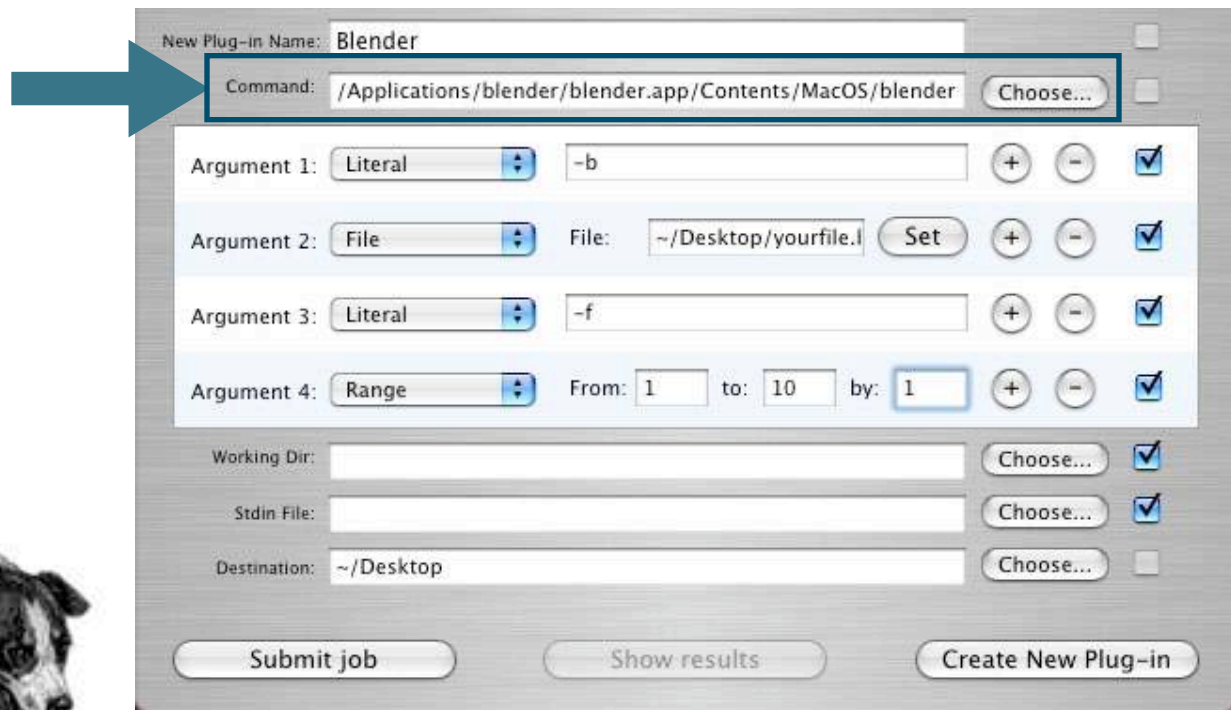
The screenshot shows the Xgrid.app configuration window for a new plugin. The 'New Plug-in Name' field is highlighted with a blue box and a blue arrow pointing to it from the left. The field contains the text 'Blender'. Below this, the 'Command' field is set to '/Applications/blender/blender.app/Contents/MacOS/blender'. There are four argument rows, each with a type selector, a value field, and a checkbox. The arguments are: Argument 1: Literal, -b; Argument 2: File, ~/Desktop/yourfile.l; Argument 3: Literal, -f; Argument 4: Range, From: 1, to: 10, by: 1. At the bottom, there are fields for 'Working Dir', 'Stdin File', and 'Destination' (set to ~/Desktop). The 'Submit job', 'Show results', and 'Create New Plug-in' buttons are at the bottom.

Argument	Type	Value	Checkbox
Argument 1	Literal	-b	<input checked="" type="checkbox"/>
Argument 2	File	~/Desktop/yourfile.l	<input checked="" type="checkbox"/>
Argument 3	Literal	-f	<input checked="" type="checkbox"/>
Argument 4	Range	From: 1 to: 10 by: 1	<input checked="" type="checkbox"/>



Xgrid.app & Plugins

Location of app



New Plug-in Name: Blender

Command: /Applications/blender/blender.app/Contents/MacOS/blender Choose...

Argument 1: Literal -b + - ✓

Argument 2: File File: ~/Desktop/yourfile.l Set + - ✓

Argument 3: Literal -f + - ✓

Argument 4: Range From: 1 to: 10 by: 1 + - ✓

Working Dir: Choose... ✓

Stdin File: Choose... ✓

Destination: ~/Desktop Choose...

Submit job Show results Create New Plug-in



Xgrid.app & Plugins

Command line arguments



New Plug-in Name:

Command:

Argument 1:

Argument 2: File:

Argument 3:

Argument 4: From: to: by:

Working Dir:

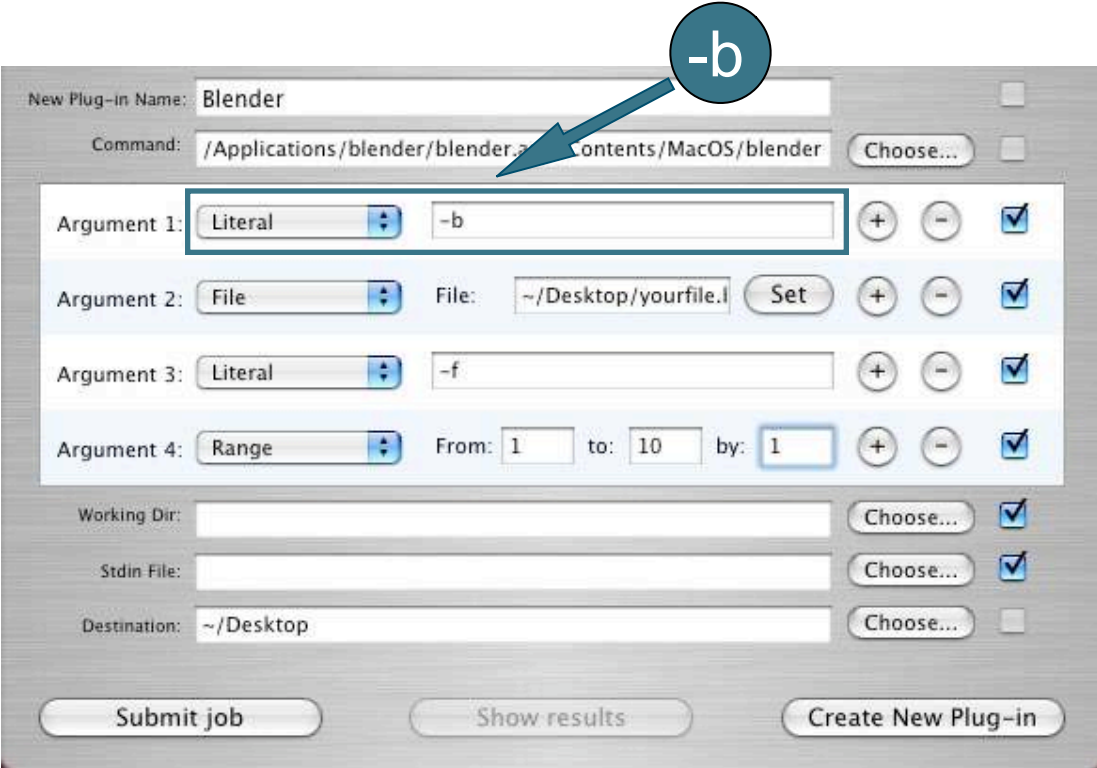
Stdin File:

Destination:



Xgrid.app & Plugins

Run in background
without GUI



New Plug-in Name: Blender

Command: /Applications/blender/blender.app Contents/MacOS/blender

Argument 1: Literal -b

Argument 2: File File: ~/Desktop/yourfile.l

Argument 3: Literal -f

Argument 4: Range From: 1 to: 10 by: 1

Working Dir: Choose...

Stdin File: Choose...

Destination: ~/Desktop

Submit job Show results Create New Plug-in



Xgrid.app & Plugins

Path to file to process

New Plug-in Name: Blender

Command: /Applications/blender/blender.app/Contents/MacOS/blender

Argument 1: Literal -b

Argument 2: File File: ~/Desktop/yourfile.l

Argument 3: Literal -f

Argument 4: Range From: 1 to: 10 by: 1

Working Dir: Choose...

Stdin File: Choose...

Destination: ~/Desktop

Submit job Show results Create New Plug-in



Xgrid.app & Plugins

Save output to file

New Plug-in Name: Blender

Command: /Applications/blender/blender.app/Contents/MacOS/blender

Argument 1: Literal -b

Argument 2: File File: ~/Desktop/yourfile.l

Argument 3: Literal -f

Argument 4: Range From: 1 to: 10 by: 1

Working Dir: Choose...

Stdin File: Choose...

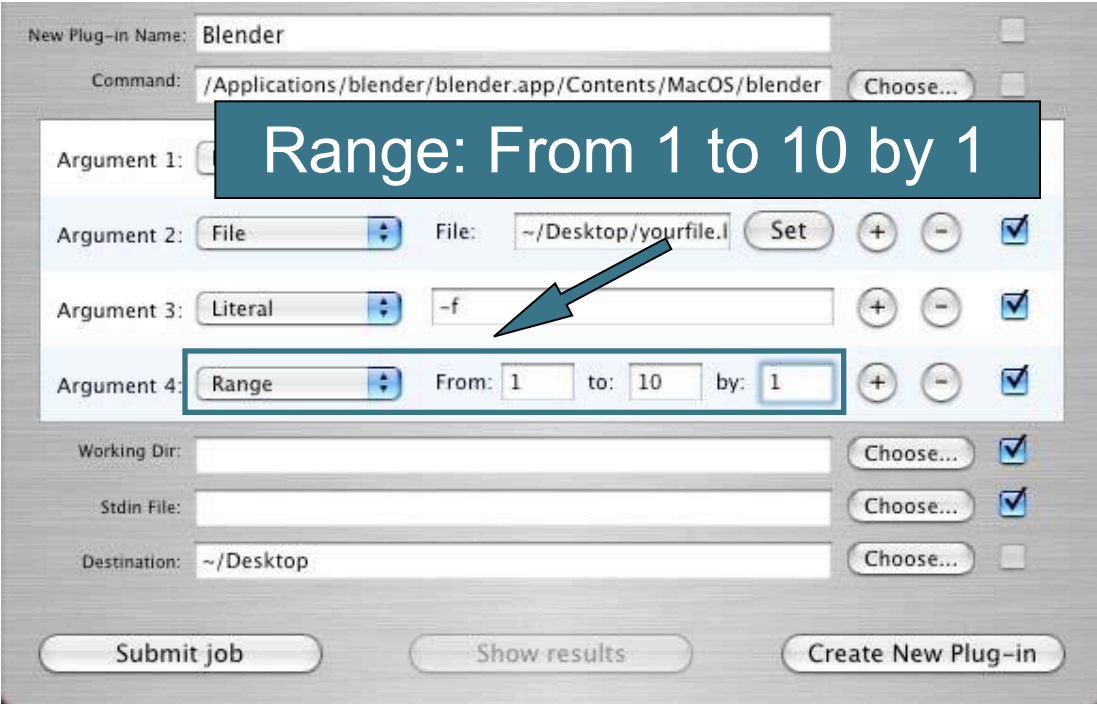
Destination: ~/Desktop

Submit job Show results Create New Plug-in



Xgrid.app & Plugins

1, 2, 3, 4, 5, 6, 7, 8, 9, 10



New Plug-in Name: Blender

Command: /Applications/blender/blender.app/Contents/MacOS/blender

Argument 1:

Argument 2: File File: ~/Desktop/yourfile.l

Argument 3: Literal -f

Argument 4: Range From: 1 to: 10 by: 1

Working Dir: Choose...

Stdin File: Choose...

Destination: ~/Desktop

Submit job Show results Create New Plug-in



Xgrid.app & Plugins

Folder to send to agents
Xgrid Agent will cd to this dir

New Plug-in Name: Blender

Command: /Applications/blender/blender.app/Contents/MacOS/blender

Argument 1: Literal -b

Argument 2: File File: ~/Desktop/yourfile.l

Argument 3: Literal -f

Argument 4: Range From: 1 to: 10 by: 1

Working Dir: Choose...

Stdin File: Choose...

Destination: ~/Desktop

Submit job Show results Create New Plug-in



Xgrid.app & Plugins

STDIN (if required)

New Plug-in Name:

Command:

Argument 1:

Argument 2:

Argument 3:

Argument 4:

Working Dir:

Stdin File:

Destination:



Xgrid.app & Plugins

Where to save output

New Plug-in Name: Blender

Command: /Applications/blender/blender.app/Contents/MacOS/blender

Argument 1: Literal -b

Argument 2: File File: ~/Desktop/yourfile.l

Argument 3: Literal -f

Argument 4: Range From: 1

Working Dir: Choose...

Stdin File: Choose...

Destination: ~/Desktop

Submit job Show results Create New Plug-in



Command Line

```
setenv XGRID_CONTROLLER_HOSTNAME 10.0.0.1  
setenv XGRID_CONTROLLER_PASSWORD L3TmeIN.
```

```
xgrid -job run -out ~/Desktop -in ~/Desktop/  
workingdir /Applications/blender/blender.app/  
Contents/MacOS/blender -b ./yourfile -f 1
```

```
xgrid -job run -out ~/Desktop -in ~/Desktop/  
workingdir /Applications/blender/blender.app/  
Contents/MacOS/blender -b ./yourfile -f 2
```

etc... to 10



Command Line

NAME

xgrid - submit and monitor xgrid jobs, nodes, and datasets

SYNOPSIS

xgrid [-h[ostname] hostname] [-p[assword] password]

xgrid -job run [-si stdin] [-in indir] [-so stdout] [-se stderr]

[-out outdir] cmd [arg1 [...]]

xgrid -job submit [-si stdin] [-in indir] cmd [arg1 [...]]

xgrid -job results -id identifier [-so stdout] [-se stderr] [-out outdir]

xgrid -job {stop | delete | parameters} -id identifier

xgrid -job {list | info | status} -id identifier

xgrid -node {list | info | status} -id identifier



Cocoa - Xgrid.app plugin API

- Requires Xgrid.app
- Only 1 non-Apple person (?) has tried it
- CocoaDev Wiki article by Charles Parnot
 - www.cocoadev.com/index.pl?XGridDummyPlugin



Cocoa - Xgrid API

- Was shown at WWDC 2004
 - STILL NDA!!!!
 - :(
 - Slides are available to those who attended
 - Subject to change
- Any app talks directly to Xgrid controller
 - Authenticate
 - Send jobs
 - Retrieve results



Security



Security - Agent - User nobody

- Can execute anything the world user can
 - /Applications
 - /bin
 - /sbin
 - /usr/bin/
 - /usr/sbin
 - etc



Security - Agent - User nobody

- Can read anything the world user can
 - /etc
 - /etc/authorization
 - /etc/hostconfig
 - /Library/Preferences
 - /Users/name/
 - /Users/name/Public
 - etc



Security - Agent - User nobody

- Can write anything the world user can
 - /tmp
 - /var/tmp
 - /Volumes
 - /Users/name/Public/Drop Box



Security - Agent - User nobody

- The main problem is not the OS or Xgrid
- The main problem is developers
 - Many apps install 777/666
 - Some are SUID root binaries
 - Developer responded that it isn't a problem...!?!
 - One app creates 777 files all over the file system
 - What are they THINKING?!
 - Some even REQUIRE 777/666 or they don't run
 - BAD BAD BAD BAD BAD!!!!!!!
 - www.macenterprise.org/content/view/85/41/
 - We feel like we are the only ones educating developers about this....



Security - Agent - User nobody

- What does this mean?
 - If you mildly trust the Client and Controller admin
 - Happy day, you are probably safe
 - Safer than running a new app you just downloaded
 - Xgrid jobs run with nobody user permissions
 - New app runs with your user permissions -- sudo anyone?
 - If you don't know/trust admin or admin lives in country with no computer crime laws
 - You have to be insane to let them run jobs



Security - Server/Client

- Server opens a port, 4111
- All passwords are encrypted
- Remaining content is not encrypted
 - But could be in the future
- No known vulnerabilities



Installing & Setting up & Removing



How to install

- Package installer - very easy to install

`/Applications/Xgrid BLAST.app`

`/Applications/Xgrid.app <-- Xgrid.app`

`/Library/Application Support/Xgrid`

`/Library/PreferencePanes/Xgrid.prefPane`

`/Library/Preferences/com.apple.xgrid.agent.plist`

`/Library/Preferences/com.apple.xgrid.controller.plist`

`/Library/Screen Savers/Xgrid.saver`

`/Library/StartupItems/GridAgent`

`/Library/StartupItems/GridServer`

`/Library/Xgrid <-- most of the files`

`/etc/xgrid`

`/usr/bin/xgrid <-- command line tool`

`/usr/libexec/xgrid <-- server processes in there`

`/usr/share/man/man1/xgrid.1`



How to remove

- [/Library/Xgrid/Scripts/XgridUninstall.command](#)
 - Stops all Xgrid processes
 - Removes all Xgrid files

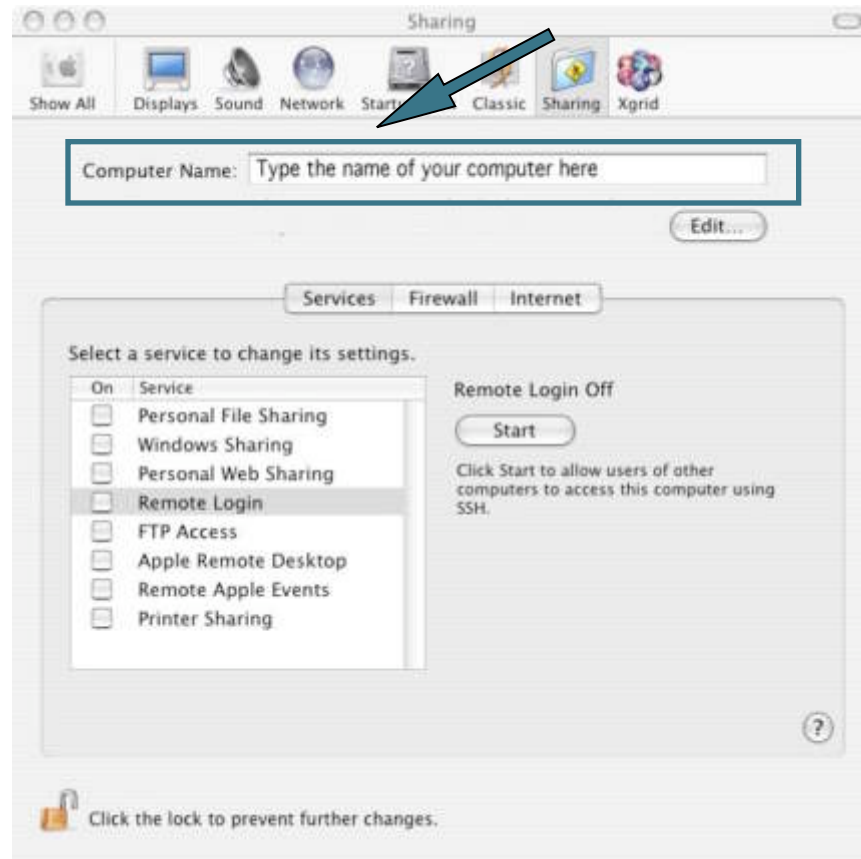


Setting Up Agents



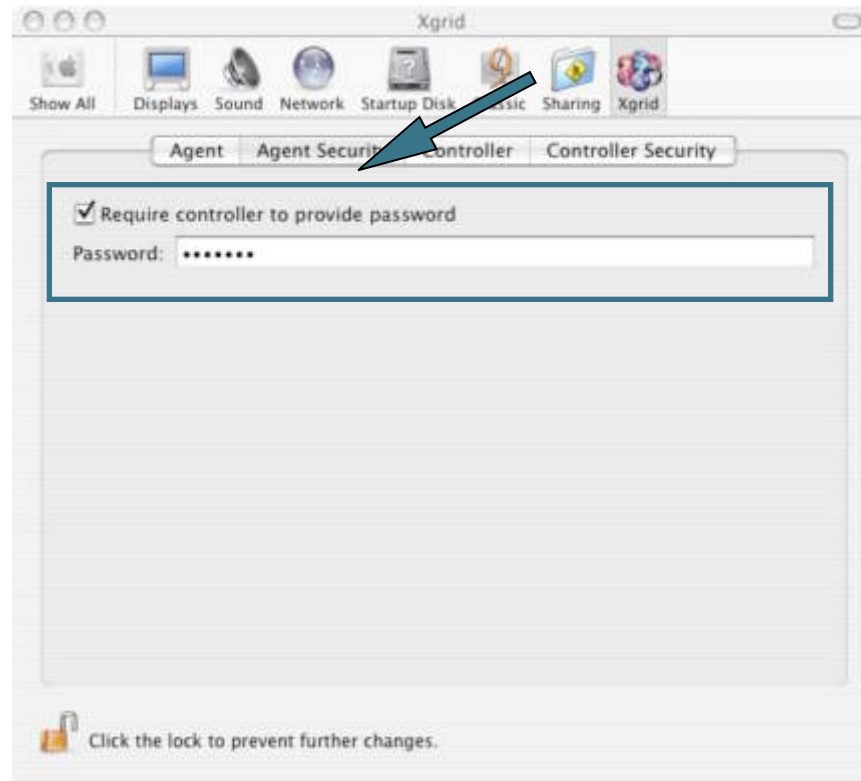
Set Up One Agent

Make sure computer name is unique



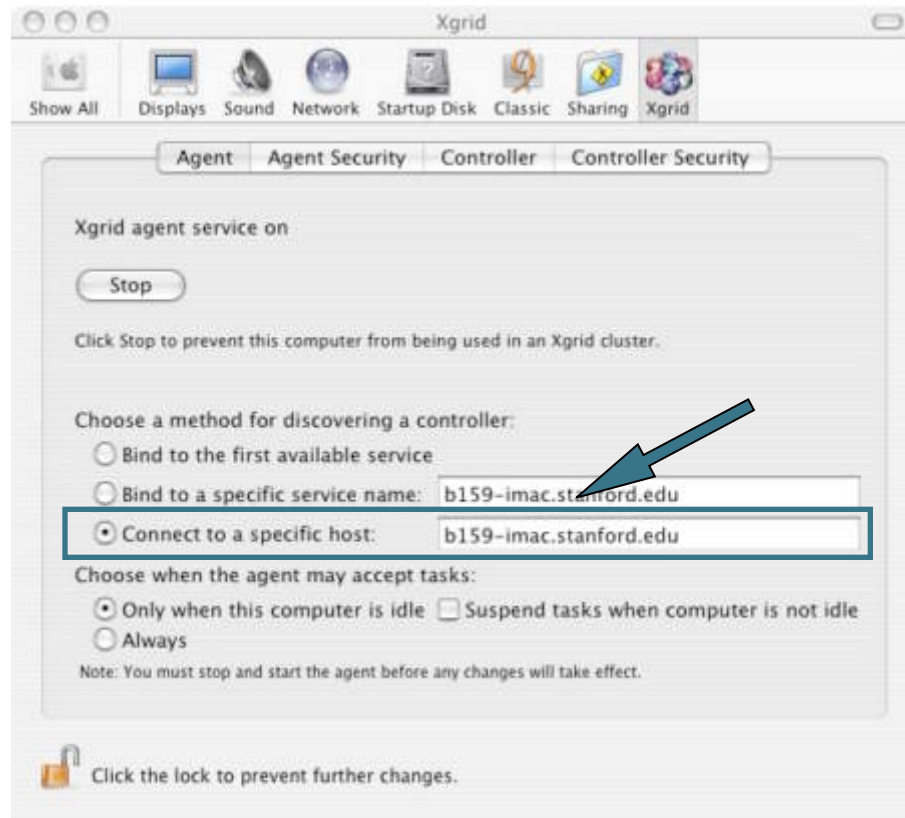
Set Up One Agent

Open System Preferences
Xgrid pane & Enter password



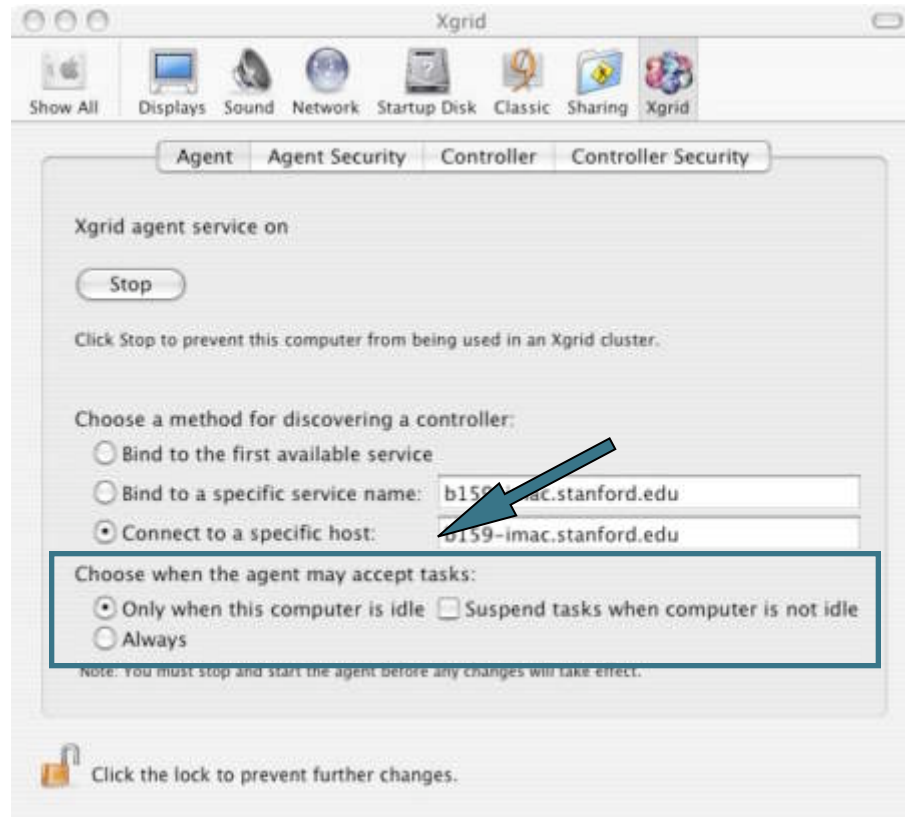
Set Up One Agent

Enter controller address



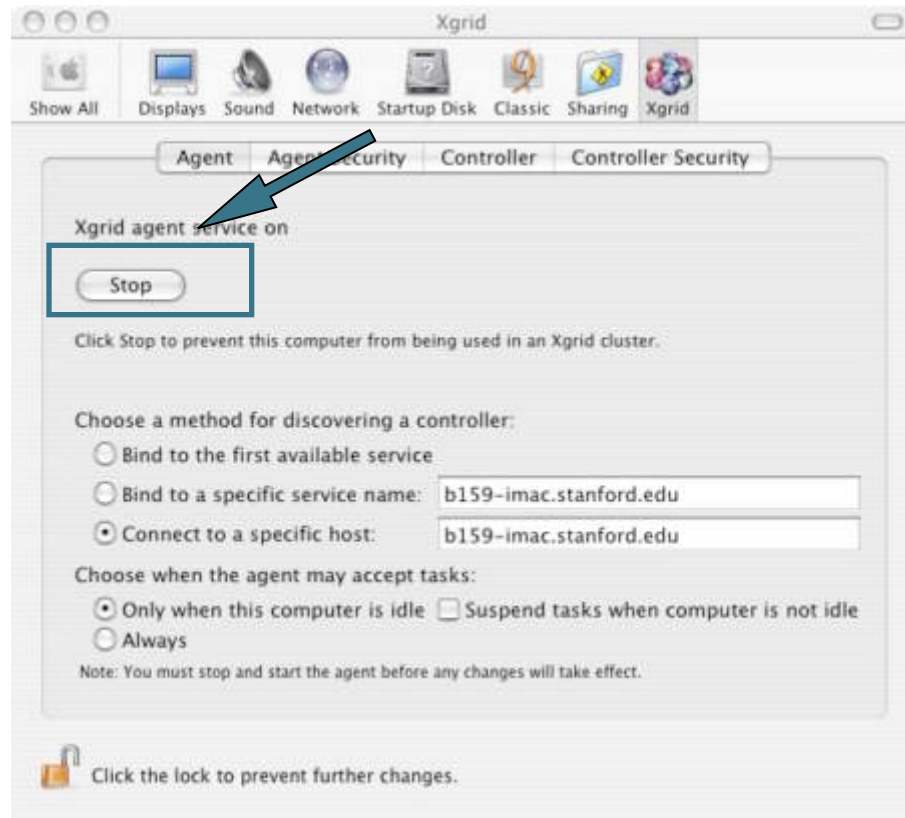
Set Up One Agent

Set usage options



Set Up One Agent

Click Start



Setting Up Multiple Agents

- Copy files to all agents
 - [/Library/Preferences/com.apple.xgrid.agent.plist](#)
 - [/etc/xgrid/GridAgent/controller-password](#)
- Start Xgrid
 - [/Library/Xgrid/Scripts/agent_on](#)
 - [/Library/Xgrid/Scripts/agent_start](#)
- Never delete this folder or files in it
 - [/Library/Xgrid/Agent/Cookies](#)



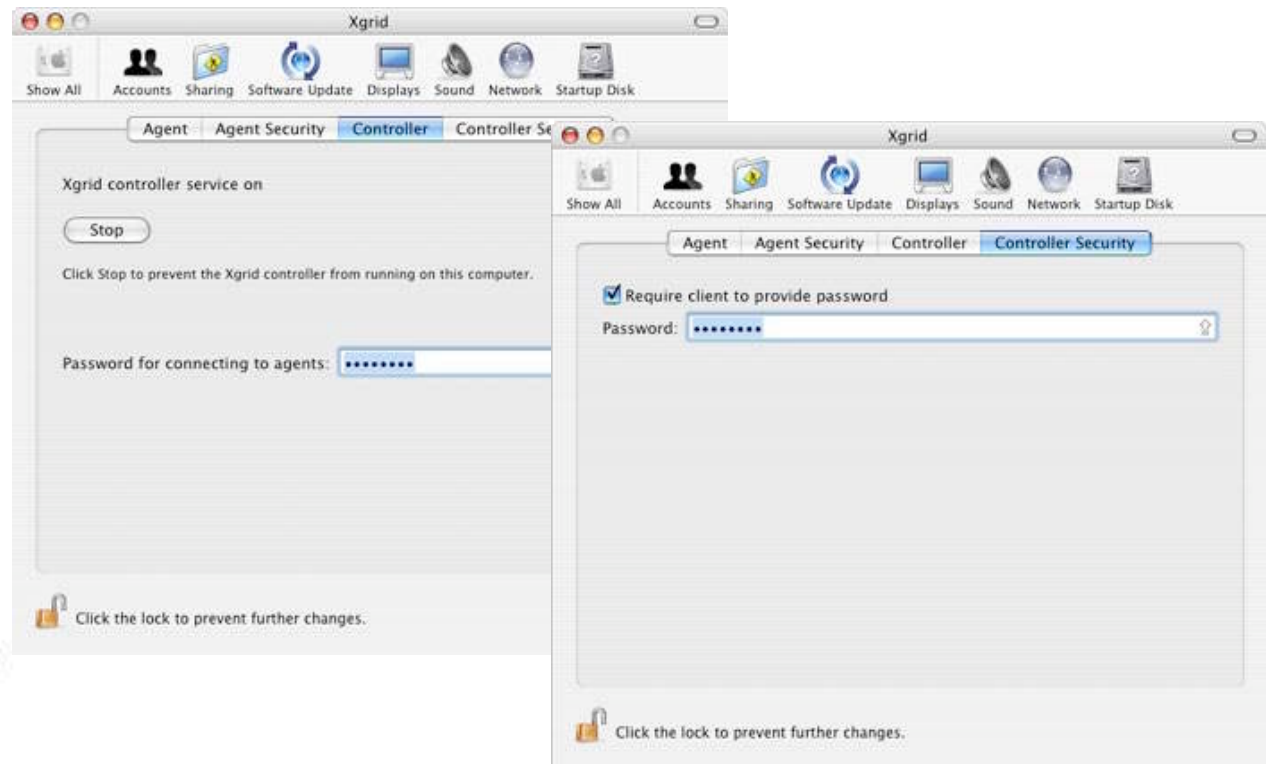
Should we try it????

- Connect to `oreilly-xgrid.scl.utah.edu`
- Password: `OR3illyXgird`



Setting up a Controller

- Just enter passwords and “Start”



Tips and Tricks



Tips and Tricks

- Command line hangs
 - Don't run `/usr/bin/xgrid` on controller
 - http://www.macos.utah.edu/Documentation/xgrid/xgrid_job_v5.pl
- OS limits (max open files & processes)
 - http://www.macos.utah.edu/Documentation/xgrid/xgrid_job_v5.pl
- Preference Pane helper tool is missing
 - <http://cmgm.stanford.edu/~cparnot/xgrid-stanford/install/prefpane-problem.html>



Tips and Tricks

- Controller crashes
 - Write a watcher script
- Controller crashes because of memory
 - Use a server to store files
 - afp/nfs & fileserver, or curl & webserver
- Connection issues
 - Check controller firewall
 - Don't delete cookies
 - Agent machine name must be unique



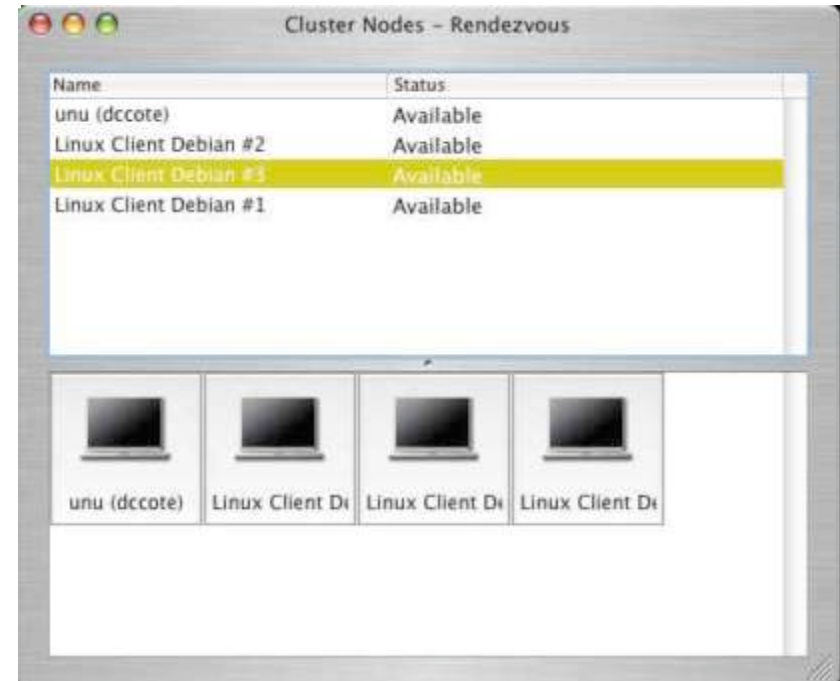
Tips and Tricks

- Application requires fixed path or files with fixed path
 - Pre-install application
 - Recompile application
- Application requires setup on agent
 - Use a script that does the setup and launches the real application
- Application can't run as "nobody"
 - /Library/Xgrid/Documentation/Xgrid Release Notes



3rd party additions

- Linux agent
 - Daniel Côté
- GridObjects
 - Fabio Invernizzi
- www.xgrid.info
 - Potential to be an Xgrid “want ads”



Let's Run A Job Right Now



Let's Run A Job Right Now

- Let's just get the names of the computers
 - hostname



Let's Run A Job 'Till Thursday

- Will execute POV-Ray render
- Change to root and look in /tmp/xgagent.... to see what it is doing
- Create folder /xgrid (777) to save results
- AIM chat room
 - "OReilly Xgrid"
- Result will be posted at
 - www.macos.utah.edu/xgrid/



Q & A

