



CometDVIP Technology

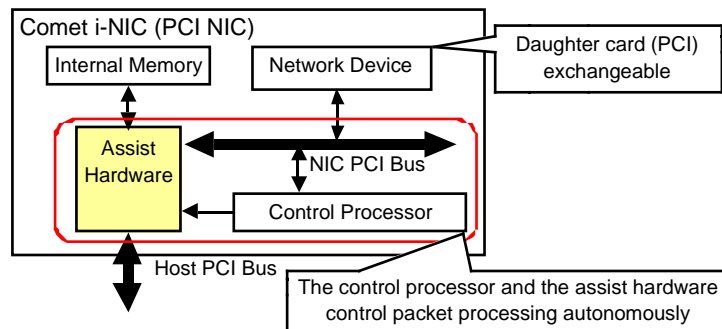
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1. Introduction



The technology of the CometDVIP series (Comet i-NIC-2, Comet DVIP-PCI, referred to as CometDVIP in the rest of this brochure) realizes high quality DV transmission to the other side of the Earth using the Internet, beyond the limited transmission distance of IEEE1394 (i.Link). There are many problems to be solved to realize such DV over the Internet (DVIP). For example, DV data needs about 25Mbps bandwidth. Transmitting such data smoothly like read/write of a DV tape, with constant communication speed, is not easy. Moreover, when DV use is expanded in future, reliability and portability will be required. Security mechanism will also be necessary for privacy sensitive areas. In this brochure, we introduce the CometDVIP technology which is used in Comet i-NIC-2 featuring a security function (IPsec IPv4) and Comet DVIP-PCI dedicated to DVIP processing.

2. Mechanism

CometDVIP is a technology to realize real-time digital video transmission over the Internet using an intelligent NIC. The CometDVIP card receives a 25Mbps digital video stream sent from an IEEE1394 port of a DV camera and then encapsulates the input packets by IP and transmits them to the Internet. There is no quality degradation because no data compression is performed. The block diagram of CometDVIP is shown in the figure below.



The CometDVIP hardware is a single slot PCI card and is mounted on a PC. The card consists of two cards, one is a PCI card for DVIP processing and the other is a daughter card mounting a network device. (Comet DVIP-PCI consists of one PCI card which has all DVIP functions and it doesn't have a CometNP.) The CometDVIP hardware consists of an embedded system microprocessor and a dedicated assist hardware. Since all processing is programmable, if there is any specification change in DVIP, the hardware can support it. The role of the PC is only to control the CometDVIP card through the host PCI bus, because CometDVIP performs all the DVIP processing and the network device control. Therefore 32bit PCI is sufficient for the PC and the PC's CPU doesn't need high performance. If Windows2000 works, the performance is enough. If Linux is used, the PC of 5 years ago is sufficient.

	Comet i-NIC-2	Comet DVIP-PCI
PCI card form	21cm PCI card	PCI short card
PCI (Host & NIC)	64/32bit, 66/33MHz	32bit, 33MHz
External I/F	IEEE1394 x 2, 100B-TX x 1	IEEE1394 x 3, 100B-TX x 1
Hard Assist	CometNP	FPGA (IP Checksum)
Supply Voltage	5/3.3V	5V
IPsec	Supported (IPv4)	Not supported
Other Features	Can be used as an intelligent NIC by replacing a daughter card (PMC)	For DVIP only (external I/F cannot be replaced)
Photo		



3. Features

CometDVIP is a DVIP processing hardware realizing bi-directional DVIP processing by a PCI card. It has following features.

- Independent of the host machine, independent processing of Comet i-NIC.
 - ✧ Small dependency to the host machine's OS (High applicability).
 - ✧ Load on the host processor is very small.
 - ✧ The host PC takes a charge of light processing such as initial setting, control, and information gathering.
- Comet i-NIC performs 100% of DVIP processing.
- Realization of IP Security (IPsec) by CometNP.
- Communication protocol conforms to DV/RTP (IETF standard).
- Data complement functionality for video data loss using previous frames.
- Bandwidth control functionality by video frame dropping without affecting audio.
- Delay control functionality, from 2 frames (60ms) to 60 frames (2sec) .
- Reduce PC's load, high precision real-time processing by a dedicated hardware.

4. Functions

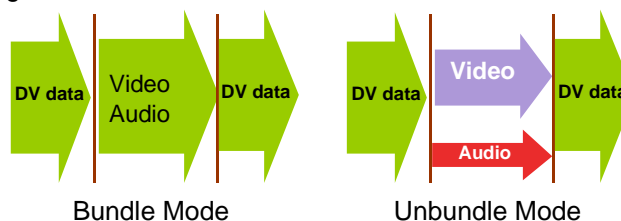
The CometDVIP software consists of a control software running on a microprocessor inside the card and a management software running on the PC. The control software realizes DVIP processing. It is downloaded from the PC while the PC starts up, and then executed. The management software is an user interface of CometDVIP. It performs download of the control software, parameter setting, and management of CometDVIP. There are two kinds of the software, one is for Windows2000/XP and the other is for Linux. For both operating systems DVIP functions are equal.

DVIP Channel	Bi-directional (send, receive)
Packet format	IPv4, IPv6, unicast, multicast, RTP
DV Video Rate	Full, 1/16, 1/8, 1/4, 1/2 frame dropping
DV Audio Rate	Full, no audio
Control Functions	Bandwidth control by frame dropping Video data complement function for data drop Delay control function, Smoothing function of IP packet transmission, Statistical information
Other Functions	Auto recovery in case of IEEE1394 bus reset Display and file saving by DV capture software for a PC
Standard	RFC 3189 RTP Payload Format for DV (IEC 61834) Video RFC 2401 Security Architecture for the Internet Protocol RFC 2405 The ESP DES-CBC Cipher Algorithm With Explicit IV RFC 2406 IP Encapsulating Security Payload (ESP)

5. Explanation of Functions

5.1 Bundle/Unbundle

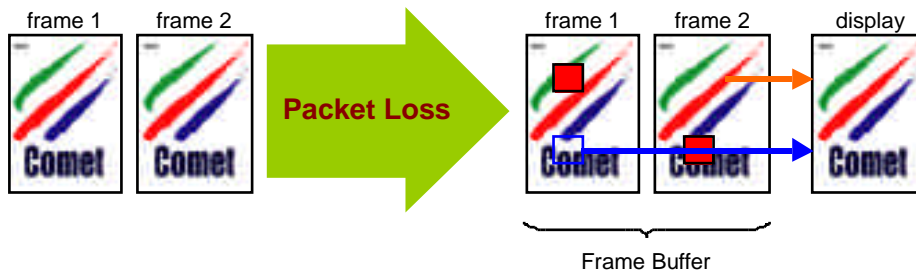
CometDVIP has two transmission modes, bundle mode and unbundled mode. In the bundle mode CometDVIP mixes audio and video in one packet and send the packet in one stream. On the other hand in unbundled mode, audio and video are transmitted separately by two streams. In both modes, video frames can be dropped without affecting audio, so the bandwidth can be controlled.





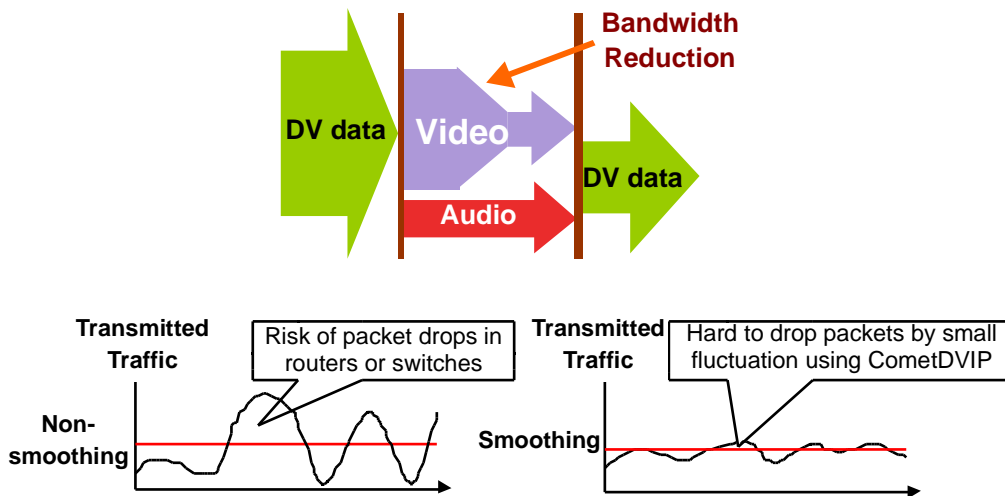
5.2 Video Data Complement Function

By storing the past frame data, in case of packet loss (data drop), CometDVIP complements video data using the stored frame data and displays them.



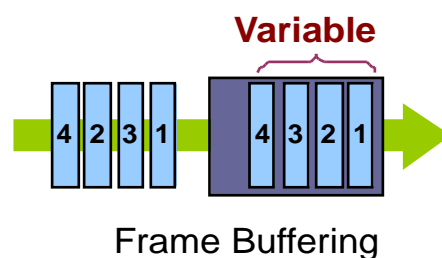
5.3 Bandwidth Control Function

CometDVIP has the video frame dropping mechanism and can control the bandwidth without affecting audio. Moreover, to improve the quality, CometDVIP uses a smoothing transmission technique when it transmits DV streams. This technique controls packet sending rate in 125 μ s units, and send the packets as smoothly as possible. For example, to realize 1/2 frame rate, easy way is sending a full DV frame first and then sending an audio only frame second, but this method causes large fluctuation of transmission rate. Such traffic with large fluctuation is hard for networks. Buffer overflow occurs in intermediate routers or switches and such overflow becomes large factor of causing packet loss. To avoid such packet loss, CometDVIP performs the smoothing transmission technique, sending full DV data in a frame and audio only data in a frame flatly using time for two frames. The technique is effective for the packet loss of the routers or the switches since it realizes small fluctuation of the traffic.



5.4 Delay Control Function

CometDVIP has a frame buffering function. It can rearrange frames whose receive ordering is changed, complement lacked receive data, and adjust delay in the receiving frame buffer from minimum 2 frames to maximum 60 frames (depends on memory size). The delay can be adjusted while stream is transmitted. Using time stamps, it rearranges packet ordering, eliminates duplicate packets and controls retransmissions.





5.5 Encryption Function

Comet i-NIC-2 has an encryption function (IPsec IPv4) . This function conforms to IP security (IPsec) of an IETF standard, encrypts whole IP packet and transmits it. The function uses ESP (Encapsulating Security Payload) for security protocol and uses DES/3DES for encryption algorithm. Key exchange and SA table management are done by a host machine. CometNP performs all the processing of IP<->ESP translation and realized over 250Mbps performance per SP using 3DES CBC encryption algorithm.

6. Applications

Following applications can be realized using CometDVIP and CometNP.

- Real-time stream communication
 - ✧ DVIP, DVIPsec
- Internet clusters (SCore with PM/Comet)
 - ✧ Realized 100MB/s performance using PM/UDP/IP , close to Myrinet cluster performance for NPB
- Comet ESP Tunnel Gateway
 - ✧ 200Mbps uni-direction performance, 400Mbps bi-direction performance using 3DES

7. Contact

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