How the Other Half Lives

Developing SDR Software for the Macintosh Platform

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1. As of May 22, 2010

About the Author

- Licensed in 1986 at age 14 as KB7AKH
- Began to program on the Apple II at age 5
- Learned C in 6th grade (on a 512k Mac)
- Spent 15 years in systems and network engineering
- Numerous industry certifications such as MCSE, Sun, and IBM AIX
- Avoids MS Windows like the plague

Myths About the Mac

- The kernel is just FreeBSD
- Because it's UNIX®, all Linux software works
- Everything's that proprietary Apple stuff

Goals of MacHPSDR

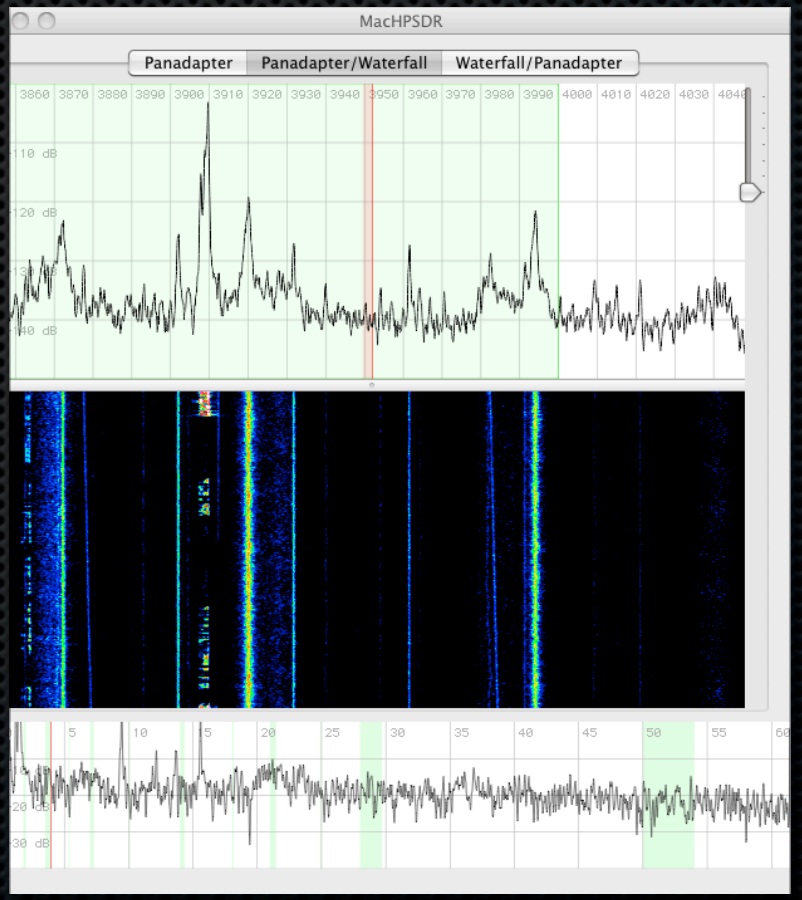
- Be a “First Class” piece of OpenHPSDR software
- Have a “Mac like” interface
- Fully leverage available Mac technologies
- Have a simple installation process
- Make the source code fully available

Mac-GHPSDR—A First Cut

- A port of John Melton's ghpsdr2 to the Mac
- Reworked the libusb code to use IOKit
- Fixed performance problems with threading
- Available at https://www.xenotropic.com/ham-svn/mac-ghpsdr

MacHPSDR

- Native Cocoa user interface
- Written in a mixture of Objective C and C
- Uses an improved version of the IOKit base from Mac-GHPSDR



Apple Technologies In Use

- Objective C
- IOKit
- Cocoa
- Core Animation
- OpenGL
- Grand Central Dispatch
- vDSP
- Sparkle Updater

Objective C

- Required to use Cocoa
- Is a dialect of C that grafts on Object Oriented concepts
- Has a different syntax than C++
- Isn’t bad once you get used to it
- Readability is really nice
  - Ex: [transceiver changeFrequency:3500000 onReceiver:4]

IOKit

- A generic framework for utilizing devices in the OS from userland
- Supports not only USB, but Firewire and other devices
- No driver installation necessary

IOKit Performance

- Asynchronous calls are greatly preferred
- Try to keep at least one transaction in the pipeline at a time
- Use realtime threads for reading and writing SDR data
- POSIX semaphores don’t work quite right, use mach
- Larger block sizes help reduce kernel $\Longleftrightarrow$ userland transitions

Cocoa

- Based on the NextStep tech (you can tell by the NS prefix to classes like NSView)
- Standard application toolkit
- C-based Carbon toolkit will not be ported to 64-bit
- Interface is built with a tool that creates a “nib” file that defines the objects on screen

Core Animation

- A technology that provides animation layers that can be composited
- Includes many default animations that happen automatically
- Stock image filters can be applied to layers
- Layers can be updated from any thread
- Layers can use a variety of drawing technologies

OpenGL

- Standard 3D rendering standard
- A Core Animation layer can provide an OpenGL context
- MacHPSDR's waterfall uses an OpenGL texture that scrolls
- MacHPSDR's panadapter draws the signal line with OpenGL into a Core Animation layer

Grand Central Dispatch

- New technology for “Snow Leopard”
- Provides a way to manage threading and parallelism
- The programmer creates queues, and the OS figures out the optimal number of threads as the program runs
- Optimizes based on the hardware available
- Not used extensively in MacHPSDR because you can’t make “real time” GCD queues

vDSP

- DSP processing functions that are a part of the Accelerate framework
- Shipped on every Mac
- Provides a set of functions that operate on arrays of floating point numbers optimized by using the processor's vector instructions (SSE/Altivec)
- Functions include FFT, convolutions, complex number manipulation, decibel calculations

The “DSP Rework” Branch

- Current trunk uses hacked up DttSP from John Melton’s ghpsdr2
- DSP Rework is a redesign of the DSP functions that DttSP performs
- Rewritten using OO concepts with Objective C
- Extensively leverages the vDSP functions

Sparkle Updater

- 3rd party freely available package
- Allows for automatic updating of software
- Uses an RSS feed containing data about your software revisions
- Also can be configured to canvas anonymous data on user's computer
- Available at: sparkle.andymatuschak.org

Future Technologies

- OpenCL
- Core Audio
- Distributed Objects

OpenCL

- “Open Computing Language”
- Designed to ease construction of massively data parallel tasks
- Computing units include the CPU, GPU, and even some custom designed IBM Cell boards
- Included in Snow Leopard
- GPGPU is difficult for SDR because of small block sizes

OpenCL + OpenGL

- Both standards maintained by the Khronos Group
- OpenGL can use the same buffers as OpenCL

Core Audio

- Standard audio framework on the Mac
- Allows the use of “Audio Units”
- Audio Units are the same plugins that Logic Pro, Garageband, and Logic Express use
- Audio Units can be embedded in any program
- Stock audio units include a 31 band equalizer, a compressor/limiter

Distributed Objects

- Allows Cocoa objects in different programs to communicate
- Similar to remote procedure calls, but on the same machine
- Hope to use this to integrate with logging software and other external programs

Future Directions

- Integration with PSK31 and other digital mode software
- Finish the “DSP Rework” branch
- Integration with logging software
- Put Audio Unit support in transmit chain
- Ichabod — the headless MacHPSDR

How Do I Get MacHPSDR

- Binary Distribution at www.nh6z.net/MacHPSDR/MacHPSDR.zip
- Source in Subversion: https://www.xenotropic.com/mac-svn/MacHPSDR

Documentation

- There is none!
- Could use an intrepid soul to help with the help files

How to Contribute

- Patches are accepted by e-mail and reviewed
- As time goes on, and if there is a critical mass of developers, SVN write access will be granted
- Bugs are tracked on Lighthouse at mcdermj.lighthouseapp.com
- The OpenHPSDR wiki is always a good place to contribute