i-Visto: Uncompressed HDTV-over-IP Transmission System for TV Broadcasting Industry

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Topics:
- Uncompressed HDTV over IP for Broadcasting Industry
- Outline of i-Visto system
- Usage examples of i-Visto
Uncompressed HDTV over IP for Broadcasting Industry

• Why uncompressed?
  – High quality
  – Low latency

• Why use IP?
  – Low cost (equipment, WAN service, short-term use)
  – Multi-format
  – Data multiplexing (control, metadata)
  – Connectivity with NLE
Necessary Bandwidth for HDTV Transmission

- HD-SDI: 1.5 G
- 10bit-Active: 1.3 G
- 8bit-Active: 1 G
- HDCAM: 140 M
- DVCproHD: 100 M
- MPEG-2: 50 - 150 M
- Digital TV: 15 - 20 M
- WM9: 3 - 6 M

Network Types:
- Ethernet
- FE
- GbE
- 10GbE
- OC-48
Transmission Delay

- From the standpoint of the broadcasting operation
  - 0 frames: ideal
  - 1 frame: possible to operate as almost zero delay by a deliberate design
  - 3 frames: limit for appearing as zero frame delay to human senses

- Factor of delay
  - Propagation delay
    - Tokyo ~ Osaka (500 km): 0.08 frames
    - Japan ~ USA (10,000 km): 1.5 frames
    - Satellite: 15 frames
  - Compression and expansion delay
    - MPEG-2: 6 ~ 15 frames
i-Visto gateway

- i-Visto gateway performs conversion between digital video signal (HD-SDI/SD-SDI) and IP packet streams

- Features:
  - PC-based system
  - Two HD-SDI streams, 0.5 frames delay
  - 10GbE, 10G POS, 2.4G POS, GbE x 2 support
  - IPv4/v6, unicast and multicast support
  - Video sync. clock transmission support
Video transmission using i-Visto gateway

Unicast (single or bi-directional)

IP multicast
Low-latency Transmission Technology

- Conventional HD-SDI cards have a big delay due to their frame buffer feature.
- New low-latency HD-SDI I/O card
  - Design change in our 2.4G POS NIC
    - Change in PHY interface (SONET -> SDI)
  - Packet processing scheme
    - one video line = one packet
Video Sync. Clock Transmission

- Objective: transmit video sync. signal in the broadcasting station to remote site to achieve video transmission without frame dropping.
  - Conventional (e.g., MPEG-2 TS):
    - Re-generate source video clock at receiver side (from sender to receiver)
  - In i-Visto:
    - Re-generate receiver side clock at sender side. Cameras at sender side use the re-generated receiver side clock.
i-Visto eXmedia server: Integration with Storage System

- Network attached high-speed storage
- PC cluster-based system
- Up to 10 uncompressed HDTV streams
Network Computing

- i-Visto media converter
  - PC-based networked video processing
    - E.g., down converting from HDTV to SDTV
Usage examples of i-Visto
• Uncompressed HDTV and two SDTV signals were transmitted in two directions over pacific OC-48c line
• Delay below three frames was achieved
  – Two-way communication was performed without any sense of incompatibility.

- Using JGNII 10GbE between Tokyo and Osaka
- Three uncompressed HDTV streams on 10GbE
- IPv4 and IPv6 streams at the same time

(JGNII: Japan Gigabit Network II)
InterBEE 2004 (Nov. 2004)

- 4 points in Japan ware connected with 10GbE
- 5 uncompressed HDTV streams on a 10GbE
- Video clock synchronization
EXPO 2005 Aichi Japan  
(Mar. 2005 ~)

- Using MPLS GbE WAN service
- Remote camera control
- Used for actual broadcasting programs
N+I 2005 Japan (June 2005)

- MPLS path change
- Connectivity test with various routers
- Uncompressed HDTV over IPv6 multicast
Summary

• i-Visto for broadcasting industry
  – Low latency (0.5-frame delay)
  – Two concatenated GbE mode support
  – Video synchronization clock transmission
  – Multiplexing control and metadata

• Future work on i-Visto
  – High-speed storage (i-Visto eXmedia server)
    • Increase to 100 uncompressed HDTV access capability
  – Network computing
    • Up-conversion, transitions, video synthesis, etc.