

VSF Video over IP (SMPTE 2022) Interoperability Demonstration January 2007



By John Dale III

In order to reduce costs and more efficiently utilize their networks, service providers are looking to migrate contribution video/audio/media services onto packet networks. This migration is not without its challenges. Packet network performance can be less than ideal. A robust method of encapsulating media signals in IP packets is absolutely necessary. There is a significant benefit for service providers and end users to utilize standards-based implementations.

The Video Services Forum (VSF) recently worked with SMPTE to standardize IP encapsulation of MPEG video/audio signals with robust error correction, which is well suited for IP networks. The Standard, SMPTE 2022-2007, is now available on the SMPTE website.

At the January 2007 SMPTE/VidTrans Joint Conference, five vendors provided hardware to conduct a live interoperability demonstration utilizing SMPTE 2022 encapsulation techniques. In addition to demonstrating interoperability between vendors, the demonstration also highlighted the robust handling of packet errors.

Demonstration Details

Vendors demonstrated interoperability by exchanging 20 Mbit/sec MPEG-2 standard-definition video over an IP network. In order to simulate real-world conditions, the video streams were subject to errors and other real-world network impairments, which demonstrated the capabilities of SMPTE 2022 standard Forward Error Correction.

A single 20 Mbit/sec maximum constant bit rate (CBR) transport stream was played out of a server as DVB-ASI and distributed to each of the five participants. This DVB-ASI stream utilized 7 x 188 byte MPEG Packets per IP Packet. One stereo pair MPEG audio 256 Kbits/sec was also included in the stream. The video was 480 x 720 x 29.97 Hz, encoded as MPEG-2, 4:2:2 profile.

Explanation of Forward Error Correction (FEC)

FEC can allow edge equipment to recover from errors introduced in the network. The more FEC information included in the data stream, the better the ability of the FEC to correct for errors. However, this comes at a price. More FEC requires more bandwidth and also increases delay. So there is a balance needed between network performance and the amount of FEC applied. In some cases, users require very low latency for live interactive applications, so the amount of FEC that can be used in these applications is limited in order to keep the delay to a minimum. In one-way broadcast applications, more aggressive FEC can be utilized.

In addition to FEC, interleaving can be utilized. Interleaving works by separating consecutive pieces of data on the network during transmission. By adding interleaving, the impact of a bursty error can be mitigated. Combining interleaving with FEC increases robustness of the

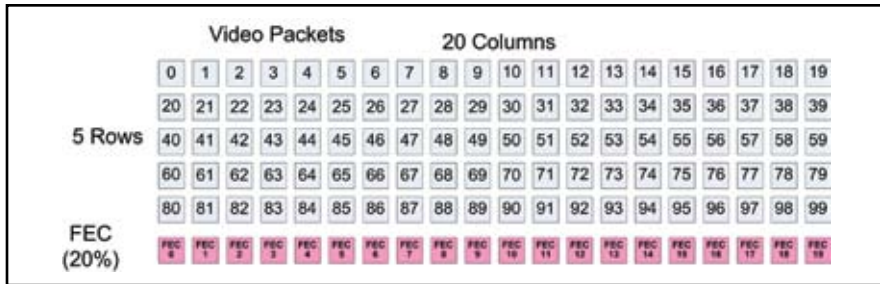


Figure 1. Column only FEC, 5-row x 20-column.

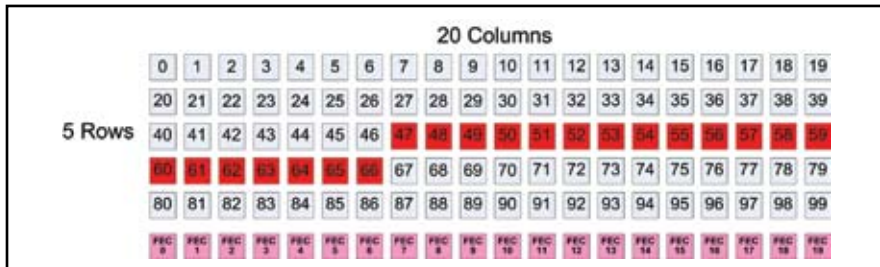


Figure 2. Example of 20 consecutive packets dropped.

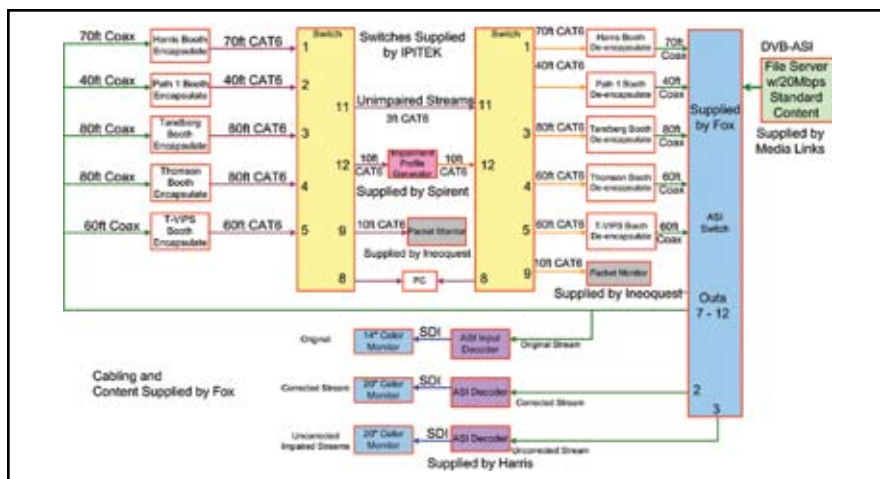


Figure 3. Demonstration wiring layout server.

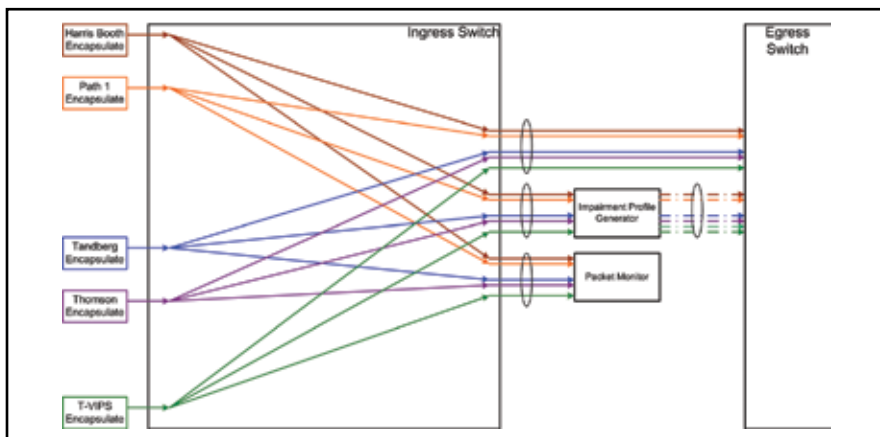


Figure 4. Ingress switch.

system, however, it adds latency to the network. Again, a balance between anticipated network performance and FEC/Interleaving is required to provide the best FEC protection while still meeting user requirements for delay.

Error Impact on Video/Audio

There is some variability in the impact of packet errors on the video/audio presentation, due the type of compression utilized. With MPEG-2, a packet error introduced at an I-frame boundary can have ripple effects through several video frames. The same error introduced a fraction of a second later may be much less noticeable. Due to the unpredictable nature of error impacts on video, error handling is extremely important.

Network Impairment and Error Correction Details for the Demonstration

To simplify the demonstration and reduce the quantity of test cases to be demonstrated, only one FEC configuration was demonstrated. It is important to note that with SMPTE 2022 encapsulation a wide variety of row/column matrixes can be set, which can handle a wide range of anticipated network performance and overall latency. The FEC configuration agreed upon by the team was Column only FEC with a 5-row, 20-column matrix (Fig. 1).

In order to demonstrate error handling, a device was placed in the network to drop packets as shown in Fig. 2.

FEC packets are computed over columns, which allow errors of one packet per column to be corrected. In the demonstration, worse case correctable consecutive packet loss (burst) is 20 packets (loss period)

with a loss distance of 100 good packets. For the demonstration, 20 packets were dropped followed by 280 good packets.

Demonstration Configuration

The drawing in Fig. 3 shows the wiring layout of the demonstration. DVB-ASI signals were distributed via coax to each participant.

Video was encapsulated and sent into the core switches via CAT6 cable. Impairments were injected to all streams and streams were re-distributed to all participants. Video/audio was sent to monitor position where side by side comparisons could be made between original video/audio, corrected video/audio, and uncorrected video/audio.

Figures 4 and 5 illustrate the stream flow through the switch and impairment generator.

Results

Twenty test cases were judged by three independent expert viewers and rated on a pass/fail basis. In each case, the judges were able to observe the three monitors showing the original stream, corrected stream, and uncorrected stream. In all 20 cases, no visible errors were observed and video quality was observed to match the original content.

Participant Team

Five MPEG equipment manufacturers—Harris Broadcast Communications, Path1 Network

Technologies, Tandberg Television, Thomson Grass Valley, and T-VIPS—provided SMPTE 2022 compliant encapsulation and de-encapsulation equipment. Connections were made through an IPITEK switch with network impairments injected into each stream by Spirent Communications hardware. IneoQuest Technologies provided additional network monitoring. Fox Digital Television provided equipment and materials as needed, to create the network system. DVBLink and Media Links provided organization and system design.

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The Author

John Dale joined Media Links Inc. in November 2005. He is the director of product management at Media Links, covering video transport and processing products. Prior to joining Media Links, Dale was product manager at the Access and Transport division of C-COR, where he managed the product portfolio of the DV6000 product line, its extensions, and derivatives. Prior to C-COR he served in the Broadband Communications Division of ADC as product manager for the DV6000 product line.

Dale has been a board member of the Video Service Forum since 2003 and co-chair of the Professional Real Time Video/Audio Over IP Network Infrastructure Activity Group, which is developing quality-of-service recommendations for video over IP networks.

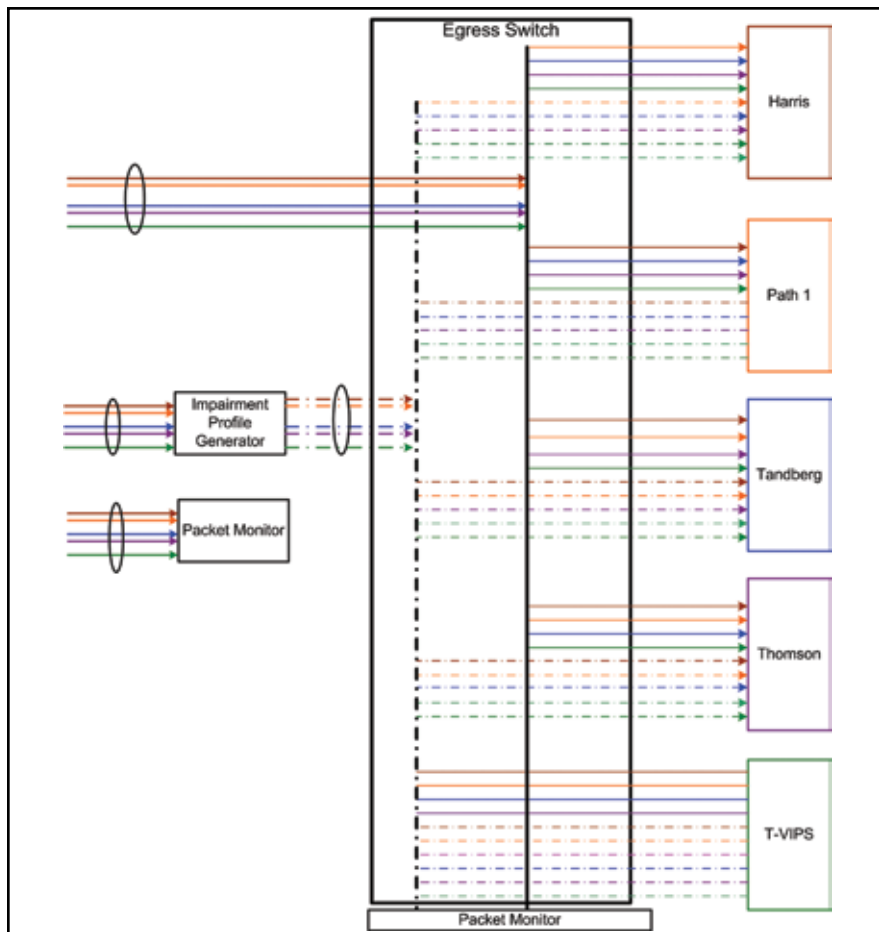


Figure 5. Egress switch.