Welcome

To Advance through Presentation
Use Page Up and Page Down Keys

Open Firmware

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Getting Started with Open Firmware

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Engineering Team

- Paul Resch
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  - NewWorld Architect
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  - Open Firmware Architect

Session Contents

- Introduction to Open Firmware
  - Booting for PowerPC and PCI
- Open Firmware and Your Device
- NewWorld and Open Firmware
- Demonstrations
- Questions & Answers
  - Including feedback

Introduction to Open Firmware

Do you have these questions?

- What is Open Firmware?
- What does it do for me?
- How do I implement it?
- Where's my support?

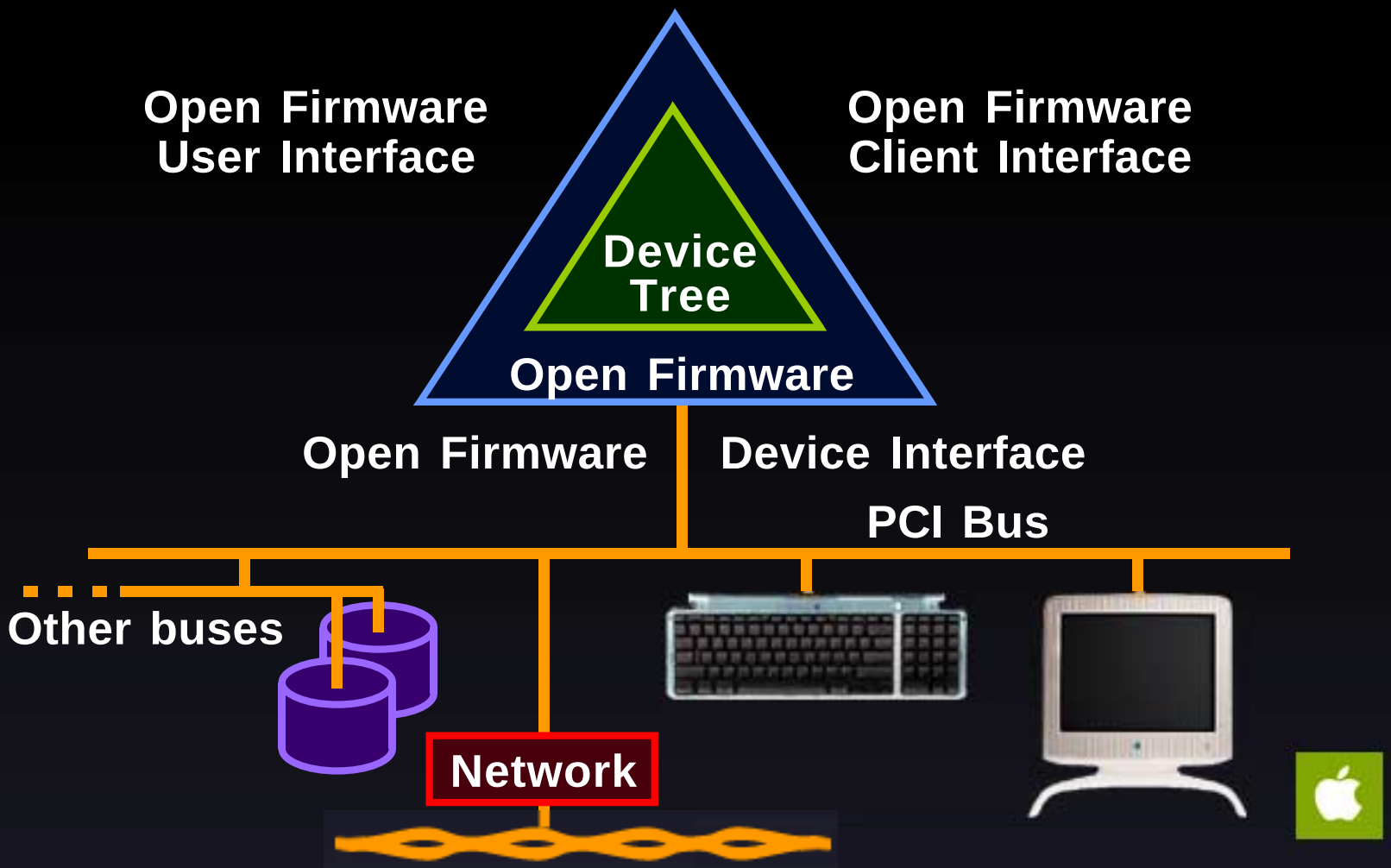
What Is Open Firmware?

- ROM based software
- Controls computer before client is loaded
- OS and ISA independent
- Detects and initializes devices
    - Motherboard
    - Plug in devices
        - Default and device specific

What Is Open Firmware?

- Extensible and programmable commands
- Based on the ANS Forth Language
- Defined by IEEE 1275

Open Firmware System Diagram



Open Firmware Clients

- Open Firmware boots Mac OS 8
- Open Firmware boots Mac OS X
- Open Firmware boots Mac OS X Server
- Open Firmware can boot your OS
    - Starting with NewWorld

Where to Get Additional Information

- IEEE 1275
  - playground.sun.com/1275/home.html
  - bananajr6000.apple.com/1275/home.html
- Bindings
- Apple Technotes and Q&As
  - Developer.apple.com/technotes/tn
- Forth, Inc.
- FirmWorks

Why Use Open Firmware?

- Save on development costs
- Independent from OS changes
- Unique device identification
- Plug-n-Play
- Participate in boot sequence
- Debug hardware
- May not need it

Level of Support

- Full: requires Expansion ROM on device
  - Unique Name
  - Boot driver
  - Runtime driver
- Minimal: requires Expansion ROM on device
  - Unique Name
  - Runtime driver
- None: no Expansion ROM

Open Firmware Devices

- Display — Full Support
- SCSI — Full Support
- Network — Full Support
- Others — Minimal or no support

Open Firmware and NewWorld

- NewWorld Architecture
- Differences between old world and NewWorld
- NewWorld Components
- Overview of NewWorld Booting
- Device Tree and the Name Registry

Introduction to NewWorld

- Allow booting from user choice
- Allow user to choose OS
- Boot ROM Architecture
    - iMac is first Macintosh with NewWorld
- ToolBox was removed
- ROM reduced from 4 MB to 1 MB

NewWorld Architecture

- Old ROM contained high and low level functionality
- NewWorld Boot ROM contains only low level functionality
    - Hardware specific
    - POST and hardware initialization
    - Open Firmware

NewWorld Architecture

- Open Firmware improved
- Device tree more complete
- More FCode drivers
  - Display
  - SCSI
  - Ethernet

NewWorld Architecture

- ToolBox remove from Boot ROM
- ToolBox ROM Image
    - ROM-in-RAM
- ToolBox in write-protected RAM

NewWorld Differences

- Open Firmware and the 9500
  - Version 1
- Open Firmware and < iMac
  - Version 2
- Open Firmware and NewWorld
  - iMac and beyond

Differences

- Memory RAM
  - No longer mapped 1-1 from logical to physical even with VM off
  - Must use Driver Services Lib for I/O
  - PrepareMemoryForIO
  - LogicalToPhysical
- Hardware Addresses
  - Hardware components including PCI bridges relocated

Differences

- Name Registry
  - New functionality
  - Configuration Variables are modifiable from Mac OS
  - Communications between ndrv and FCode drivers now possible
- gestaltMachineType
  - All CPUs have 406 ID
  - Use Name Registry to ID functionality

Differences

- Interrupt Handling
  - API remains the same
  - Latency reduced
- ROM Resources
  - Many resources were duplicated in System Folder
  - Many resources have been removed from the ROM

Differences

- ROM-in-RAM
  - ToolBox image on disk and moved to RAM during booting
  - Image is reduced in size and will be reduced further making more RAM for Mac OS
  - Write protected while in RAM

Differences

- NVRAM and PRAM
  - Old world had hard coded partitions in NVRAM
  - OS and Open Firmware NVRAM partitions were mutually exclusive
  - NewWorld NVRAM has variable size partitions
  - PRAM in OS partition with API to write and read data from offset of OS partition

Differences

- USB Manager
  - Resides in ToolBox ROM image
- ADB
  - Hardware no longer supported
  - ADB Manager treats USB as variant
  - Not all ADB hardware is supported

Differences

- Floppy
  - NewWorld support for CPUs with or without floppy
  - Developers must supply copy protection
- Video Drivers
  - Communications between ndrv and Fcode drivers to allow for user selections

NewWorld Components

- BootROM
  - Resides on motherboard
  - POST
  - Motherboard drivers
  - Open Firmware

NewWorld Components

- bootinfo File
  - Stored on System Folder
  - Mac OS specific trampoline code
  - ToolBox image
  - OS

Boot Process Overview

- POST
  - Early partial initialization
  - Partial diagnostics
  - Boot beep
- Open Firmware
  - Completes initialization
  - Builds device tree
  - Probes slots

Boot Process Overview

- Open Firmware
  - Finds and loads bootinfo file of type tbxi
  - Execute file
    - Execute script
    - Trampoline code
    - Terminate Open Firmware
    - Pass control to OS
- ToolBox initialization

Startup Control Panel

- Open Firmware boot file name and path are not a priori constants
- No longer in ROM
- User changeable
- Stored in NVRAM boot-device variable
- Open Firmware searches for boot file
    - File type is tbxi
    - Localization not required

Name Registry

- Modify Configuration Variables
  - Stored in NVRAM
    - Use options node to make changes
  - Open Firmware detects and modifies device tree
- ndrv and Fcode Drivers
  - Share monitor resolution, depth, etc.
  - Increase byte size for name and property

Demos

- Displaying a directory
- Reading a file
- Booting from a file
- Net booting

dir command

```
0 > dir hd:5,\
   18862 12/ 4/98 20: 0: 0  About%20your%20Power%20Macintosh%20G3
         2/15/99 13:54: 7  Apple%20Extras
  307200  9/29/56 17:26:55  AppleShare%20PDS
         2/15/99 13:54:40  Applications
        12/ 5/98  6: 9:26  Assistants
         2/26/99 14: 6:27  Aurora
         2/17/99 16:49:30  BBEdit%205.0
         9/29/56 12:34: 8  Cleanup%20At%20Startup
         9/21/56 16:52:53  CodeWarrior%20Pro%204
  307200  9/21/56 17:18: 6  Desktop%20DB
 1931234  9/21/56 17:17:56  Desktop%20DF
         9/24/56 16:22:38  Desktop%20Folder
       0  9/21/56 17: 3:38  DesktopPrinters%20DB
        10/ 1/98 14:21:51  Disk%20Copy
         2/15/99 13:53:58  Installer%20Logs
        12/ 5/98  6:14:42  Internet
         2/15/99 13:54:48  Mac%20OS%20Read%20Me%20Files
         2/15/99 16:39:33  MainSources
         9/24/56 20:14:12  MPW
       0 12/ 5/98  6:22:48  OpenFolderListDF%0d
         9/21/56 16:39:26  System%20Folder
         2/15/99 14:33:48  TheFindByContentFolder
         9/21/56 16:59:22  Trash
         2/15/99 13:54:33  Utilities
71303168  9/29/56 12:34:34  VM%20Storage
      55  3/26/99 16:28:48  wayne
```

load command

```
0 > load hd:5,\wayne load-size=37 adler32=13de12e7
 ok
0 > load-base  ok
1 > load-size  ok
2 > .s 800000 37
 ok
2 > dump
00800000: 5c 20 74 68 69 73 20 69 73 20 61 20 46 6f 72 74 :\ this is a Fort:
00800010: 68 20 63 6f 6d 6d 65 6e 74 0d 63 72 0d 64 65 76 :h comment.cr.dev:
00800020: 61 6c 69 61 73 0d 63 72 0d 64 65 76 20 62 72 69 :alias.cr.dev bri:
00800030: 64 67 65 20 6c 73 0d :dge ls.: ok
```

boot command

```
0 > boot hd:5,\wayne load-size=37 adler32=13de12e7

evaluating Forth source

no alias
ff85f438: /mac-io@5
ff85fc00:   /interrupt-controller@10
ff85fd58:   /scsi@10000
ff861bf8:     /disk
ff8629a8:     /tape
ff863b40:   /escc-legacy@12000
ff863d38:     /ch-a@12002
ff863eb0:     /ch-b@12000
ff864028:   /escc@13000
ff864230:     /ch-a@13020
```

Q&A Feedback

NewWorld: Paul

Open Firmware: Ron

Feedback: Wayne

Think different.™

Welcome

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