
High Definition Experience & Performance Ratings Test

# HDXPRT 2011 SCALING WHITE PAPER

*Last Revision: July 27, 2011*

**TABLE OF CONTENTS**

# 1 HDXPRT 2011 SCALING OVERVIEW

HDXPRT, the High Definition Experience & Performance Ratings Test, is a benchmarking software tool for assessing the capabilities of PCs at handling real-world media scenarios using common consumer applications. It has been collaboratively developed by the HDXPRT Development Community, administered by Principled Technologies, Inc. The benchmark presents results in a way that is meaningful to and easily understandable by consumers. HDXPRT 2011 employs mainstream, commonly used applications to test the performance of a specific system configuration. The purpose of this white paper is to show how different components influence HDXPRT 2011 scores.

# 2 BENCHMARK COMPONENTS

In this paper, we evaluate the behavior of HDXPRT 2011 with respect to digital media creation. The benchmark has three major digital media creation components, which measure the performance of a target system using best-of-breed applications executing workloads in each of three categories:

- **Edit videos from your camcorder.** This component uses the following applications: Adobe® Premiere® Elements for movie editing, professional-quality effects, and easy sharing; CyberLink Media*Espresso* to convert back and forth among a large set of devices ranging from smart phones to tablets and computational pads; and DivX™, a popular video CODEC that compresses lengthy video segments while preserving high visual quality.
- **Create memories from your digital camera.** This component uses the following applications: Adobe Photoshop® Elements for creating, editing, and organizing images; HDRsoft Photomatix as a high-quality two-stage high dynamic range (HDR) processing software for image overlaying and adjustable tone mapping; UnifiedColor™ HDR Expose to produce crisp, photorealistic HDR pictures; and Windows® 7 Drag and Drop Transcode for re-encoding media files.
- **Prepare media for on-the-go.** This component uses Apple® iTunes® as a digital media player application that allows Apple iPod®, iPhone®, and iPad® digital music and video content management, and Windows 7 Drag and Drop Transcode for media re-encoding. It also includes converting photos from raw format to JPEG format for viewing on mobile devices.

The HDXPRT 2011 Create HD score is an overall score for a target system's media creation performance. Each of the three use case categories has an associated workload that has been run to completion on a pre-defined calibration system. The benchmark determines the time it takes the target system to run each category's workload. To keep the total benchmark execution time within reasonable bounds, only a partial workload is run on the test system for each use category, and the total time to execute the complete workload for each category is obtained by extrapolating the execution time of the partial workload. The benchmark calculates an overall score for the target system as the geometric mean of ratios between extrapolated test system times for executing each category's workload, and the actual time it took the calibration system to run the corresponding use case workloads.

A higher overall score represents better performance. Because each of the execution times for the use case categories reflects the number of minutes a system needs to complete a series of tasks, lower times represent better system performance. For further information on the calibration machine, please see the General benchmark white paper available on the HDXPRT Web site.

# 3 SYSTEM CONFIGURATION

The following is the detailed configuration of the system we tested for this white paper.

| Component | Specification |
|---|---|
| **CPU** | Intel® Core™ i3-2100 processor (3M cache, 3.10 GHz)<br>Intel Core i3-2120 processor (3M cache, 3.30 GHz)<br>Intel Core i5-2300 processor (6M cache, 2.80 GHz)<br>Intel Core i5-2500K processor (6M cache, 3.30 GHz)<br>Intel Core i7-2600K processor (8M cache, 3.40 GHz) |
| **Operating system** | Windows 7 Ultimate Service Pack 1 (64-bit) |
| **Motherboard** | |
| Manufacturer | Intel |
| Model | DH67BL |
| BIOS version | BLH6710H.86A.0110.2011.0415.1506 (04/15/2011) |
| **Memory** | |
| Manufacturer | Micron® 9JSF25672AZ-1G4D1 |
| Channels | Dual |
| Type | DDR3 |
| Size | 1 x 2 GB; 2 x 2 GB; 4 x 2 GB |
| Speed | 1,333 MHz |
| Latency | 9-9-9-24 |
| **Graphics** | |
| Manufacturer model / driver | ATI Radeon™ HD 5670 / ATI 8.861.0.0 (05-24-2011)<br>ATI Radeon HD 6970 / ATI 8.861.0.0 (05-24-2011)<br>Intel HD Graphics 2000 / Intel 8.15.10.2361 (04-10-2011)<br>Intel HD Graphics 3000 / Intel 8.15.10.2361 (04-10-2011)<br>NVIDIA® GeForce® GTX 550 / NVIDIA 8.17.12.7533 (0 5-20-2011)<br>NVIDIA GeForce GTX 580 / NVIDIA 8.17.12.7533 (0 5-20-2011) |
| **Hard drive** | |
| Manufacturer model / size / RPM / cache | Seagate® HDD ST31000528AS / 60 GB / N/A / N/A<br>Samsung® SSD MK0060EAVDR / 1 TB / 7,200 RPM / 32 MB |
| **Power supply** | |
| Manufacturer | Antec® |
| Model | TruePower 650 |
| Power | 650 W |
| **Other system settings** | |
| Display resolution | 1,280 x 1,024; 60 Hz |

| Component | Specification |
|---|---|
| System restore | Off |
| Windows Update | Off |
| Screen saver | Off |
| Power Management | Off |

**Figure 1. HDXPRT 2011 scaling machine configuration.**

# 4 RESULTS

We measured the effect of the following five components on HDXPRT 2011 scores:

- Processor
- Memory size
- Internal graphics vs. external graphics cards
- Hard disk drive (HDD) vs. solid state drive (SSD)
- Intel Turbo Boost Technology

Of the system components we tested, the processor, the amount of system memory, and the graphics approach made the greatest difference in HDXPRT 2011 scores. Overall HDXPRT results improved up to 35.7 percent by increasing processor frequency and changing the processor and improved up to 17.7 percent by increasing memory size, while they decreased as much as 21.4 percent when changing from internal graphics to a discrete graphics card for the processors we tested.

## 4.1 Processor

Figures 2 and 3 show how processors with different speeds and cache sizes affected HDXPRT 2011 scores. We tested two Intel Core i3 processors and two Intel Core i5 processors—each pair with the same cache size but different speeds—and one Intel Core i7 processor. As Figures 2 and 3 show, the overall score increased as processor speeds and cache sizes increased.

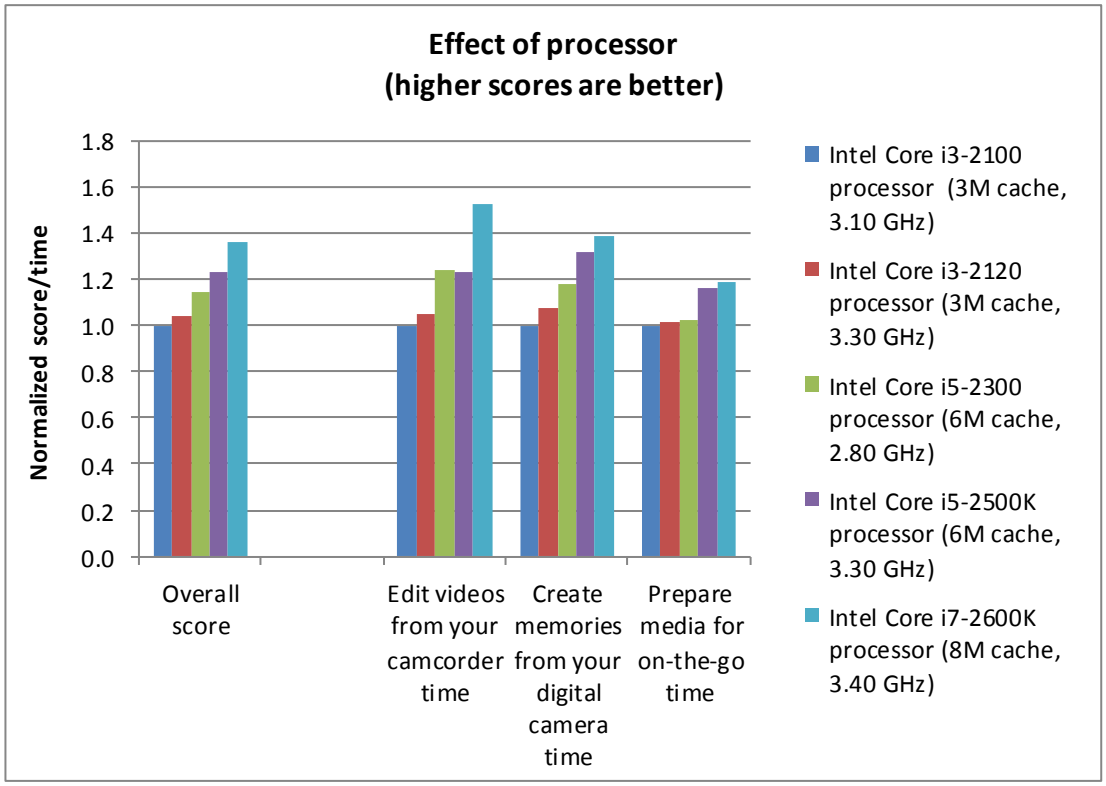


**Figure 2. Normalized HDXPRT 2011 scores and times for the system configured with varying processors and 4 GB of RAM. Higher numbers are better.**

| Processor | Intel Core i3-2100 processor (3M cache, 3.10 GHz) | Intel Core i3-2120 processor (3M cache, 3.30 GHz) | Intel Core i5-2300 processor (6M cache, 2.80 GHz) | Intel Core i5-2500K processor (6M cache, 3.30 GHz) | Intel Core i7-2600K processor (8M cache, 3.40 GHz) |
|---|---|---|---|---|---|
| **HDXPRT overall score (higher is better)** | **227** | **237** | **259** | **280** | **308** |
| Edit videos from your camcorder (lower is better) | 131.8 | 125.9 | 106.5 | 107.4 | 86.2 |
| Create memories from your digital camera (lower is better) | 67.7 | 62.9 | 57.6 | 51.4 | 48.8 |
| Prepare media for on-the-go (lower is better) | 74.9 | 73.9 | 73.1 | 64.4 | 63.1 |

**Figure 3. HDXPRT 2011 scores and use case times in minutes for the system configured with varying processors and 4 GB of RAM. Higher overall scores and lower times are better.**

The Intel Core i3-2120, at 3.30 GHz, outperformed the 3.10GHz Intel Core i3-2100 by 4.4 percent (corresponding to the 6.5 percent increase in GHz). The faster processor improved the Edit videos time by 4.5 percent, the Create memories time by 7.1 percent, and the Prepare media time by 1.3 percent.

The Intel Core i5-2500K, at 3.30 GHz, outperformed the 2.80GHz Intel Core i3-2300 by 8.1 percent (corresponding to the 17.9 percent increase in GHz). The faster processor improved the Create memories time by 10.8 percent and the Prepare media time by 11.9 percent. Surprisingly, the Edit videos time worsened slightly, by 0.8 percent.

Comparing the scores and use case times of the Intel Core i3, Intel Core i5, and Intel Core i7 processors illustrates the influence of internal processor architecture on HDXPRT 2011 performance. The Edit video workload streams are processed on a per-frame basis, with frames fitting well within the cache sizes of the tested processors. For these workloads, processing is the same for each frame and thus can be executed with high parallelism. Also, as frames are divided into blocks, these can also be processed separately by available threads.

The Intel Core i7-2600K processor executed the Edit videos tasks 19.1 percent faster than the Intel Core i5-2300 processor and 34.6 percent faster than the Intel Core i3-2100 processor. The improvement between the Intel Core i5-2300 processor and the Intel Core i3-2100 processor was 19.2 percent, showing almost linear scaling. These performance improvements are primarily due to the i7 having four physical cores with Intel Hyper-Threading Technology on each for a total of eight hardware threads (4C/8T), the i5 having four physical cores with four hardware threads (4C/4T), and the i3 having two physical cores with Intel Hyper-Threading Technology on each for a total of four hardware threads (2C/4T). The Create memories workload times are more balanced in terms of sensitivity to changes in system, and are somewhat affected by cache size. Finally, the Prepare media workload times reflect iTunes processing, which is mostly single threaded. These latter times correlate well with processor frequency changes.

As one would expect, the Intel Core i7-2600K processor, with its 8M cache and 3.40 GHz processor speed, delivered the best performance of all, with an overall score exceeding those of the Intel Core i5-2300 and Intel Core i5-2500K processors by 18.9 percent and 18.1 percent respectively. Its improvement over the Intel Core i3-2100 and Intel Core i3-2120 processors was even more dramatic, 35.7 percent and 30.0 percent respectively. These improvements reflect the improvements in the Edit videos times.

## 4.2 Memory size

Figures 4 through 7 show how different memory amounts affected HDXPRT 2011 scores and use case times. As they show, the overall score increased as the amount of memory in the system increased.

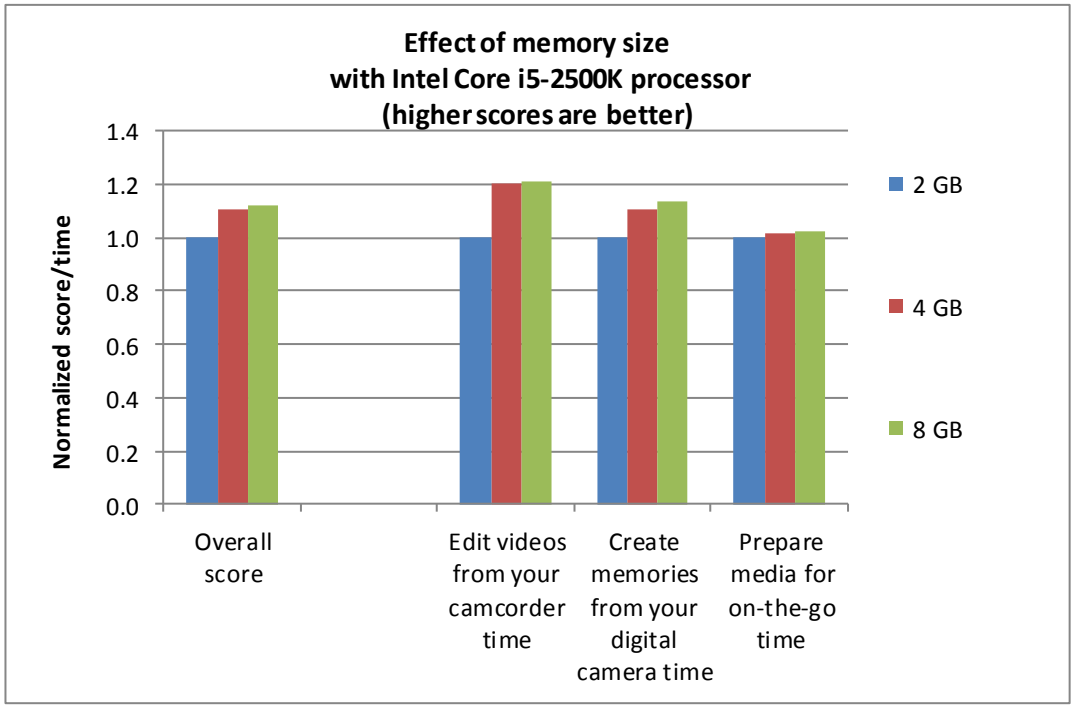


**Figure 4. Normalized HDXPRT 2011 scores and times for the system configured with the Intel Core i5-2500K processor, Intel HD Graphics 3000, and varying amounts of RAM. Higher numbers are better.**

| Amount of system memory | 2 GB | 4 GB | 8 GB |
|---|---|---|---|
| **HDXPRT overall score (higher is better)** | **253** | **280** | **284** |
| Edit videos from your camcorder (lower is better) | 129.0 | 107.4 | 106.6 |
| Create memories from your digital camera (lower is better) | 56.8 | 51.4 | 50.0 |
| Prepare media for on-the-go (lower is better) | 65.7 | 64.4 | 64.0 |

**Figure 5. HDXPRT 2011 scores and use case times in minutes for the system configured with the Intel Core i5-2500K processor, Intel HD Graphics 3000, and varying amounts of RAM. Higher overall scores and lower times are better.**

Increasing memory from 2 GB to 4 GB on the system configured with the Intel Core i5-2500K processor led to a 10.7 percent increase in overall score, while increasing from 4 GB to 8 GB brought an additional increase of only 1.4 percent. Memory increases delivered diminishing returns in all three use case categories, but especially in the Edit videos and Create memories categories; while increasing RAM to 4 GB lowered task times by 16.7 percent and 9.5 percent respectively, doubling RAM from 4 GB to 8 GB shaved only minimal additional time off these tasks (0.7 percent and 2.7 percent respectively).

The reason for these diminishing returns is that as memory size increases, a point comes where the various use case workloads fit entirely in the memory. After that threshold is reached, the associated

memory management costs for tight memory conditions disappear. We observed this behavior for both processors tested.

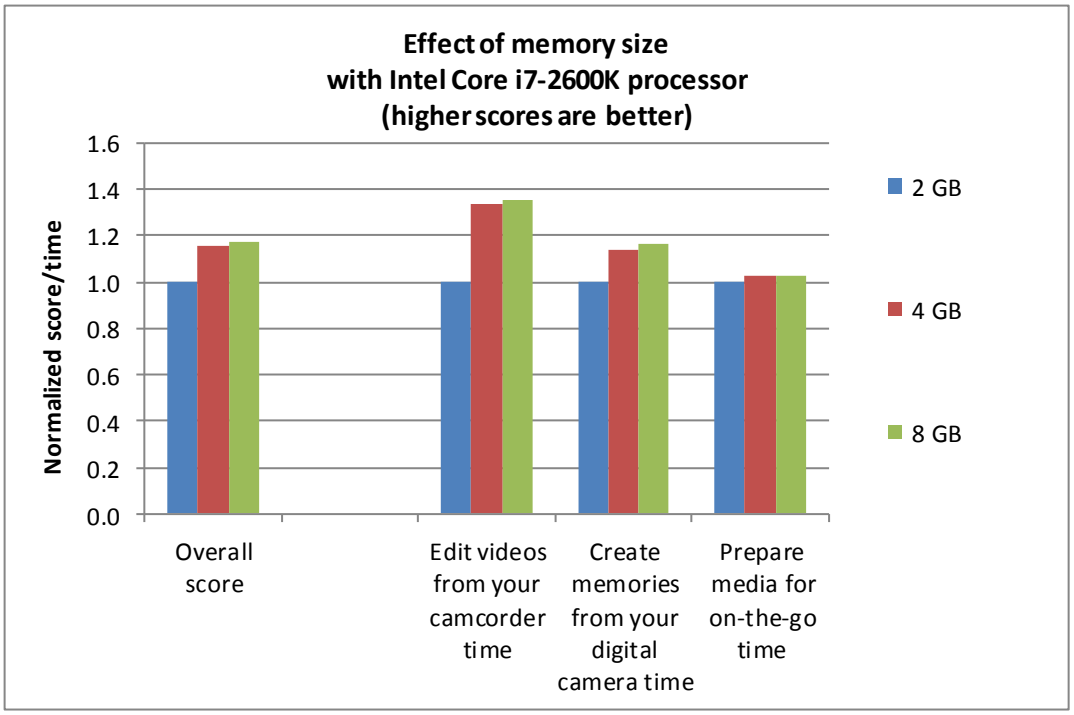


**Figure 6. Normalized HDXPRT 2011 scores and times for the system configured with the Intel Core i7-2600K processor, Intel HD Graphics 3000, and varying amounts of RAM. Higher numbers are better.**

| Amount of system memory | 2 GB | 4 GB | 8 GB |
|---|---|---|---|
| **HDXPRT overall score (higher is better)** | **266** | **308** | **313** |
| Edit videos from your camcorder (lower is better) | 114.9 | 86.2 | 84.8 |
| Create memories from your digital camera (lower is better) | 55.7 | 48.8 | 47.8 |
| Prepare media for on-the-go (lower is better) | 64.6 | 63.1 | 62.8 |

**Figure 7. HDXPRT 2011 scores and use case times in minutes for the system configured with the Intel Core i7-2600K processor, Intel HD Graphics 3000, and varying amounts of RAM. Higher overall scores and lower times are better.**

The performance results of increasing memory on the system configured with the Intel Core i7-2600K processor followed the same pattern as with the Intel Core i5-2500K processor but were more pronounced. Increasing memory from 2 GB to 4 GB led to a 15.8 percent increase in overall score, while increasing from 4 GB to 8 GB brought an additional increase of only 1.6 percent. As with the slower processor, memory increases delivered diminishing returns in all three use case categories, but especially in the Edit videos and Create memories categories; while increasing RAM to 4 GB lowered task times by 25.0 percent and 12.4 percent respectively, doubling RAM from 4 GB to 8 GB shaved relatively little additional time off these tasks (1.6 percent and 2.0 percent respectively).

## 4.3 Internal graphics vs. external graphics cards

Figures 8 through 11 show how scores and use case times were affected when we replaced the internal Intel HD Graphics 3000 that is part of the processor with two discrete NVIDIA graphics cards. As these figures show, the internal built-in graphics delivered the best overall score; both external graphics cards caused the overall scores to drop considerably. This reflects the fact that 2nd generation Intel Core processors have very efficient on-processor graphics acceleration that provides optimized encoding and rendering while sharing last-level cache with processor cores. The impact of internal graphics acceleration is most evident in the Edit videos times, where the video stream is encoded and processed significantly faster with internal processor graphics than with external cards. The corresponding performance decreases for the Create memories and Prepare media workloads are much smaller, showing less sensitivity to video encoding, as expected.

With earlier processors, the behavior we observed and report above may not necessarily be the case. We will investigate further HDXPRT 2011's behavior in this respect by testing how scoring changes with the use of other non-NVIDIA external graphics cards as well as earlier processors with less efficient graphics acceleration. We will publish these results in a follow-on white paper.

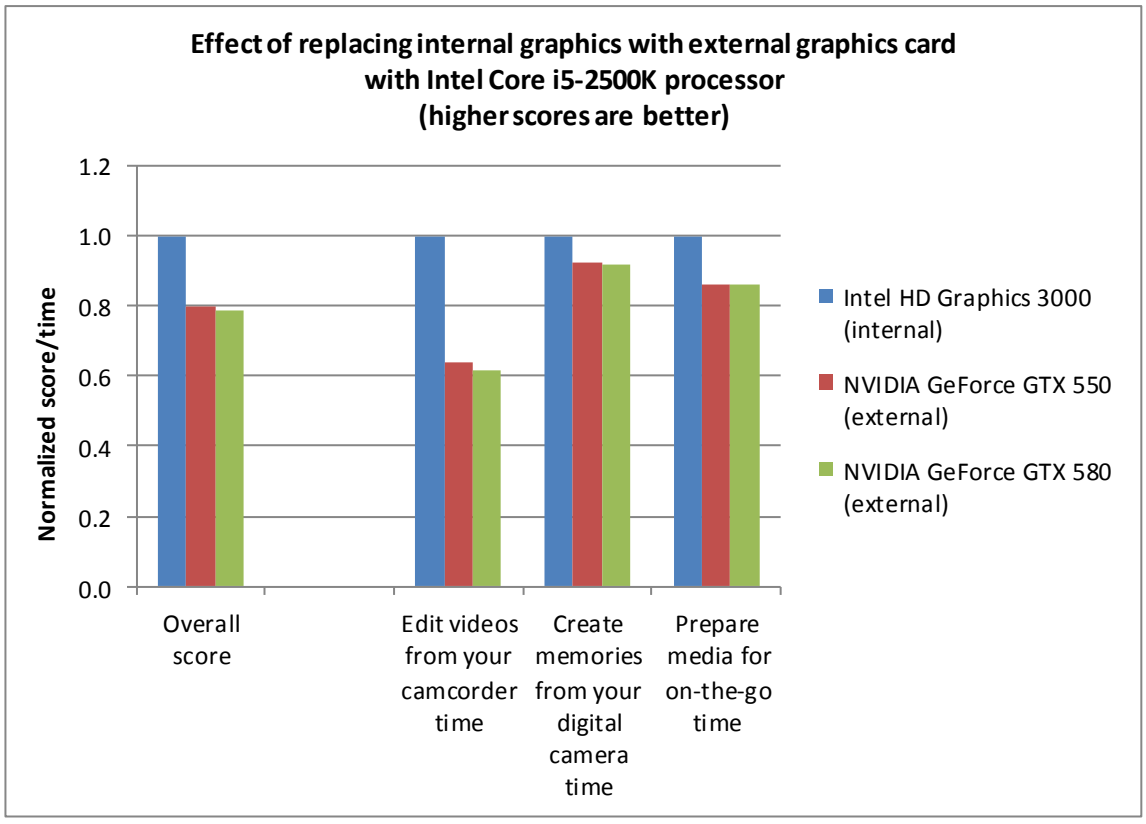


**Figure 8. Normalized HDXPRT 2011 scores and times for the system configured with the Intel Core i5-2500K processor, 4GB RAM, and either internal graphics or external graphics cards. Higher numbers are better.**

| Graphics | Intel HD Graphics 3000 (internal) | NVIDIA GeForce GTX 550 (external) | NVIDIA GeForce GTX 580 (external) |
|---|---|---|---|
| **HDXPRT overall score (higher is better)** | **280** | **223** | **220** |
| Edit videos from your camcorder (lower is better) | 107.4 | 168.3 | 173.6 |
| Create memories from your digital camera (lower is better) | 51.4 | 55.6 | 56.0 |
| Prepare media for on-the-go (lower is better) | 64.4 | 74.6 | 74.7 |

**Figure 9. HDXPRT 2011 scores and use case times in minutes for the system configured with the Intel Core i5-2500K processor, 4GB RAM, and either internal graphics or external graphics cards. Higher overall scores and lower times are better.**

On the system configured with the Intel Core i5-2500K processor, replacing the built-in Intel HD Graphics 3000 with either of the discrete cards lowered the overall score and increased all three use case times, especially the Edit videos time. The NVIDIA cards lowered the overall score by 20.4 percent and 21.4 percent; this was due mostly to the increased time the system needed to perform the Edit videos task, 56.7 percent and 61.6 percent longer than when using Intel HD Graphics 3000.

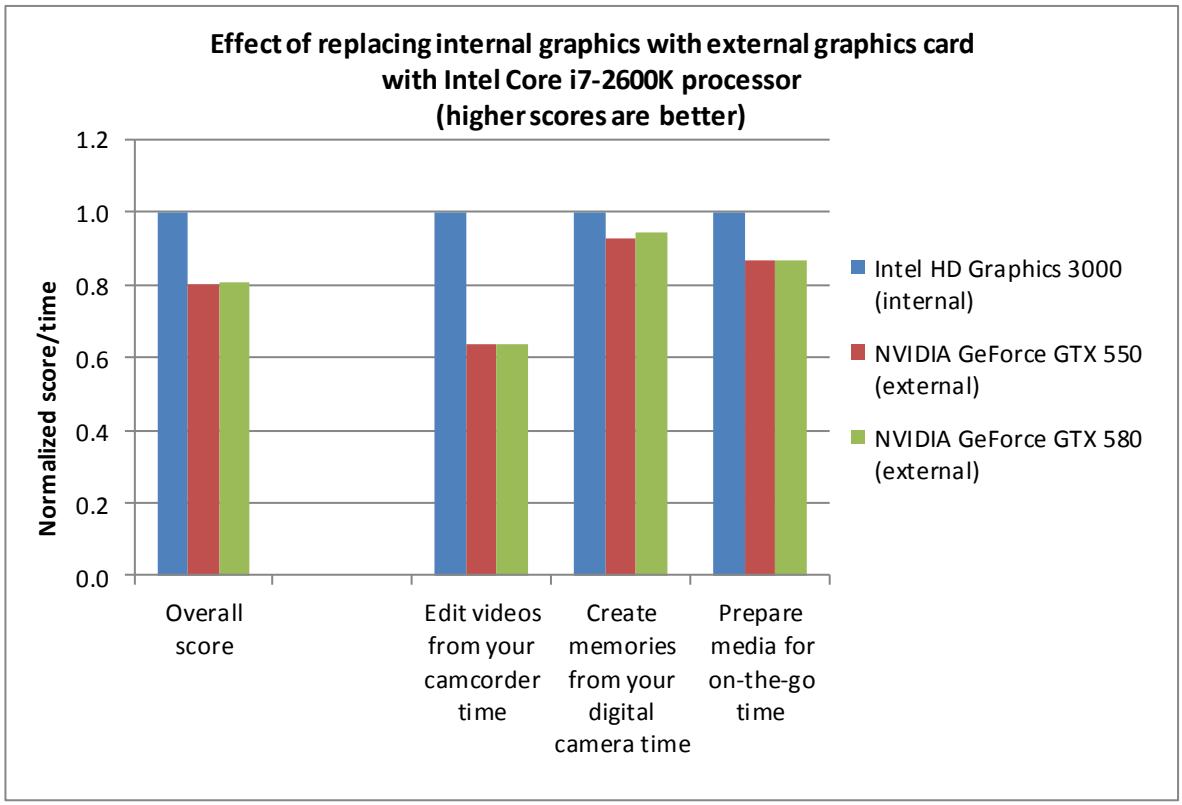


**Figure 10. Normalized HDXPRT 2011 scores and times for the system configured with the Intel Core i7-2600K processor, 4GB RAM, and either internal graphics or external graphics cards. Higher numbers are better.**

| Graphics | Intel HD Graphics 3000 (internal) | NVIDIA GeForce GTX 550 (external) | NVIDIA GeForce GTX 580 (external) |
|---|---|---|---|
| **HDXPRT overall score (higher is better)** | **308** | **247** | **248** |
| Edit videos from your camcorder (lower is better) | 86.2 | 135.2 | 135.6 |
| Create memories from your digital camera (lower is better) | 48.8 | 52.5 | 51.8 |
| Prepare media for on-the-go (lower is better) | 63.1 | 72.8 | 72.6 |

**Figure 11. HDXPRT 2011 scores and use case times in minutes for the system configured with the Intel Core i7-2600K processor, 4GB RAM, and either internal graphics or external graphics cards. Higher overall scores and lower times are better.**

On the system configured with the Intel Core i7-2600K processor, replacing the built-in Intel HD Graphics 3000 with either discrete card also lowered the overall score and increased all three use case times, especially the Edit videos time. Using the NVIDIA cards lowered the overall score by 19.8 percent and 19.5 percent; this was due mostly to the increased time the system needed to perform the Edit videos task, 56.8 percent and 57.3 percent longer than with the Intel HD Graphics 3000.

## 4.4 Hard disk drive vs. solid state drive

Figures 12 and 13 show how drive type affected scores and use case times. As they show, the overall score increased negligibly—by 1.1 percent—when we replaced a 7,200 RPM hard disk drive with a solid state drive.

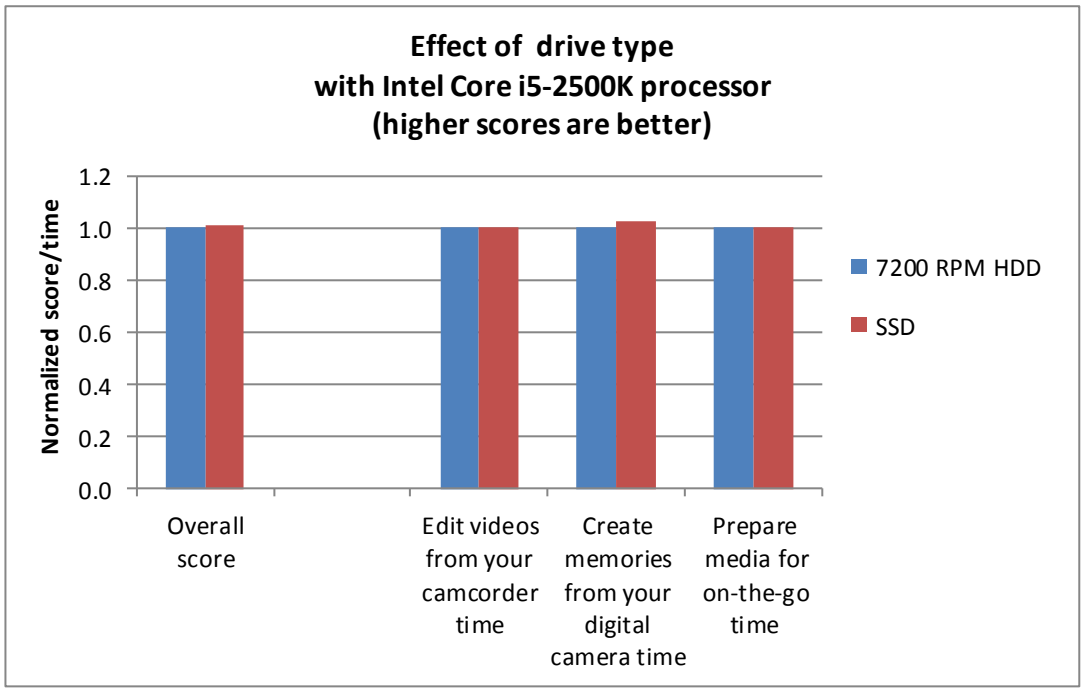


**Figure 12. Normalized HDXPRT 2011 scores and times for the system configured with the Intel Core i5-2500K processor, Intel HD Graphics 3000, 4GB RAM, and two different drive types. Higher numbers are better.**

| Drive type | 7,200 RPM HDD | SSD |
|---|---|---|
| **HDXPRT overall score (higher is better)** | **280** | **283** |
| Edit videos from your camcorder (lower is better) | 107.4 | 106.7 |
| Create memories from your digital camera (lower is better) | 51.4 | 50.0 |
| Prepare media for on-the-go (lower is better) | 64.4 | 64.3 |

**Figure 13. HDXPRT 2011 scores and use case times in minutes for the system configured with the Intel Core i5-2500K processor, Intel HD Graphics 3000, 4GB RAM, and two different drive types. Higher overall scores and lower times are better.**

The very small difference between the two types of drives suggests that disk performance is not a critical element in HDXPRT 2011, but rather that the benchmark is system memory and compute bound, as we would expect.

## 4.5 Intel Turbo Boost Technology

Figures 14 through 19 show how Intel Turbo Boost Technology affected HDXPRT 2011 scores and use case category times. The effect of this technology on the systems configured with the Intel Core i5-2300 processor and the Intel Core i5-2500K processor was negligible—raising the overall score by 0.4 percent and lowering it by 1.1 percent respectively, as Figures 14 through 17 show. However, as Figures 18 and 19 show, the effect of Intel Turbo Boost Technology on the system with the Intel Core i7-2600K processor was more pronounced, increasing the overall score by 5.8 percent.

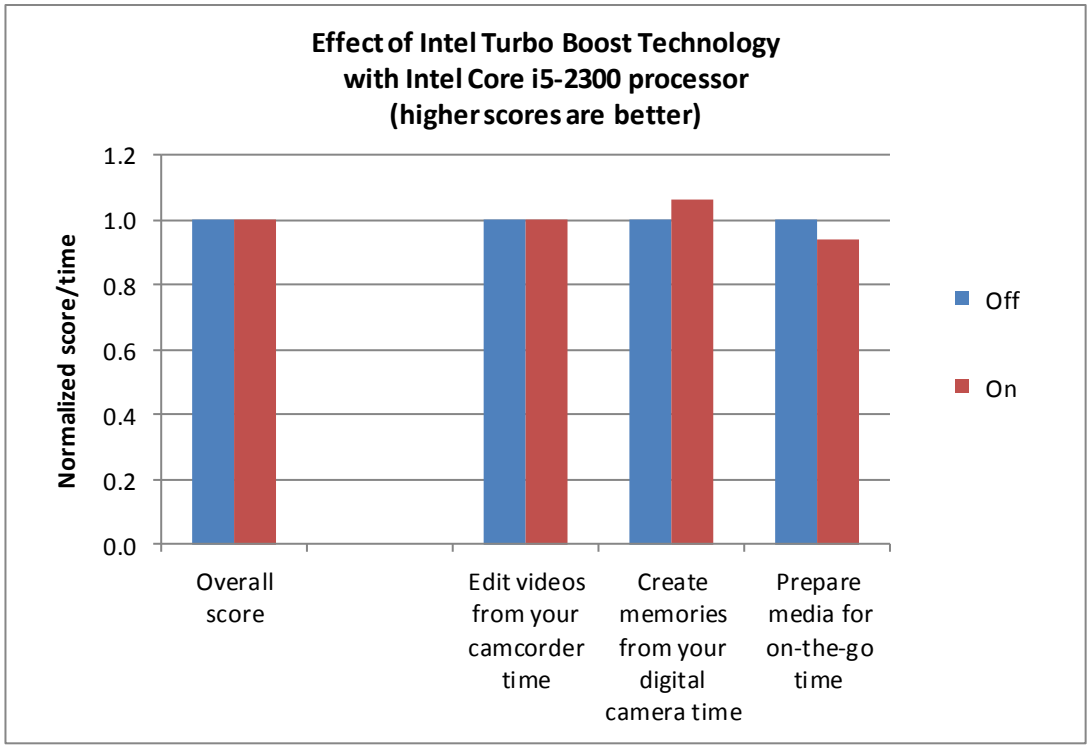


**Figure 14. Normalized HDXPRT 2011 scores and times for the system configured with the Intel Core i5-2300 processor, Intel HD Graphics 2000, and 4GB RAM. Higher numbers are better.**

| Intel Turbo Boost Technology | Off | On |
|---|---|---|
| **HDXPRT overall score (higher is better)** | **258** | **259** |
| Edit videos from your camcorder (lower is better) | 106.7 | 106.5 |
| Create memories from your digital camera (lower is better) | 61.3 | 57.6 |
| Prepare media for on-the-go (lower is better) | 68.8 | 73.1 |

**Figure 15. HDXPRT 2011 scores and use case times in minutes for the system configured with the Intel Core i5-2300 processor, Intel HD Graphics 2000, and 4GB RAM. Higher overall scores and lower times are better.**

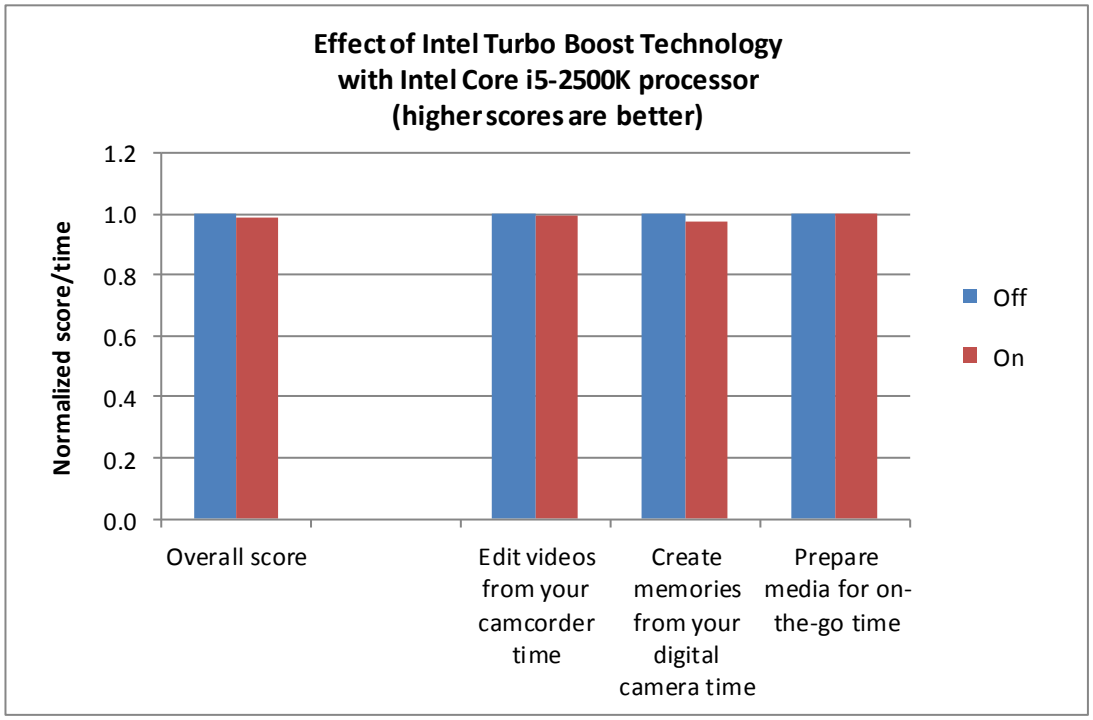


**Figure 16. Normalized HDXPRT 2011 scores and times for the configured system with the Intel Core i5-2500K processor, Intel HD Graphics 3000, and 4GB RAM. Higher numbers are better.**

| Intel Turbo Boost Technology | Off | On |
|---|---|---|
| **HDXPRT overall score (higher is better)** | **283** | **280** |
| Edit videos from your camcorder (lower is better) | 106.7 | 107.4 |
| Create memories from your digital camera (lower is better) | 50.0 | 51.4 |
| Prepare media for on-the-go (lower is better) | 64.3 | 64.4 |

**Figure 17. HDXPRT 2011 scores and use case times in minutes for the configured system with the Intel Core i5-2500K processor, Intel HD Graphics 3000, and 4GB RAM. Higher overall scores and lower times are better.**

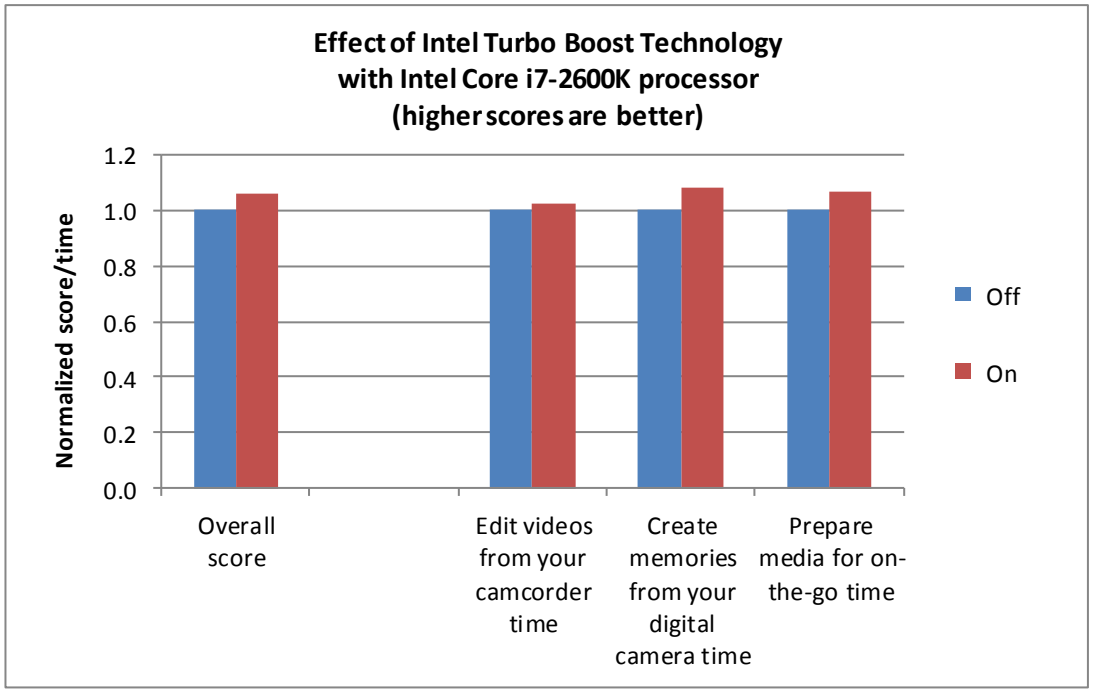


**Figure 18. Normalized HDXPRT 2011 scores and times for the system configured with the Intel Core i7-2600K processor, Intel HD Graphics 3000, and 4GB RAM. Higher numbers are better.**

| Intel Turbo Boost Technology | Off | On |
|---|---|---|
| **HDXPRT overall score (higher is better)** | **291** | **308** |
| Edit videos from your camcorder (lower is better) | 88.6 | 86.2 |
| Create memories from your digital camera (lower is better) | 52.8 | 48.8 |
| Prepare media for on-the-go (lower is better) | 67.3 | 63.1 |

**Figure 19. HDXPRT 2011 scores and use case times in minutes for the system configured with the Intel Core i7-2600K processor, Intel HD Graphics 3000, and 4GB RAM. Higher overall scores and lower times are better.**

# 5 IN SUMMARY

We found that the system components that most affected HDXPRT scores and use case times were processor speed, memory size, and graphics. Drive type and Intel Turbo Boost Technology had little effect on HDXPRT scores and use case times. The results we observed in our testing of HDXPRT 2011 were largely as we expected.

# 6 CONTACT INFORMATION

If you would like additional information or would like to provide us with feedback, please write to us at HDXPRTsupport@hdxprt.com. For up-to-date information on HDXPRT, patches, and workarounds, please visit www.hdxprt.com.