

1394 Product Seminar

HDTV Home Networks

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Presenter's Background

- Managed the Networking group at MTDC
(Matsushita Technical Development Center)
- Represented Panasonic at 1394TA, UPnP and CEA meetings
- Retired from Panasonic in 2005 and became a consultant specializing in 1394 Networking
- Now Chairman of the 1394TA Wireless work group, and Secretary of the 1394TA Audio Video work group

HDTV Home Networks

- HDTV signals require Isochronous streams of data
- Isochronous (time synchronized) for Quality of Service
- Delays in HDTV signals destroy picture synchronization
- 1394 can reserve bandwidth for Isochronous data
- 1394 can select the advantages of many different media:
 - CAT 5E or CAT 6 (twisted pairs)
 - RG 59 or RG 6 (coax)
 - POF (Plastic Optical Fiber)
- 1394 can coexist with other TV signals over the same cable by adding UWB (Ultra Wide Band) wireless techniques

1394 Isochronous HDTV throughput

- 1394's application layer throughput is about 80% of the PHY data rate (compared to 50% for Ethernet)
- 1394 reserves Isochronous throughput for each joiner until 80% of the available throughput is reserved, after which additional requests for Isochronous throughput are refused
- After Isochronous throughput is allocated, the remaining throughput is only available for Asynchronous throughput
- MPEG 2 compressed 1080i HDTV signal needs 20 Mbps
- For 100 Mbps 1394, the application layer throughput is 80 Mbps, of which 80% = 64 Mbps can be reserved for Isochronous data, allowing 3 HDTV streams (60 Mbps), and 20 Mbps for Asynchronous file transfers

Ethernet problems with HDTV

- Ethernet's application layer throughput is only about 50% of the PHY data rate
- Ethernet allows all comers to join the network
- The available throughput is equally shared and as more join the network each gets less throughput
- Each MPEG 2 compressed 1080i HDTV signal requires 20 Mbps throughput (1080p HDTV requires 40 Mbps)
- For 100 Mbps Ethernet the application layer throughput is only 50 Mbps. One 1080i HDTV signal fails each time 2 File transfers are attempted (each gets only $50/3 = 16.7$ Mbps)
- Ethernet does not reserve bandwidth for Isochronous data!

Ethernet partial solutions for HDTV

- New routers are available for Ethernet that can set priorities for HDTV and Audio signals
- These priorities can improve QOS performance provided that not too many priorities exist at the same time
- Also older legacy Ethernet devices do not recognize such priorities and must be removed from the network or isolated by one of these new routers to avoid conflicts
- Mistakes as shown above, made by a home owner can stop the QOS performance of Ethernet networks
- Ethernet networks are best effort, and can not guarantee QOS since they can not reserve Isochronous bandwidth

HDTV throughput comparisons

IEEE 1394

- 100Mbps 1394 has 80Mbps at application layer
- 80%, 64Mbps can be reserved for Isochronous data
- 3 x 1080i HDTV streams require $3 \times 20 = 60$ Mbps
- $80 - 60 = 20$ Mbps remains for file transfers
- 2 file transfers would allow each to have 10Mbps

Ethernet

- 100Mbps Ethernet has 50 Mbps at application layer
- 2 x 1080i HDTV + 1 file transfer equally allocates the 50 Mbps so each gets $50 / 3 = 16.7$ Mbps
- HDTV loses synchronization!

1394 Media Comparisons

Maximum End-to-End cable length comparison
For S400 1394

Media		Meters
Long Haul UTP (twisted pairs)	CAT 5E	50
	CAT 6	75
Long Haul Base Band Coax	RG 59	71
	RG 6	97
Via UWB over Coax (without cable splitters)	RG 59	123
	RG 6	167
Plastic Optical Fiber (POF)	Low cost	25

UTP or Coax or POF

- Homes with structured wiring tend to have CAT 5E wiring to PC locations, and Coax wiring to TV locations
- 1394 can run over either of those options
- If a home owner adds new wiring, he prefers to add Coax because it is easier to terminate Coax than CAT 5E
- Another advantage of RG 6 Coax is that it tends to have a greater end-to-end range than either CAT 5E or CAT 6
- To cross rooms under carpets POF is best since it is thin and flexible with no electrical safety risks
- Another advantage of POF is that it can run along electric power cables without picking up interference

Base Band Coax versus UWB Coax

- POF, Base Band coax & UWB coax solutions are more complex than UTP since all 1394 signals go to one wire
- 1394 via UWB can achieve 70% greater end-to-end range than Base Band 1394 if no splitters are used
- UWB coax is the most complex solution, but it can pass through cable splitters (for a reduced end-to-end range)
- However the main reason for using 1394 via UWB over coax is that it can operate over the existing coax that is used to distribute Cable TV or Satellite TV signals
- The UWB signals on the coax operate between 3.3 and 4.7 GHz, and can coexist with other TV distribution signals

1394 via UWB over Coax

- 1394 via UWB over coax networks use more complex and expensive components but can use existing coax cables
- This technology combines all the 1394 signals and transfers them through an Internet Protocol L3 bridge to a UWB stream which is injected into the coax, and that process is reversed at the other end of the coax
- These L3 bridges connect 1394 clusters using IPv4 for command and control functions so that isochronous 1394 signals can pass between 1394 clusters
- Using IPv4 overcomes the bridge aware problem in 1394 but also allows these L3 bridges to be designed to also interconnect via IP to 1394 clusters outside the home

HDTV Home Networks Contacts

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