MEDIA & ENTERTAINMENT

REAL-TIME 8Kp60 10-BIT HEVC ENCODING WITH AMD EPYC™ 7002 SERIES PROCESSORS AND BEAMR

AMD EPYC

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Performance Leadership

The AMD EPYC™ 7002 Series SoC brings exceptional speed and performance to the video operations datacenter for OTT services, Pay TV video distributors, and cloud gaming platforms. Utilizing an x86-architecture, the 2nd Gen EPYC™ processor combines high core counts, large memory capacity with ample bandwidth, and massive I/O, available with optimum ratios to reach new performance heights for HEVC video encoding.

Architectural Leadership

Match core count with application needs without compromising processor features. EPYC's balanced set of resources means more freedom to right-size the server configuration to the streaming video or cloud gaming workload.

AMD EPYC and Beamr

Running the Beamr *5* HEVC Software Encoder on AMD EPYC™ 7002 Series processors in a single-socket system, video services can encode a single real-time channel into a broadcast quality 8Kp60 10-bit HDR video stream for live OTT and broadcast services.[5] For applications where 8K is not required, users may transcode a full ABR stack including a 4K, 1080p, 720p, 480p, and 360p profile on a single machine using a dual socket AMD EPYC™ 7601 processor-based system.[1]

Quality and Performance for 10-bit HDR

Beamr's advanced HEVC software encoding technology exploits key features of the 2nd Gen AMD EPYC™ processor to deliver high-quality, high density, and fast performance, for high dynamic range (HDR) entertainment content in a simple and easy to deploy software package.

BEAMR

2nd Gen AMD EPYC™ 7742 Processor Running Beamr *5* Delivers Broadcast Quality, Real-Time 8Kp60 HEVC Encoding on a Single Socket[5]

The Beamr *5* HEVC software encoder utilizes key features of the 2nd Gen AMD EPYC™ Series processor to deliver new levels of video encoding capability to OTT video services, managed service operators, and cloud gaming distributors[6]. The new AMD EPYC™ processor architecture enables Beamr *5* to deliver world class encoding speed without sacrificing quality or technology compatibility. Beamr testing showed AMD EPYC processors delivering 10-bit HDR and 60 frames per second, even when encoding in real-time at 8K resolution[5] and with a quality level that is suitable for live linear broadcast level streaming, premium VOD entertainment, and cloud gaming content streaming.

7 nm	PCIe® Gen 4	DDR4 3200
64 Cores per socket	**128** PCIe® Gen 4 lanes per socket	**8** Memory channels per socket
World's first 7 nm x86 server CPU Highest available core count[7] to maximize parallelism	World's first PCIe® Gen 4 ready x86 server CPU[8] Doubles the bandwidth of the previous generation	World's first x86 architecture with DRR4 3200[8] Up to 4 TB of memory capacity per socket

For real-time live streaming services and cloud gaming platforms that require high resolution and high frame rates, this performance envelope has obvious advantages to help lower operating costs and raise margins.

The performance benefits of Beamr *5*, running on the AMD EPYC™ processor architecture, extends from live linear streaming services to video on demand (VOD), and cloud gaming. Shorter wall-clock times can allow more titles to be encoded in the same period of time, and up to full adaptive bitrate (ABR) ladders to be created on a single machine. These benefits are of particular interest to cloud gaming platforms and live sports streaming services where ultra-low latency is a requirement.

The AMD EPYC 7002 Series Performance Advantage

Based on a new microarchitecture, the AMD EPYC™ 7002 Series processors are built using state-of-the-art process technology, and combine high core counts, large memory capacity with ample bandwidth, and massive I/O, all with the right ratios to help HEVC video encoding reach new

performance heights. AMD EPYC's architecture delivers high throughput per execution core, and with up to 64 cores per socket, ultra-high encoding density is now possible with the Beamr *5* HEVC software encoder running on an AMD EPYC™ 7002 Series processor. This perfect match of hardware and software is how the AMD EPYC™ 7742 SoC running Beamr *5* was able to encode a real-time 8Kp60 10-bit HDR stream on a single socket within a 240W TDP envelope[5].

Executive Summary

AMD EPYC™ 7002 Series processors running the Beamr *5* HEVC software encoder help enable a competitive advantage in the race for subscriber growth for direct-to-consumer streaming services, cloud gaming platforms, and broadcast delivery networks. By turning on new service capabilities and advanced video features such as Cloud DVR, UHD, High Dynamic Range (HDR), High Efficiency Video Coding (HEVC), and VR, entertainment content distributors who take advantage of the speed, quality and flexibility that Beamr on AMD can deliver, will be able to capitalize on the 82 percent of network traffic that will be video by 2022[2]. OTT Video on Demand content is set to scale by an equivalent viewing time of 10 billion DVDs watched every month over the same time period.[2] This unprecedented volume and scale of video increases the importance of efficient video encoding software running on high-performing processors.

The Beamr *5* HEVC software encoder, operating on the 2nd Gen AMD EPYC™ 7002 Series processors support the needs of today's video and cloud gaming services by combining exceptional speed and performance with the most flexible system architecture. Consumer demand for streaming video services is increasing even while content costs are rising and subscription fatigue and competitive services are putting pressure on revenue. These trends mean operators cannot afford to invest in fixed function, inflexible video infrastructure that does not scale economically. 8K displays are starting to find their way into homes, and 4K Ultra-High Definition (UHD) display and capture capabilities are appearing on more smartphones. Wireless service providers are discovering that their networks are facing increasing congestion from data hungry devices. Video encoding software running on advanced processors provide the architectural flexibility and performance standards required for today's modern video workflows.

Modern Video Workflow Flexibility

Many options exist for Service Operators, Video Platforms, Cloud Gaming Services, CDNs, and Broadcasters to use Beamr *5* across public cloud and on-premises data centers with AMD EPYC™ processors. AMD EPYC™ powered workflows based on Beamr *5* span cloud gaming, VOD file transcoding and real-time video encoding for live streaming broadcast applications, and premium VOD file delivery.

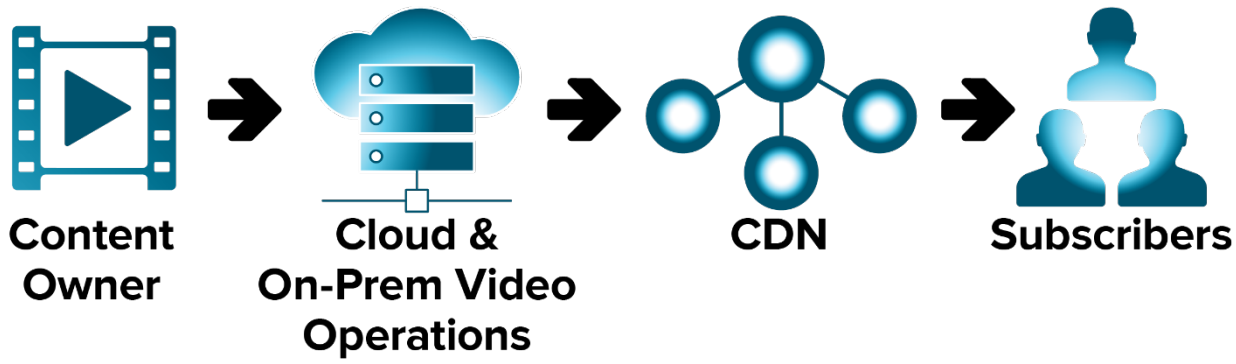

Figure 1: Video Distribution from content owner to subscriber

Beamr Advanced Video Encoding Technology

At the foundation of Beamr *5* video encoding technology is years of advanced codec development which has resulted in eleven international patents for innovations securing Beamr's high-density computing performance, bitrate efficiency, and video quality advantage. The combination of Beamr software and AMD EPYC based hardware provides key benefits, which position providers for the successful delivery of video as summarized in Figure 2.

Video service providers will appreciate the power and performance of operating the Beamr *5* HEVC encoder on the AMD EPYC™ 7002 Series of processors due to its ability to scale as a result of Beamr *5*'s unique capacity to split and re-deploy video encoding workflows on-the-fly, resulting in content processing and delivery flexibility for operators needing to dynamically configure their workflows. Planned joint engineering efforts from Beamr and AMD will increase the essential video encoding benefits of Beamr's encoding engine running on AMD.

Figure 2: Objectives of the Beamr 5 4K HEVC Encoder on AMD EPYC™ processors

Beamr Encoder Performance

Beamr *5* achieves its benchmark performance through two-level motion estimation and micro-level parallelization. A two-level motion estimation process allows incoming frames to be analyzed by the encoder, which in turn determines the scene complexity and calculates initial motion vectors while estimating with a high degree of precision, the bit demand of the frame. Using this estimate guides a second stage where the encoder directs encoding activities to the most meaningful aspects of each frame, further refining the previous estimate. By partitioning the encoding process, unproductive calculations are avoided, and a significant speedup is the result. In testing, Beamr *5* encoded a 4Kp60 clip at the same quality with up to 50% higher throughput (60fps vs 40fps) while utilizing only 25% of the CPU resources as compared with H.265.[3]

Foundational to Beamr's performance advantage, micro-level parallelization technology plays an important role in the amazing speed and compute efficiency of Beamr *5*. This innovative technology was developed from the engineering lessons learned from earlier generations of Beamr's real-time software encoders, where portions of the encoding tasks are staggered such that each micro task starts only when its data becomes available and is still resident in the cache. This means the system does not waste power and CPU cycles repeatedly writing and fetching data to and from memory.

Careful design of these micro tasks mean they can execute efficiently across the whole frame, in a well-balanced manner, such that all cores are kept uniformly busy and none are left waiting for the next task. These software optimizations have been engineered directly into the encoder implementation and do not require a specific OS or special API processor access.

To illustrate the effectiveness of Beamr *5*'s AMD EPYC™ optimization, Beamr utilized one socket of a dual-socket board with a 2nd Gen AMD EPYC™ 7742 processor to complete a single HEVC 8Kp60 10-bit HDR real-time encode using Beamr *5*.[5] Last year, Beamr also utilized a dual-socket server with AMD EPYC™ 7601 processors to encode six HEVC 4Kp60 10-bit live channels. In both cases, Beamr *5* successfully loaded all the threads used at an

impressive 90% or higher utilization across the active cores. This is a powerful demonstration of the effectiveness of Beamr's micro-level task parallelization on EPYC processor powered hardware..[1]

The AMD EPYC Performance Advantage

Based on a new microarchitecture built using the latest process technology, the AMD EPYC™ processors redesigned architecture delivers exceptional throughput per execution core. As a result, hardware parallelism is significantly increased, with up to 64 cores per socket contributing to increased encoding density. The AMD EPYC™ 7742 processor Beamr tested]delivered high-density video processing within a 240W TDP envelope[5]. Performance contributors of the AMD EPYC processors include the following:

- High core count - efficient thread management maximizes utilization of CPU cycles for production
- Efficient Power Advantage - 64 cores deliver their compute results within a 240W TDP envelope, enabling dense rack packing
- Ample memory channels – eight memory channels provide abundant memory throughput that is one of the main performance factors for video workloads.
- A large, low-latency L1/L2 cache hierarchy supports efficiency of on-die data handling, supporting memory intensive video workloads.
- Support for high-speed memory - DDR4-3200 increases data throughput.
- AVX2 256-bit parallel instructions

Conclusion

Increasing video encoding density and compute efficiency in video encoding/transcoding and cloud gaming workflows is a key requirement to secure a competitive advantage for entertainment services such as OTT streaming video platforms, multi-service operators, and cloud gaming service providers. Video architects must design workflows that are adaptable and able to deliver advanced entertainment experiences. The combination of Beamr's video technology, and software encoding engines, with AMD EPYC™ 7002 Series processors, gives video distributors and cloud gaming platforms the ability to flexibly meet customer expectations with high density, exceptional high quality.

79% of industry professionals reported that they see HEVC as a viable replacement for H.264 for 4K, and 77% reported the same for HD. [4] In combination with a growing number of 4K capable devices in consumers' homes, and with virtually every new smartphone now supporting HEVC natively, video services not planning a move to HEVC and higher resolutions will likely find themselves at a competitive disadvantage compared with those who do.

Beamr *5* running on AMD EPYC™ 7002 Series processors sets the pace for all entertainment services to deliver a robust solution that is able to meet today's technical and business requirements, while providing a meaningful improvement to the video processing and encoding capabilities of any video delivery application.

For more information about AMD's EPYC line of processors visit: http://www.amd.com/epyc

For more information about Beamr visit: http://www.beamr.com/

FOOTNOTES

1. Beamr *5* (version 4.2) 4K HEVC encoding tested by Beamr - August, 2018. Data reflects performance measurements on a two-socket system using AMD EPYC™ 7601 processors @ 2.2GHz, 32 cores. These results have not been independently verified by AMD.
2. https://www.cisco.com/c/en/us/solutions/collateral/service-provider/visual-networking-index-vni/white-paper-c11-741490.html
3. Beamr internal testing: http://beamrvideomedia.s3.amazonaws.com/pdf/Beamr_How_to_Encode_Video_for_the_Future.pdf These results have not been independently verified by AMD.
4. https://go.beamr.com/HEVC-Industry-Insights
5. Beamr *5* (version 4.5) 8K HEVC encoding tested by Beamr – July, 2019. Data reflects performance measurements on a two-socket system using one socket of an AMD EPYC™ 7742 processor @ 3.4GHz, 64 cores. These results have not been independently verified by AMD.
6. HEVC (H.265), H.264, and VP9 acceleration are subject to and not operable without inclusion/installation of compatible HEVC players. GD-81
7. Best-in-class based on industry-standard pin-based (LGA) X86 processors. NAP-166.
8. Some supported features and functionality of second-generation AMD EPYC™ processors (codenamed "Rome") require a BIOS update from your server manufacturer when used with a motherboard designed for the first-generation AMD EPYC 7000 series processor. A motherboard designed for "Rome" processors is required to enable all available functionality. ROM-06.