grass valley

APPLICATION NOTE

EDIUS and Intel's Sandy Bridge Technology

How to Turbo charge your workflow with Intel's Sandy Bridge processors and chipsets

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Would you like to cut the time it takes to author a one hour timeline for Blu-ray from over three hours to just over twenty minutes in Grass Valley™ EDIUS®? This Application Note will explain how to specify a system with the processor and motherboard that can achieve this, and how to configure it and EDIUS to unlock this potential.

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Introduction

"Sandy Bridge" was the program codename that Intel used for the second generation of Core 2 processors; the first of which started shipping early 2011. The processors kept the brand names from Core 2's first generation: Core i7, Core i5, and Core i3, but the chips themselves embody significant advances in process and design technology, as summarized in Table 1.

Feature	Previous Generation	Sandy Bridge	Main Benefits
Process	45 nm	32 nm	Higher clock speeds, lower power consumption, smaller chips.
Branch Prediction	Essentially unchanged since Pentium x	Redesigned from scratch	Up to 20% more efficient execution
HD 2000 Graphics, and			
HD 3000 Graphics	Not available, except in "Clarkdale" Core i5 and Core i3 lines.	Chip-level integration of GPU (6 or 12 execution units) to support Direct X, and Open GL APIs.	Depending on user needs, may eliminate requirement for a GPU card from vendors including nVidia, and ATI. Immersive 3D games still need an outboard GPU.
Quick Sync	Not available	Chip-level integration of fixed function logic to accelerate H.264 codec.	Fast — really fast — encoding, decoding and trans-coding with reference level picture quality.

Table 1 – *Main features and Benefits of Sandy Bridge.*

Quick Sync is the feature that's the key to achieving the significant time-savings on encoding that were mentioned at the start of this document. But let's review the encoding solutions that were state-of-the-art until Quick Sync came along, so that we can better understand how and when it can provide a benefit.

Technology Overview

Most video codecs, including the mainstream MPEG-2, DVCPRO, and H.264 solutions, use algorithms that, for the most part, are highly parallel in nature. They split the pictures into squares called macro blocks, each of which is put through a mathematical operation called a transform, the results of which are quantized before being grouped together and arithmetically coded using an algorithm that's a bit like WinZip.

Being based on thousands of small blocks, it's possible to achieve considerable speed-ups by using multiple processing or execution units on the transform part of these algorithms. The arithmetic coding part of the process is usually not tractable to software parallelization and so there is little benefit in using multiple processors for this part of the process within the context of encoding a single frame of video, as illustrated in Figure 1.
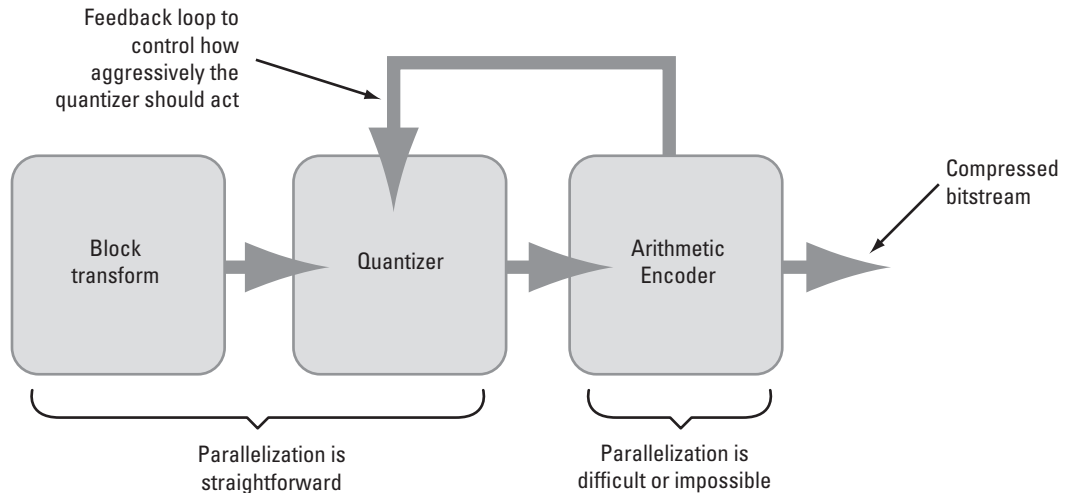
Figure 1 – *High level codec architecture.*

Technology Overview (cont.)

GPU Acceleration

Graphics Processing Units, or GPUs, as the name suggests, were originally developed to accelerate implementations of graphics APIs such as Direct X and Open GL for 3D rendering. Because 3D rendering breaks a scene into large numbers (sometimes hundreds of thousands) of polygons, each of which has to be rendered individually, it is a problem that is well matched to implementations that deploy multiple execution units. This is why the number of execution units in state-of-

the-art GPUs has risen steadily since their introduction. Nowadays, some of the high-end graphics cards available today have as many as 256 execution units.

It didn't take long before video codec engineers figured out how to re-purpose the massively parallel compute resources that GPUs provide to the parallelizable parts of encoding and decoding compressed digital video streams, with the arithmetic coding assigned to the CPU as illustrated in Figure 2.
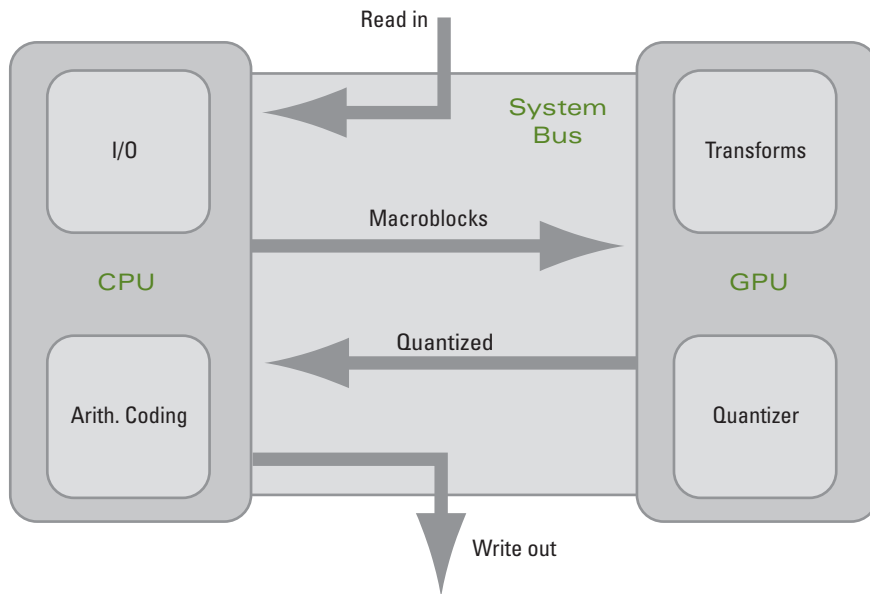

Figure 2 – *CPU-GPU architecture.*

What this figure also shows is the load that is placed on the system bus when the CPU and GPU co-operate to implement video codec algorithms. Even though PCI Express can sustain high data rates, the large arrows in the figure represent uncompressed HD data streams — and show that three of them need to share the system bus for a single stream of video. This creates a performance bottleneck that is removed once the video acceleration moves onto the same chip as the CPU as in Sandy Bridge's architecture.

Note that solutions including Adobe's Mercury Playback Engine rely on CPU-GPU co-operation similar to that illustrated in Figure 2, which is one reason for its inferior rendering performance when creating H.264, MP4, and AVCHD assets. Adobe haven't yet provided reliable support for the on-chip GPU that comes with most of the Sandy Bridge processors.

Technology Overview (cont.)

On-chip Video Codec Acceleration

Figure 3 illustrates the layout of a member of the Sandy Bridge processor family. It demonstrates that a significant fraction of the chip area is devoted to on-chip graphics functions, and that the processor cores and graphics share high-bandwidth, low-latency access to a large[1] shared cache that is also on-chip. This is one of the two main reasons that Sandy Bridge processors can achieve extremely fast video encoding performance — the bottleneck illustrated in Figure 2 has been removed — consider these figures for bandwidth:

Memory Interface	Peak Bandwidth
Off-chip DDR3-1066/1333	21 GB/s
On-chip L3 Cache	133 GB/s

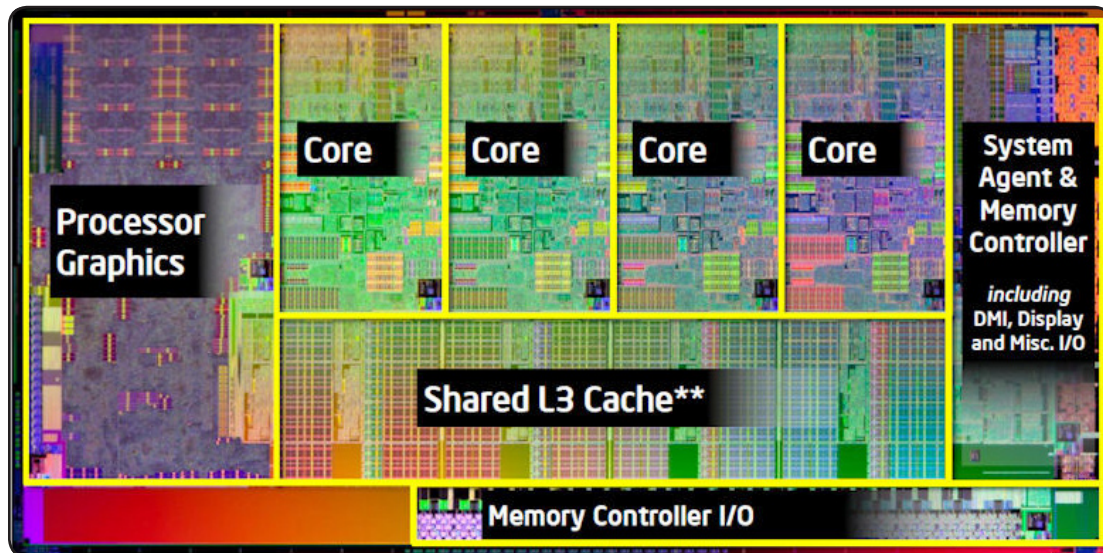**Table 2** – *Memory interface bandwidth comparison.*

Figure 3 – *Sandy Bridge chip layout*

The other big reason for the codec speed-up is that Intel have devoted some of the chip's real estate to special purpose modules that only do video coding —something their marketing people decided to call Quick Sync, which is the term that we'll use for the rest of this document.

[1]The size of the cache varies from 3 MB for an entry level i3 processor to 8 MB for a top of the range i7 model.
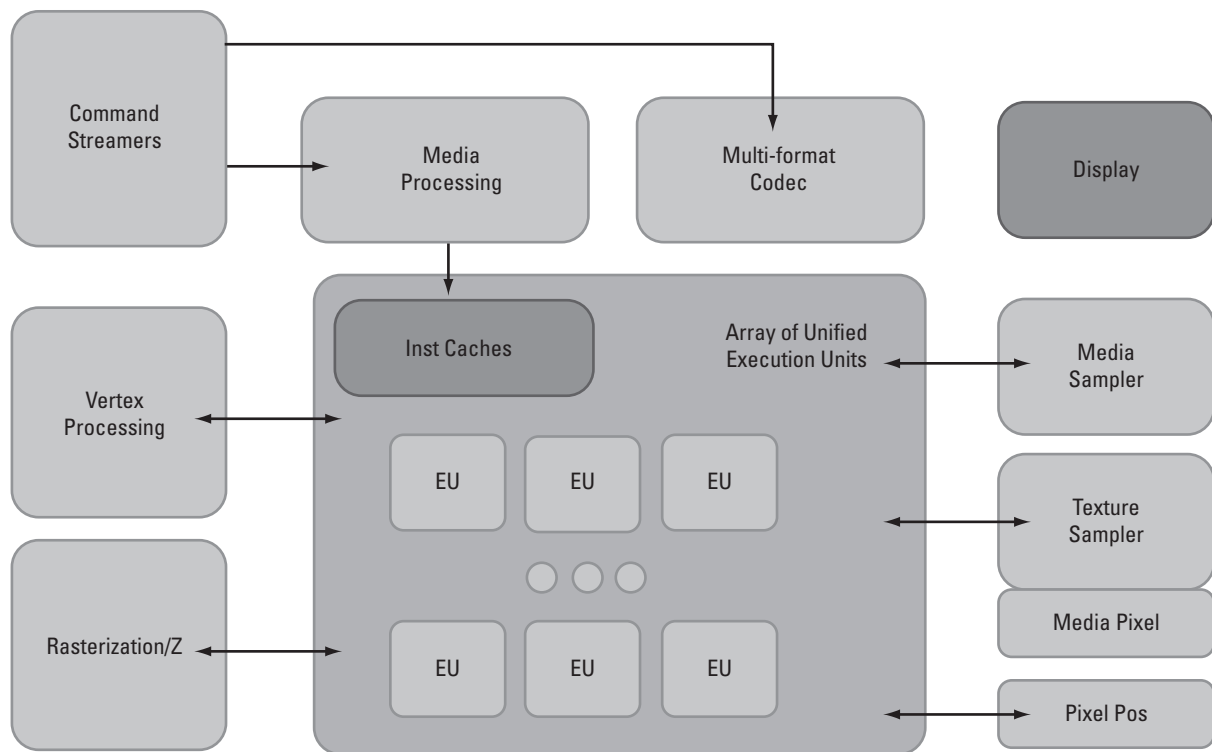
Technology Overview (cont.)

Figure 4 – *Graphics engine architecture.*

The multiformat codec shown in Figure 4 is the module that provides hardware support for MPEG-2, VC1, and H.264 decoding, and also for H.264 encoding — leaving the execution units (EUs) free for other graphics related duties.

In summary, Intel have put just the right sort of function-specific, dedicated video codec hardware as close to the CPU as it is possible to get, thereby eliminating memory bottlenecks, to deliver blazingly fast video codec performance. How fast? Let's see.

Performance

We benchmarked one of the mobile Core i7[2] processors by encoding a 180 second high definition video clip at three different profiles of AVCHD. We used the normal GPU-CPU method for one set of tests and Quick Sync for the other set.
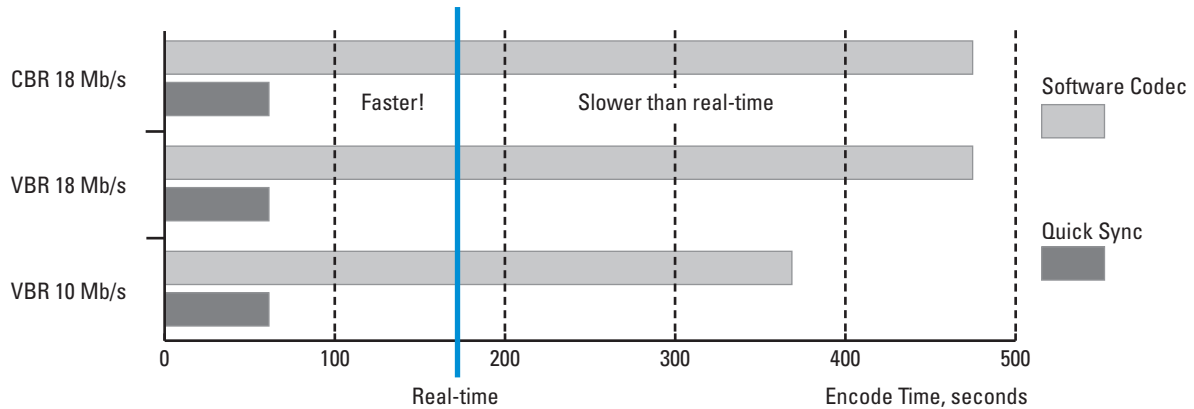

Figure 5 – *AVCHD benchmark.*

The results speak for themselves—Quick Sync encodes over 3X faster than real-time and is independent of the bit-stream profile. The more traditional approach is approximately 6X slower than Quick Sync. So, to burn a one hour movie would take over two hours without Quick Sync, compared to a little over 20 minutes if your system supports it, and you have it enabled. So how is that done? Let's look at the next section.

System Specifications

There are three things you need to get right to have Quick Sync work for you:

1) **Processor** — Must be a member of the Sandy Bridge family. Note that not any old Core i5 or Core i7 will work, because the branding doesn't guarantee that the processor has Sandy Bridge's architecture.

2) **Motherboard chipset** — Must be an H67, or preferably Z68 series. Quick Sync is disabled by the P67 chipset, so avoid that one.

3) **Monitor connections** — A monitor needs to be connected to the motherboard DVI output, and be active. This can be in addition to the GPU's DVI output, if present. More on how to get Sandy Bridge processors working together with third-party GPUs later in this note.

We'll cover these one at a time.

[2] Core i7, 2820QM, 4 cores, 8 threads, 8 MB level 3 cache.

System Specifications (cont.)

Specifying Your Processor

Choosing a processor is a complex trade-off between price, performance, battery life, and other factors on which only you, the user, can make the final trade-offs. The good news is that Intel claims support for Quick Sync pretty much across the board for its new Core i5 and Core i7 processors, so you should be OK with any of the processors listed in Table 3 and Table 4.

Brand	Model Numbers	Quick Sync Enabled?	Launch Date
Core i7 Extreme	Not available yet	No — avoid	Q4 2011
Core i7	2600, 2600S, 2600K	Yes	January 9 2011
Core i5	2300,		
2400, 2400S, 2400T,			
2500, 2500S, 2500K	Yes	January 9 2011	
Core i5	2405S, 2310	Yes	May 22 2011
Core i5	2390T	Yes	February 20 2011

Table 3 – *Processor selection—desktop*

Note: The 'K' denotes processors with 12 EUs in the graphics processor, compared with only 6 in non 'K' processors, for which reason Grass Valley recommends specifying the K type processors in desktop systems.

Brand	Model Numbers	Quick Sync Enabled?	Launch Date
Core i7 Extreme	2920XM	Yes	January 5 2011
Core i7	2820QM, 2720QM	Yes	January 9 2011
Core i7	Various designated 26xx, and 27xx.	Yes	Various
Core i5	2557M	Yes	June 20 2011
Core i5	Various designate 24xx, and 25xx.	Yes	Various

Table 4 – *Processor selection—laptop*

Note: The Extreme and 2820QM are the only laptop processors with 8 MB of level 3 cache which Grass Valley recommends for maximum performance of laptop based EDIUS installations.

Finding out what processor is installed in any given machine running Windows 7 is straightforward:

1) Click the Windows start button

2) Right-click the "Computer" menu option, and select "Properties" in the drop-down menu

3) Read the "System" section in the dialog that pops up next

But specifying the right processor is not enough. You also need to specify the right chipset.

System Specifications (cont.)

Specifying Your Motherboard

There are two chipsets that enable Quick Sync to work. The better of which is the Z68 series, because these provide the valuable property of allowing the system to use either the on-chip Sandy Bridge graphics, or a more traditional outboard GPU if you also need to use your system for heavy 3D graphics applications.

The technology that enables GPU/Quick Sync sharing is called Virtu, which was developed by LucidLogix. Virtu is hardware that acts to virtualize all the graphics facilities available within a system, so that they can act as a single, larger graphics resource. It's beyond the scope of this document to go into more detail, but Virtu is the reason that Z68 chipsets are the best choice for new EDIUS systems.

Motherboards using the Z68 chipset have been available from ASUS and Gigabyte since the April-May 2011 timeframe.

Finding out what chipset has been used for your system is only a little more complicated than identifying the processor type under Windows 7:

1) Click the Start menu

2) Right-click "Computer" in the main menu

3) Select "Manage" from the drop down menu

4) A window will pop-up, select "Device Manager" in the left hand border, to get a list of device families

5) Expand "System Devices" by clicking on the "+" symbol just to its right
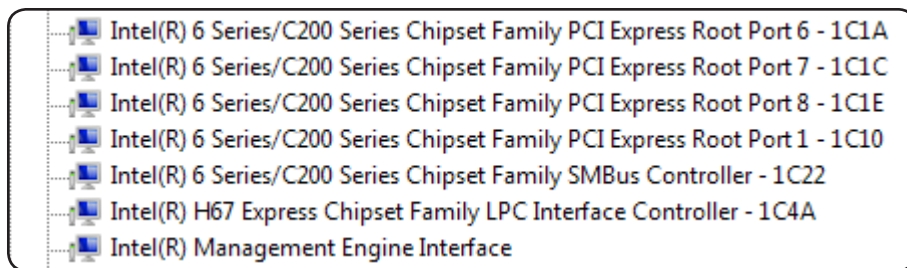
6) Find the line containing the work "chipset"

Figure 6 – *Identifying the chipset.*

This figure shows the results we obtained from using this procedure on an EDIUS system built with the H67 chipset

System Specifications (cont.)

Connect Your Monitors

The final steps to getting the benefits of Quick Sync, once you have a good combination of processor and motherboard, are to connect a monitor to the motherboard output, and, if using a GPU, connect another monitor to its output, and then use Windows to extend the desktop across both.

Quick Sync will not work without an active monitor connected to the motherboard graphics output, as illustrated in Figure 7.


Figure 7 – *Making the right monitor connections.*

Once you have the right processor, motherboard, and monitor setup, there are just a couple of simple steps remaining to have EDIUS take advantage of Quick Sync.

Using Quick Sync with EDIUS

When using EDIUS's Print to File or Burn Disk features for MP4, Blu-ray, or AVCHD exports, ensure that the option to "Use Hardware Encoder" is checked, to route the encoding via the Quick Sync hardware. Leaving it unchecked will cause EDIUS to use its normal software encoding.

The checkbox for exporting to file is illustrated in Figure 8, the burn to disk dialog is very similar.
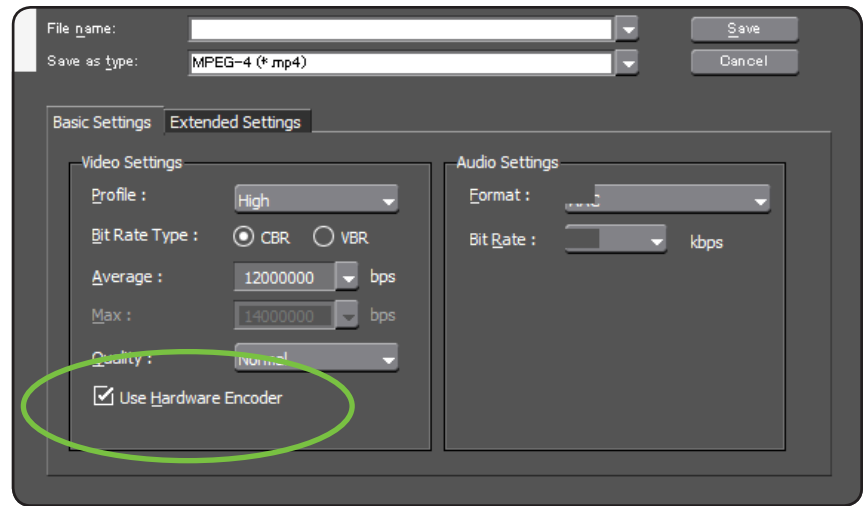
Summary

Specify and Configure your System Correctly:

- Use a Core 2 i5 or i7 Processor

- Use the Z68 chipset — to use both nVidia/ATI GPU and Sandy Bridge graphics

- Ensure second monitor is connected to motherboard graphics, and display is extended across it

Use EDIUS's "Enable Hardware Encoding" appropriate to the task at hand:

- Enable it when your main task is to encode video, especially if you are authoring a Blu-ray disk, or MP4 file. You could get results nine times faster by doing this.

- Disable it for rendering GPU intensive tasks such as Vitascene and Vistitle plug-ins, and 3D wipes and explosions. A good GPU will play back in real-time, and render faster, whereas the Intel graphics could struggle.

Link	Description
http://www.youtube.com/watch?v=Nd5Ighxa1JM&feature=related	A great demo of EDIUS exploiting Quick Sync technology, while also working with an nVidia GPU
http://www.intel.com/technology/quicksync/index.htm	Intel's overview of Quick Sync Technology

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