Distributive Computing with Xgrid

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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
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- 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
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?
Distributed agents

- Dedicated agent
- Dedicated agents
- Screensaver agent

Client

Controller
1. Client submits job to controller.
1. Client submits job to controller
2. Controller splits job and submits to Agents

Distributed agents
- Dedicated agent
- Dedicated agents
- Screensaver agent
1. Client submits job to controller
2. Controller splits job and submits to Agents
3. Agents execute tasks

- Dedicated agent
- Dedicated agents
- Screensaver agent

Client submits job to controller
Controller splits job and submits to Agents
Agents execute tasks
1. Client submits job to controller
2. Controller splits job and submits to Agents
3. Agents execute tasks
4. Agents return results to Controller

Distributed agents
- Dedicated agent
- Dedicated agents
- Screensaver agent
1. Client submits job to controller
2. Controller splits job and submits to Agents
3. Agents execute tasks
4. Agents return results to Controller
5. Controller collects task results, then returns job to Client
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
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
Xgrid.app & Plugins

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.

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

Submit job
Create New Plug-in
Xgrid.app & Plugins

Name of plugin
Xgrid.app & Plugins

Location of app
Xgrid.app & Plugins

Command line arguments
Xgrid.app & Plugins

Run in background without GUI

-b
Xgrid.app & Plugins

Path to file to process

~/Desktop/yourfile....
Xgrid.app & Plugins

Save output to file
Xgrid.app & Plugins

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

Range: From 1 to 10 by 1
Xgrid.app & Plugins

Folder to send to agents
Xgrid Agent will cd to this dir
Xgrid.app & Plugins

STDIN (if required)
Xgrid.app & Plugins

Where to save output

![Image of Xgrid.app configuration window]

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: 

Working Dir:
Stdin File:

Destination: ~/Desktop

Submit job Show results Create New Plugin
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
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 BAD!!

www.macenterprise.org/content/view/85/41/

- We feel like we are the only ones educating developers about this....
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

![Image of Xgrid configuration window showing controller address being entered.](image-url)
Set Up One Agent

Set usage options

![Xgrid agent setup window](image)
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
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