64-bit Technology: Driving The Digital Media Revolution

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Introduction

The film and music industries historically have been dependent upon analog media pipelines. Though analog pipelines are still pervasive in the industry today, media development schedules continue to be impacted by the inherent physical limitations such as processing time, linear editing, inability to re-purpose, and eventual media decay. The effects of these limitations add costs and time to media development and distribution. The film, broadcast and music industries have accepted these limitations and borne these extra costs purely out of necessity. However, over the past few years, the advent of high-performance, low-cost computers, non-proprietary software applications, and open standards has given way to eliminating these limitations. These technologies are ushering in a new revolution in media creation. This revolution encompasses breathing new life into existing film/audio catalogs, reducing the cost of production, shortening time to market, and providing an ever-expanding pallet of special effects.

Digital Video Post Production

The motion picture, television, and broadcast industries are just beginning to work with digital video and the growth of DVD, high-definition, and theatrical-quality video is placing an ever-larger burden on the computers that are used for adding and mixing special effects and for compressing for broadcast. With powerful Non-linear editing (NLE) software tools available today, creators and producers can manipulate digitized video like never before, as long as the hardware is up to the task.

Bandwidth

Essentially, I/O buses need to be capable of moving large amounts of digitized digital video. For full-screen, full-motion broadcast quality NTSC digital video, the system must be capable of successfully moving 29.97 frames per second at 720 by 480 pixels in RGB (red, green, blue) 24-bit color, which equates to 31 megabytes of data per second. A system built to handle high-definition HDTV 1080i digital video must be capable of successfully moving 24 frames per second at 1920 by 1080 pixels for a grand total of 149 megabytes of data per second. Theatrical-quality resolutions are reached via a process called “Up-RESing” where lower resolution material is upped to higher resolution material through a process of interpolation where new pixels are created by comparing and averaging existing ones. Interpolative Up-RESing requires images be moved to 2048 by 1151 pixels in size (at 24 frames per second) to allow for images to be fit into larger resolution areas of the 35mm negative. As expected, this process requires much more processing power and time with data rates equating to a whopping 170 megabytes of data per second.

Of course, these bandwidths are for single streams of video. The need for multiple video streams in high-production work, especially when multiple video streams are used for creating transitions and when special effects are applied, places an even greater bandwidth burden on the system.

Compression Issues

Compression is the translation of source material; comprised of video, audio, or a combination of both, using a variety of computer algorithms to reduce the amount of data required to accurately represent the content. Compression reduces the sheer size of uncompressed video to a size that is manageable for storage and distribution. High-end dedicated capture cards typically contain hardware compression features for handling compression chores, while the majority of consumer-based capture cards do not. Consumer-based capture cards accomplish compression chores using software bundled with the card, placing the majority of the work squarely on the host processor.

While capture cards support hardware-based special effects and digital video (DV) and MPEG compression codecs, they do not have all of the special effects and compression schemes required by the developer, leaving these chores to software-based plug-ins and applications typically bundled with the card while placing the majority of the processing load on the host processor. A typical scenario would be a capture card decompressing digital video using a DV codec built into the card using a software codec to encode the same video stream into an MPEG format and then sending the finished product to either the hard drive or an external source.

Capture cards may free the processor to some extent due to the on-board hardware DV codec handling the decompression chores, but the bandwidth problem becomes even more important because any delay will ruin the compressed MPEG video. This is especially an issue with today's I/O buses as they do not support concurrent transactions where data can be sent in both directions at the same time. Also, this scenario can be further problematic if multiple processors are used that share the same front-side bus to memory. Even if the situation is reversed and the hardware codec is fully handling the compression chores, the updated video frames still need to be downloaded from the CPU to the codec, and if the I/O pipe does not support concurrent transfers, a bottleneck is created and the same problem rears its ugly head.

Digital Audio Post Production

Audio engineers and producers are faced with the same problems that filmmakers face with analog media. They can move into the digital domain by digitizing the master tape in a high resolution and re-master for the new surround sound formats like Dolby 5.1. The Digital Audio Workstation (DAW) has now become the platform of choice for recording and mastering. This is due in part to the advent of software plug-ins that perform signal-effects processing previously done by expensive external hardware such as reverbs and compressors. Software-based systems are attractive to the producers because they lower the overall cost and protect their investments by eliminating the maintenance of "vintage" outboard gear. This makes digital recording accessible to even home users.

The high volumes, increased computing power, and reliability of personal computers has contributed to the outgrowth of digital recording from the home studio into the professional studio as the platform used for the recording, editing, and mixing of high-fidelity audio content creation. In this environment, the real-time recording of multiple independent tracks, the mixing of special effects, and the real-time editing and playback of these tracks place tremendous strains on systems that must be capable of handling these streams without skipping or glitches.

Reduced Latency Is Key

While systems utilizing older, multi-drop, shared buses such as PCI can sustain today an aggregate of 20 megabytes per second of raw audio data comprised of 48 tracks (24 in and 24 out simultaneously), each sampled at 24 bits at 96kHz, the reality is these shared buses cannot always reliably handle these audio streams when other devices are sharing the bus.

Older, multi-drop, shared I/O buses like PCI are half-duplex links where data can only be sent in a single direction at a time while other devices must wait their turn. These multi-drop buses use an arbitration method that works on an interrupt basis with shared devices to guarantee bandwidth is distributed among all devices. And, to compound the issue further, many different arbitration schemes exist amongst different architectures that can lead to inconsistencies between devices and dissimilar platforms. Also, the inefficiency, bus turnaround, and overhead imposed on data sent across older, shared buses like PCI, greatly decrease the amount of overall bandwidth available to the bus and can further encumber fluid communication. Of course, this is not the optimal scenario the naturally isochronous audio streams with time-critical data that must be moved without glitches. HyperTransport™ I/O technology, with its low latency and high-bandwidth attributes, is designed to solve these very issues.

Benefits of 64-bit Computing

Time is money in the world of feature film making and especially true for technology-dependent feature films like "*Star Wars:* Episode II *Attack of the Clones."* These films are created totally in a digital-media format. Today's sophisticated viewing audiences expect to see dazzling special effects and even greater realism with each new feature release. To increase the realism in each scene, artists and developers must always dramatically increase the amount of data that goes into each shot. From adaptively tessellated sub-division surfaces to global illumination to higher output color bit depths, the amount of hard number crunching going into a single shot is staggering. In effect, digital filmmaking is outgrowing the 32-bit address space. Accelerating the delivery of 64-bit compute engines is vital for the future of the film industry. Upcoming AMD Opteron™ processor-based platforms will offer JAK Films ("*Star Wars:* Episode II *Attack of the Clones"*), a cost-effective 64-bit development environment (Windows®- and Linux-based) to meet their technical requirements and, at the same time, will be able to reduce the very expensive rending time associated with complex scene generation.

The new world of digital audio creation will make use of 64-bit computing, too. The digital audio engineer or composer will soon have all their virtual instruments and sample libraries resident in physical memory, eliminating the need for multiple PCs or peripheral instruments. This is made possible through a greater linear address space. Having all these instruments and libraries available at one console can increase the productivity of the content creator.

Summary

The world of media production is changing from an "outsider looking in" culture, to a culture that creates. Professional, quality media creation is no longer limited to a select few. The ratio of price and performance of the tools used to create digital content is empowering dynamic growth in this market segment. Technology that earns the loyalty of the entertainment industry will gain amazing influence over the global consumer market. The upcoming 64-bit AMD Opteron processor-based platforms based on HyperTransport technology chip-to-chip I/O are the key technologies to enabling the media revolution in film and audio.

AMD Overview

AMD is a global supplier of integrated circuits for the personal and networked computer and communications markets with manufacturing facilities in the United States, Europe, and Asia. AMD produces microprocessors, Flash memory devices, and support circuitry for communications and networking applications. Founded in 1969 and based in Sunnyvale, California, AMD had revenues of approximately $2.7 billion in 2002. (NYSE: AMD).

Credits

Sean Cleveland, HyperTransport™ Technology: Optimized for Digital Video & Audio, AMD 2002

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