

THE BOOT PROCESS

From cold silicon to useful OS

OVERVIEW

- The boot process gets a machine from the useless off state to the feature rich operating system we all know and love
- Requires cooperation between hardware and software to correctly hand off processing
- Akin to the life cycle of a human - birth, newborn, infant, toddler, teen, adult

BIRTH

- Power switch flipped on
- Electricity flows from wall, through power supply where it gets converted to the levels necessary for the computer, and on to the motherboard, drives, CPU and more
- Completely unaware of the world or even what's attached to the motherboard.

INFANT

- BIOS - Basic Input/Output System - CPU looks for instructions starting at a specific address, which happens to be where BIOS resides. BIOS initializes and starts the....
- POST - Power On Self Test - A simple set of tests that BIOS performs to verify basic functioning of attached hardware.
- Like an infant, extremely limited understanding of world
- Searches for valid MBR, loads the software found there and transfers control to the...

TODDLER

- Boot Loader - Special software installed to the MBR of the boot partition which selects and loads the kernel.
- Can be configured to immediately load the default OS, or can offer choice to user
- Slightly better understanding of world - can read linux filesystems, sometimes includes powerful debugging and configuration support.
- Main job: select and load kernel, transfer control to kernel

TEENAGER

- Dreaded teenager age: knows a lot about the world, but doesn't contribute a thing. Still pretty useless.
- Kernel loads and initializes. Device drivers are loaded and initialized. Basic hardware checks performed.
- The First Process is *created from nothing*: `init`

ADULT

- init loads the inittab, specifying what software needs to be started. init starts running all of the specified startup scripts
- Services are started by init, including network configurations, X Windows, network services, databases, etc.
- At this point, the machine is finally becoming useful: otherwise, an adult
- Eventually, login processes are started and the boot process is complete!

MORE ON INIT

- init's configuration file is `/etc/inittab`
- This file details actions taken for certain global events, like `ctrl-alt-delete` and UPS `powerfail` and `powerrestore` alerts.
- This file tells init what needs to be done for a given runlevel as well as what the default runlevel is.
- A runlevel defines what services are running...

RUNLEVELS

- Runlevels:
 - S: System startup
 - 0: OS stopped, machine halted (usually powers off as well)
 - 1: Single user mode - for maintenance
 - 2: Multiuser, no NFS shares
 - 3: Full multiuser, TUI
 - 4: Unused
 - 5: Full multiuser, GUI
 - 6: Reboot

RUNLEVELS

- `telinit`: Signal the `init` process to change the current runlevel
- Switching runlevels is fairly uncommon - generally only used if system maintenance needs to be performed
- Runlevels can be used to control what services a machine provides, and can sometimes be useful to quickly reconfigure a machine for a new task

INIT SCRIPTS

- What is actually running in a given runlevel is defined by the init scripts for that level.
- That standard location for the init scripts is:
 - `/etc/rcX.d`
 - Where the X corresponds to the runlevel
- For example, `/etc/rc5.d` contains all of the init scripts that, combined, provide runlevel 5 service

RC DIRECTORIES

- The files in the rc directories start with either an S or a K:
 - S means to start the service, ie run the command with “start” as an argument
 - K means to kill the service, ie run the command with “stop” as an argument
- After the S or K, there is a two digit number which is used for ordering the execution of the scripts

ENTERING A RUNLEVEL

- So when the init process enters a runlevel, the steps are:
 - Run all of the Kill scripts, in order, with “stop” as an argument
 - Run all of the Start scripts, in order, with “start” as an argument

INIT SCRIPTS

- If you look closely, you will see that `/etc/rcX.d` actually holds a collection of symbolic links
- The actual script files are stored in `/etc/init.d`
- The main reason for this is so that there is only one copy of each init script, reducing the chance that a script change won't be reflected in all runlevels.

DAEMONS

- A daemon (or demon) is just a persistent process that performs some action or service. Daemons are what make machines useful. Examples:
 - `httpd`: Web services
 - `mingetty`: Watches terminals and starts login processes
 - `mysqld`: Database services
 - `syslogd`: Logging services

EXERCISES

- View the contents of /etc/init.d. Check out a couple of the startup scripts. Use the httpd script to start up apache. Check that it worked by going to 'localhost' in Firefox. (You'll get a 403 forbidden error, but that's expected)
- Change the runlevel to 3. What happened? Change it back to 5.
- Where can you set the default runlevel?


```
slideshow.end();
```