Mellanox IP Network for Broadcast, Media and Entertainment Production Infrastructure

The move from high definition to 4K/UHD and HDR has clearly shown the inability of existing production technology to adapt to the future of broadcast, media and entertainment production infrastructure. It's possible to "solve" the transition to 4K/UHD by quadrupling current infrastructure, but doing so also means quadrupling the capital investment in current systems – as well as quadrupling complexity and support cost. The quadruple approach clearly is not sustainable. Even worse, it will become nearly impossible once 8K becomes an essential part of the broadcast production landscape, or when wide gamut color spaces or higher frame rate becomes a standard production requirement. The answer must hence involve a new approach to the three-decade old technology, with something that meets immediate challenge such as 4K/UHD, while also enabling rapid adoption of additional new technologies.

IP-based network which powers todays data center and cloud is being considered as the suitable alternative to the existing proprietary SDI routers, coaxial cables and BNC connectors. Leading broadcasting companies such as BBC, FOX and NBC are realizing that migrating to an IP-based infrastructure empowers the broadcasters to innovate in all the areas of content creation and distribution, multi-platform support and future video formats. For the past two years, Mellanox has been leading the way with Joint Task Force on Networked Media (JT-NM), Advanced Media Workflows Association (AMWA) and Society for Motion Picture and Television Engineers (SMPTE) standards and working alongside these broadcasting companies, helping define and deliver the next generation IP studio.

Mellanox end-to-end network including SpectrumTM switches, ConnectX-4 network adapters and LinkXTM cables delivers industry's leading IP-based broadcast studio.

Mellanox Broadcasting Solution Delivers:

- End-to-end network for 4K, 8K, HDR etc. at various speeds: 10/25 & 40/50/100Gbps

- Industry's leading switch with consistent, lowest latency and jitter

- Intelligent In-fabric containerized broadcast microservices and OpenFlow support

- Flexible kernel bypass solutions on ConnectX-series adapters

- Lowest congestion and highest efficiency with innovative Packet Pacing solution

- Next-generation VCSEL and silicon photonics technology delivering lowest BER of $10e^{-15}$

Mellanox Spectrum Switches

Mellanox Spectrum deliver industry's highest performance and lowest latency Ethernet switches at various speeds including 10/25 and 40/50/100Gbps to support throughput required for all video requirements including 4K, 8K, HFR and HDR. With its flexible switch buffers with zero-packet loss, predictable network performance and QoS & DSCP marking, it provides the ultimate experience to the viewers whether its live streaming or from post production studios. The key advantages of Spectrum switches in IP-Broadcast applications are:

Consistent and very low port-to-port latency and jitter:

Mellanox switches have lowest port-to-port latency and jitter in the industry. Based on the testing done by Fox Networks, Mellanox Spectrum delivered lowest port-to-port latency and packet delay variation when compared with other switches. Fox and Aperi Corporation had earlier presented their test results across other switch vendors at 2014 SMPTE Annual Technical Conference and Exhibition. Hence as an IP-based broadcast studio scales with a Mellanox fabric, it does so with known and well understood constants.
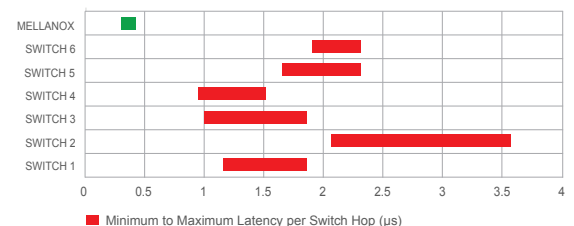

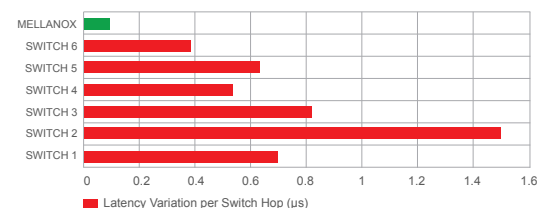*Figure 1: Port-to-Port Switch Latency*

Figure 2: Packet Delay Variations (Jitter)

In fabric containerized broadcast services:

By containerizing IP-studio services and running them on the switch allows broadcast engineers to focus on building ideal IP media fabric for their studio without utilizing additional servers and virtual machines. For example, Mellanox can build an NMOS aware switch by running both the Registration and Discovery service, and the Connection Manager within a lxc or a docker container on the switch.

OpenFlow Integration

With OpenFlow, automatic provisioning of studio IP network can be accomplished in many ways. For example, the Studio Control System can push out a new Software Defined Network (SDN) configuration using OpenFlow to the switches as a method to prepare the network for the desired workflow and video routing. Spectrum supports the latest OpenFlow 1.3 standard in multiple configurations: OpenFlow only, a port-based hybrid and a protocol-based traditional mode of operation. It is also integrated with Open Daylight (ODL), Open Network Operating System (ONOS) and other controllers.

Mellanox ConnectX-4 adapters

Mellanox ConenctX-4 Ethernet adapters provide the most flexible interconnect solution for IP-based broadcast and video streaming applications at speeds of 10/25 and 40/50/100Gbps. Broadcasting applications running over IP transport can achieve the highest efficiency and application density with the hardware-based stateless offloads and flow steering engines. These advanced offloads reduce CPU overhead for packet-processing and lowest latency. The key advantages of ConnectX-4 adapters are:

Kernel Bypass:

Video processing is a CPU intensive and strictly sequential application. Hence any optimization that can help improve CPU efficiency means lowering jitter and improving throughput. Kernel bypass improves the CPU efficiency by reducing the overhead of context switches and memory copy for I/O processing. Mellanox ConnectX-4 adapters support multiple kernel bypass solutions including RDMA, Netmap, Data Plane Development Kit (DPDK) and Mellanox VMA.

Packet Pacing to prevent network congestion:

An IP network with a multitude of bursty video senders can easily cause congestion on the switch port and by exhausting the switch buffer. Within a non-blocking fabric, this is something that needs to be addressed and eliminated in both the server and the switch. Packet pacing overcomes this challenge by rate limiting the flows out from all the senders on the server.

Hardware timestamping:

IEEE 1588 Precision Time Protocol (PTP) and SMTPE2059 enables a highly accurate timing solution with nanosecond accuracy. The protocol enables heterogeneous systems that include clocks of various inherent precision levels, resolutions and stability to synchronize with a grandmaster clock. Mellanox ConnectX-4 adapters can provide the timestamping in hardware with highest accuracy thereby eliminating the highly unpredictable jitter seen in software-based timestamping.
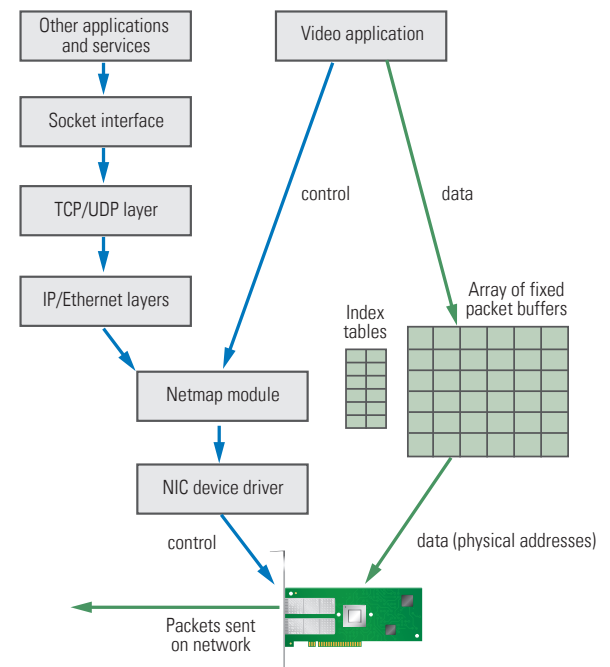

Figure 3: Optimized Network solution,
jointly developed with BBC

LinkX Cables

Transmitting video over any fabric requires a very high degree of performance and accuracy. All Mellanox Interconnects are built to a very high standard to support and maintain our company mantra of high speed and low latency. The passive copper and active fibre (VCSEL [Vertical-Cavity Surface-Emitting Laser] Silicon Photonics) cables as well as the optical transceivers are all built with lowest power and lowest cost in mind in both SFP and QSFP form factor. Tested to an industry's lowest Bit Error Rate (BER) of 10e-15 means fewer transmission errors and retries compared to competing products.

Conclusion

The move to next-gen IP based broadcast world is inevitable – thanks to the inefficient proprietary SDI fabric. This is even more evident with companies like BBC, FOX and NBC embracing their infrastructure using IP network. Mellanox end-to-end efficient broadcast network is radically changing the economics of broadcast applications including live sports coverage, production studios, data transport, content distribution and storage applications for broadcast professionals. With a proven and scalable solution, Mellanox Spectrum switches, ConnectX-4 adapters and LinkX cables allows broadcasters to save time and money, and deliver extremely reliable HDR video to their viewers.

Mellanox is an active participant of IEEE, SMPTE, AMWA and JT-NM standards to help further advance IP network requirements needed for the Media and Entertainment Industry.

About Mellanox

Mellanox Technologies (NASDAQ: MLNX) is a leading supplier of end-to-end Ethernet and InfiniBand intelligent interconnect solutions and services for servers, storage, and hyper-converged infrastructure. Mellanox intelligent interconnect solutions increase data center efficiency by providing the highest throughput and lowest latency, delivering data faster to applications and unlocking system performance. Mellanox offers a choice of high performance solutions: network and multi-core processors, network adapters, switches, cables, software and silicon, that accelerate application runtime and maximize business results for a wide range of markets including high performance computing, enterprise data centers, Web 2.0, cloud, storage, network security, telecom and financial services.
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