

Welcome

To Advance through Presentation  
Use Page Up and Page Down Keys



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# FireWire In-Depth



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# What You Will Learn

- FireWire hardware
- FireWire protocols and software
- FireWire bridge solutions





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# Technical Details

Eric Anderson

FireWire Software  
Manager and Technical Lead

# FireWire Standards

- IEEE 1394-1995
- P1394a is essentially done
- P1394b is in progress
- P1394.1 is in progress
- P1394.2 became P2100



# FireWire Hardware

- Core architecture
- Packets



# Physical Layer (PHY)

- Every device has a PHY
- Signal is repeated at each PHY ( $> 1$  port)
- PHYs negotiate node ID values
- PHYs implement arbitration
- PHYs send self ID packets
- 100, 200, and 400, with up to six ports



# Link Layer

- Most devices have a Link
- Assembles packets
- Computes and checks CRC
- Typically has FIFOs
- Host Controllers for PCI
- Single-function Links for DV, SBP-2, etc.





# Asynchronous Packets

- Sent to a memory address
- Read, Write, or Lock
- ROM, RAM, and registers
- Split transactions
- All devices send and receive asynchronous



# Isochronous Packets

- Sent on one of 64 channels
- 8000 packets/second
- Reserved bandwidth
- Up to 80% of the bus
- Cycle Master
- Isochronous Resource Manager



# Protocols

- Serial Bus Protocol 2
- Function Control Protocol
- ISO/IEC 61883
- IP-1394



# SBP-2

- Command and data transport
- Asynchronous, DMA-like, scalable
- Efficient and computer-friendly
- Good for disks, printers, scanners
- Extensive support in FireWire 2.0





# Demo

## FireBug

# FireBug

- Packet snooper for PCI-Lynx
- Not compatible with FireWire Support
- Not a commercial product

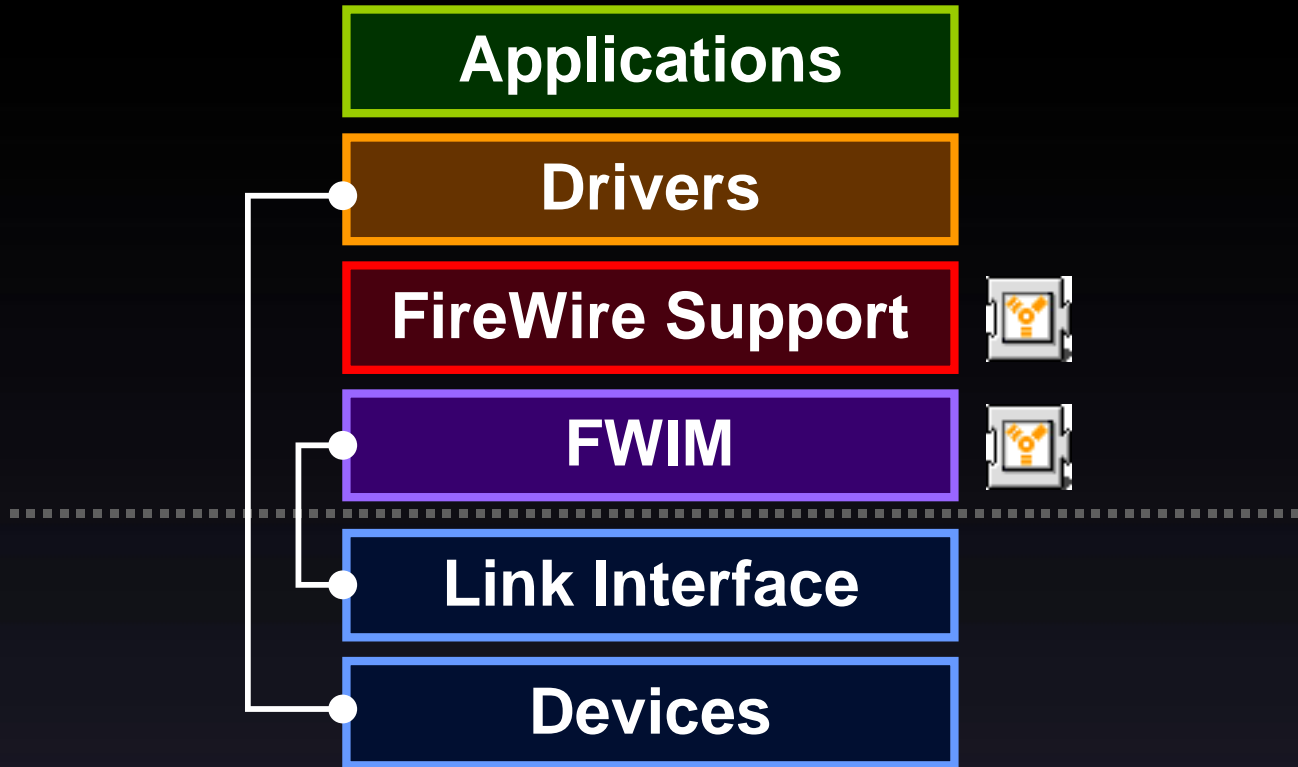


# FireWire Software

- Architecture
- Driver and FWIM loading
- Service model
- Asynch and Isoch services
- Configuration ROM services
- SBP-2 services



# Software Architecture





# Driver Loading

- Auto-detect new devices
- Auto-load driver
- Notify driver of disconnect
- One copy for each device
- Native drivers only
- Special case: Protocol driver



# FWIM Loading

- Loaded at boot time
- Loaded by CardBus enabler
- One copy for each interface
- Native drivers only
- PowerPC, PCI only



# Service Model

- Notification by callproc or AppleEvent
- Command objects
- Asynchronous command execution
- Reference IDs
- Convenience services



# Asynchronous Services

- Read, Write, Lock (address, length)
- Atomic convenience services
- Address space allocation and service
- FCP convenience services



# Isochronous Services

- Transfer is stream-like
- Packet-by-packet program
- Fine-grained timing control
- Resource allocation and maintenance



# CSR ROM Services

- Every device has a descriptive ROM
- Hierarchical search
- Create/modify local ROM data



# SBP-2 Services

- Services common to all SBP-2 devices
- Open and flexible
- Send and monitor ORBs
- Obtain and maintain Logins
- Write page tables



# SBP-2 Expert

- All SBP-2 devices are “fw609e,10483”
- Expert examines Config ROM
- Creates TheDFMData in Name Registry
- Load driver by vendor ID, firmware, etc.







# Demo

## Name Registry

# Extensions

- FireWire Support: API, Experts
- FireWire Enabler: Apple FWIMs
- FireWire CardBus Enabler
- FireWire 3.0 in ROM and Extensions



# Mac OS X/Carbon

- FireWire is below Carbon
  - Applications don't call FireWire directly
- I/O Kit will support FireWire
  - Drivers will need modification
  - Sample code to be provided



# Bridge Solutions

- LSI Logic—in products today
- Initio—in prototype
- Not “Tailgate”!



# FireWire Booting

- FireWire 3.0
- Future hardware
- New World only
- Open Firmware support
- Mac OS ROM support



# AV/C Expert

- FireWire 3.0
- All AV/C devices are “fwa02d,10001”
- Need different drivers for DV, mLAN
- Expert will take a closer look
- Similar to SBP-2 Expert



# Advanced Power

- FireWire 3.0
- FireWire 2.0 only manages local power
- Cannot use power hubs
- Notification for power sharing



# 1394 Open HCI

- FireWire 3.0
- Industry Standard Host Controller
- More Isochronous channels
- Bigger packets
- Physical DMA





# Use 6-pin Connectors

- Easier to orient
- More durable
- Power
- Apple uses only 6-pin connectors



# Use Cable Power

- Apple provides power on desktops
- Operate PHY ( $> 1$  ports)
- Operate device if possible
- Tolerate 8-33 VDC
- See relevant specifications
- No power? Use 6-pin anyway



# Hardware Issues

- Use 400 mbps—don't be a “speed trap”
- Buy a Vendor ID from the IEEE
  - [www.ieee.org](http://www.ieee.org)
- Use unique serial numbers (“GUID”)
- Send us prototypes or designs



# Related Sessions

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## **119: I/O Kit Drivers in Mac OS X**

FireWire in Mac OS X

Hall A1  
**Thurs., 1:00pm**

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## **916: FireWire Feedback Forum**

Tell us what you think

Hall J2  
**Thurs., 2:30pm**

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## **203, 204: USB Intro / USB In-depth**

Two back-to-back sessions

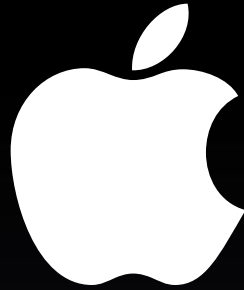
Hall A2  
**Wed., 2:30pm**  
**Wed., 4:00pm**



# FireWire Q&A

- Feedback Forum: Thurs., 2:30 pm (J2)
- [www.apple.com/firewire](http://www.apple.com/firewire)
- [www.1394ta.org](http://www.1394ta.org)
- [firewire@isg.apple.com](mailto:firewire@isg.apple.com)





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