High Resolution Video Stream

Streaming for the Internet

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Our Motivations

- Developing
  - High Bandwidth applications
  - Real time application
    - Isochronous and collaborated packet forwarding
  - Scalable application
    - Considering next generation infrastructure
- Consumer availability
  - High Technology at low cost

→ Media transport mechanism for the Internet Infrastructure

Video Streaming

- High Quality, Broadband, Low Latency
  - Resolutions
    - 120 x 80 / 160 x 120 / 240 x 160 / 320 x 240 / 480 x 320
    - 640 x 480
    - 720 x 480
    - 1024 x 768
    - 1080 x 720
    - 1920 x 1080
    - 1600 x 1200
    - 1960 x 1200
    - 3820 x 1200
    - 3820 x 2400
    - 7640 x 4800
  - Frame Rate
    - 5/12/15/25/30(29.97)/60
    - 90/120/150/180
  - Colors
    - 8 bit
    - 15 / 16 bit
    - 24 / 32 / 64 bit

1996 July, Stream Works Live

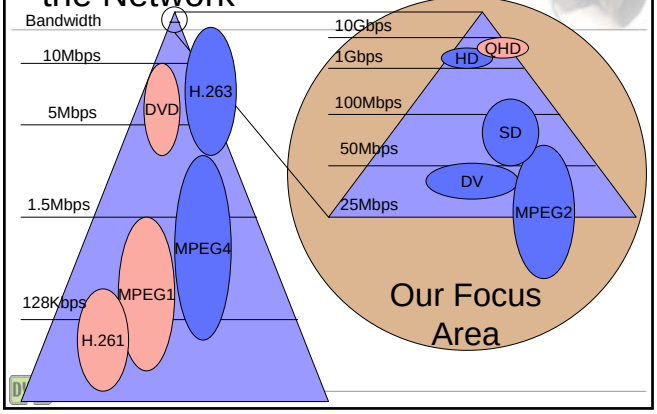
Doing Math..

- Sending Uncompressed Raw HD streams
  - 1920x1080 x 32 x 24 = 1.59Gbps = 199MB / Sec

VS.

  - PCI Bus (32Bit)
    - 33.3MHz 32Bit = 33.3 x 32 / 8 = 133MB/Sec
  - HDD – Memory – Screen – Network
  - Limitation in Bus Bandwidth
- Sending Q-HD
  - 3840 x 2400 x 32 x 24 = 7.08Gbps = 885MB / Sec
  - PCI-X

Video Streaming Over the Network



Superior Quality Streaming

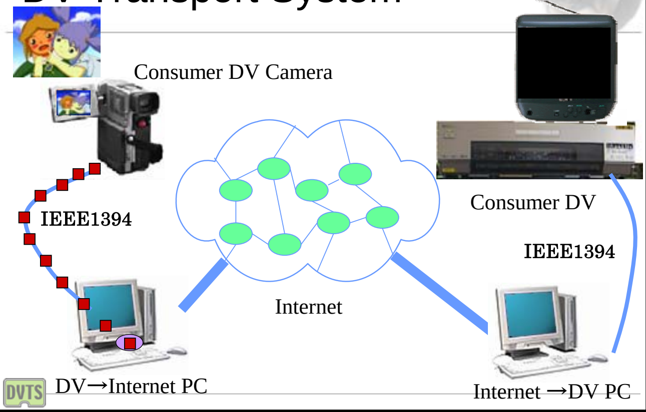
- Open source
  - Publicity
    - Inter-operability
    - standardization
  - Expansion readiness
- Possibilities
  - SOI --- distance education and collaboration
  - Multiparty real-time collaboration
- Applied use
  - Commercial embedded equipments

DVTS: Motivations

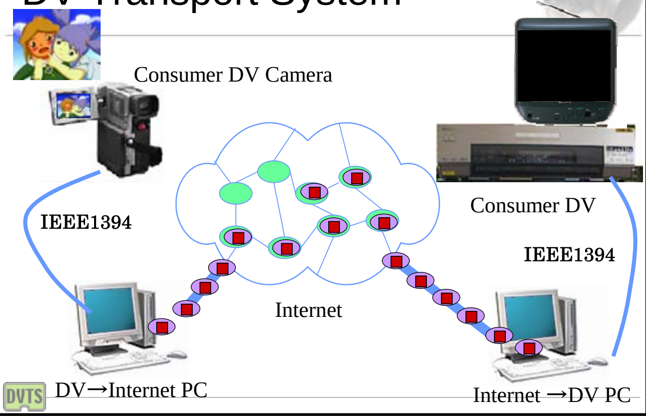
- Using the Internet
  - Realization of High Quality Video and Audio Transport
    - NTSC Television Specification requirement
      - High Quality Video Conference System
    - CD Quality Audio
  - Broadband networks and next generation protocol
    - >10Mbps
    - IPv6
  - Low cost consumer availability
    - Using consumer products
    - Realization at low cost
  - Multiple Platform (Operating System)

Started 1998

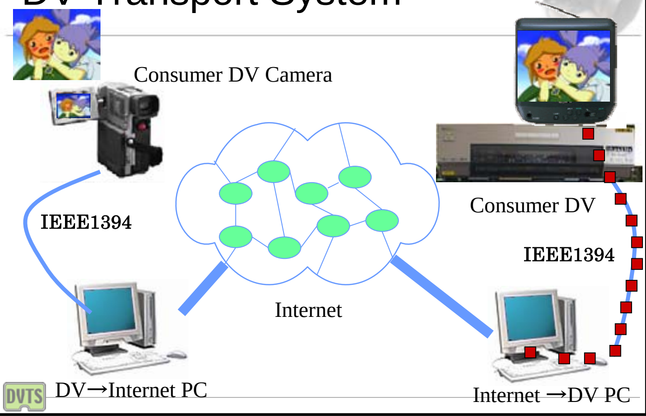
DV Transport System



DV Transport System



DV Transport System



DVTS Consortium

- Consortium to develop High quality video transport/exchange system using the Internet
  - Founded October, 2002
    - Construct development environment for DVTS
    - Standardization of DVTS
    - Rights and agreement control for DVTS

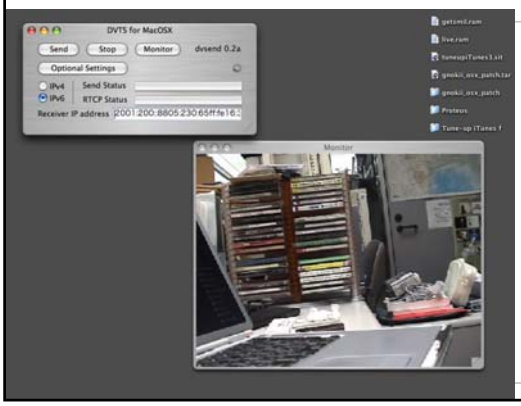
http://www.dvts.jp

DVTS Consortium

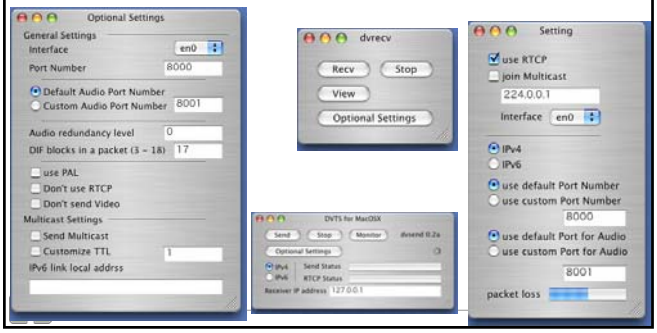
Implementation of DVTS

- Supported Environment
  - FreeBSD 4.X
  - FreeBSD 5.X
  - NetBSD 1.5.X
  - Linux 2.4.X
  - Windows ME
  - Windows 2000
  - Windows XP
  - Mac OS X

DVTS for MacOS X



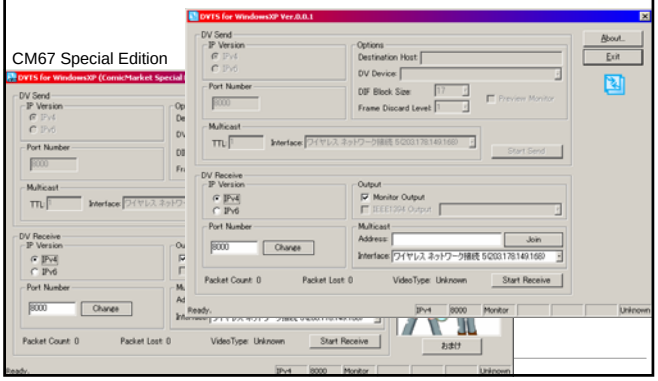
DVTS for MacOS X



DVTS for Windows

DVTS for Windows Ver 0.0.1-1

CM67 Special Edition



Windows XP

- Completely new coding from scratch
- PAL people ? NTSC people? JOIN!
  - PAL support added
- IPv6 Multicast? IPv4 Multicast? No problem!
- Dual output support
  - IEEE1394 output
  - Display output (supports full screen output)
- RTCP supported
- Flow control / Synchronization
  - Better lip synchronization problem
- DIF Block configuration for MTU adjustment
- New user interface
- SDP (send, receive)

Kazuhiro Mishima (three@sfc.wide.ad.jp)

Linux Release

- Supports MPEG2TS
  - MPEG2 based DV
  - MPEG4 based DV
- HDV Support
- Interoperability support with
  - VIDEOLan

Enhancing DVTS

Embedded DVTS by JVC

Embedded DVTS

Extension Module

Embedded Linux

Hardware DVTS By IIGA

DVoD Demo

MPEG2TS

- BS Digital Broadcast
- Recording Medium
  - D-VHS (Digital VHS)
- Video Camera
  - MICROMV(Sony)
- DV-HD
  - 720p Hi vision
  - 1080i Hi vision
- IEEE1394 Interface

→ Merge DVTS

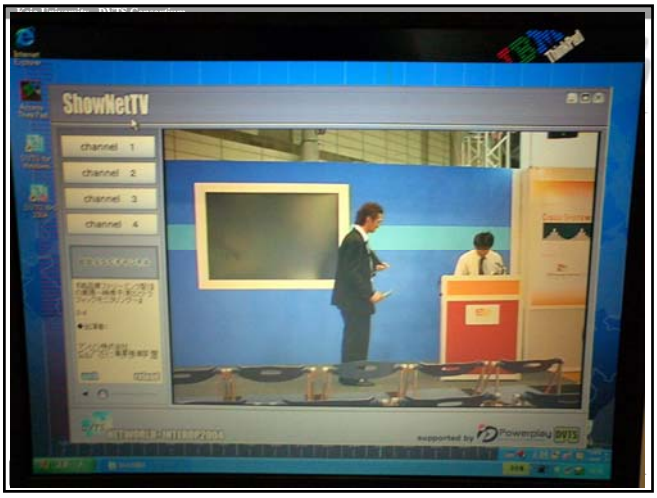
Digital Broadcasting Tuner

DVTS

Custom DVTS

- Custom DVTS
  - For INTEROP ShowNetTV
    - IPv6 Multicast
    - 3 channel

DVTS



DV Session Manager

- Mixer
- Channel control

DVTS

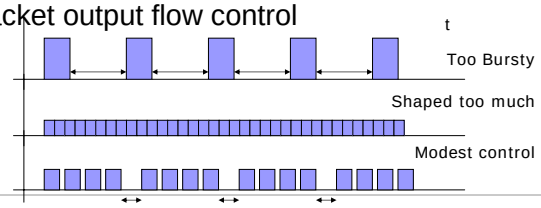
Research and Development

Interoperability Symposium

- July 21st – 23rd, 2004
- Keio Univ. SFC

Packet Flow Control

- Packet output jitter
  - Interoperability issues in
    - Hardware embedded systems
      - Has low buffer availability / Causing buffer overflow with burst traffic
    - Buffer overflow and buffer under run
- Packet output flow control



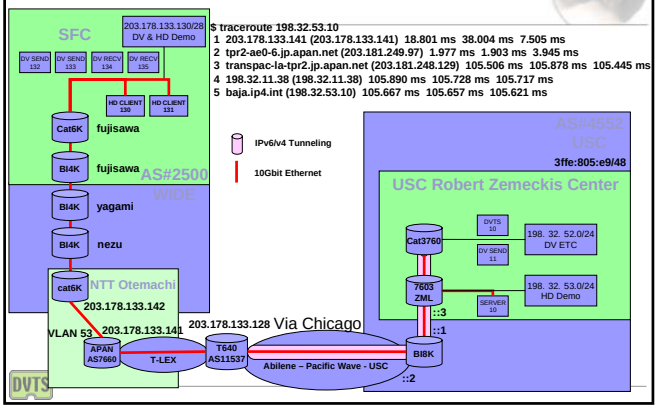
iHD demo in Interop 2004

Baja System

- 3840x2800 QHD Display
  - Collaborative HD editing system for Digital Cinema
  - Raw HD Streaming
    - 1.2Gbps
  - Demo at Robert Zemeckis Center
    - South California University
    - Sept 14th, 2004
  - IPv6 network

HD Editing System (BAJA)

Network Topology



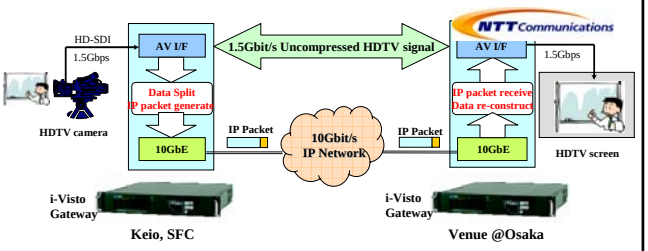
Two Uncompressed HD session

- 17th JAN Jun Murai's keynote session
  - SFC,Keio<- ->Venue
  - Uncompressed HD, DVTS
    - i-Visto by NTT
    - SFC--WIDE--JGN--Venue
- 18th JAN Larry Smarr's keynote session
  - University of Washington<- ->Venue
  - Uncompressed HD(Oneway:UW->Venue), Compressed HD, DVTS
    - iHD1500 by UWTV, NA3000 by NTT
    - UW--IEEAF--JGN--Venue

Real-time HD over IP with "**i-Visto**"

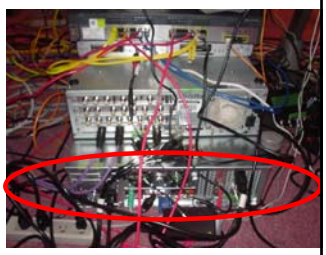
i-Visto['aibist] : Internet video studio system for HDTV production

Real-time transport system for high quality video signal over IP network such as uncompressed HDTV (1.5Gbps), SDTV (270Mbps) between multiple points which is provided by NTT Communications



iHD1500

- Real-time Uncompressed HDTV over IP transport system made by UWTV(University of Washington, Research Channel)
  - Intel Xeon 3.2GHz * 2
  - 2GB MEM
  - Intel PRO/1000 MT Dual
  - AJA Video XENA DXT (New Rev)
  - Windows XP Pro
  - cygwin



NA3000/HE1000/HD1000

- MPEG-2/HD Video transport system by NTT electronics (NEL)
  - **NA3000**
    - Up to 4 MPEG-2 streams over IP network
    - Choose RTP/UDP and unicast/multicast
    - Variable packet size up to 32KByte
    - MPEG-2 input/output: DVB-ASI (to connect encoder/decoder)
    - MPEG-2 input: packet or burst, output: packet
  - **HE1000**
    - Video input format:HD-SDI(SMPTE292M)
    - Video profile, level: MP@HL, 422P@HL
    - Video Format:1080i(1920x1080,29.97fps)、720p(1280x720,59.94fps)
    - Signal Format:4:2:0, 4:2:2 compress
    - Audio input method: AES/EBU
    - HD-MUX function
  - **HD1000**
    - Video output Format: HD-SDI、Y,Pb,Pr
    - Video profile, level: MP@HL、422P@HL
    - Audio output method: AES/EBU
    - HD-DEMUX function
    - Video Format:1080i, 720p, 480i(able to down convert)

Equipments @Venue

i-Visto

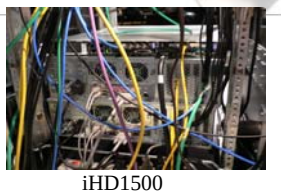
Barco DLP Projector

iHD1500/NA3000/DVTS

AV Control

Equipments @UW

NA3000



iHD1500

AV Control room

SDTV from Venue

Keio University - DVTS Consortium

Presenter's View @SFC

DVTS

Keio University - DVTS Consortium

Site View @SFC

DVTS

Keio University - DVTS Consortium

Main Theater

From UW
(Latency 40ms)

From SFC
(Latency 4ms)

DVTS

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UW and Venue

i-Visto team @venue

UW member

DVTS

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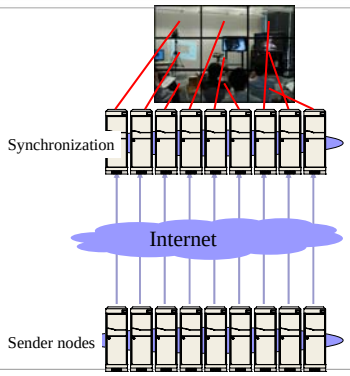
Multi-vision DVTS

- Multi-vision
  - Multiple Display
    - 3x3, 4x4
  - High resolution

DVTS

Keio University - DVTS Consortium

M-DVTS



DVTS

Technology Requirement

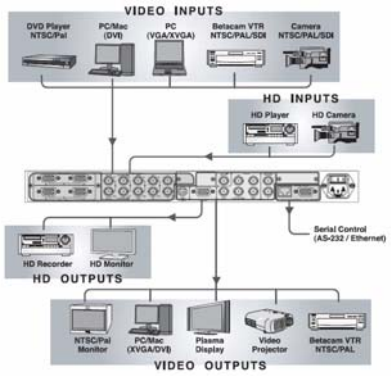
- Packet Streaming
- Synchronization
- Isochronous transport
- Jitter control
- Real time accessibility
- Collaborative packet flow control

@ Minimal Cost

Higher Quality, Higher $$$

- Higher resolution requires higher bandwidth
  - Equipment costs
    - HD Cameras
    - HD Video recorders…
- Low cost solutions
  - Using Media conversion unit (Media Scalar)
    - Indie 400
      - Conversion between
        - Composite, Component, IEEE1394, SD, HD, SDI…

Highly integrated video mixing and channeling



FYI

http://www.sfc.wide.ad.jp/STREAM

http://www.dvts.jp/