IEEE 1394 In the Home

Paul Bottorff
Bay Architecture Lab
Nortel Networks
Santa Clara CA
What We’re Going to Say

Home Networks

1394 In Home Networks

Ethernet On 1394 In Homes

Conclusions
Why Home Networks?

- Telephone Service - POTS/ISDN/ADSL/Cable/Ethernet/IP
- Television Service - Cable/Antenna/DBS/ADSL/Ethernet/IP
- Data Service - POTS/ISDN/ADSL/Cable/Ethernet/IP
- Picture Phone Service
- Home Theater System
- Audio Distribution System
- Electronic Piano and Other Instruments
- Home Computer Systems
- Control Systems for Lights/Theater/Environment/Lawn
- Door Bell System
- Intercom and Baby Monitoring System
- Alarm System
A Unified Home Network

- All outside services carried over a single network
  - Phone Service
  - Cable TV Service
  - Digital Satellite Service
  - Internet Service

- All inside services multiplexed on same network
  - Allows component interaction

- Greatly simplifies installation
  - Rather than 12 different disconnected systems

- Future proof home
  - Home wiring lasts 30-100 years
  - Retrofitting is difficult and costly

- Provides many features which are impractical today
Typical Application

- Connect any audio/video source to any display/speaker
- TV centric not PC centric
Example Problems Solved

- Copy a video tape
- Display video tape on all TV sets
- Edit home video on PC
- Display digital pictures from PC to TVs
- Record piano on PC
- Play piano from PC
- Play music on any speakers from any source
- Select between cable/DBS/IP video program sources
- Control all entertainment equipment from any room
Home Dominated By Video

• Television sets are the most common appliance in home
  • Over 250,000,000 TV sets in America
  • Only 60,000,000 PCs in America

• VCRs, Games, etc. common video peripherals

• Telephones are the second most common appliance

• Stereo is common

• PCs in the home becoming increasing video capable
Audio/Video Characteristics

- **High Bandwidth Streams**
- **Delay and Jitter Sensitive**
- **Loss Sensitive**
- **Multicast Isochronous Channels**

<table>
<thead>
<tr>
<th>Data Rate Mbits</th>
<th>Standard</th>
<th>Application</th>
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<tbody>
<tr>
<td>50</td>
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<td>Digitized VCR Quality</td>
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<tr>
<td>143</td>
<td>SMPTE 259M Level A</td>
<td>Digitized Composite NTSC</td>
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<tr>
<td>177</td>
<td>ITU-R BT.601 or SMPTE 259B Level B</td>
<td>Digitized Composite PAL</td>
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<td>270</td>
<td>SMPTE 259M Level C</td>
<td>525/625 Component Video</td>
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<tr>
<td>360</td>
<td>SMPTE 259M Level D</td>
<td>525/625 Component Widescreen Video</td>
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<tr>
<td>540</td>
<td>SMPTE 259M</td>
<td>Component Video</td>
</tr>
<tr>
<td>1500</td>
<td>SMPTE 259M</td>
<td>HDTV</td>
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</table>
1394 - The Household Interface

• Many Digital Camcorders already shipping
• DTV, DVD, DVCR, Digital Cable, and DBS on the way
• PC 99 Specifies 1394 for consumer electronics interface
• First US digital broadcast of John Glenn’s launch

World Wide 1394 Consumer Electronics Units (in K units)

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<tbody>
<tr>
<td>Camcorders</td>
<td>1,500</td>
<td>3,300</td>
<td>4,697</td>
<td>7,651</td>
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<td>DVCRs</td>
<td>64</td>
<td>660</td>
<td>1,400</td>
<td>2,985</td>
<td>6,170</td>
<td>6,232</td>
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<td>DBS</td>
<td>-</td>
<td>194</td>
<td>3,538</td>
<td>10,159</td>
<td>14,696</td>
<td>18,150</td>
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<td>DVD Players</td>
<td>-</td>
<td>-</td>
<td>675</td>
<td>4,730</td>
<td>13,050</td>
<td>21,280</td>
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<td>Cable Set Tops</td>
<td>-</td>
<td>150</td>
<td>1,860</td>
<td>6,000</td>
<td>11,680</td>
<td>17,739</td>
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<td>Game Consoles</td>
<td>-</td>
<td>-</td>
<td>980</td>
<td>6,177</td>
<td>16,349</td>
<td>18,393</td>
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<td>Digital Still Cameras</td>
<td>-</td>
<td>10</td>
<td>207</td>
<td>585</td>
<td>2,288</td>
<td>4,725</td>
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<tr>
<td>Total TV Peripherals</td>
<td>1,564</td>
<td>4,314</td>
<td>13,357</td>
<td>38,287</td>
<td>73,662</td>
<td>97,943</td>
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<tr>
<td>IEEE 1394 TVs</td>
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<td>50</td>
<td>700</td>
<td>3,000</td>
<td>7,500</td>
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<tr>
<td>Total Consumer</td>
<td>1,564</td>
<td>4,364</td>
<td>14,057</td>
<td>41,287</td>
<td>81,162</td>
<td>107,943</td>
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Source: In-Stat
Possible 1394 Home Network

- IP
- Data Box
- Telephone
- Voice Line
- Digital Cable
- 1394b Bridge
- Ethernet
- 1394a Switch
- 1394a bus

1394b
50-100 meters

1394a 4.5 meters

Study

Living Room

1394ab Bridge

1394a 4.5 meters

1394a bus
1394 Compared to 802

1394 Architecture

<table>
<thead>
<tr>
<th>Bus Resource and Node Managers</th>
<th>Transaction Layer (Read, Write, Lock)</th>
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<tbody>
<tr>
<td>Link Layer (Arbitration, Framing, Confirmation)</td>
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<tr>
<th>Physical Layer A</th>
<th>Physical Layer B</th>
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<tr>
<td>100,200,400 Mbit</td>
<td>400,800,1600,3200 Mbit</td>
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802 Architecture

<table>
<thead>
<tr>
<th>Logical Link Control (LLC)</th>
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<tr>
<th>Media Access Control (MAC)</th>
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<th>Physical Layer PHYs</th>
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64 Bit Global Memory Address Model
Confirmed and Unconfirmed Datagrams
Isochronous Multicast Channels
Memory Read/Write Transactions
Hierarchical Transaction Layer Bridges

48 Bit Unique Node ID
Unconfirmed Datagrams
Asynchronous Multicast
Reliable or Unreliable Streams
Transparent MAC Layer Bridges
Ethernet Over 1394

- **Used for home data service distribution**
  - PC to PC
  - PC to Internet
  - PC to printer
- **Easy connection to existing PCs, Routers, Cable Modems, etc.**
  - PCs only require protocol changes
  - Routers and Cable Modems unchanged
- **Future proof against changes in IP networks**
  - Not affected by transition from IP4 to IP6
  - Allows lightweight inhome protocols
- **Implemented using a subset of existing 1394 protocols**
  - May run in parallel with entertainment video or POTS
Conclusions

- 1394 bus interfaces provide an excellent foundation for providing integrated home networking
- 1394 is suited to both high quality video and low cost control interface
- Ethernet data service may be provided over