Building a Universal Mac OS X 10.4 System with Radmind

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Abstract: By splitting Mac OS X 10.4 into PowerPC and Intel versions and delaying a Universal system until Mac OS X 10.5, Apple has complicated the adoption of Intel Macs in enterprise environments. Without a Universal Mac OS X 10.4, enterprise administrators must effectively double their responsibilities and maintain two operating systems. Using Radmind, a collection of open-source system management tools, administrators can create and maintain a single Universal Mac OS X 10.4 image that will boot and run on all supported PowerPC and Intel hardware.

With the release of Intel Macintosh computers, Apple[1] has again taken the difficult step of moving to an entirely new architecture. To ease the transition, Apple has provided developers with the tools to create "Universal" binaries that can be loaded and executed by either PowerPC or Intel hardware, the goal being a platform agnosticism that should, ideally, hide the differences between architectures from the average user. In most cases, this means developers must update applications or force users to run their software in Apple's PPC emulation layer, Rosetta, and deal with performance hits accordingly. Nevertheless, whether they're running applications in emulation or natively, most home users will find the transition little more than the effort required to set up a new computer and load it with their personal information.

The same is not true for enterprise Mac OS X deployments. Most enterprise deployments rely on templates, images and loadsets to manage computers, built from a local configuration of the operating system. Apple has done a decent if not entirely consistent job up to this point of including support for all supported machines in its system software, allowing the administrator to create a single image that will boot and run on all PowerPC hardware. The trouble with Apple's introduction of Intel hardware for enterprise Mac administrators is not that PPC native applications will run in emulation, or that Vendor X has not yet announced Universal versions of their software, but rather that in introducing the Intel hardware Apple has split its OS.

By splitting its OS into PowerPC and Intel versions, Apple has doubled the administrator's workload. The administrator must maintain two systems, must twice apply updates and security patches, must build two NetBoot images, must test software on two platforms. Solutions known to work on one architecture may not work on the other. The goal, then, is a return to a single system image, one capable of booting all models of either architecture. On the surface, this would seem impossible. Apple has split the OS and provides different, though simultaneous, updates for the two platforms, and has made it clear that there

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[1] Apple Computer, Inc. http://www.apple.com/

will be no Universal Mac OS X until the release of 10.5.[2] However, a little exploration of the Intel version of 10.4 suggests otherwise. Using tools like "file" and "lipo," which Apple provides with the system, one can quickly see that most binaries included with 10.4 Intel are in fact Universal. This includes the kernel, most kernel extensions, the system libraries and frameworks; 10.4 Intel even includes the bootloaders for both platforms. What's really stopping this apparently Universal system from booting on both architectures?

The first obstacle to creating a Universal 10.4 system image is Apple. The 10.4 Intel DVD shipping will not boot on a PPC machine. One could use Apple Software Restore (ASR) to restore an Intel ASR image on to a PowerPC disk, but the native partitioning schemes of the two platforms differ, and such a restore will only leave the administrator with an unbootable system. Apple has clearly postponed official work on a Universal Mac OS X to 10.5, though that hasn't stopped others from trying to work around the limitations, with some success.[3]

The solution lies elsewhere, in a collection of open-source tools called Radmind.[4] Radmind is tripwire-based system management software, designed to track changes to the filesystem and allow the administrator to reverse those changes or capture them and store them on the server as loadsets. More importantly for the discussion at hand, Radmind allows the administrator to layer loadsets on top of one another, giving files in one loadset precedence over another. For instance, an administrator can create a set of configuration files that determine what services are running on a client, and then override subsets of those configurations by creating a higher precedence loadset with different settings, altering permitted hosts, enabled services or logging levels, all without modifying the original configuration loadset.

To create a 10.4 Universal system loadset, one must have access to a 10.4 PPC machine and 10.4 Intel machine, as the process requires Radmind system loadsets from each platform. As a Mac OS X administrator and user of Radmind, I had a 10.4 PPC system loadset at my disposal, and when we received an Intel Mac the first thing I did was create a 10.4 Intel system loadset. I hoped, after discovering the 10.4 Intel system was largely made up of Universal binaries, that building a Universal 10.4 image would involve no more than running the 10.4 Intel system software on PPC hardware. Putting my hopes to the test, I used Radmind to apply a stock 10.4 Intel system loadset to a G5 tower that had been running 10.4.5 PPC.

After applying the Intel system software, I rebooted the G5 and was greeted with the cheerful chime of a happy Mac. Curious to see how the system would react to my changes, I booted verbosely. The system came to life and displayed the grey Apple logo with spinning wheel, and then went to the console, white text on a black background, which the system shows during a verbose boot. The kernel loaded but the system promptly kernel panicked, observing that it was unable to locate the drivers for the PowerMac7,3 platform before hanging. This seemed logical. Apple has no reason to include the PPC drivers with the Intel version of the OS as long as the OS is split between architectures. The Universal kernel simply panicked due to the absence of the kernel extensions supporting the G5 motherboard.

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[2] http://appleintelfaq.com/#17.1

[3] http://rentzsch.com/tidbits/intelbasedMacBootIncompatibility

[4] http://radmind.org/

The problem, then, amounted to PPC hardware drivers excluded from the 10.4 Intel system. I could have attempted to restore the missing drivers by hand, copying drivers from my 10.4 PPC system loadset to the G5 that acted as my test machine, but this would have been an inaccurate method, prone to error, as I worked to determine which sets of drivers were required. Moreover, there was no guarantee that if I got the G5 to boot it would necessarily mean my modifications would result in a Universal system that could boot any PPC or Intel Mac.

Radmind offered another, more reliable path to the same goal. Because Radmind allows the administrator to layer loadsets, giving certain files precedence over others according to administrative design, I could add the 10.4 PPC system to the G5's profile without overwriting the universal components from the 10.4 Intel system. If more than one loadset in the machine's profile contains a given object, Radmind will install the file from the loadset with the highest precedence. In this case, it meant that Radmind would install the missing PPC kernel extensions from the 10.4 PPC system loadset while retaining all of the Universal binaries from the 10.4 Intel system loadset. After using Radmind to download the missing kexts, I rebooted the system verbosely once more.

This time the progress continued beyond the initial kernel load. Messages from kextd appeared on the G5's monitor. It gave me two warnings. The first was that it failed to load Dont_Steal_Mac_OS_X.kext, unsurprising as that extension is compiled for Intel hardware only. The other warning came from a failed attempt to load an AirPort driver, which made sense in that the machine does not have an AirPort card. On subsequent reboots neither warning returned, perhaps because the machine's kernel extension cache had been rebuilt. Shortly thereafter, following the usual status messages, the loginwindow appeared, and I was able to log in. The output from uname revealed that I was running kernel 8.5.1, the version included with the 10.4.5 Intel system update.

In subsequent testing, I used Radmind to install our entire lab configuration on top of this newly Universal OS, and everything ran smoothly, from Kerberos login to printing to logout and maintenance scripts. Having thoroughly tested the combination of PPC system with the 10.4 Intel loadset, I applied the Universal OS loadsets to the Intel iMac as I had to the G5. On reboot the Intel kernel ignored the additional PPC-native extensions and loaded without complaint. It functioned identically to its PPC counterpart, with the only exception in that regard being OpenAFS, known to have problems on Intel Macs as of this writing.

The one strange side-effect evident in this hybrid operating system is the behavior of Apple's Software Update utility. The Intel Mac displays all updates as expected, but the PowerPC Mac excludes any update relating to the operating system, whether it be a system revision or security patch. This selective blindness appears to stem from confusion caused on Apple's update server when it receives the client information. Software Update uses HTTP, and posts the client configuration to the server to determine what updates are applicable to the client. Among the details Software Update posts are the system build version and hardware model. Evidently receiving an Intel Mac build number from a PowerPC Mac causes the update server to exclude any system update in the results. This should not prove much of a barrier to the use and maintenance of the Universal 10.4 operating system, as the administrator can use Software Update without problem on the Intel Mac, and can also download and install updates manually.

Apple's reluctance to provide its enterprise customers with a Universal operating system prior to the release of Mac OS X 10.5 may be understandable. The difficulty of propagating a Universal OS patch to all 10.4 users through Software Update is no doubt intimidating, given the potential size and complexity of such an update. Add to that the cost and time of certifying the 10.4 Universal OS for all officially supported Macs, and you likely have the reason Apple has not made a Universal 10.4 available.

Nevertheless, Apple has put its enterprise customers in an awkward position. Not only is Apple migrating to a new architecture, a process guaranteed to be a little rough no matter the effort from Cupertino, not only has it split the OS and in so doing significantly increased the administrator's burden, Apple has also ceased selling several of the mid-range PowerPC systems. As Apple continues to introduce new Intel-based systems, there is no doubt they will continue to phase out the PowerPC systems, as well, tying the administrator's hands when it comes to equipment purchases. Without a Universal Mac OS X 10.4, the administrator must either accept the additional burden of maintaining what amounts to an additional operating system, or dig in their heels and refuse to buy any new machines until Apple releases 10.5. The first option demands much more work; the second is sure to be unpopular with users exposed to Apple's claims of improved system performance on the Intel hardware. Using Radmind to create a Universal Mac OS X 10.4 gives the administrator an alternative that will, I hope, help ease the transition from PowerPC to Intel Macintosh hardware in enterprise environments.