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A New Level of Price/Performance and Scalability for Media Processing

Intel® architecture with on-processor graphics yields about a 50 percent savings[1] compared to DSP solutions.

Introduction

Network traffic is exploding, placing unprecedented demands on equipment manufacturers to increase the workload density and throughput of media processing devices. The driving force will continue to be the growing popularity of video streaming and communications applications, such as Comcast*, YouTube*, Hulu*, and Netflix*, especially as high-definition video becomes more prevalent and 4K content proliferates. It is predicted that over two-thirds of mobile data traffic will be video by 2018, and mobile video will increase 14-fold between 2013 and 2018,[2] as shown in Figure 1.
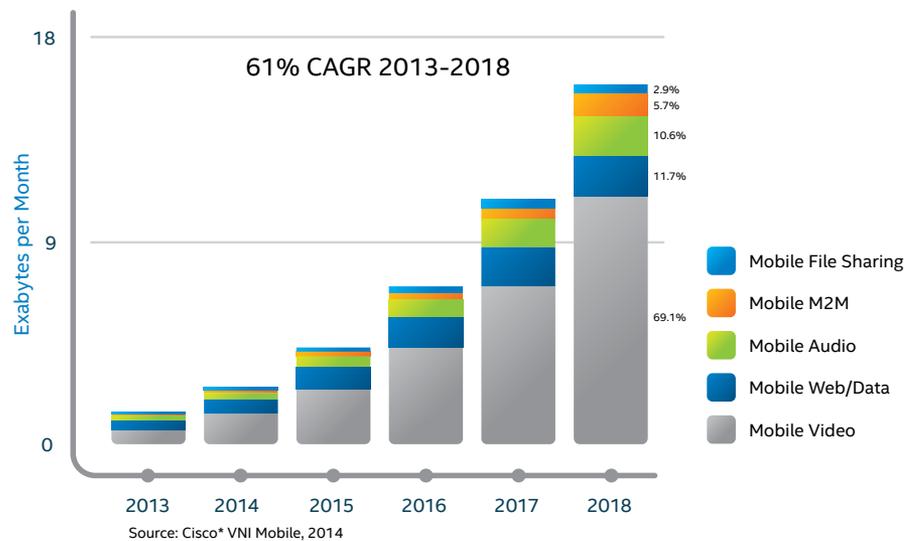
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61% CAGR 2013-2018

Exabytes per Month

2.9%
5.7%
10.6%
11.7%
69.1%

Mobile File Sharing
Mobile M2M
Mobile Audio
Mobile Web/Data
Mobile Video

18
9
0

2013 2014 2015 2016 2017 2018

Source: Cisco* VNI Mobile, 2014

Figure 1. Mobile video traffic is forecasted to be over 69 percent of all mobile data traffic in 2018

Media Market Growth Drivers

The number and types of devices available for end users to access media are increasing every day, generating demand for more media processing resources to support the wide variety of screen sizes and video formats. At the same time, TV Everywhere and OTT service providers, like Netflix, are encoding and transcoding tremendous volumes of video. For instance, Netflix is known to create 120 unique copies of a single piece of content to cater to the full spectrum of devices, resolutions, codecs, network types, etc.[3] User-generated content, with around 48 hours uploaded every minute to YouTube, could require the greatest

amount of encoding in the future. Smart cities with hundreds of thousands of cameras will process massive amounts of traffic and surveillance video. Cable service providers are broadcasting increasing amounts of real-time video.

Impact on Service Providers

To keep up with these trends, service providers must invest more in their infrastructure; however, they cannot recoup this investment solely via data plan charges. Instead, they need to find ways to reduce the burden on their network and monetize video content, such as through advertising or tiered quality of experience (QoE).

Manage bandwidth: Transcoding and transrating technologies can dramatically reduce the number of bits needed to stream video, sometimes cutting it in half or better.

Save Money: Compared to other computing solutions, service providers can realize around a 50 percent savings[1] when they deploy media processing devices based on Intel® Core™ processors, as shown later in this paper.

Make Money: New revenue-generating services are expected to emerge around automated media file indexing, ad insertion, speech processing and guaranteed QoE.

Now, Intel Core processors with Intel® Quick Sync Video (i.e., on-processor graphics) can help minimize the CapEx and OpEx of equipment executing these workloads while simplifying development and increasing scalability. Since the processor graphics is on-chip, it consumes less power than an add-in graphics card. In addition, the processor graphics delivers four to five times more media acceleration than software-only media processing,[4] and this difference is expected to increase on future processor generations.
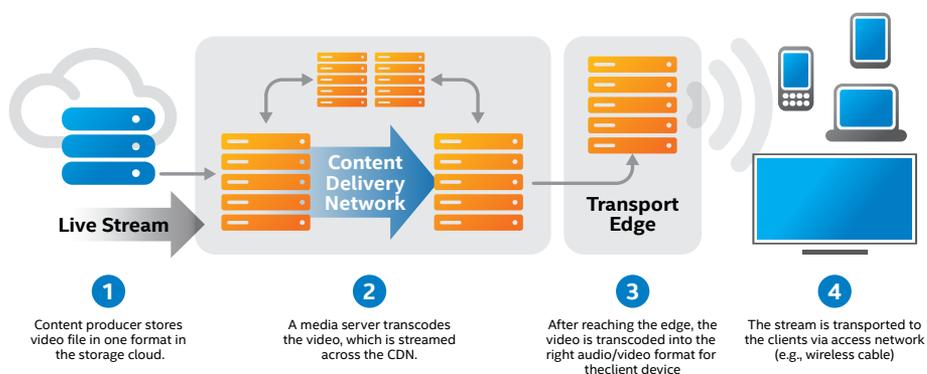

Figure 2. Media in the Network

The solution is highly scalable and low power because it's possible to put as many as eighteen Intel Core processors in a single 1U or 2U server. As a result, service providers can offer differentiated services using a solution optimized for price/performance and supported by a broad ecosystem. The Intel approach is ideal for Telco IPTV broadcast networks, cable/satellite operators, over-the-top (OTT) video and mobile video.

The Life of a Video Stream in the Network

The role of media players in the delivery of media content from content providers to consumers is shown in Figure 2 and described in the following:

1. A content producer stores a video file in a high-bit-rate storage cloud that can be accessed by multiple content delivery networks (CDNs). Just one copy of the file (i.e., one format) needs to be stored, which minimizes storage requirements and cost for the content producer. The link between the storage cloud and the CDN should have security and privacy safeguards to protect the content.

2. Before the video file is streamed across the CDN, a media processing device in a data center transcodes it into some standard formats, thus creating more streams to satisfy resolution, bit rate, codec and quality needs. The media processing device may also perform content analytics to demonstrate conformance to service level agreements (SLAs).

3. When the video stream reaches the network edge, a media processing device performs client-aware transcoding to ensure the stream is in the most suitable format based on access network bandwidth and the screen resolution of the consumer device. For instance, in a cellular network, both the transcoding and transrating steps take place at the Gi interface in the P-Gateway itself or in a box just off it. This can significantly improve the QoE for consumers.

4. The stream is sent to the consumer device via an access network such as wireless or cable. Adaptive bit rate management can help network equipment respond to network congestion or other changes in the environment.

Improvements in smart phone display technology are enabling higher and higher resolution, such that in just a few years, encoding requirements have grown considerably. Likewise, the move from standard-definition to high-definition video formats, like ultra HD (4K), has increased the need for processing power.

Media Processing Solutions

To keep up with increasing video traffic, service providers need equipment that balances the demands for computing performance, bandwidth, advanced traffic control, quality and multiple standards. Until now, media processing workloads, such as real-time encoding, transcoding and transrating of media streams, have traditionally been performed by a range of solutions based on digital signal processors (DSPs), ASICs and MIPS* processors. A more cost-effective alternative is Intel Quick Sync Video in Intel Core processors, which can be used to accelerate media processing workloads with capabilities including:

- Full decode acceleration of H.264, MPEG-2 and VC-1

- Full encode acceleration of H.264 and MPEG-2

- Video Pre/Post Processing, including denoise, deinterlace and color-space conversion

Further enhanced in the 4th generation Intel Core processor, Intel Quick Sync Video provides hardware-accelerated video encoding, decoding and transcoding of media. It utilizes the on-chip Intel Core processor HD graphics to perform dedicated media processing, thus minimal CPU cycles are expended. Developers can access these capabilities using the application programming interface (API) in the Intel® Media SDK. The SDK helps developers optimize applications for

Intel® HD Graphics' fixed-function hardware acceleration, currently part of the 2nd, 3rd and 4th generation Intel Core processors.

The SDK supports a range of operating systems, including Microsoft* Windows* 8, Linux* and OSX*, as well as accelerated H.264 encode and decode and video processing filters. The tool is extensible, allowing developers to incorporate their own software encoding and decoding in place of the default codecs when a newer and more efficient codec becomes available. The SDK is available as a free download at http://software.intel.com/en-us/vcsource/tools/media-sdk.

Processor Graphics Architecture

Intel Quick Sync Video graphics engine architecture on 4th generation Intel Core processors includes 3D compute elements, a multi-format hardware-assisted decode/encode pipeline and mid-level cache (MLC) designed to

deliver exceptional media processing, video quality and high-definition playback. The processor graphics handles the vast majority of the media processing, thus the processor cores are free to execute other workloads, such as localized ad insertion and audio processing.

The processor graphics controller, shown in Figure 3, supports up to 40 execution units (EUs) depending on the processor SKU. The EUs perform 128-bit wide execution per clock and support SIMD8 instructions for vertex processing and SIMD16 instructions for pixel processing. The controller maintains the 3D pipeline, which includes orchestrating the different stages such as the vertex fetch, vertex shading, geometry shading, clip, texturing and rasterization. The vertex shader (VS) and geometry shader (GS) stages shown in the figure are used to produce the appropriate levels of light and color within an image.
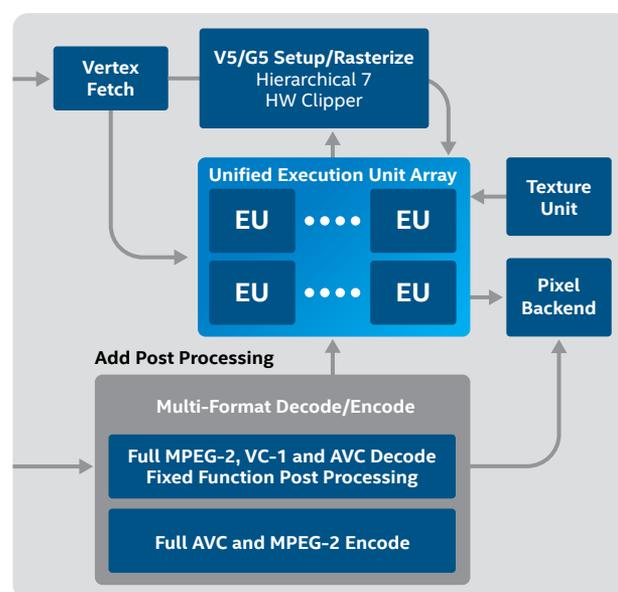

Figure 3. Processor Graphics Controller Unit Block Diagram

Percent Cumulative Savings From Intel® Core™ Processors Compared to Digital Signal Processors (DSPs)
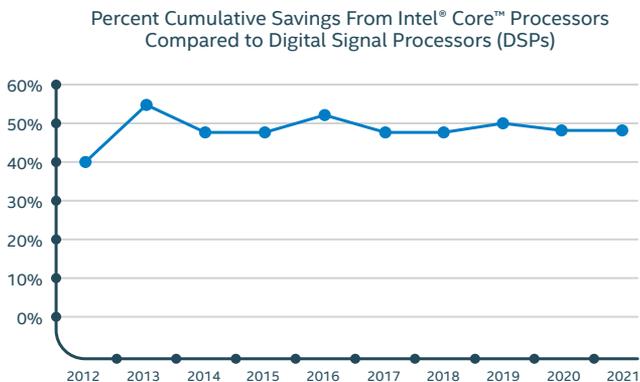
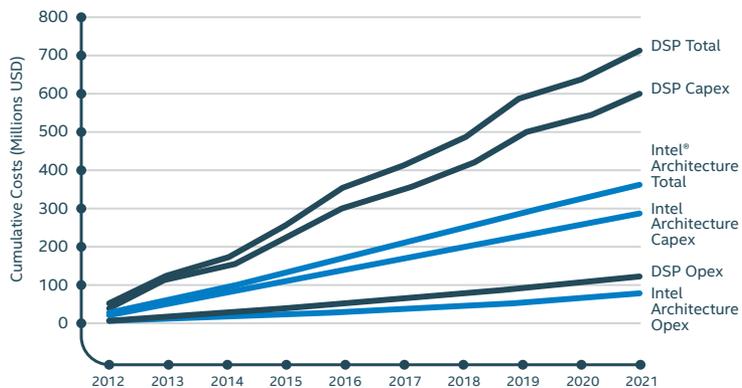**Figure 4.** Percent Cumulative Saving

Figure 5. Breakdown of CapEx and OpEx

Lowering the Total Cost of Ownership

A study by the PA Consulting Group examined the OpEx and CapEx for a service provider performing transcoding and media functions on a portion of the media traffic carried on its network. The study compared the total cost of ownership (TCO) for media processing solutions based on either of two different architectures:

- **Traditional custom DSP architecture** using specific media processing appliances running on custom hardware.

- **Intel® architecture processors** with Intel Quick Sync Video built on industry-standard blades with adapted media processing software.

The results indicated the media processing solution based on 3rd generation Intel Core processors offers a network operator or service provider a savings of around 50 percent when compared with DSP solutions, as

shown in Figure 4. The supporting data in Figure 5 shows the CapEx for Intel architecture-based solutions is significantly lower than when based on DSPs, primarily due to lower equipment cost. The OpEx savings are less than the CapEx savings because they are dominated by fixed manpower costs, which are relatively small for this type of deployment. The volume drivers were extrapolated from the Cisco* Visual Networking Index, and the analysis includes data center, power costs and personnel support costs for installation and operation.

Developer Benefits

Intel® architecture processors enable equipment manufacturers and independent software vendors (ISVs) to design scalable, cost-effective, power-efficient media processing solutions. They can create applications that take advantage of hardware-accelerated media processing for video codecs using Intel tools like the Intel Media SDK with a flexible API.

Since computers with 4th generation Intel Core processors and Intel Quick Sync Video are readily available, software developers can start writing applications immediately without waiting for custom hardware to be built.

Cost-Effective, Scalable Media Processing

As video traffic continues to surge, media processing technology will play an important role in helping service providers manage their bandwidth and deploy new revenue-generating services. Helping meet the demand for growth, quality and diverse services, 4th generation Intel Core processors enable low-power, cost-effective platforms that deliver scalable, high-performance media processing. With this solution, service providers can reduce costs while providing consumers the high quality video they are looking for on their application devices.

For more information about Intel solutions for media processing, visit
http://www.intel.com/content/www/us/en/communications/communications-media-processing.html