



Hard Disk Drive vs. Kingston SSDNow V+ 200 Series 240GB: Comparative Test

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Hard Disk Drive vs. Solid State Drive: Comparative Test

Outline

Our goal during this test was to find out how much an SSD can boost the performance of a desktop computer and how that upgrade compares to other simple upgrades, including adding more memory and installing a faster processor. The key figure we were looking for was the relative cost of each upgrade, or the answer to the question: which upgrade gives you the biggest boost per pound spent?

Testing

The results of the testing are outlined in the sections below. Each test was run on the same hardware combinations in order to work out the relative value of each type of upgrade. The costs for upgrades were taken from www.ebuyer.com on Monday 16th July 2012. Prices listed include VAT at 20 per cent and are rounded to the nearest pound. The complete hardware combinations and upgrades are detailed in the following table. Note that the cost of upgrade is relative to the base PC with a hard disk. For example, adding an SSD and more memory means that the cost of upgrade is the combination of the prices of both the SSD and memory.

PC TYPE	SPECIFICATION	COST OF UPGRADE
HDD (the base specification)	Intel Core i5-2500K, 4GB Kingston KVR1333D3S8N9HK2/4G, Western Digital Caviar Black 1TB, AMD Radeon HD 7870, Intel DZ77GA-70K motherboard	N/A
HDD + RAM	As HDD PC but with Kingston 8GB KVR1333D3N9HK2/8G	£36
HDD + CPU	As HDD PC but with a Intel Core i7-3770K	£256
HDD + RAM AND CPU	As HDD PC but with all the above upgrades	£292
SSD	As HDD PC but with a Kingston SSDNow V+ 200 Series 240GB	£155
SSD + RAM	As SSD PC but with Kingston 8GB KVR1333D3N9HK2/8G	£191
SSD + CPU	As SSD PC but with a Intel Core i7-3770K	£411
HDD + RAM AND CPU	As SSD PC but will all the above upgrades	£447

Installed software and OS

Each configuration had a fresh install of Windows 7 Home Premium 64-bit, plus the following software, all restored from an image file:

- Microsoft Office 2010
- PCMark Vantage
- Norton Internet Security 2012
- BootRacer
- AutoIT custom script to launch Office applications

The BIOS and Windows settings used were:

- SATA mode was set to AHCI for both the HDD and SSD
- For the SSD, Windows Virtual Memory was turned off
- Memory speeds were checked manually in the BIOS

Graphics cards

For this test we didn't perform a graphics card upgrade. Although a common upgrade in a desktop PC, a graphics card is primarily designed to improve games performance rather than overall system performance. The assumption for this test was that anyone who wanted faster games performance would invest in a recent generation, high performance graphic card, whereas the goal of this test was to show the overall system performance of different upgrades.

Assumptions

The tests were performed on a PC with either a hard disk or an SSD installed, but not both at the same time. The results, therefore, give the relative benefit of replacing a hard disk with an SSD, not the combination of the two. In other words, the tests assume that all data and applications are based around either storage device.

The Tests

PCMark Vantage

PCMark Vantage is an industry-standard benchmarking suite (<http://www.futuremark.com/benchmarks/pcmarkvantage/introduction/>), which is designed to test every aspect of a computer's performance. The test is split into scenarios, which includes a PC's capabilities for playing games, importing and editing photos, playing and editing videos as well as working in office applications.

Overall performance

The scores from all of the test scenarios are combined using a geometric average into an overall score, which highlights how fast a computer is. As this combined score takes into account all aspects of system performance, it's possible to compare two different upgrades and compare their overall effect on a PC's performance. The higher the score, the faster the computer.

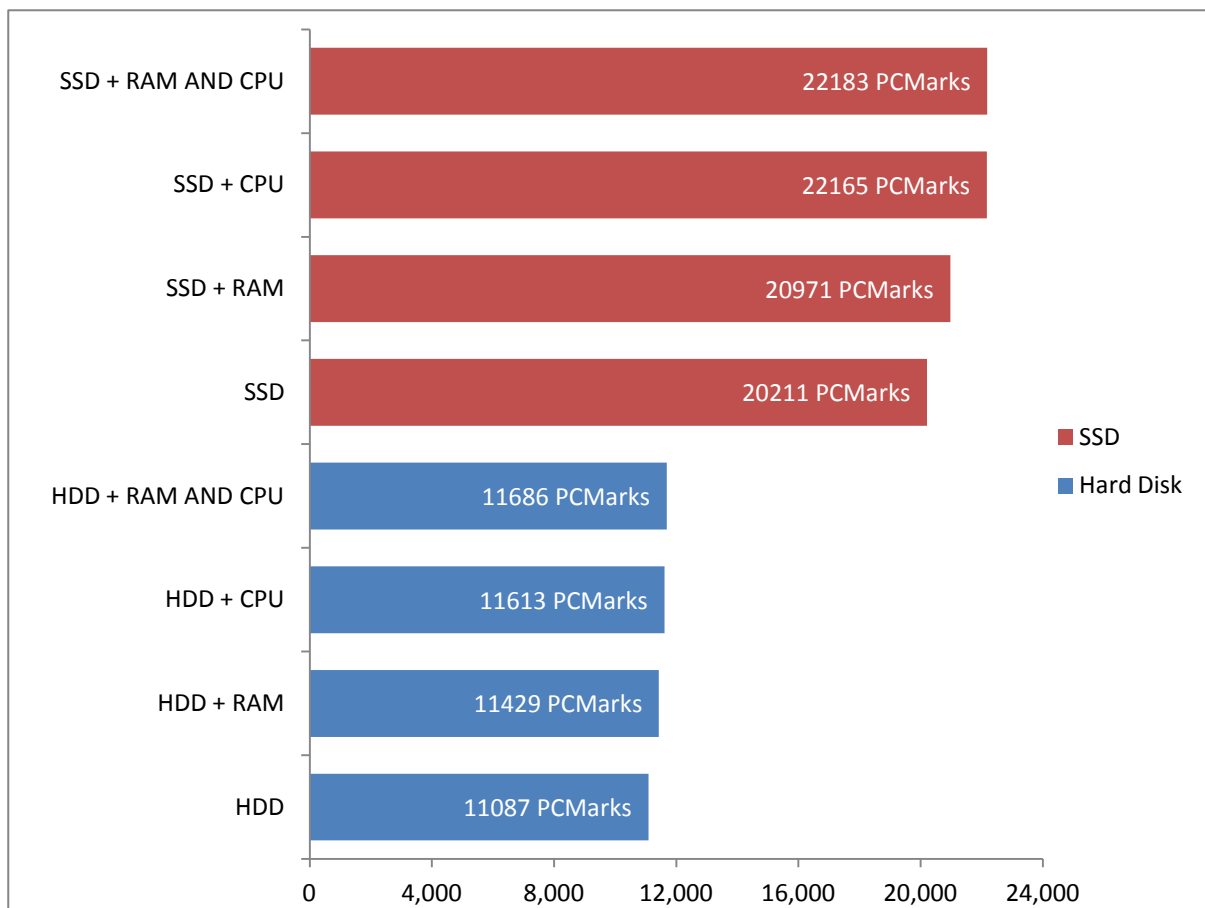


Figure 1: Overall performance as tested with PCMark Vantage

Conclusion

The SSD offered the biggest performance boost to our test PC, by far out stripping any of our other upgrades made to a computer with a standard hard disk. The fast file performance of the SSD means that data is faster to load and applications are quicker to open, making a dramatic difference to a PC's speed.

Percentage increase

An interesting way to look at the PCMark Vantage results is to see the percentage increase in performance that each upgrade produces.

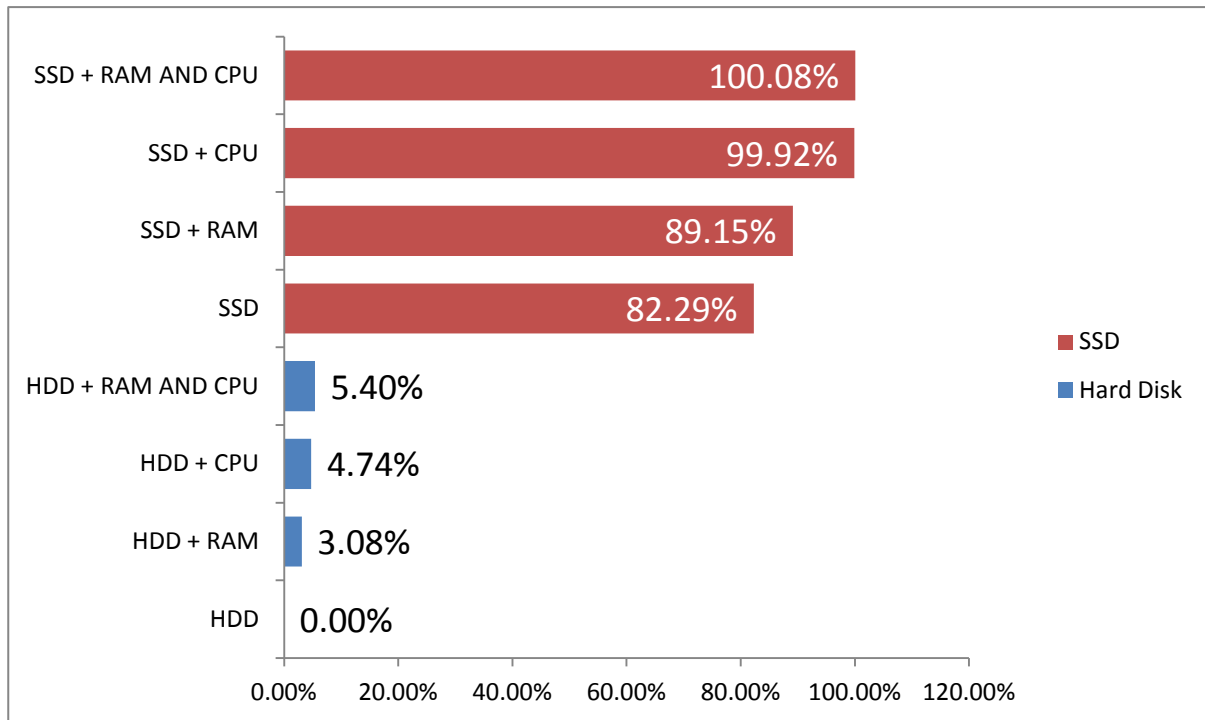


Figure 2: Relative percentage increase of each upgrade measured with PCMark Vantage against base configuration

Conclusion

While adding more memory and a faster processor all create an increase in a PC's performance, none comes close to the performance increase caused by adding an SSD. With a performance boost of just over 82 per cent over a regular hard disk, the SSD gives an incredible boost in performance and outstrips all upgrades made to a PC with a regular hard disk. An SSD upgrade is so effective that combined with adding a faster processor and more memory, a PC's performance can be doubled.

Cost of performance

Using the cost of each upgrade and the percentage boost obtained by each upgrade, we worked out the cost of each percentage point in pounds (lower cost is better). Note that we've removed the base HDD PC from the following graph, as it has no cost of upgrade associated with it.

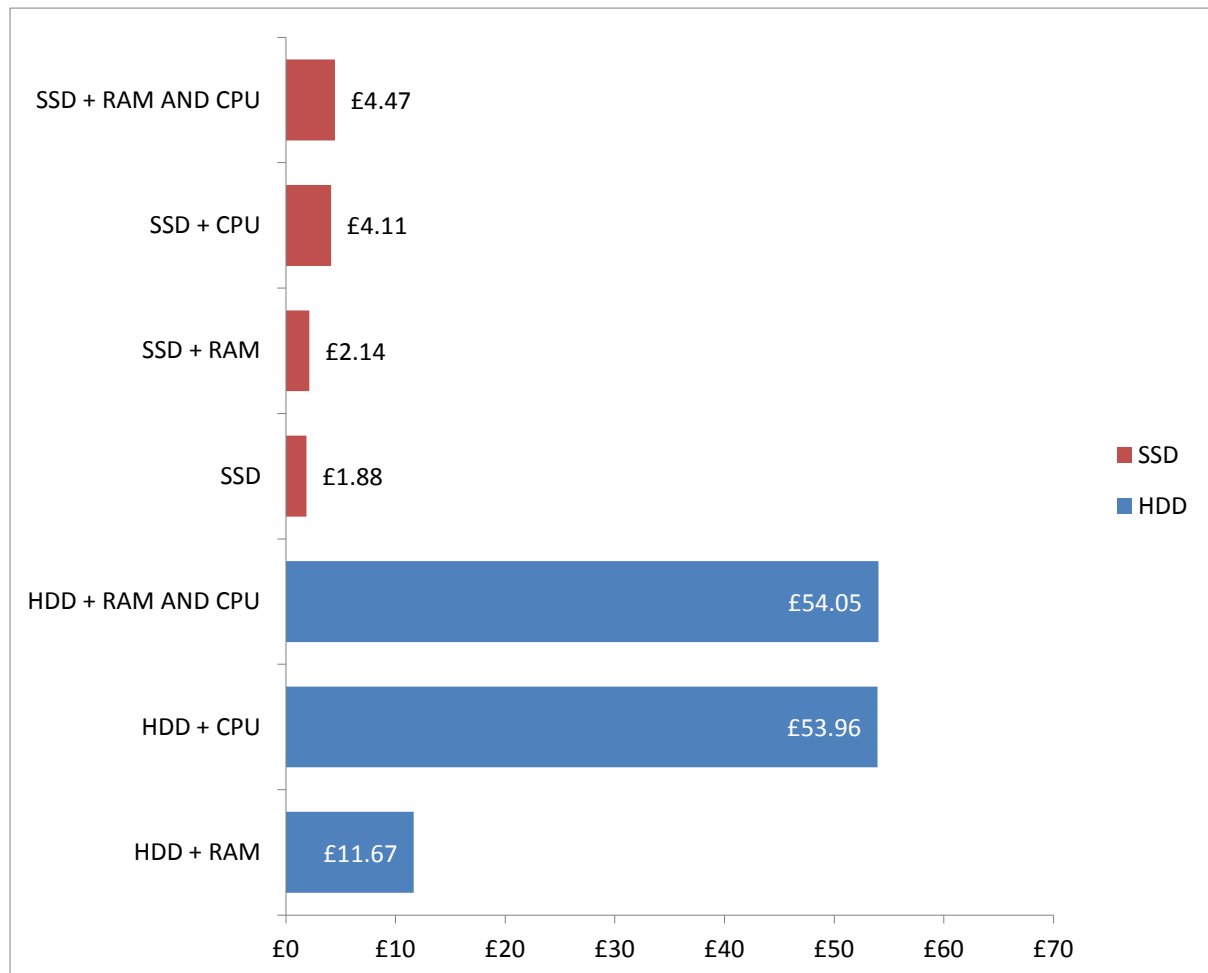


Figure 3: Cost per percentage point increase of each upgrade

Conclusion

The SSD provided, pound-for-pound, the best value upgrade. Its speed also meant that every upgrade performed on a PC with an SSD was comparatively better value than the same upgrade performed on a PC with a standard hard disk.

Considering that the SSD also produced the biggest performance increase, it is by far the best upgrade in this test. Without an SSD, every upgrade is relatively expensive for each percentage point of performance increase, with additional RAM costing just over £11 per percentage point and the CPU costing more than £50 per percentage point.

Speed tests

Boot times

We tested each PC configuration to see how upgrades affected boot times. Times were measured in seconds by the BootRacer application. Timings were made to a working Windows Desktop. For fairness, we enabled automatic log-in to Windows, so that user input (i.e. typing in a password) would never be a limiting factor. We repeated the test five times in a row and took an average of the boot times. We also removed any outliers, where Windows was clearly performing system maintenance or other tasks.

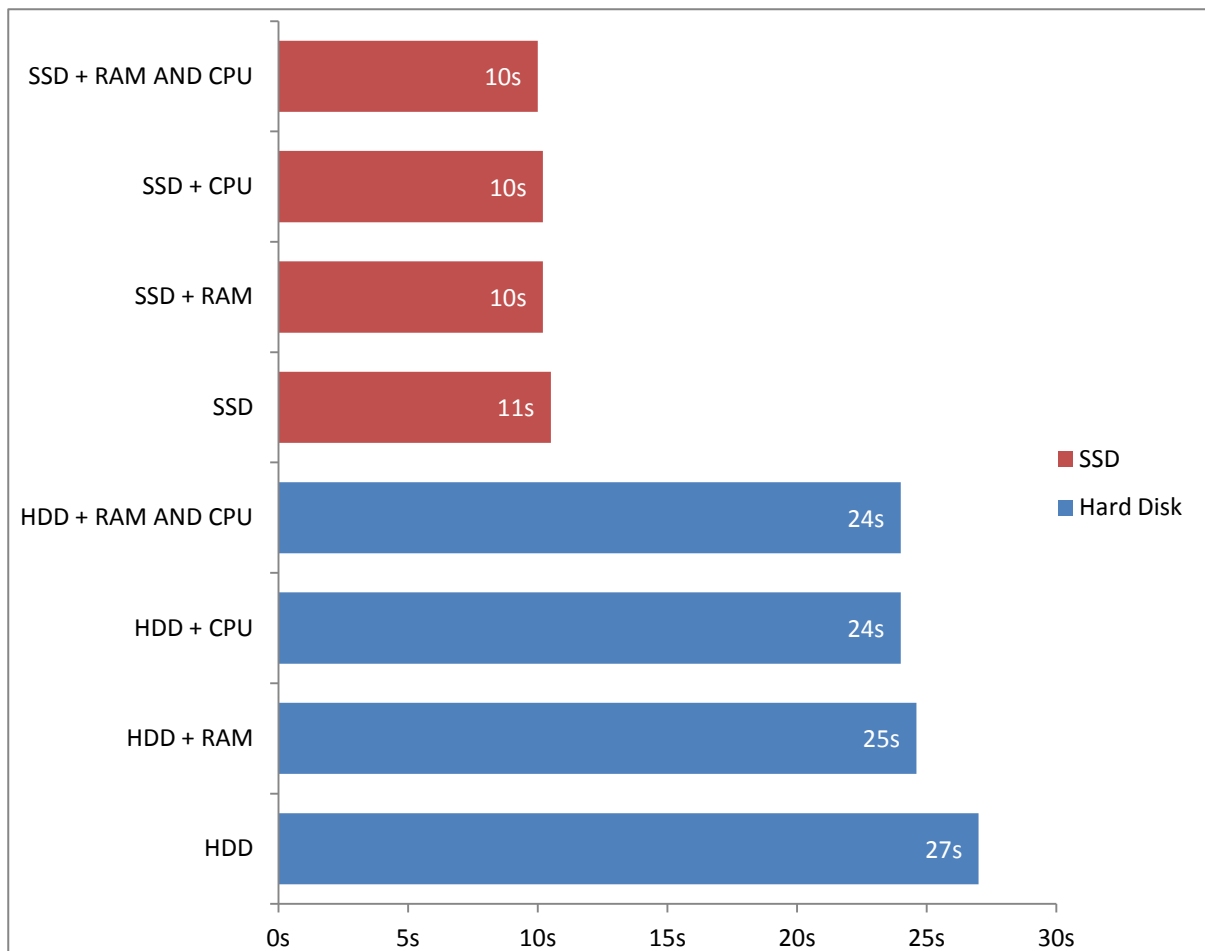


Figure 4: Boot time as measured to a working Windows 7 desktop

Conclusion

The SSD had a massive impact on boot times, thanks to much faster read speeds making it much quicker for the PC to load Windows system files, start services and get to a working desktop. Other upgrades had less impact on boot times, as this test is mostly dependent on the file transfer speed of the storage medium. Comparing a hard disk to an SSD, the SSD was 2.45x faster than the hard disk.

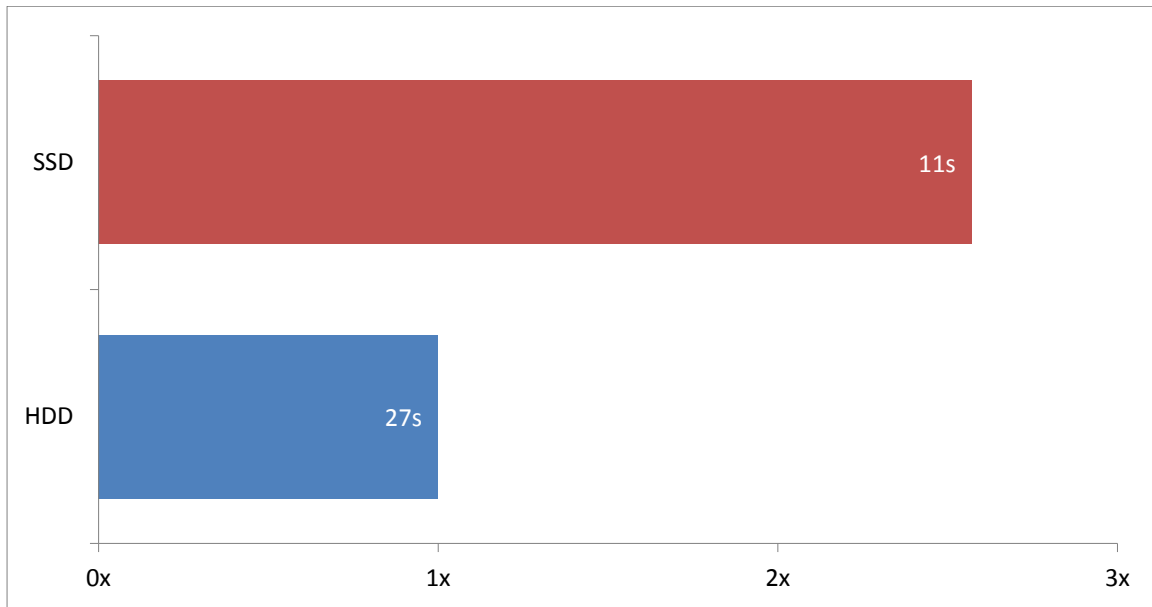


Figure 5: Average boot times, plotted to show relative speed increase

Time to open Microsoft Word

We used the Autolt (<http://www.autoitscript.com/autoit3/index.shtml>) application to write a script that automatically opened a 4MB document in Microsoft Word. This tells how much faster an SSD can load an application compared to a hard disk. Our tests showed that the only upgrade to make a difference was an SSD, as the time to load an application is highly dependent on disk speed, so our graph shows an SSD vs. a hard disk using our base PC specification.

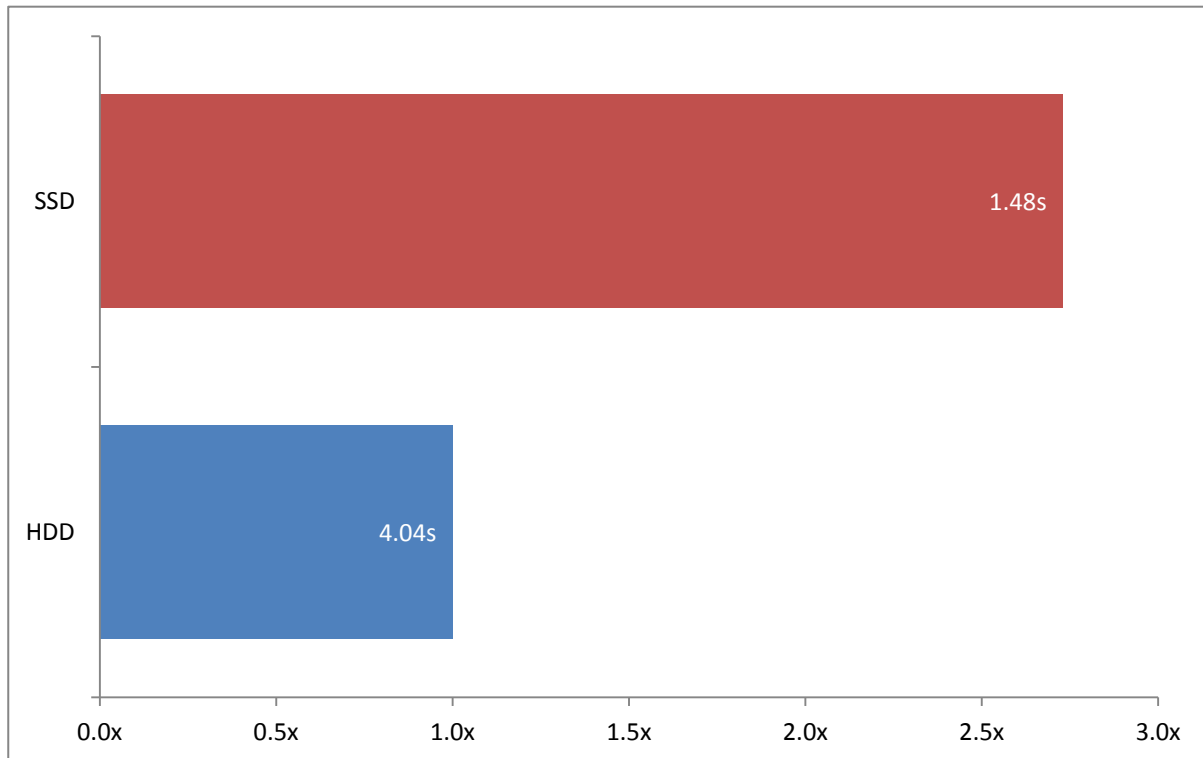


Figure 6: Time to load Microsoft Word - SSD vs Hard Disk, plotted to show relative speed increase

Conclusion

The SSD's read performance is a massive benefit when opening office applications, such as Word. This applies to loading all of the program's files and also to loading the test documents. Other upgrades don't really affect this time at all, as it's highly dependent on the speed of the storage medium. Comparing the SSD to a Hard Disk, Word started just over 2.5 times faster.

Time to open Outlook

We used the Autolt (<http://www.autoitscript.com/autoit3/index.shtml>) application to write a script that automatically opened a copy of Outlook. The application was set to Cached Exchange mode and had an inbox with 23,000 emails. It demonstrates how much faster an SSD can load an application compared to a hard disk. Our tests showed that the only upgrade to make a difference was an SSD, as the time to load an application is highly dependent on disk speed, so our graph shows an SSD vs a hard disk using our base PC specification.

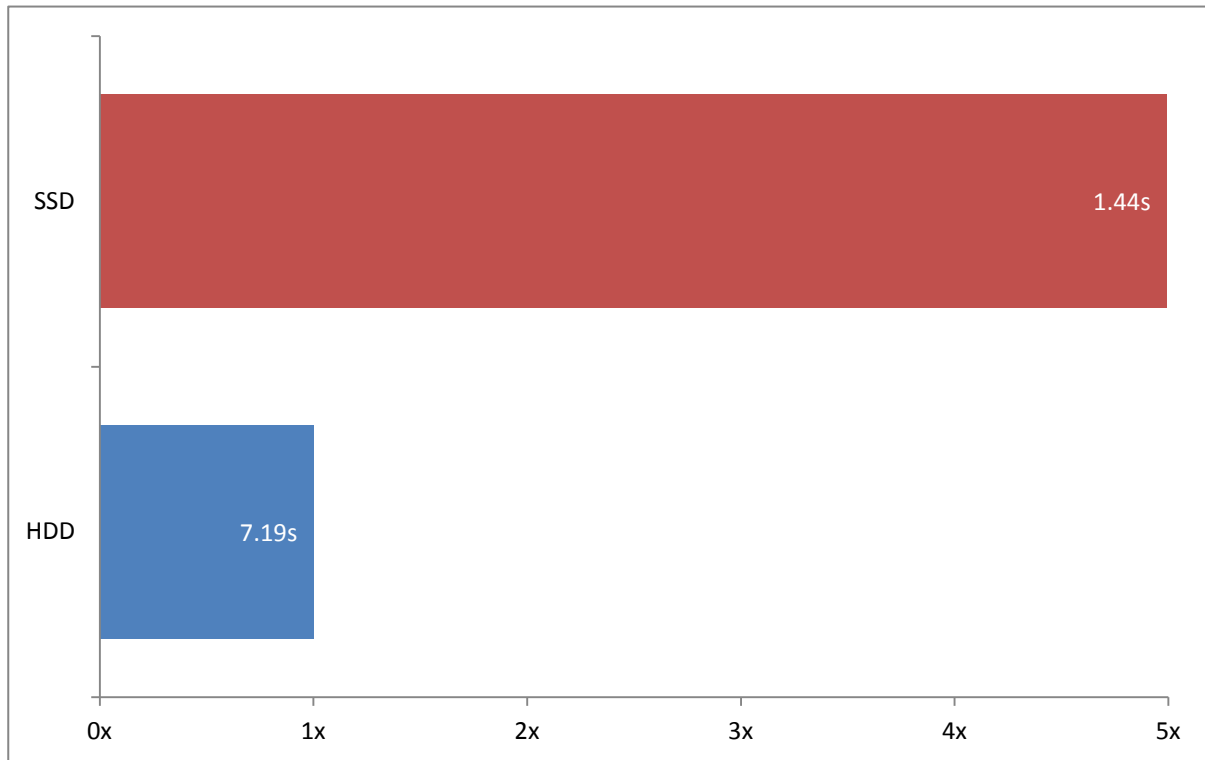


Figure 7: Time to open Outlook – SSD vs. Hard Disk, plotted to show relative speed increase

Conclusion

The SSD's read performance is a massive benefit when opening office applications, such as Outlook. This applies to loading all of the program's files and also in loading the test documents. Other upgrades don't really affect this time at all, as it's highly dependent on the speed of the storage medium. Comparing the SSD to a Hard Disk, Outlook started five times faster.

Time to run a virus scan

We used Norton Internet Security 2012 to scan the complete storage devices of each system. The results were taken directly from the application after verifying that they were accurate by manual timing. All scan times were taken as an initial scan, to prevent the software pre-caching or indexing any files. By using the same disk image for each upgrade, we ensured that the scan was performed on exactly the same number of files each time. Our tests showed that the only upgrade to make a difference was an SSD, as the scanning times are highly dependent on the access times and read performance of the storage device – showing superior performance advantage SSD has over HDD.

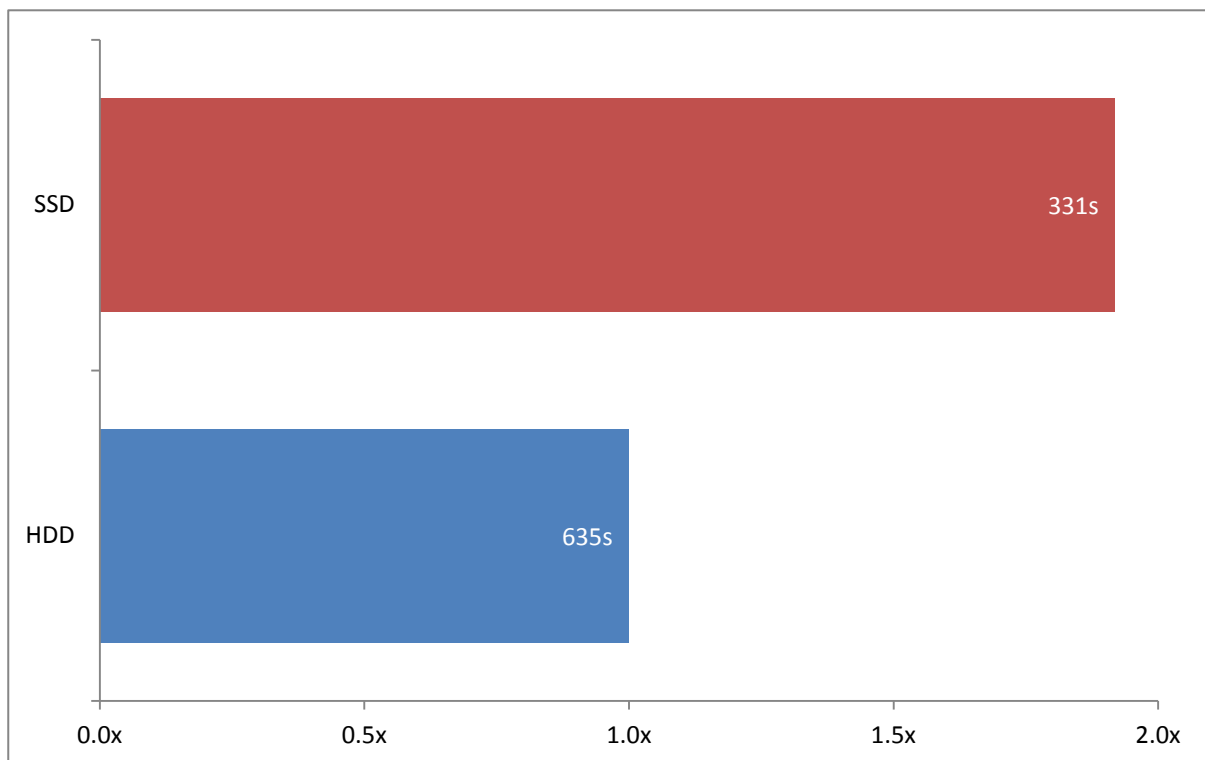


Figure 8: Time to perform a system scan with Norton Internet Security 2012 - SSD vs Hard Disk, plotted to show the relative speed increase

Conclusion

The SSD made a huge difference on performance here, whereas other upgrades had no further impact. This is because the scan used very little processor time and requires little system memory. Comparing the SSD to the HDD, the performance is almost double.

Disk speed

Our final benchmark was designed to test the raw speed of an SSD against a hard disk. To perform this test we generated a 3TB file, as a file this size demonstrates the full capabilities of an SSD versus a hard disk. We tested the read performance of each disk, by copying the file from the test disk to a RAM drive. The RAM drive uses system memory and removes any potential bottlenecks in read performance. We also tested write performance by copying the file from the RAM drive back to the test disk. The results for reading and writing were averaged to give the true file performance for each type we had chosen. All tests were tested using a script that timed how long the file copy operation took from start to finish. Windows' write caching was left turned on.

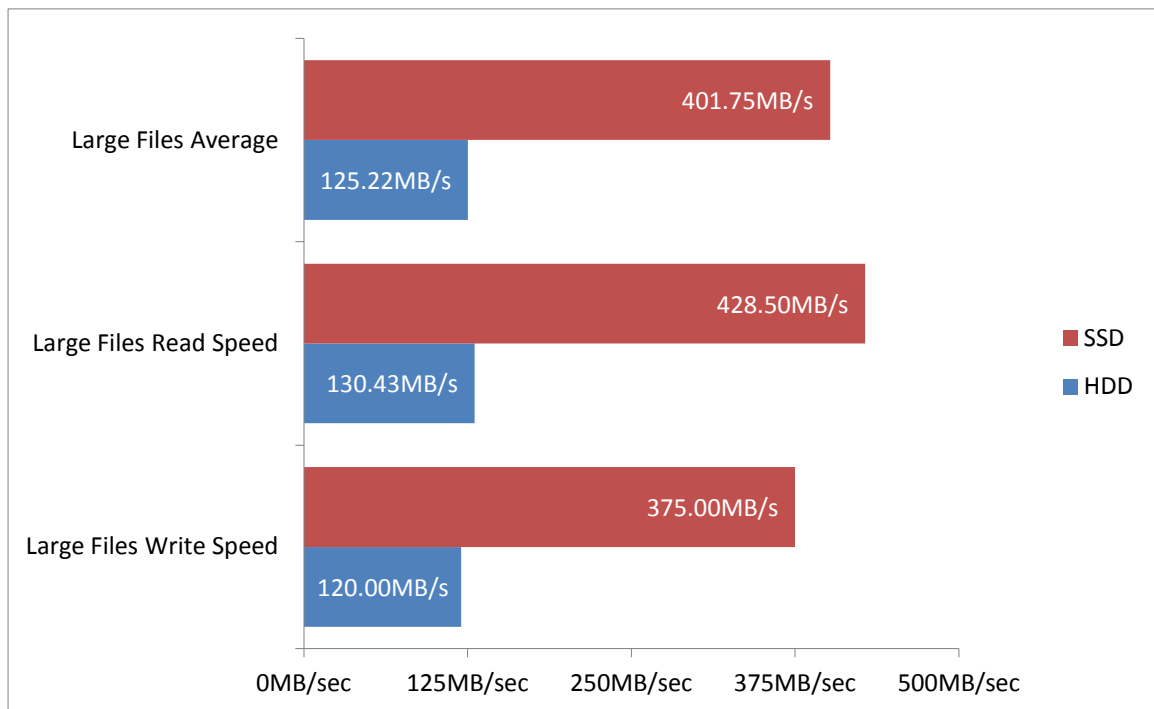


Figure 9: File transfer performance of a 3TB file, measuring read, write and average speeds

Conclusion

The SSD is incredibly quick to read files from, with our large files test resulting in 3.2 times the performance of a regular hard disk. It is these incredible read speeds that help boost a PC's performance when fitted with an SSD and massively improve disk-based tasks, such as booting Windows or running an AV scan.

The key thing about upgrading the storage device on a computer is that it affects a wide variety of tasks, thus boosting the overall performance of a computer in a way that, say, a graphics card cannot. As such, in our testing, we found that the SSD was the most effective upgrade, offering the best value and the largest boost in system performance.

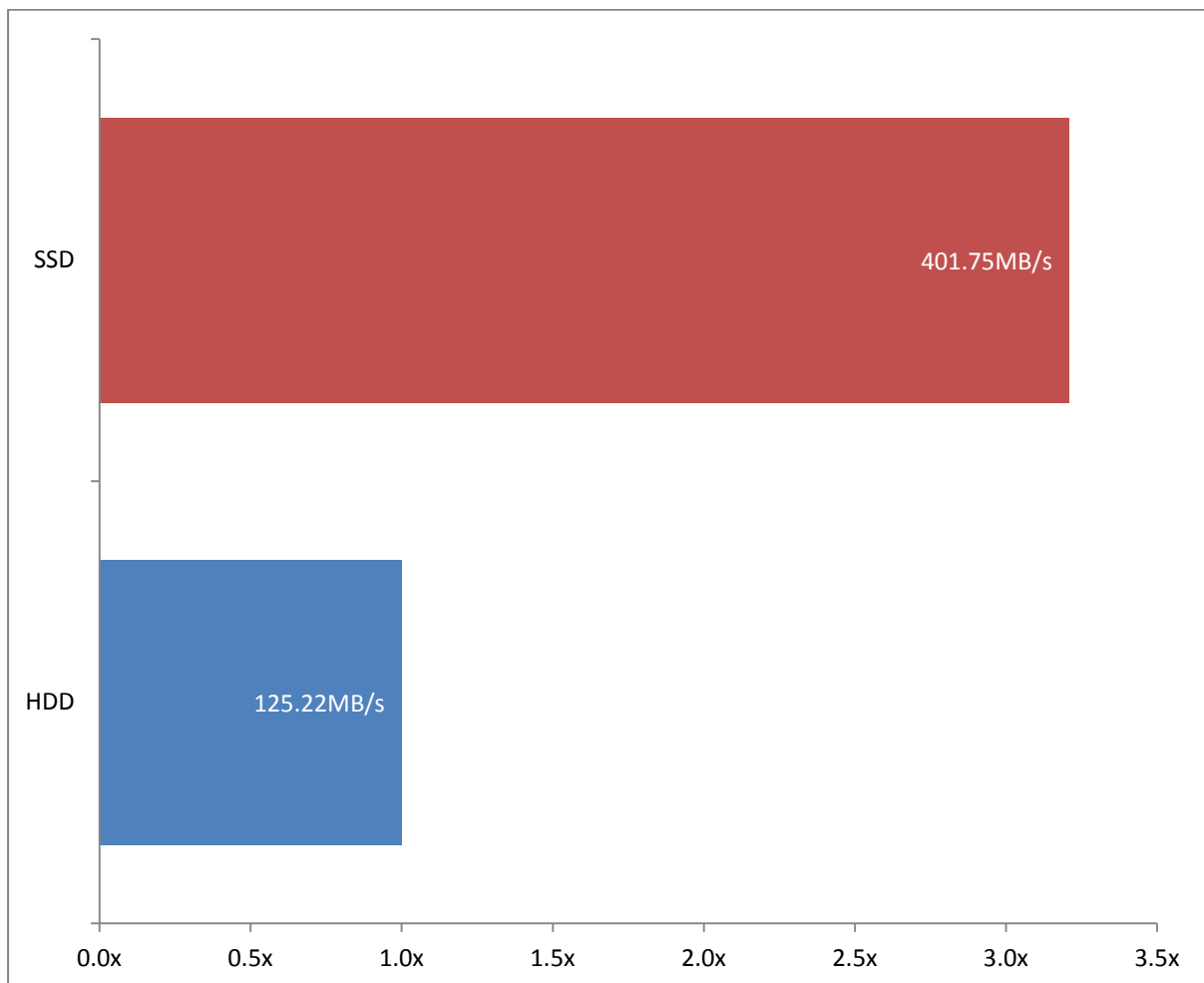


Figure 10: Average file transfer speeds - SSD vs. Hard Disk, plotted to show relative speed increase

Final conclusion

An SSD boosts the performance of any computer, from loading Windows and applications to general system performance. In our tests, replacing a hard disk with a Kingston SSDNow V+200 240GB almost doubled the system's performance.

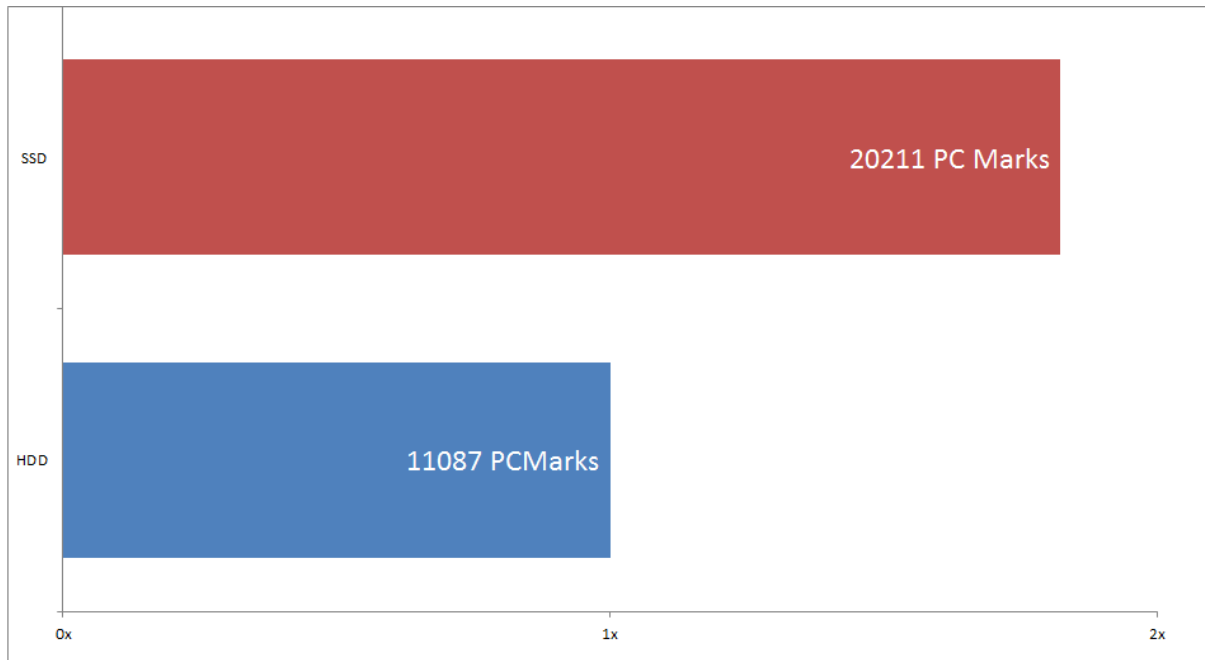


Figure 11: PCMark Vantage overall score - SSD vs. Hard Disk, plotted to show relative speed increase

With a cost of just £1.88 per percentage point increase in performance, the SSD is by far the best value and most effective upgrade out of the ones that we tested. Given the relatively small capacity of the SSD, the ideal combination for most PC users is to add an SSD as a boot drive, while retaining a hard disk for bulk storage.