UNIX Concepts

AFNOG Chix 2015
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16th Nov - 20th Nov 2015

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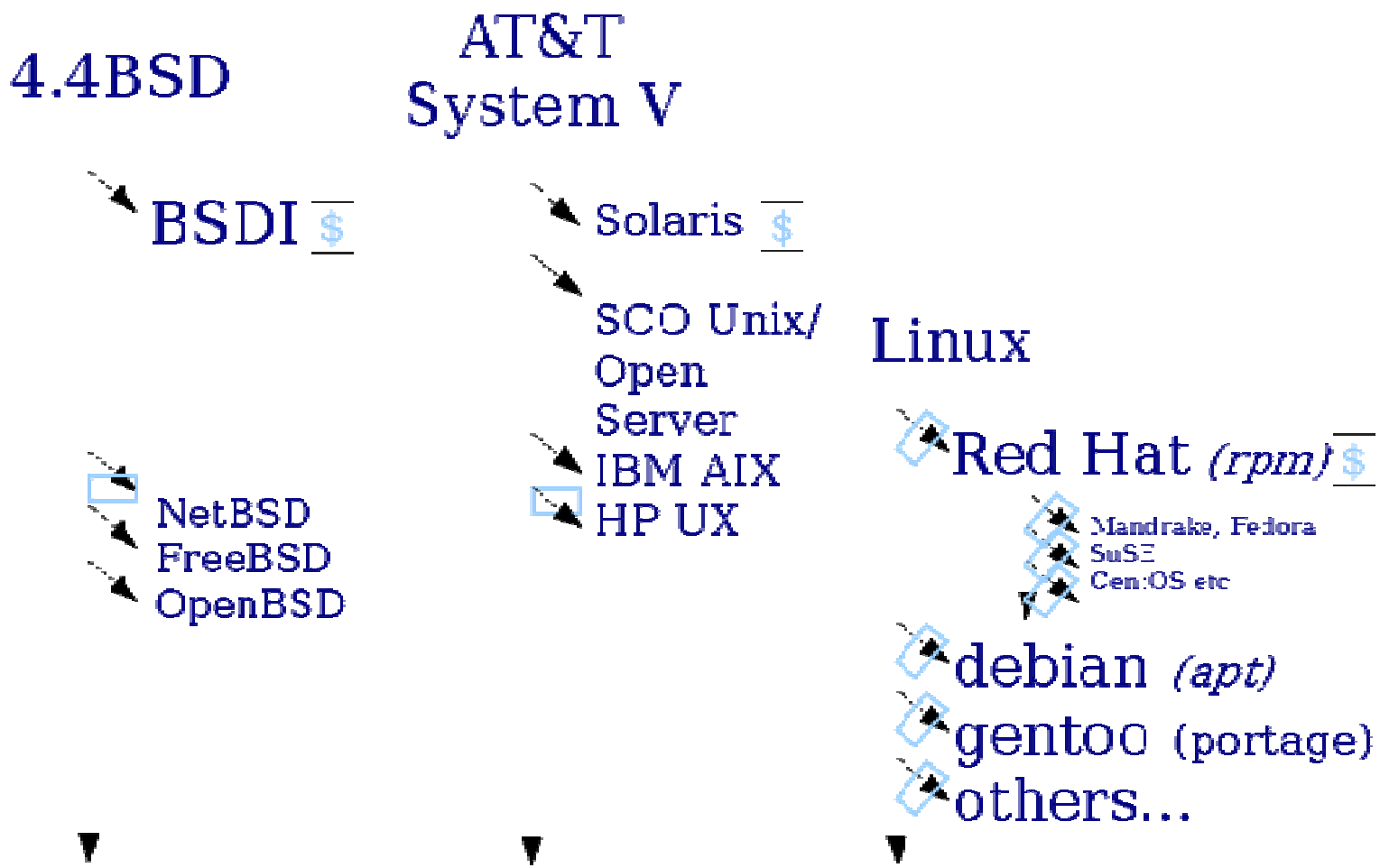
(Credits: NSRC Documentation)

AfNOG

Why use UNIX? Quick Reminder

- Scalability and reliability
  - has been around for many years
  - works well under heavy load
- Flexibility
  - emphasizes small, interchangeable components
- Manageability
  - remote logins rather than GUI
  - scripting
- Security
  - Built in a modular fashion that helps to facilitate securing the OS.

Simplified Unix family tree (Look at the wall, maybe... :-))



Is free software really any good?!

- The people who write it also use it
- Source code is visible to all
  - The quality of their work reflects on the author personally
  - Others can spot errors and make improvements
- What about support?
  - documentation can be good, or not so good
  - mailing lists; search the archives first
  - if you show you've invested time in trying to solve a problem, others will likely help you
  - http://www.catb.org/~esr/faqs/smart-questions.html

Is free software really any good?

- Core Internet services run on free software
  - BIND Domain Name Server
  - Apache web server (secure SSL as well)
  - Sendmail, Postfix, Exim for SMTP/POP/IMAP
  - MySQL and PostgreSQL databases
  - PHP, PERL, Python, Ruby, C languages
- Several very high profile end-user projects
  - Firefox, original Netscape browser
  - OpenOffice
  - Thunderbird
  - Ubuntu

FreeBSD: Why it's Cool

- Uses a single source tree
- FreeBSD project is a non-commercial & independent
- FreeBSD uses the BSD license vs. the *more* restrictive GPL license
- Proven over many years at many sites
- Excellent software package system
- Updating and upgrading FreeBSD is reliable and can be done without a binary install
- FreeBSD has a massive software repository (21788 ports as of May 2010).

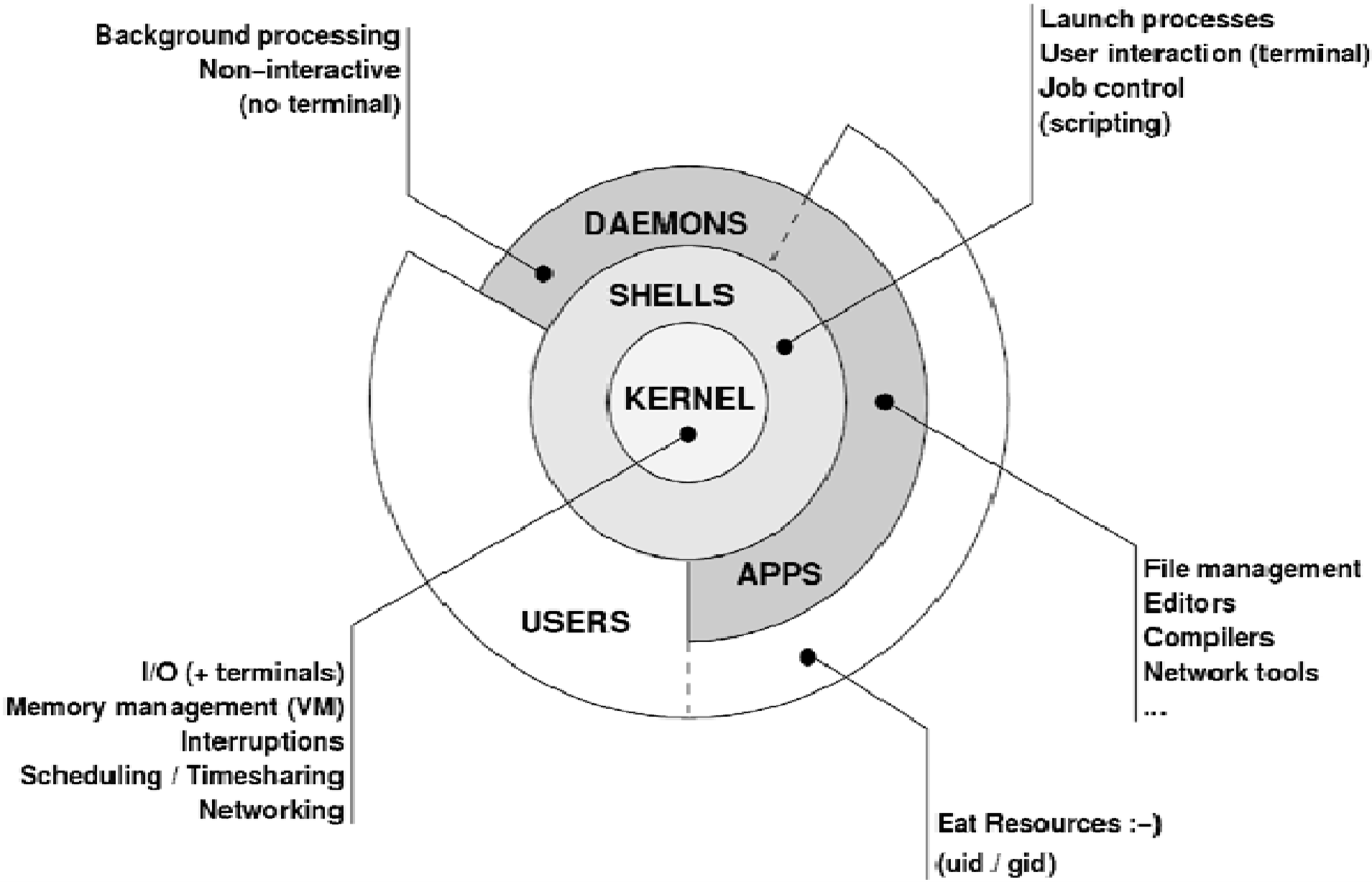
FreeBSD: Why it's Cool

- FreeBSD can run Linux applications, and it can run them as efficiently as Linux in most cases
- Several superior FreeBSD features include:
  - Indexed database file for user passwords
  - Software RAID such as `geom`
  - ZFS file system support
  - A large and experienced community for support
  - Cool, geeky logos ==>

First topics:

- Unix birds-eye overview
- Partitioning
- FreeBSD installation

The UNIX system



Kernel

- The "core" of the operating system
- Device drivers
  - communicate with your hardware
  - block devices, character devices, network devices, pseudo devices
- Filesystems
  - organise block devices into files and directories
  - data structure that allows data on a disk to be organised and accessed by the user
- Memory management
- Timeslicing (multiprocessing)
- Networking stacks - esp. TCP/IP
- Enforces security model

Shell

- Command line interface for executing programs
  - DOS/Windows equivalent: command.com or command.exe
- Choice of similar but slightly different shells
  - **sh**: the "Shell". Standardised in POSIX ($ prompt)
  - **csh**: the "C Shell". Not standard but includes command history (% prompt)
  - **bash**: the "Bourne-Again Shell". Is POSIX standard with command history, up-arrow' and 'down-arrow' recall of previous commands and the use of the TAB key to complete commands. Distributed under GPL (more restrictive than BSD license)

Shell

- Check your shell : # echo $SHELL
- Change your shell: # chsh /usr/local/bin/bash
- Define how your shell behaves in files like:
    - ~/.profile
    - ~/.login
    - ~/.bashrc
    - /etc/profile
    - Please note ~ indicated home directory
- The shell interprets commands for the operating system kernel.

User processes

- The programs that you choose to run
- Frequently-used programs tend to have short cryptic names
  - "**ls**" = list files
  - "**cp**" = copy file
  - "**cd**" = change directory
  - "**rm**" = remove (delete) file
- Lots of stuff included in the base system
  - editors, compilers, system admin tools
- Lots more stuff available to install too
  - packages / ports

System processes

- Programs that run in the background; also known as "daemons"

- Examples:
  - cron: executes programs at certain times of day
  - syslogd: takes log messages and writes them to files
  - inetd: accepts incoming TCP/IP connections and starts programs for each one
  - sshd: accepts incoming logins
  - sendmail (other MTA daemon like Exim): accepts incoming mail

Security model

- Numeric IDs
  - user id (uid 0 = "root", the superuser)
  - group ids
  - supplementary groups
- Mapped to names
  - /etc/passwd, /etc/group (plain text files)
  - /etc/pwd.db (fast indexed database)
- Suitable security rules enforced
  - e.g. you cannot kill a process running as a different user, unless you are "root"

Any questions?

?

Some reminders about PC architecture

- When your computer turns on, it starts a bootup sequence in the BIOS
- The BIOS locates a suitable boot source (e.g. floppy, harddrive, CD-ROM, network)
- The very first block is the MBR (Master Boot Record)
- The BIOS loads and runs the code in the MBR, which continues the bootup sequence

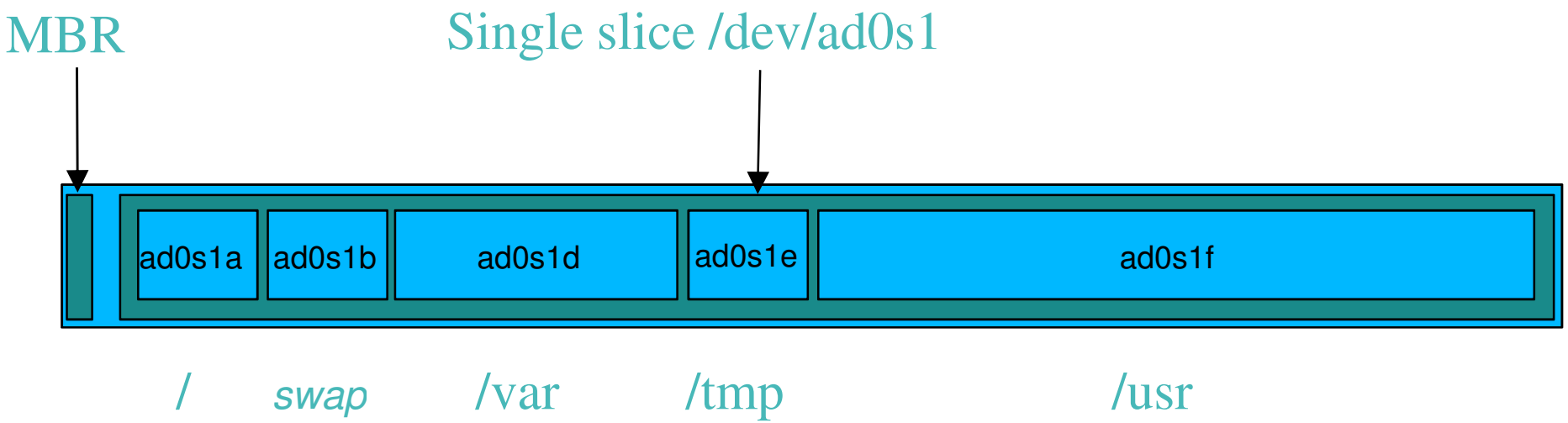
Partitioning

- The MBR contains a table allowing the disk to be divided into (up to) four partitions
- Beyond that, you can nominate one partition as an "extended partition" and then further subdivide it into "logical partitions"
- FreeBSD has its own partitioning system, because Unix predates the PC
- FreeBSD recognises MBR partitions, but calls them "slices" to avoid ambiguity

FreeBSD partitions

- Partitions (usually) sit within a slice
- Partitions called a,b,c,d,e,f,g,h
- CANNOT use 'c'
  - for historical reasons, partition 'c' refers to the entire slice
- By convention, 'a' is root partition and 'b' is swap partition
- 'swap' is optional, but used to extend capacity of your system RAM

Simple partitioning: /dev/ad0




```
/   (root partition)        ad0s1a    512MB
swap partition              ad0s1b    ~ 2 x RAM
/var                        ad0s1d    256MB (+)
/tmp                        ad0s1e    256MB
/usr                        ad0s1f    rest of
disk
```

* Clearly an old, teeny, tiny disk :-)

'Auto' partition does this:

- Small root partition
  - this will contain everything not in another partition
  - /boot for kernel, /bin, /sbin etc.
- A *swap partition* for virtual memory
- Small /tmp partition
  - so users creating temporary files can't fill up your root partition
- Small /var partition
- Rest of disk is /usr
  - Home directories are /usr/home/<username>

Issues

- /var may not be big enough
- /usr contains the OS, 3rd party software, and your own important data
  - If you reinstall from scratch and erase /usr, you will lose your own data
- /tmp could overwhelm "/"
- /usr/home can fill up /usr, some sites mount (separate out) /usr/home as well.

Core directory refresher

- / *(/boot, /bin, /sbin, /etc, maybe /tmp)*
- /var *(Log files, spool, maybe user mail)*
- /usr *(Installed software and home dirs)*
- Swap *(Virtual memory)*
- /tmp *(May reside under "/")*

d

Don't confuse the the “root account” (/root) with the “root” partition.

Notes...

- Slicing/partition is just a logical division
- If your hard drive dies, most likely *everything* will be lost
- If you want data integrity, then you need to set up mirroring with a separate drive
  - Remember, "`rm -rf`" on a mirror works very well
- If you want proper data security then you need to backup. RAID *does not* secure your data.

Summary: block devices

- IDE (ATAPI) disk drives
  - /dev/ad0
  - /dev/ad1 ...etc
- SCSI or SCSI-like disks (e.g. USB flash, SATA)
  - /dev/da0
  - /dev/da1 ...etc
- IDE (ATAPI) CD-ROM
  - /dev/acd0 ...etc
- Traditional floppy drive
  - /dev/fd0

Summary

- Slices
  - /dev/ad0s1
  - /dev/ad0s2
  - /dev/ad0s3
  - /dev/ad0s4
- Defined in MBR
- What PC heads call "partitions"

- BSD Partitions
  - /dev/ad0s1a
  - /dev/ad0s1b
  - /dev/ad0s1d ...etc
  - /dev/ad0s2a
  - /dev/ad0s2b
  - /dev/ad0s2d ...etc
- Conventions:
  - 'a' is /
  - 'b' is swap
  - 'c' cannot be used

Any questions?

?

Installing Software in FreeBSD

- Several different methods
  - ports
  - packages
  - source
  - binary
- We will go in to detail on these methods later in the workshop.

How Does FreeBSD Start?

- The *BIOS* loads and runs the *MBR*
  - The *MBR* is not part of FreeBSD
- A series of "bootstrap" programs are loaded
  - see "`man boot`"
    - `/boot.config` parameters for the boot blocks (optional)
    - `/boot/boot1` first stage bootstrap file
    - `/boot/boot2` second stage bootstrap file
    - `/boot/loader` third stage bootstrap
- Kernel is loaded, and perhaps some modules
  - controlled by `/boot/loader.conf`

How Does FreeBSD Start?

- The root filesystem is mounted
  - "root" = "/" or something like "ad0s1a"
- `/sbin/init` is run and executes the main startup script `/etc/rc`
- This in turn runs other scripts `/etc/rc.d/*`
  - /etc/rc.conf is used to decide whether a service is started or not and to specify options.

Finding more information

- Our reference handout
  - a roadmap!
- man pages
  - esp. when you know the name of the command
- www.freebsd.org
  - handbook, searchable website / mail archives
- "Absolute FreeBSD" (O'Reilly)
- comp.unix.shell FAQ
  - http://www.faqs.org/faqs/by-newsgroup/comp/comp.unix.shell.html
- STFW (Search The Friendly Web) - GIYF...