Storage kings

Need more space? **Dan Gardiner** tests 19 hard drives and SSDs, ranging from 64GB to a massive 2TB.

PC storage is cheaper and faster than ever, so if you need to upgrade your hard drive, now's a great time to nab a bargain. In the last three yearly drive roundups, Samsung has pretty much swept the field in every category. This year proved to be a little different, with Seagate in particular showing some great improvements. We also had the chance to test out some new flash memory-based solid-state drives (SSD), with very mixed results. Some were astoundingly fast, while others had trouble matching their 3.5in platter-based counterparts in important areas. If you're looking to buy an SSD, it pays to do your homework.

_BUDGET DRIVES UNDER $150

SAMSUNG SPINPOINT F1 750GB

90%

MODEL HD753LJ / **PRICE** $145
CONTACT INGRAM MICRO / **PHONE** (02) 9381 6000
WEB www.samsung.com/au

In our 2008 roundup, 750GB was the sweet spot in terms of value for money, and while that's now moved on to 1TB drives, Samsung's HD753LJ at 21c/GB is still a solid and well-priced offering. As is typical of Samsung's drives, it has very cool operating temperatures (21/23°C at idle/load, respectively) and peaking at 29dB, it never gets too loud in use. Moreover, its performance was universally good, coming first in both our synthetic and application benchmarks, and a close second in load time tests. In short, if you've only got $150 to spend on a hard drive, this is a great option.

PC User says: **A very solid all-rounder with great performance and value.**

PC USER BEST BUY

WESTERN DIGITAL WD CAVIAR BLUE 640GB

MODEL WD6400AAKS
PRICE $125 / **WEB** www.wdc.com

Western Digital's (WD) Blue line drives are the company's mid-range models. This one is a reasonably good-value drive at 21c/GB. Its Windows and *Crysis* load times were also pretty impressive (both respectively the highest in this budget category), though it didn't fare as well in Image and Security, where it was merely average. Physically, it matches WD's Green drives for noise while idle (a great 25dB) and its seek acoustics of 29dB are also decent. It did get a little hotter than most, but it managed to stay under 30°C in our test rig.

85%

PC User says: A well-priced option for those who can't stretch to Samsung's HD753LJ

SAMSUNG SPINPOINT F1 500GB

MODEL HD502IJ / **PRICE** $110 / **CONTACT** INGRAM MICRO
PHONE (02) 9381 6000 / **WEB** www.samsung.com/au

This replacement for the aging HD501LJ (see page 40) offers industry-leading thermals (idling at 21°C) and solid acoustics. It matches or beats the older HD501LJ in most benchmarks, albeit often by a small margin. However, it didn't quite keep up with the HD753LJ's excellent performance, where it was a little slower across the board. All up, while it's certainly a better choice than the HD501LJ, you'll get better bang for buck, not to mention performance, out of its 750GB counterpart.

PC User says: This one has good acoustics and thermals.

75%

Buyer's checklist

* **The right plugs.** Before you go out and buy any internal hard drive, you'll need to open up your PC and make sure your motherboard has the right interface to support it. Most PCs built in the last five years should accommodate SATA drives, but it's also important to check that your motherboard has a free SATA port for your new drive. Check your PC's motherboard manual on where to find these. Also, ensure your PC's case has a free 3.5in slot where you can install the drive.

* **Size matters.** What you use your PC for will dictate how big your hard drive needs to be. If you only use your PC for surfing the web, checking email and the occasional download, even 250GB might be too much. If you're archiving your DVDs and music to your PC, installing lots of games or doing video work, you'll need all the space you can get: go for at least one large 500GB or 750GB drive, or even larger if you can afford it.

* **Upgrade or replace?** Buying a new hard drive doesn't mean you have to reinstall your operating system — it's far easier to simply plug in your new drive and use it as a secondary disk to supplement your existing setup.

* **Bang for buck.** We can't stress this enough: drive prices vary hugely from vendor to vendor and shop to shop, so once you've settled on a size, check out each brand to find the best deal on a cost per gigabyte basis. If you're not careful, you could end up paying nearly twice the price for the same amount of storage.

HITACHI DESKSTAR P7K500 500GB

70%

MODEL HDP725050GLA360
PRICE $115
CONTACT ALTECH COMPUTERS
PHONE (02) 8831 9999
WEB www.hitachigst.com

This DeskStar is based on an older drive design compared to the bigger 1TB Hitachi models. This has had a bit of an impact on its performance. Though it performed adequately in load time tests (likely due in part to the Hitachi's 83MB/s sustained read/write speeds), it stumbled when it came to our application tests. Its other main shortcoming is that it's a little louder and hotter than most others in this category, but it's one of the better Hitachi models in this area.

PC User says: Good performance but it's a little warm and loud.

SAMSUNG SPINPOINT T166 500GB

70%

MODEL HD501LJ / **PRICE** $115
CONTACT INGRAM MICRO
PHONE (02) 9381 6000
WEB www.samsung.com/au

This drive has previously done very well in our yearly roundups; unfortunately, the price of 500GB drives has started to level out, so they're not seeing the same increases in value as their larger counterparts. This drive is also looking a little long in the tooth when it comes to performance. Samsung's newer HD502IJ matches or beats it in most areas, and while the HD501LJ's thermal performance and acoustics are still decent, its UserBench test results were disappointing and the lowest in this category.

PC User says: An older drive that's looking a little tired.

Tech terms

Average read/write speeds. These figures indicate how fast data can be written to, or read from, a drive This is given as an average, as performance decreases depending on the location of the data on the drive (data on the outside edge of a platter can be written/read faster than the inner edge).

Burst speed. How fast data can be read from the hard drive's cache memory (see below).

Cache. A chunk of memory on the hard drive itself that is used to buffer information being written to and read from the drive. It is designed to compensate for any temporary bottlenecks in the read/transfer/write process, and to store commonly accessed data. In theory, a drive with a larger cache should be more efficient.

Random access time. This is an important performance indicator, especially for small reads from all over the physical hard disk. The access time is the time it takes for the hard disk's head to start reading or writing a given piece of data. It's the delay that occurs while the head gets into position.

rpm (rotations per minute). This refers to the rotational speed of the platters inside the drive in revolutions per minute.

SATA/IDE. Almost all hard disks and optical drives have moved to the new Serial ATA (SATA) interface, meaning sockets, plugs and cables have all changed from those used by IDE. While you can still find hard drives using the IDE interface, most new models are only available in SATA. Most newer motherboards also only have one IDE socket, so they'll support two IDE drives (one master and one slave) at most. New motherboards typically have between four to eight SATA II ports (SATA II drives are backwards compatible with standard SATA controllers). SATA II is technically faster than IDE, with a theoretical transfer rate of 3Gbps (1.5Gbps for SATA), as opposed to 133MB/s for IDE.

_MID-RANGE DRIVES UNDER $250

SAMSUNG SPINPOINT F1 1TB

90%

MODEL HD103UJ / **PRICE** $175
CONTACT INGRAM MICRO
PHONE (02) 9381 6000
WEB www.samsung.com/au

The HD103UJ was a winner in last year's roundup, and while its competitors have managed to close the gap significantly in the intervening 12 months, it's still managed to keep a pace or two in front of the pack. Particularly impressive are this drive's physical characteristics: its heat output is the equal lowest of any 7,200rpm drive here (beaten only by the slower-running 5,400rpm Samsung HD103UI) and its noise levels are acceptably low. It turned in the fastest UserBench Security and Image results of all the 1TB drives and its load times, while not outstanding, were competitive on the whole.

PC User says: A great-value offering with solid performance and good thermals.

SEAGATE BARRACUDA 7200.12 1TB

85%

MODEL ST31000528AS
PRICE TBA
WEB www.seagate.com

This 1TB ST31000528AS is the first Barracuda 7200.12 drive we've seen — it's so new that there weren't any available for purchase at the time of writing. Internally, it uses two 500GB platters (most 1TB models use three 334GB platters), meaning data is more densely packed, which in itself provides a slight speed boost. It's an altogether cooler, quieter and faster drive than the 7200.10s that were on offer this time last year, with the best acoustics of any 1TB drive (equal to WD's much slower 1TB Green drive), good thermals, excellent load times and respectable application performance. If this is what Seagate's Barracuda 7200.12 drives are capable of, we can't wait to see the 1.5TB and 2TB models due later this year.

PC User says: An impressive all-rounder, but will likely cost more than some others.

SEAGATE BARRACUDA 7200.11 1.5TB

MODEL ST31500341AS / **PRICE** $250 / **WEB** www.seagate.com

While this 1.5TB, 11th-generation Barracuda isn't quite as impressive as the 7200.12 opposite, at a puny 18c/GB it offers the best value for money of any drive we tested. And despite some shortcomings, it still turned in great benchmark results, with particularly impressive Windows load times (beating the 7200.12 by a small margin), and very fast sustained read and write speeds. The issue with this drive is that it's a little on the hot side, reaching 31°C — a full 5°C hotter than the 1TB Barracuda 7200.12 — and it's quite a bit noisier than its new sibling. On the whole though, this one is still a great choice if you need lots of storage.

PC User says: Great value at 18c/GB, but it can get a bit hot and loud.

80%

SAMSUNG ECOGREEN F1 DT 1TB

75%

MODEL HD103UI / **PRICE** $175
CONTACT INGRAM MICRO
PHONE (02) 9381 6000
WEB www.samsung.com/au

This low-power 'green' drive is actually a 5,400rpm model, but despite this slower rotational speed it delivers some impressive performance. It even managed to trump many of the 7,200rpm models in our application tests, though it hit a wall in Windows and *Crysis* load times, where it was a full 20% behind the leaders. It was the coolest of any drive we tested, however. Ultimately, it's undone by its 7,200rpm sibling — the HD103UJ sells for the same price, is only slightly warmer and offers better performance.

PC User says: Good for a 5,400rpm model, but pricey.

WESTERN DIGITAL WD CAVIAR BLACK 1TB

75%

MODEL WD1001FALS
PRICE $220 / **WEB** www.wdc.com

WD's Black edition drives are supposedly its 'maximum performance' 7,200rpm models, but this 1TB version isn't much faster than the Blue edition (see page 39). Both turned out very similar average read/write speeds and benchmark results, and the Blue edition even beat this one in a couple of places. The Black can pump out up to 33dB when seeking data, making it the loudest 7,200rpm drive we tested, and it also idled at a highish 30°C. The one saving grace here is a five-year warranty — two years longer than most other companies' offerings.

PC User says: OK performance, but a bit hot and noisy.

HITACHI DESKSTAR 7K1000 1TB

70%

MODEL HDS721010KLA330
PRICE $225
CONTACT ALTECH COMPUTERS
PHONE (02) 8831 9999
WEB www.hitachigst.com

Given its comparatively slower sustained read and write speeds (72.7MB/s and 69.8MB/s, respectively), this drive actually offers decent performance, and its load time results in particular were quite respectable. Sadly, it didn't fare so well when it came to temperature or noise. It reached a rather warm 35°C in our test rig — the hottest of any of the drives in this roundup — and can output up to 32dB when seeking data. The asking price also isn't very competitive.

PC User says: Needs to be priced lower to compete.

WESTERN DIGITAL WD CAVIAR GREEN 1TB

70%

MODEL WD10EADS
PRICE $175 / **WEB** www.wdc.com

WD's Green drives are designed to save power (this 1TB model only consumes about 2.8W when idle versus 8W for normal desktop drives), but you do take a performance hit in exchange — up to 10% compared to WD's 1TB Black edition. Against Samsung's EcoGreen 1TB, the WD is a little quieter (peaking at 27dB versus the Samsung's 29dB), but runs a bit warmer. Samsung offered better application performance, but was marginally slower in *Crysis* load times. We reckon WD's drive isn't quite as appealing, though it has superior acoustics.

PC User says: Samsung's equivalent is cooler and faster.

_HIGH-END DRIVES OVER $250

WESTERN DIGITAL WD CAVIAR GREEN 2TB

MODEL WD20EADS / **PRICE** $580 / **WEB** www.wdc.com

This 2TB drive (the first and only one currently available) sells for a bit of a premium — 31c/GB is a lot to ask, especially given that 1.5TB drives are going for as little as 18c/GB. The WD20EADS's performance was fairly average on the whole. It did OK in load time tests, but was wholly unimpressive when it came to our UserBench Image and Security application benchmarks. In terms of noise and heat, it was respectable, but its 1TB counterpart (the WD10EADS) is better in both areas. If you categorically need heaps of storage, this one isn't a bad choice, but it doesn't offer great bang for buck.

PC User says: Has the 2TB drive market cornered, but isn't fantastic value.

75%

How we tested

To evaluate each drive, we ran a series of benchmarks on a test system consisting of an MSI P45 Neo3 motherboard, Intel Core 2 Duo E8600 CPU and 1GB of DDR2-1066 RAM running Windows XP Pro SP3. The benchmarks we ran consisted of:

* **HD Tach RW 3.0.4.0.** This tests a drive's theoretical performance capabilities, including average read and write speeds across the whole drive, burst speed and random access time.
* **UserBench Image 2006.** This test does a series of conversions to large image files. It involves a lot of opening and saving of files, and tests sustained reading and writing to the hard drive. We ran this test three times and the results given are the combined score of all three runs.
* **UserBench Security VR 2007.** Our security benchmark is a timed test consisting of two virus scans of 1GB of smaller files and then zipping up those same files. This gives an indication of how well a drive performs with small- and medium-sized file manipulation.
* **Load time testing**. This tests how effective a drive is at pulling large amounts of data and loading it into memory, with a smaller amount of file manipulation and writing. We performed two timed tests with a stopwatch: for the first we timed how long Windows XP took to load (from after the POST screen until the OS displayed a specific startup app); for the second we timed how long it took to load a level in *Crysis*. Each test was repeated five times, with the average of all five recorded.
* **Heat testing**. For some, heat is a critical factor when deciding what drive to buy. It's important if you're using multiple drives or other high-heat components. Each drive was tested in *PC User* Labs, which has a set temperature of 21°C. Our test rig used an Antec SLK3000B case with 120mm intake and exhaust fans. Each drive was tested separately and placed in the middle slot of the five-socket drive cage, with the intake fan blowing directly over the drive. We then booted the system running Windows XP and ran HD Tach's Full read test for 30 minutes to stress the drive, logging the drive's temperature as we went. We then allowed it to sit idle for 30 minutes. We've recorded two temperatures in the table: the highest the drive reached during HD Tach testing and the temperature when idle for 30 minutes.

HITACHI DESKSTAR E7K1000 1TB

MODEL HDE721010SLA330 / **PRICE** $320 / **WEB** www.hitachigst.com

This 1TB drive is from Hitachi's new 'Enhanced' DeskStar range (thus the 'E' in E7K1000), and it delivers very impressive performance on the whole, with application test scores that are significantly better than its standard counterparts. In fact, judging only on its test scores, this drive is the most well-rounded of all those we tested, with consistently good results in every real-world test. While its physical characteristics (heat and noise) still leave a little to be desired, they are better than before. Add to this a five-year warranty and you've got a pretty impressive package. It's a shame then that it's so expensive; at $320 (34c/GB) it's the most costly 1TB model here. And even with all its good features, it's not worth this much.

PC User says: A consistently fast performer, but too pricey for us to recommend.

HITACHI CINEMASTAR 7K1000 1TB

MODEL HCS721010KLA330 / **PRICE** $280 / **CONTACT** ALTECH COMPUTERS
PHONE (02) 8831 9999 / **WEB** www.hitachigst.com

Hitachi's CinemaStar range of hard drives boast about having low power consumption and quieter operation than their standard counterparts. And that's true in certain cases, but they're not quite as appealing when compared to competing models from WD and Samsung. This 7K1000 model, for example, consumes 8.4W of power at idle, which is rather high compared to the 2.8W drawn by the WD10EACS. It also reaches 30dB during data seeking, whereas the WD only peaks at 27dB. Moreover, it doesn't stand up that well against Hitachi's own new DeskStar E7K1000, which runs at cooler temperatures and has lower noise output — the latter would be a better option for media centre builders in our opinion.

PC User says: There are better options for media centre PCs or silent systems.

BUDGET DRIVES UNDER $150: HOW THEY COMPARE

Name and size	Hitachi DeskStar P7K500 500GB	Samsung Spinpoint F1 500GB	Samsung Spinpoint F1 750GB	Samsung Spinpoint T166 500GB	Western Digital WD Caviar Blue 640GB
Model number	HDP725050GLA360	HD502IJ	HD753LJ	HD501LJ	WD6400AAKS
Interface/cache	SATA II/16MB	SATA II/16MB	SATA II/32MB	SATA II/16MB	SATA II/16MB
Rotations per minute (rpm)	7,200	7,200	7,200	7,200	7,200
Formatted capacity (GB)	465	465	698	465	596
Cost per GB (formatted)	$0.25	$0.24	$0.21	$0.24	$0.21
Average online price	$115	$110	$145	$110	$125
Warranty	3 years	3 years	3 years	3 years	3 years
TEST RESULTS					
HD Tach 3.0.4.0					
- Random access time (ms)	18.5	13.3	13.1	13.9	12.6
- CPU utilisation (+/-2%)	3%	0%	4%	2%	2%
- Burst speed (MB/s)	249.2	243.3	242.9	223.3	237.9
- Average read (MB/s)	83.2	75	98.7	67	92.1
- Average write (MB/s)	83.1	74.6	98.1	63.4	89.7
UserBench Image 2006 (min:sec)	7:08	6:57	6:42	7:10	6:52
UserBench Security 2007 (min:sec)	2:21	2:15	2:09	2:22	2:21
Crysis level load time (sec)	50.6	51.3	49.2	50.4	46.3
Windows XP boot time (sec)	26.1	26.9	24.9	26.7	23.9
Noise level (idle/random seek, from manufacturer)	28dB/NS	27/29dB	27/29dB	27/29dB	25/29dB
Temperature (idle/maximum)	25/28°C	21/23°C	21/23°C	23/25°C	27/29°C

Note: for all time-based tests, lower is better. All drives tested on an MSI P45 Neo3 motherboard with a Core 2 Duo E8600 CPU, 1GB DDR2-1066 RAM on Windows XP Pro SP3. NS = not specified.