*BSD is dying

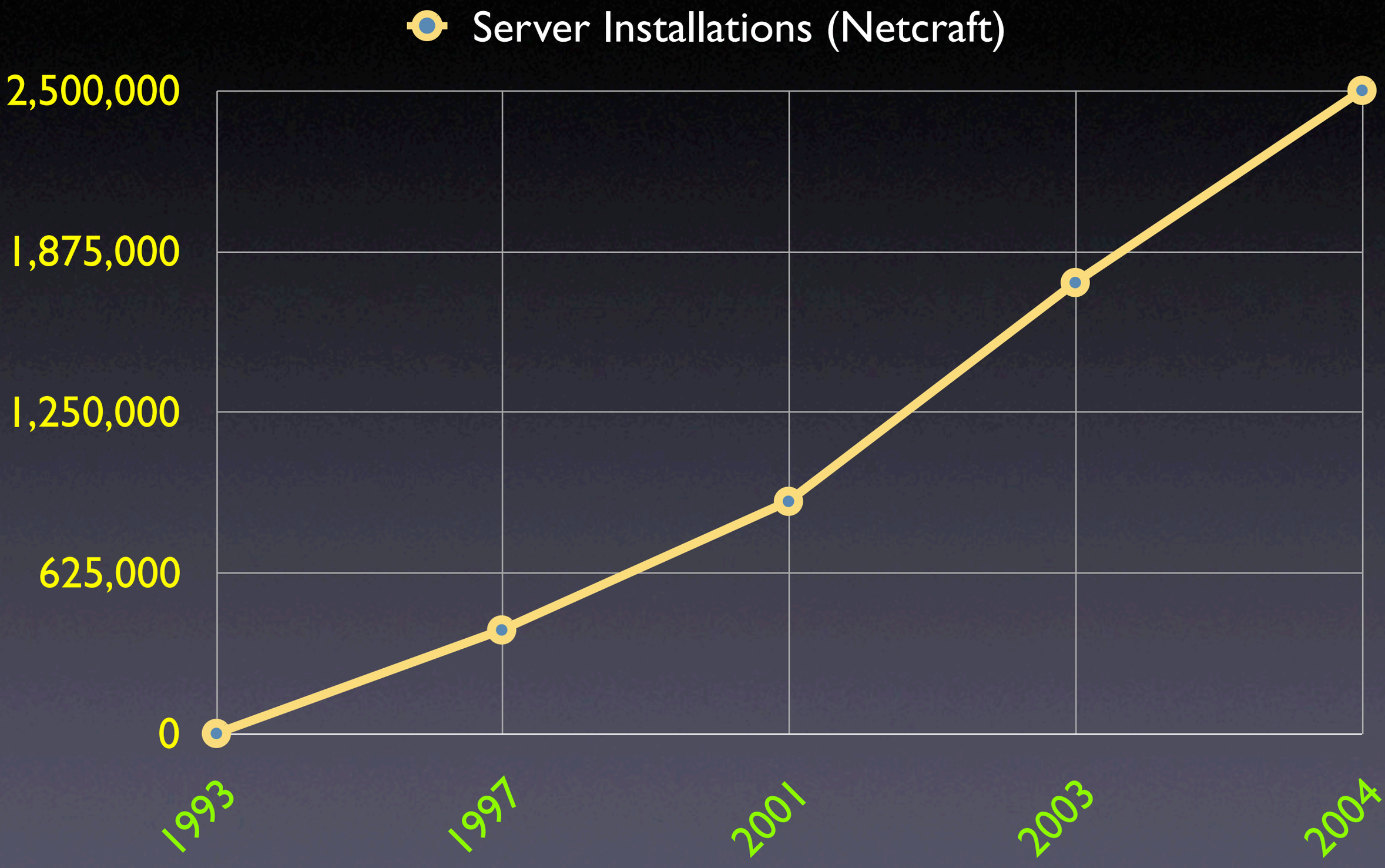
- Anonymous Coward, Slashdot

Jordan Hubbard
Apple Computer, Inc.

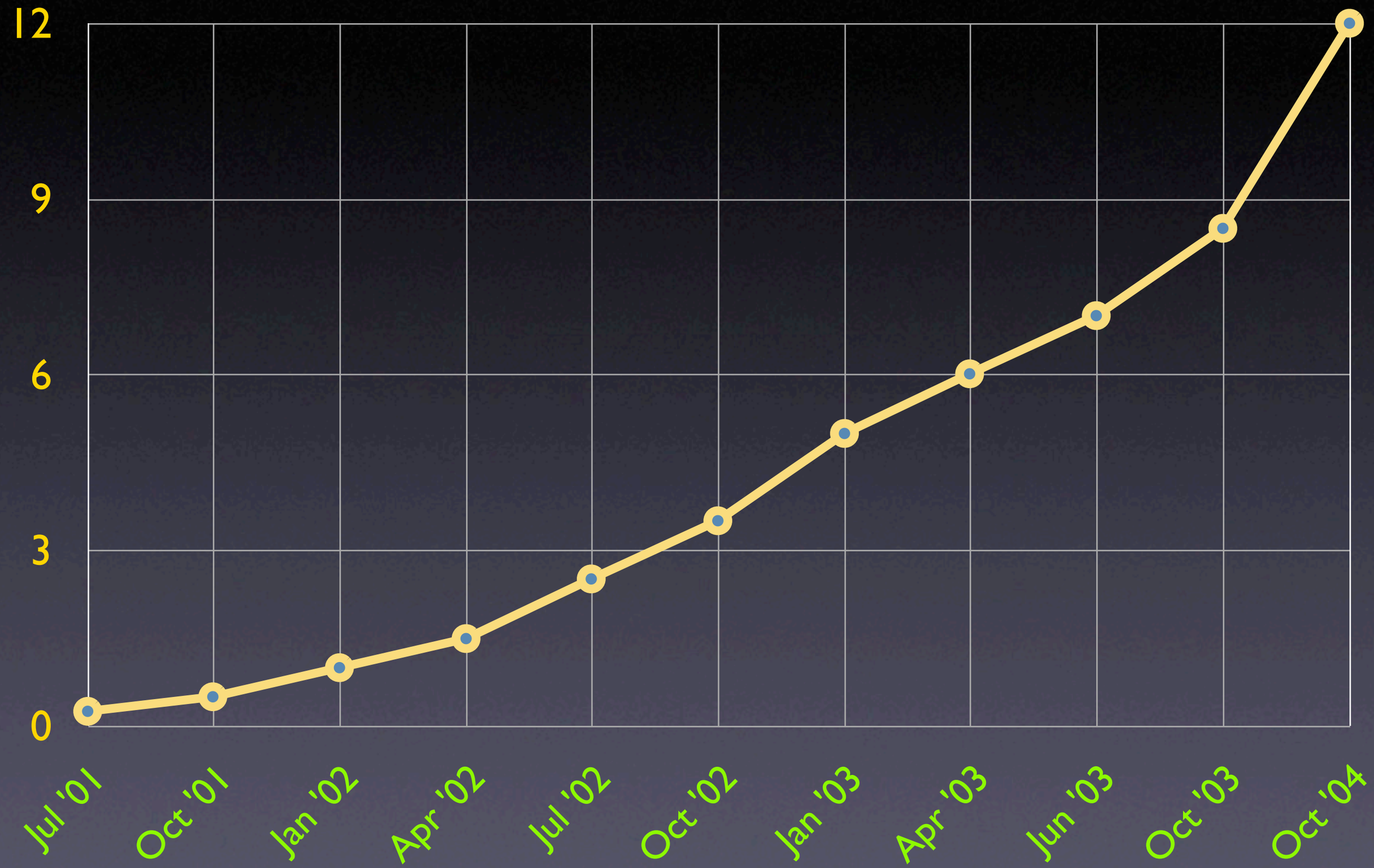
Oh really?

Let’s look at some stats...

FreeBSD Users: 2.5 Million

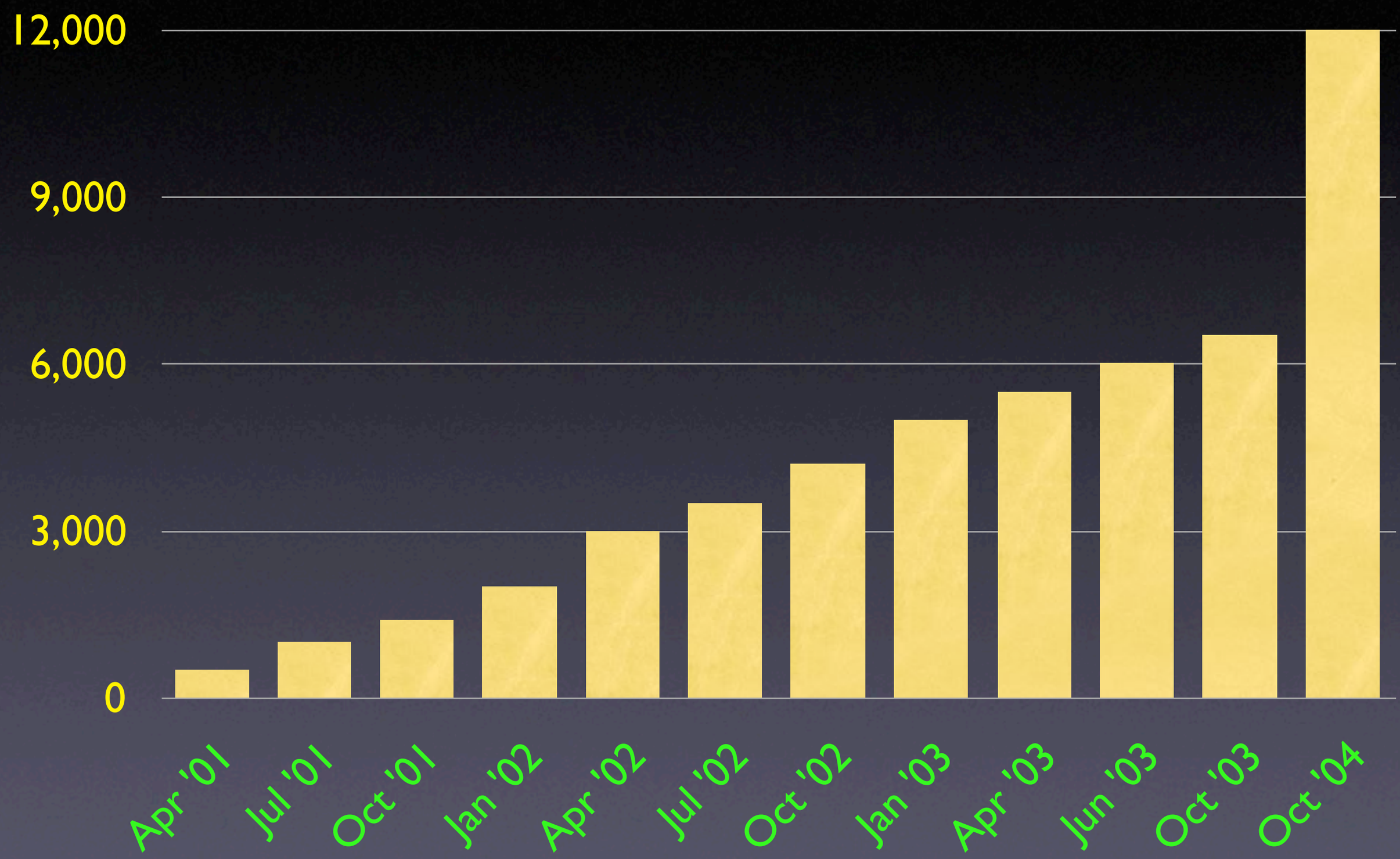


Mac OS X Users: 12 Million



Applications: FreeBSD ports

Applications: 12,000 Mac OS X Native

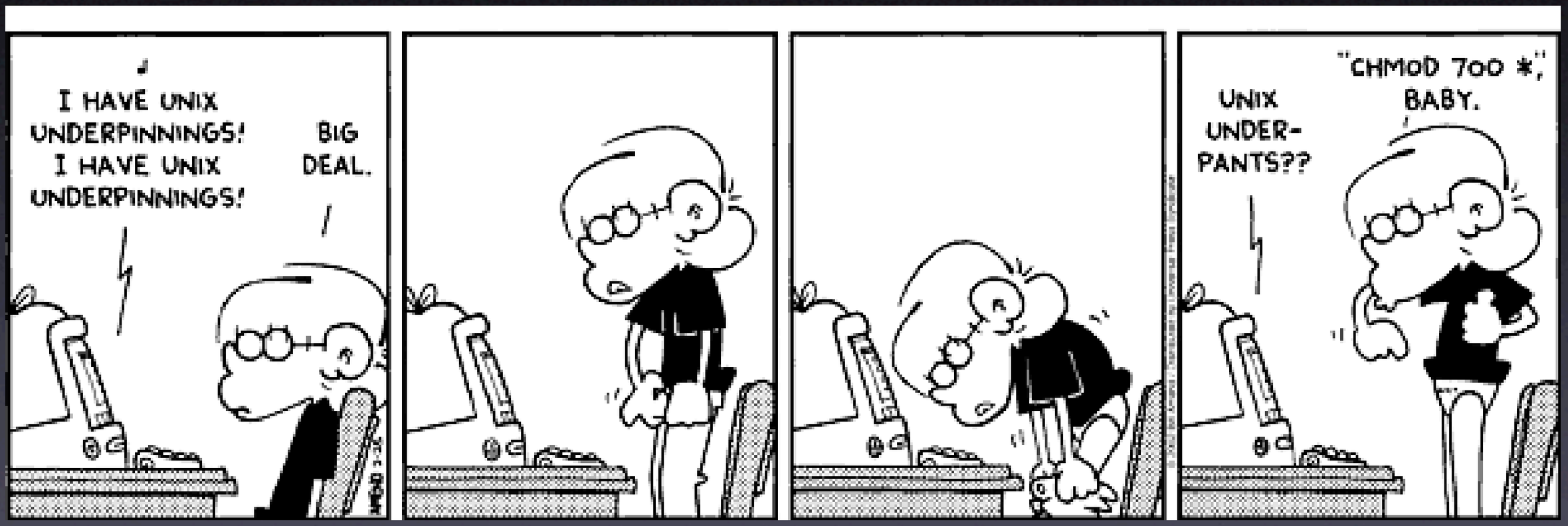


Since the arrival of Mac OS X, BSD has become the biggest desktop UNIX variant on the planet.

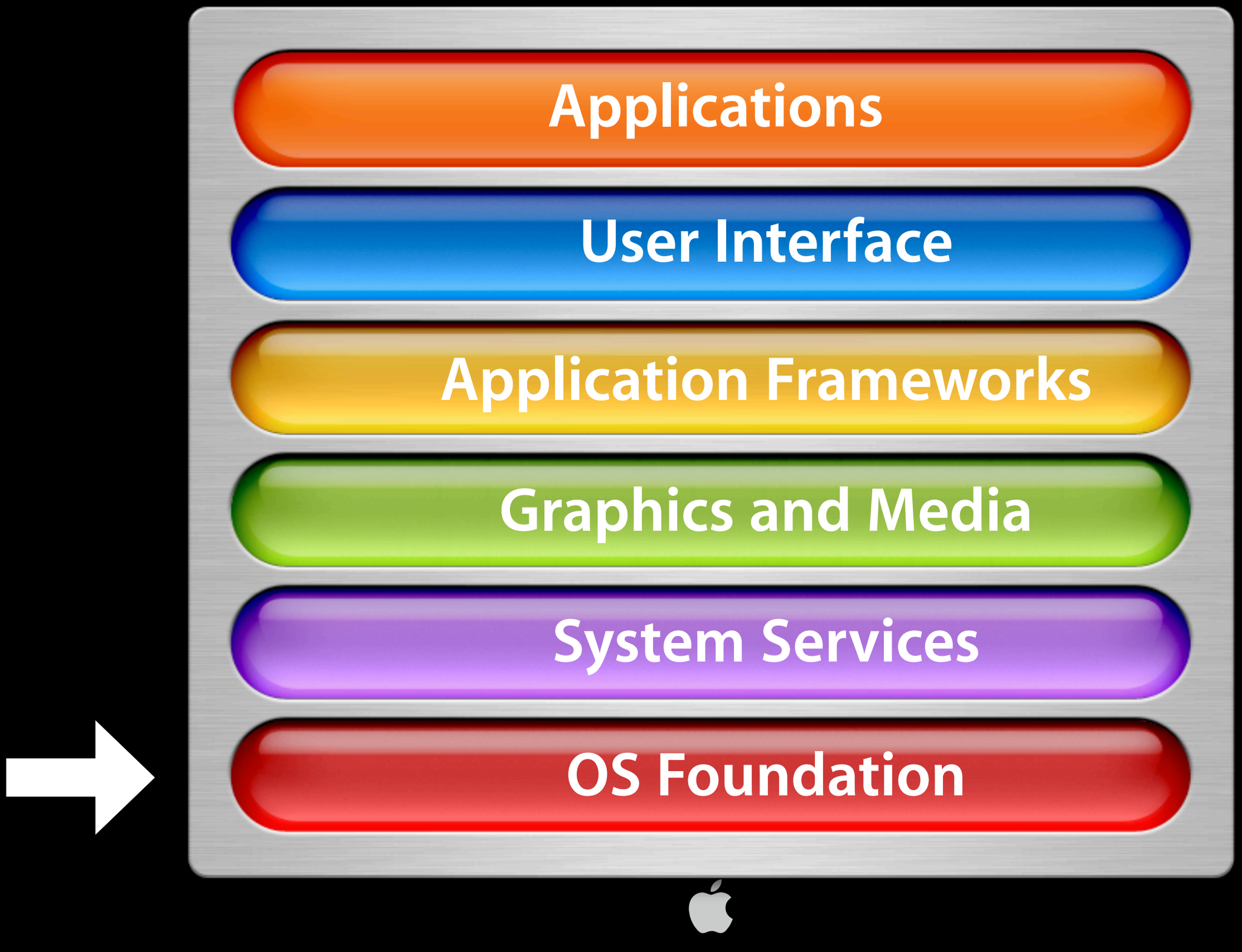
Yes, even bigger than Linux

Take ***that***, Anonymous Coward!

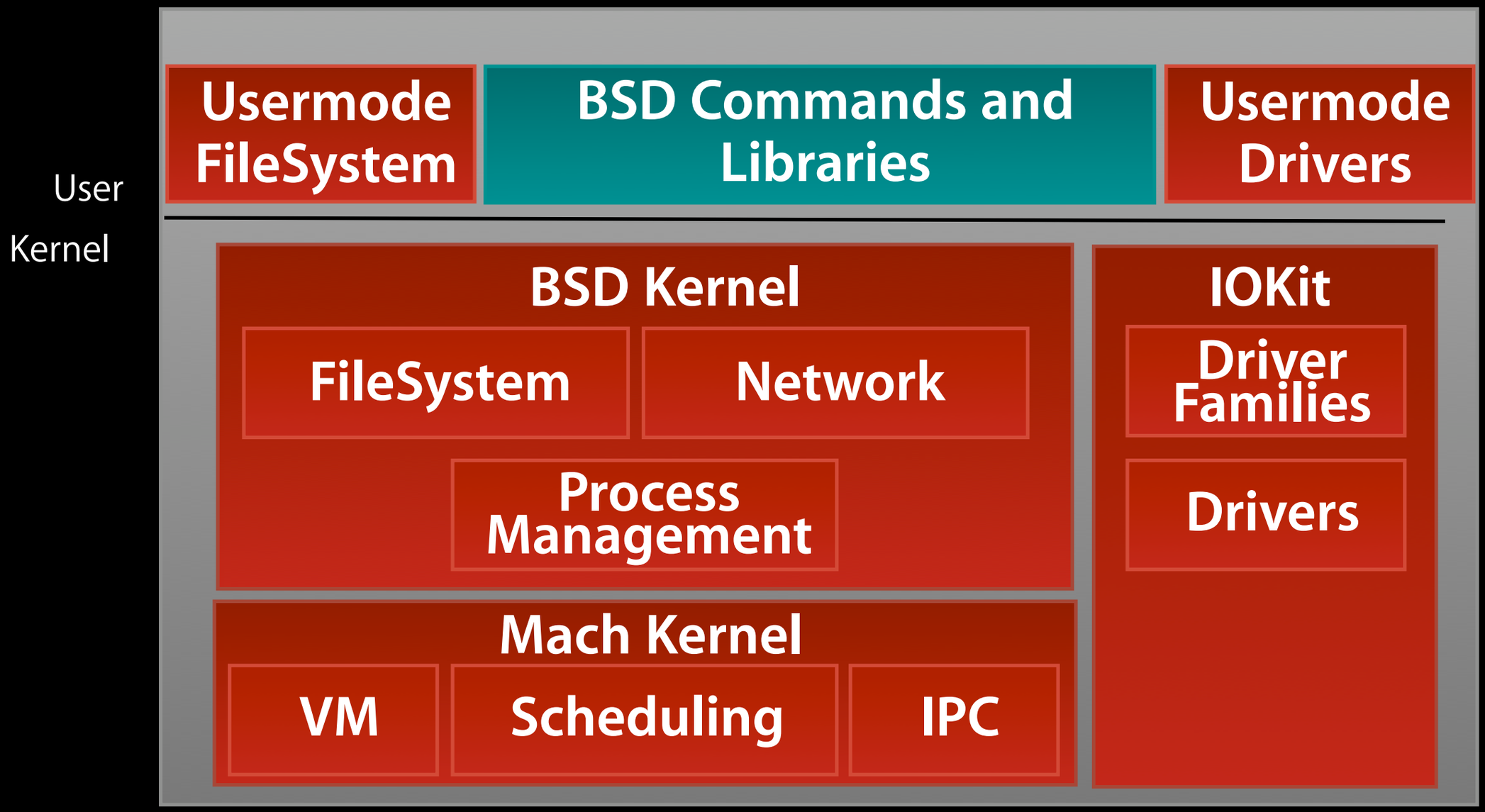
Selective overview of Mac OS X



Mac OS X Architecture

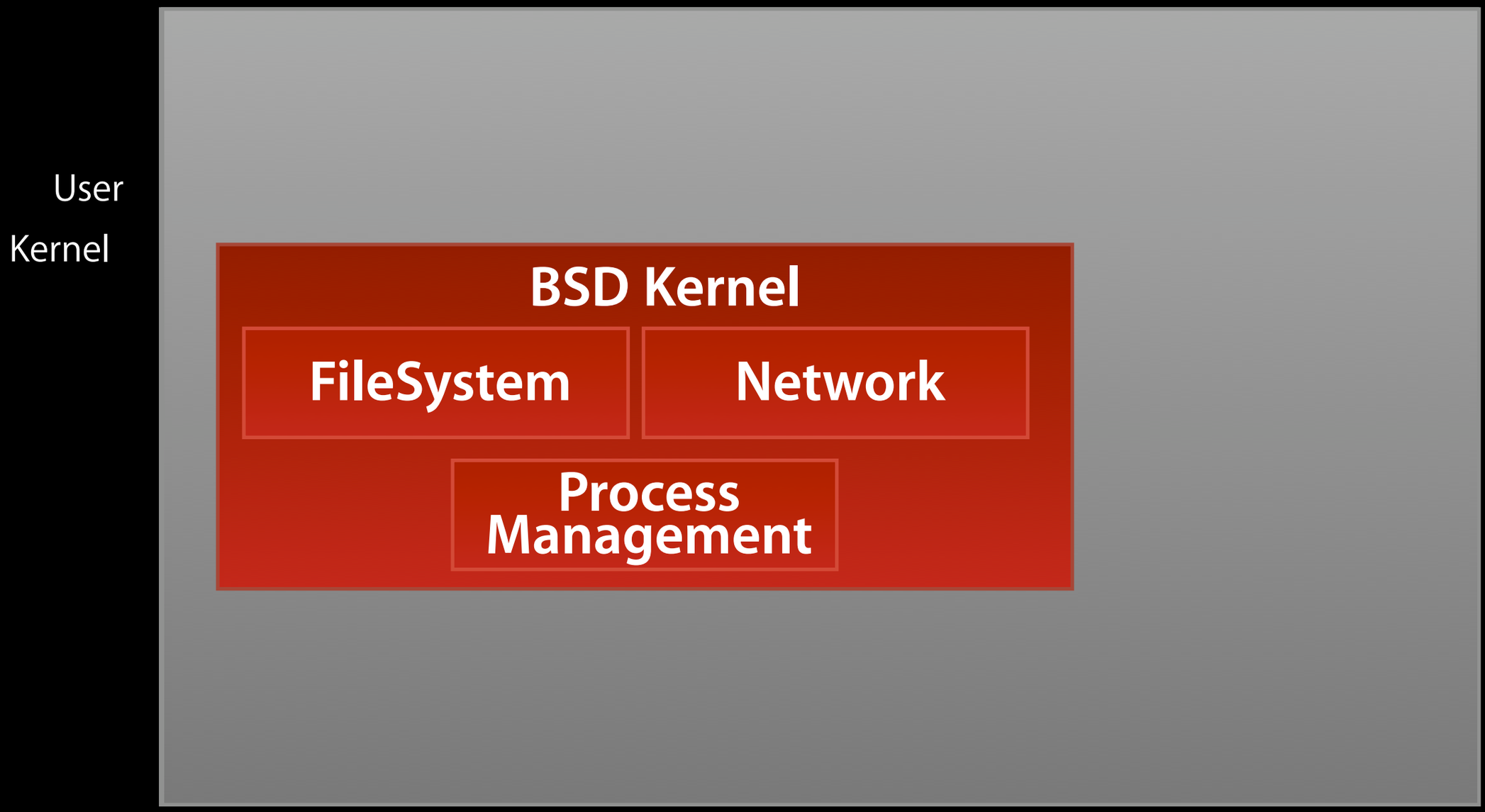


OS Foundation



Open Source "Darwin" base

OS Foundation



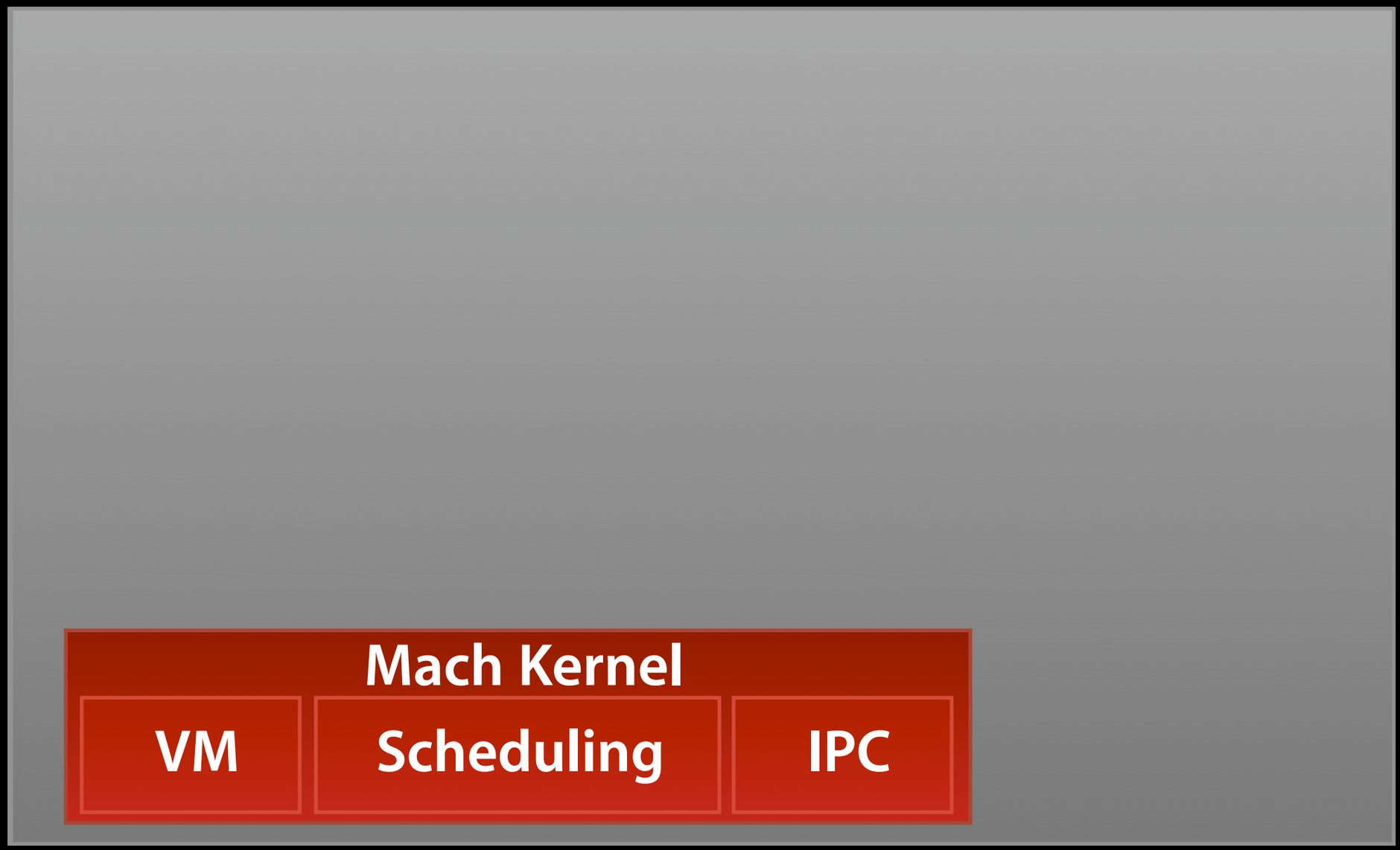
BSD Kernel

- FreeBSD 5.1 based (networking, vfs, filesystems, etc)
- Unified Buffer Cache (different than FreeBSD's)
- Clustered I/O performance enhancements
- Local File Systems
  - hfs, ufs, iso9660, udf, fat, ntfs
- Network File Systems
  - nfs, afp, smb, webDAV, ftpfs, afs

OS Foundation

User

Kernel



Mach Kernel

- Based on Mach 3
- VM, tasks, threads, scheduling and IPC
- Fine grain locking for SMP
- Support for > 4GB Physical memory
- [fairly] Light-weight threading model
- Real-time scheduling
- Event driven application programming model (via Mach ports)

OS Foundation

IOKit

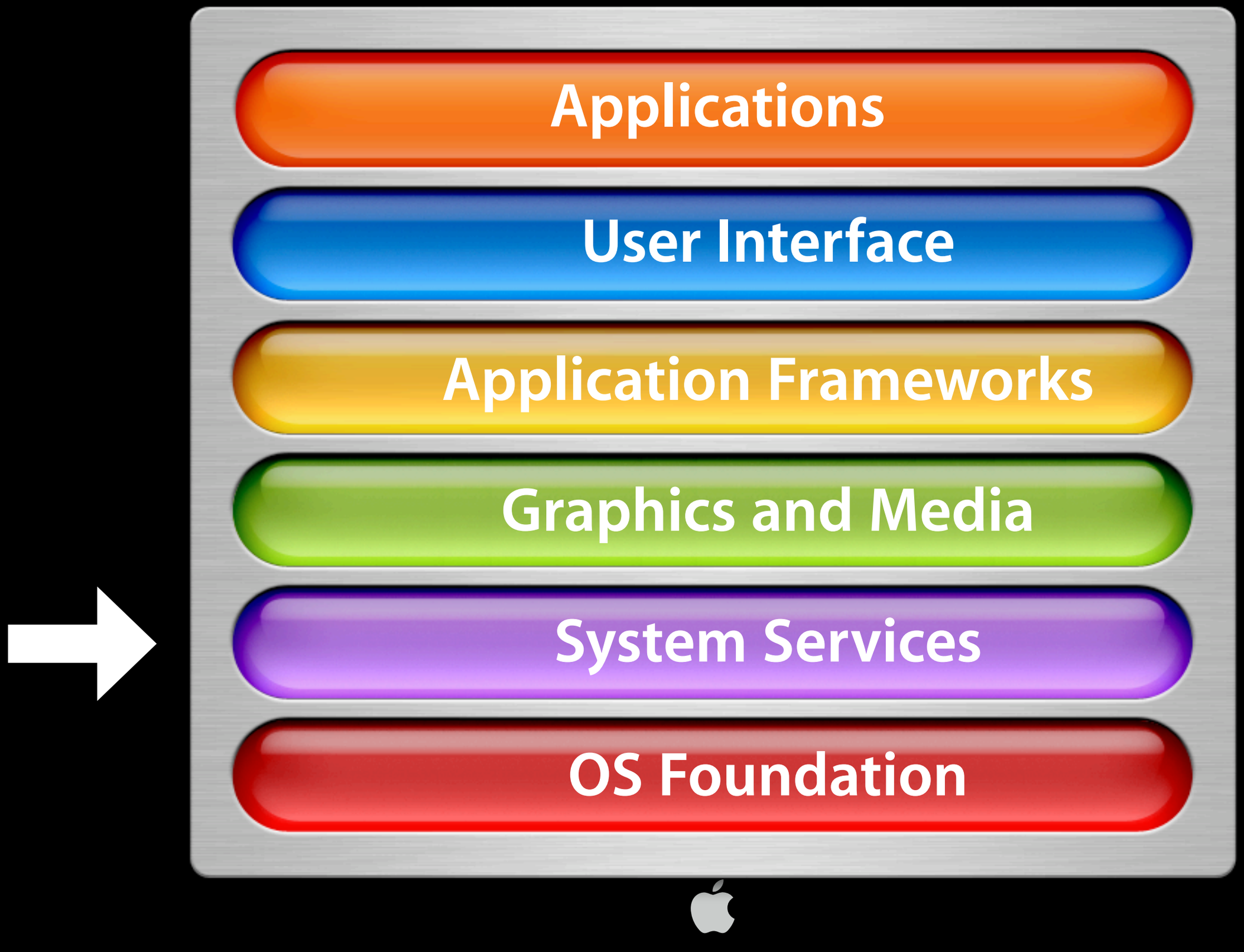
- Written in conservative C++
- OOP device family and instance model
- Support for user space drivers
- Dynamic plug and play
- Handles all device property information and provides convenient introspection via ioreg(1) and friends
- Sophisticated power management

OS Foundation

Commands and Libraries

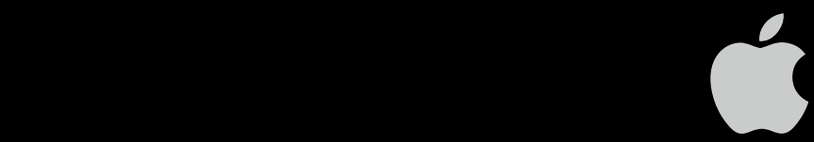
- Standard commands and libraries from FreeBSD 5.1
- A full suite of scripting languages
  - perl, tcl, python, ruby, php
- Every standard shell
  - bash, csh, tcsh, zsh, etc
- Standard editors
  - pico, vi, emacs (the best!)
- Standard C compiler suite
  - gcc, g++, Objective-C [currently at version 3.3]

Mac OS X Architecture



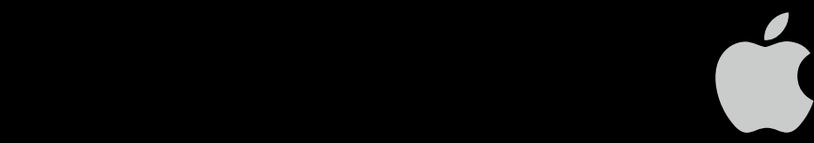
Open Directory

- Flexible plug-in architecture
  - Supports legacy flat files
  - Supports OpenLDAP
  - Supports Active Directory
- Open Source
  - http://developer.apple.com/darwin/projects/opendirectory/



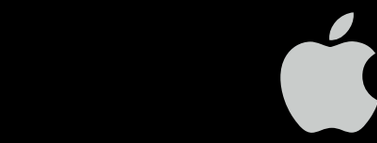
Security Server

- Full CDSA (Common Data Security Architecture) implementation
- Manages certificates, keys, passwords
- Implements keychains for easy access
- It's not OpenSSL
- Open Source references:
  - http://developer.apple.com/darwin/projects/security/
  - http://sourceforge.net/projects/cdsa/

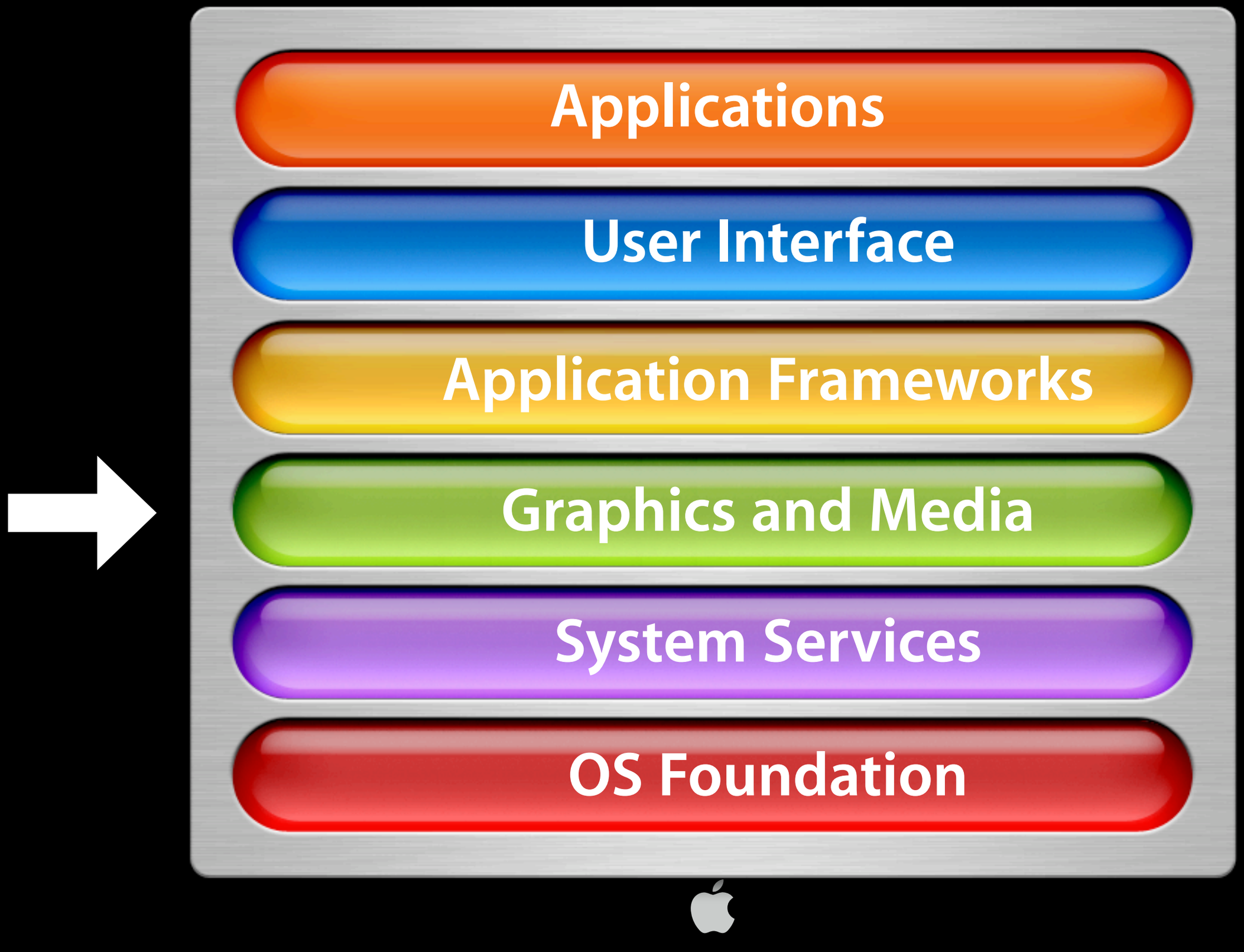


Rendezvous

- Service registration
- Service discovery
- Easy ad-hoc networking via .local namespace
- Also available for FreeBSD, Solaris & Linux (and a number of misc devices)
- Open Source references:
  - http://developer.apple.com/macosx/rendezvous/



Mac OS X Architecture



2D Graphics: Quartz

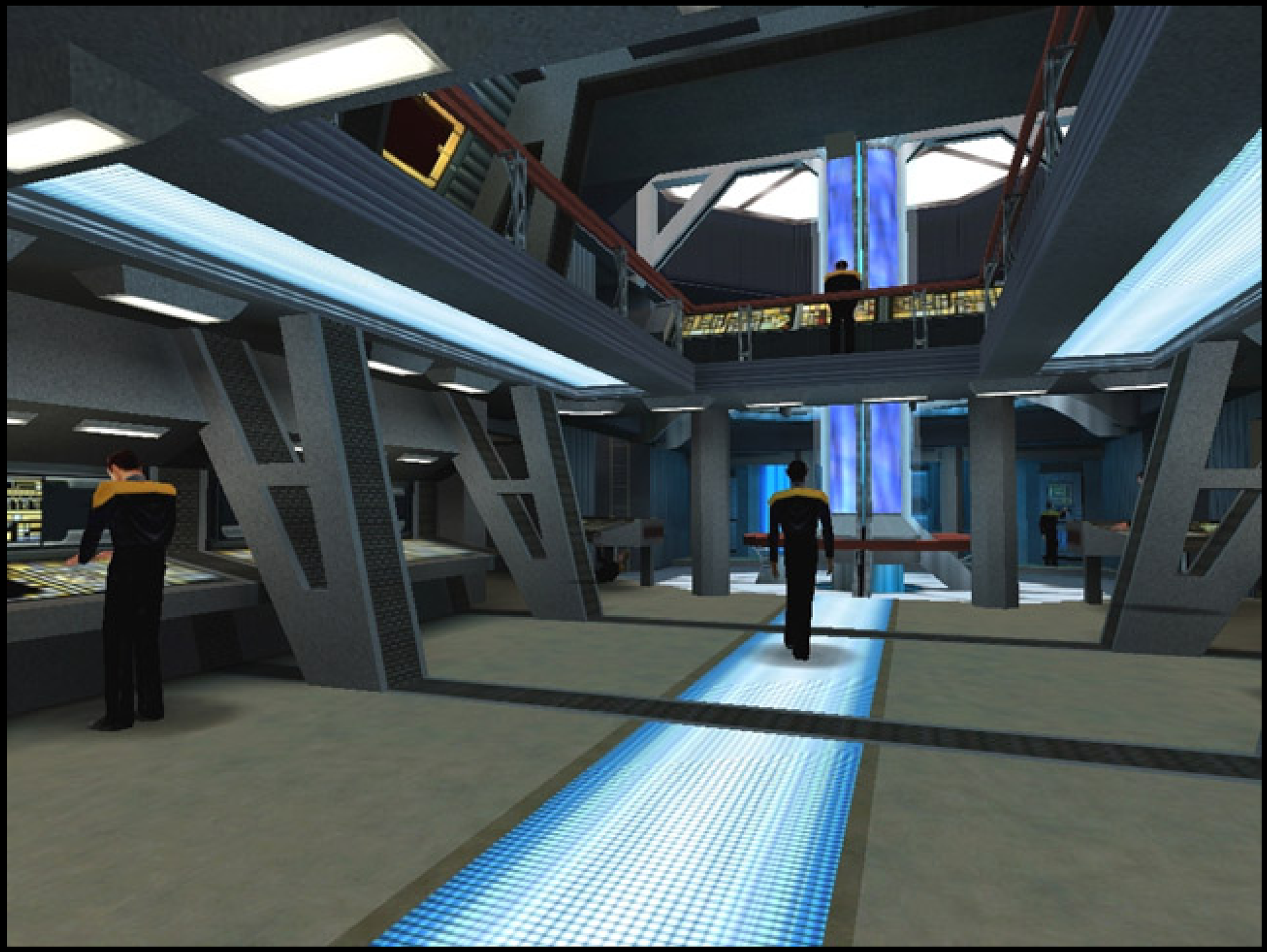
- PDF-based imaging model
- Leverages GPU
- CUPS "WYSIWYG" printing
- Python bindings
  - CoreGraphics APIs
  - QuickTime images
  - PDF, RTF, HTML

3D Graphics: OpenGL

Industry Standard
3D Technology

Keeping the world safe from DirectX

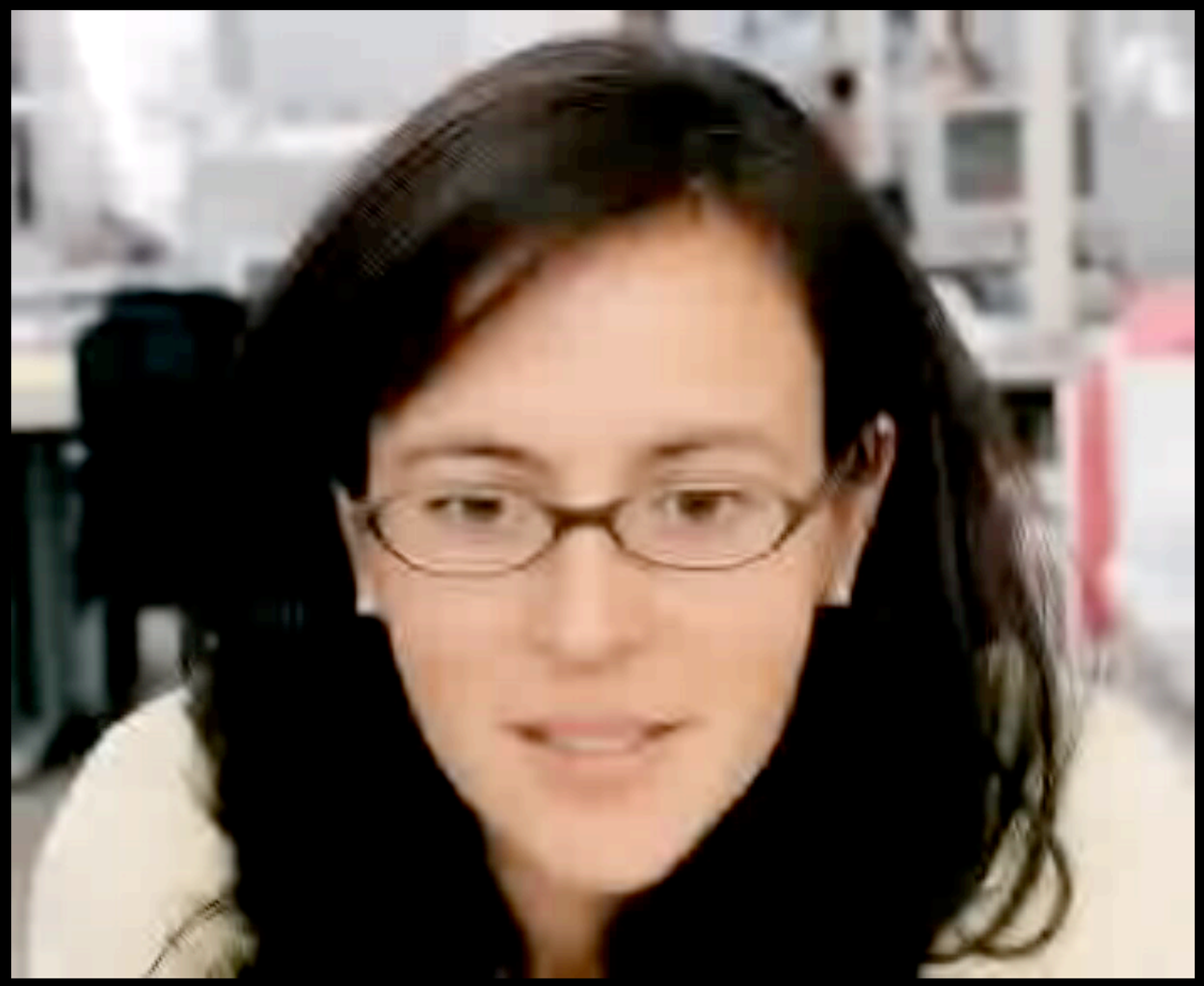
And we all know why good 3D support is especially important...



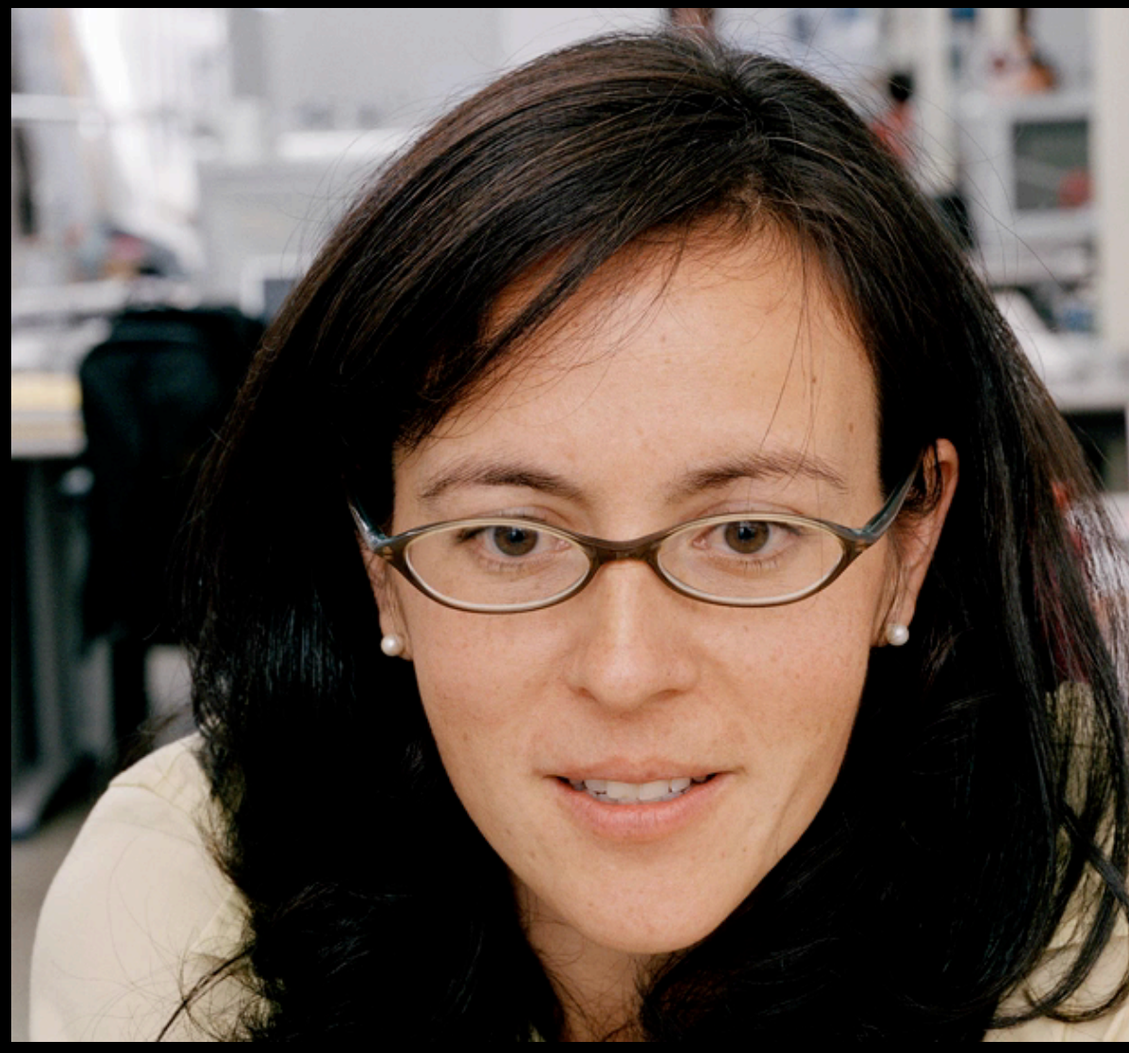
And optimized video...

H.264

Similar data rates, very different picture



H.263

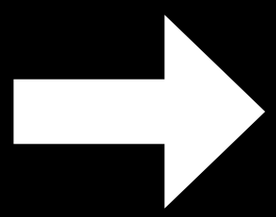


H.264

Core Audio / Core MIDI

Guaranteed latency and Audio Units architecture make apps like GarageBand possible

Mac OS X Architecture



Applications

User Interface

Application Frameworks

Graphics and Media

System Services

OS Foundation

Finder File Edit View Go Window Help

Inbox

Delete Reply Forward New Junk Get Mail Search

From Subject Date Received

Galen Stackwell Greetings Today

3 John Smith Summer Vacation Yesterday

John Smith Trip

Kathryn Lemay Sun

Galen Stackwell Goi

Michelle Re:

Ed Thompson Gre

Galen Stackwell Last d

Mike Status

Juliette Walsh Need

From: Kathryn Lemay
Subject: **Summer Vacation**
Date: July 21, 2003
To: Todd Taylor

Documents

home

Mac OS X Panther

Network

My Archives

iDisk

Home

Applications

Documents

Desktop

Pictures

Project folder

Project folder Letters Downloads

Stuff Work in progress Meeting notes

logo.jpg Reports Updated list

Images to process Adrien Picture of Beach

25 items, 13.5GB available

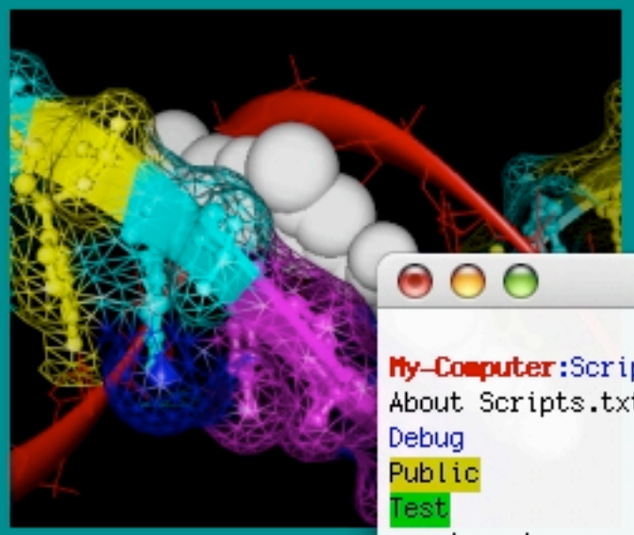
Video Chat with Aki

Edit View Go Window Help

Mon 11:16

Netropsin Presentation.ppt

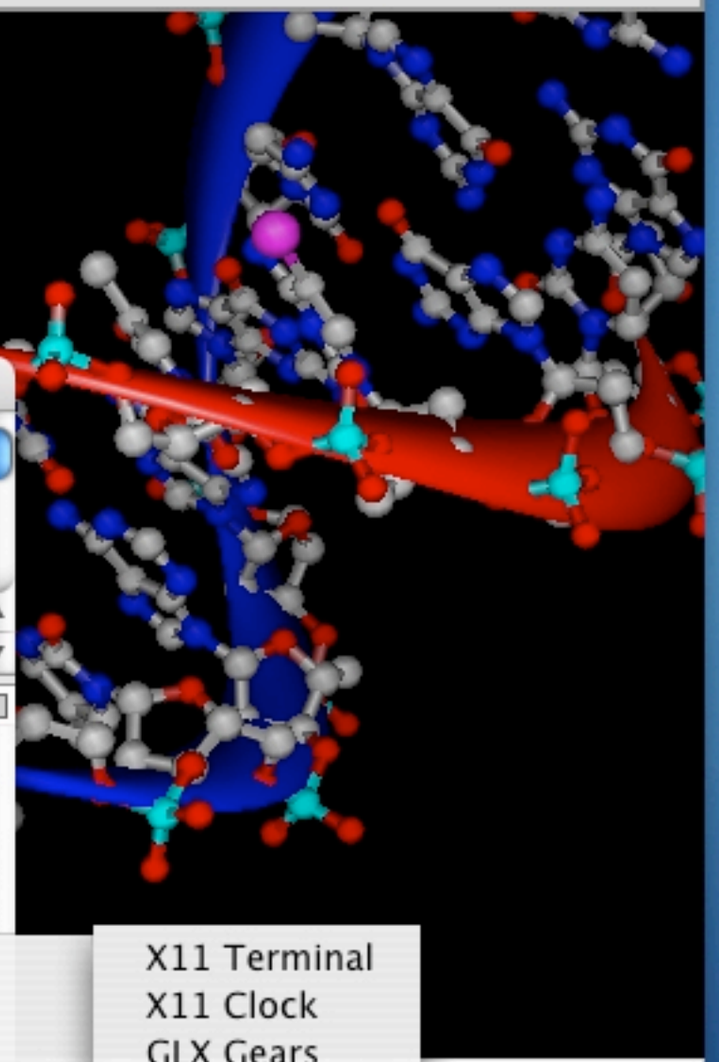
DNA with Netropsin



- Netropsin is
  between the t
  strands

Chimera

File Select Actions Tools Favorites Help



31 atoms, 32 bon

Terminal — emacs — 80x(17+7)

```
My-Computer:Scripts apple$ ls -vG
About Scripts.txt debug.tcl         query_all        trials.csv
Debug             get-data.rb       restore.pl       x11-dna-final.py
Public            matchup.py        restore.pl~      儀黑 Pro.ttf
Test              profile           setup.sh
counter.php       query             status.csh
```

```
File Edit Options Buffers Tools Help
   #if this person has recordd before, remove their previous record.  I think
   #that from a control flow POV, the DELETE then INSERT approach to
   #duplicate records is less hassle to implement than using an UPDATE.  Just
   #my humble opinion

   #&removeRepeaters($ipAddress);

   #create the meat of the SQL query
   my $valuesString = &buildValueString($ipAddress);

   my $sql = qq{ INSERT into condorcet_records
                 VALUES ( $valuesString ) };

   my $sth = $dbh->do($sql);
----:---F1  restore.pl       (Perl Isearch)--L343--79%------
I-search: SQL
```

Chimera
xload

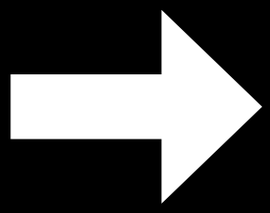
Applications ▶

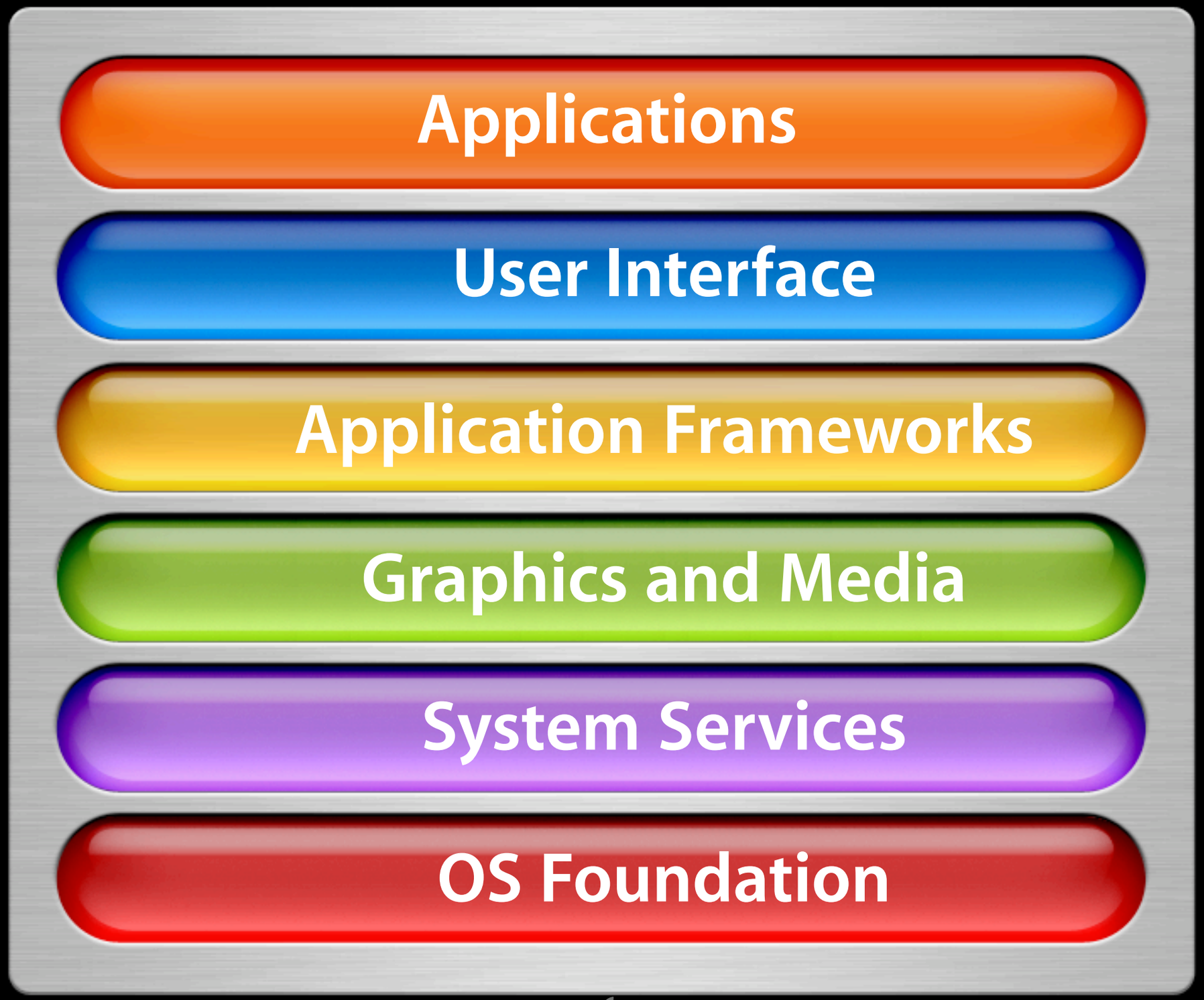
Show In Finder
Hide
Quit

X11 Terminal
X11 Clock
GLX Gears
GTK Gimp
Motif NEdit
Tk Getleft

Customize...

Mac OS X Architecture



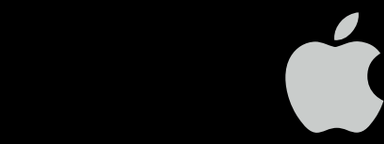


Most of the important ones...

- Microsoft Office
- Photoshop
- Quicken / Quickbooks
- Quark Xpress
- Macromedia Director and Macromedia Studio
- ... and many many more, either here or coming soon

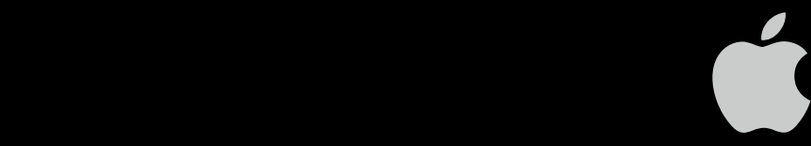
What makes us BSD users?

- The historical drive to innovate
  - Berkeley Fast Filesystem
  - TCP/IP networking
  - Virtual Memory
  - Long filenames
  - Job control
  - ... and many other things aimed at making it the first “usable” UNIX, and one that everyone wanted



What makes us BSD users?

- Two words: Software Engineering!
  - Strong organizational mentality. *"Of course anyone can build the entire system!"*
  - Dedication to quality and (sometimes aggressive) peer-review
  - Use of proper tools (like cvs) is a given
  - Unity of purpose on mission goals (more on that later)



BSD - who's who

- FreeBSD

The Post-BSD 4.4 world

- NetBSD

- OpenBSD

- Mac OS X (Darwin)

- DragonFly BSD

... and numerous commercial and research variants

So clearly, BSD is NOT dying...

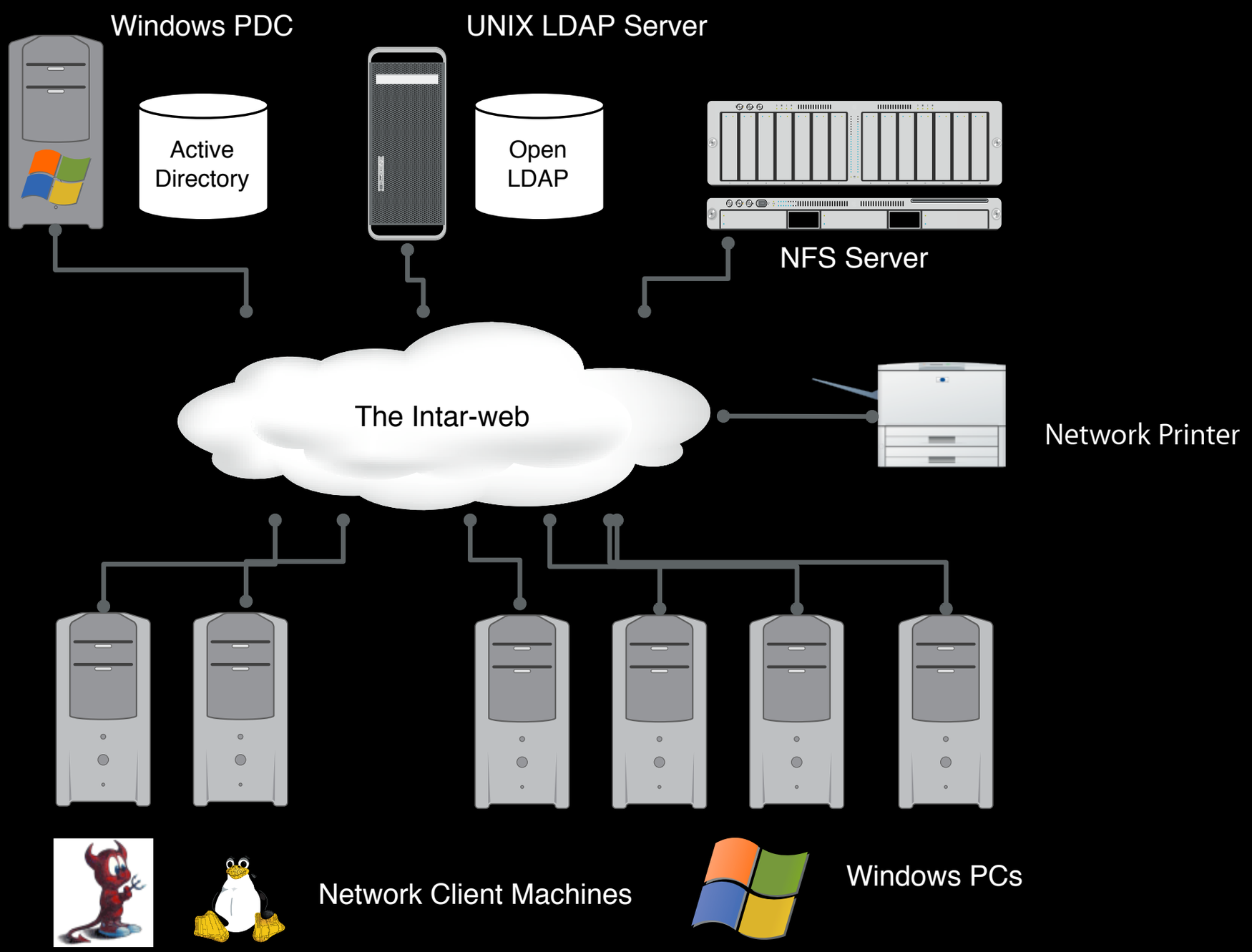
But what lies ahead?

Challenge: Authentication

Sorry, this is **not** a user information database:

nobody:*:-2:-2:Unprivileged User:/:/usr/bin/false
root:*:0:0:System Administrator:/var/root:/bin/sh
daemon:*:1:1:System Services:/var/root:/usr/bin/false
smmsp:*:25:25:Sendmail User:/private/etc/mail:/usr/bin/false
lp:*:26:26:Printing Services:/var/spool/cups:/usr/bin/false
postfix:*:27:27:Postfix User:/var/spool/postfix:/usr/bin/false
www:*:70:70:World Wide Web Server:/Library/WebServer:/usr/bin/false
mysql:*:74:74:MySQL Server:/var/empty:/usr/bin/false
sshd:*:75:75:sshd Privilege separation:/var/empty:/usr/bin/false

The present looks a lot more like this ...



Challenge: Authentication

- Face it: It's a Windows world - "Embrace and extend!"
- The traditional UNIX group model is obsolete
- The uid is obsolete and insufficient - prepare for the GUUID (and privacy concerns)
- Smart Cards are in your future...

Challenge: Authentication

- ACLs: We have them, people want them, now what?
- ACL interoperabilty - will there be any?
- Ha! The resource fork is back! POSIX Extended Attributes:
  - A challenge for the command line
  - A challenge for NFS and non-EA aware local File Systems

Challenge: API Stability

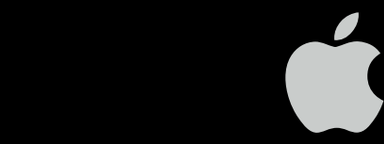
- "Hey man, just recompile it" is **NOT** an evolutionary API strategy:
  - APIs need to be clearly classified (supported, unsupported, unstable, marked for death, etc) in header namespace and doc
  - Shared library version numbers aren't proving to be sufficient
  - Current linker toolchain may not be sufficient either

Challenge: API Stability

- Restricted Kernel APIs are essential:
  - Developers like to poke into the innards, but this can strongly inhibit innovation
  - "Just recompile" really not an option here
  - Things like /dev/kmem are evil and should die (and will someday in Mac OS X)
- Proper kernel abstraction can help **both** the OS vendor and its 3rd party hackers

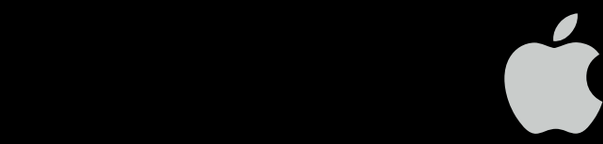
Challenge: UI + Applications

- The X Window System **still sucks**
- UI toolkit standardization still balkanized
- GPUs are getting faster and need to be better leveraged in the service of the interface
- Support for printing and good I18N support still lacking
- High level APIs - Libc isn't the place to stop

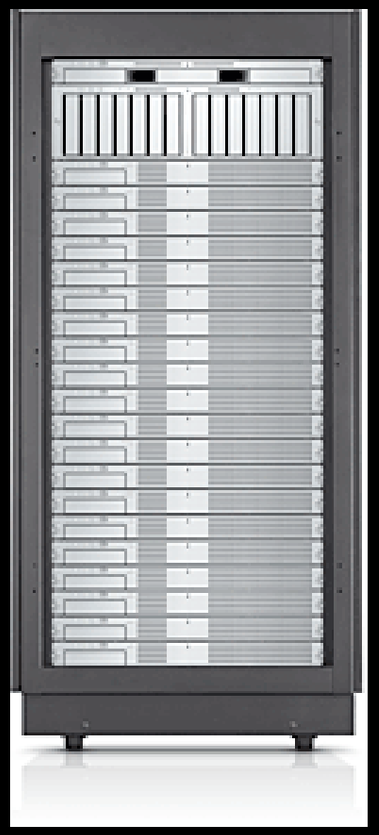


Challenge: Administration

- Administering clusters of machines is still too "bolt something together yourself"
- BSD has been slow to embrace unifying standards for configuration data (XML, get over it already!)
- Not all centralized configuration databases need to be a Windows Registry
- Service management is crude



Challenge: Hardware Trends



- Floating point performance is a more critical comparison point now
- Still a lot of low-hanging fruit in the math libraries, but very little work on them
- Hand-optimization bang-for-buck in computational problems like BLAST can be huge, and biotech is the future!
- Yes, Altivec sells a lot of XServes
- Don’t underestimate the GPU in the future

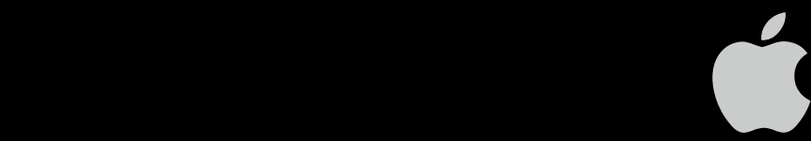
Challenge: Hardware Trends

- Embedded systems are on the rise
- A lot of embedded CPUs omit MMUs to cut cost: This is one area where BSD support is really lagging behind
- BSD's organizational ethos coupled with an embedded systems focus could be a huge win

- Don't just hand this space to Linux, NetBSD folks!

Challenge: Standards

- More and more government shops are demanding Common Criteria certification. A little audit support can go a long way!
- UNIX03 compliance is not a bad thing: It's not just about the ™, it's about portability
- New accounting laws will soon make standards compliance more necessary in the USA
- OSS strategy: Make it easy for people with money to get certification. It worked for Linux!



In Summary

- BSD is doing great, but it needs strong consensus on its mission goals to be healthy another 10 years
- BSD could also stand to remember its innovative roots. Be more open to and actively encourage "alternative thinking":
  - http://www.tel.fer.hr/zec/vimage/ - Mr Zec's network cloning stuff is very cool
  - http://www.citi.umich.edu/u/provos/systrace/ - Maybe not the final implementation, but a good idea
  - Plan9 and Linux have some interesting ideas - look at them! Experiment!

In Summary

- Apple has done a great job leveraging open source, but there are things we want to improve:
  - More effective 2-way collaboration. Not just "pull" but "push"
  - Greater visibility into the OS dev process (particularly with bug reporting)
  - More timely source drops which always match current OS and update version
  - More "co-production" with BSD community, where and when it matches their mission
  - [Your idea here]

Q&A