



1394-1995 Overview

Scott Smyers
Director
Sony US Research Laboratories



Overview of IEEE P1394-1995

- ◆ **General Information**
- ◆ **Topology Capabilities**
- ◆ **Data Transport Capabilities**
 - **Asynchronous**
 - **Isochronous**
- ◆ **Related standards activities**
- ◆ **Bus power rules**
- ◆ **Example 1394 devices**



PIEN

IEEE P1394-1995

- ◆ **IEEE standard**
- ◆ **High speed serial interface**
 - 100, 200 and 400 Mbps rates defined
 - Each packet has a speed code
 - ⌘ Different speed devices can be attached together
- ◆ **Logical topology is an arbitrated bus**
 - Each packet is preceded with arbitration
 - All nodes see all packets
 - Arbitration is fair to prevent starvation
- ◆ **Electrical signal is point to point**
 - Each node reclocks, regenerates and repeats all packets



PIEN

Arbitrary topology

- ◆ **Up to 63 nodes per bus, up to 1023 buses**
- ◆ **Nodes can be connected in a tree or daisy chain**
- ◆ **Restrictions:**
 - **16 hops worst case end to end**
 - **No loops**





Supports 2 classes of data transport

◆ Asynchronous

- Addressed, acknowledged, point to point
- Memory mapped
 - Each asynchronous request packet is addressed to a 64 bit address
- Read, Write and atomic Lock transactions defined

◆ Isochronous

- Unacknowledged broadcast
- Channel mapped
 - Each isochronous packet is addressed to a 6 bit channel number with 2 bit tag



PIEN

Asynchronous packets

- ◆ **Payload size depends on transmission speed**
 - 1 to 512 bytes @ 100 Mbps
 - 1 to 1024 bytes @ 200 Mbps
 - 1 to 2048 bytes @ 400 Mbps
 - etc.
- ◆ **Request packets contain a 64 bit address**
 - bus_id (10 bits)
 - node_id (6 bits)
 - offset_address (48 bits)

10

6

48

destination_ID



Example asynchronous packets

8

8

8

8

8

8

8

8

8

8

8

8

8

8

8

8



Asynchronous split transaction

time

< 100 ms



Asynchronous concatenated transaction

time

< subaction gap



Asynchronous unified transaction

◆ Write transaction only

time



Isochronous data

- ◆ **2 bit tag field determines format of data**
- ◆ **Addressed to a 6 bit channel number**
- ◆ **4 bit sy field for out-of-band synchronization**



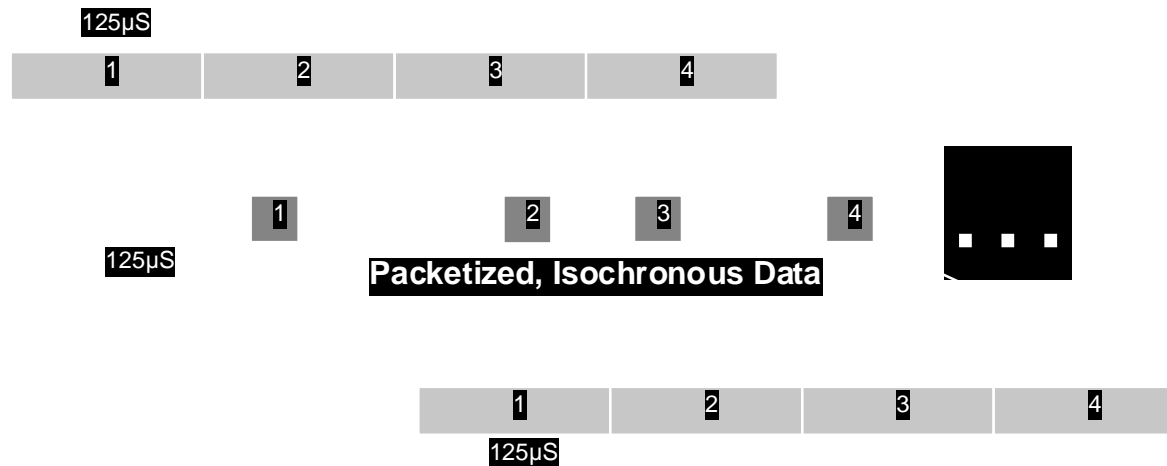
Isochronous data transport

- ◆ Isochronous cycle begins when cycle master sends a cycle start packet
- ◆ One isochronous cycle every 125 μ secs
- ◆ One packet per channel per isochronous cycle



Carrying a continuous stream of data

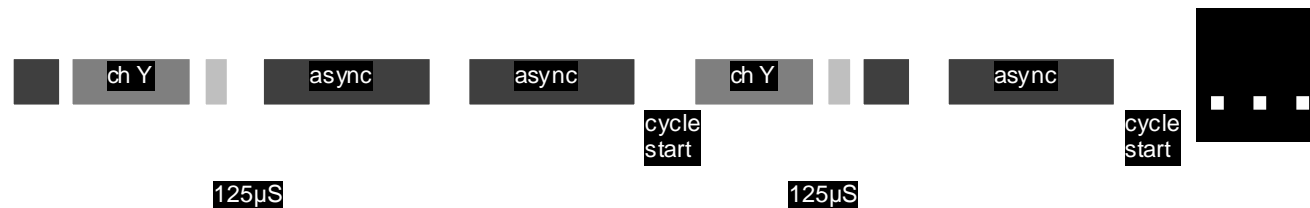
- ◆ A continuous stream of data is packetized at the talker, then reconstructed at the listener





Mixing Isochronous and Asynchronous Data

- ◆ Isochronous and asynchronous data can co-exist on the wire
 - allocated isochronous bandwidth per channel is guaranteed
 - worst case latency for isochronous is bounded
 - remaining bandwidth is evenly distributed among asynchronous sources via a fairness arbitration algorithm





Related 1394 Activities

- ◆ **1394 Trade Association**
 - AV working group
 - PC working group
 - Architecture working group
- ◆ **Standards activities**
 - IEEE 1394a
 - IEEE 1394b
 - IEEE 1394.1



1394 Trade Association

◆ **Audio/Video Working Group**

- **Continuation activity of Digital Video Consortium**
 - **Command delivery protocol**
 - **Consumer Audio/Video command set**
 - **Register level connection management**
 - **Carrying SD format video on 1394**
 - **Carrying MPEG on 1394**
 - ...
- **Consumer audio command sets & data formats**



1394 Trade Association

- ◆ **Camera Working Group**
 - 1394 conferencing camera protocols
- ◆ **PC Working Group**
 - Power distributions rules
- ◆ **Architecture Working Group**
 - Compliant optimizations that require no changes to 1394
 - Reset and arbitration optimizations
 - Some of these changes make it into 1394a
- ◆ **Marketting, Packaging, Silicon, etc.**



IEEE 1394a

- ◆ **Activity is restricted to only fully backward compatible extensions to IEEE 1394**
- ◆ **Active Work Items:**
 - **Incorporate already defined compatible extensions to IEEE 1394:**
 - **Arbitrated short reset**
 - **Common Isochronous Packet Header (tag=1)**
 - **CSR definitions for consumer protocols**
 - **Plug Control Registers**
 - **Function Control Request/Response Registers**



IEEE 1394b

- ◆ **High Speed Extensions**
 - **Shall be fully backward compatible**
 - **Retains 1394 requirement that higher speed PHYs shall be capable of communicating at all lower rates**
 - **Initial focus is 800Mbps and 1.6Gbps**
 - **Definition is open ended**
 - **scalable to 3.2Gbps, and higher**



IEEE 1394.1

- ◆ **Protocols for 1394 to 1394 bridges**
 - **Auto-configuration of busIDs**
 - **Asynchronous communications between devices on different buses**
 - **Routing of isochronous data**
- ◆ **Defines additional CSR registers**
- ◆ **Fully compatible with first generation 1394 devices**



PEN

1394 Power Distribution

- ◆ Presented by Compaq to 1394 Trade Association PC Working Group
- ◆ Defines rules for peripheral and host devices
- ◆ Does not define anything for portable computers
 - Deliberately out of scope because they are at once bus managers, peripherals, power sources, power sinks, resource drains and probably a few other things



1394 Power Classes (i.e., types of devices)

- ◆ **Power Provider**
 - puts power on 1394 bus
- ◆ **Power Repeater (self powered)**
 - repeats power, does not provide nor sink 1394 bus power
- ◆ **Power Consumer**
 - uses 1394 bus power



Power Provider Rules

- ◆ **Reports power capabilities in SelfID packet**
 - **As defined in 1394 standard**
- ◆ **Provides no more than 33V max**
- ◆ **Does not repeat power (this means diodes)**
- ◆ **Device may have any number and type of connectors**
 - **6 pin connectors - must source power on each one**
 - **4 pin connectors**



PIEN

Power Repeater Rules

- ◆ **Shall be self powered**
 - **Shall not provide bus power**
 - **Shall not sink any bus power, *ever***
- ◆ **Shall implement software controlled power (link on/off as defined in 1394 standard)**
- ◆ **Shall not mix connector types**
 - **PC peripherals may have any number of 6 pin connectors**
 - **A/V devices may have any number of 4 pin connectors (such devices are self powered, but not power repeaters!)**



PIEN

Bus Powered Rules

- ◆ **Completely powered from the 1394 bus**
- ◆ **Shall have exactly one connector**
- ◆ **Shall draw less than 1W after initially connecting to 1394**
- ◆ **May draw up to 3W after receiving a `link_on`**
- ◆ **May draw more power to become fully operational**



IEEE 1394 Devices

- ◆ **Sony Digital Video products**
 - **DCR-VX1000**
 - **DCR-VX700**
 - **DCR-PC7**
 - **Digital VCR**
- ◆ **All completely DVC compliant, including digital interface**
 - **(DVC “Blue Book” specifies IEEE 1394 as the digital video connection)**



IEEE 1394 Devices

- ◆ **Sony DVBK-1000**
 - ISA to 1394 video capture card
- ◆ **Sony DVBK-1**
 - DV hardware codec daughter card
- ◆ **Professional video editing card and software**
 - Adaptec/DPG
 - Miro/Skipstone
- ◆ **Yamaha digital audio products**
 - Demonstrated at Comdex 1996
- ◆ **JVC announced 1394 as the digital interface for Digital VHS**



IEEE 1394 Devices

- ◆ **Sony DSM-250 digital communications camera**
 - **Implements digital camera protocol**
 - **Programmable frame sizes from 160x120 to 640x480**
 - **Programmable frame rates from 3.75 fps to 30 fps**
 - **Programmable color resolution from 8 to 24 bits per pixel**



IEEE 1394 Devices

- ◆ **PCI host adapters and/or controllers
(in alphabetical order):**
 - **Adaptec**
 - **Sony**
 - **Symbios**
 - **Texas Instruments**
- ◆ **Sony Camlink chip for DVCR and
Camcorder embedded applications**
- ◆ **PHYs**
 - **IBM, Sony, TI ... others?**



IEEE 1394 Devices

- ◆ **Sony 1394 MPEG link chip for digital set top boxes**
- ◆ **Philips IEC1883 general link chip**
- ◆ **etc.**



Other 1394 News

- ◆ **VESA Home Network standards committee has defined 1394 as home network standard**
- ◆ **EIA R4.1 has defined 1394 for connection to Advanced TV**
- ◆ **DAVIC has adopted 1394 for interconnecting home electronics devices**



Other 1394 News: Device Bay !

- ◆ **Common expansion for PCs**
 - **Microsoft's vision for the future sealed PC**
- ◆ **Definition specifies 1394 for connection to mass storage**
 - **Hard Disks, CDROM, DVDROM, etc !**
- ◆ **Sponsored by:**
 - **Compaq**
 - **Intel**
 - **Microsoft**