



VisionHD2-SQX Capture and Encode Card

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+ INTRODUCTION

Users of the VisionHD2-SQX capture and encoding card from Datapath will be familiar with the common features readily found in the Vision capture card range. In addition to the available seven colour formats offered by all Vision capture cards, RGB8, RGB565, RGB24, RGB32, YUY2 and NV12, the VisionHD2-SQX offers users an additional H264 compressed video format. This makes the VisionHD2-SQX both an un-compressed and compressed video capture card. The compressed H264 video format is created using an in-built hardware encoder, system CPU resources are not compromised. This hardware acceleration allows the VisionHD2-SQX hardware to be operated in scalable environments, under the control of a single Windows operating system. This paper illustrates real world advantages provided by the VisionHD2-SQX video frame capture hardware.

+ AUTOMATIC SIGNAL DETECTION

Signal detection is provided by internal software device driver algorithms assisted by physical hardware measurements. This automated mechanism provides accurate signal detection for all source types, including analogue 3/4/5 wire RGB, DVI, HDMI and component video. Using the Datapath event call back interface, users are able to maintain a 1:1 encoded stream resolution in response to signal mode changes occurring on the input. A practical use case for automatic signal detection could be a presentation capture environment where many devices with different resolutions are used as input to the capture hardware. For this case, the application software can be written to maintain the aspect ratio of the input prior to encoding.

+ NO SIGNAL HANDLING

In the event of no signal, when the video frame capture card does not receive video on either of its inputs, the VisionHD2-SQX hardware generates a 'No Signal' frame for either encode or display. The frame is black with the text 'No Signal' centred within the frame. An incremented frame counter value is also appended to the text. The insertion of 'No Signal' frames greatly assists file and stream playback of encoded data. As 'No Signal' frames are encoded in the same format as genuine video frames, the sink or streaming end point is unaware of any physical signal events occurring on capture card input. It is important to note that the precision timestamp continues to be accumulated for 'No Signal' frames. The timestamp interval is always constant between successive frames. This functionality allows the size of encoded video files to be maintained during 'No Signal' periods, matching the specified frame rate contained within the file header. The number of frames contained in a file generated by the VisionHD2-SQX hardware will match the playback rate defined in its file header.

+ MODE CHANGE HANDLING

When an agreed buffer size has been negotiated by an encoding application, any changes to the input signal thereafter will be scaled to the original agreed resolution. For example, if a stream is setup to encode 1080p@60 FPS and at a time later the signal is then removed by the user, 'No Signal' video frames are provided at 1080p 60 FPS as described above. Further, if a second signal is inserted into the hardware by the user, or the signal on the wire simply changes to a new resolution as part of a boot sequence, 1280x720 at 60 fps for example, the VisionHD2-SQX hardware will up scale the video to 1080p in hardware prior to encoding the video frame. This functionality will work for both up and down pixel resolution conversions. Note, the decoding application in this example will not be aware of any physical resolution changes occurring on the VisionHD2-SQX input. The functionality provides a robust interface to user endpoints, effectively shielding any decoding operation from physical input changes at the source. A practical use case of the mode change handling feature is the capture and encoding of a PC during a reboot sequence. The PC source will output different resolutions when booting into the operating platform.

+ SQX STREAM SERVERS

Installation of the SQX Stream Servers provide the user with fully functional multicast and unicast RTSP streaming methods for use with the hardware accelerated VisionHD2-SQX encoder. The SQX Stream Servers aid integration of the VisionHD2-SQX hardware with minimal effort. When executed, the SQX Stream Servers will enumerate all Vision inputs capable within the system of H264 compression. If any inputs are capable of providing H264, the multicast instance of the SQX Stream Server will display the URI's required by clients to connect over the network. The unicast SQX Stream Server will display a collection of URI's representing session descriptions for a variety of scaled, bit format and frame rate sources. Streaming from the unicast server will not begin until a connection is received by the SQX Stream Server by a client. Sample6a and Sample6b found inside the SQXEasy SDK are unicast and multicast respective source code stream server examples. The open source code can easily be modified and re-compiled by the user to provide any exclusive characteristics.

+ LATENCY

Encode latency is the measurement between the first pixel arriving into the hardware frame store to the delivery of the first compressed pixel arriving in the user supplied call back function. The VisionHD2-SQX encoding latency is 3 to 4 frames. System designers may need to consider additional network transit, decoding pipeline and display technology for a complete end to end calculation. It is also important to note that the bulk of latency in networked video solutions is commonly found within the decoders play out buffer. Decreasing the size of this buffer has a proportional effect on latency. Typically, play out buffers can be 500ms in length (15 30Hz frames in length). A decoder's play out buffer is required for the smooth display of frames when packet loss and network jitter are present. These characteristics are common over large distance networked end points resulting in a large play out buffer value, however, this can be reduced for local based video networks.

LiveStream is available for un-compressed frames delivered by the VisionHD2-SQX. Using various APIs including RGBEasy, Kernel Streaming, DirectX and Open GL, low latency peer-to-peer DMA operations for un-compressed,

full fidelity frames are achieved using the Datapath proprietary LiveStream process. This technology allows capture lines (not frames) to be transferred as they arrive in the frame store. The process reduces the DMA transfer time from a full frame time to a single line time. Using Datapath LiveStream with a selection of common third party graphics devices, it has been possible to achieve a glass to glass latency from capture to display in less than 3 frames.

+ SIGNAL FORMATS

The VisionHD2-SQX capture card is capable of capturing and encoding both analog and digital video signals. The DVI-D input connectors can transport VGA, Component, HDMI and DVI video using the supplied conversion dongles. The versatile input selection capability of the VisionHD2-SQX allows the capture and compression card ideal for environments that require the handling of multiple physical input signal formats.

+ TIMESTAMPS

The Datapath hardware timestamp uses a common clock for both video and audio buffers.

Hardware time stamping provides precise knowledge of when a frame is captured, allowing multiple buffers from different input sources to be synchronized. The start time stamp corresponds to the arrival of the first pixel of a field or frame within the hardware. The hardware timer is synchronized with the systems high precision performance counter across all capture inputs in a system, regardless of whether they are from different physical capture cards. The units of the timestamp are in 100ns 'ticks' with a resolution of 100us. The VisionHD2-SQX hardware provides the compressed video frame to users of the RGBEasy and DirectShow frameworks with the fidelity of the timestamp intact.

+ MULTISTREAM

MultiStream technology exists only for the un-compressed portion of the VisionHD2-SQX card, allowing multiple client configurations, per input, in hardware for scale factor, framerate, colour space and cropping region. The encode density, providing H264 compressed frames is a shared resource for both true HD inputs found on the card. The composite input does not provide compressed data. The encoders shared compression resource is equivalent to a single 1920x1200 at 60 fps stream or dual 1920x1200 at 30 fps compression on both HD inputs possible.

+ SDK

As the VisionHD2-SQX is an extension of the feature set commonly found with the existing Vision capture card series, all configuration for encoding parameters is documented in the RGBEasy SDK. Encoded H264 video frames are accessed using the 'ChainBuffer' and 'Callback' function calls, see Sample3d and Sample6x for further details. Sample6a and Sample6b of the RGBEasy SDK are examples of a unicast and multicast stream servers respectively, combining these API calls with the open source Live555 RTSP library.

A typical VisionHD2-SQX installation provides access to H264 video frames through the Datapath User Mode source filter for the DirectShow framework. The source filter provides generic 'Pin' properties for connections to other DirectShow Filters such as the Microsoft DVB-T decoder filter. The VisionHD2-SQX source 'Filter' contains all RGBEasy specific functions wrapped for the DirectShow interface.

+ CONCLUSION

The VisionHD2-SQX capture and compression card is provided for users of video wall controllers to enable full fidelity captures onto the video wall. In Addition, the card provides a compressed representation of the input allowing network access of the input for multiple clients. On delivery to the network, compressed video sources are able to use properties of the network to be transported, switched and multicast to one or more remote end points. These locations can be user workstations, secondary video walls or network attached video storage solutions. The actions of providing this functionality does not compromise system resources, the processor within the host system used to run and control the Windows operation platform is not compromised. The hardware scalable model allows system designers to scale solutions according to specification without limiting factors. Figure 1.0 shows a typical video wall system capable of compression with network distribution in addition to common multiple graphical outputs and multiple capture inputs.

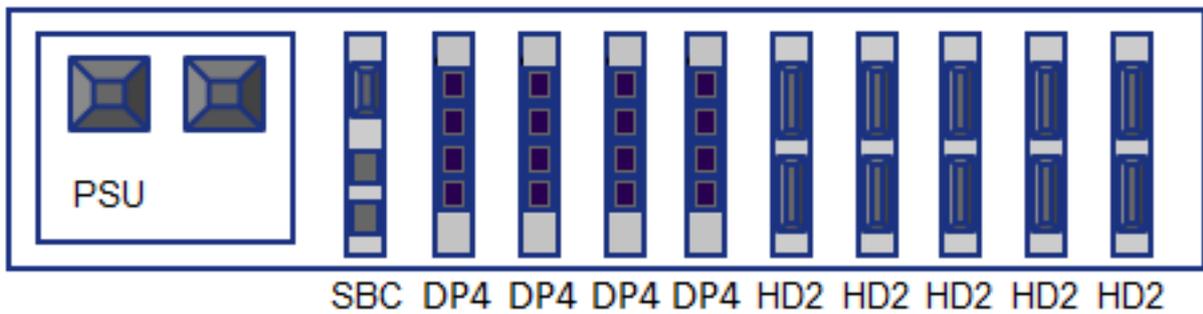


Figure 1.0 Video Wall Controller

A second use case for the VisionHD2-SQX capture and compression card is the use of a fully configurable encoding station. Using a Datapath VSN 990/970 motherboard, it is possible to create a system capable of ingesting 18 true HD inputs using 9 VisionHD2-SQX cards in the 9 available PCIe slots as shown if figure 2.0 below.



Figure 2.0 Encoding Station

An encoding station described here has the usability and configuration found in a Windows operating platform. For example, all inputs of the system can be monitored for signal event notifications and encoder configuration within a single application. Legacy video signals such as VGA, DVI and HDMI can be routed to a single location, input to the system and multicast onto the network. The 'Mode Change' and 'No Signal' handling functionality of the Vison HD2-SQX described above will eliminate physical anomalies occurring at the source.