Accelerating Smooth 4K Live Streaming Solution for Remote Production (REMI)

Advent of 5G mobile networks expected to underpin significant workflow improvements

Introduction

4K/UHD broadcasting is increasing rapidly especially for sports and other live events. To provide a better service and improved experience for their sport fans, many broadcasters are looking to update their on-site production and streaming facilities. Others are turning to a new paradigm, that of Remote Production (REMI), a trend sure to be accelerated by the rollout of 5G mobile networks. In fact a recent study by the European Broadcasting Union found that an overwhelming majority of broadcasters will adopt 5G and that Remote Production was identified as the main use case.

Naturally the focus is on event coverage, and often this is based in Outside Broadcast (OB) trucks. The general upgrade to 4K/UHD and beyond in local facilities and OB trucks brings challenges in the space, weight and power requirements for all the relevant live video encoding and streaming gear required, and for REMI applications, a further challenge is in efficient provision of multi-channel encoding. Advantech can help equipment makers and more adventurous system integrators to be successful by providing a range of commercial off the shelf encoding and streaming equipment that addresses these needs, offering high quality performance in a compact and low power way. This paper describes how.

Key Application Requirements

The focus is on providing broadcast quality 4K/UHD live contribution links from an OB van or a remote production rack back to the distribution hub or the central facility in the smallest footprint and using the least power. Some of the key challenges and requirements include:

- ◆ Live contribution: reliably encode and stream 4K at a solid 60fps using 4:2:2 chroma subsampling
- ◆ Good Compression: maximize quality for the limited available uplink bitrate using HEVC
- ◆ Limited Space: racks are normally only 600mm deep and compact size is required.
- ◆ Minimize Power: always limited in mobile applications, both to source power to operate and to remove heat during operation
- ◆ Low Latency: as low as possible within other constraints

A typical use case results in a single or redundant programme uplink from an on-site production facility, but recently interest is growing in a new workflow using Remote Integration (REMI) Production. In this case, all the output from local cameras are individually sent to a central hub or, increasingly, a cloud based service where the coverage is then assembled. This simplifies the local production requirements at the cost of increasing the focus on multiple encoded uplink streams to support multiple channels. Since the uplink encoding is often the most computationally complex operation of the workflow, this simply puts even more reliance on accelerated encoding systems to address these needs.

How Advantech Can Help

Advantech's Video Solutions Division offers a range of low power, high performance video capture and encoding accelerators that are particularly suitable for live production contribution applications. The acceleration products, under the VEGA family name, include modules boards and systems all capable of broadcast quality 4K/UHD live HEVC encoding at 60fps, many with 4:2:2 support, and all with low power, compact size and low latency.

Of particular benefit are:

VEGA-3311: Single channel 4K/UHD or 4 x 1080p 60fps 10bit 4:2:2 capable HEVC/AVC encoder accelerator plug in board with a variety of direct video capture options including 4 x 3G SDI, 1 x 12G SDI or dual 10G Ethernet supporting SMPTE ST2110 ingress. As a PCIE plug-in card, VEGA-3311 can be used to add contribution grade HEVC or AVC encoding to existing equipment, or can be used along with Advantech's flexible VEGA-7010 server to create multi-channel encoders for remote production applications. The VEGA-3311 offers a high degree of programmability via either a dedicated SDK or a simple-to-integrate FFMPEG plug-in, and even can act as an accelerator for the Wowza streaming engine.

VEGA-6301 / VEGA-6301M: Ultra-compact all-in-one encoder application platform built on the same base 3G/12G SDI video capture capability and 4K/UHD 60fps 10bit 4:2:2 HEVC encoding functionality as VEGA-3311 with additionally an x86 processing subsystem for management interface, streaming protocol generation, and system control. With a sub-100W power consumption and ½ rack width dimensions, the VEGA-6301 offers a compelling performance density with easy integration. For applications requiring adjunct recording, the VEGA-6301M offers the same performance but with more internal storage and faster network interfaces in a marginally larger footprint.

VEGA-7010: Highly flexible video server and video appliance platform offering unparalleled flexibility in a 1U short depth profile with 4 full height PCI Express slots and a server class Xeon E3 CPU supporting Intel QuickSync Video functionality for additional video processing. The VEGA-7010 can fit in 600mm racks such as those used in trucks or small equipment closets, offers redundant power supplies, robust cooling, and expandable storage. The VEGA-7010 can support up to four VEGA-3311 boards giving 4 x 4K/UHD live contribution channels per 1U appliance in under 300W total power consumption. With this level of performance, the server can efficiently offload heavy-lifting video processing tasks in live workflows and significantly improve density, scalability and cost of live UHD video solutions.

MediaFlow Video Manager: MediaFlow is an additional software package that system integrators can use to deploy standalone video encoding or transcoding applications using VEGA-33xx series accelerators. It runs on the VEGA-7010 host under Linux, and allows quick deployment of the accelerated encoding functions together with appropriate encapsulation and streaming outputs.

VEGA-8300 8K family: Where 4K isn't quite enough, VEGA-8300E and 8300D are new all-in-one platforms supporting live UHD2/8K 60fps 10bit 4:2:2 HEVC contribution encoding and decoding. VEGA-8300 series are ready to use by system integrators as a result of collaboration between Advantech and software partner Spin Digital who provide optimized media playout software for the decoder, and web-based system management software for the encoder.

VEGA-2002: For smaller scale operations, and when 4:2:2 support is not required, Advantech can offer a very compact encoder box that offers 4K/UHD 60fps 10bit live HEVC or AVC encoding and streaming in a 12W package. With an easy to use web configuration interface and support for HDMI inputs as well as SDI, VEGA-2002 is a portable and flexible option for many different applications. It can be supplied as bare module for OEMs or integrators to fit into customized enclosures.

Real Life Use Case

Advantech helped a national broadcaster in Taiwan to implement a 4K live streaming system tailored for sport-focused events such as professional baseball and basketball. Using Advantech VEGA technology, the broadcaster was able to add real-time 4K/UHD encoding to their outdoor broadcasting (OB) van and mobile electronic field production rack. Now they are able to provide a live-sport TV-streaming service so all their sport fans can watch live sports including CPBL (Chinese Professional Baseball League) and SBL (Super Basketball League) and enjoy real-time 4K multiple angle viewing pleasure anywhere.

There were several 4K cameras setup in each stadium to generate the 4K video content. Local production then created a single 4K feed on four 3G-SDI cables to be encoded and transmitted for further distribution.

Therefore, the main requirement was to implement a real-time 4K HEVC 60 fps contribution-encoding engine, connecting to SDI-based equipment across 4 x 3G-SDI and transmitting the compressed video streams via MPEG-TS over UDP.

Other requirements included a need for low-latency, ultra-low-power, and a guarantee that live performance could be sustained. Moreover, for a space-limited environment such as OB van or a mobile rack, a compact size would be needed.
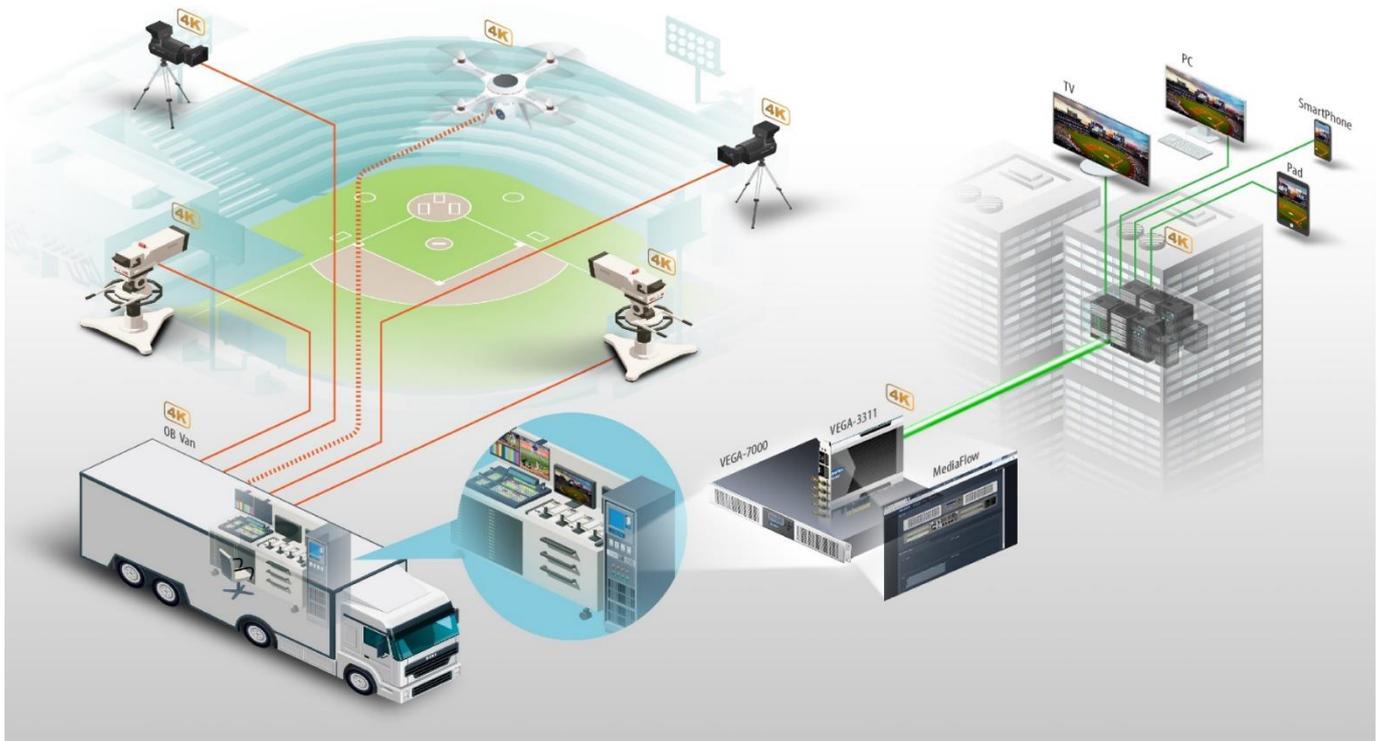
The broadcaster made use of Advantech's VEGA-3311 4K/UHD encoder mounted in a VEGA-7000 video server and running MediaFlow software to manage the various encoding tasks required including the TS over IP streaming output. The streaming output from the OB truck was relayed over network to the central production facility via a decoder from Harmonic and then onwards to consumers via OTT broadcast.

Advantech VEGA Benefits:

- Acquisition support: raw video from 4K cameras or local switchers can be directly acquired by the VEGA-3311 via built-in 4-ch 3G-SDI inputs and be encoded directly. When used in standards-based equipment, this both maximizes PCI Express slot usage and minimizes the need to process raw video internally.

- High quality video encoding: the VEGA-3311 supports professional grade 4Kp60 10-bit 4:2:2 HEVC encoding. The hardware-based solution is ideal for contribution with guaranteed performance at high bit rates enabling high quality contribution encoding and low latency.

- Cost efficient and flexible: thanks to the convergence of IT and broadcast technology, the VEGA-3311 can be integrated into existing server based applications leveraging the economies of scale of COTS hardware. System developers can easily offload heavy lifting video processing tasks to the VEGA-3311 to reduce dramatically time to market and in-house development efforts.

- Application ready platform: Advantech can provide a range of video-focused server products, optionally with MediaFlow control and management software. MediaFlow is customizable web-based video management software; its user-friendly interface allows an operator to set up and use the platform without any programming ability required.

- Integrated Video Solution Provider: Advantech offer one-stop shop video solution from video server, 4K encoding accelerator cards, and media software, plus with our dedicated R&D support and global experience, we deliver states-of-the-art products and real-time service

Products Used in this Project:

- VEGA-7000 High Density 1U Rack-mount Video Server
- VEGA-3311 4K HEVC Broadcast Video Encoding / Decoding Card
- MediaFlow Web-based video software

Summary

Advantech's video solutions, including video server and UHD PCIe encoding cards, offer customers a cost-effective contribution grade 4K encoding solution without compromising operational efficiency, floor space, power consumption and total cost of ownership (TCO). It's an ideal solution in live productions whether it is a contribution encoder at a major event or a broadcast encoder in the central studios.