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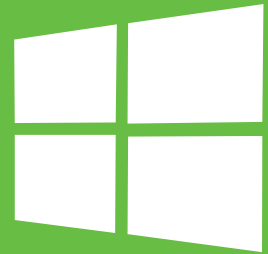
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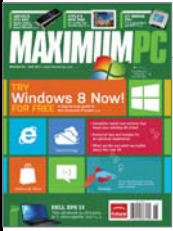
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JUNE 2012

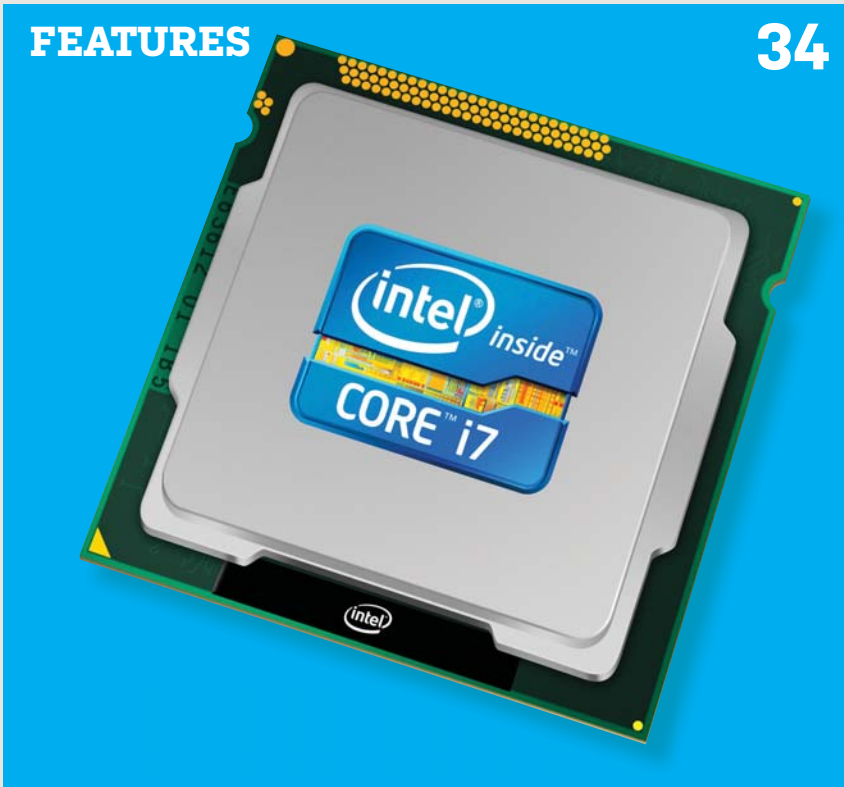WINDOWS 8 CONSUMER PREVIEW

IVY BRIDGE

GEFORCE GTX 680

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inside
JUNE 2012

MAXIMUM PC

Gordon
Mah Ung

THE LEGACY OF LEGACY

WINDOWS 8 IS not a final product, so it wouldn't be fair to render a verdict before final code is available. But I don't need to be a high-priced Washington pollster to see that a very wide swath of mouse jockeys are going to be seriously pissed-off.

Trying to use Windows 8's Metro UI—at least in the current beta state—will immediately make comfortable Windows users feel like octogenarians at the local community center's shared computer station. When you can't even figure out how to shut down an app or call up the Lucky Charms bar, it's enough to make you want to pound the mouse on the table until it shatters.

I'm not here to bag on a beta product, though; I'm here to say that the teeth-gnashing and hair-pulling that many folks will undoubtedly go through is normal, and to explain why we're going through it yet again.

One of the lovely qualities of the PC platform is its respect for legacy support. Things are never just burned down wholesale and started anew. Even Microsoft can't just come in, tell everyone to dump x86 for, say, ARM, and then direct all hardware and software vendors to suck it up and rewrite everything from scratch. Few companies in the world have the kind of dictatorial power and arrogance to slap its customers and partners around like that.

Instead, new technologies are almost always gradually phased in on the PC with a bridge back to the previous generation. This was done for PATA to SATA, and serial/parallel to USB, and from Windows 3.1 to Windows 95. Legacy software and hardware is always respected; it's at the very essence of the PC.

And this is why we're undoubtedly going to be mired in an interface that works great for touch, or great for mouse and keyboard, but not for both. It is, essentially, *not* the best of both worlds. Unfortunately, this is what you get when you try to move the platform forward while somehow leaving a fallback for those who can't take the change.

So, while you're slamming your fist on the table, shaking your flat panel back and forth, or jumping up and down and cursing the UI change, there is actually a greater good at work.

Gordon Mah Ung is Maximum PC's deputy editor, senior hardware expert, and all-around muckraker.

THE NEWS

What's Next for Magnetic Storage?

The new tech that's enabled 1Tb-per-square-inch areal density

IN MARCH, Seagate announced that it had broken an areal-density milestone, hitting one terabit per square inch. In its announcement, Seagate claimed the milestone, which was reached using heat-assisted magnetic recording (HAMR), could enable 60TB desktop hard drives by the time the technology fully matures. Today's hard drives, which use perpendicular magnetic recording (PMR), cap out at around 625Gb per square inch, and Seagate estimates that PMR will reach its density limit at around 1Tb per square inch sometime around 2015, so the race is on to find a replacement mechanical storage technol-ogy—and Seagate is just one of the hard drive manufacturers betting on HAMR.

Heat-assisted magnetic recording uses lasers to superheat a 50nm spot on a magnetic-alloy surface (iron-platinum, in this case) in order to change the polarity of the heated section. Because the surface requires heat to change its polarity, HAMR bits don't interfere with each other, so data degradation errors that creep into PMR media as density on those devices increases won't occur on HAMR drives.

Mark Re, senior VP of Heads and Media R&D at Seagate, says that the first commercial HAMR drives

HAMR drives won't look much different from today's hard drives—except for the addition of a laser.

should appear around 2015, right around the time PMR drives reach their theoretical density limit. According to Re, HAMR drives shouldn't require much more power or produce more heat than today's hard drives. The iron-platinum alloy used in HAMR drives contains more platinum than the cobalt-platinum alloy used in current PMR platters, so platters will be slightly more expensive, but since they can be manufactured on today's platter fabs, they won't require new manufacturing equipment. Re expects HAMR drives to replace today's PMR drives in all situations where 3.5-inch and 2.5-inch magnetic drives are currently deployed.

While traditional hard drive manufacturers work on the next generation of mechanical storage devices, though, solid-state drives continue to advance. In November 2011, Intel and Micron announced a 128Gb NAND die at 20nm, enabling an eight-die package of 128GB. Given that a 2.5-inch drive can hold 16 packages, that could enable 2TB SSDs by the end of 2013. Solid-state memory requires less power and puts out no vibration and little heat, and modern MLC NAND is much faster than mechanical stor-age. Will mechanical storage still be around by the end of the decade?

"Absolutely," says Mark Re. Citing reports that the demand for data storage grows by an average of 40 to 50 percent each year, Re points out that it would be infeasible to replace magnetic hard drives, with their "reliable storage at affordable prices," with solid state drives for storage of all that data. "Even if you wanted to replace more of that storage with flash memory, it becomes prohibitively expensive" to build enough NAND fabs to accommodate capacity demand. Re anticipates that flash media and magnetic storage will continue to coexist for a long time to come.

Maximum PC tends to agree. While we see solid-state storage overtaking mechanical drives for most consumer applications within the next five years or so, that doesn't mean mechanical drives will go away. We've got to store all that data somehow, and even if laptops and ultrabooks do away with mechanical drives, there's just nothing like a desktop with 12TB worth of data crammed into it. Not to mention all those server farms that hold "the cloud."
–Nathan Edwards

Holey Optochip Capable Of 1Tb/s Data Transfer Rates, Batman!

Turns out, punching holes through standard 90nm silicon CMOS chips is a decent first step toward superfast supercomputing. That's the key to IBM's awesomely named "Holey Optochip," a prototype optical chip sporting 48 holes that can transfer data at a blistering-fast 1 terabit (1 trillion bits) per second.

Optical data transmission uses pulses of light to send information faster and more efficiently than the standard "electrons via wire" method. The holes let light through to the 24/24 split of optical receiver/transmitter channels on the opposite side of the chip.

IBM says the parallel optical transceiver can transfer the equivalent of 500 HD movies every second with its 1Tb/s data rate. (Of course, that's in-chip speed; other system components would slow that down.) As if that weren't cool enough, IBM used industry-standard parts to ensure an easy economy of scale when the chip hits manufacturing, *and* the Holey Octochip is green, to boot—using just 5W of power. **–BC**
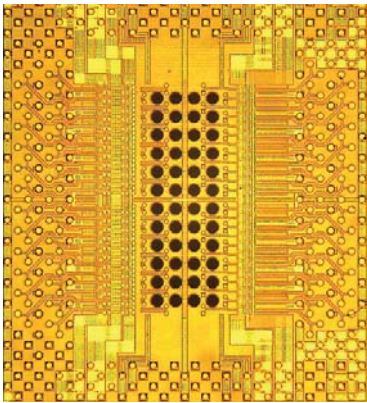
Image source: IBM

Android Tablets to Overtake iPad by 2015

These days you might get the impression that Apple's iPad is the only tablet in existence. We'll let Apple enjoy its moment in the sun, because as analyst firm IDC points out, Android tablet shipments are on track to overtake iOS by 2015. According to IDC, Apple might remain the dominant single vendor, but "the sheer number of vendors shipping low-price, Android-based tablets means that Google's OS will overtake Apple's in terms of worldwide market share."

The trend has already begun. IDC notes that Android made strong gains in Q4 of 2011, in which its market share grew to 44.6 percent, up from 32.3 percent in Q3. This came at the expense of Apple's iOS/iPad platform, which dropped from 61.6 percent in Q3 2011 to 54.7 percent in Q4. **–PL**

Maingear Unveils Upgradable All-in-One

All-in-one PCs aren't known for their upgradability, but then again, all-in-one PCs haven't been built by boutique builder Maingear—until now, that is. Maingear is spreading its proverbial wings with the Solo 21, which uniquely sports an SSD caching solution out of the box.

With a starting price of $1,000, default specs include an Intel Core i3-2125, upgradeable to Intel Core i7-2600S; an Intel DH61AG motherboard supporting USB 3.0, SATA 6Gb/s, 32nm and 22nm processors; 4GB DDR3/1333, upgradeable to 16GB DDR3/1333 memory; a 32GB SSD caching drive standard; a 500GB HDD, up to a 2TB 7,200rpm HDD; a DVD burner; and an Intel 802.11n, Bluetooth wireless adapter. Adding a touchscreen display costs another $129. **–BC**

Tom Halfhill
Fast Forward

CLOCKS DON'T GROW ON TREES

EVERYONE KNOWS that a microprocessor operates at a regular clock frequency (say, 2.5GHz), which is synchronized to an internal signal that throbs like a heartbeat. Fewer people know that the clock signal reaches every corner of the chip through another circuit called a clock tree or clock mesh.

Clock circuits are vital, but processors are getting so fast that conventional clock circuits are becoming inadequate. Clock trees are troublesome at frequencies higher than about 2.0GHz because slight variations in their branch structures delay some signals, knocking the clock out of sync. In faster processors, clock meshes replace the branches with a wire network resembling a woven fabric, but they are more complex.

Result: Clock circuits in high-performance processors can consume about one-third of the chip's total power—often tens of watts. That's a heavy tax for routine timekeeping.

AMD is trying something different. Future "Piledriver" CPU cores will use a *resonant clock mesh* to reach frequencies as high as 4.4GHz. Resonant meshes aren't new, but a startup company named Cyclos has refined the concept. AMD, ARM, and other companies are adopting the technology.

Cyclos uses a simple circuit known as a tank to generate an oscillating-wave signal that resonates throughout the mesh. Once generated, the signal flows back and forth at a regular rate, assisted by its own momentum, much like the pendulum in a grandfather clock. Consequently, a resonant mesh requires less power than conventional clock circuits. In test chips, the Cyclos mesh has slashed power by 33 percent.

However, AMD expects to save only about 5–10 percent in Piledriver because the new core is largely based on today's Bulldozer core, which has a conventional mesh.

Future clean-sheet designs should realize greater power savings. And fear not, overclockers—resonant meshes will still let you tweak the clock speed.

Tom Halfhill was formerly a senior editor for *Byte* magazine and is now an analyst for *Microprocessor Report*.

Thomas
McDonald
**Game
Theory**

TOO MUCH DARKNESS FOR AN M

WHAT EXACTLY does it take for a game to get an AO rating? The official ESRB statement is simply this: "Titles rated AO (Adults Only)… may include prolonged scenes of intense violence and/or graphic sexual content and nudity."

I think we all know the "violence" part of that sentence is just a flat-out lie. Manhunt 2 and Thrill Kill are the only games tagged AO for violence, and Thrill Kill was never even released. The rest of the AO games earned their rating for either gambling or sexual content, and most of the sexual games wanted the AO in order to attract attention. Games awash in the most extreme violent content are squeaking by with M ratings, making a farce of the ratings system.

The reason for this is quite clear. ESRB is a voluntary industry organization. Mainstream retailers have refused to carry AO games, which means that an AO is the kiss of death in the marketplace. When money talks, the ESRB walks.

Yet there should be a place for an AO rating in a game world that takes its craft seriously. It's absurd that the fairly tame Halo series and the extreme The Darkness games share the same rating.

After spending many hours with The Darkness II, I was left wondering: How is this an M? The language would make Tony Montana blush, the violence is incredibly graphic, the sexual content is astonishing, and the entire tone of the game is dark and nasty, from the peeing id monsters, to the cannibalism, to the women performing sexual acts in a brothel.

Don't get me wrong: This content is married to some absolutely superb gameplay. I wearied of the vile tone after a while and just gave up, but there's some fine work on display in the game. But by no stretch of the imagination should this be on store shelves next to M-rated titles like Mass Effect 3 and Skyrim. No way. The ESRB has created a perfectly good rating system. Now they need to find the courage to use the whole thing.

You can follow Thomas McDonald on Twitter: @StateOfPlayBlog.

Marvell Readies New SATA 3.1 SSD Controller

Marvell Semiconductor announced in March that it was ready to ship its new 88SS9187 SATA controller for SSDs. The 9187 controller includes an on-chip RAID controller that can recognize and retire defective NAND modules. The chip also includes advanced error correcting and support for DDR3 DRAM cache. It's compliant with SATA 3.1, which includes support for the mSATA spec, as well as queued Trim commands.

Marvell's first 6Gb/s SATA processor, the 88SS9174, powered many SSDs including Crucial's C300 and m4, Plextor's M2, and even Intel's 520 Series SSD. All had solid sustained read performance, but lagged behind controllers by SandForce, Indilinx, and Samsung in sequential and random writes. Marvell claims drives powered by the new 9187 will reach "maximum sequential read performance for a SATA 6G device," (which works out to a theoretical maximum of 768MB/s, minus overhead) and up to 500MB/s sequential writes. *Maximum PC* looks forward to testing devices based on the new 88SS9187 controller. **–NE**

RAM Prices Head North

With memory-chip maker Elpida filing for bankruptcy, RAM prices are expected to climb out of the dumpster and finally begin heading north, analysts say.

Japanese RAM maker Elpida filed for bankruptcy with a whopping $5.55 billion in debt early this spring. The fate of the company isn't known, but its bankruptcy sent prices of DRAM heading up, with analyst firm iSuppli reporting a 15 percent jump in one day. Samsung, Hynix, and Micron are expected to benefit from Elpida's troubles.

A cursory look at some memory modules on etailer sites shows prices aren't spiking as quickly as predicted. A pair of 4GB DDR3/1333 DIMMS costs $41, up from $34 in December but far lower than the high of $100 from March of 2011. **–GU**

Windows 8 Watch

Knowledgeable Sources Say It's Coming this Fall

According to Bloomberg reporters who spoke to "people with knowledge of the [Windows 8] schedule," the new OS will be launched in October. And you can expect to see it on x86-based PCs and ARM-based tablets at launch, although ARM offerings will be limited. The timing helps Microsoft take advantage of holiday purchasing.

Analyst IDC predicts that the release of Windows 8 and growing consumer interest in ultraportable laptops (e.g., ultrabooks and the like) will give PC sales a big boost at the end of 2012, helping the industry crawl out of the 9 percent decline it experienced in 2011.

Meanwhile, both Mozilla and Google are hard at work readying Metro-friendly versions of the Firefox and Chrome browsers. Word of these developments comes after Microsoft announced that Windows 8 will support desktop, Metro-style, and Metro-style-enabled desktop browsers. **–KS**

Quinn
Norton
**Byte
Rights**

THE INTERNET OF ALEXANDRIA

I LOVE THE FACT that if you leave the plebs of the net unwatched for even a minute, they build giant, gorgeous libraries for everyone to use.

But throughout history libraries have always been burned, and today is no exception. Now we set fire to the fruits of the human mind using copyright enforcement rather than old-fashioned fire.

Earlier this year, a story as old as Napster's music catalog (the largest ever built, then the largest destroyed months later) reared its head again. The U.S. was destroying collections built on the net. A piracy-enabling site with almost a half-million books called Library.nu was shut down. Library.nu wasn't actually that glamorous a piracy site. It was overwhelmingly technical and academic—not books for casual reading, but books for people who need books. Library.nu catered to the global middle class and those looking to better themselves, but this didn't thwart copyright enforcement from shutting it down.

Megaupload, shuttered by U.S. law enforcement, held roughly 25 petabytes of data. The fate of this data was debated between Megaupload wanting the corpus for legal defense, the MPAA wanting the data for possible civil prosecution, people just wanting their data back, and the government happy to turn it all off. No one spoke for the final interested party—history. History will surely wonder what the hell we were smoking that caused us to think it was no big deal to delete 25 petabytes of human expression, right before destroying our most universal open library, only 10 years after destroying the greatest catalog of music we'd ever assembled. Like watching the opening stroke of a dark age, our children will surely wonder what made us think that systematically burning down human knowledge was OK, because they surely won't care about the finer points of 20th century copyright law.

Quinn Norton writes about copyright for Wired News and other publications.

Adobe to Charge for Premium Flash Features

First Adobe abandoned Flash for mobile phones and tablets. Now the company says it intends to charge developers to use the new premium features of its ubiquitous plugin technology.

Although this seems like yet another nail in the Flash coffin, Adobe says the features for 3D acceleration and domain memory management will allow developers to stream a "console-quality" gaming experience and easily sandbox existing C++ code. The problem will be Adobe's cut of 9 percent from games with more than $50,000 in revenue—that includes a cut of up-front sales as well as in-game ads and in-game sales. Adobe says games that are packaged in Adobe AIR will remain free—for now. **–GU**

All Your .com Domains Are Belong to U.S.

Do you own a .com domain? If so, the U.S. government can seize it at any time. The same applies to .net, .org, .biz, and other top-level domains (TLDs).

How is this possible? According to a report in *Wired*, Uncle Sam has done this "hundreds of times," and it's because the companies that administer these websites are based in the U.S., says Nicole Navas, an Immigration and Customs Enforcement spokeswoman.

According to Navas, the U.S. government typically serves court-ordered seizures on VeriSign, an American company based in Reston, Virginia and the authoritative registrar for .com, .net, .cc, .tv, and .name. The U.S. government can also seize .org domains, all of which are managed by the Public Interest Registry, also based in Virginia.

Even foreign websites registered with a VeriSign subcontractor aren't safe from seizure. **–PL**

Intel Brings Eight Cores with Xeon E5-2687W

By now, enthusiasts are well aware that Intel's top-end Sandy Bridge-E six-core chips are actually eight-core chips with two cores permanently shut off. If you've been wondering what your neutered chip would be like with an additional two cores, you no longer have to.

Intel's new 3.1GHz Xeon E5-2687W, aka "Sandy Bridge-EP," features eight cores and a Turbo clock of 3.8GHz. That's about 100MHz lower than a stock-clocked 3.3GHz Core i7-3960X and its top Turbo speed of 3.9GHz. The additional two cores bring additional L2 cache, upping the total on the Xeon E5-2687W to 20MB vs. the 15MB in the Core i7 chip.

So why didn't Intel sell this chip instead of the Core i7-3960X? Intel's official line has always been that its decision was made to give users higher clock speeds and contain thermals. The thermal specs of the new Xeon seem to bear that out. Intel rates the fastest Sandy Bridge-E chip at 135 watts TDP; the new Xeon pushes that to a 150 watt TDP, which almost mandates the use of liquid cooling. The new Xeon is LGA2011 and is drop-in compatible with existing X79 boards. It won't be cheap, though; the new chip is priced at $1,885 in volume pricing. Other key differences between the Xeon and Core i7 part include the former's inability to be overclocked, its two QPI connections for use in multisocket motherboards, and its support for up to 750GB of system RAM rather than the Core i7's measly 64GB. **–GU**
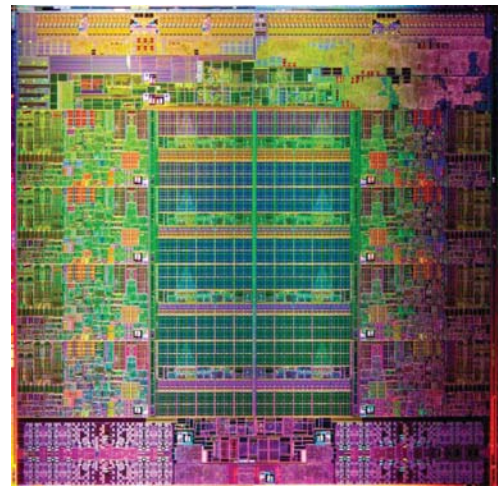
THE LIST

8 OF THE BEST TECH COMMERCIALS OF ALL TIME

8 — APPLE MACINTOSH, 1984, 1984

Who can forget the highly stylistic, Orwellian-themed ad directed by Ridley Scott that introduced the world to the Macintosh? bit.ly/rcZLHB

7 — ELECTRONIC DATA SYSTEMS, HERDING CATS, 2006

Herding cats as a metaphor for EDS's ability to "bring together information, ideas, and technologies and make them go where you want." Hi-larious. bit.ly/4B7TR

6 — MICROSOFT, BELIEVE, 2007

"Believe" was but a cog in the Halo advertising campaign, but, as evidenced by its many awards and recognitions, an important cog it was. bit.ly/wHFJWn

5 — AT&T, FLASH MOB, 2011

What better fate for a flash mob participant than to misplace his mob. Uni-mob, anyone? bit.ly/lHvKRQ

4 — ENERGIZER, THE ENERGIZER BUNNY, 1988

That interminable drumming bunny has penetrated our cultural consciousness. bit.ly/xx7je0

3 — HULU, ALEC IN HULUWOOD, 2009

We love the cynical dis of the entire TV industry and portrayal of Hulu as a nefarious organization of brain-eating aliens. bit.ly/cA73vQ

2 — MAXELL, BLOWN AWAY GUY, 1980

Those cassette tapes could blow a lot of air! bit.ly/9dJ8In

1 — MOTOROLA XOOM, EMPOWER THE PEOPLE, 2011

Used Orwellian theme to take a shot at Apple. Touché. bit.ly/fdIbjD

HEAD TO

BY ALEX CASTLE

PlayStation Vita vs. iPhone 4S

For those of us who remember wasting hours with the original, green-screened GameBoy, the thought that the era of portable gaming consoles may be coming to an end is a bit sad. While their TV-tethered cousins will be around for at least another generation or two, super-powerful smartphones like the iPhone 4S are calling into question the need for dedicated portable gaming devices like the new PlayStation Vita.

After gaming extensively on both, we've come up with a point-by-point breakdown that we think explains why portable consoles aren't dead yet.

Round 1: Display

Now this is a tough call to make. The iPhone 4S and the PlayStation Vita have two of the nicest screens we've ever seen, though they're very different. The iPhone 4S's "Retina Display" is an absolute marvel of pixel density—text and game graphics are crisp and clear.

The Vita, on the other hand, has the advantage of way more screen real estate, with a 5-inch screen that dwarfs the iPhone's 3.5-inch display. The Vita's OLED screen is significantly lower-res (two screens have approximately the same pixel count, but the Vita's larger screen is much lower density), but it looks fantastic, with good contrast and bright, vivid colors.

Though both screens are top class, we think the Vita's is the better choice for gaming. The iPhone's smaller screen, usually partially obscured by fingers, doesn't give game UIs any room to breathe.

**Winner:
PlayStation Vita**

Round 2: Controls

Here we find the iPhone's biggest drawback as a gaming platform. The capacitive multitouch screen of the iPhone is responsive, and has been put to great use in games like Infinity Blade and Angry Birds, which distill gameplay down to a series of swipes, but there's no getting around the fact that you can do a whole lot more with buttons. The PlayStation Vita also has capacitive multitouch (by the way) but the real standouts are the dual analogue sticks and full complement of face and shoulder buttons.

Want an example? Try playing Street Fighter 4 on the iPhone 4S and Ultimate Marvel vs. Capcom 3 on the PlayStation Vita. Both are ports of fighting games, but the former is a crude, oversimplified imitation, while the latter feels like the same exact game on a smaller screen.

**Winner:
PlayStation Vita**

Round 3: Hardware

It's difficult to directly compare the internals of the two systems, as neither Apple nor Sony have been very forthcoming about the exact specifications of the chips that run them: the iPhone's dual-core A5 system-on-a-chip and the Vita's quad-core ARM proc. Both systems feature PowerVR SGX GPUs—though, again, the iPhone's is dual-core, while the Vita's is quad. Both the iPhone 4S and PlayStation Vita have 512MB of RAM, and you can get the iPhone 4S with 16, 32 or 64GB of internal storage. The Vita can also be configured with 16, 32, or 64GB of storage, though it requires an additional purchase of a (new, proprietary, expensive) memory card.

In terms of overall build quality, the iPhone 4S is clearly superior. The Vita is a lovely device, don't get us wrong, but it's entirely plastic and just doesn't feel as solid as the metal-and-glass iPhone.

Winner: iPhone 4S

Round 4: Software

Comparing the software available on the two platforms is a matter of breadth versus depth. The iPhone 4S, with its 500,000 (and counting) apps has more games than you could play in a lifetime. And lest this be confused with a quantity-versus-quality argument, a lot of them are quite good. Polished, clever, and addictive, iPhone 4S games can be a great way to kill five minutes or even an hour.

But still, they're not *deep*. You won't find a game like Uncharted: Golden Abyss or Rayman Origins on the iPhone. These Vita titles are full-featured, console-quality experiences available on the go. Unfortunately, the launch lineup has some all-stars (all the games mentioned in this article, for instance) but also a lot of duds. Only time will tell what size of game library we can expect from the Vita in the years ahead.

**Winner:
PlayStation Vita**

HEAD

The iPhone isn't specially built for gaming, but it (or a smartphone like it) is probably already in your pocket.

The PlayStation Vita is the most sophisticated portable gaming console ever released—but does it still have a market?

Round 5: Other Features

So far, we've been comparing the two devices strictly as gaming platforms, but both include a lot of non-gaming features. Both are media consumption devices, for instance, with applications for listening to music and watching video. The Vita does this job just fine, though it can't compete with Apple's iPod heritage and wealth of content streaming and discovery apps.

Both also feature front- and rear-facing cameras. The iPhone 4S's rear-facing camera is quite possibly the best smartphone camera currently available. The Vita's... well, the less said about the Vita's cameras the better. Suffice it to say, you won't be using these for anything but augmented reality games.

And, of course, there's the fact that the iPhone 4S is also a phone, and has a wealth of useful non-game apps—a counterpoint to the fact that the iPhone is significantly more expensive, taking the price of a phone contract into account.

Winner: iPhone 4S

And the Winner Is...

If the **PlayStation Vita** couldn't distinguish itself as a gaming platform that's clearly superior to the iPhone 4S, it would be in big, big trouble. Fortunately for Sony, it's clear that the PlayStation Vita is simply the best way to play real, high-quality games while you're away from home. Games look better on the Vita's giant, colorful screen, and the array of physical controls opens up the whole world of responsive, fast-paced gameplay. You're not going to find the same buffet of almost-free, play-and-forget games that you see on the App Store—but you will get the kind of in-depth gaming experience you used to only be able to get on a console, anywhere you go.

DOCTOR

THIS MONTH THE DOCTOR TACKLES...

> Motherboard Swaps
> Too Many Cores
> Understanding Trim

Getting Ready for the Move

I switched the motherboard on my PC from an Nvidia 680i SLI to a BioStar motherboard (I don't remember the model number). Of course, this motherboard isn't like the 680i at all. I plan on buying another motherboard that fits my Core 2 Quad Q6600 CPU. Is there anything I should do in advance before changing motherboards? I want to keep all my data on my both of my hard drives.

—Anderson Wu

THE DOCTOR RESPONDS: You didn't say whether your data was kept on separate physical drives, or if you had one drive with two partitions. You should always consider a clean install when replacing your motherboard, but the Doc understands why you wouldn't—sometimes you don't want to deal with the hassle of reinstalling all your software. The Doctor does recommend you back up your data onto a separate external drive before you go any further.

Sometimes moving from one board chipset to another works perfectly fine, and other times Windows will blue screen when you try. If you want to pursue an in-place board swap, make sure you boot into Safe Mode while on the old platform and uninstall all the chipset and device drivers from Windows. Then power down, swap motherboards, power up, and install the new

motherboard's drivers. We've seen this work before, so it's worth a shot. Again, make sure your data is backed up first.

One other thing to consider: You may have to reactivate Windows with the new install, as activation will trip over the new NIC and various other hardware changes. We know readers complain that we mention this too much; but if you purchased an OEM copy of Windows, there is a slight chance Microsoft will deny reactivation, as OEM copies are technically tied to the motherboard.

Too Many Cores?

A friend of mine cannot install 64-bit Windows 7 because it blue-screens during the install process. He has a Core i7-2600K on an MSI H61M-P21 (B3)

motherboard. He has been able to trick the installer; if it only sees one, two, or three cores, it installs fine. But once he re-enables all four cores, it craps out. The 32-bit version of Window 7 works fine, XP works fine. Linux installs and runs fine. Microsoft won't help him, since he has an OEM version of Windows 7.

—Monty

THE DOCTOR RESPONDS: The Doctor has installed Windows 7 on more than 300 different makes of motherboards and systems, with as few as one core and as many as 12, and has never, ever seen this one. That doesn't mean the problem doesn't exist, though. Some people have reported multiprocessor issues with Windows 7—but most of those cases seem

confined to older hardware. Your board was produced when the Core i7-2600K was released, so there's no reason for the two not to work. The Doctor first recommends that you get another Windows 7 disc and try that. Dirty, scratched, or badly burned Windows 7 installer discs can cause all kinds of sporadic problems. If you are burning the disc, try burning it at a slower speed. If that doesn't clear up the issue, consider updating the BIOS. Perhaps your board has a pre-production BIOS on it that doesn't like the 2600K. It's a rarity, but you can't rule out a BIOS update. The Doctor recently had a case where a motherboard would simply not install a USB Wi-Fi device until the BIOS was updated.

Trim Out the Mystery

I purchased a 64GB Samsung 830 Series SSD and was really excited that this new drive had support for Trim. My old SSD did not, and the performance was lackluster at best. But in looking for information about Trim online, I have found so many different answers for what feels like a very simple question: What is required for Trim to work? I have read that you need a compatible OS and SSD, which I have. I have also read that your SATA controller needs to support Trim, your BIOS needs to be up to date, and your SATA controller has to be in AHCI mode instead of IDE. I was
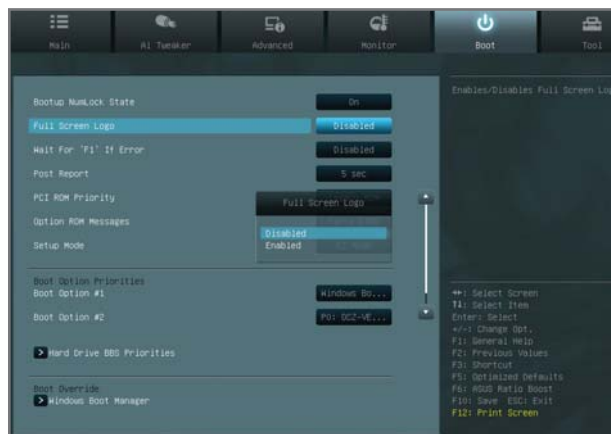
Use your BIOS's X.M.P. setting to auto-detect and set your RAM timing.

↘ submit your questions to: doctor@maximumpc.com

overwhelmed. So I looked for a simple software package that could tell me if my system supported Trim. No luck. The tools I did find were only able to tell me if my SSD supported Trim and/or if it was enabled in Windows 7—not whether it was actually working. Help! Usually I can find the answers with a little bit of study on my own, but I have been so overrun with misinformation that I can no longer see the forest for the trees. Give it to me straight! Am I Trim-ready with a compatible OS (Windows 7 x64) and an SSD with Trim support, or do I need more? My motherboard is an MSI Eclipse SLI.

—**Garn**

THE DOCTOR RESPONDS: The ICH10R south bridge on that X58-based board does support Trim if you're using the latest Intel chipset drivers and RST drivers (which you can get from MSI's website). Make sure you're using the Intel SATA drivers and not the native Microsoft ones that Win7 auto-installs, and that your SSD is plugged into one of the SATA ports controlled by the south bridge—those are the six black SATA ports mounted just above the IDE port on the right edge of the motherboard. In the BIOS, make sure those ports are set to AHCI mode. If all that is the case, Windows should automatically send Trim commands to the SSD. Simple, right?

Many Questions, Few Answers

I'm building my first PC, modeled after the Battlefield 3 PC article in the Holiday 2011 issue of *Maximum PC* (but swapping in a Core i7-2600K for the 2500K). What speed and capacity should I look for in RAM? I am considering Corsair Vengeance 16GB (4x 4GB) 1600. Intel says the i7-2600K is set up for 1,333MHz at max. I know the Asus mobo will recognize the RAM, but will the processor now be a bottleneck? Also, how critical is it to adhere to the memory QVL lists in the Asus manual? Lastly, what's the deal with XMP? Can I utilize the mobo XMP profile with all four DIMMs?

—**Charles Parker**

THE DOCTOR RESPONDS: The bare minimum amount of RAM you should run today on a dual-channel rig is 4GB, with 8GB being pretty standard. Going beyond 8GB doesn't get you much bang for your buck, unless the app you use or the multitasking you do requires the extra RAM. However, RAM is so cheap now, it's hard not to want to load up, so the Doc understands if you opt for 16GB. As for speed, the Doctor has found that with the latest high-performance CPUs, additional memory bandwidth can actually help in some encoding tasks; a DDR3/1600 set is probably all you need. Core i7 isn't officially rated for DDR3/1600 and up, but it'll run fine all day—Intel is just being hyper-conservative. And yes, your CPU is the bottleneck on many tasks, just as your HDD and GPU will be in others, but don't worry about it.

QVL, or qualified vendor lists, are important if you're going to run the board with a full load of RAM at the highest possible speed. So if you want to run four XGB DIMMs at X speed, and want to be 100 percent sure they'll run, defer to the QVL list. For standard RAM configurations, though, you'll be fine 95 percent of the time, as long as your capacity and speeds are supported by the motherboard.

XMP is Intel's Extreme Memory Profile spec, which makes it very easy to overclock your RAM. In the olden days, if you wanted to run your RAM at a certain speed and timing, you had to manually input the timings into the machine's BIOS. With XMP, all you have to do is tell the BIOS to run your shiny new modules at, say, DDR3/1866, and it'll pull the information from the RAM's SPD, or Serial Presence Detect and automatically run the speeds outlined by the module maker. ⏻
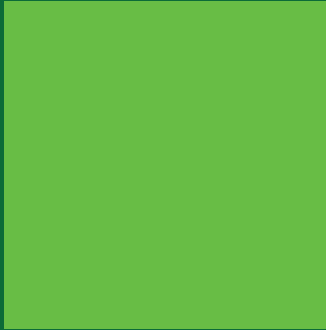
USE WINDOWS 8 TODAY!

By David Murphy

WITH THE WINDOWS 8 CONSUMER PREVIEW, YOU DON'T NEED TO WAIT AND WONDER WHAT MICROSOFT'S NEXT OS WILL BE LIKE—WE'LL SHOW YOU HOW TO DIVE RIGHT IN, NOW!

WELCOME TO WINDOWS 8, otherwise known as the future of your desktop. To some, it's known as a big, fat headache, a misdirection on the part of Microsoft in its quest to unify the Windows experience across all devices—smartphones, tablets, laptops, desktops, you name it.

But you needn't take anyone's word for it. You can judge for yourself, now that Microsoft has released the Consumer Preview of its latest operating system for the masses to enjoy (or criticize). This release sits somewhere between the delicate states of Final and Beta, which is a polite way of saying you can download and test it out for free right this very moment. But hold your breath if you find a feature that's a wee bit underdeveloped or buggy: Windows 8 isn't set in stone, although it's expected to reach store shelves by 2012's holiday season.

We've rolled up our shirtsleeves and jumped into the best and worst parts that Windows has to offer, so feel free to use this article as a helpful guide for your first steps into Windows 8. We'll show you how to install the operating system without ruining your current Windows environment, then we'll take you on a brief, guided tour of the parts of Windows 8 we love and the parts... well, let's just say the Metro UI takes some getting used to, OK?

We'll give you a glimpse of some of the more useful apps you can download—even as previews—from the Windows Store. And then we'll wrap it all up with some predictions for Windows 9 and beyond. Here's a spoiler: The odds of Metro going away are about as likely as Microsoft acquiring Apple and building the iWindow.

Got it? Wave one final goodbye to the Start button, and let's begin!

How to Install Windows 8 Consumer Preview

Install

To keep your existing OS intact (which we hardily recommend), you can either dual boot or use a virtual machine

You like using your current operating system. In fact, you probably have a great number of files, applications, and games all inter-twined with your current operating system. And the absolute last thing you want to do is back up everything within your operating system, wipe your drive, and introduce a fresh-faced—and not yet final!—Windows 8 into your life as your primary OS. You have two options when it comes to testing out Windows 8 without mucking up your primary Windows installation, settings, files, or any of that: You can split your current hard drive storage setup to create an extra, blank partition—Windows 8 goes there. Or, if you just want to monkey around in a self-contained environment within your current operating system, you can install Windows 8 onto a virtual PC.

Which option you choose is a matter of preference. A dedicated installation on a new partition, or dual-boot scenario, gives Windows 8 the full attention of your system's mighty resources. The downside? You'll have to suffer through the boot menu every time you load your PC; you won't be able to access your true "primary" operating system from Windows 8; and any changes (or issues) you create are permanent, as you don't really get a chance to "roll back" that which you've done.

Virtualization, on the other hand, costs you system resources and overall speed—it can be a real hog—but it allows you to marry Windows 8 to your existing operating system. Transferring files is easy; jumping between the two operating systems is easier; you can test out apps in Windows 8 and still be able to use them in your existing OS if things go sour; and, most importantly, you can quickly revert to prior versions of the OS and easily delete your virtual Windows 8 once you're done toying around.

Here's how you do both:

DUAL-BOOTING: Before creating a new partition on an existing drive, it's a good idea to back up your data, just to be safe. Now grab the Windows 8 Consumer Preview setup file (bit.ly/AC9D52) and give 'er a run. While your version of the operating system downloads (32-bit or 64-bit, depending on what the setup program picks for your PC), go check your available hard drive space in Windows Explorer. You'll need to have at least 16 gigabytes free for a 32-bit installation of Windows 8, or 20 free gigabytes for a 64-bit installation.

Once the download is completed, Windows will prompt you to install Windows 8 by giving you three options to pick from: Install now, install on another partition, and install later. Pick option number two (partition), and the subsequent screen will ask you how you want to go about creating the installation media you'll need to use (image A).

We recommend that you use a USB key for a Windows installation whenever possible (it's just so speedy), but some older motherboards have iffy support for USB-based installations. So you might need to choose the optical disc option.

The setup program will automatically format your key and slap the necessary files on it. As this process chugs along, fire up your control panel (Windows 7 users), go to System and Security, then Administrative Tools. Now double-click Computer Management, and then select the Disk Management option from the left-hand menu. Roll up your shirt-sleeves: It's time to partition your hard drive (image B).
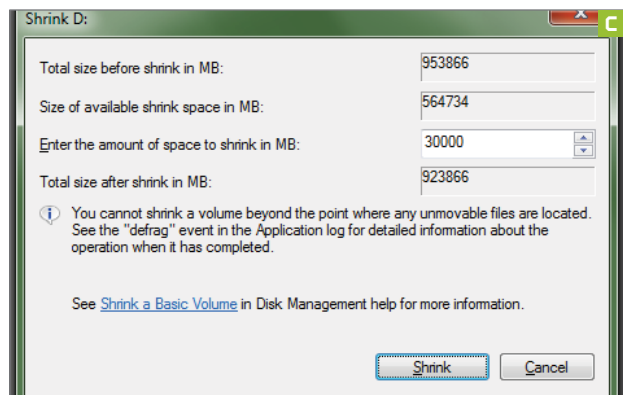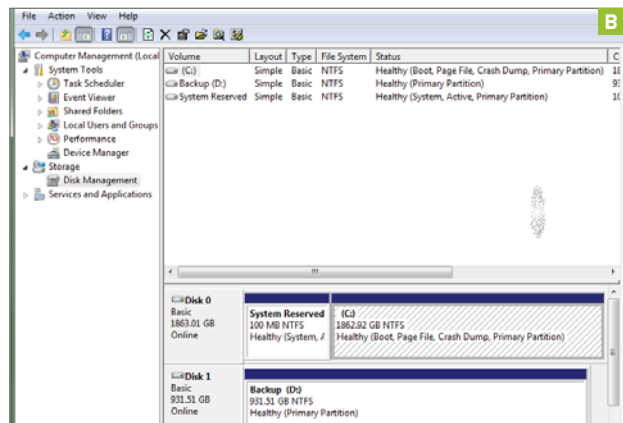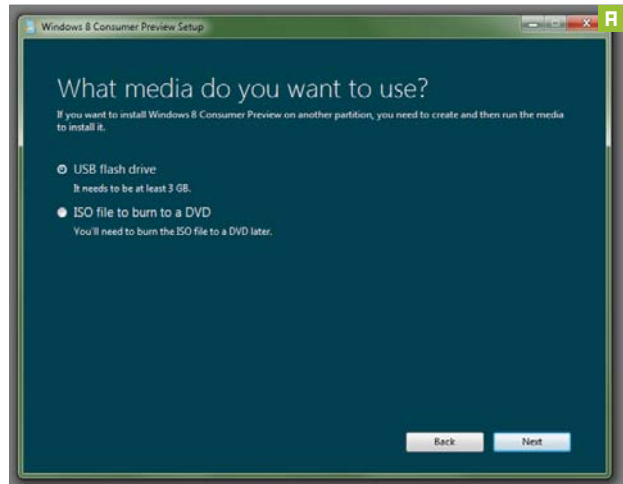
Everyone's hard drive setup can vary, so we'll just walk you through the basics of splitting a single drive partition into two. Right-click the graphical storage "chunk" that's home to your primary NTFS volume (C: for you, but we're using our spare drive D: for the purposes of example) and select Shrink Volume. Input just how much you want to shave off your primary operating system's partition—remember, 1,024 megabytes equals one gigabyte—and hit the Shrink button (image C).

What do you get? A new chunk of black, unallocated space to the right of your once-larger primary partition. Right-click this empty space and select New Simple Volume. The prompts are fairly self-explanatory after this point—just make sure to give your new partition a recognizable name and format it as an NTFS partition. Voilà. You're ready to install Windows 8.

Once the Windows Consumer Preview setup program has finished with your USB key, restart your computer. As it reboots, watch your boot sequence for any prompts related to "booting" or "boot order"—in our case, we only have to hit the F12 key to access a "boot from" menu. But since your motherboard is surely different, this option might be mapped to another key. Or, worse, you might have to go into your BIOS settings and change your system's boot order. If in doubt, check your motherboard manual.

Select the correct option—USB HDD, in our case—reboot your computer, and the official Windows 8 installation program should automatically fire up. Click the Install Now button, enter you product key (that you received when creating your USB Windows 8 installer), accept Microsoft's license terms, and select the option for a Custom installation. Pick the partition you previously created (hence the importance of giving it a memorable name), click Next, and go make yourself a pleasant beverage while you wait for the installer to work its magic.

From there, it's all downhill: Windows 8 will reboot your system a few times before the installation finishes, and it'll then ask you a series of questions to help you personalize your operating system prior to the first official run. One last tip, however: When you go to reboot your system to actually *load* Windows 8 for the first time, take out your USB key during your motherboard's boot sequence. If not, and if you set your system to always boot off any available USB devices before your hard drive, you'll find yourself continually looping back to the Windows 8 installation program. That's just silly.

VIRTUALIZING: Who needs partitions when you can just run your new operating system *within* your operating system? Once you've downloaded the Windows 8 Consumer Preview installation files and the setup program is asking you where you'd like to slap 'em—on a USB key or as an ISO file to burn to a DVD—you're going to pick the ISO option. Save the ISO file somewhere on your computer, but don't go reaching for the DVDs just yet—no need.

Head on over to the official website of the (free) virtualization software Oracle VM VirtualBox (bit.ly/iiEJOZ) and download the setup file. Why aren't we using Windows Virtual PC, you Windows 7 users might ask. Simple: It doesn't support 64-bit installations of operating systems; plus VirtualBox has support for 3D graphics, which will make for a more satisfying Windows 8 experience.

Once you've installed VirtualBox, click the big ol' New button in the app's upper-left-hand corner. Enter a good name for your virtual machine on the next prompt and make sure that both Microsoft Windows and Windows 8 are selected within the corresponding OS Type drop-downs (image D).

From here, there aren't a lot of options you really need to edit—you can pass through most using the default options that VirtualBox has already selected on your behalf, save for those we mention below.

Click Next until you're given a slider that asks you to adjust how much memory you want to assign to your virtual operating system. Windows 8 requires a minimum of one gigabyte to run; if you can spare it, up your virtual machine to at least two gigabytes, or 2,048 megabytes (image E).

Now, where are you going to physically store your operating system's files? On a virtual hard drive, of course! The option to "Create new hard disk" is selected by default once you reach VirtualBox's Virtual Hard Disk screen. That's great. Click Next until you reach the screen where
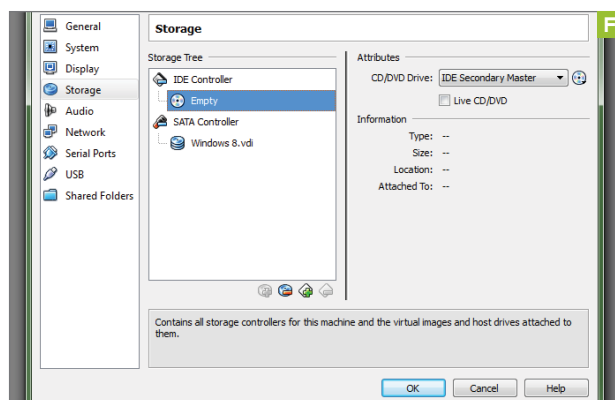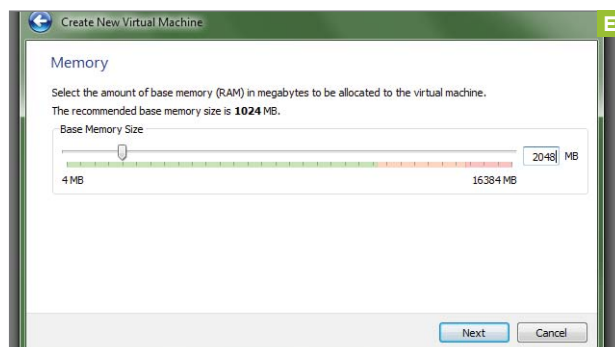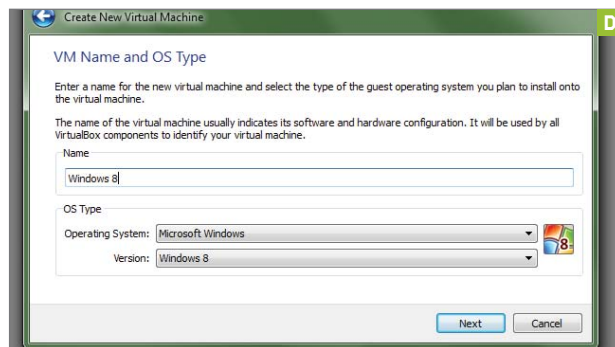
you're asked to set your hard drive's size. Remember: 16 gigabytes minimum for a 32-bit installation, 20 gigabytes minimum for a 64-bit installation. Adjust your size as you see fit, then click Next (selecting all the default prompts from that point forward) until you're taken back to the main VirtualBox Manager screen. Almost there!

Highlight your new Virtual Machine and click the big Settings icon above. While you can fiddle with a number of advanced settings to boost the performance of your Windows 8 installation—like adding support for more of your CPU's cores within the System menu—the most critical action you need to perform is mounting the ISO you previously made in order to install the OS.

Click the Storage option on the left-hand menu in the Settings window. Under IDE Controller, it should say Empty next to an icon of a CD. Click Empty. Then, click the icon of a CD that appears next to the CD/DVD Drive drop-down menu on the right portion of the Settings window. Go find your ISO file. Click OK to mount the disc and exit out of the Settings window (image F).

Ready? Click the big green Start arrow after you've clicked on your Windows 8 virtual machine. Run through the Windows 8 installation process (it's easy, since you're just custom-installing the operating system to a single virtual hard drive), run through the Windows 8 personalization process, and enjoy your new OS within an OS.

Tips

15 Windows 8 Tips and Tweaks

To Windows regulars, Win8 might feel like a totally foreign—and not altogether friendly—land. Here are some pointers for getting oriented

1 HOT CORNERS ARE YOUR FRIENDS If you're a bit befuddled the first time you fire up Microsoft's newest operating system, we understand. Microsoft has left a number of navigational elements invisible to your eye unless you move your mouse over one of the four extreme corners of your screen. Hover your mouse over the top-right or bottom-right to access the Charms Bar: Windows 8's built-in Search and Sharing capabilities, as well as a list of devices you can send the contents of the current app to and Windows 8's ever-important Settings menu. Hover your mouse over the top-left or bottom-left corners of your screen to jump between open apps on Windows 8's Switch List, just like you would otherwise do by hitting the combination of Alt + Tab on your keyboard.

2 METRO: JUST TYPE IT! When you're in Windows 8's Metro UI and you want to load an app, don't bother moving your mouse around the screen or trying to scroll your way to wherever it is you've placed the app's tile icon. Just start typing. Literally—start typing. You don't have to go find the search button or any of that: Windows 8 will try to find anything you type, be it "solitaire" or "control panel," or what have you.

3 HOT FOR HOTKEYS Unless you're rocking a touchscreen PC, navigating your way around the Metro UI (and its horizontal-friendly apps) can be a bit of a drag. So don't use your mouse; use your keyboard. Check out some of these helpful hotkeys for flying through the OS and controlling its many elements:
WINDOWS KEY + TAB – Opens the left-hand Switch List.
WINDOWS KEY + C – Opens the right-hand Charms Bar.
WINDOWS KEY + I – Opens your ever-important Settings menu.
WINDOWS KEY + T – Dumps you back to Desktop Mode and cycles through your open windows on the taskbar.
WINDOWS KEY + LEFT/RIGHT ARROW KEYS – Docks the app to the left, middle, or right side of the screen with each press.
WINDOWS KEY + M – Jumps to the Desktop and minimizes all applications.
WINDOWS KEY + Q – Opens up Windows 8's global search utility within Metro.

4 THE PC SETTINGS PANEL IS YOUR BEST FRIEND In its infinite wisdom, Microsoft has decided to split the options you can configure on Windows 8 between the contents of its typical Control Panel and a new Metro-based Settings menu, which can be accessed by going to the Charms

8 THINGS WE LIKE ABOUT WINDOWS 8

1 LINK UP We applaud the company's efforts at reaching out to other popular third-party services for super-easy integration of email and contacts into Windows 8's default apps.

2 SYNC UP For folks who enjoy being able to tap into their data wherever they are, Microsoft's SkyDrive integration within Windows 8 is a perfect complement to the synchronizations the OS can perform when your Microsoft Account and Windows 8 user account are one and the same—allowing you to pull up your apps, preferences, people, etc., on any Windows 8 computer you log into.

3 STORAGE SPACES: NEWBIE RAID Storage Spaces greatly simplifies the process of combining storage of all kinds—physical hard drives, solid-state drives, external hard drives, and flash storage—into giant pools of available storage. You can take away drives, add drives, and swap drives in and out: Microsoft says that a "resynchronization" process will rebuild the two-way mirror, three-way mirror, or parity of a pool, or what you'd otherwise see in your typical Windows environment as a single storage volume (e.g., C:\).

4 GREAT REASON TO BUY AN XBOX 360 You know a feature is going to be a big deal when we get this excited about it *and it doesn't even work in the Windows 8 Consumer Preview*. By that, we're referring to Microsoft's planned integration with users' Xbox 360 gaming consoles. In short, it appears that Microsoft wants to break down the wall that separates console gaming and PC gaming by allowing gamers to stream the

Bar's Settings option and clicking the slightly buried More PC Settings link. Here's where you'll be able to adjust your lock screen's background, Metro's colors, how notifications and Windows 8's built-in search work, the names of the attached devices Windows 8 has found, and your specific synchronization settings, among other important options.
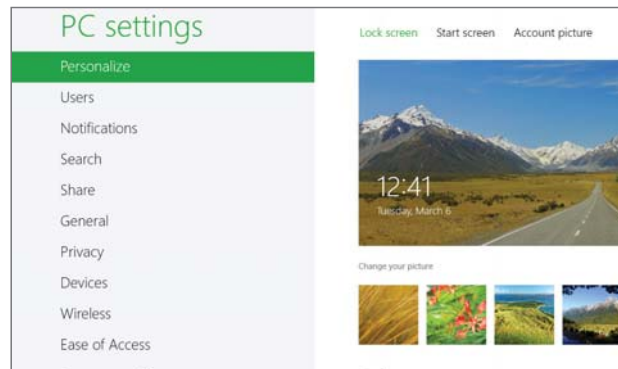
5 WINDOWS 8 VS. DISASTER Well, you've gone and done it. Either as a result of something (or things) you've installed, some setting you've mucked up, or just general apathy toward the well-being of your PC, Windows 8 doesn't work right anymore. In Windows past, this would normally force you to take a trip down reinstallation lane. That part hasn't changed, but Windows 8 now makes it really easy to return a broken operating system to happiness once again. Click the General tab within the aforementioned More PC Settings menu. The Refresh option strips your system of the third-party apps you've installed and returns it to factory-default settings, but keeps your User files. The Reset option wipes your operating system clean of all your data and returns your system to Windows 8's factory-default settings.

6 ENABLE SAFE MODE Speaking of computer disasters, if you want to reboot your system into Safe Mode, you can't just jam on the F8 key prior to Windows 8 loading: You have to first enable Safe Mode itself. Type "cmd" on your Metro UI, right-click

the Command Prompt app (called cmd), and select to run it as an administrator. Then type `bcdedit /enum /v` on the command prompt screen and hit Enter. Copy the entire "identifier" string (including the braces) for the entry that has "Windows 8 Consumer Preview" as the description, not "Windows Boot manager." Then, type the following into the command prompt: `bcdedit /youridentifierstring /d "Windows Developer Preview (Safe Mode)"` and hit Enter. After that, type in `msconfig` and hit Enter.

Within the System Configuration menu, click the Boot tab and select the entry called Windows Developer Preview (Safe Mode). Click the Safe Boot option, the Make All Boot Settings Permanent option, click OK, and click Yes. Restart your system, and you'll be given the option to launch either your normal Windows 8 environment *or* your new Safe Mode environment.
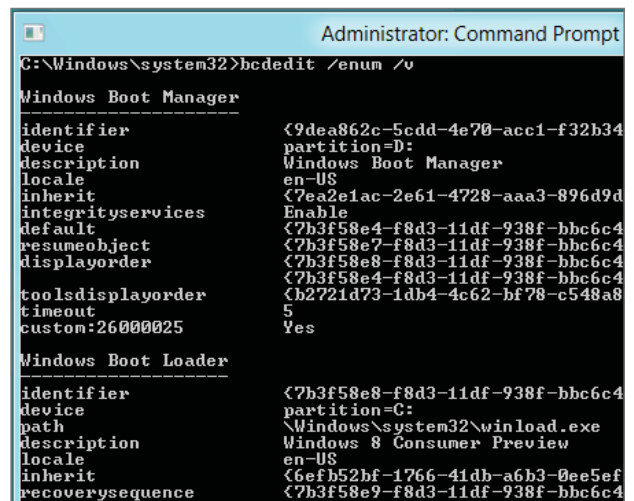
7 BE A SUPER-ADMINISTRATOR IN ONE CLICK Here's a great hidden tidbit of Windows 8: Move your mouse cursor to the lower-left corner of Windows 8's Metro or Desktop mode until it pops up the live thumbnail of the alternate environment. But don't left-click; right-click. You'll pull up a

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multimedia contents of their systems to their consoles (and attached televisions), and stream their games from their consoles to their PCs.

5 BELLS AND WHISTLES A number of the fun little improvements found within Windows 8 are mostly cosmetic—too small to warrant individual mention here, but still worth calling out in aggregate. While much can be said about Windows 8's split Classic Desktop/Metro UI interface, we love-love-love some of the tweaks that Microsoft has put into cornerstones of the operating system.

6 SPEEDIER STARTUP AND SHUTDOWN We can't speak to the overall "snappiness" of Windows 8, as we'd be comparing an application-packed installation of Windows 7 to a barebones, fresh installation of Windows 8. But we *can* (and did) compare the two operating systems' startup and shutdown times.

On a fairly antiquated laptop (by today's standards), Windows 8 beat Windows 7's shutdown time by a full 10 seconds, taking just 17 seconds from the press of the Shut Down button to a powered-off state. From the press of the power button to the Windows 8 Lock Screen (or Windows 7

login screen), Windows 8 took just 32 seconds. Windows 7? Almost a full minute (51 seconds).

Why such a dramatic difference? Windows 8 slaps the kernel into hibernation mode when you shut down the system, saving your system from having to reinitialize it on the next boot.

7 SENDING EXPLORER TO THE OFFICE Fire up Windows Explorer within Windows 8, and you'll swear you've accidentally launched Microsoft Office 2007. That's right: The ribbon is here. Or, to say it another way, Microsoft has finally started taking steps to unify its user interfaces across its major applications. Amen.

8 STRONGER SEARCH We were fans of Windows 7's speedy indexed search capabilities, but Windows 8 ups the ante by adding a lovely looking (and lovely functioning) search screen directly within the Metro interface. And here's the fun bit: You don't have to click anything at all to start searching. You need merely start typing the app you're trying to find. Boom! Up pops Windows 8's search window.

menu of shortcuts to a bunch of handy power-user options, including Command Prompts, your Disk Management window, and your System menu, among others.

8 HATE METRO? Here's a fun one. Fire up Windows Explorer and navigate to your Windows directory. Do a search for "shows desktop," and copy the shortcut that you find into the following location: C:\Users*username*\AppData\Roaming\Microsoft\Windows\Start Menu\Programs\Startup. By doing so, you'll ensure that Windows 8 always boots to the Classic Desktop instead of its Metro UI.

9 FAST-UNINSTALL APPS Looking for a quick way to nuke any Windows Apps or third-party apps you've installed on Windows 8? Just right-click the app's icon within Windows' Metro UI and select Uninstall. Third-party apps will jump you to the good ol' Windows Programs and Features window for the same ol' Windows uninstallation routine you should be used to by now. Apps downloaded from the Windows Store will simply disappear. Poof!

10 HATE PASSWORDS? Passwords are important, especially if you're using Windows 8 to share files within a network. For important files and directories, you're going to want to make sure that only those with user accounts on your system can access your files. Or, if you're extra security-conscious, you're also going to want to make sure your system is password-locked whenever you step away from your desk (via Windows' Lock Screen).

But what if you don't like having to type in your password each time you boot your computer? You can remove this part of the process—but still use your password to protect other parts of Windows 8—by hitting Windows Key + R and then typing "netplwiz" into the Run window's field and hitting Enter. Uncheck "Users must enter a user name and password to use this computer" and click OK.

11 BYPASS WINDOWS' DEFAULT APP CHOICES Some of the new apps built directly into Windows 8's Metro UI are of questionable usability—here's looking at you, Video app. But it's equally frustrating to have to use an "open with this app" command whenever you want to pull up a new file format.

Our solution? Edit your file-opening preferences in one big batch. Type "default programs" within Windows 8's Metro UI and click the corresponding link that appears. Select "Set your default programs" and have at it—each program will tell you how many extensions it *can* open versus how many it *is* opening, just to give you a sense of your batch-processing power.

12 TASK MANAGER IS AWESOME One of the better upgrades in Windows 8 is to Task Manager. Load it up by typing "task manager" in Metro (or give your system the three-finger salute), then click the More Details link at the

8 THINGS WE HATE ABOUT WINDOWS 8

1 BRING ON THE ADVERTISEMENTS Microsoft does plenty to integrate its virtual storefronts into the OS at any cost. Case in point? The Video app. The first thing you'll see upon launching it is not a gallery of your videos, or a top-20 list of local videos you've watched, or anything like that. No, you get a spotlight of all the quote-unquote awesome content you can purchase from Microsoft directly.

2 WHERE THE HECK AM I? Since Windows 8 is like Windows 7 with a fancy new tablet design bolted onto the side, Microsoft has done an amazing job (not!) of splitting important content and op-

tions between the two different environments. In essence, you set up your system settings in two different settings locations. And while we see how that might work on paper—Metro settings follow Metro, Desktop settings follow Desktop— this walled-garden approach is unnecessary. Settings are settings; if you can't adjust Metro in Desktop, Microsoft should at least give users a better way to access each environment's settings options from the settings panels of the other.

3 STRAPPING A BOMB TO A MONKEY The Windows Metro UI could not feel any more like its own operating environment that's been strapped, rather crudely, onto the back of Windows 7.

Sure, there are a few cosmetic upgrades to the classic desktop—many we like, in fact. That doesn't remove the disjointing effect of having to constantly shift your focus between a svelte, common experience and a graphical monstrosity.

Shoot, plugins aren't even supported on the Metro version of Internet Explorer. You have to select the "View on the desktop" option, hidden beneath a wrench icon near IE's Metro address bar, just to watch a freakin' YouTube video. *Come on.*

bottom of the window. Up pops Window 8's new-and-improved Task Management program.

Of particular interest is the prettied-up Performance tab, which reveals the last 60 seconds of your system's CPU, Memory, Disk, and Network use. A new App History tab gives you a look at just how many resources your apps eat up over a lengthier period of time. And the ability to enable or disable apps that start with Windows itself has been moved from Windows' System Configuration menu to the Task Manager's Startup tab.

13 **MANAGE THY TILES** Want to move tiles? Easy: Drag them around. Want to move a tile to its own column? Drag it on over—it's exactly how you form new groups of apps. Want to shuffle an entire column's worth of tiles around? First, click the magnifying glass icon in the lower-right corner, and then move away. And although you can select multiple tiles by right-clicking each one, you can't move a number of tiles *en masse*. Sorry!

Finally, resizing tiles—those that can be resized—is as easy as right-clicking the tile and selecting the Smaller or Larger option.

14 **SYNC UP** Windows 8 comes with a plethora of ways to synchronize your operating system to all the various third-party accounts you hold on other sites. The most important one

to link up is your Microsoft Account, which you can do when you set up Windows 8 for the first time *and* via the Users menu within PC Settings (Charms Bar > Settings > More PC Settings). By doing so, you'll be able to load your preferred themes, settings, languages, and app settings—to name a few—on any Windows 8 machine you touch. Your Microsoft Account also powers Windows 8's SkyDrive cloud storage, for what it's worth.

But that's not all. You can integrate your Hotmail, LinkedIn, Google, Facebook, and Twitter accounts with Window 8's People application. And, if it works, you can chat with your Facebook and Windows Messenger friends via the aptly named Messaging application.

15 **SHUT DOWN** One of the more peculiar features of Windows 8 is how Microsoft buried the shutdown button within its Metro UI. You can always switch over to Desktop mode and give it the ol' Alt+F4 to receive your shutdown options. But you can also create an actual shutdown tile that accomplishes the same effect in Metro.

Within Desktop mode, right-click the desktop and create a new shortcut. For its location, you'll want to type in the following: shutdown.exe -s -t 00. Feel free to name the shortcut whatever you want ("Nuke it from orbit"?). Once it's on your desktop, fire up Windows Explorer and move the shortcut to your C:\ProgramData\Microsoft\Windows\Start Menu\Programs directory. Jump back to your Metro interface and you'll see your Shutdown button appear as a brand-new tile. Click once, and off goes your system!

8 Best Apps from the Windows 8 Store

Apps

You can pick up these programs right now, within Microsoft's store, and install them directly into Metro, like apps onto a smartphone

1 CUT THE ROPE In Cut the Rope, which has a striking similarity to Angry Birds—just replace "catapult physics" with rope-cutting—your goal is to capture stars with a piece of candy. The candy dangles from a rope (or many ropes), and how and where you cut the rope affects its height and ability to sway into other objects (like stars. Or a frog's mouth). You'll figure it out; trust us. And you won't stop playing, either.

2 EVERNOTE Evernote is designed to be the digital archive of your various "notes to self"—as well as any other documents, images, and other such attachments you want to keep tabs on. The Windows 8 app (in preview) only accepts text notes right now, but it does synchronize these with any other device you've installed Evernote on. And you can still view other elements (like pictures) that you've placed into notes using other devices; you just can't put them there yourself on Windows 8.

3 COOKBOOK Cookbook is a perfectly designed application for Windows 8's Metro UI. It delivers just enough useful information (recipes and cooking instructions) without seeming sparse. It displays adequate illustrations of the food you're trying to make without turning the app into one giant picture and caption combination after another. Our only qualm is a big one: No search. Hopefully a big fat tie-in to Windows 8's type-anything-in-Metro search tool makes its way to this app—otherwise, it's just a tad under-flavored.

4 NEWS REPUBLIC Like many apps gracing the Consumer Preview of Windows 8, News Republic shows a lot of promise, but it's not quite up to the standards one can enjoy from other apps on, say, one's tablet PC—in other words, it's no Pulse or Flipboard. But as a fairly nondescript news reader, News Republic performs well. Adding new topics you want to follow is as easy as searching for them using Metro's app-contextual search. And once you have your favorites set up, you need merely click into each category to see what the news of the hour happens to be.

5 SIGFIG Although we're slightly annoyed that we have to first register for an account to use this stock market-watching application, it makes complete sense once you see the power of SigFig in action.

Connect your brokerage account to the app, and you'll get easy access to your portfolio via Windows' Metro UI—and more importantly, statistics and graphics related to your portfolio's performance.

While we'd love to also be able to research potential purchases via the app—or even make these sells and buys within the app itself—SigFig doesn't disappoint when it comes to presenting key financial information in a digestible (and pretty) fashion.

6 GRANTOPHONE Sorry, Windows 8 desktop and laptop users, but we had to throw at least one bone in this brief app roundup to your touchscreen-happy counterparts. Grantophone joins the throngs of different apps on the various smartphone markets that help you make funny sounds with your device. We're talking synthesized sounds that, if combined together, could get you one step closer to recreating your favorite
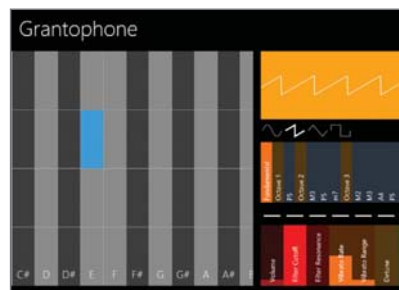
Daft Punk jam. To detail Grantophone's multitude of settings would take the rest of this article's space.

7 PIRATES LOVE DAISES It's not the greatest tower defense game you'll play, but it does have its enjoyable, swashbuckling moments. Like all tower defense games, you'll have no choice but to continue playing once you've started to build up your mighty pirate defenses.

8 SLAPDASH PODCASTS Slapdash Podcasts is to audio broadcasts what the aforementioned News Republic is to articles.

The Future of Windows

We hazard a few predictions about where Windows will go from here

How do you predict the future? It's easy: There's going to be a Windows 9 in a few years—unless Microsoft pulls an Apple and just goes with, "The New Windows," or "Windows," or something like that. As for what might be inside Microsoft's future operating system, however, that's a whole 'nother ballgame.

It's not that hard to get caught up in some childlike fantasy when asked to predict the future path of Microsoft's main OS. You know—Windows 9 will allow your desktop to transform into a giant robot, or Windows 9 will be an on-the-fly hybrid OS that transforms into a simpler version of Metro for free-floating tablet devices and the full-fledged Windows 9 when these devices are connected to a dock/keyboard setup.

Honestly, we kind of like the robot idea.

But let's get serious. What's likely to be the future direction of Microsoft Windows? Even considering that the general consumer reaction to Windows 8—assuming it's not just a Band-Aid for tablets while Microsoft devotes the core of its resources to a completely revamped version of the OS—will likely play a role in what Microsoft decides to do within its big follow-up.

ONE OPERATING SYSTEM. PERIOD

Since one can't mention Windows 8 without saying something about its Metro UI in the very next breath, here's the first prediction: Metro is just the beginning. The meeting ground, as it were. It feels as if Microsoft's grand goal is to unify its devices under a single operating system, similar to how there's always one story written about Apple every three months that suggests the company is on the verge of combining OS X and iOS.

So what are the benefits of transforming Windows into a hardware-agnostic platform? Easy: One look and feel for consumers, whether they're using their next-generation Xbox consoles, PCs, smartphones, or tablets. One development platform and unified APIs would allow apps and features to cross over between devices without demanding a huge chunk of developer resources. And, of course, apps could release faster (if not simultaneously) on all devices—great news for those used to waiting six months for a smartphone version of a new PC program to hit. To borrow a phrase from the late Sun Microsystems: "Write once, run anywhere."

We can't foresee how Microsoft might balance the simplicity of its Metro-style interface against the expansiveness of its classic Desktop interface—currently a sore point for those playing with Microsoft's squares for the first time. But we do think their roles will switch.

Microsoft will make Metro (or an equivalent tablet-style UI) the dominant measure of Windows 9, which will force the company to find some way to make a simple interface complex when it's warranted. Perhaps this will involve a tighter integration of Windows Explorer (et al) within Metro, versus the cop-out "switchy interface" treatment of Windows 9's predecessor OS. Perhaps Microsoft will turn over a rock and find a Jonathan Ive of software to make this difficult pairing possible.

IT'S JUST A SCREEN

Microsoft is going to do everything it can to pull devices together as tightly as possible underneath the Windows 9 umbrella. Your tablet won't just be an independent product, for example. It'll interact with your primary computer's Windows 9 installation as if it were your primary (or secondary) monitor. It'll be your Xbox controller or Wii U-style helper interface. It'll be your remote control—not just for interacting with other Windows 9 products, but the traffic cop for guiding data transfers and/or streams to the other Windows 9 devices you own.

I'm not talking about some souped-up tricorder fantasy where you can suddenly use your Xbox 720 to turn on your kitchen sink from three miles away. But based on Microsoft's brief experiments with "one screen for many purposes" in Windows 8, it's only fitting that the company extends this philosophy to cover even more scenarios (and more devices) with Windows 9. And maybe the company could even let consumers use their Kinect 2 motion-trackers to shift between screens or send their files flying around different devices.

THANKS, CLOUD. THANKS, VALVE

Another no-brainer: Windows 9 is going to be tied into the cloud. Just how much, though, is the big question. At the very least, you can count on deeper integration—perhaps even built directly into the filesystem—of Microsoft's SkyDrive-based hosting.

The time is not far off when cloud-based storage won't be a separate app you load within Windows or a folder you simply drop things into. It'll just be. You'll still be able to keep certain apps and mission-critical files on your desktop (for performance or security), but Windows' default storage mindset will switch from the local to the ethereal. (Plus, this would give Microsoft a way to upsell customers on virtual storage space and permanently tie them into the Windows family forevermore. Ta-da!)

Now, how much crazier we get with the cloud is anyone's guess. This includes everything from behind-the-scenes backups of your entire hard drive, to apps that run completely in the cloud and just require a minimal hook within your OS to function, to the real biggie: a cloud-based operating system. In the latter scenario—which would use techniques Microsoft's been busy patenting—you'd download or physically install just a small chunk of data required to actually boot an operating system.

The bulk of Windows 9 (or 10?) would live in the cloud—your device would be akin to a terminal, which makes us wonder how we'd approach software such as games: Would these run in the cloud as well and just stream an image to one's device? What happens when one's Internet connection is slow, jittery, or nonexistent? Does that mean your OS goes offline for good? Your videogame dude dies?

We could keep our heads in the hardware clouds all day long, if we'd like. But at the very, very least, here's hoping that future incarnations of Windows adopt a Valve-like approach to software.

A "buy once, run anywhere" concept could allow a user to authenticate into Windows 9 on any hardware device, and then just as easily download and run apps he or she has previously purchased via the Microsoft Store. Given just how app-centric Windows 8's Metro UI has become, it only makes sense to let users download (or stream) a Microsoft Office app, or a partner's Adobe Photoshop app, for example. The world is going digital distribution: Microsoft should, and will, embrace its conveniences for end users. ⏻

By Gordon Mah Ung

INTRODUCING
INTEL'S
IVY BRIDGE

WORLD'S **SMALLEST-PROCESS** CONSUMER CPU COMES OUT IN A BIG WAY

YOU ARE, NO DOUBT, quite familiar with Intel's CPU-release "cadence" of tick-tock by now. If not, the short story is that every tock brings a major breakthrough, while ticks are decent upgrades but nothing to Twitter home about.

That's not necessarily the case with Intel's latest tick, the Ivy Bridge CPU. Sure, the performance enhancements on the x86 side of the aisle won't exactly knock you on your tuchus, but they're still decent. The upgrades to the graphics core, however, make Ivy Bridge more noteworthy.

As we know, Intel found religion through graphics and has been progressively improving on it ever since. The Clarksfield CPUs moved graphics directly into the CPU package, and Sandy Bridge CPUs moved graphics directly onto the CPU die itself. With Ivy Bridge, Intel says it outdid itself by doubling the graphics performance of Sandy Bridge.

If you're ready to write off Ivy Bridge as an incremental chip that you, the enthusiast, don't need to give a damn about, you're wrong. There's a lot more to Ivy Bridge that makes it *the* default CPU for an enthusiast who doesn't want to jump into the bigger, pricier LGA2011 socket. Don't believe us? Read on to find out why you want this CPU instead of Sandy Bridge.
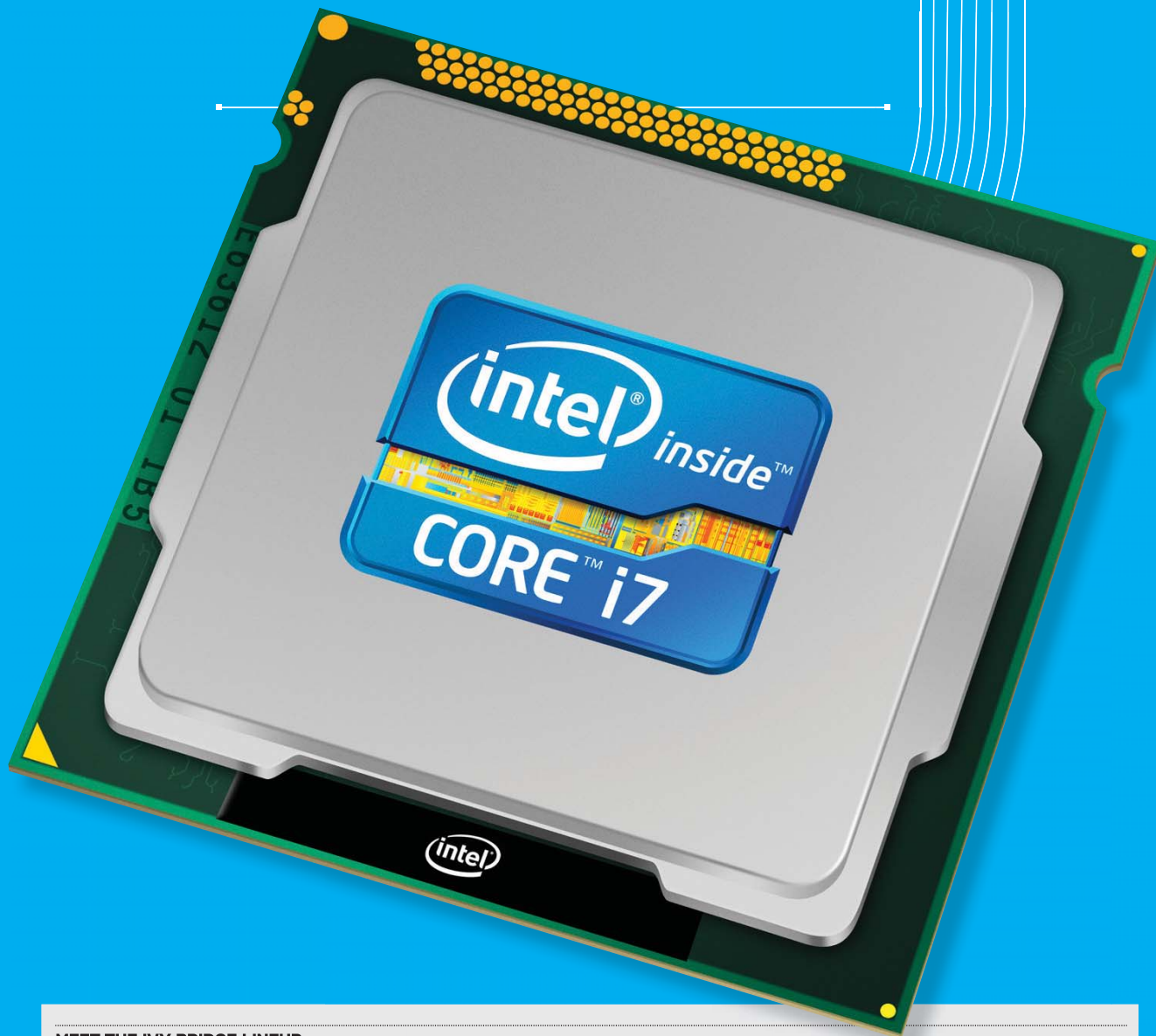
MEET THE IVY BRIDGE LINEUP

CPU	Core i7-3770K	Core i7-3770	Core i5-3570K	Core i5-3550	Core i5-3450	Core i7-3770T	Core i7-3770S	Core i5-3550S	Core i5-3450S
Volume Price	$313	$278	$212	$194	$174	$278	$278	$194	$174
TDP	77W	77W	77W	77W	77W	45W	65W	65W	65W
Cores / Threads	4 / 8	4 / 8	4 / 8	4 / 8	4 / 4	4 / 8	4 / 8	4/8	4 / 4
CPU Base Frequency	3.50GHz	3.40GHz	3.40GHz	3.30GHz	3.10GHz	2.50GHz	3.10GHz	3.0GHz	2.80GHz
Max Turbo Frequency	3.90GHz	3.90GHz	3.80GHz	3.70GHz	3.50GHz	3.70GHz	3.90GHz	3.70GHz	3.50GHz
DDR3	1,600MHz	1,600MHz	1,600MHz	1,600MHz	1,600MHz	1,600MHz	1,600MHz	1,600MHz	1,600MHz
L3 Cache	8MB	8MB	6MB	6MB	6MB	8MB	8MB	6MB	6MB
Graphics	HD4000	HD4000	HD4000	HD2500	HD2500	HD4000	HD4000	HD2500	HD2500
Graphics Base Frequency	650MHz	650MHz	650MHz	650MHz	650MHz	650MHz	650MHz	650MHz	650MHz
Graphics Max Frequency	1,150MHz	1,150MHz	1,150MHz	1,150MHz	1,100MHz	1,150MHz	1,150MHz	1,150MHz	1,100MHz
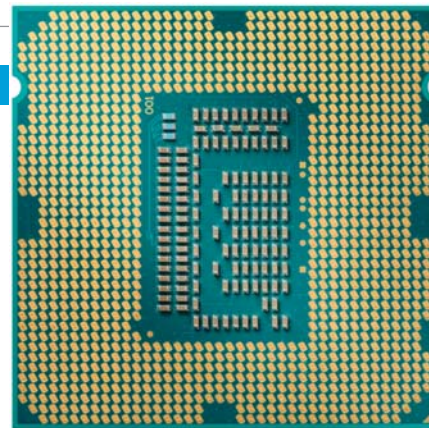
WORLD'S FIRST CHIP WITH '3D' TRANSISTORS

Despite its revolutionary tri-gate design, Ivy Bridge doesn't do much to advance x86

We've long dubbed Intel the master of the fab. The company's prowess in chip fabrication is the envy of the world. Yeah, there was that little thing with the Pentium 4, which hit the process wall like a freight train, but for the most part, Intel's mastery of chip fabrication has always made its new CPUs a tour de force of technology that makes you wonder if the company doesn't have a crashed flying saucer hidden at 2200 Mission College Boulevard.

With Ivy Bridge, Intel again amazes with the world's first use of tri-gate, or 3D, transistors. Also called finFETs, for fin field-effect transistors, the 3D transistors literally rise up off of the die to dramatically reduce power consumption while increasing performance.

In a traditional planar transistor, current flows on a flat surface like a river. A gate, which ostensibly controls that flow, lies across the top of that river with contact only along a small surface. With a finFET, or 3D tri-gate, the flow of power spans a fin that juts from the surface. Instead of just contacting the surface along one dimension, the gate encircles it and makes contact on three sides.

Intel says this gives it far greater control of power and enables it to drive the signal harder while adding only a small amount to the build cost. Despite having similar architectural underpinnings to Sandy Bridge, Ivy Bridge should provide better performance while consuming significantly less power than an equivalent SB processor. So

far, that seems to be panning out. A typical performance Sandy Bridge chip, such as the 3.4GHz Core i7-2600K is rated at 95 watts. The new 3.5GHz Core i7-3770K is rated at 77 watts. And those are higher-performing processors. Tri-gate should pay even more dividends at lower power thresholds. Right now, Intel is only detailing its quad-core parts. Dual-core CPUs haven't been announced yet, but we'll be curious to see how aggressively Ivy Bridge performs in notebooks.

Ivy Bridge isn't just a process story, though. It's about keeping the chains moving. If, after all this investment in 3D transistors, the damned CPU isn't any faster, no one would care if it were made out of the purist shimmering samite. Fortunately, that isn't the case, as you'll read in our

IVY BRIDGE VS. SANDY BRIDGE: BENEATH THE SURFACE

The 22nm-based Ivy Bridge processor is considerably smaller than its predecessor. It has nearly 400 million more transistors yet is about 25 percent smaller. What's more interesting, however, is how much real estate is dedicated to each task on the new Ivy Bridge vs. Sandy Bridge. These die shots (not to scale) show that the almost 2x performance bump in graphics comes at the price of die space. Intel, however, discounts any criticism regarding how much emphasis it placed on graphics over x86 functionality and says just because it looks like more space was expended on graphics doesn't mean it's more important. Um, OK.

Sandy Bridge — Core, Core, Core, Core, System Agent & Memory Controller including Display, DMI and Misc.I/O, Processor Graphics, Shared L3 Cache, Memory Controller I/O

Ivy Bridge — Core, Core, Core, Core, System Agent & Memory Controller including Display, DMI and Misc.I/O, Processor Graphics, Shared L3 Cache, Memory Controller I/O
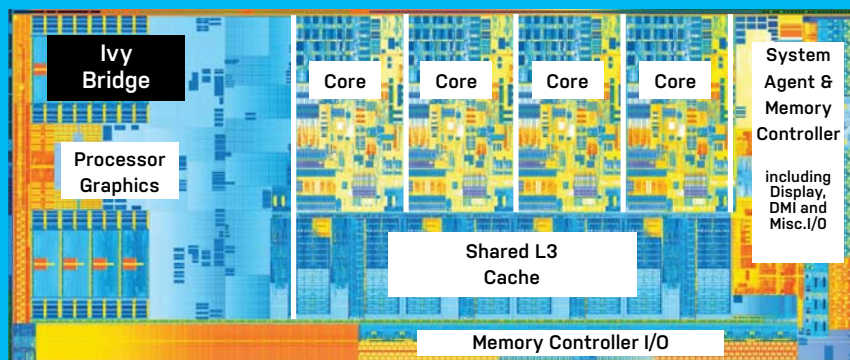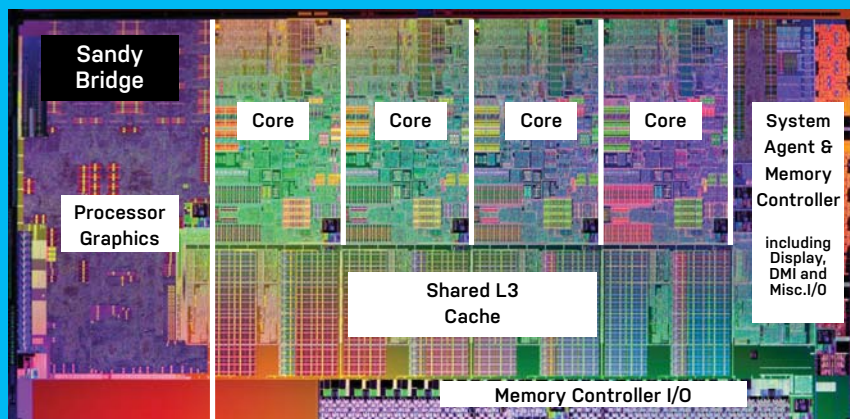
chip showdown on page 40. But first, let's break it down two ways: Even Intel says Ivy Bridge isn't a big step forward for pure x86 performance, as it's largely a die shrink of the Sandy Bridge core. The cache remains the same and the base clocks are similar. Where Ivy Bridge appears to have an edge in x86 performance is in its lower power envelope. As you know, Intel essentially overclocks, or "Turbo Boosts," the chip based on how much power it's eating and how hot it's running. So if a chip can run cooler and consume less power than its counterpart, it can run at a higher turbo clock for longer.

Where Intel seems to have put most of its focus this time is in the GPU side, which you can read about in detail on page 38.

OVERCLOCKING

With Ivy Bridge, Intel maintains the "K" versions that it introduced with its Lynnfield procs and continued on with Sandy Bridge. Like Sandy Bridge, Ivy Bridge isn't hugely tolerant of bclock, or base clock, overclocking. Intel says the most you should expect is a 7 percent bclock nudge before things go sideways. Instead, overclocking

will continue to rely on upping the Turbo Boost or clock ratios. Intel has enhanced Ivy Bridge a bit by increasing the maximum core ratio overclock from 59 on Sandy Bridge to 63. Ivy Bridge also now lets you change the core ratios in real time. Graphics support a greater range for overclocking, too, and Ivy Bridge will let you run the RAM up to DDR3/2667 through overclocks (DDR3/1600 is the official speed.)

One thing we're hearing about that may dismay Ivy Bridge users is that you can't push the processor hard at voltage levels Sandy Bridge would tolerate. Some board makers we've spoken to say that pushing Ivy Bridge hard at anything beyond 1.32 volts could make it go up in smoke. Generally, overclocks of 4.5–4.6GHz can be hit, but anything beyond will require exotic cooling. Extreme overclockers will be pleased, however, that the chip seems to hit high freqs on liquid helium and liquid nitrogen, so there is a payoff for the elite clock tweakers.

COMPATIBILITY

We've long railed against Intel for releasing new sockets with new CPUs (remember

the short-lived Socket LGA1156 and Socket 423 and numerous LGA775 versions?), but the company has stepped up to the plate for the Sandy Bridge-to-Ivy Bridge transition. As Intel promised, most LGA1155 boards will support Ivy Bridge procs if the firmware and BIOS are updated to support the chip by the board maker. However, not all chipsets will make the Ivy Bridge cut. Intel has intentionally left out support for the business chipsets Q65, Q67, and B65 while supporting consumer H61, H67, P67, and Z68. Why leave some out? Intel believes the days of an IT shop getting down and dirty and upgrading processors in an office-drone PC are long gone, so there's just no reason to expend the resources on unnecessary support. Besides getting the latest core technology from Intel, switching to Ivy Bridge on older 6-series boards should also give you PCIe 3.0 support on some slots.

7-SERIES CHIPSET BRINGS FEW CHANGES

CONSPIRACY THEORISTs, unite: If you're one of the tinfoil hat wearers (this means you, Nathan Edwards) who was absolutely certain Intel was trying to sandbag USB 3.0 in order to push Thunderbolt, the new Z77 chipset puts your suspicions to rest. The Z77, you see, finally brings native USB 3.0 support to the world of Intel. Why all the fuss over native support? First, it cuts the cost of a board slightly, since the board maker has one less chip to supply. Generally, performance and compatibility of integrated USB 3.0 tends to be better, too. Finally, native support means USB 3.0 in just about every new PC going forward. That means more devices and lower costs, which, as Admiral Kirk says, is better for me, better for you, and (pause) better for them.

Native USB 3.0 won't extend to all ports on a motherboard, though. The Intel PCH supports up to four USB 3.0 ports, so on motherboards that offer more than that, it'll be a mix of USB 2.0, Intel USB 3.0, and third-party USB 3.0 support. On the Gigabyte GA-Z77X-UD5H that we used, for example, it had four USB 3.0 ports on back with an additional three USB 3.0 headers. This was done by using the Intel chipset support and a discrete controller from VIA.

Beyond USB 3.0, the 7-series chipset is a fairly incremental update. SATA support, for example, is the same weak-sauce mix of two SATA 6Gb/s and four SATA 3Gb/s. When we critically asked why not all 6Gb/s ports? Intel threw it back in our face by saying that backward compatibil-

ity with the 6-series boards was important to keep costs down on the 7-series boards. And since we're always whining about backward compatibility, isn't that important? Well, yes—but this is the last time, Intel. The 5-series, 6-series, and now 7-series have all shared the same SATA 6Gb/s configuration, so we better not see the 8-series with it, too.

Other key differences between 7-series and 6-series are support for three displays using Ivy Bridge's graphics chip and, of course, support for both Sandy Bridge and Ivy Bridge chips out of the box. Is there a performance difference? Frankly, no. For our tests, we used a Gigabyte GA-Z77X-UD5H board, first with the Core i7-3770K, which we then swapped out for a Core i7-2600K.
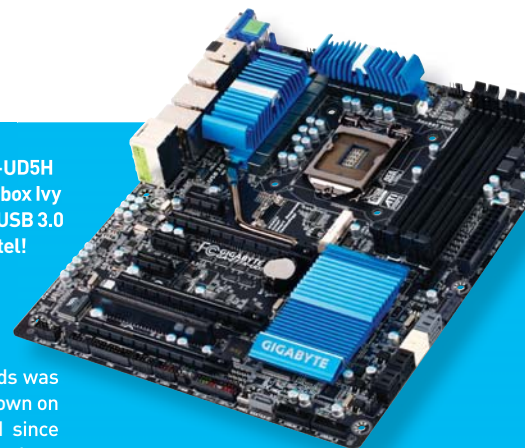
We then re-ran our benchmarks and compared them to our Z68/2600K numbers. The difference? Nada, other than the weird, unexplainable bogies we had with a couple of benchmarks. The two, frankly, are essentially indistinguishable. Even the Intel USB 3.0 support didn't prove to be superior to any of the discrete USB 3.0 chipsets we've tested. So if you're considering whether to move from Z68 just to upgrade, we don't recommend it. However, if you're building a new box on an Ivy Bridge processor, we'd build on Z77 just to have the latest chipset.

IVY BRIDGE GRAPHICS

It's what everyone's been waiting for. Does Intel deliver?

We're all Charlie Browns when it comes to Intel graphics. Intel, of course, is Lucy, pulling the graphics eye-candy football away after promising that *this time* will be different. Once again, Intel is promising that this generation of the GPU built into the upcoming Ivy Bridge 22nm CPU will be different. Honest!

Several years ago, Intel promised to speed up its graphics core by 10x per generation—and that 10x speedup would start with Ivy Bridge. With Ivy Bridge upon us, it's worth diving in to its internal architecture to understand what's really changed.

Based on what we know about DirectX 11 compute shaders and the OpenCL 1.1 implementation, it looks like Intel's new GPU is getting a pretty robust set of compute-capable shaders. That's an encouraging sign, as is support for hardware tessellation.

Those are the gross differences. Internally, the GPU has been redesigned from the ground up. The GPU is partitioned into five domains. The global asset area takes care of geometry. It includes geometry, vertex, and hull shaders, plus the tessellator. Setup is also in this section. The resulting output is fed into the thread dispatch engine to the execution units (EUs), which do a lot of the heavy lifting. After the EUs are done, the render section takes over.

Intel's hardware tessellation engine is fixed-function, but can accept different cues for setting the overall level of tessellation. The EUs have been beefed up, with each EU offering 2x the performance per watt of Sandy Bridge. The higher-end HD4000 has 16 EUs, up from 12 on Sandy Bridge's GPU. Intel also added an L3 cache to the GPU, which improves overall throughput, since data doesn't need to be fed to the GPU from the ring bus as frequently. This also saves on overall power.

One of the key performance-enhancing features is co-issue of instructions to execution units. Sandy Bridge supported this on some operations, but Ivy Bridge extends this to many more operations.

How does this affect actual performance with PC games? We ran a few tests on very early drivers. What we saw was definitely encouraging.

Even with early drivers, we're seeing about a 25 percent or better increase with 3D games. You'll still need to sacrifice some detail levels, but you'll get acceptable performance in all but the most bleeding-edge games. Titles like StarCraft II, Civilization V, Modern Warfare 3, and Portal 2 will probably run fine, if you're willing to dial back resolution, turn off AA, and run at medium or lower detail levels. It's probably best to steer away from highly demanding titles, though, such as Deus Ex: Human Revolution or The Witcher 2.

Note that 3DMark 2011 actually runs, giving clear evidence that Ivy Bridge is indeed DirectX 11 compliant. That's not a big score, but the fact of the score is encouraging. As with Sandy Bridge, Ivy Bridge includes a dedicated, fixed-function video encoder. Intel is claiming a nearly 2x encode advantage over Sandy Bridge, but that will depend on the application and workload. We saw only a 6 percent gain over Sandy Bridge when encoding an HD video file for iPhone using CyberLink's Media Espresso 6.5 (295 seconds for Ivy Bridge versus Sandy Bridge's 311 seconds.) Encoding performance is likely to be better with stereoscopic content, for example.

Finally, the new GPU, in conjunction with motherboards using Intel's 7-series chipsets, will support up to three simultaneous displays. As with Sandy Bridge, DVI support will be limited to single link only, but that will only affect a handful of users with older 30-inch monitors. Full bandwidth support for very high resolutions will be available through DisplayPort 1.2 or HDMI 1.4a.

Overall, Ivy Bridge's graphics are clearly better. Desktop users who are regular performance gamers will definitely want to stick with their favorite discrete graphics card, but owners of Ivy Bridge ultrabooks might be able to get a reasonable gaming fix now—provided the unit is built with the HD4000. It's unlikely that the HD2500 will be much use for gaming. **–Loyd Case**

SPECIFICATIONS

	Intel HD Graphics 2500 / 4000 (Ivy Bridge)	Intel HD Graphics 2000/3000 (Sandy Bridge)
Execution Units	6/16	6/12
DirectX Support	DX11 (including H/W tessellation and compute shaders)	DX10.1
OpenGL	OpenGL 3.1	OpenGL 3.0
Display Support	3	2
OpenCL 1.1	On the CPU core	CPU and GPU

BENCHMARKS

	Core i7-3770K	Core i7-2600K
3DMark 11 Entry	E1,770	DNR
3DMark 11 Performance	P767	DNR
3DMark Vantage Entry	E18,419	E11,824
3DMark Vantage Performance	P4,092	P2,236
Dirt 2 1680x1050 Medium. No MSAA (fps)	26.8	22.9
Far Cry 2 19x10 High. Ranch Long (fps)	23.7	15.7

Best scores are bolded. For our testing we used a Core i7-3770K and a Core i7-2600K on a Gigabyte GA-Z77X-UD5H with 4GB of DDR3/1333 and 64-bit Windows 7 Professional.

IVY BRIDGE VS. THE BENCHMARKS

New kid proves itself to be the new standard bearer

For our testing, we used a Gigabyte GA-Z77X-UD5H motherboard with the new Z77 "Panther Point" chipset. To this we added a 3.5GHz Core i7-3770K and installed a fresh copy of 64-bit Windows 7 Professional along with 8GB of DDR3/1600, a GeForce GTX 580 card, and a 150GB Western Digital Raptor. And we reached for the same set of mostly CPU-dependent benchmarks that we've used to review the last few rounds of processors.

For direct comparisons, we decided to pit the new 3770K against the Core i7-2600K and Core i7-3820. Why not the Core i7-2700K, which is the same clock as the Core i7-2600K? The Core i7-2700K has always been a bit of an odd-duck part to us. You pay $25 over a 2600K and really only get 100 more megahertz. Why bother? Obviously, the LGA2011 Core i7-3820 can't be tested in the same board as Core i7-3770K, so we used our old standby: the Asus P9X79 Deluxe.

While we included Intel's i7-3960X six-core processor in the chart, this is really about Intel's quads. The test suite includes everything from 3D modeling tests, to video editing and video transcoding, to several synthetic benchmarks and a few gaming tests with the resolutions cranked down low enough to take the graphics card out of the equation.

Ultimately, we want to answer three pressing questions: Do you buy a Sandy Bridge or Ivy Bridge for your new build? Should you upgrade from your Sandy Bridge to Ivy Bridge? Should you just by-pass Ivy Bridge for Sandy Bridge-E or a hexa-core chip?

LET'S DIG INTO THE NUMBERS.

When we look at all three quad cores, it's clear that Ivy Bridge has a performance advantage over the Sandy Bridge part in just about every benchmark. Across the board, we generally saw a 5 to 15 percent advantage in favor of the Ivy Bridge. In fact, the only place where Ivy Bridge was slower was in 3DMark's GPU test and Dirt 2. Why? Frankly, we don't know. We actually expected the scores to be fairly close, with Ivy Bridge slightly ahead of the pack, but for baffling reasons it was slower in these tests. Even more baffling, an exact duplicate of our configuration at Gigabyte HQ put the numbers where they should have been. What's going on? We're not sure, as we swapped every component possible in an attempt to find out where the gremlin was but could not root it out.

Despite these two anomalies, it's pretty clear that Ivy Bridge is faster over the similarly priced Sandy Bridge part. The real shocker was its competitiveness with the Core i7-3820 in some benchmarks. We thought the Core i7-3820's base clock advantage of 200MHz and quad-channel memory would put it in front, but that wasn't always the case. In some benchmarks, the Core i7-3770K was ahead by a small, but measurable margin of 3 to 6 percent.

One interesting benchmark to examine here is the Cinebench 10 Single Core test. That's where we have Cinebench 10 render runs only on a single core instead of across all cores. This is probably the best indication of how efficient Ivy Bridge's cores are against the previous generations

TOP PROCS COMPARED

	Intel Core i7-3770K	Intel Core i7-2600K	Intel Core i7-2700K	Intel Core i7-3820	Intel Core i7-3930K	Intel Core i7-3960X
Code Name	Ivy Bridge	Sandy Bridge	Sandy Bridge	Sandy Bridge-E	Sandy Bridge-E	Sandy Bridge-E
Clock	3.5GHz	3.4GHz	3.5GHz	3.6GHz	3.2GHz	3.3GHz
Turbo Clock (max)	3.9GHz	3.8GHz	3.9GHz	3.9GHz	3.8GHz	3.9GHz
TDP	77W	95W	95W	130W	130W	130W
Cores / Threads	4 / 8	4 / 8	4 / 8	4 / 8	6 / 12	6 / 12
Volume Pricing	$317	$317	$332	$285	$555	$990
Graphics Core	HD4000	HD3000	HD3000	N/A	N /A	N/A
Process	22nm	32nm	32nm	32nm	32nm	32nm
Total L2 Cache	1MB	1MB	1MB	1MB	1.5MB	1.5MB
Total L3 Cache	8MB	8MB	8MB	10MB	12MB	15MB
Die Size	160mm²	216mm²	216mm²	293mm²	435mm²	435mm²
Transistor Count	1.4 billion	995 million	995 million	1.27 billion	2.27 billion	2.27 billion
Socket	LGA1155	LGA1155	LGA1155	LGA2011	LGA22011	LGA22011
Memory Controller	Dual-channel DDR3/1600	Dual-channel DDR3/1333	Dual-channel DDR3/1333	Quad-channel DDR3/1600	Quad-channel DDR3/1600	Quad-channel DDR3/1600
DDR Frequency Overrides	DDR3/2667	DDR3/2133	DDR3/2133	DDR3/2400	DDR3/2400	DDR3/2400

of chips. It's just no contest. Ivy Bridge's core is about 15 percent faster than Sandy Bridge's and 9 percent faster than Sandy Bridge-E's.

Don't think that gives Ivy Bridge a definitive edge over the big boys, though. Despite each core being faster, more cores still matter if your application uses them. Even the ancient Core i7-990XE has an edge over the Core i7-3770K in many of our multithreaded benchmarks. We will be honest, though—the margin isn't as great as we would have expected.

But let's get back to our questions: Do you buy a Sandy Bridge or Ivy Bridge for your new build? This one's easy. Ivy Bridge, my friend. With the price of 2600K and 3770K exactly the same, there's really no reason to buy a 2600K, unless you're limited by your motherboard's support for it.

Should you upgrade from your Sandy Bridge to an Ivy Bridge? No. It would be foolish to think that just because Ivy Bridge is here your Sandy Bridge chip is a piece of junk. The only reason we could see upgrading is if you're coming from a lower-end, limited Sandy Bridge chip or need better integrated graphics, but otherwise, Sandy Bridge has plenty of life left in it.

Should you just bypass Ivy Bridge for Sandy Bridge-E or a hexa-core chip? That question can't be answered by us. It has to be answered by your computing needs. While we think Ivy Bridge is a hell of a chip, it's not faster than a hexa-core, even an older one, on thread-heavy tasks like 3D rendering and modeling, video encoding, and other content creation jobs. We still recommend that if you compute for a living, using thread-heavy tasks, it's worth the stretch for a hexa-core chip such as the Core i7-3960X or Core i7-3930K. Long term upgraders may also want to invest in LGA2011, which should live well into 2013. LGA1155 will likely sunset with the next Intel CPU, code-named Haswell.

All that aside, we think the Core i7-3770K is the new king of the midrange. Yes, it's hard to have the same enthusiasm we had when the Core i7-2600K first arrived and wiped the floor with all other CPUs, but you shouldn't discount Ivy Bridge. It's fast, it's cheap, and it's cool. What more could you ask for? ⏻

SPECIFICATIONS

	3.5GHz Core i7-3770K on Z77	3.4GHz Core i7-2600K on Z68	3.6GHz Core i7-3820	3.3GHz Core i7-3960X
Cores / Threads	4 / 8	4 / 8	4/8	6 / 12
RAM	8GB DDR3/1600 Dual-channel	8GB DDR3/1600 Dual-channel	8GB DDR3/1600 Quad-channel	8GB DDR3/1600 Quad-channel
PCMark7 Score	3,607	3,450	3,443	3,662
PCMark7 Lightweight	2,601	2,612	2,598	2,681
PCMark7 Productivity	2,400	2,269	2,306	2,410
Cinebench 10 Single Core	6,914	6,011	6,209	6,363
Cinebench 10 Multi Core	26,448	23,315	24,456	35,638
Cinebench 11.5	7.66	6.84	7.46	11.35
POV Ray 3.7 RC3 (sec)	193.60	218.93	202.01	143.1
Fritz Chess Benchmark	14,179	13,065	14,190	13,823
Intel Burn Test (GFlops)	92.0	89.7	87	152
Bibble (sec)	118	137	129	103
Sony Vegas Pro 10 (sec)	2,615	2,752	2,468	1,900
ProShow Producer (sec)	977	1,063	1,004	856
MainConcept (sec)	688	1,120	730	551
CyberLink Espresso 6.5 (CPU) (sec)	339	379	309	293
CyberLink Espresso 6.5 (Discrete GPU) (sec)	325	329	306	287
CyberLink Espresso 6.5 (QuickSync) (sec)	295	311	N/A	N/A
7-Zip 64MB load 12 threads (MIPS)	20,794	19,046	21,485	30,156
7-Zip 64MB load Max Core Threads (MIPS)	22,033	19,288	21,590	30,156
wPrime 4-thread, 1024M (sec)	322.3	349.3	353.5	301.5
wPrime 6-thread, 1024M (sec)	265.6	293.2	265.5	202.3
wPrime 8-thread, 1024M (sec)	225.7	248.3	228.1	184.5
wPrime 12-thread, 1024M (sec)	244.8	271.2	245	148.5
HandBrake (sec)	294	336	311	234
Sandra (GB/s)	16.4	17.6	37.8	39.9
Valve Particle Test (fps)	195	179	196	299
Dirt 2 (fps)	112	189	188.8	187
Far Cry 2 (fps)	230.8	202.39	220	253
3DMark2011 Score	P5,960	P6,469	P6,653	P6,732
3DMark2011 GPU	5,485	6,186	6,267	6,154
3DMark2011 Physics	9,660	8,184	9,477	13,019
3DMark2011 Combined	6,446	6,671	6,759	6,602

NVIDIA'S

By Loyd Case

KEPLER:

OVERCOMING THE SINS OF FERMI

NVIDIA'S LATEST GPU IS FREAKING FAST, SIPS POWER, AND DRIVES FOUR DISPLAYS FROM ONE CARD

Johannes Kepler once wrote, "Nature uses as little as possible of anything."

Nvidia's latest GPU, code-named Kepler after the German mathematician, could be inspired by that quote, as much as by the original Kepler's mathematical prowess. The new GPU—the GTX 680—offers superb graphics horsepower, but requires only two 6-pin PCI Express power connectors. It's a big departure from the last-generation GTX 580, which was fast, but power hungry.

We'll talk about performance shortly, but let's first look at Kepler's underlying architecture.

SMALLER EQUALS BIGGER

Kepler GPUs are built using a 28nm manufacturing process, allowing Nvidia to build in more circuits in less die area.

Like Fermi, Kepler is a modular architecture, allowing Nvidia to scale the design up or down by adding or subtracting functional blocks. In Fermi, Streaming Multi-processors, or SMs for short, are the basic building blocks from which the GTX 500 line of GPUs is built. The CUDA core counts inside the SMs can vary. For example, each SM block in the GTX 560 Ti contains 48 CUDA cores, while the GTX 580 SM is built with 32 cores. The GTX 580, on the other hand, has a total of 16 SMs of 32 cores each, for a total of 512 CUDA cores.

Kepler's functional block is the SMX. Kepler GPUs are built on 28nm, which allowed Nvidia's architects to scale things a bit differently. So Nvidia increased the number of cores inside a Kepler SMX to a stunning 192 CUDA cores each.

The GTX 680 GPU is built from eight SMX blocks, arranged in paired groups called GPCs (graphics performance clusters). This gives the GTX 680 a whopping 1,536 CUDA cores.

The SMX doesn't just house the CUDA cores, however. Built into each SMX is the new Polymorph engine, which contains the hardware-tessellation engine, setup, and related features. Also included are 16 texture units. This gives the GTX 680 a total of 128 texture units (compared with the 64 texture units built into the GTX 580). Interestingly, the cache has changed a bit— each SMX still has 64KB of L1 cache, part of which can be used as shared memory for GPU compute. However, that means the total L1 cache has shrunk a bit, since there are only eight SMX units in the GTX 680, not 16, as with GTX 580. The L2 cache is also smaller, at 512KB rather than the 768KB of Fermi.

Another interesting change is that pre-decoding and dependency checking has been offloaded to software, whereas Fermi handled it in hardware. What Nvidia got in return was better instruction efficiency and more die space. Interestingly, the transistor count of the GTX 680 GPU is 3.5 billion, up only a little from the 3 billion of the GTX 580. The die size has shrunk, however, to a much more manageable 294mm²—by contrast, Intel's Sandy Bridge 32nm quad-core CPU die is 216mm².

TEXTURES, ANTIALIASING, AND MORE

One of the cooler new features from an actual application perspective is bindless textures. Prior to Kepler, Nvidia GPUs were limited to 128 simultaneous textures; Ke-
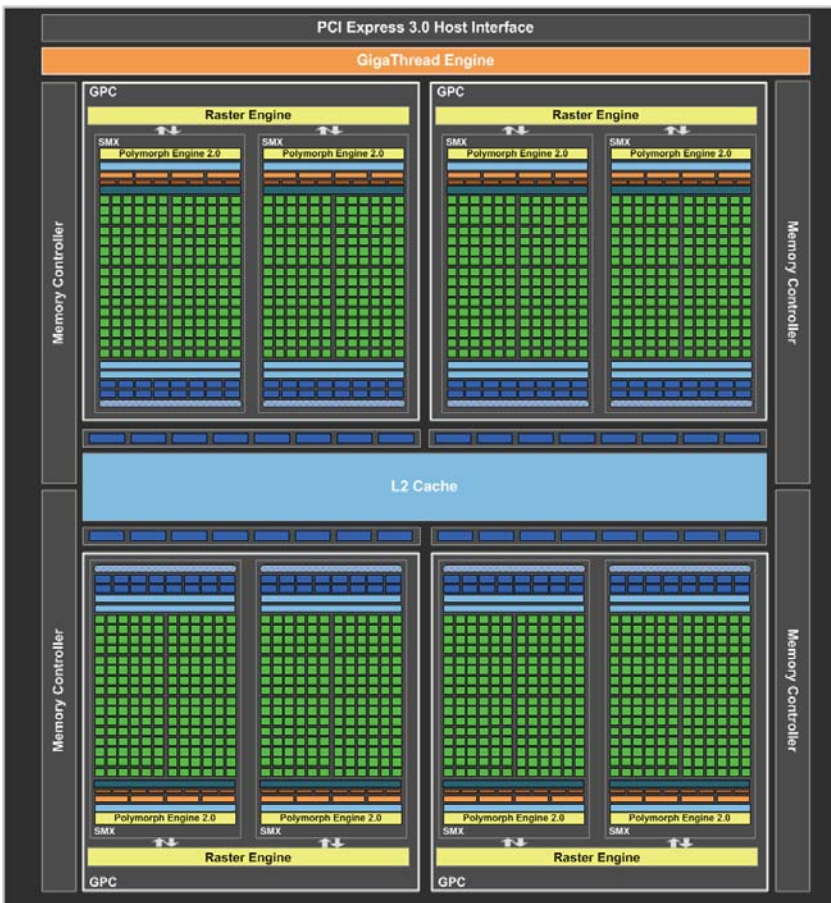
The GTX 680 offers three times as many graphics compute cores as the GTX 580, but they're arranged differently.

pler boosts that by allowing textures to be allocated as needed within the shader program, with up to 1 million simultaneous textures available. It's doubtful whether games will use that many textures, but certain types of architectural rendering might benefit.

Nvidia continues to incorporate its proprietary FXAA antialiasing mode, but has added a new mode that it's calling TXAA. The "T" stands for "temporal." TXAA in its standard mode is actually a variant of 2x multisampling AA, but varies the sampling pattern over time (i.e., over multiple frames.) The result is better edge quality than even 8x MSAA, but the performance hit is more like 2x multisampling.

Another cool new feature that will also eventually be supported in older Nvidia GPUs is Adaptive Vsync. Currently, if you lock vertical sync to your monitor's refresh rate (typically 60Hz, but as high as 120Hz on some displays), you'll get smoother gameplay. However, you might see a stutter as the frame rate drops to 30fps or below, due to the output frames being locked to vsync.

On the other hand, if you run with vsync off, you may see frame tearing, as new frames are sent to the display before the old one is complete.

Adaptive Vsync locks the frame rate to the vertical refresh rate, until the driver detects the frame rate dropping below the refresh rate. Vsync is then disabled temporarily, until the frame rate climbs above the monitor refresh rate. The overall result is much smoother performance from the user's point of view.

Finally, Nvidia has beefed up the video engine, building in a dedicated encode engine capable of encoding H.264 high-profile video at 4x–8x real time. Power usage is low in this mode, consuming single-digit watts, rather than the shader-driven tens of watts of past GPUs.

THE GTX 680 GRAPHICS CARD

Nvidia built an improved circuit board to host the GTX 680 GPU. The board will ship with 2GB of GDDR5, with the default memory clock running at 6,008MHz—the first board to ship with 6GHz GDDR5. The GTX

680 also introduces GPU Boost, an idea borrowed from the world of x86 CPUs. GPU Boost increases the core clock speed if the internal thermal environment permits. This allows games that offer lighter overall load to get additional performance as needed. In another departure, the GTX 680 offers a single clock—the shader clocks are now the same as the core clock frequency. Product boxes will likely show both the base and boost clocks on the box. As with recently released AMD products, the GTX 680 is fully PCI 3.0 compliant.

A few notable things spring to mind when examining the specs. First, this is a 256-bit wide memory interface, as opposed to the 384-bit interface of AMD's Radeon HD 7970. Nvidia makes up for this with both improved memory-controller efficiency plus higher-clocked GDDR5. The frame buffer is "only" 2GB, but that was enough to run our most demanding benchmarks at 2560x1600 with all detail levels maxed out and 4x MSAA enabled.

Also worth calling out is Nvidia's new devotion to power efficiency. The GTX 680 is substantially more power efficient than its predecessor, with a maximum TDP of just 195W. Idle power is about 15W. We saw the power savings in our benchmarking.

The GTX 680 is also the first single-GPU

SPECIFICATIONS

	Nvidia GeForce GTX 680	XFX Radeon HD 7970
Number of Cores	1,536*	2,048*
Texture Units	128	128
ROPs	32	32
Base Clock Frequency	1,006MHz	1,000MHz
Boost Clock Frequency	1,058MHz	NA
Memory Clock Frequency	1,502MHz actual	1,375MHz
L2 Cache Size	512KB	768KB
Frame Buffer Size	2,048MB	3,072MB
Memory Interface	256-bit	384-bit
Memory Data Rate	6Gb/s	5.5Gb/s
Manufacturing Process	28nm	28nm
Transistor Count	3.5 billion	4.3 billion
Connectors	2x dual-link DVI, 2x HDMI 1.4a (Fast), 2x DisplayPort 1.2	2x Mini DisplayPort, 1x dual-link DVI, 1x HDMI 1.4a (Fast)
Power Connectors	2x 6-pin	1x 6-pin, 1x 8-pin
Thermal Design Power (TDP)	195W	250W

* Note: Nvida and AMD graphics compute cores are not directly comparable.

AN ULTRABOOK WITH TEETH?

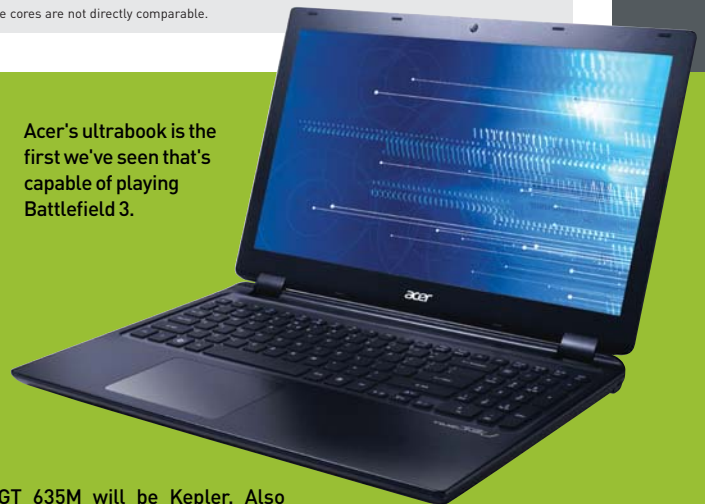Acer's ultrabook is the first we've seen that's capable of playing Battlefield 3.

NVIDIA'S KEPLER-BASED desktop card, the GeForce GTX 680, is certainly the star of the show, but the company's move on notebooks could prove to be equally exciting. With the die shrink from 40nm to 28nm, Nvidia says it's now capable of putting some real muscle into mobile form factors. The first example of that is Acer's Timeline M3 notebook, which we got to take for a spin around the block.

Nvidia likes to say that Kepler puts the ultra in ultrabook and, after using Acer's Timeline M3, we'd have to concur. The GeForce GT 640M mobile GPU sports 384 cores, a 128-bit memory path, and up to a 625MHz clock, on either GDDR3 or GDDR5—notebook builders could tune parts for lower clocks and performance, given their thermal budgets. As for

the thermal budget, Nvidia says it can extract more performance out of its new parts by working closely with notebook vendors to prevent any thermal scraps from being left on the table. For example, if a notebook designed for 40 watts has 15 watts set aside for the CPU, normally only 20 watts would be used for the GPU, leaving 5 watts of thermals that could have been used to run the GPU harder. Nvidia seeks to change that.

Nvidia will initially offer six 6-series GPUs for notebooks. Several are legitimately new Kepler-based GPUs, with a few using the older 40nm-based Fermi GPUs. Interestingly, the top-end GeForce GTX 675M and the GeForce GTX 670M are still based on Fermi. The GeForce GTX 660M, GeForce GT 650M, GeForce GT 640M, and GeForce

GT 635M will be Kepler. Also throwing a curveball into the graphics choices is the GeForce GT 640M LE, which will available as either a 28nm Kepler or 40nm Fermi part. So good luck picking your poison.

The good news is that the poison is so sweet. The Acer Timeline M3, while pushing the definition of an ultrabook, offers truly wonderful gaming performance for its class. The notebook is capable of playing Battlefield 3 at its native resolution of 1366x768 on the Ultra set-

ting. On multiplayer maps, we measured frame rates in the low 30s to high 20s using FRAPs and Mark I Eyeball methods. For us, that's not really enough. Ticking the settings to High in BF3 gave us low 50s, though, which is much improved for a first-person shooter. Considering how thin the Timeline M3 is—.79 inches—it's a hell of an accomplishment. A full review of the Acer will bubble up next month, but for now, color us impressed.

card from Nvidia to support more than two displays. Users can add up to four displays using all four ports. Nvidia was strangely reticent about discussing its DisplayPort 1.2 implementation, which should allow for even more monitors once 1.2-capable monitors and hubs arrive on the scene later this year.

The GTX 680 cooling system is a complete redesign, using a tapered fin stack, acoustic dampening, and a high-efficiency heat pipe. The card was very quiet under load, though perceptually about the same as the XFX Radeon HD 7970's twin-cooling-fan design. Of course, having a more power efficient GPU design is a big help. The GTX 680 is no DustBuster.

HOW DOES IT PERFORM?

We pitted the GTX 680 against two previous GTX 580 designs: the slightly overclocked EVGA GTX 580 SC and the more heavily overclocked EVGA GTX 580 Classified. The XFX Radeon HD 7970 Black Edition was also included. We ran our usual benchmark suite at 2560x1600 with 4x MSAA enabled, along with the FutureMark and Unigine synthetic tests.

The GTX 680 clearly takes most of the benchmarks, though the XFX HD 7970 eked out a couple of wins. Note that it's possible some of these benchmarks are actually becoming CPU limited, even with 4x MSAA, but it's hard to say for certain. That's very likely the case with HAWX 2, where the older GTX 580 Classified—albeit a heavily overclocked GTX 580—managed a 1fps advantage.

The GTX 680's idle power ratings are impressive, too. The total system power at idle was just 116W, 8W better than the XFX card. However, Nvidia doesn't incorporate anything like AMD's ZeroCore technology, which reduces power to a bare 3W when the display is turned off (as when Windows 7 blanks the screen.) Even better is the power under load—the GTX 680 is the only GPU to run at under 300W at full load.

The GTX 680 we tested is Nvidia's reference card, and it's likely that some manufacturers will ship retail cards at higher core clock speeds. Retail cards will be available upon launch (March 22, 2012). Nvidia is pricing the card at $500, but prices may vary a bit depending on the manufacturer. That $500 price tag substantially undercuts AMD's Radeon HD 7970 pricing by as much as $100, which makes the GTX 680 look even better for high-end gamers.

The GTX 680 may regain Nvidia the performance crown briefly held by AMD, and is priced lower, to boot. What's most intriguing, however, is that Kepler likely has some headroom for even greater power, which may allow Nvidia to ship an even higher-end GPU

when needed. The performance horse race continues, and while the top spot now belongs to Nvidia, the company also needs to deliver midrange GPUs to compete with AMD's more recent product moves. In the long run, gamers will benefit from more choices and competition. It's a win all around. ⏻

The new cooling system is more efficient and much quieter than older Nvidia cards, even on load.
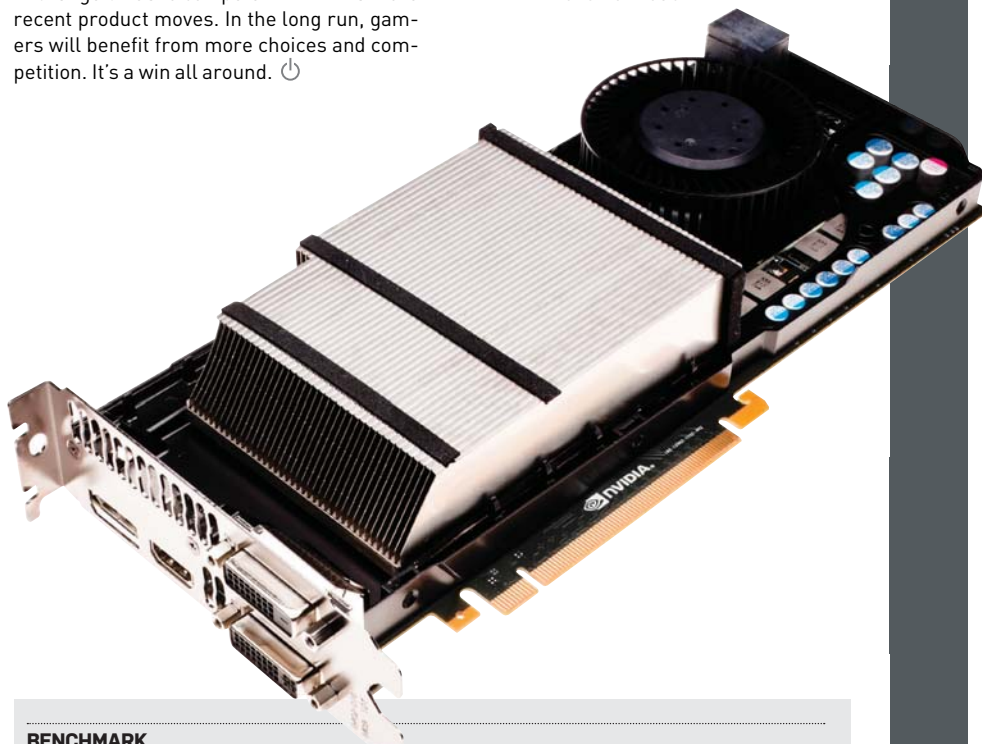
BENCHMARK

	Nvidia GTX 680 Reference	EVGA GTX 580 SC	EVGA GTX 580 Classified	XFX Radeon HD 7970 Black Edition
Price	$500	$550	$620	$580
3DMark 2011 Perf	**9,391**	6,747	7,321	8,393
3DMark Vantage Perf	**34,065**	26,936	28,559	32,813
Unigine Heaven 2.5 (fps)	**31**	22	23	29
Shogun 2 (fps)	**33**	22	24	29
Far Cry 2 / Long (fps)	**108**	85	92	100
HAWX 2 DX11 (fps)	127	120	**128**	120
STALKER: CoP DX11 (fps)	**40**	28	29	39
Just Cause 2 (fps)	74	58	73	**83**
Batman: Arkham City (fps)	**93**	70	73	82
Metro 2033 (fps)	28	26	28	**31**
Core / Memory Clocks (actual)	1,006* / 1,502	797 / 1,013	855 / 1,055	1,000 / 1,425
System Power @ idle (W)	**116**	140	140	124
System Power @ full throttle (W)	**297**	344	385	349

*Note: Nvidia's GTX 680 also has a peak GPU Boost clock speed of 1,056MHz.

Best scores are bolded. Our test bed is a 3.33GHz Core i7 3960X Extreme Edition in an Asus P979X Deluxe motherboard with 16GB of Corsair DDR3/1600 and an AX1200 Corsair PSU. The OS is 64-bit Windows Ultimate. All games are run at 1920x1200 with 4x AA unless otherwise noted. Note also that we've changed our test bed and game benchmarks slightly, so these benchmarks aren't comparable to earlier reviews.

HOW TO

STEP-BY-STEP GUIDES TO IMPROVING YOUR PC

WINDOWS TIP OF THE MONTH

ALEX CASTLE
ONLINE MANAGING EDITOR

USE CHECKBOXES TO SELECT MULTIPLE FILES

Selecting multiple files in Windows Explorer using the Ctrl and Shift keys can be a pain. If it's something you do often, make your life much easier by opening the Folder Options (found in the Organize menu in Windows 7), then selecting the View tab and enabling "Use checkboxes to select items."

MAKE · USE · CREATE

56
Access Your Media Remotely with Remote Potato

60
Measure Your Online Influence with Klout

RETURN THE START BUTTON TO WIN8

ONE OF THE most contentious changes found in Windows 8 has been the removal of the Start menu, traditionally accessed from the icon at the left of the taskbar. In its place, Microsoft expects you to use the new Metro UI start menu—a suggestion that has not gone over well with many PC users.

This switch is so fundamental to Windows 8 that Microsoft does not offer a built-in way to get the traditional Start menu back (unlike in Windows 7, which let you revert to the old-school taskbar, if you wanted). Fortunately, the community is already hard at work on the problem.

There are several start menu replacers already available for download, but our favorite is from the always-reliable Stardock. Called Start8, it's available at www.stardock.com/products/start8/.

Just download and run the program to get a handsome new Start menu right where you expect it to be.

↘ submit your How To project idea to: comments@maximumpc.com

Access Your Media Remotely with Remote Potato

—Nick Peers

YOU'LL NEED THIS

MEDIA
Should go without saying, but if you want to stream media, you'll need a collection of digital media files to stream.

REMOTE POTATO SERVER
Get this media streaming software at www.remotepotato.com.

WINDOWS MEDIA CENTER is the perfect central location for all your media: music, photographs, video, and recorded television shows. Its main drawback is that all that media is tied to your home computer.

Remote Potato is a free program that lets you access all the media stored in Windows Media Center on your home computer from another location. You can access it over your home network or—via the Internet—from outside your home on a computer or smart mobile device using its web browser or a dedicated app.

And not only do you get access to your home computer's media collection, Remote Potato lets you remotely set up and manage your TV recordings while you're out, too, which is perfect if you're stuck at work and worried you'll miss your favorite show.

1 INSTALL REMOTE POTATO SERVER Install Remote Potato Server from www.remotepotato.com onto your home computer running Windows 7 Home Premium or later, with Windows Media Center already set up and configured. When prompted during the setup process for Remote Library Access, enter your Windows username and password to gain access to your music library **(image A)**.

» Follow the rest of the setup prompts; once complete, click Close. After a short pause, the server will automatically start and a wizard will guide you through the initial setup process. Start by ticking "Yes, enable security" and providing a username and password, which you'll use each time you wish to access your media remotely.
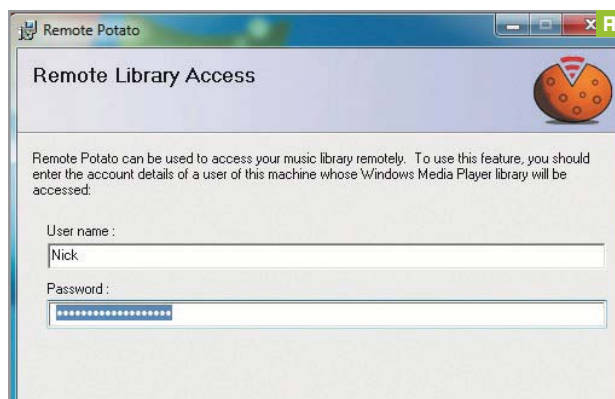
2 CONFIGURE THE SERVER You need to assign your PC a static IP address **(image B)**—see bit.ly/static-win7 for a simple step-by-step guide to doing so. Next, consult your router's documentation or visit www.portforward.com to learn how to access your router's configuration utility. This is typically done by typing the router's IP address into your web browser.

» Once logged in, look for the Port Forwarding section. Follow the instructions to add two separate port forwarding rules, as instructed by the Remote Potato setup wizard: Enter the port or port range into the appropriate boxes, and enter your computer's static IP address, too **(image C)**. Make sure the rule is enabled, and click Apply.

» Return to Remote Potato and complete the wizard—leave "I will use my external IP address to access Remote Potato" selected and click Next **(image D)**. The final screen reveals how to access your media server via another computer, either over your internal network or over the wider network. Make a note of these settings and click Close.

» Next, click No when prompted about the iPhone app. Click the Settings button to reveal a selection of options: Choose what media to share in the General tab **(image E)**, then tweak your television channel settings through the TV Guide and Channel tabs. Once done, click the Play button to start the server, which is now ready for action.

forgotten to record a favorite show, for example. Select TV Guide from the menu to browse for shows to record **(image G)**, or click Scheduled Recordings to manage recordings set up previously.
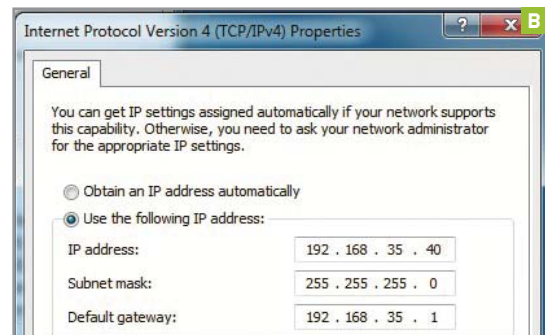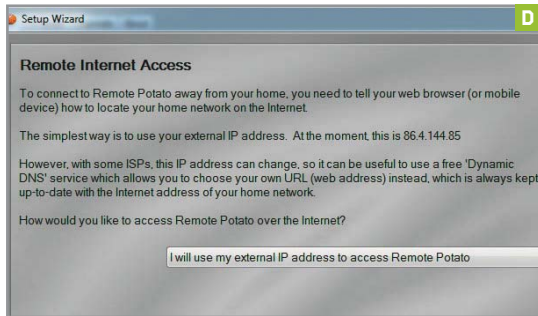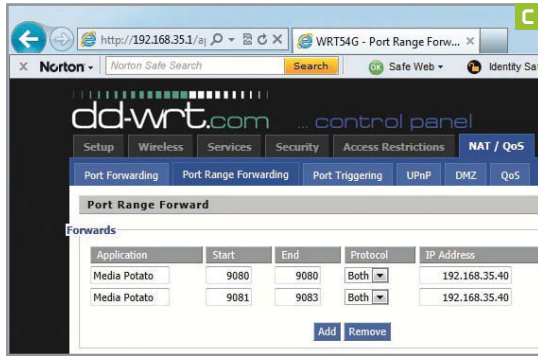
3 **ACCESS YOUR COLLECTION REMOTELY** Open a web browser on the other computer and type in http://0.0.0.0:9080, replacing 0.0.0.0 with the static IP address you created in step two. Press Enter and if necessary install Microsoft Silverlight, following the instructions to ensure the best-quality access to your media. Enter your username and password to log on.

» Click Yes if prompted by Silverlight to increase storage. Select what type of content to access from the main menu—music, pictures, recorded TV programs, video, and movies—then browse the folders to locate individual files **(image F)**. View or listen to single files, or use the controls to set up playlists or watch picture slideshows.

» If you record TV on your PC, you can schedule new recordings as well as configure existing ones directly from your web browser—perfect if you've

4 **GET MOBILE ACCESS** You can access your media through your smart mobile device via its web browser **(image H)** or a dedicated app (search its app store). There's Smart Potato for Windows 7 phones ($2.49), Remote Media Center (free) for Android, and Remote Potato/Remote Potato HD ($6.99) for iPhone and iPad.
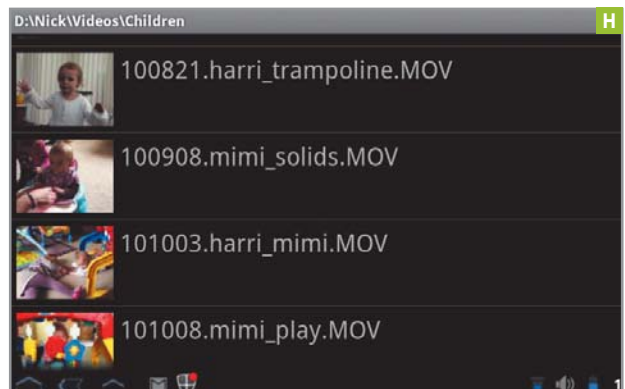
Measure Your Online Influence with Klout
–Rachael D'Cruze

YOU'LL NEED THIS

SOCIAL MEDIA ACCOUNT

You don't have to be a social media maven to use Klout, but you will have to have at least one account with a social media service like Facebook or Twitter in order to get a score.

WHILE WE'VE ALWAYS had the power to influence other people, that power, which is being democratized, is much easier to harness with new social media tools. But how much influence do you have over others? Do your Facebook "likes," retweets, posts, and comments go unnoticed, or are you an online mover and shaker? This is where Klout comes in, measuring your influence based on your ability to drive action in social networks, and providing you with an updated Klout Score each morning.

Klout provides insights to help you better understand your own power—whether others trust your opinions online, what topics you're the most influential on, and how you compare with your friends. Your Klout Score measures your online influence on a scale of 1 to 100, but the average Klout Score is 20, not 50—bear that in mind when you get yours.

1 GET KLOUT AND ADD NETWORKS Head to www.klout.com. You'll see "Sign in with Twitter" and "Connect with Facebook" buttons **(image I)**. Click either of these to log in.

» A pop-up screen will now appear. Check the "I'm an individual influencer" button and type in your email address, as requested. You are now signed up to Klout. Click "I'm ready" in the new window, and let the narcissistic fun begin.

» To get the most out of Klout, add all the social media sites that you tend to use **(image J)**. Make your way through the social media icon buttons, which simply prompt you to sign in and give Klout permission to access your information. If there are some listed that you don't use, you don't need to click on them.

» When you are finished, click Continue.

2 EXPLORE YOUR SCORE You'll now be shown a range of your friends and followers from Facebook and Twitter. You can invite them to use Klout through the invite button, or skip this step. When you're done, click Continue and in the pop-up window you'll see your Klout Score **(image K)**. Click the buttons underneath to share your score, using your various social media accounts.

» You'll now be taken to your Klout dashboard **(image L)**. Click the red "View your profile" button. At the top of your profile you'll be able to see how many people you influence through social media and what topics you are influential on. Look further down the page for an analysis of your Klout Score. As we said before, don't be too disappointed if it's in the region of 20.

» So, what does your Klout Score actually mean in terms of your social media presence? Your Klout Style will explain everything. Click the Klout Style link on the left-hand side of the homepage. On the

chart you'll see where you fit and get an explanation of your current Klout Score **(image M)**. It's great for seeing how your friends and followers fare, too.

3 **GET PERKS** Klout automatically pulls your About text from Twitter.

» If you want to change it, choose Settings in the drop-down menu on your home page. You can type in an alternative profile, add your gender and birthday, and change your profile picture **(image N)**. Joined more social media sites? Click "Connected networks" and tell Klout about them, as well, to help them track your score.

» From the drop-down menu in the top right of your profile page, which is accessed by clicking your name, choose Perks **(image O)**. Klout Perks are exclusive products and experiences that you earn based on your influence, which of course is measured by your Klout Score. Explore the perks to see if anything strikes your fancy.

» You've now successfully come to grips with Klout and discovered how much online influence

you have in your combined social media networks. As your online presence grows, your Klout Score will increase in accordance and you'll have earned more perks **(image P)**. So don't forget to check back regularly to see what goodies you've earned. ⏻

*i*fixit presents:
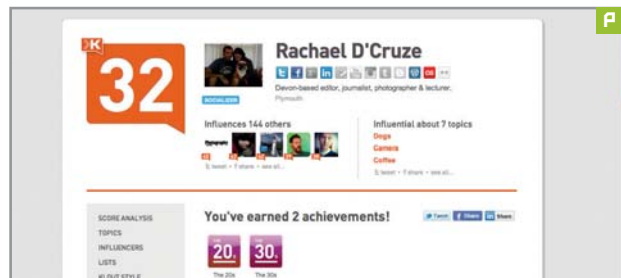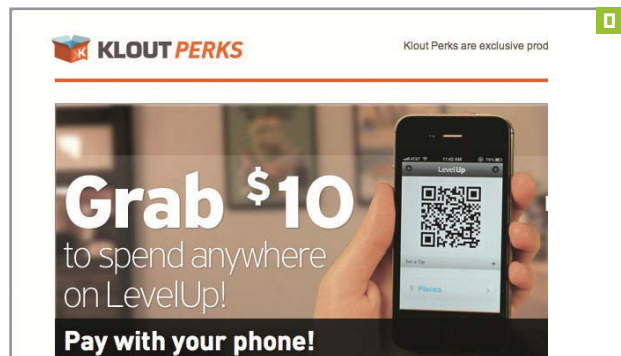
AUTOPSY

THIS MONTH WE DISSECT...

Apple's New iPad

About iFixit

iFixit is a global community of tinkerers dedicated to helping people fix things through free online repair manuals and teardowns. By making this knowledge readily available, iFixit helps thousands of people repair their devices every day. Why? Because companies like Apple don't provide repair parts and documentation to end users. iFixit believes that everyone has the right to maintain and repair their products. To learn more, visit www.ifixit.com.

MAJOR TECH SPECS:

- Dual-core Apple A5X processor with integrated quad-core graphics
- 9.7-inch, LED-backlit IPS LCD with 2048×1536 Retina display
- 16, 32, or 64GB Toshiba NAND flash memory
- 5MP HD rear-facing camera
- 1GB DRAM comprised of two 4Gb Elpida LP DDR2 parts
- Broadcom BCM4330 802.11 a/b/g/n baseband/radio with integrated Bluetooth 4.0+HS
- Qualcomm MDM9600 3G and 4G wireless modem (not the expected second-generation MDM9615)
- Qualcomm RTR8600 multiband/mode RF transceiver for LTE bands

KEY FINDINGS:

- Getting inside the new iPad was as tricky as we expected. The front panel is glued to the frame. We carefully used a heat gun to loosen the adhesive, worked to budge the panel with some guitar picks and plastic opening tools, and finally, gently lifted it off with some heavy-duty suction cups.

- Next to the logic board is a gigantic battery, which takes up most of the space inside the iPad. While the iPad 2 housed a formidable 25 watt-hour Li-ion battery, the new iPad ups the ante to 42.5 watt-hours. Its 3.7 volts and estimated 10 hours of use (9 with cellular data network) are comparable to that of the iPad 2, but Apple put the extra 17.5 watt-hours to good use powering the greatly improved CPU and GPU. The additional capacity was accomplished by increasing the physical size, not by employing new battery technology.

- Repair score: 2 out of 10
While the new iPad's design is essentially the same as the iPad 2, which received a reparability score of 4, we've learned a lot about the design since then. We've spent the last year trying to repair the iPad 2, with mixed success. We are awarding the new iPad an abysmal 2 out of 10, and we're retroactively dropping the reparability score of the iPad 2 to a 2 as well. The adhesive on the front is extremely difficult to remove without damaging the glass, making repair and end-of-life recycling very difficult.

- Apple claims the new iPad is environmentally friendly with a "Recyclable aluminum and glass enclosure." The materials may be recyclable, but the assembled unit is not. We spoke with Steve Skurnac, president of Sims Recycling Solutions—one of the largest electronics recyclers in the world. He told us, "Sealed units make it difficult to remove the batteries. From a recycler's point of view, the hazardous components [like batteries] need to be easily separated or removed."

BUILD IT

NATHAN EDWARDS **SENIOR EDITOR**

Make Way for the Midsize Menace

Pound for pound, you know the sound: Here's a Kepler-powered microATX gaming rig that won't break the bank—or your back

LENGTH OF TIME: **2 HOURS** LEVEL OF DIFFICULTY: **INTERMEDIATE**

THE MISSION Oh, microATX. You're the awkward middle child of motherboard form factors: neither as fully powered as a regular ATX board nor as compact as Mini-ITX. On the other hand, it's possible to build a hell of a rig with microATX in a relatively small footprint without compromising power, and I've been intending to do so for a while. I took a shine to the X79-powered microATX mobo Gordon Mah Ung reviewed in the April 2012 issue, and when the sky angels slipped a Kepler GPU into my rucksack, I knew what I had to do.

It's not going to be easy fitting all these high-powered parts into a minuscule chassis, but if you want easy, build a full-size machine. When I'm done, I'll have a box just 14.5 inches tall, 15.2 inches deep, and 8.25 inches wide—one that kicks a disproportionate amount of ass, no matter how tricky we have to get with the zip ties.

CHOOSING THE HARDWARE

I'VE HAD MY eye on Silverstone's TJ08-E microATX case since we re-viewed it in March 2012. It's a bit cramped, but it has good airflow and a sleek aesthetic—as well as an unusual motherboard orientation—and it has plenty of room for long videocards and a few drives.

Now, most microATX motherboards suffer from budget-itis: They're cheap and underpowered compared to full ATX boards. The Asus Ram-page IV Gene? Not so much. It has LGA2011 support, quad-channel memory (though only four DIMM slots), 6Gb/s SATA ports, three 16x PCIe slots, great onboard audio, and ground-effect LEDs. Just for fun.

Intel's Core i7-3820 is a great processor, and an obvious choice for an LGA2011 CPU under $300. It's a quad-core part at 3.6GHz stock and includes HyperThreading. Plus, if you want to upgrade to a six-core CPU later, LGA2011 is the only way to fly.

The Rampage IV's RAM slots are close to the CPU socket, so I can't use an enormous CPU cooler. NZXT's Havik 120 features dual fans and excellent performance, but I'm still using RAM with low-profile heat spreaders to avoid bumping up against the fans.

For storage, I'm sticking with my personal price/performance sweet spot: a 120GB 6Gb/s SATA SSD and a 3TB storage drive.

There's not much room in the TJ08-E for excess cabling or lengthy PSUs, so I'm using the Silverstone Strider Plus 750W, which is fully mod-ular and only 6.3 inches deep. This should help me keep my wiring tidy.

Oh, and I'll be using Nvidia's brand-new GeForce GTX 680, which is faster than the GeForce GTX 580 and competitive with the Radeon HD 7970 but uses just two 6-pin power cables (see Loyd Case's detailed Ke-pler breakdown on page 42). At $500, this card is a hell of a deal, sips power (for a high-end GPU), and fires a pretty big shot directly across AMD's bow.

UNDER THE MAGNIFYING GLASS

The TJ08-E's cramped quarters and unusual layout mean I can't follow a typical build order. Instead, the steps are optimized for cable manage-ment as well as, well, component management. Here are the highlights.

INGREDIENTS

	PART	URL	PRICE
Case	Silverstone TJ08-E	www.silverstonetek.com	$95
PSU	Silverstone Strider Plus 750	www.silverstonetek.com	$140
Mobo	Asus ROG Rampage IV Gene	www.asus.com	$290
CPU	Intel Core i7-3820	www.intel.com	$285
Cooler	NZXT Havik 120	www.nzxt.com	$55
GPU	Nvidia GeForce GTX 680	www.nvidia.com	$500
RAM	16GB Corsair Vengeance LP	www.corsair.com	$130
Optical Drive	Plextor CD/DVD burner	www.plextor.com	$20
Hard Drive	3TB Seagate Barracuda	www.seagate.com	$190
SSD	Corsair Force GT 120	www.corsair.com	$170
OS	Windows 7 Professional 64-bit (OEM)	www.microsoft.com	$139
Total			$2,014

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1 FIRST, ADD POWER

REMOVE THE TJ08-E's side panels, then remove the six screws securing the top panel and take that off, too. Make sure the fol-lowing cables are attached to the PSU: 24-pin and 8-pin ATX, two 6-pin PCIe power, and two SATA power cable strands. Remove the rest of the modular cables and slide the PSU into the top of the case, fan side up. Secure it with four screws (I used the PSU's included thumbscrews) and pull the cables through the opening that leads behind the motherboard tray.

2 WHAT DRIVES YOU

NEXT, WE'LL INSTALL the drives. Lay the case on its side and remove the four screws securing the drive cages to the bottom of the case. Remove the trays and secure the SSD directly to the bottom of the case.

3 WORD TO YOUR MOTHERBOARD

MOUNT THE RAM and CPU into the motherboard, install the I/O shield into the case, then mount the motherboard into the chassis. Bring your 8- and 24-pin motherboard power connections behind the motherboard tray toward their respective connectors and plug them in. Now is also a good time to start connecting front-panel connectors, like USB 3.0, audio, power and reset switches, and LEDs.
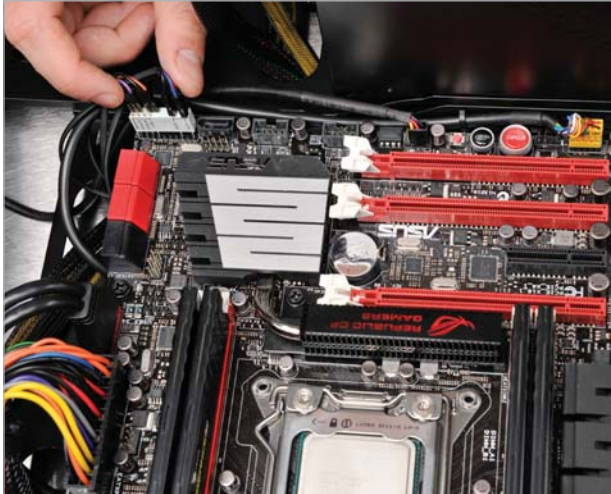
4 DRIVES PART DEUX

WITH THE MOTHERBOARD in place, it's time to add the storage drive. Take the lower hard drive cage (the one-bay one) and mount the hard drive into it with four screws in the mounting holes marked HDD. Reattach the hard drive cage to the bottom of the case. You can either remove the empty top three-drive cage for a less cluttered case or leave it in, to channel air from the intake fan toward the CPU fans. It also includes a pad to support the GPU, if you're into that.

Run a three-port SATA power cable from the PSU to the drives. Plug the last power adapter on the string into the hard drive, then tuck the cable under the drive and plug the second plug into the SSD. Attach SATA data cables to both drives and plug them into the middle red ports on the motherboard. Those are the native Intel 6Gb/s SATA ports.

Install the optical drive in the top 5.25-inch bay and secure it with four screws, then connect SATA power and data.

5 COOL (AND THE GANG)

NOW THAT ALL the fiddly bits are ready, it's time to install the CPU cooler. Install the four double-sided mounting thumbscrews, add the mounting bars, secure them with nuts, and apply a small dot of thermal paste to the CPU. Mount the heatsink with the crossbar and tighten the screws evenly, alternating every few turns until the CPU is secure. Secure the fans onto the heatsink, making sure they are drawing air from the front of the chassis and exhausting it toward the rear. Plug both fans into the included Y-connector and attach them to the CPU_FAN header on your board.
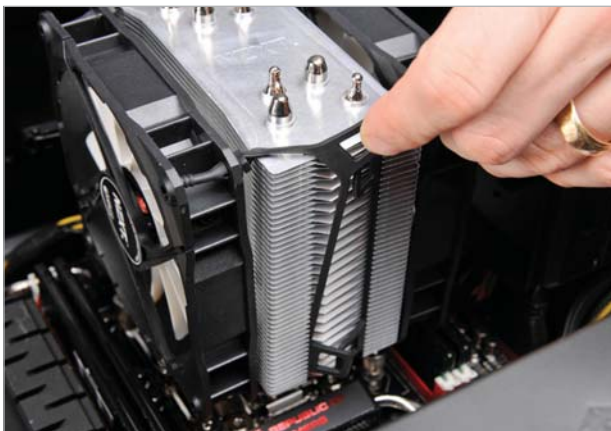
6 GAME ON

LAST, YOU'LL install your GPU. Remove the metal cover that blocks access to the expansion slots, then remove the lower two expansion slot covers (what would be the top two, if the case's motherboard orientation weren't upside down.) Install the GPU into the PCIe slot closest to the CPU cooler. If you left the top drive cage in, the end of the GPU should rest atop the cage. Secure the card into the expansion slots and plug in the two 6-pin power cables. Double-check your power and data connections, replace the metal cover, and turn the case upright. Reattach the top and side panels, and power on!

1. The TJ08-E's front fan, an 18cm Air Penetrator, is powerful enough to cool everything in the rig, thanks to the case's simplified airflow.

2. I left the empty drive cage in place to help channel air to the CPU cooler, but you can remove it if you prefer a less cluttered interior.

3. The last-minute addition of an Nvidia GTX 680 gives my rig more oomph but ruins the nice black-and-red color scheme I was going for.

PUNCHING ABOVE ITS WEIGHT CLASS

THE MIDSIZE MENACE IS small, yet mighty. It's functionally equivalent to our Tax Refund PC from last month, but in a smaller package. It uses the same CPU and amount of RAM, as well as a similar GPU. The SSD in the Midsize Menace is a little faster, and the storage drive is larger and faster, but the Tax Refund PC has a Blu-ray drive and a higher-wattage PSU.

So how much smaller is the Midsize Menace than the Tax Refund PC, which we housed in an NZXT Phantom 410 midtower chassis? The Midsize Menace, in a Silverstone TJ08-E, is just under six inches shorter than the TRPC, five inches shallower, and about a quarter-inch narrower. That makes for a lot less bulk on your desk.

Using the Rampage IV's Gamer OC BIOS setting, it took about two seconds to get a stable 4.4GHz overclock on the 3820, and Gordon Mah Ung's experience last month shows that the 3820 can be easily overclocked to 4.7GHz on air. At 4.4GHz, though, it's within spitting distance of last month's Tax Refund machine, and the differences are attributable to the clock speed. More time with the Midsize Menace, and it'd be just as fast as last month's high-end box.

If you don't mind a cramped build process and the loss of some elbow room (as well as expandability down the line), you can get a machine that's just as fast as the Tax Refund PC but more compact, for the same amount of money—or even a little less.

BENCHMARKS

	ZERO POINT		0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%
Vegas Pro (sec)	3,049	2,319	
Lightroom 2.6 (sec)	356	270	
ProShow 4 (sec)	1,112	915	
MainConcept 1.6 (sec)	2,113	1,707	
STALKER: CoP (fps)	42.0	62.3	
Far Cry 2 (fps)	114.4	151.1	

Our current desktop test bed consists of a quad-core 2.66GHz Core i7-920 overclocked to 3.5GHz, 6GB of Corsair DDR3/1333 overclocked to 1,750MHz, on a Gigabyte X58 motherboard. We are running an ATI Radeon HD 5970 graphics card, a 160GB Intel X25-M SSD, and 64-bit Windows 7 Ultimate.

REVIEWS

TESTED. REVIEWED. VERDICTIZED.

INSIDE

ORIGIN PC
CHRONOS
PAGE 77

ORIGIN

The traditional shoebox design might not gracefully blend into a living room environment, nor will the noise.

Origin PC Chronos

Fast and affordable, this rig takes aim at Alienware

ORIGIN PC'S GAME plan with its new Chronos box is pretty clear: It wants a piece of the buzz that Alienware stirred up with its much-lauded X51 mini gaming PC.

Where Origin PC hopes to punch the Alienware X51 in its exoskeleton nose is in performance. The Alienware X51 that we reviewed in the May 2012 issue came with a GeForce GTX 555 and 3GHz Core i5-2320 (the fastest configuration at the time). The Chronos easily out-specs that with its liquid-cooled 3.4GHz Core i5-2550K and EVGA Classified GeForce GTX 560 Ti 448 card. To make it even less fair, Origin takes advantage of the liquid cooler to clock the chip up to 4.7GHz on the Zotac Z68ITX-A-E board.

With its 57 percent higher base-clock speed, it's no surprise that the Chronos outpaced the Alienware X51 by more than 40 percent in our application tests, as well as nearly 110 percent in STALKER: CoP and 78 percent in Far Cry 2.

But what about small form factors with a bit more muscle? We compared the Chronos to the CyberPower LAN Party Evo that we reviewed in July 2011 and found that the Chronos actually did pretty well. Granted, it's not completely fair to put a PC today against one available last summer, but we'll do it anyway. The LAN Party Evo box had nearly the same chassis, but was packed with a GeForce GTX 580, a 3.4GHz Core i7-2600K, and a 120GB SSD. The Chronos actually wins in three of our app benchmarks and ties in one. On the other hand, it makes an interesting statement about Hyper-Threading. Despite being clocked 1.3GHz slower, the Evo's 2600K is right on the tail of the non-Hyper-Threaded Core i5-2550K. The Evo's full-boat GeForce GTX 580 also outruns the Chronos's GPU. That LAN Party Evo, however, cost about $900 more in 2011 money.

It's not all about specs and shekels, though. You also have to consider the other tangibles in this class of machine: Is it quiet? Are there gaffes with the build? We think the Chronos is a bit loud thanks to its heavy overclock; both the CyberPower and the Alienware rigs were nearly silent—especially the X51, with its Optimus technology, which lets it run on its whisper-quiet integrated graphics for low-intensity uses. Why other vendors can't get this feature yet we don't know. Hear us, Nvidia?

We also have an issue with the slot-fed drive in the Chronos. The way the drive is mounted leaves a slight gap between it and the case, which caused us to slip a disc into the case and not the drive.

So is the Chronos an X51 slayer? We don't think so. It's still about $200 more than the X51, and to be frank, we think they don't directly compete. As much as Alienware denies it, we see the X51 as an attack on gaming consoles—it's more of a console form factor box than a small form factor box, in our opinion. That doesn't take away from Origin PC's Chronos, though.

At this price, it offers a lot of performance in a traditional shoebox design that's perhaps more at home at a LAN party than a media center rack. **–GORDON MAH UNG**

VERDICT
9

Origin PC Chronos

➕ **WEREWOLVES** Fast, cheap, and compact.

➖ **VAMPIRES** SSD caching would help drive performance; it's a tad loud.

$1,200, www.originpc.com

BENCHMARKS

	ZERO POINT		
Vegas Pro (sec)	311	2,747 (-89%)	
Lightroom 2.6 (sec)	356	307	
ProShow 4 (sec)	1,112	798	
MainConcept (sec)	2,113	1,833	
STALKER: CoP (fps)	4,006.0	41.2 (-99%)	
Far Cry 2 (fps)	114.4	102.1 (-11%)	

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

Our current desktop test bed consists of a quad-core 2.66GHz Core i7-920 overclocked to 3.5GHz, 6GB of Corsair DDR3/1333 overclocked to 1,750MHz, on a Gigabyte X58 motherboard. We are running an ATI Radeon HD 5970 graphics card, a 160GB Intel X25-M SSD, and the 64-bit version of Windows 7 Ultimate.

SPECIFICATIONS

Processor	Intel 3.4GHz Core i5-2550K OC'd to 4.7GHz
Mobo	Zotac Z68ITX-A-E
RAM	8GB Kingston DDR3/1600
Videocard	EVGA GTX 560 Ti 448 Classified
Soundcard	Onboard
Storage	750GB HDD (7,200rpm)
Optical	Slot-fed DVD burner
Case/PSU	Silverstone SG08 / 600W PSU

The Apple filling really won't burn your tongue.

Apple iPad
One giant high-res step forward for tablets

APPLE DIDN'T CALL the newest iPad the iPad 3 or the iPad HD—just the iPad. And that's fitting, because while it's a handsome upgrade to the best tablet on the market, it's not a huge leap forward. If you've used any iPad for more than 10 minutes, this won't blow you away—the revolution was two years ago. Now it's time to iterate.

Yes, it's a little bit thicker: 9.4mm, compared to the 8.8mm iPad 2. And it's a skootch heavier: 1.44 pounds, or 1.46 pounds if you get Wi-Fi + 4G; the iPad 2 ranged from 1.33 pounds for Wi-Fi to 1.35 pounds for the AT&T version of the Wi-Fi + 3G. We bet you won't notice. What you will notice is the 4G/

LTE speed and the Retina display.

The bright 9.7-inch display's dizzying resolution is now 2048x1536, or 264ppi. That's four times the pixels on the 1024x768 iPads of yore, and the best screen we've ever seen on a hunk of electronics. It's got a million more pixels than a 1920x1080 HDTV, plus better color saturation than the iPad 2.

And Apple's offering 4G LTE models (which also add HSPA+) on both Verizon and AT&T. We recommend Verizon—it throws in Personal Hotspot for free with your data plan. But even the AT&T one is zippy: The best speed we saw in dozens of tests on the LTE network was 53Mb/s downlink, and the worst was a still-speedy 9Mb/s. LTE has a maximum theoretical throughput of 73Mb/s, but, of course, results will vary based on the strength of the network in your area. The new iPad's Bluetooth 4.0 is also a step up from the previous model's Bluetooth 2.1 + EDR.

Battery life is awesome: Apple claims 10 hours on Wi-Fi or nine hours on 4G LTE, and we regularly got more than that, up to 14 hours of mixed use. Since the battery is larger (42.5 watt hours), it takes longer to charge. You pretty much have to charge it overnight to go from nearly empty to full.

Inside, the A5X chip is an Apple-designed, dual-core, 1GHz system-on-chip with 1GB of RAM and quad-core graphics. It runs fast, with a Geekbench score of 746, but it can get a little warm if you're doing processor-heavy stuff—don't believe the hype, you won't be physically burned. It's fast and responsive, with no noticeable lag

and super-quick loading times.

The camera is pretty capable, if you're confident enough in your own coolness to walk around snapping photos with a tablet. The rear "iSight" camera takes 5MP stills and 1080p video, with an infrared filter, face detection, tap-to-focus, and video stabilization. The front camera hasn't improved, taking VGA-quality stills and video—it's great for videochatting, but that's about it.

The built-in voice dictation is super handy, but it's not full Siri; that beta service is still limited to the iPhone 4S. Just as well—Siri requires a network connection, and even then it just stops working if the server is too busy. Adding a few million new users probably wouldn't help.

So should you upgrade? If you have a tablet and you're happy with it, don't rush out and get the new iPad. But if you're buying your first tablet, Apple's is the king of the hill, with more than 200,000 iPad-specific apps, and the most polished mobile OS. **–SUSIE OCHS**

SPECIFICATIONS

Operating System	iOS 5.1
Processor	1GHz dual-core A5X
Memory	1GB
Storage	16GB, 32GB, 64GB
Cameras	5MP rear (1080p video), VGA front
Connectivity	IEEE 802.11b/g/n, optional 4G LTE (AT&T model also has UMTS/HSPA/HSPA+/DC-HSPA, GSM/EDGE. Verizon model has CDMA EV-DO Rev. A, UMTS/HSPA/HSPA+/DC-HSPA, GSM/EDGE), Bluetooth 4.0
Weight	1.44 pounds (Wi-Fi model), 1.46 pounds (Wi-Fi + 4G)
	5MP rear (1080p video), VGA front
Dimensions	9.5x7.31x0.37 inches

VERDICT 9 KICK ASS!

Apple iPad

➕ **FUJI** Same price; quad-core graphics; better camera; LTE speeds; gorgeous high-resolution display.

➖ **GRANNY SMITH** iPads with A5 and A5X processors haven't been jailbroken; same storage capacities as iPad 2.

$730, www.apple.com

Thanks to advances in areal density, today's 5,400rpm drives are faster than the 7,200rpm drives of yesteryear.

Hitachi Deskstar 5K4000

Finally, a 4TB hard drive. That's one more than three!

MOST OF US DON'T NEED 4TB hard drives. Most of us don't even need 3TB drives. Unless you create, edit, or store lots of high-definition video; have backups of all your machines; have a massive lossless audio library; or…. You know what? Maybe we do need 4TB drives. After a couple of years making do with puny 3TB drives (like animals!), it's time to get 25 percent more stuff into our 3.5-inch drives. Though other drive makers offer 4TB external drives, Hitachi GST is the first drive maker to give you 4TB on the inside. And didn't your mother or mother-equivalent teach you that it's what's on the inside that counts?

We've been expecting 4TB drives since Seagate's 1TB/platter 3TB drive in the January 2012 issue, but the four-platter 4TB 7,200rpm drive we've been dreaming of isn't here yet. Instead, we get Hitachi's Deskstar 5K4000, which packs a full four terabytes into a standard 3.5-inch drive, but on five platters, not four. The platters have a maximum areal density of 443Gb per square inch. The 5K4000 has 32MB of cache, a 6Gb/s SATA controller, and a spin speed of 5,400rpm.

One of the wonders of modern areal density is that today's 5,400rpm drives can hit average sustained read and write speeds north of 100MB/s—truly impressive, considering a fast 7,200rpm drive couldn't average 90MB/s four years ago. By that standard, the Deskstar 5K4000 is excellent, with read averages of 108MB/s and writes of 105MB/s across the whole disk. Of course, because this is a mechanical drive, that means speeds vary—read and write speeds start near 140MB/s near the beginning of the volume but fall to around 60MB/s at the end. Random-access times average around 19ms—on the slower side for a modern 5,400rpm drive.

The 5K4000 is faster than the 3TB Caviar Green, but slower than a 7,200rpm 3TB drive. No surprise there.

Hitachi flat-out refused to give us an MSRP for the Deskstar 5K4000, so our street price is based on the one store carrying the 4TB Deskstar at press time: OWC (Macsales.com), which sells the drive for $350. Hard drive prices are still in flux, but at press time you could get a 3TB Seagate Barracuda for $200, meaning you could score 6TB of faster storage for just $50 more than the 4TB Hitachi drive. However, the two Barracudas would take up twice the space, consume more power, and put out more heat.

If you just want the single highest-capacity hard drive you can get today, the Deskstar is your drive. Hitachi gets points for being first out of the gate, and we look forward to both the 7K4000 and four-platter 4TB drives from other vendors. **–NATHAN EDWARDS**

BENCHMARKS

	Hitachi Deskstar 5K4000	Seagate Barracuda 3TB	Hitachi Deskstar 7K3000 (3TB)	WD Caviar Green (3TB)
HDTune 4				
Avg Read (MB/s)	108.3	**155.8**	119.5	101.5
Random-Access Read (ms)	19.9	**14.9**	15.7	15.7
Burst Read (MB/s)	**378.3**	325.7	318.7	183.3
Avg Write (MB/s)	105.6	**150.7**	118.5	96.9
Random-Access Write (ms)	18.5	**14.9**	15.7	15.6
Burst Write (MB/s)	335	**335.5**	315.6	183.1
Premiere Pro Encode (sec)	435	455	**435**	530
PCMark Vantage	6,135	6,766	**7,663**	4,910

Best scores are bolded. All drives tested on our hard drive test bench: a stock-clocked Intel Core i3-2100 CPU on an Asus P8P67 Pro (Rev 3.1) motherboard with 4GB DDR3, running Windows 7 Professional 64-bit. All tests performed using native Intel 6Gb/s SATA chipset with IRST version 10.1 drivers.
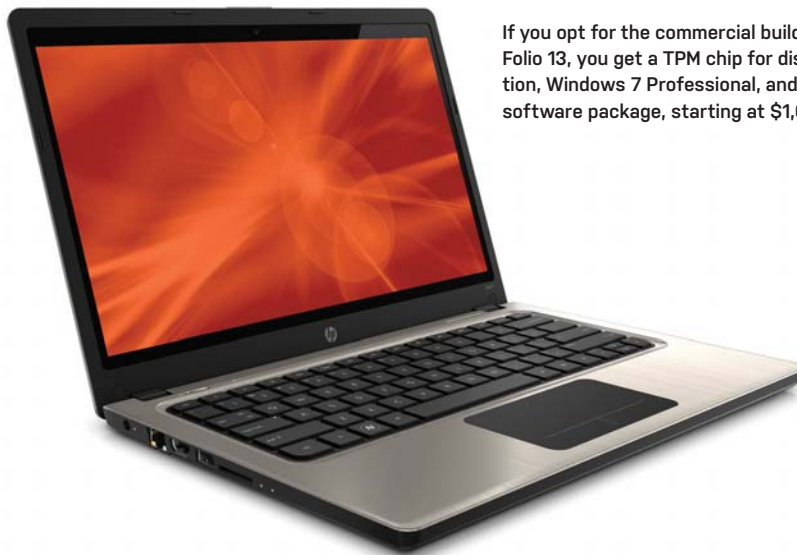
VERDICT

8

Hitachi Deskstar 5K4000

➕ **FORTEANA** Four terabytes! One drive!; average sustained speeds above 100MB/s.

➖ **FART** Slower than a 7,200rpm drive; first out the gate means lack of competition.

$350 (street), www.hitachigst.com

If you opt for the commercial build of the Folio 13, you get a TPM chip for disk encryption, Windows 7 Professional, and a cleaner software package, starting at $1,000.

Edge-to-edge Gorilla glass adds to the XPS 13's sharp aesthetic and makes the screen less vulnerable to the rigors of regular use and travel.

Ultrabook Pro-Am

HP and Dell offer up portables that bridge the work/recreation divide

The first wave of ultrabooks to hit our Lab (February 2012) surprised us by actually delivering on the much-hyped mix of good looks, portability, and affordability. There was, of course, variation in how closely each of the first four models we tested hit the mark, but we were genuinely impressed. The standout in that first cohort was Asus's UX31E Zenbook. This month we see how ultrabooks from Dell and HP measure up. **–KATHERINE STEVENSON**

HP FOLIO 13

While HP's Folio 13 is sized similarly to the other ultrabooks we've tested, sporting a 13.3-inch screen and measuring 12.54x8.67x.7 inches, it's a bit heavier than the others, but not by much. With a lap weight of 3 pounds, 4.8 ounces, it's 3.7 ounces heavier than the Asus Zenbook, although its battery is nearly twice the size and weight of the latter's.

Aesthetically, the Folio 13 is pleasing.

The lid, keyboard deck, and palm rest are all brushed aluminum. Screen bezel, trackpad, and keyboard are black, as is the Folio's underside, which sports a rubberized finish that makes the laptop nicely grippable. In all, it's a handsome and well-contructed device.

The Folio 13's port selection is comparatively generous for this class. Ethernet, full-size HDMI, and a media reader are all welcome inclusions, and one of the two USB ports is a 3.0 variety, although the driver for the Fresco Logic USB 3.0 controller wasn't installed in our model (d'oh!). When it was, performance for the port was in line with expectations, giving us reads and writes to an external USB 3.0 drive of 217.7MB/s and 184.4MB/s, respectively.

The guts of the Folio 13 consist of a 1.6GHz Intel Core i5-2467M, 4GB of RAM, and a 128GB SSD. The specs aren't dissimilar to what we found in the Asus Zenbook, and the two fall within the same price range, but the Zenbook performed considerably better in our tests. (Check out the benchmark chart, where the Zenbook now represents our new ultraportable zero-point.) The Zenbook clearly enjoys the advantages of a 20

BENCHMARKS

		ZERO POINT		
Premiere Pro CS3 (sec)	1,080	1,500 (-28%)		
Photoshop CS3 (sec)	168.3	177 (-4.9%)		
ProShow Producer (sec)	1,347	1,842 (-26.9%)		
MainConcept (sec)	2,354	3,251 (-27.6%)		
Quake III (FPS)	217.3	152.6 (-29.8%)		
Quake 4 (FPS)	46.6	37.8 (-18.9%)		
Battery life (min)	310	317		

0%   10%   20%   30%   40%   50%   60%   70%   80%   90%   100%

Our zero-point ultraportable is an Asus Zenbook UX31E with a 1.7GHz Intel Core i5-2557M, 4GB of DDR3/1333 RAM, integrated graphics, a 128GB SSD, and Windows 7 Professional 64-bit.

SPECIFICATIONS

CPU	1.6GHz Intel Core i5-2467M
RAM	Single-channel 4GB DDR3/1333
Chipset	Intel HM65
Display	13.3-inch, LED-backlit, 1366x768
Storage	Samsung 128GB SSD
Connectivity	USB 2.0, USB 3.0, HDMI, headphone/mic, Ethernet, media reader, webcam, Bluetooth, 802.11 a/g/n
Lap / Carry	3 lbs, 4.8 oz / 4 lbs, 0.7 oz

percent faster CPU (when you combine base clock and Turbo frequency), a superior SSD (which runs on a 6Gb/s bus), and a dual-channel RAM configuration.

In use, the Folio 13 is accommodating. The keys on the island keyboard are a good size, and their slightly rubberized texture feels nice to the touch and keeps your fingers from slipping; the keyboard is backlit. The trackpad is responsive and does a respectable job with scrolling and multitouch gestures, but the integrated right and left buttons require a little more pressure than we prefer. The screen offers the same resolution as most other ultrabooks, 1366x768 (the exception being the Zenbook's 1600x900), and like the others, it's a TN panel, which means a narrow optimum viewing angle and comparatively poor contrast. And the Folio's screen doesn't get particularly bright. Its speakers, on the other hand, pump out surprisingly full sound for a laptop of this size. Our model—the consumer build vs. commercial—included the Windows 7 Professional upgrade (Windows Home Premium comes standard at the base price of $900), along with a host of third-party apps (of varying usefulness), as well as HP's own suite of management software.

There's a lot here for the price, alright, in an attractive, well-made body, but the fact is, Asus's Zenbook UX31E offers more performance and more cutting-edge style for nearly the same price.

DELL XPS 13

Dell's XPS 13 certainly isn't wanting for style. Sporting a slick wedge profile that measures .24–.71 inches front to back, the XPS 13 is all matte-silver, machined aluminum up top, with a carbon fiber base. A soft-touch surface on the bottom makes the device easy to grip and two rubber "feet" that run horizontally along the underside will surely hold it in place on any surface and promote airflow. Dell even took care to construct a thin metal door on the XPS 13's underside to hide the Windows certificate of authenticity sticker and sundry other unsightly logos.

An embedded magnet keeps the lid securely attached to the base when the laptop is closed, but opening it can be a challenge—it's a two-handed affair. Inside, the XPS 13 continues its logo-free theme (save for the "XPS" on the screen bezel). The black, soft-touch palm rest is void of third-party branding. It's kept company by a black magnesium clickpad and a shiny black island keyboard, which is backlit. The screen consists of edge-to-edge Gorilla glass. As with the HP Folio 13, it's 13.3 inches with a 1366x768 resolution. The TN panel displays all the typical weakness—move your head or the screen beyond the narrow sweet spot and see contrast and colors diminished.

Dell offers the XPS 13 at a starting price of $1,000, configured similarly to HP's Folio 13, but the company sent us its beefiest configuration, sporting a 1.7GHz Intel Core i7-2637M and a 256GB SSD on a SATA 6Gb/s bus. The difference is apparent in our benchmark results. The XPS 13 performed pretty closely with our zero point, save for the Photoshop test, where the Zenbook displayed anomalous results. The XPS 13's slight leads are likely due to the 2637M's 100MHz Turbo frequency advantage. Aggressive cooling could also be a factor—the XPS 13's fan was noticeably, even distractingly,

loud under load (even after a BIOS update meant to address thermals). Because it's priced nearly 50 percent more than the Zenbook, we'd have hoped for a larger performance delta. Sure, twice the storage capacity counts for something, but $400-plus? And for that you get no media reader or Ethernet port.

On the other hand, the XPS 13 is enterprise-friendly, offering TPM along with other IT-centric options. It also features Intel's Smart Connect technology, which updates your email and select apps while your system is asleep, so the most current info is there for you instantly. Rapid Start, a requisite of ultrabooks, is present, too, making the XPS 13 capable of booting in 19 seconds and coming out of sleep near-instantaneously.

Is it a solid package? You betcha—particularly for business-folk who aren't budget-conscious.

VERDICT

8

Dell XPS 13
$1,500, www.dell.com

SPECIFICATIONS

CPU	1.7GHz Intel Core i7-2637M
RAM	Dual-channel 4GB DDR3/1333
Chipset	Intel HM65
Display	13.3-inch, 1366x768
Storage	Samsung 256GB SSD
Connectivity	USB 2.0, USB 3.0, Mini DisplayPort, headphone/mic, webcam, Bluetooth, 802.11 a/g/n
Lap / Carry	2 lbs, 15.9 oz / 3 lbs, 9.3 oz

VERDICT

7

HP Folio 13
$1,020, www.hp.com

BENCHMARKS

		ZERO POINT	
Premiere Pro CS3 (sec)	1,080	1,080	(0%)
Photoshop CS3 (sec)	168.3	109	
ProShow Producer (sec)	1,347	1,300	
MainConcept (sec)	2,354	2,248	
Quake III (FPS)	217.3	228.5	
Quake 4 (FPS)	46.6	46.7	
Battery life (min)	310	266	(-14.2%)

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

Our zero-point ultraportable is an Asus Zenbook UX31E with a 1.7GHz Intel Core i5-2557M, 4GB of DDR3/1333 RAM, integrated graphics, a 128GB SSD, and Windows 7 Professional 64-bit.

SPECIFICATIONS

	Radeon HD 7870	Radeon HD 6870	Radeon HD 6950
Stream Processors	1,280	1,120	1,408
Geometry Engines	2	1	2
Core Clock	1,000MHz	900MHz	500MHz
Memory Clock	1,200MHz	1,050MHz	1,250MHz
Memory Type	2GB 256-bit GDDR5	1GB 256-bit GDDR5	2GB 256-bit GDDR5
Texture Units	80	56	88
ROPs	32	32	32

XFX's HD 7870 is equipped with HDMI, DVI, and DisplayPort—sadly, adapters for other connectors must be purchased separately.

XFX Radeon HD 7870 Black Edition

Recaptures the crown in the $350 category

AMD'S MARKETING pitch for the new Radeon 7800-series GPUs suggests that "serious gaming starts here." Built on AMD's Graphics Core Next, the 7800 series, previously code-named "Pitcairn," offers impressive performance for less than the price of AMD's 7900 series. Let's take a quick look at key features, as compared to the Radeon HD 6870 and 6950 GPUs, AMD's previous players in the mid-range.

The 7870 has 1,280 stream processors—more than the 6870, but fewer than the 1,408 in the Radeon HD 6950. The 7870's 1,000MHz stock clock speed is 11 percent higher than the 900MHz of the 6870, and twice the 6950's 500MHz clock. In the Black Edition HD 7870, XFX boosts the core clock an additional 5 percent to 1,050MHz. The 7870 ships with the same 2GB of 256-bit GDDR5 as the 6950—double the 1GB of the 6870.

The Black Edition ships with XFX's semi-custom dual-fan cooling solution. As with past cards in this class, the HD 7870 requires two 6-pin power connectors. One disappoint-ment: XFX is continuing its policy of leaving out monitor adapter connectors, so if you don't have a DVI, HDMI, or DisplayPort connector on your monitor, then you'll need to shell out a little extra for one. It's mostly not a problem for single-display users, but people with multiple monitors may need to acquire adapters.

The downside: Radeon HD 7870 cards, including the XFX Black Edition, will be priced in the $350 range. The Radeon HD 6870 cost around $250 to $270 when it first shipped. So is the XFX Black Edition HD 7870 worth the price? Let's look at performance compared to MSI's seriously overclocked Radeon HD 6950 and Asus's GTX 570 Direct CU II. We'll also toss in numbers for the older XFX Radeon HD 6870, but it's really no competition for the new 7870.

We ran our standard suite of benchmark numbers, reporting the scores for 1920x1200 with 4x AA enabled where possible. The XFX Radeon HD 7870 crushes all comers in its class, with one exception: the heavily tessellated HAWX 2 benchmark. That answers the pricing question: The XFX HD 7870 is the king of the hill in its class at the moment. Power usage at idle is impressively low, as well, and the card's noise levels don't get too annoying under load.

The bad news for AMD is that Nvidia now has its Kepler machine rolling, so it's likely that AMD and XFX will have some competition in this price range in the near future. But for the time being, you can't pick up a better card for $350. **–LOYD CASE**

BENCHMARKS

	XFX Radeon HD 7870	Asus GTX 570 DirectCU II	MSI Radeon HD 6950 Twin Frozr III	XFX Radeon HD 6870
Price	$360	$315	$320	$142
3DMark 2011 Perf	**6,994**	6,063	5,412	4,478
3DMark Vantage Perf	**27,800**	24,493	22,987	19,374
Unigine Heaven 2.5 (fps)	**33**	29	24	21
Shogun 2 (fps)	**34**	31	29	DNR*
Shogun 2 (1080p, fps)	**61**	44	48	41
Dirt 3 (fps)	**72**	65	40	52
Far Cry 2 / Long (fps)	**114**	109	102	83
HAWX 2 DX11 (fps)	143	**154**	101	97
STALKER: CoP DX11 (fps)	**43**	37	36	27
Just Cause 2 (fps)	**56**	52	43	37
Batman: Arkham City	**61**	60	55	46
Metro 2033	**22**	**22**	**22**	4
Core / Memory Clocks (MHz)	1,050 / 1,250	742 / 950	850 / 1,300	900 / 1,050
System Power @ idle (W)	**119**	127	126	121
System Power @ full throttle (W)	299	310	273	**254**

*Shogun 2 benchmark at 1920x1200 with max detail and 4x AA will not run on cards with only 1GB of frame buffer. Best scores are bolded. Our test bed is a 3.33GHz Core i7 3960X Extreme Edition in an Asus P979X Deluxe motherboard with 16GB of Corsair DDR3/1600 and an AX1200 Corsair PSU. The OS is 64-bit Windows Ultimate. All games are run at 1920x1200 with 4x AA unless otherwise noted.

VERDICT 9 KICK ASS!

XFX Radeon HD 7870 Black Edition

➕ **SEVEN SAMURAI** Seriously fast for its price; low power usage at idle; 2GB frame buffer.

➖ **THE LAST SAMURAI** No monitor adapters in the box.

$360, www.xfxforce.com

Phanteks PH-TC14PE

Noctua imitator impresses

YOU'RE FORGIVEN if you've never heard of Phanteks. After all, the company only makes one heatsink, though it comes in four colors, and it's only been out since last fall. The Phanteks PH-TC14PE consists of a nickel-plated copper heatsink and five thick heat pipes, rising through two sets of anodized aluminum cooling fins in orange, blue, red, or plain ol' aluminum.

Fans of Austrian engineering might notice that the PH-TC14PE looks a lot like Noctua's NH-D14. They're almost exactly the same (massive) size and follow the same basic design. The TC14PE's box even says "Designed in Europe." But, see, it's totally different, because the Phanteks cooler has five thick heat pipes and the Noctua has six smaller-diameter pipes. The Phanteks' colored fin stack is a tiny bit shorter than the tips of the Noctua's heat pipes and around a tenth of an inch wider. Also like the Noctua, the Phanteks cooler can interfere with the RAM slots on some motherboards. We couldn't install it at all on a microATX Rampage IV board, and we had to use RAM without towering heat spreaders on our P9X79 Deluxe board in order to install the Phanteks.

You can clip up to three fans onto the TC14PE. The Phanteks comes with two 14cm 3-pin fans and a dizzying array of accessories, including a PWM adapter and a Y-splitter. It includes mounting brackets for LGA775, 1155/1156, 1366, and 2011, as well as AM2, 2+, 3, 3+, and FM1. The mounting bracket is a variant on the usual mounting-bar-and-crossbeam setting. It's sturdier and easier to use than NZXT's but not as solid and chunky as Prolimatech's—though it enables more pressure between the CPU and heatsink. There's even less room between the fin stacks than there is on the Noctua, so you'll need a very long or very skinny screwdriver to mount the Phanteks heatsink.

On our overclocked LGA2011 test bed, the Phanteks PH-TC14PE performed incredibly well: nearly 3 C cooler than the NH-D14 SE2011 and NZXT Havik 120, our previous favorites. With an additional Phanteks 14cm fan, temperatures dropped another 2 C.

The Phanteks PH-TC14PE outperforms the Noctua NH-D14 SE2011 on our tests, but has a slightly tougher installation process, and its fans, unlike the NH-D14 SE2011's, require an adapter for PWM. It's about $10 more expensive, but it does come in four different colors, which is a nice touch. If your build has room for a giant air cooler, we've never tested a better one. **–NATHAN EDWARDS**

VERDICT
9
K!CK ASS!

Phanteks PH-TC14PE

➕ **FANBOY** Best performing air cooler we've tested; comes in four colors.

➖ **BRAN** Huge; conflicts with large RAM heat spreaders; narrow install.

$100, www.phanteks.com

BENCHMARKS

	Phanteks PH-TC14PE	CM Hyper 212 Evo	Noctua DH-14
Ambient Air	25	**23.8**	25.2
Idle Temperature	**34.2**	36.2	**34.1**
Burn Temperature	**69.3**	74	72.3

All temperatures in degrees Celsius. Best scores bolded. All tests performed using an Intel Core i7-3960 at 4.2GHz, on an Asus P9X79 Deluxe motherboard with 16GB DDR3/1600, in a Thermaltake Level 10 GT with stock fans set to High.
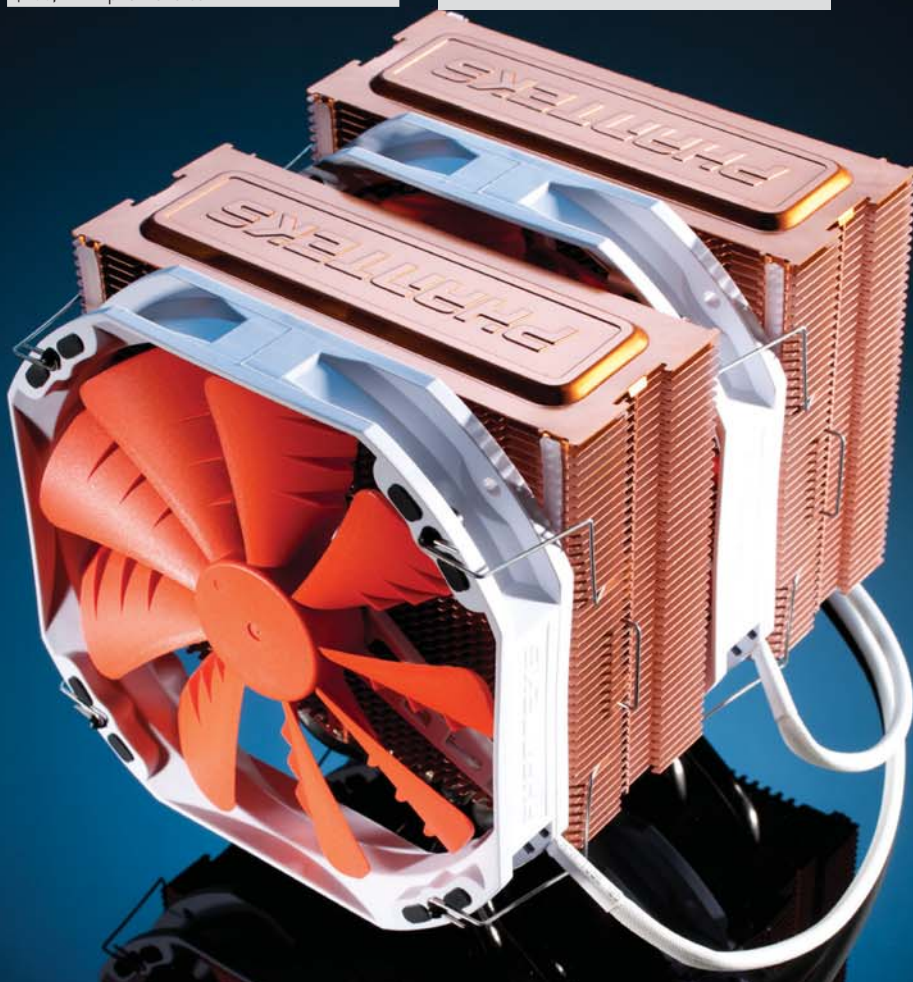
The bland looks shouldn't dissuade you from the VP2365-LED's excellent performance.

ViewSonic VP2365-LED

This affordable IPS panel has us smitten

THIS E-IPS SCREEN from ViewSonic shows what's possible when a technology is pushed hard enough. With a 23-inch diagonal screen and 1920x1080 resolution, the VP2365-LED ticks the same full-HD 1080p box as cheap TN panels; but look closer and you'll spot the differences.

The viewing angles are quoted at 178 degrees for both horizontal and vertical. That might not sound like a dramatic increase over the 170 and 160 degrees typically claimed for TN screens, but it makes a huge difference. The 1,000:1 static contrast ratio also hints at a quality panel.

Slightly less impressive is the 6ms claimed for gray-to-gray pixel response. It's the one metric by which IPS panels can't compete with TN technology. The VP2365-LED's 250cd/m2 brightness isn't exactly stellar, either, especially considering that it packs an LED backlight rather than old-school CCFL tech. The screen's stand and chassis are bland to the point of anonymity, but the device is sturdy and stable. It also offers full adjustability, including rotate, swivel, tilt, and VESA wall-mount compatibility.

What you don't get is much peripheral technology. Unlike many cheaper screens, the ViewSonic VP2365-LED's onscreen menu isn't stuffed with fancy image-processing options, but offers full color, gamma, and temperature configurability. There's a dynamic contrast function too, but switchable pixel-response modes and fancy adaptive color processing are absent.

Frankly, that's no great loss. Nor is the superficially limited connectivity (DVI and VGA is your lot) much of a downside. Instead, ViewSonic has cooked up a no-nonsense package that focuses on the things that matter—panel, backlight, and chassis quality.

The VP2365-LED put in a strong showing in the Lagom suite of test images (www.lagom.nl/lcd-test/). Both black and white scales offered oodles of detail. The color scales weren't shabby, either, and the viewing angles did the usual IPS thing, which means they were wide enough to be a non-issue. That often annoying effect of IPS screens, IPS glow, wasn't evident.

It's not entirely flawless, though—the 250cd/m2 backlight rating translates into less than retina-searing brightness. This isn't an issue in normal use, but it makes for a slightly less flexible monitor. The only other hitches involve the pixel response and refresh rate. Both, frankly, are relative. In absolute terms, the VP2365-LED is more than quick enough for games, movies, you name it. But it's not as lightning-quick as an overdriven TN panel.

Overall, this is an incredibly impressive panel. It's not quite the holy grail of PC paneldom—a screen that marries the best attributes of all available monitors, ditches the bad bits, and does it all at price you can afford. That the ViewSonic VP2365-LED doesn't quite pull that off is no surprise. But it comes awfully, awfully close—much closer than any other screen in the same price bracket. **–JEREMY LAIRD**

VERDICT
9

ViewSonic VP2365-LED

➕ **POTATO WEDGES** Great bang for the buck.

➖ **TATER TOTS** Bland chassis; could be brighter.

$320, www.viewsonic.com

Seasons don't fear the Reaper, but everyone else does, and they should.

Mass Effect 3

Shepard goes out with a very big bang

OUR SHEPARD LOOKS like hell. He's got shadows under his eyes that'd frighten the seediest of back-alley dwellers. Even when he smiles—for instance, while warmly embracing an old friend—there's a palpable weariness to the gesture. This man, this hero we've piloted through countless near-apocalyptic trials and tribulations, is at the end of his rope. The Reapers have decided that all organic life is ripe for the picking, and Earth's looking mighty juicy. Shepard's got the weight of the entire universe on his shoulders, and little by little, every agonized step forward breaks his back a bit more.

After playing through Mass Effect 3, we look a lot like our Shepard, but for different reasons. We clearly haven't slept, and basic hygiene has become so foreign a concept that we reply to the word "shower" with, "Yeah, it's about 4:27 p.m." Mass Effect 3, you see, is one of those experiences. By no means is it perfect, but it's a tale so gripping as to have its own gravitational pull. It's Shepard's darkest hour,

and we had no intention of seeing the sun until its credits roll.

By and large, it was quite a ride, too. There's a renewed sense of urgency to the proceedings that all but evaporated under the relaxing afternoon sun of Mass Effect 2's leisurely jaunt. The Reapers have finally arrived. Humans, Turians, Krogans, and probably Count Choculans are dying right and left. There's no time to stop and smell the roses—or help, like, 12 supposed intergalactic badasses deal with serious daddy issues, as it were. Mass Effect 3 is a race to the finish from start to, well, finish.

Well, mostly. The game does occasionally get bogged down in "go here, grab this for the War Effort" fetch quest-ery. Granted, these missions are generally quick and relatively painless, but they add up to the point of threatening to overwhelm. Moreover, being the universe's own personal Boy Scout—say, by finding a Medi-Gel formula for one doctor while every

passing second supposedly moves all life closer to certain doom—sometimes creates an experience that's jarringly at odds with itself.

By and large, though, Mass Effect 3 is an incredibly satisfying conclusion—especially if you've been along for the ride throughout the whole series. Without spoiling anything, previous choices come back in a big way, and closure-packed cameos abound. Despite the depressing finality of it all, Mass Effect 3 left us with big, goofy grins on our faces more times than we can count. BioWare's galaxy-size ambitions paid off in spades, creating a fascinating universe full of friendly faces—something, in other words, that we desperately wanted to save.

Fortunately, we had quite an impressive suite of tools at our disposal with which to do it. Combat this time around feels impressively weighty, and class skills take branching paths as they level up. For instance, one level of our Vanguard's bone-shattering charge attack allowed us to pick between a wider impact radius or higher single target damage. So it's a matter of tailoring different skills to your play style over time. Copious weapon modifications, meanwhile, gave us a similar degree of control over how our enemies met their exceedingly painful fates after they said hello to our little friends. No, it's not a return to the
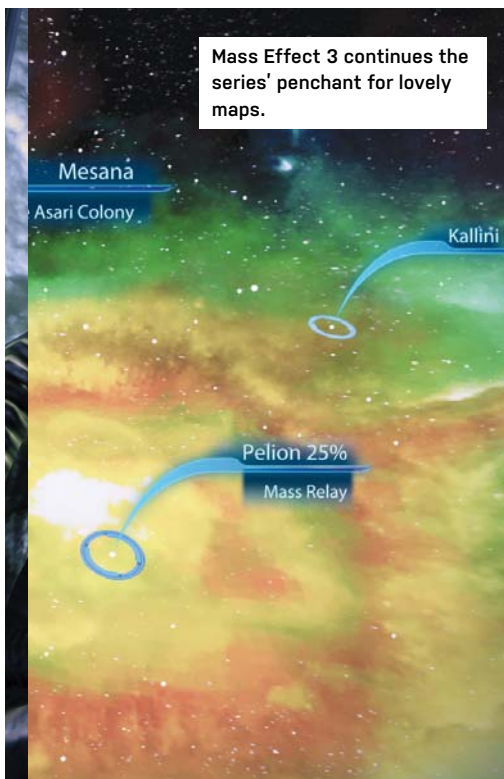
Mass Effect 3 continues the series' penchant for lovely maps.

There's no shortage of Reapers and other baddies to fold, spindle, and mutilate.

It's not all Gigeresque biomechanical foes; sometimes you just gotta fry a mech.

Good Olde Days when RPGs required reams of spreadsheets and a friend you suspect may have been bitten by a radioactive calculator, but it's a welcome step up from Mass Effect 2's straight-and-narrow progression.

Level design, similarly, won't have first- and third-person shooting's finest quaking in their combat boots, but we did find quite a few areas with multiple paths and vertical structures that let us get the drop on our foes. On the downside, squad control is still a console-centric mess, with only extremely imprecise line-of-sight targeting to dictate where your thick-headed, squishy-brained squad members end up. We would have killed for a Dragon Age: Origins–style isometric tactical view, but instead, enemies just killed us while we shouted, "No! Use the other side of cover!" in protest.

By comparison, the much-vaunted addition of up-close-and-personal melee attacks and rolls have a much softer impact on the experience. Sure, we dodged and flopped around like the universe's most deadly beached dolphin, but it didn't factor too heavily into the actual effectiveness of our battle strategies. Moreover, while "SHEPARD SMASH"-ing baddies across rooms was especially satisfying for our biotic, borderline-psychotic Vanguard, the latter half of the game basically made it suicidal with

a couple of insta-death melee enemy types.

Oddly enough, the refined combat doesn't truly get its chance to shine until three other players have joined the fray. Yes, defying all odds, Mass Effect 3's co-op multiplayer is shockingly solid, and it even manages to tie back into the main story. It's basically Horde Mode (read: fending off waves of increasingly tougher baddies) meets RPG character progression, but BioWare knocks that seemingly simple pitch out of the park. Overwhelming chaos tends to produce all manner of class-based amusement—for instance, an Adept's black-hole-like singularity lifting enemies off the ground just in time for a Vanguard to come screaming in and punch them into an infinite abyss—and experience points roll in at an addictively satisfying pace. Sadly, however, lacking level and enemy variety relegate multiplayer to the status of particularly potent distraction—not full-blown lifestyle choice.

Then there's the glue that holds multiplayer and single-player together: Galactic Readiness. In a nutshell, it's an in-game location-based score that ultimately contributes to Shepard's success in the big Final Showdown. Admittedly, the main plot beats stay the same even if you never detach from your symbiotic relationship with single-player (and you can technically obtain needed War As-

sets via single-player side quests), but multiplayer's the most straightforward route to an optimal ending. Somewhat frustratingly, your Galactic Readiness score also drops a percent every day you don't join the multiplayer fray, so flying strictly solo is quite an uphill battle.

Ultimately, multiplayer's a not-entirely successful step off Mass Effect's well-worn path, but hardly a deal breaker. Really, the main issue is that swaying the tide of a giant, galaxy-wide war is a notion diametrically opposed to what BioWare does best: the little things. Plenty of games can be "epic," but Mass Effect's much-loved heart circulates lifeblood made up of rich personality and detail.

And in that respect, Mass Effect 3 is perhaps the most massively effective game in the series. We nearly wept as our new transport pilot, Steve, struggled to come to grips with the recent death of his husband, yet giggled to the point of tears thanks to jabs at the expense of Garrus's calibrations and Mass Effect 1's elevators. And then—all the way on the other side of the figurative room—there's Shepard's face, which quietly tallies the toll of a truly atrocious war. No, Mass Effect 3 isn't perfect. Yes, it occasionally steps on its own toes in terms of both game mechanics and writing. But honestly, as far as long, tearful goodbyes go, it doesn't get much better than Mass Effect 3. –NATHAN GRAYSON

VERDICT
9
KICK ASS!

Mass Effect 3

◼ **THE END** A fitting conclusion to one of gaming's finest trilogies; improved combat and character progression; surprisingly solid multiplayer.

◼ **THE END... ?** Fetch quests occasionally get in the way of storytelling; sometimes-frustrating squad controls; multiplayer lacks longevity, variety.

$59, masseffect.com, ESRB: M

LAB NOTES

NATHAN EDWARDS **SENIOR EDITOR**

Blueprints for
Your Budget

The back of the mag: now with better rig-building advice!

BEST OF THE BEST has been one of our most popular sections in the magazine, but because it prioritizes performance over price, building a great rig isn't always as simple as going down the list and grabbing the top product in each category. So starting this month, we've moved Best of the Best online (where, don't worry, it'll be updated) and we're using the space at the back of the magazine for a new section.

That section is called Blueprint, and here's how it works: We've built three rigs at three approximate price points: Baseline, Performance, and Ultra. Baseline gets you a powerful rig, suitable for gaming and content creation. Performance gets you more, and Ultra gets you into six-core, dual-GPU territory. These rigs are Lab-tested (and overclocked), editor-approved, and we'll keep them up-to-date. So you can build with confidence, whether you go straight off the list or use it as a jumping-off point, and whether your budget is $1,300 or $4,000.

BEST OF THE BEST
Maximum PC-approved hardware and components for your rig building needs

High-End Air Cooler
Phanteks PH-TC14PE

The Noctua-alike that out-Noctua'd Noctua, Phanteks only makes one air cooler, the PH-

Full-Tower Case
Cooler Master Cosmos II

With support for up to four graphics cards, nine fan or three radiators, and 11 hard drive bays

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Gordon Mah Ung
Deputy Editor

Rumors say the next-gen consoles will come out next year, using graphics technology already available on the PC this year. Sure, the rumors say 4K gaming will be possible, but I doubt it. At least, I doubt new consoles will be capable of even half the eye candy you get from the PC today. This just cements my belief that the consoles have already lost the next-gen gaming war before it's even begun.

Katherine Stevenson
Editor-in-Chief

This month I've been playing around with Windows 8—actually, playing is too lighthearted and fun a word for the experience. I've been clumsily stumbling around the OS, trying to figure out how to perform basic functions that I've taken for granted in previous Windows versions. Like closing a freakin' app once I'm done with it in the Metro UI! It doesn't take very long before I go running back into the warm, familiar arms of Windows 7.

Alex Castle
Online Managing Editor

I'd like to say that this month I broke down and bought the new iPad, but that wouldn't really be accurate. It was less a "breakdown" and more a "highly anticipated follow-up purchase" after getting two years of satisfaction from my first-gen iPad. My desktop loyalties will always lie with the PC, but it's time somebody who isn't Apple steps up and makes a world-class tablet experience.

Richard Koscher
Art Director

Meanwhile, in the paper technology world, I am happy to announce that *Maximum PC* has been nominated for two WPA Maggie Awards! One for Best Redesign and the second one for Best Special Interest Magazine. The awards ceremony will be held in Los Angeles. The competition is stiff and, like they say, being nominated is an honor in itself.

LETTERS

WE TACKLE TOUGH READER QUESTIONS ON...

> Apple Zealotry
> Moderate PC
> Dream Machine 2012

To BIOS or Not

I'm having trouble decid-ing which BIOS updates to install. A "good" article would be very appropriate here in the mag. When going to the manufacturer's site to download updates, there are many to choose from. For example, my Asus P5B Deluxe has years of BIOS updates to install. My com-puter is from 2006, and I have never updated my BIOS. My Gigabyte motherboard was updated once. So, do I ever need to update? Normally, you seem to suggest that it's worth staying current with a BIOS. I realize that when you have problems, update, but if everything seems to be OK, why? And what's the best way to update your BIOS?

—George Miller

DEPUTY EDITOR GORDON MAH UNG RESPONDS: You have a very good point; we could certainly do an entire article on updating the BIOS. We still feel that the general guideline holds: Don't mess with it if it works. For your vintage board, I'd just leave it alone. The only time I gener-ally try to stay on top of the latest BIOS is when a new chipset or CPU is released. In the first few months,

board vendors are usually tweaking for performance and stability and the updates are worth installing. If it's a mature chipset, though, I'd probably read through the various change logs for each BIOS to weigh the value of installing them. For what it's worth, many modern motherboards recover from bad BIOS updates quite easily. In the hundreds of motherboards I've updated, I've probably only had one go south permanently.

Heard That!

Just opened the new May issue and read the letters, particularly the "PC: Piece of Crap" letter, and my wife is wondering why I just yelled out, "Yeah, Gordon, you put that [guy] in his place!"

In my 10-plus years as an IT professional, I've had this argument with a lot of people; you just can't seem to get the Apple cult to believe that their precious Macs are not infal-lible. I'm writing this email on my iPad that I use daily and love (which, coinciden-tally, I recently had to replace the digitizer on), so I'm not "anti-Apple," by any stretch, but to think that PCs are crap and Apple is perfect just gets on my nerves. It's like the

people who bought Toyotas a few years ago, claiming they never had problems... just before their accelerators got jammed while driving.

Love the magazine, and thanks for not taking any crap from those clueless Apple turds. Have a great day.

—Mike Kinney

Too Much of a Good Thing?

Love the mag, and have been reading since the end of the *boot* days. I've always tried to stay abreast of new tech, and generally live up to the *Maximum PC* credo. But I'm finding it more and more difficult to keep up. I've got a fairly decent system, circa 2010 maybe. But it seems like in the time I waited for my Radeon 5970 on back order, a faster, better, more capable card came out. I was really pumped when I saw the cover of the latest issue, "Hard-ware Hacks" (March 2012). I was thinking that maybe I'd get some tips to bring me up to speed a bit. But alas, most of the tips were to make current, insanely fast hardware even *more* insanely fast. So I guess my question is this: Can you recommend a publication along the lines of *Moderate PC*? Even though prices are not even close to

what they used to be (I paid $3,500 for my first Pentium 75), products are developing so quickly, how can the aver-age user keep up?

—Michael Day

EDITOR-IN-CHIEF KATHERINE STEVENSON RESPONDS: I understand your frustra-tion, Michael. We experience the same feeling every year when we are configuring Dream Machine. Just when we think we've got the ulti-mate setup, newer, faster, better parts come out— sometimes before our DM is-sue even hits the newsstand! I'm sorry the Hacks article didn't help with any of your hardware, but I presume you weren't entirely serious about *Moderate PC*—what would be the fun in that? Yes, we're unabashed in our celebration of extreme computing, but you should also know that we regularly give space to more down-to-earth options, such as our "Build a PC on Any Budget" feature last month. You'll also be happy to know that our new Blueprint section in the back of the magazine will give configuration recom-mendations for PCs at three different price levels every month.

↘ submit your questions to: comments@maximumpc.com

Speaking of Dream Machine...

If the Dream Machine is all about power and excess, why haven't we seen a quad-proc setup? I was impressed with the DM2010, but was shocked to see you did not continue that multiprocessor trend with the DM2011.

I'm a hardcore gamer, but I work in film and animation, with heavy, heavy emphasis on rendering, video processing, and multitasking. Most of your builds seem focused on gaming, but I'd like to see how you guys would build a kickass quad-processor rig intended for that type of work, if not in the Dream Machine, then just a custom-build article. I was thinking a Tyan mobo, four Xeons, 48GB RAM, and more. Let's see what you can do!

—Welbon I. Salaam

DEPUTY EDITOR GORDON MAH UNG: It's a bit early to say what will be in Dream Machine 2012, but I can say that we've probably built four dual-processor machines over the years. It mostly depends on what we judge to be worthy of attempting in the short time frame we have to pick parts. When building the Dream Machine we also consider bang for the buck. While 2P boxes are pricey,

going to 4P would probably quadruple the price, and more importantly, likely would not pay dividends for a workstation user. They're often made for server applications and wouldn't support, for example, letting you run multiple graphics cards, and often have a bias toward RAM capacity, not RAM bandwidth. The processors also don't support overclocking and usually run at far lower clocks speeds. Even Google and Facebook mostly bypass 4P boxes for more affordable 2P machines. Don't get me wrong, the idea of a box with 64 available threads is sexy, but would likely not be faster in most existing benchmarks, which have a hard time pushing 12 threads sometimes. That's not to say you couldn't see a Xeon in this year's Dream Machine. Who knows, maybe a machine with 16 cores and 16 threads would be a worthwhile endeavor this year.

Hybrid Comparison, Please

You guys should write an article on hybrid SSD drives. I'm sure I'm not the only one who can't afford an SSD and doesn't want to compromise capacity. The thing with hybrid solutions, though,

is that there are so many different kinds, it's hard to know which one is the undisputed king of performance and which one gives you the best bang for buck. Some of the solutions that could be compared: OCZ Revo Hybrid drives in a PCIe slot, Seagate's Momentus XT hybrid drive, Intel's Smart Response Technology, and Gigabyte's Z68XP-UD3-iSSD motherboard.

I think this would be a fascinating article on the merger of HDD with SSD technology, which, for those of us enthusiasts on a budget (i.e., most of your readers) would be highly informative.

—Florian Prat-Vincent

SENIOR EDITOR NATHAN EDWARDS RESPONDS: Yeah, that's a good idea, especially as more companies come out with caching SSDs designed for Intel SRT. I think I did compare the Revo Hybrid to the Momentus XT in my review of the Revo (February 2012), but there's just no competition—1TB rotational storage with a 120GB SSD sweeps the floor with a 750GB drive with 8GB NAND cache. But comparing the Revo Hybrid to an SRT solution is a great idea. ⏻

[NOW ONLINE]

THE ROGUES GALLERY: 15 FRUSTRATINGLY PROPRIETARY STORAGE FORMATS

Sharing: It's one of the first things we're taught as children. One of the most basic social graces, sharing allows us to create new friendships, divvy up precious resources, and expand our horizons. Too bad the board of directors of so many high-tech companies never figured this out. Companies like Sony, Apple, and Iomega have been saddling us with proprietary memory solutions for years now. Go to bit.ly/GGH79g for our list of 15 of the very worst offenders.

THE BUILDS

BASELINE

INGREDIENTS

PART		URL
CASE	Fractal Design Define R3	www.fractal-design.com
PSU	Corsair TX750M	www.corsair.com
Mobo	Gigabyte GA-Z68XP-UD3	www.gigabyte.com
CPU	Intel Core i7-2500K @4.0GHz	www.intel.com
Cooler	Cooler Master Hyper 212 Evo	www.coolermaster.com
GPU	EVGA GeForce 560 Ti 448	www.evga.com
RAM	8GB Patriot Gamer DDR3/1600	www.patriotmemory.com
Optical Drive	Samsung SH-222 DVD Burner	www.samsung.com
Solid State Drive	OCZ Agility 3 120GB	www.ocztechnology.com
Hard Drive	WD Caviar Green 2TB	www.wdc.com
OS	Windows 7 Home Premium 64-bit	www.microsoft.com

Approximate Price: $1,300

PERFORMANCE

INGREDIENTS

PART		URL
CASE	NZXT Phantom 410	www.nzxt.com
PSU	Corsair HX850W	www.corsair.com
Mobo	Asus Sabertooth X79	www.asus.com
CPU	Intel i7-3820K @4.7GHz	www.intel.com
Cooler	NZXT Havik 120	wwww.nzxt.com
GPU	VisionTek Radeon HD 7970	www.visiontek.com
RAM	16GB Corsair Vengeance DDR3/1600	www.corsair.com
Optical Drive	LG WH12LS39 BD-R Burner	www.lg.com
Solid State Drive	OCZ Agility 3 120GB	www.ocztechnology.com
Hard Drive	Seagate Barracuda 3TB	www.seagate.com
OS	Windows 7 Professional 64-bit	www.microsoft.com

Approximate Price: $2,100

IF THIS RIG LOOKS familiar, there's a good reason: It's the Sweet Spot PC from our May 2012 feature. Why is the midrange PC from that story our baseline build here? Because it truly hits a sweet spot. As Gordon Mah Ung wrote last month, it's fast without being overkill, stylish without being ostentatious, and it's at a price point that isn't rife with compromises. It has a fast overclockable CPU, a great GPU, a speedy SSD, *and* 2TB of mass storage, all in a quiet, classy chassis. It's a no-BS enthusiast build that might lack bells and whistles but doesn't lack speed or power. In a couple of months, look for an Ivy Bridge refresh.

KICK YOUR BUDGET up by 700 dollars or so from the Baseline, and you get our Performance screamer: eight threads instead of four, eight DIMM slots instead of four, and an upgrade path to a six-core CPU. That, plus twice the RAM, one of the fastest GPUs on the market, a Blu-ray burner, and a CPU that'll clock up to 4.7GHz without even a K or X designation, and you've got a rig fit for *serious* gaming and content creation. The badass black-and-red color scheme is a nice bonus.

ULTRA

HOW DO YOU top our Performance rig? With a screaming-fast, overclocked six-core CPU and *two* of the fastest single-GPU cards available, obviously. Our Ultra configuration is $3,900 of power, with some bells and whistles thrown in, too.

Intel's Core i7-3930K is $600 worth of six-core madness, and the Corsair H100 cooler makes it easy to push the CPU to 4.8GHz from its 3.6GHz stock speed. Two Radeon HD 7970 cards in Cross-Fire give preposterous gaming performance.

Cooler Master's Cosmos II case is huge and luxurious, with plenty of airflow to cool everything, and the Asus motherboard can accommodate another Radeon HD 7970 when two cards just won't cut it. Storage gets a boost up to a 256GB Samsung 830 SSD and 6TB of speedy hard drives.

Our Ultra configuration is for the *Maximum PC* reader who needs ultra-fast encoding and rendering, tip-top graphical prowess, and speedy storage. It's a step above what's necessary for 95 percent of the population, but don't worry—it's still a few steps below Dream Machine territory.

For our complete Best of the Best list of recommended components, visit www.maximumpc.com/best-of-the-best.

INGREDIENTS

PART		URL
CASE	Cooler Master Cosmos II	www.coolermaster.com
PSU	Thermaltake Toughpower Grand 1050W	www.thermaltakeusa.com
Mobo	Asus P9X79 Deluxe	www.asus.com
CPU	Intel i7-3930K @4.8GHZ	www.intel.com
Cooler	Corsair H100	www.corsair.com
GPU	XFX Radeon HD 7970 (x2)	www.xfxforce.com
RAM	16GB G.Skill Ripjaws DDR3/2133	www.gskill.com
Optical Drive	Plextor PX-LB950SA BD-R Burner	www.plextor.com
Solid State Drive	Samsung 830 Series 256GB	www.samsung.com
Hard Drive	Seagate Barracuda 3TB (x2)	www.seagate.com
OS	Windows 7 Professional 64-bit	www.microsoft.com

Approximate Price: $3,900

SUGGESTED PAIRINGS
Kick-ass peripherals for your new rig

MIDRANGE MONITOR
ViewSonic VP2365-LED
$320, www.viewsonic.com

KEYBOARD
Razer BlackWidow Ultimate
$130, www.razerzone.com

MOUSE
Cyborg R.A.T. 9
$100, www.cyborggaming.com

GAMING HEADSET
Corsair Vengeance 1500
$100, www.corsair.com

SPEAKERS
Corsair SP2500
$205, www.corsair.com

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PSU	Thermaltake Toughpower Grand 1050W	www.thermaltakeusa.com
Mobo	Asus P9X79 Deluxe	www.asus.com
CPU	Intel i7-3930K @4.8GHZ	www.intel.com
Cooler	Corsair H100	www.corsair.com
GPU	XFX Radeon HD 7970 (x2)	www.xfxforce.com
RAM	16GB G.Skill Ripjaws DDR3/2133	www.gskill.com
Optical Drive	Plextor PX-LB950SA BD-R Burner	www.plextor.com
Solid State Drive	Samsung 830 Series 256GB	www.samsung.com
Hard Drive	Seagate Barracuda 3TB (x2)	www.seagate.com
OS	Windows 7 Professional 64-bit	www.microsoft.com

Approximate Price: $3,900

SUGGESTED PAIRINGS

Kick-ass peripherals for your new rig

KEYBOARD
Razer BlackWidow Ultimate
$130, www.razerzone.com

GAMING HEADSET
Corsair Vengeance 1500
$100, www.corsair.com

MIDRANGE MONITOR
ViewSonic VP2365-LED
$320, www.viewsonic.com

MOUSE
Cyborg R.A.T. 9
$100, www.cyborggaming.com

SPEAKERS
Corsair SP2500
$205, www.corsair.com