
Part 1:

Status of Interconnectivity verification in 'i-Visto'



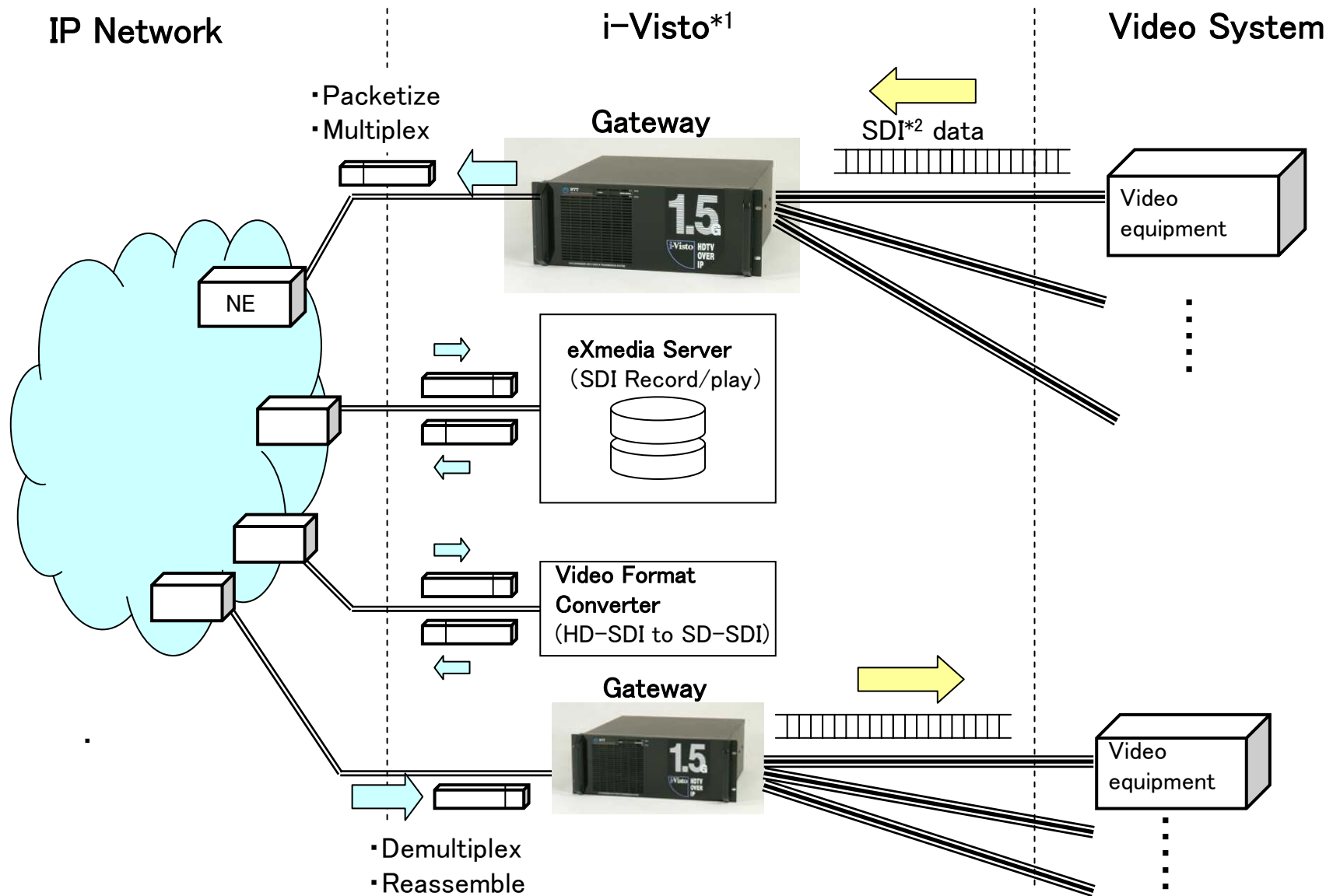
Tetsuo Kawano and Takeaki Mochida

NTT Laboratories
(i-visto@core.ntt.co.jp)

Objective

- Extend i-Visto interconnectivity with network equipment (Router, Switch), network service (Internet, Private Line), and video equipment (VTR, Camera, Monitor, etc.).

i-Visto & related systems



i-Visto gateway specification

- **Network interfaces**

 - 10GBASE-SR/LR (new design)

 - 1000BASE-SX/LX/T

 - POS OC-192c/48c

- **Video interfaces**

 - HD/SD-SDI (IN/OUT)

 - Reference video clock (IN/OUT)

- **Hardware**

 - Xeon platform + Linux Kernel (customized)

 - high-performance HD/SD-SDI capture card (new design)

 - network interface card

- **Software**

 - Original application (on Linux OS)

Network Interface & Function

Function Layer	Video Stream Transmission				Signaling	
	Speed (over 1.5 Gbps)	Reliability	Latency/jitter control	Multicast	Stream /Session control	Video-Clock synchronization
Application	10 to 8bit compression (optional)				<API>	Send & Recv. Video reference clock over IP
L4 & L5 •UDP •RTP(custom)	Splitter (HDSDI by GbE x2)	Error detection •sequence number •UDP checksum	<Measuring latency> •Socket Buffer Control			
L3 •IPv4/v6		<FEC>		IPv4/v6 Multicast Addressing		
L1 & L2 •Ethernet •POS	Jumbo frame	Error detection •CRC <redundant path>	Shaping & rate control			

◇ in development

Interconnectivity with network equipment

	connectivity
Ethernet Switch	XG800 (10 GbE) <input checked="" type="checkbox"/>
	EdgeIron (10 GbE) <input checked="" type="checkbox"/>
	Apline & Summit (GbE) <input checked="" type="checkbox"/>
	GS 4000 (10 GbE) <input checked="" type="checkbox"/>
	IP 8800 (10 GbE) <input checked="" type="checkbox"/>

	connectivity
IP Router	CRS-1 (10 GbE, IPv6 Multicast.) <input checked="" type="checkbox"/>
	AX 7800R (10 GbE, IPv6 Multicast.) <input checked="" type="checkbox"/>
Service	Domestic/International Private Line Service (> 1 Gbps) by NTT GROUP <input checked="" type="checkbox"/>

SDI Interface & Function

	format	functions (error detect & error correct)
SDI Input	SMPTE292M (HD-SDI)	check video line number ⇒ alert & stop forwarding
	SMPTE259M (SD-SDI)	
SDI Output	SMPTE292M	detect packet jitter ⇒ insert or drop a video frame
	SMPTE259M	
Sync. Input	<ul style="list-style-type: none"> ▪ External Tri-level/Black Burst ▪ Internal 	
Sync. Output (Remote)	Tri-level	

Interconnectivity with SDI equipments

		SDI-IN	SDI-OUT			SDI-IN	SDI-OUT
VTR	DVCPRO HD AJ-HD150 AJ-HD12000	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	SDI Monitor	DT-V1910	<input checked="" type="checkbox"/>	
	HDCAM HDW-M2000 HDW-250	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		BVM-D20	<input checked="" type="checkbox"/>	
Camera	HDCAM HDW-750		<input checked="" type="checkbox"/>		DM-3000	<input checked="" type="checkbox"/>	
	SDCAM DVM-707		<input checked="" type="checkbox"/>	SDI Switcher /Converter	TDP370M (Switcher)	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
	HDV Camera HDR-FX1 XLH1		<input checked="" type="checkbox"/>		MultiBridge (Embededer)	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>

Future Plans

Network Function

Integrate Control API

QoS

Flexible Redundant functions (Multi Path, FEC, resend)

Video Function

Flexible Compression according to IP-Network Condition

Upgrade the level of SDI multiplexation (>10 Gbps)

Standardization/Extension to Other systems.

Packet format

Control API

Part 2: Interoperability with other HD over IP system

Interoperability with other HD over IP system

- Objective
 - Increase use chance and activate research and development of HD over IP system.
 - Create new use of a super-broadband network.
- Current uncompressed HDTV over IP system
 - i-Visto (NTT)
 - iHD1500 (Research Channel)
 - UltraGrid (USC/ISI)
 - Etc.

Compatibility issue

- Session control (signaling)
 - How initiate HD streaming ?
- Packet format
 - Header format
 - Payload format

Session control

- Differs according to the usage
 - Broadcasting business
 - Video conference
 - Etc.

Header format

- Most of all system use RTP based header
 - Almost agreeable
 - Example:
 - RFC-4175: RTP Payload Format for Uncompressed Video
 - Future issue
 - Multi-stream
 - Stereo video, multi channel audio, time code, etc.
 - Multi-format
 - Resolution (HD, SD, SHD, 24f/30f, etc.)
 - Compression (Uncompress, MPEG-2, JPEG-2000, etc.)
 - FEC, Re-transmission control, Encryption, etc.

Payload format (Audio)

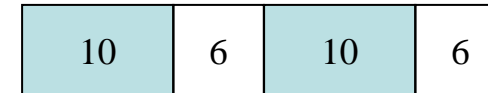
- Embedded audio (SMPTE-292M over IP)
 - Suitable for broadcasting professional use
 - ANC data (Time code, station ID, etc.)
 - Full HD-SDI (1.485 Gbps)
 - Include 16% of blank data
 - HD-SDI card must support transparent mode
- Active video + Audio
 - Easy for software based audio processing
 - Multi-location conference system, etc.
 - NLE connectivity
 - Low bandwidth
 - Active video (1.244 Gbps) + Audio (1Mbps x ch)
 - Need video and audio synchronization mechanism

Payload format (10-bit data handling)

- How 10-bit data store into 32/64-bit memory ?

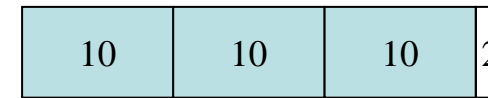
A. 2 words into a 32-bit word

- $(10 + 6 \text{ (padding)}) + (10 + 6 \text{ (padding)})$
- Compatibility with NLE and imaging software
- +60% bandwidth (2.376 Gbps)



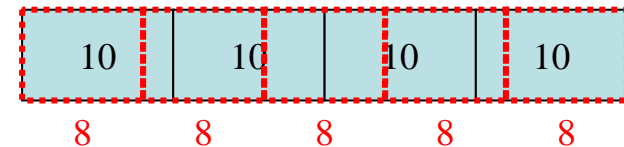
B. 3 words into a 32-bit word

- $10 + 10 + 10 + 2 \text{ (padding)}$
- +6.7% bandwidth (1.584 Gbps)



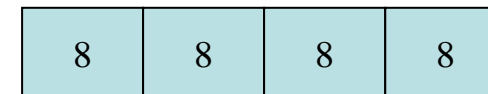
C. 4 words into 5 bytes (RFC-4175)

- no padding
- Not easy to video processing
- No extra bandwidth (1.485 Gbps)



D. 10-bit to 8-bit down conversion

- Enough for video conferencing
- Easy to software processing
- Less bandwidth (0.995 Gbps (active video only))



Our proposal for first step of interoperability test

- Our proposal
 - No session control
 - Sender: destination IP address
 - Receiver: source IP address (or any host)
 - Embedded audio
 - Major HD-SDI card supports transparent mode
 - Simple external interface
 - Easy to synchronize video and audio
 - B. three 10-bit words into a 32-bit word
 - Easy for video processing and small extra bandwidth consumption
 - Software based format conversion is become available using current powerful PC
 - Header: RTP base
 - RFC-4175 is almost agreeable excluding the payload format

Thank you